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Determination of Inhibition Effect of Propolis Extract on *Watermelon mosaic virus* in Edible Seed Squash

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ABSTRACT

Edible seed squash (*Cucurbita pepo* L, ESS), which is grown for its seeds to consume as a snack, has a very important place in vegetable production in Türkiye. Viruses are one of the most problems in the cultivation of ESS in the country. One of these diseases is *Watermelon mosaic virus* (WMV, *Potyvirus*, Potyviridae). Also, it's very common and devastating on other cucurbits worldwide. Propolis, which is composed mainly by the plant resins and exudates that honey bees gather, showed antiviral activity against plant and human viruses. In this study, the potential of propolis to control WMV was investigated by taking advantage of these antimicrobial properties of propolis. For this purpose, propolis extracted with 95% ethanol and diluted in distilled water to obtain different concentrations as 2, 4, 6, 8 and 10% were used. Effects of propolis against WMV were determined by *in vitro* and *in vivo* studies. Except of 2, and 4%, all concentrations caused to symptoms reductions of the infection, in all studies. In the result of *in vitro* studies, the ratios of healthy plants were calculated as 10, 20, 40% and 20, 30, 50% after one and two hours, respectively. *In vivo*, by spraying concentrations of 6, 8 and 10% before inoculation obtained healthy plants as 20, 40 and 60% after one-hour period, and as 20, 30 and 50% after two-hour period, while the extracts sprayed after inoculation, ratios of healthy plants as 10, 20 and 30% after one-hour period, and as 10, 20 and 20% after two-hour period. According to the results of the study, it was determined that applications of different propolis concentrations had the potential to reduce WMV infection, and these results should be supported by field trials.

1. Introduction

Propolis is a resinous mixture that bees produce from a mixture of various flower nectars and their own secretions to prevent other organisms (such as insects and microorganisms) from entering the hive through the hive entrance and cracks in the hive. The word propolis is derived from two Greek words, pro (in front of) and polis (city or community). This substance has been used in traditional medicine all over the world since ancient times. Recent research has shown that propolis has a wide range of pharmacological properties, including antibacterial, antioxidant, anti-inflammatory and anti-tumor activities (Marcucci, 1995; Bankova et al., 1996; Kujumgiev et al., 1999; Abd El Hady and Hegazi, 2002). The activity and components of propolis vary according to its geographical origin (Kujumgiev et al., 1999). Many different studies have been conducted on the antifungal and antibacterial activities of propolis, but there is also abundant information on the antiviral activity of this substance (Marcucci, 1995; Takemura et al., 2012). The antiviral activity of propolis has been reported for different plant and animal viruses such as Influenza A and B viruses, Human immunodeficiency virus (HIV), Hepatitis virus, Infectious bursal disease virus (IBDV), Herpes simplex virus (HSV), Vaccinia virus, Poliovirus and reovirus, *Broad bean mottle virus* (BBMV), various viruses in potato (Abd El Hady and Hegazi, 2002; Fahmy and Omar, 1989; Mohamed and Owayss, 2005; Bufalo et al. , 2009; Schnitzler et al., 2010; Doğan and Hayoğlu, 2012; Coelho et al., 2014).

Squashes or pumpkins are produced in many parts of the world and have an important commercial importance in different economies. Total cucurbit production worldwide is higher than that of tomatoes or citrus fruits and is about half the size of potatoes (Gaba et al., 2004). According to the data of 2021, ESS was planted in 866.682 da agricultural area in Türkiye and 64.861 tons of squash seeds were produced (TÜİK, 2022). As in many parts of the world, squash is produced in Türkiye for its seeds and flowers as well as for its fruits (Vural et al., 2000).

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Squash plant has a special importance among cucurbits since its fruits are consumed as vegetable and its seeds are consumed as snacks. Seeds of squash or pumpkin (*Cucurbita pepo* L., *C. moschata* Duchesne) are one of the most consumed snack foods in the Türkiye. In recent years, with the decrease in rainfall and the increase in irrigation costs, there has been an increased interest in edible seed squash (ESS) cultivation in Türkiye, since it can be grown well in arid environments (Yeşil, 2021a).

Watermelon mosaic virus (WMV) is a disease agent of the genus *Potyvirus* in the family Potyviridae with a single-stranded RNA genome and 780x12 nm curved rod-shaped virions. This virus is non-persistently transmitted by more than 20 aphid species (*Aphis gossypii, A. craccivora, A. spiraecola, Myzus persicae* and *Macrosiphum euphorbiae*). It can also be easily mechanically transferred from infected plants to healthy plants by plant sap. In warm regions, it persists throughout the year in wild cucurbits (*Melothria pendula, Momordica* spp. and other cucurbits) and cultivated cucurbits. WMV causes apparent leaf symptoms and severe stunting in susceptible cucurbit species. Symptoms such as mosaic, blister mosaic, vein banding, curling and narrowing of the leaf area occur on the leaves of cucurbit crops. Some varieties show mottling on the leaves. In fruits, deformation usually occurs and fruit color changes in some varieties (Anonymous, 2022). WMV can infect more than 170 plants, including cucurbits, some legumes and orchids (Sharifi et al., 2008). Many studies have reported that WMV is widespread in cucurbit production areas of Türkiye and causes economically important yield and quality losses in these plants (Yılmaz et al., 1992; Kaya and Erkan 2011; Topkaya and Ertunç 2012; Yılmaz 2014; Şevik and Balkaya 2015; Korkmaz et al., 2018; Yeşil: 2019a, b; 2020, 2021a).

The main objective of this study was to determine the effect of different propolis concentrations on WMV infection and to demonstrate an environmentally friendly approach in the control of WMV, one of the most common viral diseases in cucurbits including vegetable species grown in large areas in Türkiye.

2. Materials and Methods

2.1. Virus inoculum

Within the scope of the study, WMV isolate coded W-26 (Yeşil, 2013), which was previously isolated from zucchini and diagnosed both serologically and molecularly, and at the same time, the coat protein gene (cp) was subjected to partial sequence analysis and uploaded to the gene bank (NCBI) with the accession number KF021299, was used as the virus inoculum source. WMV-infected leaf samples stored in the deep freezer were crushed in mortars containing PBS (Phosphate-Buffered Saline, phosphate buffer, 0.01M, pH:7) buffer using a mortar and pestle on ice. In order to confirm the purity of the WMV-contaminated plant extract, serial inoculations were carried out consecutively on *Chenepodium quinoa* Willd. plants, the local lesion host of the virus. Subsequently, the virus was inoculated with cotton by applying previously carborundum powder to the leaves of the squash for replication. These plants were kept under climate chamber conditions (25 ± 2 ℃, 14 s. light / 10 s. dark) and were observed 14 days after inoculation and were found to show WMV symptoms. WMV infections in samples taken from these plants were confirmed by DAS-ELISA test before the virus was used as an inoculum source.

2.2. Preparation of propolis extracts

Pure propolis samples obtained from honey bee breeders were extracted with 95% pure ethanol, filtered through two layers of muslin and the ethanol was removed by evaporation (Mohamed and Owayss, 2005). Dilutions of 2, 4, 6, 8 and 10 % concentrations were prepared with distilled water to be used in the experiments. The effects of different propolis concentrations on WMV infection were investigated in in vitro and in vivo experiments.

2.3. In vitro effect of propolis extract on WMV

In this phase of the study, different concentrations (2, 4, 6, 8 and 10 %) of propolis dilutions were mixed with WMV-infected plant extract and the effect of this mixture on the activity of the virus was tried to be revealed. For this purpose, 500 µl each of WMV-infected plant extract and different concentrations of propolis dilution were mixed. *In vitro* experiments were carried out by mechanically infecting 1 ml of the mixture (WMV-infected plant extract + propolis dilution) on the leaves of edible seed squash immediately, after 1 and 2 hours of waiting. In each assay, 10 edible seed squash plants that had developed true leaves were inoculated and treatments were evaluated 14 days later according to the presence of symptoms. Mechanically inoculated plants were tested by DAS-ELISA to confirm the presence or absence of WMV. In addition, only WMV-inoculated plants were used as positive controls and only propolis dilution-inoculated plants were used as negative controls.

2.4. In vivo effect of propolis extract on WMV

In this phase of the study, propolis dilutions of different concentrations (2, 4, 6, 8 and 10 %) were applied directly to the leaves before (immediately before, 1 and 2 hours before) and after (immediately after, 1 and 2 hours after) WMV infection. Spraying was carried out until the edible seed squash leaves infected or to be infected with WMV were completely wetted with the dilution. In the *in vivo* stage, all plants were mechanically infected with WMV. In each experiment, 10 edible seed squash plants that had developed true leaves were infected with the virus and kept under climate chamber conditions (25 ± 2 ℃, 14 s. light/10 s. dark photoperiod) for symptom development. After 14 days, treatments were evaluated according to the presence of symptoms. Both symptomatic and healthy-looking plants were tested by DAS ELISA test to confirm the presence and

absence of WMV, respectively. In addition, only WMV-infected plants were used as positive controls and only propolis dilution-infected plants were used as negative controls.

3. Results and Discussion

3.1. Symptoms observed in WMV-infected ESS plants

The WMV isolate coded W-26 used during the study was obtained from the leaves of the edible seed squash (*Cucurbita pepo* L.), which was shown to be naturally infected by different methods in a previous study. When the isolate was inoculated on *C. quinoa* Willd. plants, local lesions were observed and the isolate was purified by repeated inoculations. Subsequently, the isolate was inoculated on the edible seed squash plants for propagation.

Mechanical inoculations of the W-26 isolate on the edible seed squash plants caused the formation of mosaic symptoms approximately 1 week after inoculation. However, observations performed on the 10th day of inoculation showed that in addition to the mosaic symptom, deformations such as blistering and roughening also developed on the leaves.

3.2. In vitro effect of propolis extract on WMV

The results of mixing different concentrations of propolis dilutions (2, 4, 6, 8 and 10 %) with WMV-infected plant extracts and the effect of this mixture on the activity of the virus immediately or after 1 and 2 hours are summarized in Table 1. After inoculation of the propolis+WMV mixture on edible seed squash plants, the plants were observed on the 14th day and symptoms were recorded. In the treatments carried out at this stage of the study, all of the propolis dilutions mixed with WMV-infected plant extract were found to be ineffective against WMV infections when applied to the leaves without waiting, while all other propolis concentrations except 2% and 4% concentrations were found to be effective in suppressing WMV infection when applied after waiting for 1 or 2 hours. The percentages of healthy plants were calculated as 10, 20, 40 and 20, 30, 50 %, respectively, after 6, 8 and 10 % propolis dilutions were applied to the leaves of the edible seed squash after one and two hours of waiting. As a result of *in vitro* treatments, propolis extract at 10% concentration was found to be the most successful concentration in inhibiting WMV infections.

In addition, the plants were subjected to DAS-ELISA test to confirm that the presence or absence of WMV infection was the cause of the presence or absence of symptoms in all inoculated squash plants in the treatments. Therefore, the presence of WMV was detected in symptomatic plants, while WMV infections were not detected in healthy plants.

Table 1
Inhibition effects of different concentrations of propolis extract on WMV infections according to different periods of storage

Treatment	Nr. of plants	K+[1]	K-[2]	Propolis concentration (%)				
				2	4	6	8	10
Immediately	Inoculated	10	10	10	10	10	10	10
	Healthy	0	10	0	0	0	0	0
	Effect (%)	0	100	0	0	0	0	0
After 1 hour	Inoculated	10	10	10	10	10	10	10
	Healthy	0	10	0	0	1	2	4
	Effect (%)	0	100	0	0	10	20	40
After 2 hours	Inoculated	10	10	10	10	10	10	10
	Healthy	0	10	0	0	2	3	5
	Effect (%)	0	100	0	0	20	30	50

[1]K+: Only WMV-inoculated positive control, [2]K-: only propolis-inoculated negative control.

3.3. In vivo effect of propolis extract on WMV

The results of the inhibition of WMV infection by spraying the leaves with propolis extract prepared at concentrations of 2, 4, 6, 8 and 10 % before and after WMV infection are given in Table 2. At this stage of the study, propolis concentrations were sprayed on the leaves of the edible seed squash at different times: immediately before WMV infection, 1 and 2 hours before WMV infection, immediately after WMV infection and 1 and 2 hours after WMV infection. Again, 14 days after WMV inoculation, the plants were evaluated according to the presence or absence of symptoms. When the *in vivo* treatments results were evaluated, it was observed that, as in the *in vitro* treatments, propolis applications made immediately before or immediately after WMV inoculation did not show success at any concentration. However, it was observed that spraying the leaves with 2% and 4% propolis dilution was ineffective in terms of preventing WMV infection for all application times. In *in vivo* treatments, the ratios of healthy plants obtained by spraying 6, 8 and 10% dilutions of propolis before inoculation were calculated as 20, 40 and 60 % when applied one hour before inoculation and 20, 30 and 50 % when applied 2 hours before inoculation. Again, in propolis applications performed after WMV inoculation, healthy plant ratios were determined as 10, 20 and 30 % after one hour and 10, 20 and 20 % after two hours.

In addition, plants were subjected to DAS-ELISA test in order to confirm that the presence or absence of WMV infection was the cause of the presence or absence of symptoms in all inoculated squash plants in the treatments. Thus, the presence of WMV was detected in

symptomatic plants, while WMV infections were not detected in healthy plants.

As a result of the *in vivo* treatments, the effect of different concentrations of propolis extract on reducing WMV-induced symptoms in the edible seed squash plant was highest when applied before WMV inoculation. When the results were analyzed, it was observed that when propolis extract was applied to the leaves of the squash plant 1 hour before WMV inoculation, the concentrations of 6, 8 and 10% prevented WMV infection by 20, 40 and 60%, respectively. These results are promising especially in the control of WMV, which is a virus that has a large number of host plants and weed species belonging to different families and can be transmitted very effectively by about 20 different aphid species. In this context, it would be useful to confirm the data obtained in this study by testing them in field conditions.

Table 2
Inhibition effects of different concentrations of propolis extract applied before and after WMV inoculation on WMV infection in edible seed squash plants

Treatment	Nr. of plants	K+[1]	K-[2]	Propolis concentration (%) (Before / After inoculation)				
				2	4	6	8	10
Immediately	Inoculated	10	10	10/10	10/10	10/10	10/10	10/10
	Healthy	0	10	0/0	0/0	0/0	0/0	0/0
	Effect (%)	0	10	0/0	0/0	0/0	0/0	0/0
1 hour	Inoculated	10	10	10/10	10/10	10/10	10/10	10/10
	Healthy	0	10	0/0	0/0	2/1	4/2	6/3
	Effect (%)	0	10	0/0	0/0	20/10	40/20	60/30
2 hours	Inoculated	10	10	10/10	10/10	10/10	10/10	10/10
	Healthy	0	10	0/0	0/0	2/1	3/2	5/2
	Effect (%)	0	10	0/0	0/0	20/10	30/20	50/20

[1]K+: Only WMV-inoculated positive control, [2]K-: only propolis-inoculated negative control.

The results obtained in this study on the inhibitory effect of propolis extract on virus infection are similar to the results of previous studies on the subject in the literature. It was reported that propolis dilutions applied both *in vitro* and *in vivo* conditions to suppress *Cucumber mosaic Cucumovirus* (CMV, Bromoviridae) infections in zucchini plants suppressed CMV by up to 50% in treated plants (Yeşil, 2021b). In a study conducted in Serbia, different propolis concentrations were applied under both *in vitro* and *in vivo* conditions to control infections caused by *Zucchini yellow mosaic Potyvirus* (ZYMV, Potyviridae), which is an important problem in oil pumpkin cultivation areas. According to the results of the application, it was observed that propolis extract prepared at concentrations of 5 and 10% showed inhibitory effects on ZYMV infection both *in vitro* and *in vivo* conditions (Vucurovic et al., 2017). Mohamed and Owayss (2005) showed that different propolis concentrations applied *in vivo* and *in vitro* on *Broadbean mottle Bromovirus* (BBMV, Bromoviridae) reduced virus infection by up to 35-80%. Fahmy and Omar (1989) planted apical meristems and shoots from six different potato cultivars infected with viruses on modified Murashig-Skoog (MS) culture medium supplemented with propolis extract, and it was determined that the presence of Potato S, Y, M and X viruses was significantly reduced in potato plants grown on this propolis-containing medium for about 1 month. In the studies in the literature, it is reported that propolis also has inhibitory effects on viruses that cause disease in animals. Coelho et al. (2014) reported that propolis caused up to 64-fold decrease in *Picornavirus* replication, 32-fold decrease in influenza virus, 8-fold decrease in measles virus and 103-fold decrease in rubella virus replication. In addition, as a result of a study on mice; it was reported that when 5% propolis solution was applied before Influenza virus infection, the infection was completely prevented, while propolis did not show any inhibitory effect when applied after infection (Ghisalberti, 1979).

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Determination of Some Virus Diseases on Gerbera Plants in Antalya Province

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TSV

ABSTRACT

Gerbera spp., which is in the Asteraceae family, is the most widely cultivated cut flower ornamental plant in Türkiye after carnation. Approximately 74% of Türkiye's production is met from Antalya province. Virus diseases are a problem in the cultivation of *Gerbera* as they significantly reduce the yield and quality. In this study, which was carried out to detect some virus diseases seen in *Gerbera* production areas in Antalya province, surveys were carried out in commercial production areas in the 2021-2022 production season. For this purpose, a total of 112 leaf samples, which are thought to be infected with viruses, were collected from 100 *Gerbera* plants showing symptoms similar to virus disease symptoms and 12 selected weeds regardless of the presence of symptoms. These leaf samples, which were later brought to the laboratory, then were tested by the Double Antibody Sandwich Enzyme-linked Immunosorbent Assay (DAS-ELISA) method to detect infections of *Tomato spotted wilt virus* (TSWV), *Cucumber mosaic virus* (CMV), *Tobacco streak virus* (TSV) and *Impatiens necrotic spot virus* (INSV). As a result of the tests, TSWV (41.9%), CMV (1.7%) and TSV (37.5%) infections were detected in *Gerbera* plant samples. In addition, TSWV (25%) infections were most common in weed samples, followed by TSV (16%) and CMV (8.3%) infections. The presence of INSV virus was not detected in any of the leaf samples tested by DAS-ELISA. With this study, TSWV, TSV and CMV infections in *Gerbera* production areas in Türkiye were revealed for the first time.

1. Introduction

Gerbera is an ornamental plant belonging to the daisy family (Asteraceae). There are approximately 30 known species in nature. Gerbera has an important place in the production of ornamental plants in the world and in our country. According to 2020 data, world cut flowers and potted plants are produced on a total area of 749.200 ha. 77% (580.000 ha) of the world ornamental plants production areas are located in the Asia/Pacific region. The most important producers among Asian countries are China and India (Anonymous, 2021). In 2018, the most important exporting countries in the world are the Netherlands, Colombia and Germany, respectively. Türkiye ranks 25th among the world exporters (Anonymous, 2021).

According to the data of the Turkish Statistical Institute, the most produced cut flower types in 2019 were Carnation, Gerbera and Rose, respectively. In 2019, the Gerbera production area was 1 202 162 square meters and the Gerbera production for the same year was 134 481 050 pieces. For Antalya province, the production area is 905.000 square meters and the production amount is 100.040.000 pieces (TÜİK, 2021). Approximately 3/4 of Türkiye's production is met from Antalya province's Gerbera greenhouses.

Viral diseases, as well as fungal and bacterial diseases, significantly affect Gerbera production, leading to reduced yield and quality. There are many studies conducted in different parts of the world to determine the viral diseases of Gerbera. Kaminska (1993) investigated the presence of *Tomato spotted wilt virus* (TSWV), *Impatiens necrotic spot virus* (INSV) and *Chrysanthemum stem necrosis virus* (CSNV) by serological methods in Gerberas grown in greenhouses in Vranjska Banja, Serbia. As a result of the tests performed by the researcher, only TSWV was detected in the plant samples. This is the first report of TSWV in Serbia. Verma et al. (2004) conducted a serological study to determine virus infections in Gerbera production areas in India and found the presence of *Cucumber mosaic virus* (CMV) in plant samples. This study is the first report of CMV on Gerberas in India. Kondo et al. (2011) observed chlorotic spots and necrosis on chrysanthemums in Aomori Prefecture, Japan. Symptomatic plants were tested for *Cucumber mosaic virus*, *Tomato spotted wilt virus*,

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Impatiens necrotic spot virus and *Tobacco mosaic virus* by immune Strip. The results were positive for INSV and negative for CMV, TSWV and TMV. The presence of INSV on chrysanthemums was then confirmed by RT-PCR. This is the first report of INSV on chrysanthemums in Japan. There are some studies on TSV, which has not been diagnosed on Gerbera but has been diagnosed on some ornamental plants belonging to the Asteraceae family. Dijkstra (1983) investigated the presence of *Tobacco streak virus* (TSV) on a sunflower showing severe necrosis and chlorosis on the leaves. Serological tests proved the presence of TSV.

In the literature, only one study was found on the detection of virus diseases that are a problem in Gerbera production areas of Türkiye. In this study conducted by Türkoğlu and Fidan (1992), virus infections detected in carnations, gladiolus and Gerberas produced commercially in the Aegean Region were discussed. Possible viruses in these plants were transferred to test plants by mechanical inoculation method. Identification was made according to the symptoms and physical characteristics of these isolates on the test plants. With this study, the presence of *Tobacco mosaic virus* (TMV) and *Tobacco rattle virus* (TRV) infections in Gerberas was determined. Atay (2016) conducted a study on *Tobacco streak virus* (TSV) on *Helianthus annuus*, a field plant belonging to the Asteraceae family, to diagnose virus diseases in sunflowers in the Thrace Region. Samples of 244 plants and weeds thought to be infected were collected from production areas and subjected to serological tests. As a result of the tests, the presence of TSV was detected. This study is the first study in the Thrace Region where viral diseases on sunflower were determined. Since there are not enough studies on this subject in our country, this study was carried out to determine the presence of *Tomato spotted wilt virus* (TSWV), *Cucumber mosaic virus* (CMV), *Tobacco streak virus* (TSV) and *Impatiens necrotic spot virus* (INSV) which are likely to infect Gerbera plants.

TSWV is included in the Bunyaviridae family, *Tospovirus* genus (Tsompana, 2005; Şevik 2015). It is transmitted by thrips. The most important vectors are *Frankliniella occidentalis* and *Thrips tabaci* (Krisha-Kumar, 1993). In general, tanning, yellowing, mosaic, leaf curling, necrotic spots, necrotic lines and stunting are observed in plants. CMV is included in the genus *Cucumovirus* in the Bromoviridae family (Uzunoğulları and Gümüş, 2015). It is carried by infected plant sap and seeds of some hosts. There are more than 75 vectors of CMV, the most important and widespread of which are Cotton aphid (*Aphis gossypii*) and Green peach aphid (*Myzus persicae*) (Adkins 2000; Beşkeçili et al., 2021). In general, yellowing, stunting and narrowing of leaf lamina symptoms appear in plants infected with the virus in the early period. TSV is a virus species belonging to the *Ilarvirus* genus of the Bromoviridae family. The virus is transmitted into the plant and causes disease by pollen and thrips (Atay, 2016). The general symptom on the plant is necrotic and/or chlorotic ring spots on the leaf, especially near the veins. INSV is a virus agent belonging to the genus *Tospovirus* that can be transmitted by thrips (Şevik and Tohumcu, 2010). This virus, which has similar symptoms with TSWV, was initially known as a race of TSWV, but studies have revealed that it is a different species (Anonymous, 2020).

In this study, the presence of TSWV, CMV and TSV viruses, which constitute a problem in Gerbera production areas in Antalya province, was revealed for the first time as a result of serological tests. However, the presence of INSV was not detected in any plant samples tested.

2. Materials and Methods

2.1. Survey studies and collecting plant samples

In November 2021 and February 2022, within the scope of guided surveys carried out in the Gerbera production areas in Kepez district of Antalya province, Gerbera plants showing stunting and yellowing in the production area, chlorotic spots, ring spots and mosaic on the leaves, deformations in flowers, irregular formations of petals, damaged by acari, thrips and whiteflies, which play a role in the transmission of viral diseases, and leaf and flower samples collected from some weeds showing density inside and outside of the production area were the main materials for this study.

For this study, a total of 112 leaf samples were collected from 8 different production areas of approximately 50 decares in Kepez district during guided field surveys. The samples collected from the production areas were individually numbered with the place of collection, date, plant species and field size. The collected samples were stored in a deep freezer at -20 °C for serological studies.

2.2. Serological Assays

Double-antibody sandwich enzyme-linked immunosorbent assay (DAS-ELISA) test, which is one of the serological methods for the detection of possible infections of TSWV, CMV, TSV and INSV, was applied to Gerbera with symptoms similar to virus infections, as well as leaf and flower samples taken from weeds inside and outside the production area. For this purpose, DAS-ELISA tests were carried out by following the protocols recommended by the commercial company (Bioreba), which provided TSWV, CMV, TSV and INSV specific antibodies and positive controls. The tests were performed in a volume of 100 µl and in duplicate for each sample. For some Positive controls, extracts from known diseased plant samples were used. At the end of the ELISA tests, samples with absorbance values at least twice or more than the absorbance value read at 405 nm for the negative control in the ELISA reader were considered positive (Clark and Adams, 1977; Yeşil, 2021).

3. Results and Discussion

3.1. Collected Plant Samples in Field Studies

During the field surveys conducted in Kepez district of Antalya province between 2021 and 2022 production years, 100 plant and 12 weed samples were collected that were thought to be infected with TSWV, CMV, TSV and INSV viruses (Table 1.).

Table 1
Numbers and areas of the surveyed greenhouses and species and numbers of collected plant samples during survey studies in Kepez district.

Surveyed greenhouses	Area of the greenhouse (da)	Plant species	Number of samples
Greenhouse 1	4	*Gerbera* spp.	9
		Senecio vernalis	1
Greenhouse 2	6	*Gerbera* spp.	18
		Malva sylvestris	1
		Senecio vernalis	1
Greenhouse 3	4	*Gerbera* spp.	9
		Senecio vulgaris	1
Greenhouse 4	12	*Gerbera* spp.	18
		Medicago sativa	1
		Malva sylvestris	1
		Urtica sp.	1
Greenhouse 5	4	*Gerbera* spp.	9
		Senecio vulgaris	1
Greenhouse 6	9	*Gerbera* spp.	14
		Medicago sativa	1
Greenhouse 7	6	*Gerbera* spp.	14
		Senecio vernalis	1
		Medicago sativa	1
Greenhouse 8	5	*Gerbera* spp.	9
		Malva sylvestris	1
Total	50	*Gerbera* spp.	100
		Weeds	12

3.2. Observed Viral Symptoms on the Plants in the Surveyed Greenhouses

Viral symptoms such as stunting, general yellowing, discoloration of leaves, chlorotic spots, concentric ring spots, mosaic, chlorotic line on the pedicel, flower deformations and discoloration were observed in *Gerbera* plants during surveys in *Gerbera* production areas in Kepez district of Antalya province. In addition, thrips, acari and whitefly pests were observed in some parts of the production area.

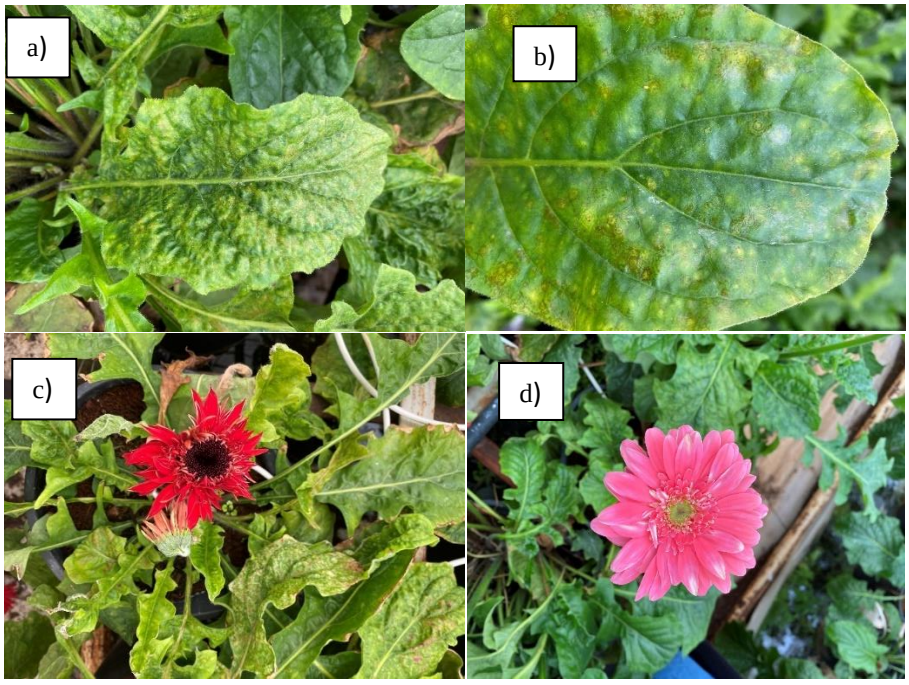

Figure 1
Common virus diseases symptoms on *Gerbera* plants. a) Chlorotic spots with puckering, b) Chlorotic and necrotic ring spots on leaves. c) Deformations on flower, d) Discolorations on petals.

Symptoms observed in the plant samples collected during survey studies vary according to the plant species, variety, age, developmental period (seedling, vegetative, flower), infection time, climatic conditions and virus species.

3.3. Results of DAS-ELISA Tests

Leaf and flower samples from a total of 112 plants, including 100 *Gerbera* plants showing viral disease symptoms and 12 weed samples showing density inside and outside the greenhouse, were collected from *Gerbera* production areas in Kepez district of Antalya province between 2021-2022, and DAS-ELISA test was applied to reveal the possible presence of TSWV, CMV, TSV and INSV viruses.

The disease rates of viral diseases seen in these plant samples were calculated separately for *Gerbera* plants and weeds (Table 2.).

Of the 100 *Gerbera* plants collected during surveys in the production areas, 44 were infected with TSWV and 40 with TSV; of the 12 weed samples, 5 were infected with TSWV, 2 with CMV and 1 with TSV. The presence of INSV virus was not detected in the collected samples. *Gerbera* plants in the production areas have a disease rate of 44% TSWV, 1% CMV, 40% TSV viruses. For the sampled weeds, this rate was calculated as 66.6% in *Medicago sativa*, 33.3% in *Malva sylvestris*, 100% in *Urtica* sp. and 50% in *Senecio vulgaris* (Tables 3 and 4).

Table 2
Relative incidences of the viruses according to DAS-ELISA tests.

Plant type	Number of tested samples	Nr. of infected samples (+)	Nr. of healthy samples (-)	Relative incidence (%)
Gerbera spp.	100	59	41	59
Weeds	12	5	7	41,6

Table 3
Relative incidences of TSWV, CMV, TSV and INSV on *Gerbera* spp. according to DAS-ELISA tests.

Virus	Nr. of infected samples (+)	Nr. of healthy samples (-)	Relative incidence (%)
TSWV	44	56	44
CMV	0	100	0
TSV	40	60	40
INSV	0	100	0

Table 4
Relative incidences of TSWV, CMV, TSV and INSV on the weed samples according to DAS-ELISA tests.

Weed species	TSWV	CMV	TSV	INSV	Number of samples	Nr. of healthy samples (-)	Relative incidence (%)
Medicago sativa	2	2	1	-	3	1	66.6
Malva sylvestris	1	-	-	-	3	2	33.3
Urtica sp.	1	-	-	-	1	0	100
Senecio vulgaris	1	-	1	-	2	1	50
Senecio vernalis	-	-	-	-	3	3	0

In this study, the presence of three different virus diseases that are a problem in *Gerbera* production areas in Kepez district was determined. Infections of TSWV, CMV and TSV viruses were detected as a result of testing of plant and weed samples collected from production areas with DAS-ELISA test.

Within the scope of this study, the rates of double (6.25%) and multiple (0.89%) virus infections were also determined as a result of DAS-ELISA test. When Table 4.5. is examined, it is seen that *Gerbera* plant samples were intensively infected with TSWV (44%) and TSV (40%) viruses. In some *Gerbera* spp. samples, TSWV+TSV double (5%) infections are present.

Double and multiple virus infections were also present in weed samples. There is TSWV+CMV double infection (33.3%) on *Medicago sativa* and TSWV+TSV double infection (50%) on *Senecio vulgaris*. TSWV+CMV+TSV multiple infections (33.3%) are observed on another example, *Medicago sativa*.

Table 5
Number of single, double and multiple infections in plant samples collected from *Gerbera* production areas of Antalya province according to plant species.

Surveyed greenhouse	Sample species	TSWV	CMV	TSV	INSV	TSWV + CMV	TSWV+TSV	TSWV+ CMV + TSV
Greenhouse 1	*Gerbera* spp.	1	-	3	-	-	-	-
	Senecio vernalis	-	-	-	-	-	-	-
Greenhouse 2	*Gerbera* spp.	13	-	-	-	-	5	-
	Malva sylvestris	-	-	-	-	-	-	-
	Senecio vernalis	-	-	-	-	-	-	-
Greenhouse 3	*Gerbera* spp.	3	-	1	-	-	-	-
	Senecio vulgaris	-	-	-	-	-	-	-
Greenhouse 4	*Gerbera* spp.	-	-	8	-	-	-	-
	Medicago sativa	-	-	-	-	-	-	1
	Malva sylvestris	1	-	-	-	-	-	-
	Urtica sp.	1	-	-	-	-	-	-
Greenhouse 5	*Gerbera* spp.	-	-	6	-	-	-	-
	Senecio vulgaris	-	-	-	-	-	1	-
Greenhouse 6	*Gerbera* spp.	-	-	8	-	-	-	-
	Medicago sativa	-	-	-	-	-	-	-
Greenhouse 7	*Gerbera* spp.	-	-	4	-	-	-	-
	Senecio vernalis	-	-	-	-	-	-	-
	Medicago sativa	-	-	-	-	1	-	-
Greenhouse 8	*Gerbera* spp.	1	-	1	-	-	-	-
	Malva sylvestris	-	-	-	-	-	-	-

There are not many studies on virus diseases that cause problems in *Gerbera* production areas in our country. However, there are similar studies investigating the presence of TSWV, CMV and TSV viruses for other crops.

In a study conducted on *Helianthus annuus*, a field plant belonging to the Asteraceae family in the Thrace Region, the presence of TSV was identified (Atay, 2016).

The presence of TSWV, DsMV (*Dasheen mosaic Potyvirus,* Potyviridae) and CMV diseases was investigated on some ornamental plants including *Gerbera* plants in Yalova, but TSWV and CMV viruses were not found on ornamental plants in the study (Kibar, 2014).

In a study conducted on bulbous ornamental plants in Çanakkale region, although virus or virus-like disease symptoms were observed in all samples, CMV virus was detected only in some of them. It is thought that the plant samples were infected with other viruses or virus-like diseases, either single or multiple (Karanfil et al., 2016). A study by Samuitiene and Navalinskiene (2008) on ornamental plants in Lithuania supports this view. In their study investigating CMV infections, they generally stated that virus and virus-like symptoms in ornamental plants are caused by a large number of viruses and virus-like diseases similar to each other.

In a study on viral diseases on *Gerbera jamesonii* in Greece, TSWV virus was identified, while INSV virus was not detected. Thrips populations were also noted in the observations made (Chatzivassilliou et al., 2000).

The most effective vectors of TSWV in Türkiye are *Frankliniella occidentalis* and *Thrips tabaci*, which play an active role in the spread of the disease (Tunç and Göçmen, 1995; Yeşil and Gömlekli, 2021). Similarly, thrips play an important role as a vector in the spread of TSV virus. In a study conducted on peanuts in India, it was determined that thrips were effective in the spread of TSV virus (Prasada Rao et al., 2003). A significant population of thrips was also observed in the production areas during survey studies. Considering all these, TSWV and TSV viruses can be easily spread in *Gerbera* production areas by thrips.

Weeds are an important factor in the spread of virus diseases. TSWV can infect 41 ornamental plants grown in greenhouses. In addition, many weed species are hosts of TSWV (Arli-Sokmen et al., 2005; Şevik 2015). In a study conducted by Costea et al. (2004), the presence of CMV virus was found to be the highest on weeds.

4. Conclusions and Recommendations

DAS-ELISA test, which is a serological method, was applied to the plant samples collected as a result of the survey studies. According to ELISA results, disease rates of 44% TSWV and 40% TSV were determined in 100 *Gerbera* spp. plants. INSV virus was not detected in the tested plant samples.

According to the results of the ELISA test on weed samples, the presence of TSWV, CMV and TSV were detected. The presence of INSV was also not detected on weeds. The disease rates of virus diseases on these weeds were calculated as 66.6% in *Medicago sativa*, 33.3% in *Malva sylvestris*, 100% in *Urtica* sp. and 50% in *Senecio vulgaris*. No virus was identified on *Senecio vernalis* leaf samples.

In addition, according to the ELISA test results, double and multiple infections were detected on the samples. TSWV+TSV double (5%) infection on 5 *Gerbera* spp. samples, TSWV+CMV double (33.3%) infection on 1 *Medicago sativa* sample, TSWV+TSV double

(50%) infection on 1 *Senecio vulgaris* sample, and TSWV+CMV+TSV multiple (33.3%) infection on 1 *M. sativa* sample were determined. Considering the presence of double and multiple infections in the ELISA test results and the fact that the collected samples showed virus and virus-like disease symptoms, it is thought that there are other virus diseases that have not been tested on the samples.

The fact that virus disease symptoms are commonly seen in some of the *Gerbera* greenhouses and that most of the producers do not have information about virus diseases is an issue that needs attention in terms of cut flower production and economy for Antalya province. Various training programs should be planned to inform producers about these virus diseases.

In some of the gerbera greenhouses, weeds were also commonly observed. Since weed species are hosts of virus diseases in addition to their direct damages, they cause these diseases to be seen in production areas in the following years. For this reason, weeds should be well identified and attention should be paid to weed control.

Effective insecticides should be used against vector insects, which are one of the most important factors in the spread of virus diseases, and quarantine measures should be taken against virus diseases that are not detected in the region, and production areas should be protected by preventing the transmission of virus diseases.

The data obtained as a result of the study will be the basic data for the future researches to be carried out in the region and will be a guide for both public institutions and organizations related to the subject and technical personnel working in the private sector and conscious producers.

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The Effect of Some Pre-Emergence Herbicides on Weeds and Corn Yield

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Application time

ABSTRACT

In this study, two herbicides (Isoxaflutole 225 g/l + Thiencarbazone-Methyl 90 g/l + Cyrosulfamide 150 g/l and Dimethenamid-P 280 g/l + Terbuthylazine 250 g/l), which are commonly used pre-emergence period against weeds that cause problems in corn planting areas were investigated. The experiments were carried out under field conditions in order to investigate the effect of registered dose of the herbicides to the weeds and corn yield components at the Konya province in 2018 – 2019 years. Herbicides Isoxaflutole 90 g/l + Thiencarbazone methyl 150 g/l + Cyprosulfamide and 280 g/l Dimethenamide-p + 250 g/l Terbuthylazine were tested in the pre-emergence period of the corn plant at doses of 35 ml/da and 300 ml/da, respectively. As a result of the experiments, Isoxaflutole 90 g/l + Thiencarbazone methyl 150 g/l + Cyprosulfamide were determined as the most effective herbicide to control weeds and increase corn yield components when it was applied during pre-emergence period. The effectiveness of herbicides was determined according to the biomass of weeds and their number in m^2. In addition, in both years, *A. retroflexus* was determined as the most intense species with 16.83 plants/m^2 and 32.97 plants/m^2 ratios respectively, in the experimental areas. Considering the corn stem diameter, cob length, corn stem length, corn stem dry and fresh weight, dry and fresh cob weight, thousand-grain weight and yield per decare in both years, it was determined that the active substances used increased in yield 2 to 3 times compared to the weed control plots.

1. Introduction

Corn is a C4 plant that makes the best use of solar energy and produces the driest matter per unit area. Corn production in Türkiye is increasing rapidly every year. The underlying reason for this is to make agricultural lands irrigable through various projects. Corn, which has an important role in Türkiye's agriculture, is used in many areas. These are human food, animal feed, biofuel industry, starch-based sugar industry, vegetable oil industry and bioethanol industry (Özcan, 2009; Anonymous, 2012).

Corn ranks third among cereals in the world following wheat and paddy in terms of cultivation area, but ranks first in production and yield. According to 2019 FAO data, 1,090 million tons of corn yield was obtained from 188,6 million hectares of cultivation area in the world (Anonymous, 2019c). In Türkiye, 6.5 million tons grain produced in an area of 6.9 million decares in 2020 (Anonymous, 2022).

Konya province was the first rank in terms of grain corn production in Türkiye with 1.1 million tons in 100K ha. Silage corn cultivation area was 30,774 ha and total production was 1.8 million tons. (TUİK, 2019).

Various problems are encountered during the cultivation of corn, which is of great importance in terms of agriculture. One of them is weeds that may result in yield and quality looses. The growing period of the corn with 3-10 leaves after emergence was considered the critical period against weeds (Doğan et al., 2004a). Although weed control has been partly carried out in corn production in the world, yield loss due to weeds was around 10.5% on average, while this rate was 20-30% in Türkiye (Güncan and Karaca, 2018). A study conducted by Oerke et al. in 19 different geographical regions has indicated that the yield loss might reach up to 40.3% when weed control practices were not performed (Oerke et al., 1999; Oerke, 2006). These losses depend on many factors such as species, density, distribution of weeds, soil structure, soil moisture, soil temperature and amount of organic matter in the soil. Weed control in corn may carry out both mechanically and chemically as

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well as cultural measures. Although the last two methods gave good results in weed control even if they increased production costs. (Doğan et al., 2004b).

Skrzypczak and Pudelko (1993), in their study on corn cultivation areas, showed that the herbicides with Atrazine, Linuron, Atrazine + Linuron and Atrazine + Metolachlor effectively suppressed some broad-leaved weeds such as *Chenopodium album* L., *Viola arvensis* Murray., *Polygonum nodosum* L., *P. nodosum* L., *Amaranthus* sp. and *Lamium amplexicaule* L. when they applied pre-emergence.

Jodie and Potter (2002), investigated the effectiveness of Nicosulfuron against various weeds. The herbicide applied at different doses, successfully controlled *Chenopodium album*, *Amaranthus retroflexus*, and *Setaria glauca*.

Wilson et al. (2007), conducted a study to investigate the sulfonylurea herbicides that gave the best results in *Cichorium intybus* L. As a result, they reported that the most successful weed control was obtained from thifensulfuron + tribenuron, tribenuron and rimsulfuron + thifensulfuron applications.

Schuster et al. (2007), collected *C. album seeds* from four different regions of the United States (Nebraska, Ohio, North Dakota and Kansas) to determine response of C. album on glyphosate efficacy (1.1 kg / ha) at various growing stages including 2.5 cm, 7.5 cm and 15 cm shoot lengths. As a result, they determined that *C. album* was more sensitive to herbicide when it was at the earliest stage compared to other growth periods.

Uysal (2012) found that the recommended doses and double doses of rimsulfuron (5 and10 g/da), nicosulfuron (125 and 250 g/da) and foramsulfuron + Iodosulfuron-methylsodium + Isoxadifen ethyl (200 and 400 g/da) herbicides provided sufficient weed control and no injury was found on the corn plant applied recommended doses of the herbicides.

Doğan et al. (2015) determined that glyphosate, a total herbicide used to reduce the weed density in the fields where corn was planted, could be used pre-planting and pre-emergence, but this application increased the production cost. They stated that the most effective and most suitable chemical control might be obtained from the active ingredients applied pre and post-emergence in order to protect the corn plant from the negative effects of weeds.

In this study, it was aimed to determine the impacts of two pre-emergence herbicides to weed species and corn growth, which are commonly used against weeds that are a problem in corn, and their effects on some yield components in Konya province ecological conditions.

2. Materials and Methods

This study was carried out in field conditions in Aydoğmuş neighborhood of Güneysınır district of Konya province in 2018 and 2019. As trial materials, 225 g/L Isoxaflutole + 90 g/l Thiencarbazone-methyl + 150 g/L Cyprosulfamide (ITC) and 280 g/l Dimethenamide-p + 250 g/l Terbuthylazine (DT) active ingredient herbicides, grain corn variety NK Famoso (*Zea mays* L.). Soil samples taken from the experiment areas of Aydoğmuş district were analyzed in the laboratories of Selçuk University, Department of Soil Science and Plant Nutrition. In each year, the soil of the trial area, texture class clayey-loam, pH 7.2-7.35, total salt 270-266 µs, lime 9.3-12.3%, organic matter 2.52-2.91%, total nitrogen 0.126-0.145, nitrogen 24.5-19.8 ppm, phosphorus was analyzed taking 24.6-99.3 ppm and potassium 258-410.33 ppm.

Meteorological data for the years 2018-2019 of Aydoğmuş district were obtained from Konya Province Meteorology Station. This data includes monthly average temperatures, monthly average relative humidity and monthly total precipitation (Table 1).

Table 1
Meteorological data of Konya province 2018 and 2019

	Years	January	February	March	April	May	June	July	August	September	October	November	December
Mean relative	2018	80.7	64.3	52.9	47.7	61.2	54.2	40.4	38.5	41.6	62.7	66.8	83.3
humidity %	2019	79.9	73.2	61.7	66.5	40.5	51.9	43.4	44.8	44.0	55.3	65.7	
Mean Temp	2018	1.4	7.0	10.6	13.6	16.7	20.4	24.0	23.5	19.8	13.4	7.9	3.0
°C	2019	1.2	4.0	6.2	9.2	18.1	20.8	22.1	22.6	19.2	15.7	9.7	
Total rainfall	2018	97.1	19.3	55.0	19.3	103.1	90.7	4.7	3.3	4.1	33.3	26.7	84.9
(mm=kg/m^2)	2019	80.5	56.3	24.7	35.8	3.7	36.2	5.6	8.4	6.2	17.5	41.2	

On 15.04.2018 and 14.04.2019, NK Famoso corn variety was planted in the experimental area with a pneumatic seed driller with 70 cm spacing and 15 cm row spacing. In the experimental areas, 40 kg/da 15-15-15+Zn and 20 kg/da urea (46% N) were applied during seed sowing. Following the emergence, sprinkler irrigation was applied once and then drip irrigation was applied 10 times (for 10 hours). After planting, 45 plots of 20 m^2 were designed on the trial area. 1 m and 0.5 m safety alleys were left between the blocks the plots, respectively. In order to avoid the border effect, the plots were set up at least 2 m from the field edge. Weedy control plots without weed control were also included. The

experiment was set up according to the randomized blocks design and was carried out with 3 replications.

Figure 1
General view of trial plots

The plant protection product applied to the soil with 225 g/L Isoxaflutole + 90 g/l Thiencarbazone-methyl + 150 g/L Cyprosulfamide (ITC) active ingredient is classified as Group F2: 27 according to its mechanism of action. After being absorbed by plant roots, it is carried in xylem and phloem, exerts systemic effects and inhibits carotenoid synthesis. (Barbour, 1996). This herbicide, which can be applied from planting to the post-emergence (2-3 leaves) period of the corn plant, suppresses the graminae and broad-leaved weeds that are a problem in corn and kills. (Anonymous, 2019a).

Herbicide with 280 g/l Dimethenamide-p + 250 g/l Terbuthylazine (DT) active ingredient is classified as K3+C1 according to its mechanism of action and provides inhibition of cell division and inhibition of photosynthesis. It has contact and systemic effects and is effective against some graminae and broad-leaved weeds (Barbour, 1996; Anonymous, 2019b).

The herbicides used pre-emergence in the trials were applied on April 19 in 2018 and April 16 in 2019. Herbicides were applied with Oleo Mac SP 126 brand motorized back sprayer with 3 atm pressure. A 2 m long boom with 5 fan jet nozzles was mounted on the sprayer. Spraying was done with an average of 400 liters of water per ha.

Determination of the species and intensities of weeds in the experimental area

Species and intensities of weeds in the experimental area were determined after crop emergence. For this purpose, a 0.25 m^2 frame (0.5 x 0.5 m) was thrown into each plot 3 times and counted, and the species and intensities of weeds were determined. Density was calculated using the following formula belonging to Odum (1971). According to this formula, the total number of plants was divided by the total area counted and the intensities in the plots were determined.

Density= T.Y./n

T.Y: Total density of each species in the counted areas (pieces)

n: Counted total area (m^2)

Determination of the effect of herbicides on weed biomass

In order to determine the effect of herbicides applied to the corn plant on weeds, 25 days after the application (DAA) of herbicides to the plots, a 0.25 m^2 frame was thrown 3 times on each plot, and the species and numbers of weeds in the frame were recorded. The weeds in each frame were then harvested from the root collar and brought to the laboratory and differentiated on the basis of species. Dry weights and number of plants per m^2 were determined by sampling from control plots with the same method at different periods of the corn plant.

In order to determine the dry weight of the weeds, after drying in an oven at 65 ^oC for 48 hours, was noted by weighing them on sensitive scales (referring to Anderson (1930), Hitchcock (1931)).

Determination of the effect of herbicides on the number of weeds per m^2

In order to determine the effect of herbicides applied in the pre-emergence period of the corn plant on weeds, a 0.25 m^2 frame was applied to each plot 3 times 20-25 DAA. Weed species and numbers in the frame were counted and recorded, and the number of plants per m^2 on the basis of species and the effects of herbicides on weeds were calculated.

Determination of the effect of herbicides on corn stem diameter, plant and ear length

The root collar circumference of 10 plants (10 plants on a 1.42 m row) harvested from a random row in the middle of each plot was measured and recorded with the help of a tape measure. Then, these circumference values were calculated with the formula Circumference = 2.π.r and the diameter (R) of the body was found. Trunk length was measured from the harvested above-ground part of the corn to the last tip of the tassel. The ear length was measured from the starting point of the grains to the tip of the ear.

Determination of the effect of herbicides on corn plant and ear fresh and dry weight

When the moisture content of the obtained grains fell below 15%, 10 randomly selected plants were harvested from each plot. The corn ears of the harvested plants were separated from the plants and the fresh weight was obtained by weighing the plant stem. The plants dried in the shade were weighed after 20 days and the stem dry weights were obtained. Fresh weighing the corn ears separated from the plants was found after dried period for 20. The fresh and dry weight values of 10 randomly selected plants were divided by 10 and the average fresh and dry weight (g/plant) of a corn plant and ear was calculated.

Determination of the effect of herbicides on kernel yield and 1000 kernel weight

Kernel yields (kg/da) were calculated by separating the kernels from the corn cobs obtained from 10 plants in each plot. In addition, 1000 kernel were counted and weighed for each parcel from these kernels.

Statistical Analysis

Corn plant fresh and dry weight (g/plant), stem diameter (cm), plant height (m), fresh and dry corn ear weight (g), kernel yield (kg/da), 1000 kernel weight (g), weed dry weight (g/m^2), weed density (number/m^2) and % effect values of herbicides were subjected to statistical analysis. Variance analyses were performed and the means were seperated by Tukey multiple comparison test using Minitab software (Ver 16.0). Homogeneity test was also performed between the two years, since there were differences between most criteria, the mean of the years was not given in the results.

3. Results and Discussion

3.1. Species and Intensities of Weeds in the Trial Area

The 5 most intense weed species and densities in the field in 2018 were respectively *Amaranthus retroflexus* L. 16.83 plants/m^2, *Chenopodium album* L. 3.11 plants/m^2, *Convolvulus arvensis* L. 2.75 plants/m^2, *Alhagi pseudalhagi* (Bieb.) Desv. 1.58 plants/m^2, and *Chondrilla juncea* L. 0.77 plants/m^2 determined (Table 2).

Table 2
Weed species and densities in the experimental area (2018)

Scientific name	Family	Density (plant/m^2)
Amaranthus retroflexus L.	Amaranthaceae	16.83
Chenopodium album L.	Chenopodiaceae	3.11
Convolvulus arvensis L.	Convolvulaceae	2.75
Alhagi pseudalhagi (Bieb) Desv.	Fabaceae	1.58
Chondrilla juncea L.	Asteraceae	0.77
Aristolochia maurorum L.	Aristolochiaceae	0.75
Reseda lutea L.	Resedaceae	0.47
Hordeum vulgare L.	Poaceae	0.44
Acroptilon repens (L.) DC.	Asteraceae	0.27
Xanthium strumarium L.	Asteraceae	0.08
Citrullus lanatus L.	Cucurbitaceae	0.08
Lactuca serriola L.	Asteraceae	0.08
Salsola ruthenica Iljin	Chenopodiaceae	0.08
Sinapis arvensis L.	Brassicaceae	0.05
Polygonum aviculare L.	Polygonaceae	0.02
Hibiscus trionum L.	Malvaceae	0.02

The 5 most intense weed species and densities in the field in 2019 were respectively *A. retroflexus* 32.97 plants/m^2, *C. album* 26.55 plants/m^2, *X. strumarium* 6.94 plants/m^2, *S. nigrum* 4.44 plants/m^2, and *H. trionum* 4.27 plants/m^2 determined (Table 3).

Table 3
Weed species and densities in the experimental area (2019)

Scientific name	Family	Density (plant/m^2)
Amaranthus retroflexus L.	Amaranthaceae	32.97
Chenopodium album L.	Chenopodiaceae	26.55
Xanthium strumarium L.	Asteraceae	6.94
Solanum nigrum L.	Solanaceae	4.44
Hibiscus trionum L.	Malvaceae	4.27
Elymus repens (L.) Gould	Poaceae	4.19
Convolvulus arvensis L.	Convolvulaceae	3.19
Sinapis arvensis L.	Brassicaceae	3.11
Bifora radians Bıeb.	Apiaceae	3.05
Solanum tuberosum L.	Solanaceae	2.44
Ecballium elaterium (L)A.Rich.	Cucurbitaceae	1.5
Chondrilla juncea L.	Asteraceae	0.94
Heliotropium europaeum L..	Boraginaceae	0.47
Veronica hederifolia Poiret	Scrophulariaceae	0.36
Lactuca serriola L.	Asteraceae	0.21
Conium maculatum L.	Apiaceae	0.16
Phalaris paradoxa L.	Poaceae	0.08
Chrozophora tinctoria (L) Rafin	Euphorbiaceae	0.05
Polygonum aviculare L.	Polygonaceae	0.02

Tepe (1997), reported that weed species that are a problem in corn in general, *Aristolochia clematitis* L., *A. retroflexus*, *Artemisia vulgaris* L., *Cirsium arvense* (L.) Scop., *C. album*, *Cynodon dactylon*, *C. arvensis*, *Cyperus rotundus*, *Datura stramonium* L., *Digitaria sanguinalis*, *Echinochloa crus–galli*, *Echinochloa*

colonum, Portulaca oleracea, Polygonum spp., *Setaria* spp., *S. nigrum, S. arvensis* L., *Sorghum halepense, X. strumarium*. Yavuz and Şahin (2021), on the other hand, detected *E. crus-galli, Amaranthus retroflexus, S. halepense, Abuliton theophrastii, Solanum nigrum* and *Chenopodium album* species in corn experimental areas.

It is thought that the difference in weed density between 2018 and 2019 is due to the different weed seed reserve, soil structure and environmental factors.

3.2. Effect of Herbicides on Weeds

In 2018, the plots on which soil herbicides were applied pre-emergence were observed on the 25th and 50th DAA, and three quadrats were placed on the control and sprayed plots. Although weeds were found in the control plots, they were not found in the sprayed plots. In 2019, weeds were found in the plot observations 25 DAA in Table 4

Effect of herbicides on weed dry weight per m^2 (2019)

Application	*S. tuberosum*		*X. strumarium*		*C. arvensis*		*L. serriola*	
	Dry weight	%Effect	Dry weight	%Effect	Dry weight	%Effect	Dry weight	%Effect
ITC	2.11	68	0.16	80	0.04	73	0	100
DT	3.18	51	0.63	24	0.01	93	0.23	23
Control	6.60	0	0.83	0	0.15	0	0.30	0

ITC and DT killed *Lactuca serriola* L. whereas *C. arvensis* control by DT was 91% (Table 5).

Table 5

Effect of herbicides on the number of weeds per m^2 (plant/m^2 in 2019)

Uygulamalar	*S. tuberosum*		*X. strumarium*		*C. arvensis*		*L. serriola*	
	Plant/m^2	%Effect	Plant/m^2	%Effect	Plant/m^2	%Effect	Plant/m^2	%Effect
ITC	5.77	27	2.22	83	4.00	24	0	100
DT	6.66	16	3.10	76	0.44	91	0.88	66
Control	7.99	0	13.33	0	5.33	0	2.66	0

3.3. Effect of Herbicides on Corn Yield Components

The effects of ITC and DT on corn yield elements are given in Table 6.

Table 6

Effect of herbicides on corn yield components (2018 and 2019)

Yield parameters	Weedy control		Pre-emergency herbicides			
			ITC		DT	
	2018	2019	2018	2019	2018	2019
Stem diameter (cm)	1.01	0.48^{B}	1.24	1.35^{A*}	1.22	1.29^{A}
Corn ear length (cm)	20.40^{B}	17.2^{B}	23.13^{A}	24.5^{A}	21.20^{B}	25.3^{A}
Plant height (m)	2.69	2.22^{B}	2.81	2.89^{A}	2.83	2.75^{AB}
Stem fresh weight (kg)	0.245	0.130^{B}	0.330	0.400^{A}	0.283	0.360^{A}
Stem dry weight (kg)	0.155	0.070^{B}	0.236	0.220^{A}	0.196	0.185^{A}
Corn ear fresh weight (kg)	0.270	0.182	0.340	0342	0.306	0.335
Corn ear dry weight (kg)	0.220	0.170	0.303	0.330	0.266	0.320
1000 kernel weight (g)	345.22	346.90	358.32	383.69	352.83	394.90
Yield (kg/da)	0	1616^{B}	0	2650^{A}	0	2633^{AB}

* Means followed by the same letter are not different (p>0.05).

the plots where soil herbicide was applied, and the dry weight in m^2 and the species number of the plants are given in Tables 4 and Table 5. Despite the application of the same active ingredients, this difference between years is thought to be due to the location difference of the trial area, weed seed reserve in the soil, seed dormancy, soil structure and environmental factors.

When we look at the effect of the ITC herbicide applied in the trials on the dry weight of the weeds, 100% and 80% effect was obtained against *L. serriola* and *X. strumarium*, respectively, while the DT herbicide was 93% effective against *C. arvensis* (Table 4). Pannaci and Covarelli (2003) indicated that mesotrion, imazamox and thifensulfuron controlled corn weeds including *C. album*, *X. strumarium*, *S. nigrum*, and *A. retroflexus* even if they used lower rate than recommended rate.

Although the effect of the applied herbicides on the stem diameter of corn was found to be insignificant as a result of the statistical analysis made on the data of 2018, the difference between them was found to be significant when compared to the herbicide control. The difference between the results obtained in 2019 was found to be statistically significant. The stem diameters of the plants in the herbicides applied plots increased approximately 3 times compared to the plants in the weedy control plots (Table 6; Figure 2).

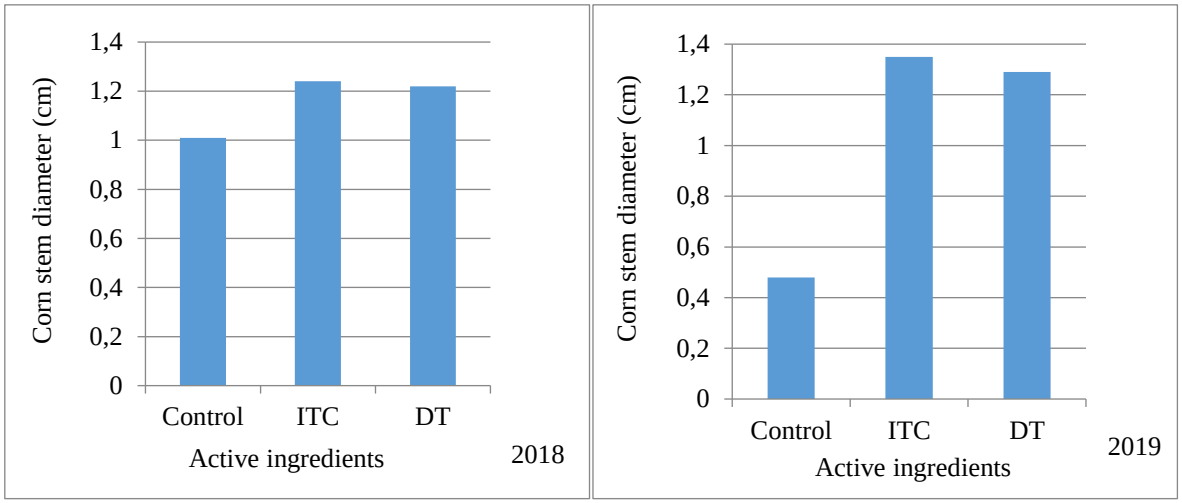

Figure 2
Effect of herbicides on corn stem diameter (2018 and 2019)

The effect of applied herbicides on corn ear length was found to be statistically significant in both years when compared to the weedy control. In 2018, the longest corn ear length was obtained from the plot where the ITC asset was used. In 2019, the longest corn ear length was obtained from the plots where the DT asset was applied (Table 6; Figure 3).

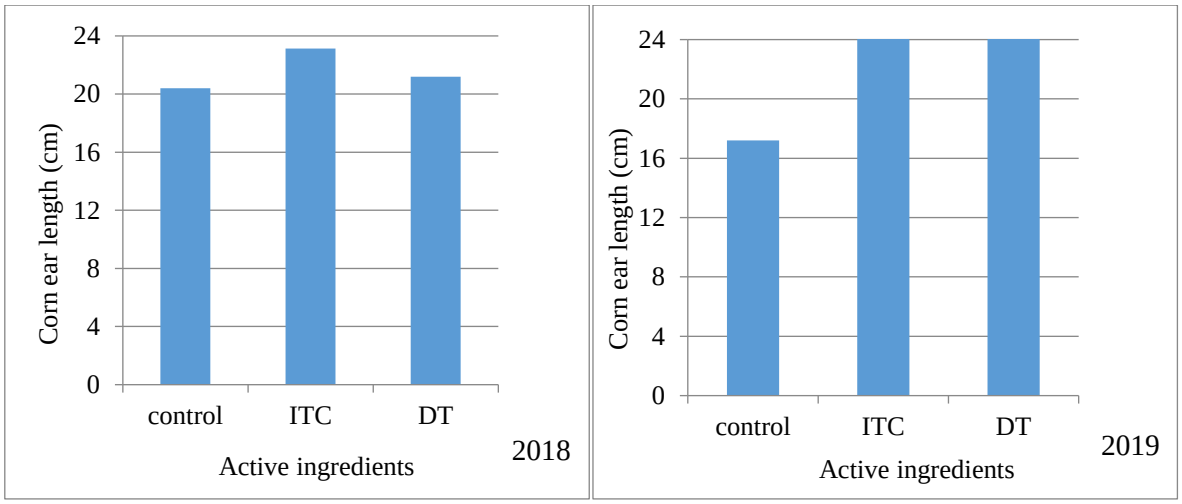

Figure 3
Effect of herbicides on corn ear length (2018 and 2019)

When we look at the effect of herbicides on corn plant height, the difference was statistically insignificant in 2018, but significant in 2019 compared to weedy control. The differences in corn height in the pre-emergence herbicide applied plots are presented in the table and figure (Table 6; Figure 4). Boz et al. (2015) also set up field trials in their studies on the symptoms caused by non-recommended herbicides in corn. While yellowness and whiteness of the leaves and shortening of the plant were observed at the dose of 37.5 ml/da of glyphosate applied in the first week, in addition to these symptoms at the dose of 75 ml/da, wilt and drought were observed in the plant. At doses of 150 ml/da and higher, drying and death were observed in the plant. They found that the leaves were yellow and white, shortened in length at 37.5 and 75 ml/da doses of glyphosate applied in the second week, and after the appearance of necrotic spots on the plant at 150 ml/da and higher doses, drying and death were observed in the plant.

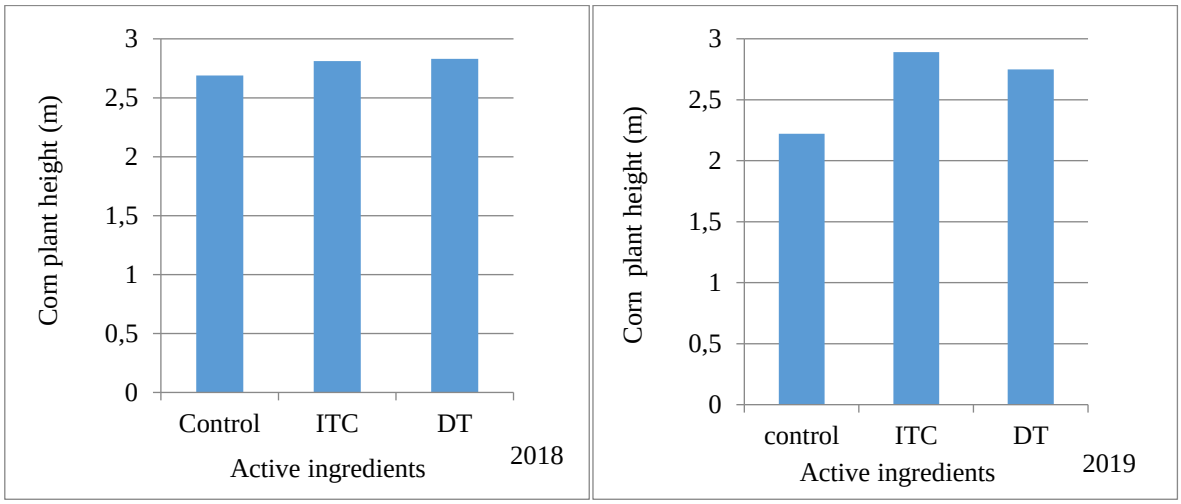

Figure 4
Effect of herbicides on corn plant height (2018 and 2019)

While the effect of ITC and DT herbicides applied on the corn plant on the stem fresh weight of the corn plant was statistically insignificant in 2018, but significant in 2019. In the herbicide-treated plots, corn plant stem fresh weight was significantly different compared to the weedy control plots. (6; Figure 5).

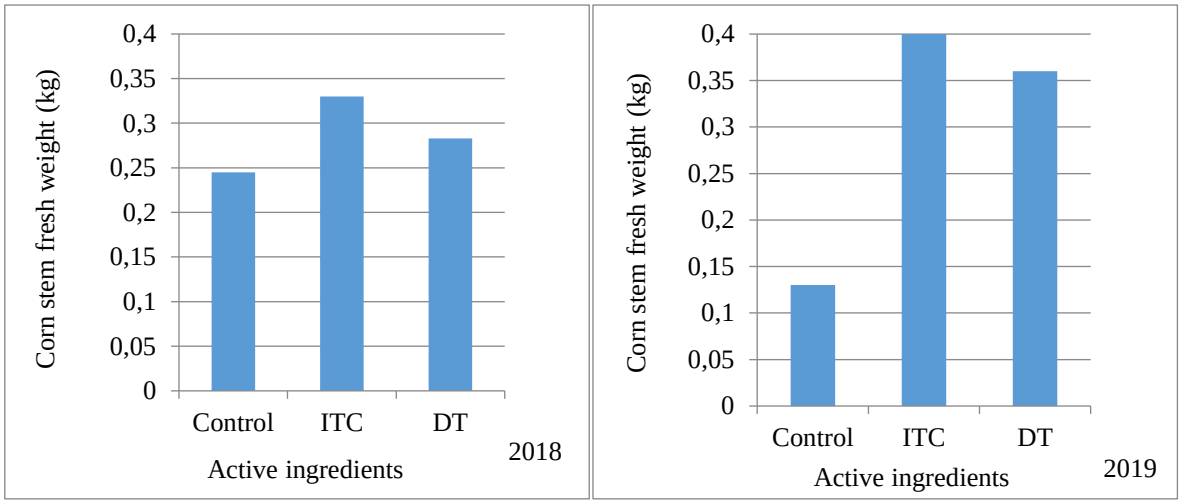

Figure 5
Effect of herbicides on corn stem fresh weight (2018 and 2019)

The impact of ITC and DT herbicides applied on the corn plant on the stem dry weight of the corn plant was statistically insignificant in 2018 while the difference between them was significant in the next year. In the herbicide-treated plots, corn stem dry weight was significantly different from the weedy control plots. (Table 6; Figure 6). Similarly, Yavuz et al. (2018) applied glufosinate, glyphosate, isoxaflutole + thiencarbazonemethyl + cyprosulfamide and imazamox active ingredient herbicides to 25 corn lines under greenhouse conditions to determine the effects of some herbicides on dry weight of weeds and corn. Corn biomass of corn lines were the highest in plants applied to isoxaflutole+thiencarbazone-methyl+cyprosulfamide and the least in plants treated to glpyhosate.

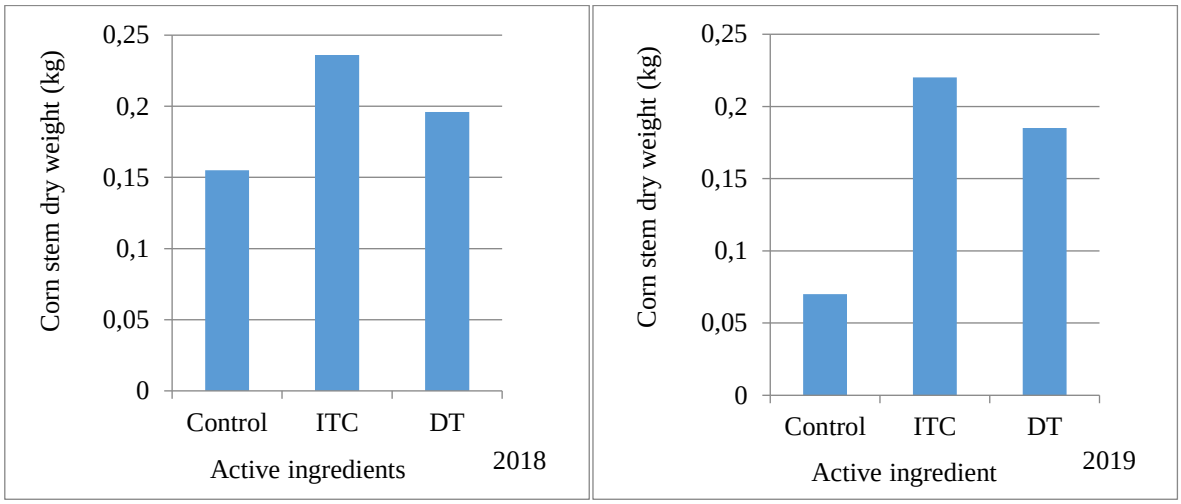

Figure 6

Effect of herbicides on corn stem dry weight (2018 and 2019)

Although the effect of ITC and DT herbicides applied on corn ear fresh and dry weights of corn was not significant statistically in both years, an apparent difference between the weedy control and sprayed plots were seen, especially in 2019 (Table 6; Figure 7; Figure 8).

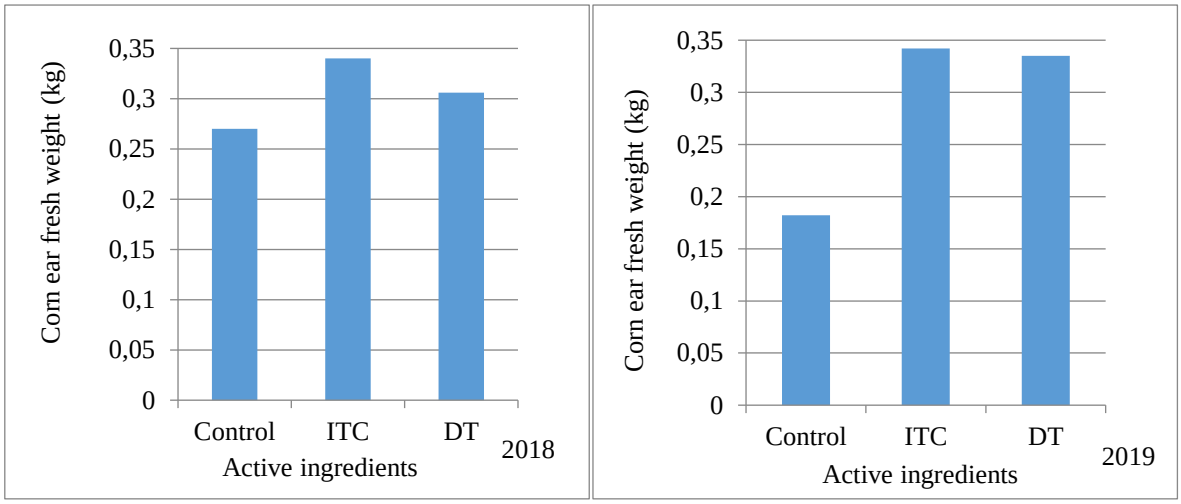

Figure 7

Effect of herbicides on corn ear fresh weight (2018 and 2019)

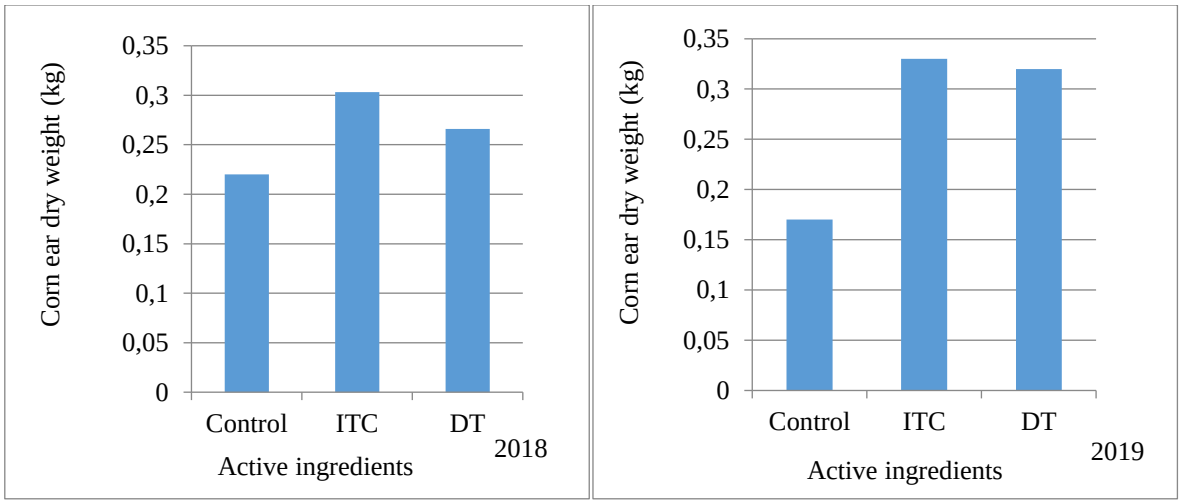

Figure 8

Effect of herbicides on corn ear dry weight (2018 and 2019)

When we look at the effect of herbicides applied on the pre-emergence corn plant on the 1000 kernel weight of corn, the difference was found to be insignificant in 2018 and 2019. When we compare the 1000 kernel weight of 2018 with the weedy control plots, the 1000 kernel weight was obtained from the plots with the highest ITC active ingredient applied. When we compare the 1000 kernel weights obtained in 2019 with the weedy control plots, the highest 1000 kernel weight was obtained from the plots of DT active ingredient applied. The difference between the years is thought to be due to the field and environmental conditions (Table 6; Figure 9).

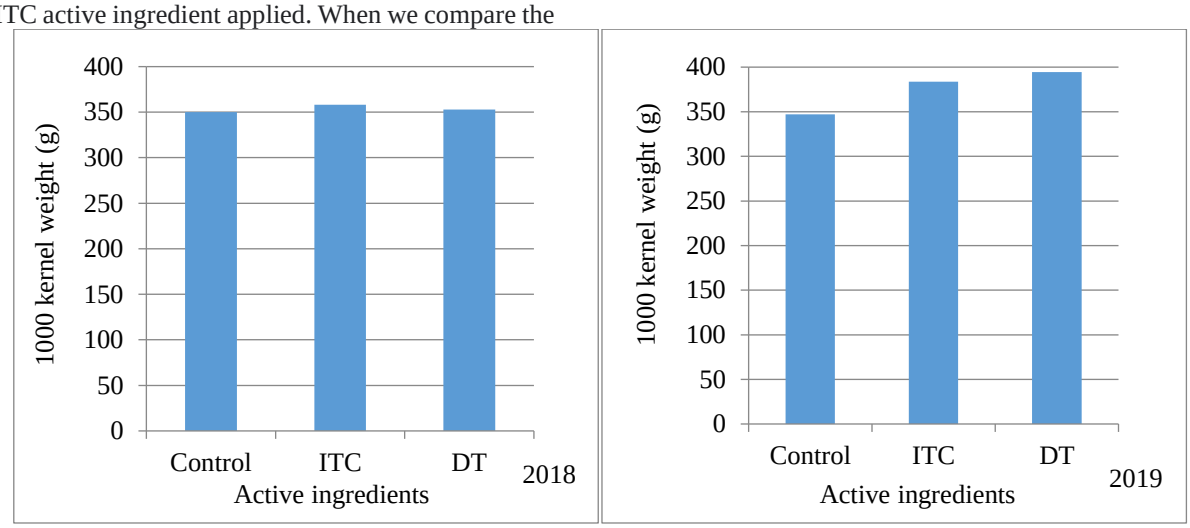

Figure 9
Effect of herbicides on 1000 kernel weight (2018 and 2019)

When we look at the effect of ITC and DT herbicides applied on corn plant on corn yield, the highest yield was obtained from the plot where ITC active ingredient was applied compared to the weedy control plots. It is seen that both herbicides provide a significant increase in corn yield. According to the data obtained, the highest yield in the corn plant was obtained from the herbicide applied pre-emergence (Table 6). With the herbicides applying from the soil, absence of competitive weeds that can share the water, light and nutrient elements in the environment from the corn plant comes to the surface of the soil has ensured that the plant grows physiologically in the critical period, and in the following periods, high yield was obtained compared to weedy control plots (Table 6; Figure 10).

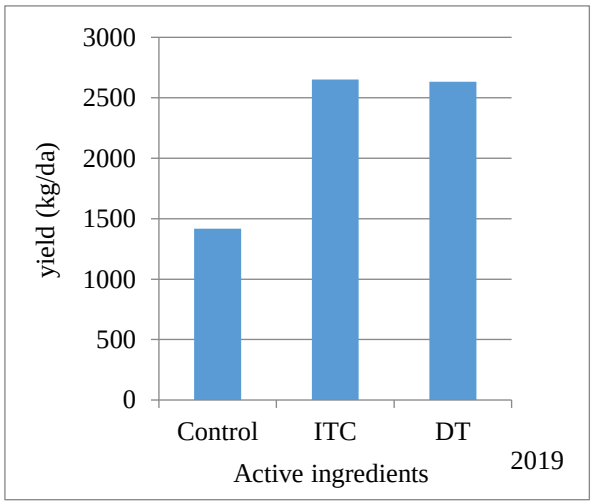

Figure 10
Effect of herbicides on kernel yield (2018 and 2019)

4. Conclusions

Due to the slow growth of the corn plant in the early stages of seedling development and the large distance between the rows, it cannot compete with weeds sufficiently and remains under the pressure of weeds. The development period after the emergence of the corn, when it has 3 to 10 leaves, is the critical period for weeds. If they are not effectively controlled at this period, serious decreases in corn yield could not be inevitable. Corn, which is an important crop in the world and in Türkiye, is faced with various problems in different periods of its development like weeds.

Both of these herbicides controlled *A. retroflexus*, *C. album*, *X. strumarium*, *C. arvensis* and *S. nigrum*, which are the most common species in the experimental areas.

Considering the corn stem diameter, cob length, corn stem length, corn stem dry and fresh weight, dry and fresh cob weight, thousand-grain weight and yield per decare in both years, it was determined that the active substances used increased in yield 2 to 3 times compared to the weed control plots. Similarly, it is reported that the competition of corn against weeds is weak during the emergence of the corn plant to the soil surface and the seedling growth period. If weeds are not controlled, the yield loss can reach 80%. Also that many weeds may use more nutrients than corn. For example, *Chenopodium* spp. absorb 3 times more phosphorus, 2 times more nitrogen than corn, and potassium as much as corn from soil (Anonymous, 2019c).

Both herbicides used pre-emergence provided an excellent increase in yield when compared to the weedy control. Although there is no significant difference between the impact of them, ITC was more successful in terms of grain yield per ha than DT. Although the

herbicides used pre-emergence vary depending on soil seed bank, soil structure and environmental factors. However, if the land is heavily infested with weeds, weed emergence can be observed 20 days after spraying, albeit a little. In this case, a post-emergence herbicide may be recommended considering the weed density. When deciding to post-em application, the economic damage thresholds of the weeds should be considered. Otherwise, the input costs will increase and environmental pollution will be caused by the extra herbicides applied to the land.

As in all cultivated plants in the world and in Türkiye, weed control methods such as cultural, mechanical or chemical do not provide sufficient benefit if they use alone. Therefore, weed control methods should be combined. Among these methods, the most commonly used hoeing and herbicide application. Since hoeing increases labor and production costs, farmers tend to use herbicides with a lower cost, short duration of action and high success rate.

Despite the residue problem and some negative effects of herbicides on ecology, yield losses can be prevented with timely and correct use. However, at this point, it is necessary to comply with the recommended dose and pay attention to the application time. Another important issue is that herbicides with different mechanisms of action should be used alternately against the problem of weeds developing resistance to herbicides. Herbicides that act in the soil in a short time and have high selectivity should be avoided.

5. Acknowledgements

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Evaluation of Popular Recreation Places in Konya in Terms of Safety and Maintenance Criteria: In The Case of Kalehan Ecdat and Japon Parks

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ABSTRACT

Both the negative impact of the covid pandemic that we have experienced in the last 2 years, and the understanding of having green areas with higher standards have come to the fore more today. While the longing for green spaces has increased in individuals who are closed in their homes in the pandemic environment, the necessity of these green spaces to be more well-maintained and safer has emerged, considering the pandemic conditions. The aim of this research is to determine the status of the facilities and the park in general in Kalehan-Ecdat and Japon Parks, two of the most popular urban parks in Konya, and to compare them with each other in terms of maintenance and security. These two popular parks constitute the main material of the research. A total of 256 visitors using the parks were surveyed on a voluntary basis, paying attention to the pandemic hygiene conditions, face-to-face and online using Google surveys. Kalehan-Ecdat and Japon parks were evaluated by the park users in terms of the well-maintained and safety of the facilities they contain and the park in general, in order to determine their current status and to compare them with each other. While 60% of the users found both parks well-maintained, 4% found them unmaintained. When the security conditions of the parks were evaluated, Kalehan-Ecdat park, which has straight access roads and patrols in the park, was found to be 70% safe in terms of circulation, while the Japon park, which had deserted areas in places due to its lively design, was found to be 50% safe.

1. Introduction

A landscape design understanding that is physically, socially, and visually adequate and has a high standard has started to gain importance today. Urban spaces are of great importance in meeting the needs in this direction in the daily life cycle between work and home. The most important of such places are the city parks, which contain many recreational opportunities and facilities. Urban Park areas can be defined as common use areas organized by city administrations for the purpose of people resting, walking, performing various recreational activities and approaching nature. (Güngör and Polat 2017). Urban green spaces are vital for cities to achieve sustainability. Optimum design and management of green space is necessary to counter the pressure from increased use due to urban concentration. Green spaces within the city are important not only for the bio-physical functioning of cities, but also for social functionality, such as reducing the urban heat island effect or preserving biodiversity. The primary social function of green spaces is recreation, but green spaces also have other socio-cultural benefits. For example, they provide opportunities for social interaction or mental regeneration and are important for human health. However, as the urban population grows, cities face the challenge of ensuring that growing numbers of populations continue to have equal access to the benefits of green spaces. (Schrammeijer et al. 2022).

It is important for the developing urban ecosystem to adequately assess the role and benefits of green spaces for people living in the city. In the last decade, the concept of ecosystem services has gained importance in sustainability and quality of life discussions. Also, at the policy level, more emphasis is placed on human dependence on nature. In urban areas, the direction of intangible benefits or cultural ecosystem services is very important, and the quality of green space is an important factor in how people receive cultural ecosystem services. In order to strengthen this link in urban areas, it is

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necessary to have an understanding of the quality and management of urban ecosystem services to ensure sustainable urban planning and general well-being. Urban green spaces have been the subject of studies in different areas, but correlations with assumed benefits are generally based on their presence/amount. Therefore, green spaces are a complement to the urban physical structure. These spaces are a kind of urban land use with ecological, social and economic characteristics (Sarcheshmeh et al, 2020).

Urban parks are areas that provide opportunities for exercise, recreation and social interactions for disabled and elderly people. Especially city parks, which are easily accessible by users, play an important role in maintaining and regaining a healthy lifestyle (Sung et al. 2022).

It is the primary duty of city administrators to keep the facilities operational in order to provide suitable physical and social environments to park users and to provide them with interesting experiences. Especially in urban areas, limited parking space, high usage density and high diversity of activities make it difficult to fulfill these goals (Gobster, 2002).

One of the biggest problems in the management of parks today is being able to reconcile the conflicting interests of the different groups that use them. Those who seek a quiet environment, those who play lively and noisy games, dog walkers, picnickers, young people, the elderly, athletes and children all want to do whatever activity they want at that moment without being disturbed. In addition, different researchers argue that park conditions, maintenance, policies and programs affect park use and physical activity levels (San Jose, 2014).

Urban open spaces such as public parks and green spaces are important health-promoting facilities that play an increasingly critical role in contributing to the sustainable future of cities. At this stage, it is necessary to make the right planning, design and maintenance programs for the parks. The design and management of the park should take into account the recreational needs of all target groups it is intended to serve (Yücel 2020).

Although the wishes and expectations of the people who will use the park are determined by various methods at the planning stage, there are very few studies that measure the impressions and reactions of the users about the park after the realization of the park (Altınçekiç and Erdönmez, 2001).

Today, the understanding of physical, social and visual adequate and superior standards of outdoor arrangement has begun to find its place. Urban spaces are of great importance in meeting the needs in this direction in the daily life environment. The most important of these types of spaces are urban parks, which contain many recreational opportunities and facilities (Polat and Önder, 2004).

Preferences in the visual evaluation of the environment and the determination of environmental protection The human-environment relationship and the interactions used are important in terms of preserving the character of the external environment (Bozhüyük, 2007).

Green areas are areas that allow individuals who work indoors all day to relax in nature. Urban green spaces in cities are often defined as the lungs that allow the people of the city to breathe. Today, the idea that urban green spaces are an integral and very important part of a city is accepted. (Belmeziti, Cherqui and Kaufmann, 2018).

It is possible for a healthy and living city to exist to the extent that all individuals can live peacefully, comfortably and move freely (Baş 2016).

The purpose of this research; It is to determine the current status of the two most important urban parks in the Selçuklu district of Konya and the facilities in them in terms of security and maintenance criteria. In addition, it is to obtain information about user experiences within the scope of park visits of park users. The general conditions of the facilities in the parks will be revealed and suggestions will be made to use the park areas more effectively with the findings obtained.

2. Materials and Methods

This study was conducted in Konya. These two popular parks constitute the main material of the research. A total of 256 visitors using the parks were surveyed on a voluntary basis, paying attention to the pandemic hygiene conditions, face-to-face and online using Google surveys. Kalehan-Ecdat and Japon parks were evaluated by the park users in terms of the well-maintained and safety of the facilities they contain and the park in general, to determine their status and to compare them with each other.

3. Results and Discussion

While 60% of the users found both parks well-maintained, 4% found them unmaintained.

When the security conditions of the parks are evaluated, Kalehan-Ecdat park, which has straight access roads and patrols in the park, was found to be 70% safe in terms of circulation, while the Japon park, which had deserted areas in places due to its lively design, was found to be 50% safe.

In the last ten years, intensive afforestation studies have been carried out in Konya city parks. However, exotic species are generally preferred in these studies. As a result, adaptation and maintenance problems arise, and even plants dry up. While great efforts are made to increase the vegetation cover of the city parks to a sufficient level and to increase the growth rate, the principle of sustainability is not observed.

It is necessary to create opportunities for park users who are in demand for other recreational activities. Physical activities reduce the risk of some chronic diseases. The construction of facilities, especially for those who

want to do sports and physical activity, is considered important in terms of human health and life comfort.

A total of 256 visitors using the parks were surveyed on a voluntary basis, paying attention to the pandemic hygiene conditions, face-to-face and online using Google surveys. Within the scope of the research, 256 park users were interviewed. Their demographic characteristics are given in Table 1. The rates of the demographic characteristics of the users have emerged at a level to represent the whole city of Konya. Kalehan-Ecdat and Japon parks were evaluated by the park users in terms of the well-maintained and safety of the facilities they contain and the park in general, in order to determine their current status and to compare them with each other. While 60% of the users found both parks well-maintained, 4% found them neglected. When the security conditions of the parks are evaluated, the Kalehan-Ecdat park, which has smooth access roads in terms of circulation and patrols in the park, was found to be 70% safe. The Japon park, which has uninhabited areas due to its dynamic design, was found to be 50% safe.

As can be seen in Table 2,

Safety: good+very good= %49,99

Safety: bad+very bad= %1,95

Maintanence: good+very good= %58,66

Maintanence: bad+very bad= %4,29

As can be seen in Table 3,

Safety: good+very good= %49,99

Safety: bad+very bad= %1,95

Maintanence: good+very good= %59,77

Maintanence: bad+very bad= %3,9

In the last decade, intensive plantation works were carried out in Konya urban parks. However, in general, exotic species are preferred in these studies. As a result of this, adaptation and maintenance problems arise and even the plants dry out. While a great effort is made to raise the vegetation of the urban parks to a sufficient level and to increase the growth rate, the principle of sustainability is not considered. It is necessary to create opportunities for the park users who are in demand for other recreational activities. Physical activities decrease the risk of certain chronic diseases. The construction of the facilities especially for people who want to do sport and physical activity is considered important in terms of human health and life comfort.

Table 1

The Demographic Characteristics of the Users

Gender	Woman (%)		Man (%)									
	123	48,05	133	55.95								
Age	18-34		35-49		50-64		65 >					
	153	59.77	56	21.87	44	17.18	3	1.18				
Residence	Karatay		Meram		Selçuklu		Other					
	32	12.5	20	7.81	201	78.51	3	1.18				
Education	Primary School		High School		College		University		MSc-PhD			
	20	7.8	46	17.96	55	21.48	127	49.6	8	3.16		
İncome (₺)	Min.wage		6000-9000		9001-12000		12001-15000		15000 >			
	26	10.15	79	30.85	104	40.62	42	16.4	5	1.98		
Profession	Worker		Civil Servant		Tradesman		Student		Housewife		Retired	
	16	6.25	196	76.56	21	8.2	18	7	4	1.56	1	0.43

Table 2

Current situation of the Kalehan-Ecdat park in Konya

Evaluate the Kalehan-Ecdat park in Konya in terms of safety.												
Very bad (%)		Bad(%)		Normal (%)		Good (%)		Very good (%)		Undecided (%)	
1	0,39	4	1,56	70	27,35	77	30,08	103	40,23	1	0,39
Evaluate the Kalehan-Ecdat park in Konya in terms of maintenance.											
Very badly-maintained		Badly-maintained		Normal		Well-maintained		Very well-maintained		Undecided	
1	0,39	10	3,90	94	36,66	65	25,39	85	33,27	1	0,39

Table 3

Current situation of the Japon park in Konya

Evaluate the Japon park in Konya in terms of safety.												
Very bad (%)		Bad(%)		Normal (%)		Good (%)		Very good (%)		Undecided (%)	
1	0,39	4	1,56	122	47,67	71	27,73	57	22,26	1	0,39
Evaluate the Japon park in Konya in terms of maintenance.											
Very badly-maintained		Badly-maintained		Normal		Well-maintained		Very well-maintained		Undecided	
1	0,39	9	3,51	92	35,94	67	26,17	86	33,6	1	0,39

The parks are expected to provide service for the demands and needs of people in different age groups, gender, and occupational groups separately. Therefore, it is necessary to consider designs, with priority, that give users peace and confidence, and that will enable them to

relax, rest and most importantly be satisfied with that place in the planning.

- Park administrations should increase their maintenance works,
- The toilet facilities in the parks must be sufficient and quality,
- It is necessary to increase the usage related to the water element and to use materials with higher quality,
- The sufficiency and quality of the parking areas should be increased,
- The quality of the playgrounds and the park officers should be increased,
- The facilities that will provide opportunities for recreational activities should be established in the park,
- The park officers should be educated, and they should be carefully selected from among those who will adapt to the job.

4. Coclusion

The duplication of such studies will be the basis for the renewal of the parks in use, will increase user satisfaction for these parks, and will shed light on other related professional disciplines, especially landscape architecture, in future planning, design, implementation and management studies.

It is expected that the parks will serve the wishes and needs of people of different ages, genders and occupations separately. For this reason, designs that give the user peace and security, relax, rest and, most importantly, ensure that he is satisfied with where he is, should be considered as a priority.

In this study, by focusing on the Japon and Kalehan Parks located in the city center, the demands of the users for urban parks and green spaces and their general evaluations of these parks and green spaces were determined to improve the quality of life. These data will be guiding for creating urban park strategies in the coming years. In the results of working, Park managements should increase their maintenance work, the toilets in the parks should be in sufficient number and quality, the use of water elements should be increased, and higher quality materials should be used, the adequacy and quality of the parking areas should be increased, the arrangements made for the disabled should be made according to the standards, the equipment and the playgrounds should be used. It was observed that the quality of the park staff should be increased, there should be interesting facilities that will allow recreational activities in the park, the park staff should be trained to establish healthy social relations with the public, and they should be carefully selected from people who will adapt to the job.

Due to its increasing population, the city of Konya needs more and more recreational areas as well as more green areas every year. It should not be forgotten by those who run cities that people will always need accessible, safe and well-maintained park areas. However, due to the limited number of surveys used in the study area and the low sample size due to covid conditions, the current research results should only be generalized after a study with wider participation to understand the general approach of the local people to the city. Improving the park areas by considering the needs and demands of the users and finding solutions to the problems will increase the level of satisfaction with the city parks and the number of visitors visiting these parks.

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Research Article

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Climate Change and Plant Health: A Bibliometric Analysis

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Plant Health

ABSTRACT

Climate change, the effects of which are becoming more evident day by day, is seen as a serious threat to sustainable agriculture. As a result of the diseases and pests being affected by climate change, it is inevitable that changes will occur in the state of plant health, which has an important place in sustainable agriculture. Evaluation and analysis of the literature is of great importance, as research and assessments focusing on the impact of climate change on plant health use current knowledge. In this study, which was carried out to contribute to the aforementioned subject, bibliometric analysis was performed on the indexed researches on climate change and plant health in the Web of Science (WoS) database according to the determined search query. Information on different subjects such as authors, countries, published journals, citations, sources used and keywords related to the studies were analyzed with the Bibliometrix package developed in R software and the data were visualized. Quantitative results were obtained on subjects such as prominent authors, journals, countries, and common keywords as a result of bibliometric analyses. According to the results, the importance of multidisciplinary studies is becoming more and more important. In addition, it is gaining popularity to benefit from technological developments in the face of changing and emerging needs in the processing of all kinds of information about climate change. This study was carried out to show that there is an alternative way to gain a general perspective on climate change-related issues in similar studies to be carried out. It is thought that these and similar bibliometric analysis studies can contribute to the execution of more successful studies, thanks to the information on different topics they provide.

1. Introduction

The concept of 'one health', which expresses the whole of human, animal and environmental health, will gain more importance as a result of the increase in their relationship with each other in the changing world conditions with the effect of climate change and other factors. Plant health, which is considered as a sub-branch of environmental health, has a much more important role than it is thought because it is related to food, which forms the basis of human and animal nutrition. Plant diseases have the potential to harm large human populations as a result of their effects such as causing disease in humans and animals, famine due to lack of clean food, acute or chronic poisoning, exposure to pesticides and disruption of natural processes (Andrivon et al. 2022; Morris et al. 2022).

Experiencing devastating events such as drought, flood and extreme weather events with the effect of many factors, especially changes in temperature and CO_2 values, is interpreted as a sign that climate change will have a more serious impact in the future. As a result of the environmental and ecological conditions being affected by the changing conditions, it is inevitable that the sustainable agriculture will be negatively affected. All of the pathogen-host-vector factors that make up the three pillars of plant health are in a very close relationship with the environmental factor. The different situations that arise in plant health with the effects of climate change are a great threat to sustainable agriculture and food security. The necessity of multidisciplinary approaches for understanding and resolving impacts and consequences is now an indisputable reality (Jeger et al. 2021; Malhi et al. 2021; Priyanka et al. 2020).

More studies of important issues and expanding research areas cause the rapid growth of the literature

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and the increase of unexplained information. Bibliometric analysis studies, in which a large number of scientific studies are analyzed, can reveal changes and developments in any subject, make trends and deficiencies visible, and provide researchers with information on many different topics (Donthu et al. 2021). Many bibliometric analyzes have also been made on climate change, which is a hot topic and contains a large amount of data. In relation to climate change and agriculture, Fu and Waltman (2022) on the large-scale climate change research literature, Sweileh (2020) on the climate change and food security literature, Sarkar et al. (2022) on the sustainable agriculture literature, and Yuan and Sun (2022) on the rice and climate change research literature, are examples of bibliometric analysis studies. Bibliometric analysis has been carried out on many issues related to climate change, such as economy, energy, migration, and adaptation.

In our study, it has been shown that a quick perspective can be provided by making bibliometric analyzes on terms related to climate change and plant health, which is a subject that has not been examined before according to our available information.

2. Materials and Methods

In order to obtain material suitable for the purpose of the study, a search was made in the Web of Science (WoS, www.webofknowledge.com) database with the query created on the relevant subject. Search for "TS=(climate change*) AND TS=(plant disease*)", "TS=(climate change*) AND TS=(plant pest*)" and "TS=(climate change*) AND TS=(plant weed*)" queries were used. Search results were processed with tidyverse (Wickham et al. 2019) and bibliometrix (Aria and Cuccurullo 2017) packages developed in R v4.2.1 (R Core Team 2021) software language in R Studio v2022.07.0 (RStudio Team 2020) environment. After merging the query results, the studies were filtered. The studies were limited to those written after 2000, only in the 'article' type and only in English, and the analyzes were carried out on these studies.

3. Results and Discussion

After filtering, bibliometric analyzes were made by considering 3391 of 3902 studies associated with climate change and plant health (in terms of diseases, pests and weeds). Studies have been published in 886 different journals by 12738 different authors in total. The annual growth rate calculated over the distribution of 3391 publications by years was found to be 21.6%. Although there are some fluctuations, it can be seen that the annual number of publications is increasing, suggesting that the subject is being addressed more and more (Figure 1).

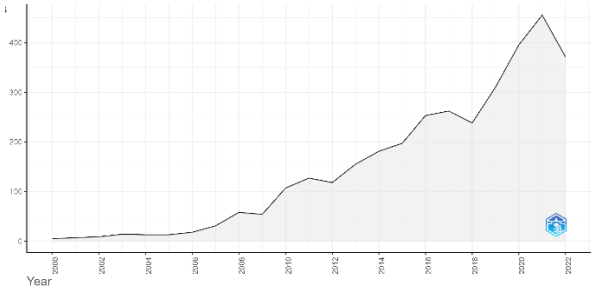

Figure 1
Annual publication increase

Among the 886 different journals in which the publications are included, the fact that the first 20 journals are not specific on the basis of the subject, but are multidisciplinary and have high H-index, shows that plant health and climate change are given importance and are handled in a multi-faceted manner (Figure 2). In terms of the number of publications, PLOS ONE journal ranks first with 92 publications, while FRONTIERS IN PLANT SCIENCE journal ranks second with 63 publications, and GLOBAL CHANGE BIOLOGY journal ranks third with 59 publications. Other journals have ~50 or fewer publications. Unlike the ranking of the number of publications according to the H index, GLOBAL CHANGE BIOLOGY is the first (34) while PLOS ONE is the second (29) and CLIMATIC CHANGE is the third (22).

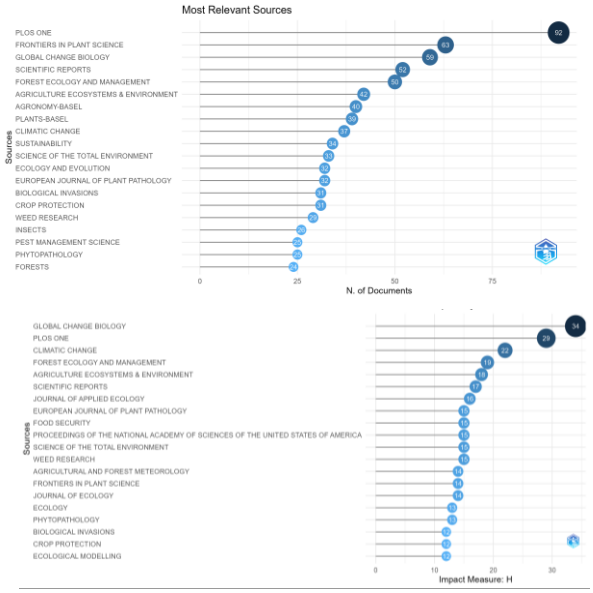

Figure 2
The first 20 journals according to the number of publications (above) and the first 20 journals according to the H index (below)

According to the number of publications, it is seen that the top 20 authors have at least 10 publications and the productivity of the authors in terms of publications has increased after 2010 (Figure 3). The top three authors are Darren Kriticos, Lewis Ziska, and Philip Hulme. When the publication contents of these authors are examined, it is seen that they have extensively covered topics such as ecology, ecosystem, biodiversity,

control strategies, invasive species, or have developed models and software for analyzes on various subjects. For example, Daren's modeling tool named CliMond (Kriticos et al. 2012), Lewis Zisca's studies (Hatfield et al. 2011) on the effects of climate change on agriculture, Philip Hulme's studies (Walther et al. 2009) on invasive species in a warming worldare among the highly cited studies. In general, there is an average of 5.2 authors per publication and the number of single-authored studies is 146, while the international co-authorship rate is 35.7%.

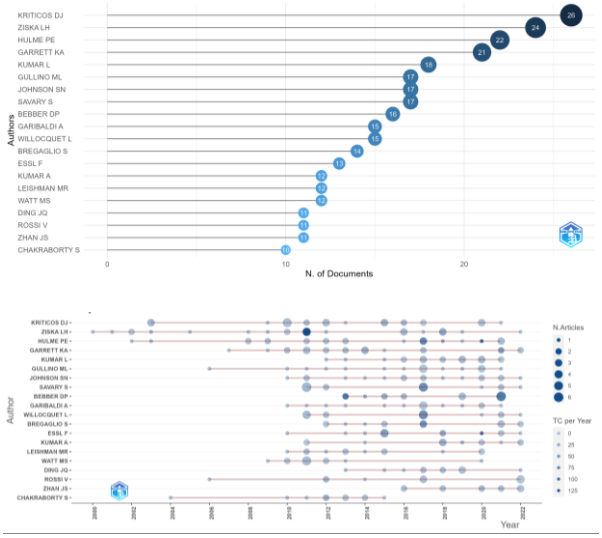

Figure 3
Top 20 authors by number of publications (above) and their productivity by years (below)

Looking at the first 20 publications among the analyzed studies, it is seen that they received at least 360 citations (Figure 4). For example, studies on tree death due to drought (Allen et al. 2015), interaction between species in climate change (Gilman et al. 2010), and the consequences of climate change for invasive species (Hellmann et al. 2008) are the three most cited studies among the analyzed studies. The relatively broad perspective of these studies provides evidence for the necessity of a multidisciplinary approach to the subject.

When the citations made in the analyzed studies are examined, it is seen that there are studies that provide an overview on certain topics (Figure 4). From genomes to ecosystems, the effects of climate change on plant diseases (Garrett et al. 2006), the direct effects of increasing temperature on herbivorous insects (Bale et al. 2002), climate change and plant disease management (Coakley et al. 1999) studies are among the most cited studies in the analyzed studies. The high citation of studies on a more specific subject such as plant health shows that the subject we have examined has been addressed in many studies and is an important subject to be investigated.

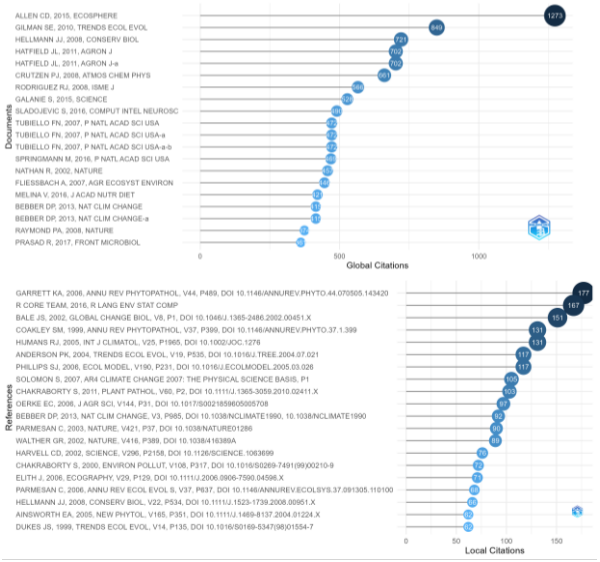

Figure 4
Among the studies we analyzed, the top 20 most cited studies (above) and the top 20 most cited studies by analyzed studies (below)

In addition, it is an interesting result that R software (R Core Team 2021) ranks second among the most cited studies. This result shows that software and analysis programs are used extensively in publications on climate change and plant health. It is thought that the need to develop new software and programs for changing needs may arise in future analyzes. While the developments in artificial intelligence and machine learning technologies in recent years have made important contributions to the analysis and interpretation of all kinds of data, the accuracy of the data is now becoming more important for correct predictions.

When the keyword plus words revealed by the Web of Science database according to the contents of the studies were evaluated, it was determined that while climate change (1078) was the most frequently used keyword, words such as temperature (305), growth (285), management (263), responses (233), impacts (219), resistance (218), plants (202), diversity (201) were also frequently used (Figure 5).

On the other hand, when the 50 most used author keywords in the analyzed publications were evaluated, it was found that climate change (874) was the most frequently used keyword, while it was frequently used in words such as invasive species (90), agriculture (85), food security (82), adaptation (80), global warming (73), biodiversity (71), drought (70), temperature (70) (Figure 5). These results show that the authors use relatively more general keywords.

Figure 5
Word cloud created according to the frequency of use of keyword plus (above) and author keywords (below)

When the author keywords are examined by years, it is seen that the keywords of gene editing and intercropping, together with the terms of machine learning and deep learning related to artificial intelligence, have been trending in recent years (Figure 6). These results are proof that research subjects are rapidly shifting to that field according to changes and developments.

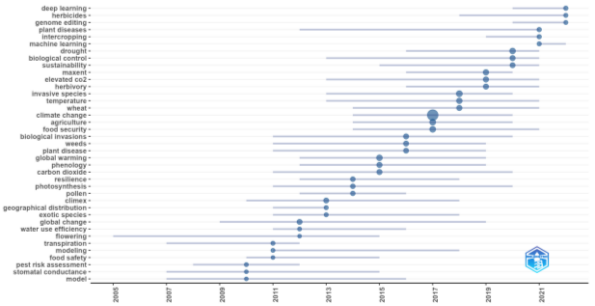

Figure 6
Change of author keywords by years

When we look closely at the relations between journals, it can be seen that there is a grouping of journals with relatively ecology-based multidisciplinary content or general coverage and phytosanitary-based journals. (Figure 7). However, even if grouping is mentioned, the fact that all journals have a large number of relations with each other in one way or another strengthens the multidisciplinary understanding.

When publications are associated with countries through authors, the USA (633) ranks first in terms of total publications, both within itself (507) and in cooperation (126) with multiple countries, followed by countries such as China (286), Australia (262), United Kingdom (204), and India (168). The top 10 countries in terms of the number of citations received are listed as USA, UK, Australia, Italy, Germany and others in parallel with the number of publications, although there are some differences (Figure 8). It is considered as an important inference that China and India, which are in the first place in the number of publications, cannot show the same success in citation. As in our results, it was determined in Fu and Waltman (2022) study that there is a difference between developed and developing countries in scientific production.

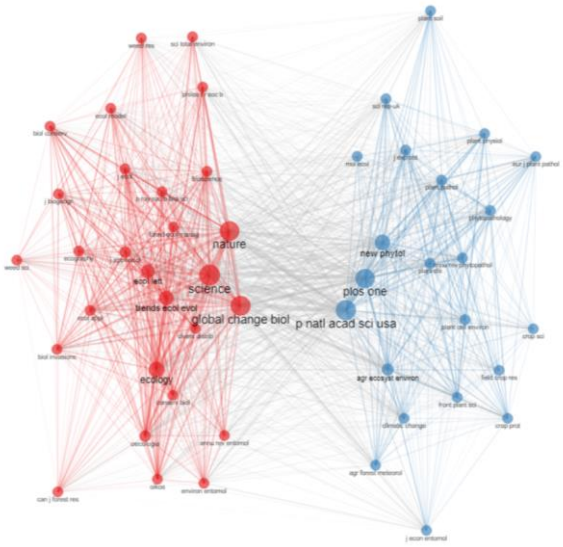

Figure 7
Relationship between journals

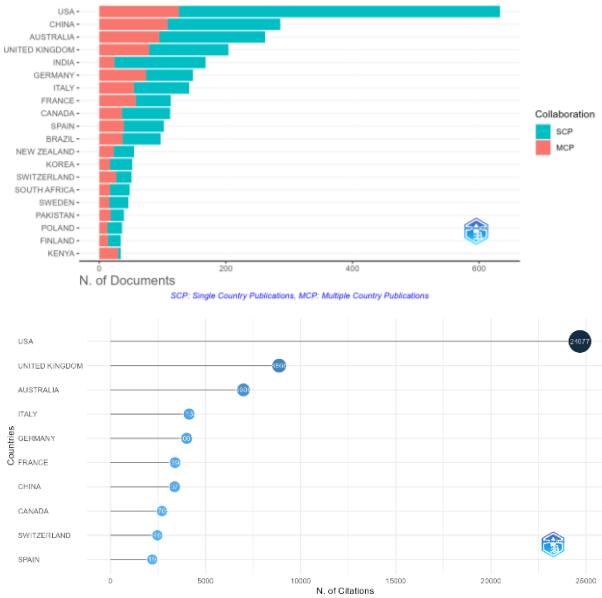

Figure 8
Ranking of countries (top 10) in terms of number of collaborations (above) and number of citations by country (top 20) (below)

When publications are associated with universities, institutions and departments through the authors, the USA has the highest number of units among the top 20 institutions, while countries such as China, Australia and England have more than one unit. The differences in unit names such as policy, management, plant pathology, plant sciences, biodiversity, environment, ecology and ecosystem suggest that the subject is handled from multiple perspectives. (Figure 9).

Figure 9
Top 20 organizations in terms of number of publications

As a result, bibliometric analyzes are a useful method for making many information inferences as well as providing an overview of the subject being studied (Donthu et al. 2021; Moral-Muñoz et al. 2020). Bibliometric analyzes can enable researchers, academic journal management, planning and decision-making management bodies such as universities and government institutions to obtain useful information about countries, people, journals, institutions and different (missing, potential or priority) points related to any subject. Other researchers mention similar benefits of bibliometric analyzes in their studies (Donthu et al. 2021; Fu and Waltman 2022; Yuan and Sun 2022).

Due to the wide scope of the subject we examined in our study, it can be difficult to make sense of the diversity other than certain names that come to the fore. Performing bibliometric analysis by limiting the subject can be a solution to overcome this deficiency. On the other hand, meticulous control of the analyzed data can provide more accurate results. It is thought that this study can provide a limited but general overview in the light of bibliographic information on plant health and climate change, as well as being a guide for similar analyzes. In order to reduce the possible effects of climate change on plant health and contribute to the sustainability of agriculture, there is a need for more multidisciplinary studies to be conducted and the information produced to be processed.

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Examination of Shopping Malls on The Usage Preferences of Physical Disabilities: On-Site Evaluation From Konya/Turkey

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ABSTRACT

With this research, the suitability of the existing large shopping malls in the city of Konya for the use of physically disabled individuals, the problems they may experience in their use and their expectations were evaluated. For this purpose, a survey was conducted in 4 large shopping malls, private or public rehabilitation malls for the disabled, and the Konya Branch of the Turkish Association for the Disabled. The research was carried out in 2018-2019. A survey was conducted with disabled people who volunteered on different days, weekdays, and weekends. Even though it is difficult to access, the shopping mall where they can be most comfortable as a disabled person has been "Novada". While "Novada AVM" stands out due to the ease of use of the sanitary facilities, the presence of landmarks for the visually impaired, the presence of a battery-chair charging station and the availability of wheelchairs, "Kent plaza", where its staff receives "sign language" training for the speech-impaired, is one of the preferred shopping malls. has been. In this research, "Kulesite" shopping mall has been the most preferred shopping mall due to the ease of transportation by "tramway".

1. Introduction

The increase in the world population has a significant impact on the development and growth of cities. This development and growth in cities cause a decrease in urban open and green spaces over time. It is a common problem today that green areas lose their properties because of structuring over time (Arısoy 2020, Akay and Önder 2022, Olgun et all. 2022).

People who cannot reach green areas have started to prefer shopping centers that stand out with their large gardens in the city.

Cities that develop unplanned after industrialization make it difficult for people to live in the city. The fact that wrong urban space designs cause serious productivity losses even in people without any physical disability draws even more attention to the problems of people with temporary and permanent disabilities (Güngör, Atasoy and Arısoy, 2018).

Shopping malls are at the forefront of postmodern areas that fulfill the functions of the city square or streets and avenues of the past in terms of their functions, but where there is no limit in terms of usage permits. The new production-consumption relations and developments in communication that emerged after industrialization brought some different practices in public spaces (Taşçı, 2014).

Cities, which have grown rapidly and become unplanned with industrialization movements, make people's collective lives increasingly difficult. The fact that faulty urban designs cause serious loss of productivity even on people who do not have any physical disability draws more attention to the problems of people with temporary and permanent disabilities. One of the main problems in our country as well as in the world is the situation of disabled individuals and their families. Disabled people, who are an integral part of society, often encounter obstacles in social life, as they are seen as consumers and people in need of care. This situation: it tires people with disabilities more than the deficiencies caused by their physical disabilities (Bekci, 2012).

According to the reports prepared by the United Nations (UN) and the World Health Organization (WHO), it is observed that approximately 10% of the world's population is disabled and this rate reaches 15% in some countries. In our country, according to the data of the Turkish Statistical Institute (TUIK), 12% of our population consists of individuals with disabilities. Accordingly, it is understood that approximately 8.5 million

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disabled individuals live in our country (Yılmaz et al. 2012).

In our country, where the rate of disabled people is so high, there are many problems faced by individuals with different types of disabilities, especially in their internal circulation in the places they live, in reaching the urban spaces from these spaces and using the spaces comfortably. These problems include both physical problems related to the use of urban space and social problems related to urban life. These social and physical problems prevent the person from socializing. Disabled individuals cannot even step into working life due to discriminatory practices. Disabled individuals cannot move easily in urban areas and cannot use urban transportation vehicles in a way that they can continue their daily lives. At the same time, individuals experience the negativities of being disabled at the highest level due to the fact that institutions and many urban structures are not suitable for disabled individuals (Yılmaz and Özservet, 2013).

In addition to individuals with permanent disabilities, every person may experience temporary disability at a certain time in their life. Even a healthy person can become disabled for some reasons such as insomnia and lack of attention. In addition, the quality of life of the city is very important for children, the elderly and mothers who use strollers. In this context, the regulation of the physical environment conditions in a way that facilitates the life of the disabled will be resolved with the sensitive behavior of the responsible persons and organizations. For this reason, many studies are carried out on this subject to attract the attention of people and organizations (Bekci, 2012).

The World Health Organization (WHO) defines disability as “a deficiency or limitation in the performance of normal activities, expressed as the behaviors, abilities and tasks expected of the person or the body as a whole” (WHO 1980). According to the expanded definition by the ICIDH (International Classification of Impairments, Disabilities and Handicaps), an extension of the World Health Organization, disability is “the deprivation and/or limitation of the ability of a person to perform what is considered normal and perform the activities expected in a certain manner because of disability. (Bush 2006). Disability is the mental-physical disorders that limit the individual's life activities, and it is a state of limitation-deficiency in the abilities and power of the individual (Coleman, 2000; Whyte and Ingstad, 1995).

Approximately 10% of the world's population (Helander, 1993) and approximately 12% in our country (Prime Ministry Administration for Disabled People, 2003) consist of disabled individuals. When one wonders what the status of the research of countries with disabilities is, which have a significant proportion in terms of population, it can be said that there are sufficient studies on the subject in the USA and European Union countries. Compared to these countries, it can be said that Turkey's attempts to create academic/national research and databases on people with disabilities are insufficient. Even though the necessary legal regulations and practices have started to be implemented within the framework of the European Union harmonization policies in Turkey in recent years, the important thing is to reveal what, which practices, and behaviors are "blocked" for disabled individuals in the context of daily life practices and social relations (Burcu, 2007).

Sociological studies on disability state that the meaning of disability is related to the reactions of other people. Undoubtedly, the socio-cultural characteristics of that society are effective in the formation and shaping of these reactions. For example, a paralyzed woman is disabled because her mobility is impaired. However, beyond the limitation of movement, disability in the social sense is not only the situation of not performing the movement, but also the result of the society's failure to provide ramps, elevators, pavement crossings to the wheelchair individual, and on the other hand, it is related to being prevented by others living together due to this failure. Therefore, it is important to describe what is thought about people with disabilities, when it is accepted that others' perspectives on disabled people are important factors that determine the social position and cultural portrayal of disabled people (Burcu, 2011).

Shopping is a very ancient and fundamental form of action that has been performed by mankind since its existence. The adventure of consumption, which started in agoras, open and closed marketplaces, with the rise of capitalism in the 19th century, extends to the backs and passages, to the big stores, which are considered the ancestors of consumption places, to the inner-city shopping malls and to the consumption cathedrals as it is used today (Süer and Sayar 2001).

Due to the industrial revolution and the rapid rise of capitalism and the development of production processes, an extraordinary increase was observed in the amount and variety of products produced. In order to sell and consume the surplus products produced, the demand for the produced product had to be created and the market expanded. Thus, the process was constructing a new social form with the consumption tools it designed in accordance with its own logic. The subsistence economy, which has a certain sociability and unique relationship style in open and small-scale markets, has gradually left its place to larger markets and stores, and the social relations in these new spaces have transformed (Aydın, 2005).

The aim of this study is to identify the problems and difficulties faced by disabled individuals, who are an important part of social life, in shopping malls, what is effective in their shopping mall choices, and to develop solutions.

2. Materials and Methods

The main material of the study is the shopping malls in Konya. Within the scope of the study, Accessibility Basic Information Technical Manual for Local Governments published by the Prime Ministry Administration

for Disabled People (OZIDA) and TS 12506 "Urban Roads - Structural Measures and Markings on Streets, Avenues, Squares and Roads for the Disabled and Elderly" prepared by the Turkish Standards Institute (TSE). Design Rules", TS 12576 "Structural Measures for Accessibility on Urban Roads, Sidewalks and Pedestrian Crossings and Design Rules of Markings", TS 9111 "Regulations for the Residence of Disabled People", "Accessibility for the Disabled for an Unhindered Environment" published by the United Nations Design Guide" and "ADA Accessible Design Standards", standards published by various individuals, institutions and organizations were taken into consideration.

In the survey studies, the expectations of the disabled individuals regarding the interior architecture and plant design in the shopping malls and transportation to the shopping mall were evaluated. For this purpose, a survey was conducted in 4 large shopping malls, private or public rehabilitation malls for the disabled and the Konya Branch of the Turkish Association for the Disabled. A survey was conducted with the disabled people who volunteered on different days, including weekdays and weekends, regarding the choice of shopping mall. To determine the situation, on-site surveys were used as material.

3. Results and Discussion

According to the results of the chi-square test;

A statistically significant relationship was found between gender and preferred shopping malls ($p<0.05$). While 100% women preferred Kule Site and 80% women preferred M1 as a shopping mall, Kent Plaza and Novada were preferred by 100% men.

A statistically significant relationship was found between age and preferred shopping malls ($p<0.05$). Shopping mall Kule Site is 76.9% between the ages of 18-34, M1 is 100% between the ages of 35-49, Novada is 54.2% between the ages of 35-49, Kent Plaza is 64%, 3 percent preferred between 50-64 years old.

A statistically significant relationship was found between the settlement (the place of residence) and the preferred shopping malls ($p<0.05$). The shopping mall Kule Site was preferred by Selçuklu district with 53.8%, M1 by 100% Selcuklu district, Kent Plaza by 100% Selcuklu district and Novada by 100% Selcuklu district.

A statistically significant relationship was found between education level and preferred shopping malls ($p<0.05$). The shopping mall Kule Site was preferred by high school graduates with a rate of 59.6%, M1 with a rate of 100%, university graduates with a rate of 66.7% for Novada, and university graduates with a rate of 92.9% for Kent Plaza.

A statistically significant relationship was found between income status and preferred shopping malls ($p<0.05$). Those who own the shopping mall Kule Site with 61.5% income of 9000-12000 TL, M1 with 100% income level of 9000-12000 TL, Novada with 100% income level of 9000-12000 TL and Kent Plaza with 64.3% Those with an income level of 9000-12000 TL preferred.

A statistically significant relationship was found between occupation and preferred shopping malls ($p<0.05$). The shopping mall Kule Site was preferred by 78.8% civil servants, M1 by 100% civil servants, Novada by 45.8% by housewives and Kent Plaza by 42.9% by students.

A statistically significant relationship was found between shopping malls preferred due to preference ($p<0.05$). The shopping mall Kule Site was preferred by those who were close to 90.4% of their houses, those who found the M1 easily accessible 100%, those who found Nova easy to get around 58.3%, and those who wanted the presence of an elevator and ramp 100% at Kent Plaza.

A statistically significant relationship was found between transportation and preferred shopping malls ($p<0.05$). The shopping mall Kule Site was preferred by the Tramway with 65.4%, the M1 by 100% handicapped cars, Novada by 100% and Kent Plaza by 100% handicapped car users.

A statistically significant relationship was found between the environment quality and preferred shopping malls ($p<0.05$). The shopping mall considers Kule Site 36.5% normal and 36.5% good, M1 100% good, Novada 50% good and 50% very good, and Kent Plaza 92.9% Those who found the rate very good preferred it.

A statistically significant relationship was found between the existing disabled equipment and preferred shopping malls ($p<0.05$). Those who found the shopping mall Kule Site 100% too little, 90% too little for M1, 87.5% less for Nova, and 50% enough for Kent Plaza preferred it.

A statistically significant relationship was found between maintenance and preferred shopping malls ($p<0.05$). Those who found the shopping mall Kule Site 46.2% normal, the M1 normal 70%, Novada well-maintained 100% and Kent Plaza 57.1% well-maintained preferred it.

A statistically significant relationship was found between ease of use and preferred shopping malls ($p<0.05$). Those who found the shopping mall Kule Site to be normal 44.2%, M1 100% good, Novada good 66.7% and Kent Plaza 92.9% very good preferred it.

A statistically significant relationship was found between shopping mall quality and preferred shopping malls ($p<0.05$). Those who find the shopping mall Kule Site 36.5% normal and 36.5% good, M1 100% good, Nova 50% good and 50% very good, and Kent Plaza 92.9% very good preferred.

As seen in table 1, a statistically significant relationship was found between access and preferred shopping malls ($p<0.05$). Those who found the shopping mall Kule Site to be normal 44.2%, M1 100% good, Novada good 66.7% and Kent Plaza 92.9% very good preferred it.

Table 1
Preferred Shopping Mall and Social Indicator Relationship Evaluation

N:100		Kulesiten=52	M1n=10	Novadan=24	Kent plazan=14	
		n(%)	n(%)	n(%)	n(%)	P-value
Gender	Woman	52(100)	8(80)	-	-	<0,001
	Man	-	2(20)	24(100)	14(100)	
Age	18-34	40(76,9)	-	-	-	<0,001
	35-49	12(23,1)	10(100)	13(54,2)	-	
	50-64	-	-	11(45,8)	9(64,3)	
	65+	-	-	-	5(35,7)	
Residential	Karatay	9(17,3)	-	-	-	<0,001
	Meram	15(28,8)	-	-	-	
	Selçuk	28(53,8)	10(100)	24(100)	14(100)	
	Other	-	-	-	-	
Education	Primary school	21(40,4)	-	-	-	<0,001
	High school	31(59,6)	10(100)	-	-	
	College	-	-	8(33,3)	-	
	University	-	-	16(66,7)	13(92,9)	
	MSc.-PhD	-	-	-	1(7,1)	
Income	0-6000	9(17,3)	-	-	-	<0,001
	6000-9000	11(21,2)	-	-	-	
	9000-12000	32(61,5)	10(100)	24(100)	9(64,3)	
	>12000	-	-	-	5(35,7)	
Working condition	Employee	11(21,2)	-	-	-	<0,001
	Officer	41(78,8)	10(100)	4(16,7)	-	
	Housewife	-	-	11(45,8)	-	
	Student	-	-	9(37,5)	6(42,9)	
	Unemployed	-	-	-	5(35,7)	
	Retired	-	-	-	3(21,4)	
Reason for Prefe-rence	Close to House	47(90,4)	-	-	-	<0,001
	Easy to access	5(9,6)	10(100)	9(37,5)	-	
	Easy to navigate	-	-	14(58,3)	-	
	Lift/Elevator	-	-	1(4,2)	14(100)	
Transport	Ramp	34(65,4)	-	-	-	<0,001
	Tramvay	4(7,7)	-	-	-	
	Bus	3(5,8)	-	-	-	
	Minibus	11(21,2)	10(100)	24(100)	14(100)	
Quality	Too bad	4(7,7)	-	-	-	<0,001
	Bad	10(19,2)	-	-	-	
	Normal	19(36,5)	-	-	-	
	Beautiful	19(36,5)	10(100)	12(50)	-	
	Very nice	-	-	12(50)	13(92,9)	
	Indecisive	-	-	-	1(7,1)	
Equipment	Too bad	52(100)	9(90)	-	-	<0,001
	Bad	-	1(10)	21(87,5)	-	
	Normal	-	-	3(12,5)	7(50)	
	Beautiful	-	-	-	3(21,4)	
	Very nice	-	-	-	2(14,3)	
	Indecisive	-	-	-	2(14,3)	
Care	Too bad	9(17,3)	-	-	-	<0,001
	Bad	19(36,5)	-	-	-	
	Normal	24(46,2)	7(70)	-	-	
	Beautiful	-	3(30)	24(100)	8(57,1)	
	Very nice	-	-	-	5(35,7)	
	Indecisive	-	-	-	1(7,1)	
Ease	Too bad	5(9,6)	-	-	-	<0,001
	Bad	9(17,3)	-	-	-	
	Normal	23(44,2)	-	-	-	
	Beautiful	15(28,8)	10(100)	16(66,7)	-	
	Very nice	-	-	8(33,3)	13(92,9)	
	Indecisive	-	-	-	1(7,1)	
Quality	Too bad	4(7,7)	-	-	-	<0,001
	Bad	10(19,2)	-	-	-	
	Normal	19(36,5)	-	-	-	
	Beautiful	19(36,5)	10(100)	12(50)	-	
	Very nice	-	-	12(50)	13(92,9)	
	Indecisive	-	-	-	1(7,1)	
Access	Too bad	5(9,6)	-	-	-	<0,001
	Bad	9(17,3)	-	-	-	
	Normal	23(44,2)	-	-	-	
	Beautiful	15(28,8)	10(100)	16(66,7)	-	
	Very nice	-	-	8(33,3)	13(92,9)	
	Indecisive	-	-	-	1(7,1)	

4. Coclusion

In every building and design around us, care should be taken to ensure that it meets the needs of every human being, regardless of age, gender and disability. It should not be forgotten that every person can be a candidate for disability.

According to the results of the survey, disabled individuals at all age levels were taken into consideration. Kule Site constitutes most shopping mall preferences in Konya. The biggest reason for choosing this shopping mall is that it is easy to access.

They mostly go to shopping malls by their own means. They prefer the tram most from public transportation vehicles because, ready ramp etc. They can get on and off without needing anyone. Their second preferred means of public transportation is the bus because; Having a ramp makes it easy to get on and off. Due to the narrowness of the ramp and the area, they prefer the minibuses less.

They use the shopping malls only to take their receivables and leave.

The equipment that the shopping malls want to have in them, if any, is the battery charging station and elevators. They do not need a companion very much.

They stated that they are very disturbed by the fact that people who are very healthy than themselves park in the parking lots for the disabled in the garden of the shopping malls and they want the disabled parking lots to be increased. They stated that the indoor and outdoor seating areas will be supported by wooded areas, providing a nice environment to get rid of the concrete piles.

They stated that the elevators were generally sufficient, but they complained about waiting in line at the Tower Site.

The entrances, exits, sinks and toilets of the shopping malls are designed for the disabled. They stated that it is usually normal in the transitions between the departments, but some of the departments are left too narrow without being aware of it and they experience difficulties in the transition.

They expressed that those who park vehicles in disabled parks, sidewalks and ramps should empathize and learn from their misbehavior.

It should not be forgotten that all people are equal and by removing the barriers, disabled individuals also take part in social life like healthy individuals. It is the duty of the whole society, especially designers and managers, to take the necessary measures for disabled individuals to benefit from these rights.

5. Acknowledgements

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The Effect of Sex Ratio and Population Density on Adult and Female Egg-Laying Behavior and Female Longevity of *Plodia interpunctella* (Hübner) (Lepidoptera: Pyralidae)

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ABSTRACT

This study was conducted to determine the effects of sex ratio and population density on *Plodia interpunctella* (Hübner) adult and female egg laying behavior. This study was conducted to determine the effects of sex ratio and population density on *Plodia interpunctella* (Hübner) adult and female egg laying behavior. The studies were carried out in the laboratory of the Department of Plant Protection of the Faculty of Agriculture of Selçuk University and in the climate room at 28±1ºC, 70±5% relative humidity and dark environment. Experiments were carried out in 1 Liter jars with 4 replications. Seven for the sex ratio in the trials (1/1.2/1.3/1.4/1.5/1.6/1.7/1 Male/Female), five for the population density (2/1.4/2) .6/3.8/4.10/5 Male/Female) (in a fixed sex ratio of 2 male/female) different parameters were used. According to the results obtained, an increase was observed in the number of eggs laid by a female from the early stages to the intermediate levels in the sex ratio and population density. When we look at the effect of the sex ratio, the number of eggs laid by the female in the ratio of 5 males / 1 females reached the highest level with 312 eggs. In the population density, the female left the largest number of eggs (360 eggs) at a density of 9 adults. In mass production of *P. interpunctella*, the highest number of eggs will be obtained from females if the adult population density is 9, the sex ratio is 5 males / 1 female and adult food is provided.

1. Introduction

Plodia interpunctella (Hübner) (Lepidoptera: Pyralidae) causes significant damage to many stored products. This pest causes damage to many stored products, dried fruit, grain products, nuts and many other products during the larval stage. It causes loss of product weight as a result of feeding on the products it infects during the larval period, and significant losses in quality characteristics due to the body residues of the pests, the dirt they leave and the silky nets and similar substances they secrete. *Plodia interpunctella* (Hübner) is an insect that damages storage products. It is found in every continent except Antarctica (Rees et al, 2004). *P. interpunctella* feeds from the outside, and the larvae weave a web both inside and on the surface of the food. *P. interpunctella causes* direct and indirect economic loss in the product (Phillips et al., 2000, Mohandass et al., 2007, Kalyoncu and Özge, 2014). The development period is 37-52 days under favorable conditions. It gives 2-5 progeny offspring per year, depending on climatic conditions (Athanassiou, 2004; Anonymous, 2008; Eğridal, 2017). In this study, found that the best egg production in *Anopheles albimanus* (Diptera: Culicidae) was in 1 female and 3 males (Bailey et al. 1980). *Rhynocoris marginatus* (Fab.) (Hemiptera: Reduviidae) with 4 different densities (25, 50, 75 and 100) that the ratio of the total number of eggs laid is higher at 50 predator densities and this rate decreases as the density increases (Sahayaraj 2002). This study determined the number of eggs laid by *Chelonus inanitus* (Hymenoptera: Braconidae) mated females at different temperatures. Accordingly, he reported that mated females lay 612 eggs at 20 ºC and 1219 eggs at 28 ºC, and the sex ratio was approximately 1:1 at 20 and 25 ºC, but this ratio changed in favor of males with the increase in temperature (Rechav 1978). In this study, determined that *Anthocoris minki* Dohrn (Hemiptera: Anthocoridae) and females lay 22.7, 16.1 and 12.9 eggs at 250, 400 and 550 adult densities, respectively. Accordingly,

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as the density increased, the number of eggs laid by the females during their lifetime decreased. (Çoban 2015). In insects, sex ratio is an important factor in determining population density. Although this ratio varies in different species, besides environmental factors such as the age of the female, the number of eggs laid after fertilization, population density, amount and type of food, temperature, in some species photoperiod plays an important role determining the sex ratio (Yeşim & Gülel, 2006). It has been reported that the average development time of *Orius sauteri*(Poppius) (Heteroptera:Anthocoridae). from egg opening to adulthood is 12.9 days for males and 13.3 days for females (Murai et al. 2001).In this study, it was determined that the average number of eggs laid per female during the egg laying period of *Orius albidipennis* (Reuter)(Hemiptera: Anthocoridae)at 25±1 oC temperature and 65±5% proportional humidity conditions was 85.07±10.64 and the egg-laying rate was 69.01±6.29%.(Büyük, M., & Kazak, C. 2010). The hatching time of *Orius albidipennis* (Reuter) (Hemiptera:Anthocoridae) at 25 oC was 3.8±0.1 days, and the nymph development times were 3.1±0.1, 2.6±0.1, 2.2±0.09, 2.0±0.06 and 3.2±0.1 days, a total of 12.1±1.2 days. have stated that. (Cocuzza et al., 1997).

2. Material and Method

Material

For production, *P.interpunctella* (Hübner) was taken from the stock culture in the Entomology laboratory of the Department of Plant Protection, Faculty of Agriculture, Selcuk University. The stock culture was grown for use in the study in a climate cabinet (nüve TK 120) at 28±1ºC, in a dark environment with a proportional humidity of 70±5%. With the help of a mouth aspirator, harmful adults were transplanted into jars containing peanuts to lay eggs. The mouths of the jars are closed with tulle so that the adults do not escape from the jars and so that they can breathe. Trials were established from the culture obtained from the adults grown here. Egg counts were made using a stereo zoom microscope. In order to observe the eggs taken with the help of a brush, they were placed in petri dishes. Pure water was used to clean the jars.

Laboratory Studies

The dried fruit moth *P.interpunctella* (Hübner) individuals used in this study were grown in one-liter jars with peanuts in a gavuze-covered mouth. Male and female adults from the stock culture were transferred to jars containing peanuts for spawning. In this way, they are provided to lay eggs. When the larvae hatched from the eggs became pupae, sex determination was made from the pupal abdomen and male and female individuals were determined and placed in separate jars. Trials were set up from one-day-old males and females. Adult individuals were transplanted using a mouth aspirator. In the thesis study of the individuals reared here, the effects of different sex ratio and population density on the number of eggs laid by *P. interpunctella* females during their lifetime, on the lifespan of adult females, on pre-oviposition, oviposition and post-oviposition times were investigated. As adult food, 10% sugar water was impregnated with cotton and given in the small medicine cap. Each jar formed a replica. The study was carried out in the same way for each replication in a randomized plot design with 4 replications.

The effect of sex ratio on egg production, pre-oviposition, oviposition, post-oviposition times and female longevity of Plodia interpunctella (Hübner) female

After the larvae grown in peanuts became pupae, sex determination was made and males and females were placed in separate jars. Trials were set up from adult one-day-old unmated males and females. Experiments were carried out in 1 liter jars with 4 replications. Adult transplants were performed using an oral aspirator. The sex ratios to the jars are 1/1, 2/1, 3/1, 4/1, 5/1, 6/1 and 7/1 male/female. To be fed into one liter jars, 10% sugar water was impregnated with cotton and given in the small medicine cap. The mouths of the jars are closed with tulle to allow them to breathe. After the adult females started to lay eggs, the jars were observed every day, the egg counts were made, the jars were cleaned and their food was renewed. The same procedures were continued every day until the death of the adults. Egg count and nutrient replenishment were maintained daily throughout the experiment.

The effect of population density on egg production, pre-oviposition, oviposition, post-oviposition times and female longevity of Plodia interpunctella (Hübner) female

After the pupal period, males and females separate and mature in separate jars, at a certain age (1 day old) and at a constant sex ratio (2 males / 1 female) and at 5 different population densities (3, 6, 9, 12 and 15 adults) jars, dark conducted in the environment. It was placed in one-liter test jars, which were placed in a gauze-closed container with 10% sugar water soaked with cotton. By following the trials every day, the necessary data were recorded until the adults died.

4.Results and Discussion

4.1. The Effect of Sex Ratio on Egg Production, Pre-oviposition, Oviposition, Post-oviposition and Female Longevity of Plodia interpunctella (Hübner) Female

It has been determined that as the sex ratio changes, the changes in the number of eggs laid by the female are statistically significant. The sex ratio was formed as 1/1, 2/1, 3/1, 4/1, 5/1, 6/1, 7/1 (male / female). The number of eggs laid by a female was determined in the ratio of these sexes. According to this sex ratio, the number of eggs laid by a female was determined as 129, 149.75, 266.75, 272, 311.50, 264.75, and 254.75, respectively. When Table 1 is examined, the highest number of eggs was determined as 311.5 eggs in the ratio of 5/1 (male / female) sexes. The lowest number of eggs was determined as 129 eggs when the sex ratio was 1/1.

In addition, an increase in the number of eggs laid by the female from 1/1 to 5/1 sex ratio was detected, When

we look at the ratio of 5/1 sexes to 7/1 sex ratios, a decrease in the number of eggs laid by the female has been detected. As indicated in Table 2 the effect of sex ratio on female pre-oviposition, oviposition, post-oviposition time and female lifespan was investigated. In terms of sexes, the effect of the female on the pre-oviposition time was found to be insignificant, while the effect on the oviposition and post-oviposition times was statistically significant. Likewise, it has been determined that the effect on female lifespan is also significant. When you look at the pre-oviposition time in Table 2, it has been determined that the pre-oviposition period is the longest with 1.0 day in the ratio of 1/1 sexes, while it is the shortest with 0.0 days in the ratio of 4/1, 5/1, 6/1 male/female. Considering the oviposition period, it was determined that it was the longest with 15.0 days in the ratio of 3/1 sexes, and the shortest period with 06.0 days in the ratio of 7/1 sexes. It was determined that the longest pot-oviposition period was 1.7 days at the rate of 1/1 sexes in the post-oviposition ratio, and the least duration with 0.0 days at the rate of 5/1 sexes. In the effect of sex ratio on female lifespan, it was determined that the longest female lifespan was 16.2 days in the ratio of 3/1 sexes, and the shortest female lifespan (07.2 days) in the ratio of 7/1 sexes. In their study, found that the best egg production in Anopheles albimanus was in 1 female and 3 males (Bailey et al. 1980). Created 29 pairs, one female and one male, from *Sitona crinitus* in his study under greenhouse and field conditions. The average number of eggs laid per female was 380.7 (65-482) in the Greenhouse -1 group that spent the winter in the field, 315.4 (10-556) in the group that spent the winter in Greenhouse-1, 304.5 (24-465) in the Greenhouse-2 group that spent the winter in the field, In the group that spent the winter in Greenhouse-2, it was determined as 387.6 (85-598). The total number of eggs laid by females in each group was determined as 13706, 11039, 10660 and 10078, respectively (Yıldırım 2008).

Table 1
Effect of sex ratio on female egg production of *Plodia interpunctella* (Hübner) in dark medium with nutrients

Sex ratio (Male/female)	Number of Eggs laid (Number)		
	Least	The most	Average ± Standard error
1/1	63	204	129.00 ± 30.85 c*
2/1	128	166	147.75 ± 07.89 c
3/1	228	266	266.75 ± 07.45 ab
4/1	259	288	272.00 ± 06.54 ab
5/1	253	354	311.50 ± 20.03 a
6/1	245	280	264.75 ± 07.66 ab
7/1	237	275	254.75 ± 08.70 b

*There is no difference (P>0.05) between the means shown with the same letters in the same column.

Table 2
The effect of sex ratio on pre-oviposition, oviposition, post-oviposition times and female longevity of *Plodia interpunctella* (Hübner) females in nutrient dark environment

Sex ratio (Male and female)	Pre-oviposition, Oviposition, Post-oviposition Duration And Female Life (Days)			
	Pre-ovipozisyon (Least -most) AVG.±S.E.	Ovipozisyon (Least - most) AVG.±S.E	Post-ovipozisyon (Least - most) AVG.±S.E	Female lifespan.±S.E
1/1	(0.0-3.0) 1.00 ± 0.70 a*	(08-14) 10.00 ± 1.35 b	(1.0-2.0) 1.75 ± 0.25 a	12.50 ± 1.65 c
2/1	(0.0-2.0) 0.75 ± 0.47 a	(09-22) 14.00 ± 2.85 a	(0.0-2.0) 0.75 ± 0.47 b	15.75 ± 2.13 a
3/1	(0.0-1.0) 0.25 ± 0.25 a	(13-18) 15.00 ± 1.08 a	(0.0-2.0) 1.00 ± 0.40 b	16.25 ± 1.60 a
4/1	(0.0-0.0) 0.00 ± 0.00 a	(09-13) 10.25 ± 0.94 b	(0.0-2.0) 0.75 ± 0.47 b	11.50 ± 1.32 c
5/1	(0.0-0.0) 0.00 ± 0.00 a	(12-16) 14.00 ± 0.91 a	(0.0-0.0) 0.00 ± 0.00 c	14.00 ± 0.91 b
6/1	(0.0-0.0) 0.00 ± 0.00 a	(08-10) 09.00 ± 0.40 bc	(0.0-1.0) 0.25 ± 0.25 c	09.25 ± 0.47 d
7/1	(0.0-2.0) 1.00 ± 0.40 a	(05-07) 06.00 ± 0.40 c	(0.0-1.0) 0.25 ± 0.25 c	07.25 ± 0.47 e

*There is no difference (P>0.05) between the means shown with the same letters in the same column.

4.2. The Effect of Population Density on Egg Production of Plodia interpunctella (Hübner) Females on Pre-oviposition, Oviposition, Post-oviposition and Female Longevity

It was determined that the changes in the number of eggs laid by the female among the changing population densities were statistically significant**.** In this study, adult population densities of 3, 6, 9, 12, 15 were established in a fixed sex ratio (2 male / 1 female) of one-day-old adults. As seen in Table 3, the egg numbers of the population densities were determined as 147.75, 219.25, 360.08, 286.62 and 187.50 eggs, respectively. As seen in Table 3, while the highest egg number was 360.0 in 9 adult population density, the lowest egg number was 147.7 eggs in 3 population density. In addition, it was determined that there was an increase in the number of eggs from 3 population densities to 9 population densities, and a decrease in egg number from 9 population densities to 15 population densities. It was found that the effect of the population density on the pre-oviposition and post-oviposition times of the female was not statistically significant. It has been determined that the effect on oviposition time and female life is significant. Considering the effect of population density on female pre-oviposition time, it was determined that the longest pre-oviposition period was 0.50 ± 0.28 days in 3 and 6 adult population densities, while the shortest time was 0.00 ±

0.00 days in 12 and 15 adult population densities. Considering the oviposition period, it was determined that the longest period was 14.75 ± 0.47 days in the 9 adult population density, while the lowest oviposition period was 11.75 ± 0.75 days in the 12 adult population density. Considering the post-oviposition time, the longest post-oviposition time was found to be 1.25-0.62 days in the population density of 15 adults. Considering the effect of population density on female lifespan, it was determined that the longest female lifespan was 15.50 ± 0.50 days in 6 adult population densities, while the shortest lifespan was 12.25 ± 0.75 days in 12 adult population densities (Table 4). In his study, determined that *Anthocoris minki* males and females lay 22.7, 16.1 and 12.9 eggs at 250, 400 and 550 adult densities, respectively. Accordingly, as the density increased, the number of eggs laid by the females during their lifetime decreased. (Çoban 2015). In their study, it was determined that the average number of eggs laid per female during the egg laying period of *Orius albidipennis* at 25±1 ºC temperature and 65±5% proportional humidity conditions was 85.07±10.64 and the egg-laying rate was 69.01±6.29% (Büyük, M., & Kazak, C. 2010). Emphasized in her study that *Rhynocoris marginatus* with 4 different densities (25, 50, 75 and 100) that the ratio of the total number of eggs laid is higher at 50 predator densities and this rate decreases as the density increases (Sahayaraj 2002). As we determined in our study, as the density increased, an increase was detected in the number of eggs laid by a female, and a decrease was recorded after a certain density. These studies by researchers stating that increasing density has a negative effect on the egg production of the adult female support the data of our study.

Table 3
Effect of population density on female egg production of *Plodia interpunctella* (Hübner) in nutrient dark medium and constant sex ratio (2 males / 1 female)

Population density (Number of Adults) (2 Male / 1 female)	Number of Eggs Laid (Number)		
	Least	The most	Average ± Standard error
3	128.0	166.0	147.75 ± 07.89 d*
6	207.5	237.0	219.25 ± 06.50 c
9	349.0	379.3	360.08 ± 07.16 a
12	259.0	319.0	286.62 ± 15.61 b
15	150.4	258.3	187.50 ± 13.96 c

*There is no difference (P>0.05) between the means shown with the same letters in the same column.

Table 4
Effect of population density on pre-oviposition, oviposition, post-oviposition times and female longevity of *Plodia interpunctella* (Hübner) females in nutrient dark environment and constant sex ratio (2 males / 1 female)

Population density (Number of Adults) (2 Male / 1 female)	Pre-oviposition, Oviposition, Post-oviposition Duration And Female Life (Days)			
	Pre-ovipozisyon (Least -most) AVG.±S.E	Ovipozisyon (Least - most) AVG.±S.E	Post-ovipozisyon (Least - most) AVG.±S.E	Female lifespan.±S.E
3	(0.0-1.0) 0.50 ± 0.28 a*	(11-13) 12.00 ± 0.57 b	(0.0-1.0) 0.25 ± 0.25 a	12.75 ± 0.75 b
6	(0.0-1.0) 0.50 ± 0.28 a	(13-16) 14.50 ± 0.64 a	(0.0-1.0) 0.50 ± 0.28 a	15.50 ± 0.50 a
9	(0.0-1.0) 0.25 ± 0.25 a	(14-16) 14.75 ± 0.47 a	(0.0-1.0) 0.25 ± 0.25 a	15.25 ± 0.75 a
12	(0.0-0.0) 0.00 ± 0.00 a	(10-13) 11.75 ± 0.75 b	(0.0-1.0) 0.50 ± 0.28 a	12.25 ± 0.75 b
15	(0.0-0.0)0.00 ±0.00 a	(13-15) 14.00 ± 0.40 a	(0.0-3.0) 1.25 ± 0.62 a	15.25 ± 0.47 a

*There is no difference (P>0.05) between the means shown with the same letters in the same column.

5. Conclusions and Recommendations

In this study, the effects of sex ratio and population density on female egg production in the adult period of *P.interpunctella* were investigated. In addition, the effects of the above-mentioned living and non-living ecological factors in the adult period of Plodia interpunctella on female per-oviposition, oviposition, post-oviposition and lifespan were investigated. When the effect of the sex ratio on the female egg production was examined, it was determined that the female lays the most eggs with 312 eggs in the ratio of 5/1 (male / female) sexes. Considering the effect of population density on female egg production, it was found that females laid the highest number of eggs (360 eggs) at 9 adult density (2 male / 1 female fixed sex ratio). Although the effect of photoperiod on pre-oviposition and post-oviposition times was found to be statistically significant, it was stated that it was mostly between 0.0-1.75 days. In the effect of the photoperiod on the oviposition period, the longest duration was determined as 3 males / 1 female 15.0 in the sex ratio, and 14.7 days in the population density of 9 adults (2 male / 1 female fixed sex ratio). The effect of photoperiod on female lifespan is also statistically significant, and the sex ratio of the longest-lived female is 3 males / 1 female 16.2 days. It was determined that 6 adults (2 males / 1 females at a fixed sex ratio) were 15.5 days in population density. The number of eggs laid by the female increased until a certain population density (9 adults), and after this point, the number of eggs laid decreased as the density increased. In the sex ratio, the number of eggs laid by the female increased up to the ratio of 5 male / 1 female, while the number of eggs laid by the

female decreased as the sex ratio increased in favor of the male.

Recently, pesticides against pests have been used quite frequently and intensively. The effects of the drugs used, such as threatening human and animal health, drug residues in foodstuffs, environmental pollution and increased cost have also been added. For this reason, it has become necessary to switch to alternative environmentally friendly and cost-effective methods. Biological control is the most sustainable, cost effective and environmentally friendly method.In mass production of *P.interpuncella*, the highest number of eggs will be obtained from females if the adult population density is 9 and the sex ratio is 5 male/1 female and adult food is provided. This research will be useful in egg parasitoid research and in mass production of egg parasitoids in the supply of host eggs. It will contribute to the mass production needed in both laboratory and field researches about *P.interpunctella*.Thanks to the effects of living and non-living ecological factors on female egg laying behavior in the adult biological period of *Plodia interpunctella*, as well as the ecological factors affecting the pre-adult biological periods, efficient and effective mass production will be possible in the laboratory and insectarium. Many studies have been done about this pest before. When the studies we have done and previous studies are combined, scientific data on this harmful species will increase and it will contribute to both mass production and toxicological physiological studies.

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Plant Viruses and Plant Growth Promoting Rhizobacteria (PGPR) Relationships: A Shiny Application

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ABSTRACT

In the face of climate change, the point of view of existing agricultural production systems is changing, and biological issues are gaining importance in terms of sustainable agriculture. Environmentally friendly biological solutions come to the forefront in the management of diseases and pests that put pressure on sustainable agriculture. It has been proven by many studies that plant growth promoting rhizobacteria (PGPR) have positive effects on plant growth, as well as reduce or prevent viral diseases. However, determining the targeted virus species, the PGPR strains used, or the plant strains tested requires a serious literature review and reading. In this study, which can be considered as a preliminary study, a database of PGPR and plant virus relations literature was created in a dynamic infrastructure that can be constantly updated, and a web interface was developed as an R/shiny application. Thanks to this preliminary study, which has examples in different fields, it is thought that it is possible for researchers to quickly access the literature on the subject, plan cost-effective projects, and identify the missing or potential points of the subject. According to the information in the database, it was determined that CMV was the most targeted virus, different strains of *Bacillus* and *Pseudomonas* genera were used the most as PGPR agent, tomato (*Solanum lycopersicum*) and cucumber (*Cucumis sativus*) were the most tested plant species, and single applications were tested more. It is thought that this and similar studies will enable researchers to gain a quick perspective on the subject, facilitate the management of the information they have acquired, and contribute to effective planning in their new studies.

1. Introduction

The threat and consequences of climate change on sustainable agriculture are becoming more visible with each passing day. In this respect, in the face of decreasing resources for ensuring food security and sustainable agriculture, more effort is needed than ever in order to protect existing assets and use them efficiently. In the activities of human beings, whose desires and needs are endless, it is essential to protect micro and macro biodiversity, as there are many points that have not been scientifically clarified, as well as the deterioration of the natural ecosystem (Chávez-Dulanto et al. 2021; Dubey et al. 2019; Nhemachena et al. 2020).

Plant growth promoting rhizobacteria (PGPR), which are a part of the natural ecosystem, directly and indirectly contribute to plant health with many interactions. PGPRs, which are of great importance for sustainable agriculture, can lead to triggering resistance against viruses or other pathogens in the host plant, thanks to their ability to affect the expression of signaling pathways or genes involved in plant defense. The discovery of this defense mechanism has revealed the possibility of using PGPRs under biological control as an alternative way to combat plant diseases. However, despite the developing technology and ever-increasing knowledge, the effects and mechanisms of PGPRs on viruses and other pathogens are not fully understood (Khoshru et al. 2020; Priya et al. 2021; Yadav 2020).

When acting with the awareness that each study contributing to the literature has a separate importance, it can be difficult to follow the studies or to control this information when the knowledge grows. In order to overcome these problems, it is necessary to follow the technological developments and ensure their use.

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However, when the data produced around the world is compared with the data processed, the difference is seen as very large. At this point, thanks to software languages such as R and Python, it becomes easier to make analyzes and inferences on the data. R software language, which is simple and fast to learn, is widely used in the academic community as it provides many uses such as statistics, analysis, modeling, bioiformatic analysis, data editing, data visualization, map creation, reproducible document creation, web environment development (Giorgi et al. 2022; Grüning et al. 2018; R Core Team 2021).

Web interfaces, which facilitate the delivery of information to large masses, both in the field of biology and in many other fields, can be developed thanks to the R/shiny package (Chang et al. 2017; Jia et al. 2022). Thanks to the R/shiny package, it is possible to design a web interface capable of analysis, as well as an interactive web interface where the information in the literature or a database is compiled and shared manually or automatically. The following are examples of web interface development studies with the R/shiny package, which were created with manually compiled information; manual compilation of xenograft studies in the model organism zebrafish, ZenoFishDb (Targen et al. 2020), manual compilation of ligand-receptor pairs in plants (Xu et al. 2022), manual compilation of metadata from terrestrial metagenome studies (Corrêa et al. 2020), manual compilation of literature on Parkinson's disease (Wang et al. 2020), manual compilation of the content of transcriptomic and proteomic datasets related to fibrosis disease (Fanidis et al. 2021).

This study was carried out as a preliminary study of the idea of developing a manually compiled database and web interface in order to provide a quick overview of the basic level information about the targeted, applied and used organisms in PGPR and plant virus association research.

2. Materials and Methods

Different databases such as Web of Science (www.webofknowledge.com) and Scopus (www.scopus.com) were searched with the keywords PGPR and plant viruses. In the results of the search, the information of the studies on the relevant subject is processed in the tables in the Excel program. In order to ensure data integrity, the names and taxonomic information of plant, virus and bacterial species were taken from the National Center for Biotechnology Information (NCBI, (Schoch et al. 2020)) and International Committee on Taxonomy of Viruses (ICTV, (Walker et al. 2022)) databases and recorded in the tables.

The data were processed in R Studio v2022.07.0 (RStudio Team 2020) environment to be suitable for analysis with different packages such as tidyverse (Wickham et al. 2019) and DT (Dowle and Srinivasan 2022) developed in the R v4.2.1 (R Core Team 2021) software language. In order to create a dynamic and interactive infrastructure, a web interface was developed with the shiny (Chang et al. 2017; RStudio Team 2013) package. The plotly (Sievert 2020) package was used to visualize the data.

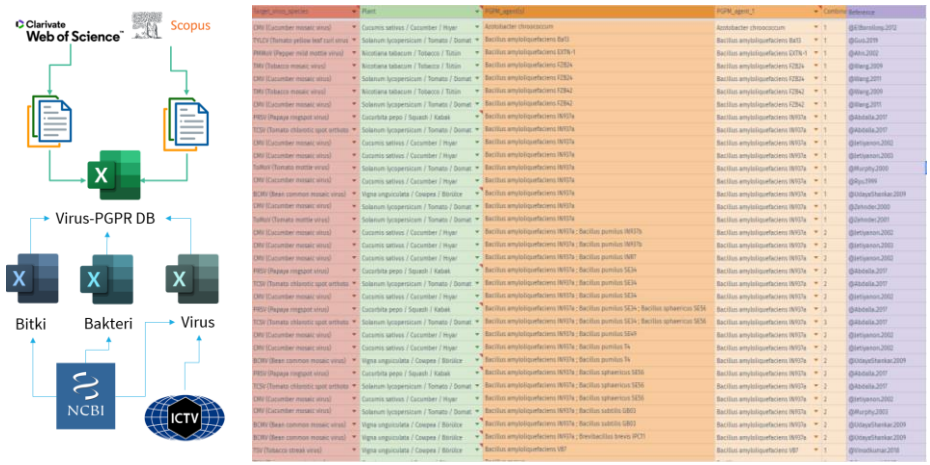

Figure 1
Work flow diagram in data collection, created main table and R packages used

3. Results and Discussion

On the main screen of the developed web interface, the total number of plant, virus and PGPR species, the sum of different single and multiple combinations, the total number of references in the database and the number of different applications are displayed. The species of plant, virus and PGPR bacteria, as well as their taxonomic groups, and the number of information provided by the references and the distribution of multiple combinations are shown in graphs (Figure 2). In addition, in the developed system, it is possible to search on the tables where the data is collected and the results can be exported. All graphics and other informative parts are updated automatically when data is added to the tables. The system can be viewed on mobile environments as well as desktops without any deterioration in graphics, and full control over all graphics and tables can be achieved.

When the graphics that are automatically generated according to the information in the database are examined, CMV (82) ranks first among 24 different virus types in terms of the targeted virus species. The targeting of CMV in many studies may be due to its ease of transport by insects and more problems due to the wide host range. The fact that virus species that cause serious damage to some warm climate plant species are also targeted, shows that the PGPR-virus issue is addressed in disease management. Bacterial species and strains used among 79 PGPR agents were classified as follows; *Bacillus amyloliquefaciens* IN937a (26), *Bacillus pumilus* SE34 (23), *Pseudomonas fluorescens* Pf 1 (18), *Pseudomonas fluorescens* CHA0 (16), *Bacillus sphaericus* SE56 (15), *Bacillus pumilus* T4 (15), *Bacillus pumilus* INR7 (11), *Bacillus pumilus* IN937b (11) and other starains (less than 10) (Figure 3).

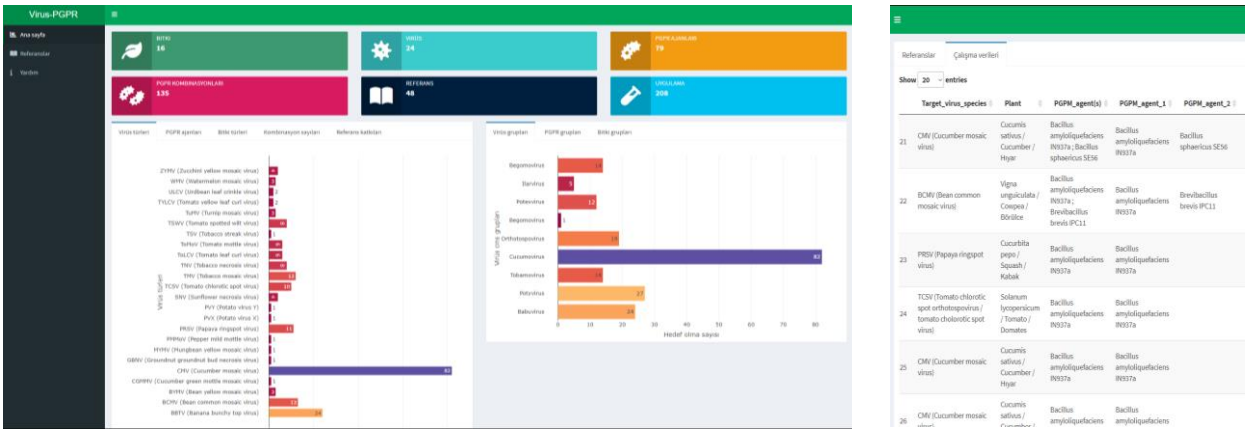

Figure 2
General view of the developed web interface and data tables page

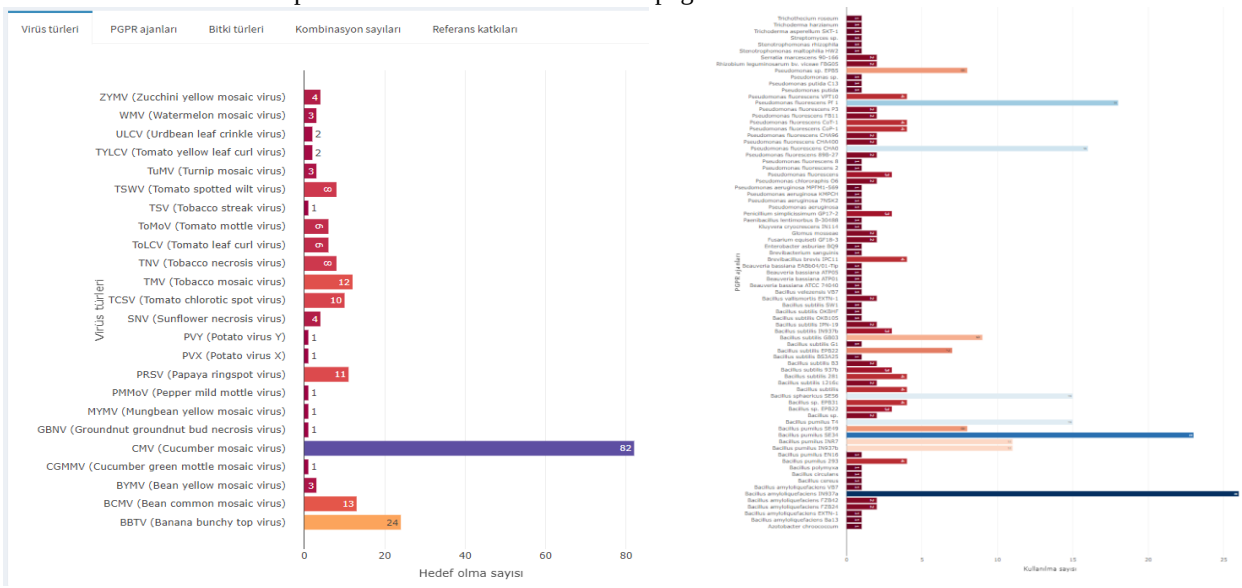

Figure 3
Graphs showing virus species and PGPR agents

On the other hand, among the 16 plant species, Solanum lycopersicum (tomato) and Cucumis sativus (cucumber) are the most studied (54-50). When it was examined how many different combinations of plants, viruses and bacteria were investigated in the studies, it was determined that the majority of them provided information in less than 10 combinations (Figure 4).

Although single (136) applications are intense in studies, multiple (72) applications are being investigated. The most common in multiple combinations are applications with two stains (63).

Cucumovirus ranks first among 9 different virus groups in terms of being a target. It is a remarkable finding that Cucumovirus (82), Potyvirus (27), and Orthotospvirus (19) genera, which include many virus species spread by vectors, are in the first place. Studies among 7 plant groups were carried out intensively on plants of the Cucurbitaceae (71) and Solanaceae (79) families. Among 15 different bacterial families, Bacilliceae (177) and Pseudomonadaceae (78) genera are used extensively in studies (Figure 5).

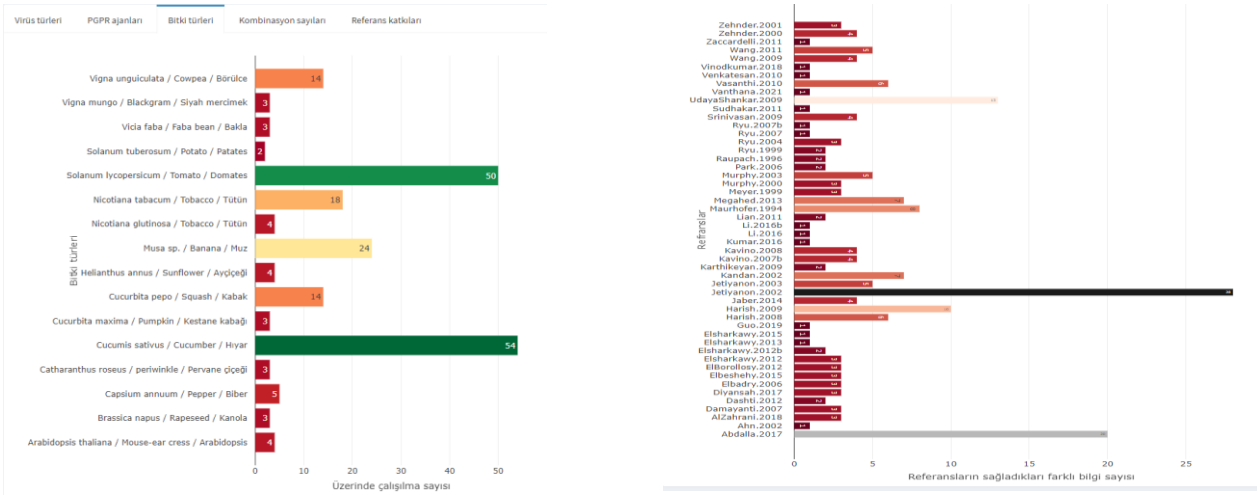

Figure 4
Graphs showing the number of studies by plant species and the number of different information provided by references

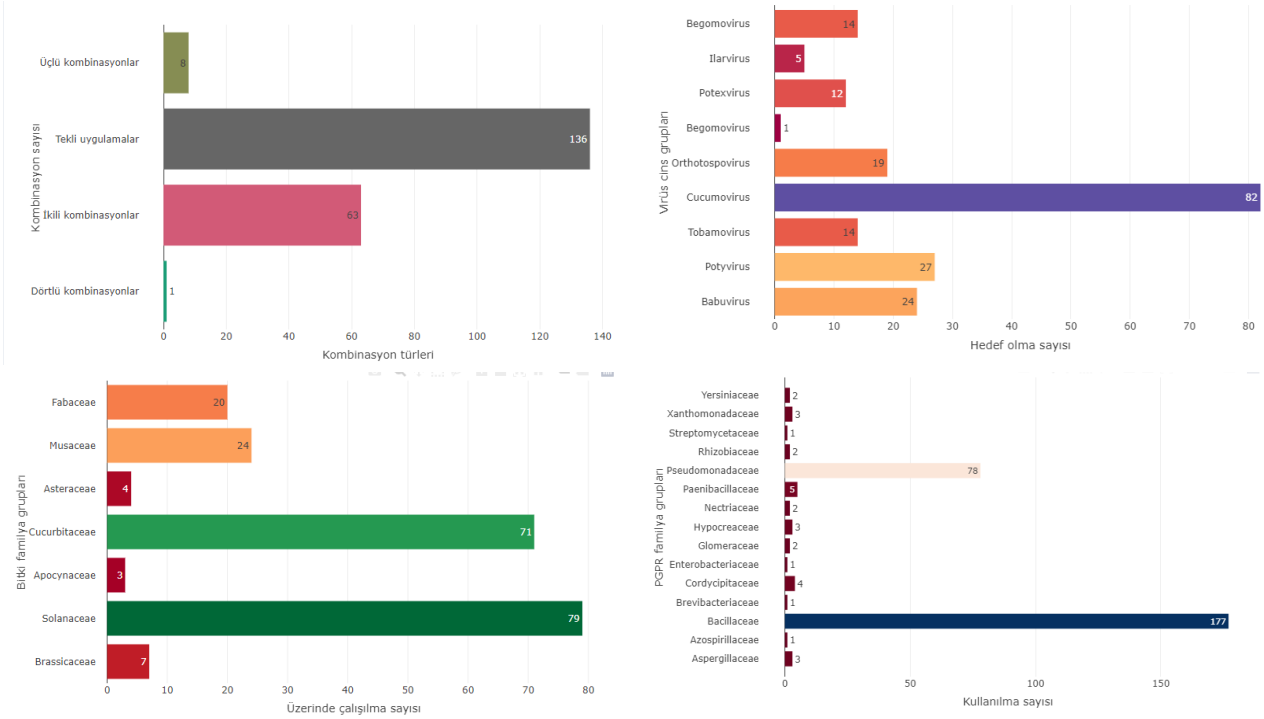

Figure 5
Graphs showing the number of single and multiple combinations, virus groups for targeting, number of studies per plant family group, and number of PGPR agents at family level

The processing and interpretation of biological data, the amount and complexity of which is rapidly increasing, becomes increasingly difficult. Thanks to the development of web interfaces and databases, it is possible to obtain information by processing biological data and make it easily accessible (Jia et al. 2022).

Having a good command of the literature plays an important role in carrying out successful studies in order to avoid repetitions unintentionally, to identify deficiencies or potential points, to plan correctly and to manage resources well (Antezana et al. 2009; Satyahadewi and Perdana 2021). Biological solutions such as PGPR are gaining more and more importance in the control of viral diseases for which there is no effective control method (Khoshru et al. 2020; Maksimov et al. 2019; Priya et al. 2021).

When the data are evaluated, although generally positive results are obtained from PGPRs in the control of plant virus diseases, it takes time for the expected effect to occur and emerge due to various limitations and deficiencies. Although it has many shortcomings, there is a need to plan different studies for the development of this emerging system. In addition, with the ideas that our study gives to the researchers, it is hoped that they will carry out similar studies on different subjects in order to evaluate the literature more effectively.

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Determination of Antagonistic Effect Between Some Fusarium Species and Root Bacteria Isolated from Eggplant Roots

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ABSTRACT

In this study, it was aimed to determine the antagonistic effect between and isolated from eggplant roots and some root bacteria conditions. 24 bacteria were isolated from soil samples taken from the rhizosphere regions of infected and non-infected plants in different eggplant production areas and 22 of them were evaluated as candidate biocontrol agents. According to the results of the research, 13 out of 22 bacteria were effective against, 14 against, and 9 against between 40% and 100%. The most effective bacteria against were 22B (100%) and 11B (74.4%). Among the bacteria tested for effectiveness against, 3B (100%), 10B (100%) and 18B (100%) completely inhibited fungal growth. These bacteria are followed by 11B (88.85%) and 13B (85.55%). 11B and 24B inhibited mycelial growth of 100%.

1. Introduction

Eggplant () is a purple-black vegetable that was first consumed in China and India. Türkiye ranks 4th in eggplant production after China, India and Egypt (Anonymous, 2018). Root rot and wilt diseases caused by soil-borne *Fusarium* spp. are factors that limit and reduce production in eggplant. They can infect the eggplant at every stage of the growing period. In the control against; In addition to the use of resistant varieties and non-infected soil and plants, alternation and the use of fungicide, biological control against and are the main methods (Agrios, 1988; Kurt, 2020).

The fungus penetrates plant tissue through wounds and natural openings. It forms lesions on the edges of the leaves and does not show a systemic distribution. There is discoloration in the leaf veins and sagging of the petioles. Root rot, wilt and death are seen in the later stages of the infection.When a longitudinal section of the plant is taken, chocolate-colored spots and rot appear on the root collar and root tissue (Miller et al., 1996). species can maintain their vitality in the soil for a long time in the form of chlamidospores (Türktaş and Koral, 2018). Biological control studies have a special importance in order to reduce the density of species such as, which has limited chemical control, in the soil. The relationship between these disease agents and various bacterial antagonists in biological control is examined (Özaktan et al., 2010).

There are bacteria in colonies in the rhizosphere region of plants, and some of them directly or indirectly affect the plant positively by taking advantage of the nutrients secreted by the roots. These bacteria are called plant growth promoting rhizobacteria (PGPR). PGPRs play an important role in improving plant health through events such as nitrogen fixation, minimizing the contamination of metal elements in the soil, phosphate solubility, phytohormone production, and antifungal activities of the ACC deaminase enzyme. PGPRs play a vital role in supporting plant growth and increasing soil fertility, as well as having a great importance in controlling plant diseases (Seyedsayamdost 2019).

Bioagent bacteria slow the growth of fungal pathogens both *in vivo* and *in vitro* with antifungal activities (Chakraborty et al., 2008). Gram-negative and gram-positive biocontrol agents protect plants from infections by phytopathogenic organisms. In a study by Saha et al. (2012), they tested 141 isolates of *Bacillus subtilis* on *Fusarium solani*, which causes *Fusarium* Wilt, *in vitro* and found that it limited fungal growth by showing an antagonistic effect.

Antimicrobial metabolites of bacterial species are low molecular weight and have proven to be lethal against other plant pathogenic microorganisms (Sahu et al., 2019). In a study, *Bacillus* and *Pseudomonas* isolates were isolated from the rhizosphere part of eggplant, and siderophore, protease and cyanide enzyme production were tested, and their cell wall destructive activities were examined and it was stated that they showed an antagonistic effect against *Fusarium oxysporum*

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Schlecht. f.sp. *melongenae* (Fomg) and reduced the severity of the disease (Jarl et al.,1999).

In addition, these biocontrol agents form a biofilm against many fungal pathogens by producing siderophores (Beneduzive et al., 2012).

Bacillus spp. has proven to be a biocontrol agent by producing secondary metabolites against some important fungal pathogens (Hanschen and Winkelmann, 2020).

It has been determined that biocontrol agents such as *Brevibacillus breves*, which secretes fengycin and iturin-A, and *Bacillus subtilis*, which secretes gramicidin, are the best biocontrol agents that inhibit the growth of fungal plant pathogens (Latorre et al., 2016).

It is found in some commercial preparations such as *Bacillus* spp., *Pseudomonas* spp., *Serratia* spp. and *Streptomyces* spp, developed for biological control against *Fusarium* wilt (Bora and Özaktan, 1998; Janisiewicz and Korsten, 2002).

In this study, antagonistic effects of 22 bacteria were investigated against *Fusarium oxysporum, Fusarium solani* and *Fusarium profileratum* from isolated eggplant roots.

2. Materials and Methods

2.1. Materials

2.1.1. Fungal material

The pathogens of *Fusarium oxyporum*, *Fusarium solani* and *Fusarium proliferatum* used in the study were obtained from the root parts of diseased plants from the villages of Amasya (Sevincer, Karaköprü and Karasenir).

2.1.2. Bioagent Bacteria

22 potential bioagent bacteria used in the study were isolated from the rhizosphere region of infected and non-infected plants in the eggplant production areas in Muğla province Fethiye district, Antalya province Manavgat district and Aydın, Amasya, Konya.

2.2. Methods

2.2.1. Collection and Isolation of Plant and Soil Samples

Infected and non-infected plant samples were collected by survey in the infected areas and brought to the laboratory. The plant samples to be isolated were first washed with tap water and the tissues between 0.5-1 cm from the root collar, thin roots, branches and leaves in the infected areas were cut with the help of a sterile scalpel and sterilization process was started. The sterilization process consists of 5 steps. In the first step, 1% NaClO was added to 100 ml of water. Tissue pieces were kept in this solution for 3 minutes, and then with the help of sterile forceps, they were kept in 100 ml sterile distilled water 3 times for 3 minutes and transferred to blotting paper. Afterwards, tissue pieces were inoculated in PDA (Potato Dextrose Agar) medium as 4-5 pieces per petri dish. They were placed in an incubator at 25°C for their growth. From the 2nd day, the developments in the petri dishes were checked and transferred to the PDA medium until pure growth was achieved. Macroscopic and microscopic diagnoses of isolated agents were made.

Since the soil samples taken from the infected areas were moist, they were left to dry by laying at room temperature the night before the isolation. Then, after the dried soils were sieved with the help of a sieve with a diameter of 1 mm, 10 g of soil was weighed and placed in sterile 250 ml flasks. 90 ml of sterile water was added to the soils in the flask and shaken in a water bath for 30 minutes. 1 ml of the suspension in the flask was taken with the help of a micro pipette, put into the tube containing 9 ml of sterile water, and after mixing for 30 seconds in the tube mixer, 1 ml of this mixture was taken and added to the tube containing 9 ml of sterile water for dilution. This dilution step was repeated 6 times.

From these suspensions, 100 µl of the fifth and sixth dilutions were taken and plotted on the NA medium with sterile glass baguettes. It was incubated at 25±1°C for 24 hours until bacterial colonies developed. Then, colonies growing on Nutrient Agar medium were examined and colonies showing different morphological development were selected and NA cultured until pure culture was obtained.

2.2.2. Single Spore Isolation

Fusarium grown in PDA media at 24-25°C for 7 days was taken from the tip of the preparations with the help of a sterile loop and transferred to an eppendorf tube containing 1000µl of sterile distilled water. Then, the eppendorf tube was vortexed for 30 seconds. 30µl was taken from this homogeneous tube with the help of a sterile pipette and transferred to an eppendorf tube containing 1000µl of distilled water. This tube was also vortexed for 30 seconds. After dilution twice, 30µl was taken from the last tube with the help of a sterile pipette and inoculated into 2% water agar (20.0g Agar-100ml water-30ml Streptomycine solution). The prepared preparations were placed in an incubator at 20±5°C, alternating 12 hours of dark and 12 hours of light. After 12-18 hours, the petri dishes were checked with a microscope and the spores forming the germ tube were cut with the help of a sterile scalpel and planted in PDA medium containing 40mg Streptomycine/100ml. They were placed in a 25°C incubator for growth (Leslie and Summerell, 2006).

The fungi, whose development was followed for 7-10 weeks, were stored in 3 ways for later use. In the first method, it was transferred using slanted agar and stored at +4°C. In the second procedure, *Fusarium* colonies were transferred to eppendorf tubes with 15% glycerol suspension and stored at -20°C. In the third method, *Fusarium* colonies incubated on Whatman filter papers, which is a long-term storage method, were stored at -20°C.

2.2.3. Identification of Fusarium Species and Bacterial Isolates

The characterization of 12 purified *Fusarium* and 22 bacterial isolates used in the assays was done by MALDI-TOF biotyping.

2.2.4. Testing of Antagonistic Effects of Bacterial Isolates against Fusarium Species (Fusarium solani, F. oxysporum, F. proliferatum)

As a result of isolation studies, rhizosphere bacteria were evaluated *in vitro* against *Fusarium solani, Fusarium oxysporum* and *Fusarium proliferatum* with dual culture method to determine their antifungal activities. Fungi were

grown on Potato Dextrose Agar (PDA) medium and rhizosphere bacteria were grown on Nutrient Agar (NA, Merck) medium. Fungi were incubated at 25°C±1 for 7 days and bacteria at 25°C±1 for 24 hours. After incubation, 2 agar discs of 4 mm, taken from *Fusarium* cultures, were placed opposite each other, equidistant from the center of petri dishes with 9 cm diameter antibiotic-free PDA media was left for incubation. The experiment was set up with 2 replications for each bacterium. The control petri dish was formed by mutually planting fungi without drawing bacteria between them.

In order to understand how much bacteria and fungus inhibit mycelial growth, the inhibition zone (Zone of Inhibition, Z_1) was evaluated by measuring the distance. The percent effect of inhibition rates was calculated according to the formula given below;

Inhibition rate (%) = $(r_1-r_2/r_1) \times 100$

According to the formula r_1, radial growth of the pathogen; r_2 represents the radial evolution of the pathogen and the biological agent (Tozlu, 2003; Ghildiyal and Pandey, 2008).

3. Results and Discussion

3.1. Fusarium Species Isolated from Eggplant Roots

In our study, a total of 16 *Fusarium* isolates obtained from eggplant roots were identified. Of these isolates, 6 were identified as *Fusarium oxysporum*, 7 as *F. solani*, 1 as *F. proliferatum*, and 1 as *Fusarium* sp. According to the diagnostic results, a complete diagnosis of 1 isolate (may be *F. oxysporum* or *F. proliferatum*) could not be made (Table-1).

Table 1
Fusarium species isolated from eggplant roots

Izolate Codes	Fungi Species
Alakova KB.3	*Fusarium oxysporum*
Sevincer I.K.8	*Fusarium solani*
Alakova-2 K.B.2	*Fusarium solani*
Kayseri- 4 2	*Fusarium oxysporum*
Kayseri-1 2	*Fusarium oxysporum*
Alakova Gövde 2	*Fusarium solani*
Isa Keles Sevincer 2	*Fusarium* sp.
Aşılı küçük kok-2 3	*Fusarium solani*
Aşılı Karaköprü I.K. saf1	*Fusarium proliferatum*
Aşılı küçük kok-1 3	*Fusarium oxysporum*
Körkuyu K.B	*Fusarium solani*
Karasenir K.B H.B 1	*Fusarium oxysporum*
Anamur Kayabaşı no. 3 KB2	*Fusarium oxysporum-Fusarium proliferatum*
Anamur Kayabaşı Black no.2 10	*Fusarium oxysporum*
Aşısız Anamur I.K.2	*Fusarium solani*
Sevincer I.K 8	*Fusarium solani*

The isolates highlighted according to the table are the species used in the study.*3.2. Bacteria Species Isolated From Eggplant Roots*

Code numbers and species names of bacterial isolates obtained from eggplant rhizosphere are as given in Table 2:

Table 2
Bacteria species isolated from eggplant roots

Isolate Codes	Bacteria Species
1B	*Stenotrophomonas maltophilia*
2B	*Lysinibacillus fusiformis*
3B	*Pseudomonas putida*
5B	*Staphylococcus epidermidis*
6B	*Bacillus megaterium*
7B	*Enterobacter bugandensis*
8B	*Bacillus megaterium*
9B	*Pseudomonas chlororaphis*
10B	*Pseudomonas chlororaphis*
11B	*Bacillus subtilis*
12B	*Pseudomonas chlororaphis*
13B	*Pseudomonas chlororaphis*
14B	*Stenotrophomonas maltophilia*
16B	*Pseudomonas chlororaphis*
17B	*Acinetobacter vivianii*
18B	*Enterobacter bugandensis*
19B	*Exiguobacterium* sp.
20B	*Acinetobacter calcoaceticus*
21B	*Acinetobacter calcoaceticus*
22B	*Bacillus thuringiensis*
23B	*Pseudomonas chlororaphis*
24B	*Bacillus cereus*

These bacteria; *Stenotrophomonas maltophilia* (2), *Lysinibacillus fusiformis* (1), *Pseudomonas putida* (1), *Staphylococcus epidermidis* (1), *Bacillus megaterium* (2), *Enterobacter bugandensis* (2), *Pseudomonas chlororaphis* (6), *Bacillus subtilis* (1), *Acinetobacter vivianii* (1), *Exiguobacterium* sp. (1), *Acinetobacter calcoaceticus* (2), *Bacillus thuringiensis* (1), *Bacillus cereus* (1).

3.3. Antagonistic Effects of Some Selected Bacteria on Fusarium Species

In this study, soil samples were taken from different regions and tested against 3 *Fusarium* species in order to investigate the diversity of rhizobacteria and to reveal their activities. In the trials, the success rate was accepted as 40% and above.

While *Bacillus thuringiensis* was 100% effective against *Fusarium solani*, *Bacillus subtilis* was 74.4% effective.

Pseudomonas putida and *Enterobacter bugandensis* were 100% effective against *Fusarium oxysporum*. It was also observed that *Staphylococcus epidermidis* inhibited mycelial growth with a rate of 77.7% and *Pseudomonas chlororaphis* with a rate of 85.5%. In a study conducted by Özaktan and Bora (2004) using *P. putida* against *F. oxysorum*, they found that the severity of the disease decreased by 80-84%.

It prevented mycelial growth of *Bacillus subtilis* and *Bacillus thuringiensis* with 100% inhibition rate against *Fusarium proliferatum*. *Pseudomonas chlororaphis* was a successful biological agent with a 72.2% inhibition rate (Table 3).

Table 3
Percentages of inhibition of *Fusarium* species by bacteria used in the antibiosis trial

BACTERIA ISOLATES	CODE	INHIBITION RATES (%)		
		F. solani	*F. oxysporum*	*F. proliferatum*
Stenotrophomonas maltophilia	1B	46,65	36,6	37,7
Lysinibacillus fusiformis	2B	36,60	25,5	38,8
Pseudomonas putida	3B	33,3	100	23,3
Staphylococcus epidermidis	5B	57,75	77,75	24,4
Bacillus megaterium	6B	47,75	42,2	38,85
Enterobacter bugandensis	7B	0	54,4	26,6
Bacillus megaterium	8B	0	0	44,4
Pseudomonas chlororaphis	9B	42,15	55,5	57,7
Pseudomonas chlororaphis	10B	42,2	100	26,6
Bacillus subtilis	11B	74,4	88,85	100
Pseudomonas chlororaphis	12B	51,05	55,5	44,4
Pseudomonas chlororaphis	13B	52,15	85,55	72,2
Stenotrophomonas maltophilia	14B	56,6	66,65	64,4
Pseudomonas chlororaphis	16B	35,5	42,2	54,4
Acinetobacter vivianii	17B	0	31,05	29,95
Enterobacter bugandensis	18B	0	100	28,85
Exiguobacterium sp[2]	19B	35,5	37,7	29,95
Acinetobacter calcoaceticus	20B	39,9	36,65	22,2
Acinetobacter calcoaceticus	21B	41,05	28,85	34,4
Bacillus thuringiensis	22B	100	42,2	35,5
Pseudomonas chlororaphis	23B	34,4	33,25	48,6
Bacillus cereus	24B	53,3	44,4	100

Many *Bacillus* species have been reported to be biocontrol agents against fungal diseases (Ongena and Jacques 2008), and biomolecules derived from them have been reported to inhibit the germination of fungal spores (Matar et al., 2009; des Grades et al., 2012). It is known that many antimicrobial peptide substances or bacteriocins are produced by *Bacillus subtilis* (Hammami et al., 2009; Umer et al., 2021).

P. aeruginosa, *P. putida*, *P. fluorescent* and *P. syringae* from *Pseudomonas* strains have the ability to control soil-borne fungal pathogens (Aksoy, 2006), in some studies, the germination of siderophores produced by *Pseudomonas putida* Trevisan and chlamidospores of *Fusarium* species. It has been observed that it suppresses the development of the pathogen by inhibiting it (Elad and Baker, 1985; Özaktan et al., 2010).

In this study, it is seen that the effect of the use of natural biopreparates and natural products used in the biological control of *Fusarium* Wilt in the eggplant plant is not to be underestimated. In addition, the results suggest that these agents will be have a potential natural fungicide. Making preparations of bioagents that are effective in biological control and applying them in combination with alternative methods will provide great benefits in control strategies.

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Comparison of Plant Detection Performance of CNN-based Single-stage and Two-stage Models for Precision Agriculture

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ABSTRACT

The fact that arable land is not increasing in proportion to the ever-increasing population will increase the need for food in the coming years. For this reason, it is necessary to increase the yield of crops to make optimum use of arable land. One of the most important reasons for the decrease in yield and quality of crops is weeds. Herbicides are generally preferred for weed management. Due to deficiencies in herbicide application methods, only 0.015-6% of herbicides reach their target. The use of herbicides, which is an important part of the agricultural system, is an issue that needs to be emphasized, considering the risk of residue and environmental damage. In parallel with the rapid development of electronic and computer technologies, artificial intelligence applications have had the opportunity to develop. In this context, the use of artificial intelligence for plant detection in the subsystems of herbicide application machines will contribute to the development of precision agriculture techniques. In this study, the plant detection performances of single-stage and two-stage Convolutional Neural Network (CNN)-based deep learning (DL) models are evaluated. In this context, a dataset was created by taking images of *Zea mays*, *Rhaponticum repens* (L.) Hidalgo, and *Chenopodium album* L. plants in agricultural lands in Konya. With this dataset, the training of the models was carried out by the transfer learning method. The evaluation metrics of the trained models were calculated using the error matrix. In addition, training time and prediction time were used as quantitative metrics in the evaluation of the models. The plant detection performance, training time, and prediction time of the models were 85%, 8 h, 1.21 s for SSD MobileNet v2 and 99%, 22 h, 2.32 s for Faster R-CNN Inception v2, respectively. According to these results, Faster R-CNN Inception v2 is outperform in terms of accuracy. However, in cases where training time and prediction time are important, the SSD MobileNet v2 model can be trained with more data to increase its accuracy.

1. Introduction

The most preferred method for weed management is the use of herbicides (Ali et al., 2015). It is also observed that herbicides are used in more than 90% of the total area planted for maize in European Union countries (Vasileiadis et al., 2015). Although weeds do not cover the entire soil surface, the most common use of herbicides is to apply them over the entire area. It is obvious that if herbicide use is not optimized, various environmental and economic risks are evident (Pérez-Ortiz et al., 2016; Zheng et al., 2017). Traditional methods of weed control are limited in terms of time, cost, and errors. These limitations can be overcome with the use of computer vision systems. In this respect, the use of herbicides in weed control can achieve better results if they target only weeds and are applied selectively according to a specific weed class (dos Santos Ferreira et al., 2017). Variable rate herbicide application is also recommended when it comes to herbicide use in precision agriculture practices (Asad et al., 2020; Bàrberi, 2002). The most important step to realizing weed control with an automated system within the framework of precision agriculture is to detect weeds correctly (Liu and Bruch, 2020).

In this study, the performance evaluation of Single Shot Multibox Detector (SSD), a two-stage detector that

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can be used in the subsystems of robotic machines for automatic weed control, and Faster R-CNN, a two-stage detector, was carried out with a dataset created with plant images taken from Konya plain agricultural lands.

The study is organized as follows. The second section of the paper describes the two-stage and single-stage detectors. The third section describes the dataset, object labeling, model training, performance metrics, and experimental results. In the last section, the results are evaluated, and future work is presented.

2. Materials and Methods

State-of-the-art DL algorithms in object detection generally consist of two main parts: object detectors and backbone architectures. In an object detection network, backbone architectures extract features from input images. The quality of the extracted features directly affects the performance of the algorithm. Object detectors, on the other hand, perform classification based on the extracted features and identify bounding boxes. Object detectors can be categorized into two main categories as two-stage and one-stage according to the object detection method. In the first stage, two-stage detectors use a region proposal network (RPN) to identify regions that are likely to contain objects. In the second stage, classification and object location are determined. In single-stage detectors, these processes are performed at one time (Zaidi et al., 2022). This provides an advantage in terms of speed (Jiao et al., 2019). The basic architectures of two-stage and single-stage detectors are shown in Figure 1.

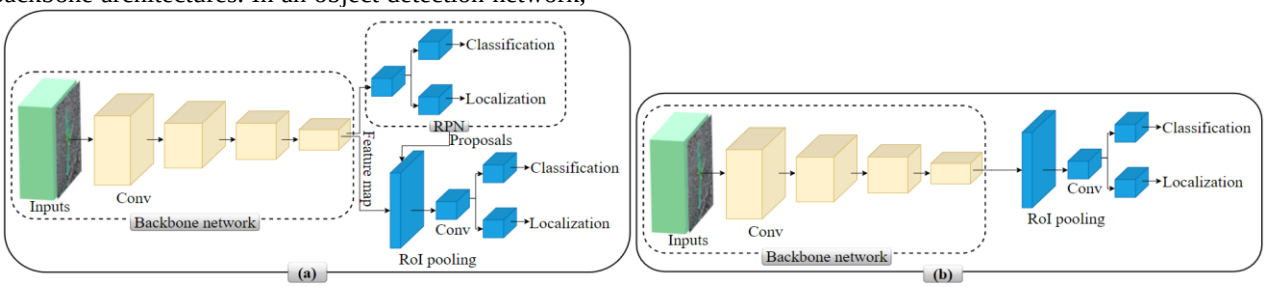

Figure 1
Basic structure of detectors (a) Two-stage detectors, (b) Single-stage detectors (Jiao et al., 2019)

2.1. Faster R-CNN Inception v2

In the CNN algorithm, creating boxes of different sizes for objects of different sizes and detecting the region proposal each time by shifting the boxes on the image would require too much computer power and too much processing. For this reason, different R-CNN algorithms have been developed. Within CNN algorithms, the region suggestion that is likely to be an object in an image is used in R-CNN algorithms.

In R-CNN, region proposals are created by the selective search in which the same class value is assigned to the pixels in each closed area separated from each other in shape or color in an image that is likely to contain objects in the images to be region proposals. The marked regions are brought to the same size and passed through the CNN one by one to check whether there is an object in that region and if so, the detected object is assigned to a class. The region boundaries are defined by linear regression based on the relationship between the dependent variable and independent variables, and the classification is based on a supervised learning method, namely the Support Vector Machine (SVM), which is based on a model created using known data with known results, and is based on the determination of decision boundaries or, in other words, hyperplanes to optimally separate the data belonging to the classes from each other (Girshick et al., 2014). The training and prediction times of R-CNN are very long as all the region proposals are passed through the CNN one by one.

Fast R-CNN, which has the same structure as R-CNN but uses a different technique to speed it up, has been developed. In Fast R-CNN, the entire image is directly passed through the CNN without identifying any region in the image and a high-resolution feature map is extracted. From this feature map, a region proposal is generated by the selective search. Again, as in R-CNN, the marked regions are resized to the same size and given directly to the Fully Connected Layer (FCL) this time. In this way, each region is not passed through the neural network separately as in R-CNN. In this case, excessive time loss is avoided. Classification is then performed, and the boundaries of the detected object are determined. The boundaries are determined by linear regression, and the classification is performed using the SoftMax function, which is used for multiple classification problems and produces outputs between 0 and 1, indicating the probability that each given input belongs to a class (Girshick et al., 2015). Fast R-CNN works quite fast in the training phase. However, it spends most of the time in the testing phase making region proposals.

Faster R-CNN was developed to reduce the time spent on region recommendation, which is the disadvantage of Fast R-CNN and to make the model work even faster. Faster R-CNN (Ren et al., 2015) gains speed by making the region suggestion within the network instead of getting region suggestions with Selective Search. After applying CNN to the input image, the feature map is extracted. Then, unlike Fast R-CNN, it makes region proposals through RPN. After RPN identifies the regions, the rest of the operations are

the same as Fast R-CNN. After the identified regions are resized, they are given to the FCL, and classification is performed. In this case, it is necessary to train both the RPN and the CNN.

The RPN has two tasks: to decide whether there are objects in each proposal region and to determine the box size of proposals. CNN, on the other hand, has two tasks: to perform classification in the region and determine the boundaries of the object after classification.

Inception v2 (Szegedy et al. 2016) is one of the widely used and highly accurate CNN architectures. This architecture is designed to avoid the complexity of CNNs by reducing the depth of the network.

2.2. SSD MobileNet v2

It was mentioned above that in the faster R-CNN, regions in the image that are likely to be objects are first identified and then classified using FCL. In SSD, on the other hand, these two are done at one time. An image is taken as input and passed through the CNN to obtain feature maps of different sizes. In all feature maps, bounding rectangles are obtained with the help of a 3x3 convolutional filter. For each rectangle, both boundaries and classifications are determined simultaneously. Since these rectangles are present in every activation map, they can recognize both small objects and large objects. During training, the correct boundaries are compared with the predicted boundaries. The best rectangles predicted above 50% are labeled as positive.

MobileNet v2 (Sandler et al., 2018) is designed to improve computational cost and accuracy by adding jump links between the convolution layers in MobileNet v1 (Howard et al., 2017), a lightweight network backbone that uses in-depth convolutions developed for embedded and mobile vision applications.

2.3. Experimental Design and Statistical Analysis

2.3.1. Dataset

A data set was created from the images obtained by using mobile phones and cameras in Konya and its surrounding districts. A total of 1500 images were selected from this data set by taking 500 images each from the images of *Zea mays*, *Rhaponticum repens* (L.) Hidalgo, and *Chenopodium album* L. plants, which are given in Table 1 below and whose sample images are shown in Figure 2. These selected images were resized to 640 pixels on the short side so that the aspect ratios would not be distorted for fast training. Of the total 500 images of each type, 80% were used for training and 20% for testing. Thus, 1200 images were used for training and 300 images were used for testing.

Table 1
Created dataset

Species	Scientific Names	EPPO Code	Training Data		Total
			Train (%80)	Validation (%20)	
1	*Zea Mays*	ZEAMX	400	100	
2	*Chenopodium album* L.	CHEAL	400	100	1500
3	*Rhaponticum repens* (L.) Hidalgo	CENRE	400	100	

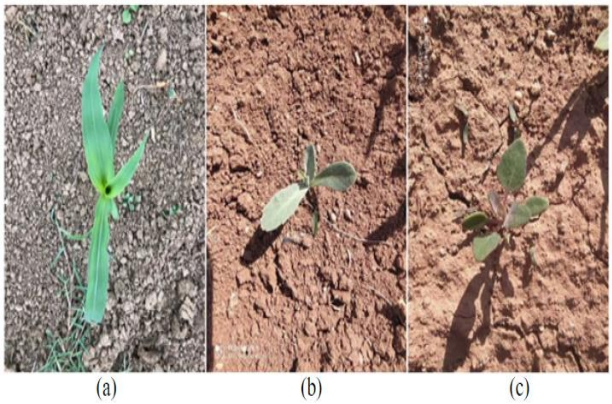

Figure 2
Example dataset images; (a) *Zea Mays*, (b) *Rhaponticum repens* (L.) Hidalgo, (c) *Chenopodium album* L.

2.3.2. Labeling

For labeling processes, xml files were created by labeling all images using the open-source LabelImage (Tzutalin, 2015) tool, an example of which is shown in Figure 3.

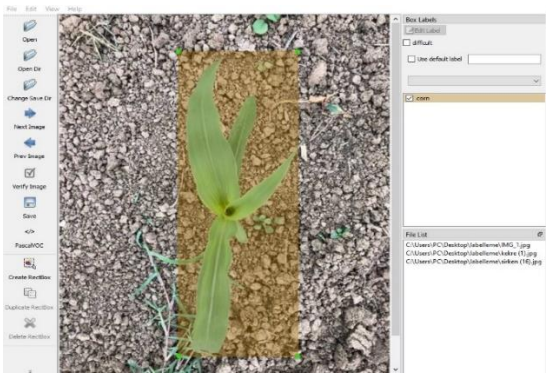

Figure 3
Example labeling for *Zea Mays*

2.3.3. Training Processes

Since building and training, a model from scratch would require a lot of time and powerful computers, two models were created using transfer learning, a method in which a pre-trained model for one task is redesigned for a second task. Tensorflow, an open-source DL library, was used in both models. The preferred models were pre-trained with the Tensorflow Object Detection API (Tensorflow, 2021) using the Common Objects in Context (COCO) dataset consisting of 91 object types

and 2.5 million labeled data. We retrained these models by transfer learning using our dataset and object detection was performed. Thus, we were able to observe the successful results by training on a low-equipped computer with little data. For transfer learning using pre-trained models:

- The coefficients of the convolution layers were fixed,
- The number of output neurons activated by the activation function in the output layer was changed to match the desired number of classes,
- The network coefficients of the FCL between the output layer and the convolution layers were retrained with new data with random initial values.

The training times of the Faster R-CNN and SSD models trained for 10,000 steps using the generated dataset and Intel Core i5 3230M 2.60 GHz processor are shown in Table 2 and the training graphs are shown in Figure 4.

Table 2
Training times of the models

Model	Training steps	Training time (h)
Faster R-CNN Inception v2	10.000	22
SSD MobileNet v2	10.000	8

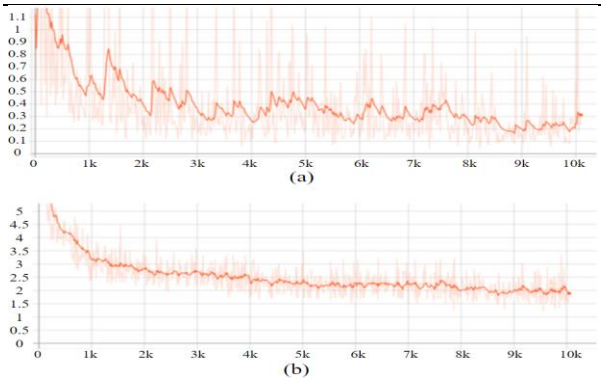

Figure 4
Total loss graphs of the models according to iteration; (a) Faster R-CNN Inception v2, (b) SSD MobileNet v2

2.3.4. Performance Metrics

The confusion matrix allows us to find the correlation between model performance and test results. This matrix provides information about the correct or incorrect classification of positive and negative samples. Table 3 shows a two-class confusion matrix.

Table 3
Two-class confusion matrix

	Prediction	
	Positive	Negative
Positive	TP (True Positive)	FN (False Negative) (Type-2 error)
Negative	FP (False Positive) (Type-1 error)	TN (True Negative)

The elements of the confusion matrix can be defined as follows:

- TP: The model correctly predicted the positive class as a positive class.
- FP: The model incorrectly predicted the negative class as a positive class.
- FN: The model incorrectly predicted the positive class as a negative class.
- TN: The model correctly predicted the negative class as a negative class.

The three-class confusion matrix is given in Table 4 and the calculation of the matrix elements is given in Table 5.

Table 4
Three-class confusion matrix

		Prediction		
		C_1	C_2	C_3
Actual	C_1	T_1	F_{12}	F_{13}
	C_2	F_{21}	T_2	F_{23}
	C_3	F_{31}	F_{32}	T_3

Table 5
TP, TN, FP, and FN calculation for a three-class confusion matrix

Class	TP	TN	FP	FN
C_1	$TP_1=T_1$	$TN_1=T_2+T_3+F_{23}+F_{32}$	$FP_1=F_{21}+F_{31}$	$FN_1=F_{12}+F_{13}$
C_2	$TP_2=T_2$	$TN_2=T_1+T_3+F_{13}+F_{31}$	$FP_2=F_{12}+F_{32}$	$FN_2=F_{21}+F_{23}$
C_3	$TP_3=T_3$	$TN_3=T_1+T_2+F_{12}+F_{21}$	$FP_3=F_{13}+F_{23}$	$FN_3=F_{31}+F_{32}$

Statistical calculations can be made using the TP, FP, FN, and TN values in the confusion matrix (Martínez et al., 2022). In this study, the precision, recall, accuracy, and F1 score in Table 6 were determined as the performance evaluations of the models.

Table 6
Performance metrics

Metrics	Formula	Description
Precision	TP / (TP + FP)	Accuracy rate of positive predictions
Recall	TP / (TP + FN)	Accuracy rate of true positives
Accuracy	(TP + TN) / (TP + TN + FP + FN)	Gives the success of the model
F1 Score	(2*TP) / (2*TP + FP + FN)	It is the harmonic mean of the precision and recall values. Includes all error costs.

3. Results

Training and model tests were performed using the same computer. A total of 75 images were created by taking 25 images from each class that the model had not seen before, and the test data were created by resizing the short side of the image to 640 pixels so that the aspect ratio would not be distorted as it was done when creating the training and test data.

For both Faster R-CNN Inception v2 and SSD MobileNet v2 models, the threshold value was chosen as 0.5. That is, 50% similarity and above is considered a correct prediction. Also, predictions above the bounding box threshold (IoU) of 0.5 were considered valid. The same test data was given as input to both models and the error matrix for the three classes in Table 7 was created.

Table 7
Confusion matrices of models

	Prediction					
	Faster R-CNN Inception v2			SSD MobileNet v2		
	ZEAMX	CHEAL	CENRE	ZEAMX	CHEAL	CENRE
ZEAMX	25	0	0	23	2	0
CHEAL	0	25	0	0	25	0
CENRE	0	1	24	0	15	10

The calculations in Table 5 were made and the statistical results in Table 8 were obtained by species.

Table 8
Performance of models by species

Metrics	Faster R-CNN Inception v2			SSD MobileNet v2		
	ZEAMX	CHEAL	CENRE	ZEAMX	CHEAL	CENRE
Precision	1	0,96	1	1	0,6	1
Recall	1	1	0,96	0,92	1	0,4
Accuracy	1	0,99	0,99	0,97	0,77	0,8
F1 Score	1	0,98	0,98	0,96	0,75	0,57

The average of the results for the final evaluation is shown in Table 9.

Table 9
Overall performance of the models

Metrics	Faster R-CNN Inception v2	SSD MobileNet v2
Precision	0,99	0,87
Recall	0,99	0,77
Accuracy	0,99	0,85
F1 Score	0,99	0,76

Examples of the prediction results of the models on the test dataset images are given in Figure 5.

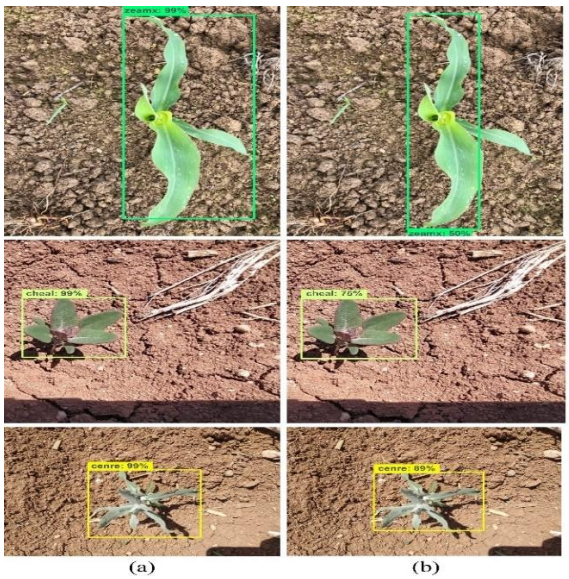

Figure 5
Predictions of the models; (a) Faster R-CNN Inception v2, (b) SSD MobileNet v2

Prediction time was also used as a quantitative metric in model evaluation. The prediction times of the models per image are given in Table 10.

Table 10
Prediction times of models

Model	Prediction time per image (sec)
Faster R-CNN Inception v2	2,32
SSD MobileNet v2	1,21

4. Discussion

In this study, CNN-based single-stage and two-stage models that can be used in the subsystems of robotic herbicide application machines were evaluated. In this context, a data set was created by capturing images of *Zea mays*, and *Rhaponticum repens* (L.) Hidalgo, and *Chenopodium album* L. plants in Konya plain agricultural lands. Using this dataset, SSD MobileNet v2, a single-stage detector, and Faster R-CNN Inception v2, a two-stage detector, were trained. Models were given images they had not seen before, and performance evaluations were made. The accuracy and F1 score scores of the two-stage detector were found to be 0.99. The accuracy and F1 score of the single-stage detector were 0.85 and 0.76, respectively. In terms of time, the two-stage detector has a training time of 22 h and a prediction time of 2.32 s, while the single-stage detector has a training time of 8 h and a prediction time of 1.21 s. According to these results, the performance of the two-stage detector is high. However, the single-stage detector performs better in terms of training and prediction time. The single-stage detector is therefore preferable where time is of the essence. In addition, training with more data and/or using data augmentation techniques can improve the performance of the single-stage detector to the desired level. In this study, promising results were obtained by evaluating a dataset containing a few images. In our future studies, we plan to investigate high-performance methods for plant detection for precision agriculture applications.

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Effects of Climate Changes on Rose Fungal and Bacterial Diseases in Landscape Areas of Konya Province, Türkiye

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ABSTRACT

Rose, a plant belonging to the family Rosaceae, is one of the most popular and versatile flowering shrubs in urban landscape areas. In recent years, rose bacterial diseases are getting to increase and they cause significant economic losses. The severity and distribution of these problems change every year according to the changing climatic factors, growing areas, the type of roses and the level of being affected by biotic and abiotic factors. In this study, on the 106 rose cultivars located in landscape areas of Konya province was determined different diseases symptoms at various levels by carried out survey studies in 1998-2022 years. As a result of the diagnosis of obtaining bacterial and fungal isolates, bacterial blights (*Pseudomonas syringae* pv. *syringae* and *P. s.* pv. *morsprunorum*), *Xanthomonas hortorum*, fire blight (*Erwinia amylovora*) and crown gal (*Rhizobium radiobacter*), downy mildew (*Peronospara sparsa*), rust (*Phragmodium mucronatum*), black spot (*Diplocarpon rosae*), powdery mildew (*Sphaerotheca pannosa* var. *rosae*), gray mold (*Botrytis cinerea*) were determined as the pathogen on the rose cultivars. It is thought that the findings obtained from the study will contribute to the future development of rose cultivation by revealing the different pathogens and disease levels in roses as a result of the changing climatical conditions.

1. Introduction

The rose (*Rosa* spp.) is often called the "Queen of Flowers" and is the world's most popular garden and landscape plant. Many rose cultivars are susceptible to a range of pests, diseases and environmental influences that reduce their value in use. Most of the biotic and abiotic problems affecting roses are closely related to climatic conditions (Ross, 1985). It is known that some rose varieties are naturally more resistant to certain pests and diseases than others **(** McLeod, 2002).

Important fungal and bacterial diseases seen in roses used in landscape areas and for cut flower cultivation, downy mildew (*Peronospara sparsa*), rust (*Phragmodium mucronatum*), black spot (*Diplocarpon rosae*), powdery mildew (*Sphaerotheca pannosa* var. *rosae*), gray mold (*Botrytis cinerea*), fungal wilt (*Verticillium* spp.), crown gal (*Rhizobium radiobacter*), bacterial blight (*Pseudomonas syringae* pv. *syringae* and *Pseudomonas syringae* pv. *morspurunorum*), bacterial wilt (*Ralstonia solanacearum*), fire blight (*Erwinia amylovora*), bacterial canker (*Xanthomonas hortorum*) can cause significant economic losses. The severity and distribution of these problems changes every year according to climatic factors, growing areas and type of roses (Douglas, 2022).

Climate change is one of the most important environmental problems of our time. Plant growth and yield are significantly affected by high atmospheric carbon dioxide concentration, temperature, changes in precipitation regime and extreme weather phenomena. In addition, climate change; human-induced processes such as pollution of air, water and soil, along with factors such as long-distance transport of exotic species and urbanization, will further affect plant diseases. These factors will contribute to the rapid spread of diseases. Temperature affects many life chains in the disease cycle of many pathogens, such as survival, spread, penetration, development and reproduction. In general, the increase in temperature facilitates the wintering of pathogens, increases their productivity, accelerates population development, increases the ability to cause disease, and allows them to spread over wide geographical areas by providing better spread. Increasing temperature increases spore germination especially of rust fungi. It has also been reported to cause an increase in some leaf spot diseases. Temperature also plays a vital role in the

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localization of some bacterial diseases. Bacterial infections can be seen to start in places where temperature-related diseases are not seen. High humidity creates favorable conditions for the development of many foliar diseases and soil-borne fungal pathogens. High CO_2 concentration results in better reproduction of fungal spores. As the increased CO_2 increases photosynthesis, it reduces the plant's use of water effectively and ozone damage. Therefore, with the increase of CO_2, plant growth and yield increase. In addition, physiological changes in the host plant cause an increase in host resistance against the pathogen. In general, the effect of increased CO_2 concentration on plant diseases can be positive or negative, but in most cases it increases disease severity. Disease development is the cumulative result of host and pathogen influencing factors. Microbial populations and control agents affect the plant-pathogen relationship. The effects of climate change may differ in different plant-pathogen systems. Due to the changing climatic conditions, plants need more pesticide applications (Akbaş, 2018).

As the world becomes warmer and climate events stronger, we need roses that can perform well in the garden and landscape. For this reason, in our trials, which were initiated to determine the disease levels of different rose varieties in areas and regions with different climatic characteristics, the situation for the last 24 years in roses grown under the conditions of the Central Anatolia Region was first revealed. It is aimed to contribute to the future development of rose cultivation by revealing the findings obtained from the study, the pathogens and disease levels that differentiated in roses as a result of the changing climate crisis.

2. Material and Metot

2.1. Plant Material

The rose varieties that have been grown in the landscape areas of Konya province in the last 24 years and examined in the survey studies for disease detection are given in Table 1.

2.2. Isolation and identification of bacterial and fungal pathogens

The roses showing disease symptoms were taken together with their branches, flowers and leaves, and isolated on nutrient agar (NA), King B (KB) media for identification of the bacterial agents. The isolates were stored at -20 °C until identification. Bacterial diagnostic tests, biochemical, morphological, physiological and molecular, were made according to Kovacs, 1956, Thornley, 1960, Klement et al., 1963, Lelliot and Stead, 1987; Klement et al., 1990; Bouzar et al., 1995; Schaad et al., 2001. In addition, the isolates were analyzed by MALDI-TOF MS technique.

Also, leaf, branch, shoot and stem samples were also taken for fungal agents and isolated on potato dextrose agar (PDA) medium (Warcup, 1958). Developed colonies were transferred to petri dishes containing fresh medium and pure cultures were obtained. All isolates taken from here to the skewed agar in tubes were examined microscopically and their microscopic diagnoses were made according to Barnett and Hunter (1972).

2.3. Pathogenicity tests of bacterial and fungal isolates

Pathogenicity tests were performed on Zwergenfee rose cultivar in 4 year-old according to Lelliot and Stead, 1987, Nameth et al., 1999 for the bacteria and Cai et al., 2009; Talgø and Stensvand, 2013; Li et al., 2017 for the fungi. Evaluations were made taking into account typical disease symptoms 30 days after inoculations.

2.4. Soil structure in landscape areas of Konya province

The results of the analysis of the existing soils in the landscape areas of Konya province are given in Table 2.

Accordingly, the soils where roses are grown are clay loam or loamy, alkaline, poor in organic matter, and chalky. These soils do not pose a problem for rose cultivation.

2.5. Meteorological characteristics of Konya province

In Konya province, summers are warm, dry and clear, and winters are very cold, snowy and partly cloudy, and the temperature varies between -4 and 31 °C throughout the year. The warm season is 3.3 months long and the hottest month is July; the highest temperature in this month is 30 °C and the lowest temperature is 17 °C. The cold season is 3.4 months long and the coldest month is January; In this month, the average low temperature is -4 °C, while the high temperature is 4 °C. The rainy season in Konya lasts for 7.8 months, from October 12 to June 7, and the rainiest month is December, with an average precipitation over 37 mm. The dry season starts on June 7 and the month with the least rain is August with an average of 0.8 days and at least 1 mm of precipitation (Table 3).

3. Results and Discussion

From past to present, roses are one of the most popular plants, not only for ornamental or aesthetic purposes, but also for religious, social, economic, health and cultural purposes, in short, they have an important place in our daily lives. In terms of their use, roses are not only indispensable for indoor spaces, but also have great importance in landscaping, garden art, plastic and phonetic art (Altıntaş, 2010; Quest and Ritson Quest, 2003; Özçelik and Orhan, 2014).

There are very few studies on the detection, prevalence and diagnosis of bacterial diseases in roses. Aysan and Şahin (2003) reported that *R. radiobacter* caused an epidemic in roses in the Eastern Mediterranean Region in the early 2000s in our country. Examining 6 different rose greenhouses in Adana and Mersin provinces, they observed that approximately 40% of them formed galls. Depending on the age and variety, seedling losses in rose varieties in rose nurseries in Kenya vary between 5% and 60% due to *R. radiobacter* (Maina et al., 2011). Tumor symptoms caused by *R. radiobacter* are frequently

encountered worldwide on roses (Gümrükçü and Gölkçü, 2005). Mohan and Bijman (2010) detected *P. s.* pv. *syringae* and *P. s.* pv. *morspurunorum* in their study on roses. Pernezny et al. (2008) investigated the susceptibility of rose cultivars against *Xanthomonas* spp. and reported that RADrazz and RADtco cultivars were more susceptible to the disease. In the province of Konya, *E. amylovora* was detected in different hosts belonging to the Rosaceae family at a rate of 67% in fire thorn, 100% in medlar, 80% in hawthorn and 27% in ornamental apple (Atasagun and Bastas, 2018). *E. amylovora* from *Rosa rugosa* has been isolated from Dachau and Miesbach in southern Germany (Vanneste et al., 2001). The Dutch Food Safety Authority observed symptoms of *Ralstonia solanacearum* on roses grafted on potatoes (Anonymous, 2015).

When the climatic data of the years 1998-2022 during the collection of roses showing symptoms of disease from the landscape areas of Konya province are examined, the monthly average maximum temperature increased from 18.49 °C to 20.28 °C and, the monthly total precipitation decreased from 32.30 to 25.92 (mm=kg). ÷m²). When these climatic data were examined in terms of the development criteria of pathogens, it showed that suitable environments for some new pathogens were formed (Table 4).

In our study, landscape roses were scanned in 106 different rose varieties in landscape areas in 298 different regions in Konya province between 1998-2022. Isolations were made from plants with wilting, yellowing, shoot blight, leaf spots, gall formation, root collar blight, discharge on roots and stems, swellings, flower blight, stem cracks and scar tissue on roses. After morphological, biochemical and molecular identification and pathogenicity tests, fungal and bacterial pathogens were identified for the last 25 years (between 1998 and 2022) are presented in Table 5.

Climatic changes are highly influential on host susceptibility or resistance to pathogens. As a result of climatic changes, about 250 new disease records have been created in ornamental plants and pathogens cause a serious problem (Waage et al., 2007). Another factor affecting plant health is the increase in the amount of CO_2. Increasing air pollution reduces the resistance of the plant and makes the plant susceptible to pathogens (Davies et al., 2011).

There is a dynamic relationship between plant diseases and regional climate and flora. Therefore, in order for phytopathogens to multiply and spread, the environment, host and pathogen must coexist under suitable conditions. Along with climate change, changes in air temperatures and seasonal extremes will cause new pathogens to disperse to different locations that will affect the spread of the pathogen, and will lead to changes on the epidemiology of many phytopathogens (Chakraborty and Newton 2011; Garret et al. 2011). Climatic factors, especially temperature, are important for the development of fungal and bacterial pathogens, and any change in temperature during the developmental stages of the pathogen affects the severity of infection and the duration of the pathogen to maintain its viability in the soil (Vary et al., 2015).

Temperature, humidity, precipitation and other factors affect the spread of the agents (Patterson et al. 1999). The increased amount of CO_2 will encourage vegetative development in plants; It will increase the moisture density between the leaves and this will cause rust, powdery mildew, cancer, bacterial exudate, leaf spots, blight symptoms on leaves, shoots and flowers (Manning and Tiedemann, 1995).

With the climate change, the moving of the areas where the plants spread to different locations causes the phytopathogens to be carried along with them (Cammel and Knight, 1992). Irregularities in precipitation regimes cause delays in the harvest date, and problems in pollination when it coincides with the flowering and pollination period. Due to prolonged rainfall, the moisture content in the leaves and soil increases, creating a suitable environment for plant pathogens (Anonymous, 2008).

As a result of unconscious irrigation in the areas where roses are planted, which need water in increasing hot weather conditions and dry conditions, the moisture rate in the leaves and soil increases, and accordingly, there is an increase in fungal and bacterial diseases in increasing intensity and in different species.

Disease prediction models based on meteorological data can help identify meteorological factors that are significantly associated with disease. Such disease prediction models can be combined with a general modeling to simulate future scenarios of disease outbreaks, although general epidemic models operate at larger resolution scales.

Considering the adverse environmental conditions due to climate change, this research can be a guide source because it is the first study thought to be done for fungal and bacterial diseases in roses. Our study, which was carried out by considering the differences on the basis of varieties, was carried out in the climatic values and soil characteristics of Central Anatolia. Disease development in rose varieties should be examined in other regions and countries similar to the climatic values in Konya conditions. In addition, preventing varieties that are sensitive to changing climatic conditions and disease factors from causing problems in terms of both visuality and cost necessitates the use of resistant varieties or the breeding of new rose varieties

Table 1
Rose varieties examined in terms of diseases in the landscape areas of Konya province

1	Abracadabra	28	Crimson F.c	55	Larissa	82	Rosenstadt Freising
2	Afrodit	29	Cubana	56	Lavender F.c	83	Rugelda
3	Alexandra	30	Diamant	57	Lemon F.c	84	Salita F.c
4	Amore F.c	31	Dornröscheschloss Sababurg	58	Lions Rose	85	Sangerhauser
5	Andolusian	32	Escimo F.c	59	Marango	86	Solero
6	Angel F.c	33	Flaming F.c	60	Mariandel	87	Sunbeam F.c
7	Angela	34	Foxy F.c	61	Memoire	88	Sunny
8	Apricot F.c	35	Garten Spass	62	Nicole	89	Tatiana
9	Bad Birnbach	36	Gebrüder Grimm	63	Patricia	90	Valencia
10	Bad Wörishofen	37	Gerber Engel	64	Pepita	91	Vulcano F.c
11	Blush F.c	38	Jugendliebe	65	Petticoat	92	Zwergenfee
12	Brillant	39	Königin Der Rosen	66	Planten Un Blomen	93	Sevillana (Meillant)
13	Cheryy Girl	40	Mon Petit Chou	67	Pompenella	94	Bahçe Gülü
14	Chica F.c	41	Neue Revue	68	Queen Of Hearts	95	Beverly
15	Cinderella	42	Champs Elysees	69	Romantic Antike	96	Lynda
16	Esmeralda	43	Reve De Paris	70	Adolf Horstmann	97	Laguna
17	Grafin Diana	44	Rayon De Soleil	71	Bingo Meillandecor	98	Eden Rose
18	Zepeti	45	Scarlet Bonica	72	Popcorn Drift	99	Donatella
19	Frıendly	46	Creme Chantilly	73	Cherry Bonica	100	Meryem
20	Pretty	47	Pink Double Knock Out	74	Sophia Romantica	101	Picasso
21	Livia	48	Double Knock Out	75	Abbaye De Cluny	102	Princess
22	Traviata	49	White Knock Out	76	Lady Romantica	103	Gülfem
23	Summertime	50	Sunny Knock Out	77	Ruban Rouge	104	Teodora
24	Michelangelo	51	Baie Des Anges Romantica	78	Salvador Dali	105	Vivald
25	Allegro	52	Princesse C. De Monaco	79	Harlequin	106	Sultana
26	Rustica	53	Harmonie	80	Zelal		
27	Laperla	54	Blue River	81	Rose Dot		

Table 2
Soil structure in rose-planted landscape areas of Konya province

Depth	Saturation with water (%)	pH	EC (mmhos/cm)	Salinity (%)	$CaCO_3$	Organic matter (%)	Class
0-30	49,5	7,69	1,4	1,5	49,33	0,94	CL
30-60	50,6	8,02	1,6	2	55,77	0,66	L
60-90	48,4	7,9	2,2	2,9	60,06	1,05	L

L; Loamy soil

CL; Clay loam soil

Table 3
Average meteorological data determined on months basis between 1929 and 2021 years in Konya province

	Jan.	Feb.	March	April	May	June	July	Agust	Sept.	Oct.	Nov.	Dec.	Yıllık
Avarage Temperature (°C)	-0.2	1.5	5.6	11.1	15.9	20.1	23.5	23.3	18.8	12.8	6.5	1.7	11.7
Average Maximum Temperature (°C)	4.6	7.0	11.8	17.5	22.4	26.7	30.2	30.2	26.0	20.0	13.0	6.6	18. 0
Average Lowest Temperature (°C)	-4.2	-3.3	-0.2	4.3	8.6	12.6	15.9	15.6	11.0	5.9	0.8	-2.3	5.4
Average Insolation Time (Hours)	3.3	4.6	5.9	7.2	9.0	10.7	11.8	11.4	9.7	7.3	5.3	3.2	7.4
Average Monthly Total Rainfall (mm)	38.1	28.5	29.3	32.0	43.1	26.1	7.5	6.4	13.5	29.5	32.2	43.2	329.4
Highest Temperature (°C)	19.9	23.3	28.9	30.9	34.4	36.7	40.6	39.0	38.8	31.6	25.4	21.8	40.6
Lowest Temperature (°C)	-28.2	-26.5	-16.4	-8.6	-1.2	1.8	6.0	5.3	-3.0	-8.4	-20.0	-26.0	-28.2
Daily Total Highest Rainfall (mm)						22.02.1945	73.7						
Daily Fastest Wind (m/sn)						18.04.2012	32.4						
Highest Snow (cm)						22.02.1945	66						

Table 4
Monthly average meteorological values between 1998 and 2022 in which disease detections were made in roses in the landscape areas of Konya province (Meteorology Regional Directorate of Konya)

Monthly Average Meteorological Values	Years (1998-2022)		Situation
Soil Temperature (°C) in 5 cm	12,80	15,40	2,6 (+)*
Soil Temperature (°C) in 10 cm	12,70	14,31	1,61 (+)
Above Ground Min. Temperature (°C)	1,48	1,95	0,47 (+)
Actuel Pressure (hPa)	899,82	898,38	1,44 (-)**
Max. Temperature (°C)	18,49	20,28	1,79 (+)
Min. Temperature (°C)	7,40	9,80	2,40 (+)
Temperature (°C)	12,51	14,93	2,42 (+)
Wind Speed (m÷sn)	1,43	1,18	0,25 (-)
Areal Precipitation (mm=kg÷m²)	32,30	25,92	6,38 (-)
Number of Rainy Day	7,50	6,80	0,7 (-)

* incresing

** decreasing

Table 5

Fungal and bacterial diseases on roses between 1998-2022 years and differences at the last 10 years in Konya province

Fungal Diseases (1998-2012)	Fungal Diseases (2013-2022)
Mildew (*Peronospara sparsa)*	-
Rust (*Phragmidium mucronatum*)	Rust (*P. mucronatum*)
Black spot (*Diplocarpon rosae*)	-
Powdery mildew (*Sphaerotheca pannosa* var. *rosae*)	Powdery mildew (*S. p.* var. *rosae*)
Gray mold (*Botrytis cinerea*)	-
Bacterial Diseases (1998-2012)	Bacterial Diseases (203-2022)
Crown gal (*Rhizobium radiobacter*)	Crown gal (*R. radiobacter*)
Bacterial blight (*Pseudomonas syringae* pv. *syringae*)	Bacterial blight (*P. s.* pv. *syringae*)
-	Bacterial blight (*P. s.* pv. *morspurunorum*)
-	Bacterial wilt (*Ralstonia solanacearum*)
Fire blight (*Erwinia amylovora*)	Fire blight (*E. amylovora*)
-	Bacterial canker (*Xanthomonas hortorum*)

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Physical Properties and Germination Characteristics of Black Carrot Seeds of Kırıkhan Local Cultivar in Ereğli District of Konya Province

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Field emergence

ABSTRACT

Black carrot production is an important agricultural activity for local farmers of Ereğli and Karapınar districts of Konya province. About 20% of the black carrots produced are used in turnip industry and 80% is used in concentrate production. The color value of black carrots of Kırıkhan local cultivar is higher than that of black carrots of Ereğli cultivar. Therefore, concentrate companies prefer the local cultivar of Kırıkhan in Ereğli and Karapınar Districts of Konya. In this study, some physical properties of black carrot seeds of local population of Kırıkhan cultivar were determined and seeds were sown at three different on-row seed spacings (2.5, 5 and 7.5 cm). Sowing was performed on ridges in three narrow rows as to have 7.5 cm between the rows and at a forward speed of 0.64 m s^{-1}. Average length values of the classified bare and coated black carrot seeds were respectively determined as 3.52 and 4.02 mm, geometric mean diameter values as 1.65 and 2.31 mm, sphericity values as 47.49 and 58.73%, thousand-seed weights as 2.20 and 6.67 g, germination rate values as 82.50 and 76.30%. Fracture resistance value of the coated seeds was measured as 4.89 Nmm^{-2}, water dissolution time as 18.48 s and one-seed ratio in coating as 96%. In field trials conducted at different sowing distances, average germination time of classified bare seeds and coated seeds were repectively determined as 9.40 and 9.18 days, germination rate index values as 1.688 and 1.547 [plant (m day)$^{-1}$] and the field emergence rate values as 54.15 and 52.39%.

1. Introduction

Carrot (*Daucus carota* L.) belongs to the genus Daucus with 22 species and it is the most important cultured member of the Apiaceae family. An estimated 13 sub-species of Daucus carota have been identified (Simon and Goldman, 2007). One of these sub-species is the cultivated carrot and the other twelve are wild forms that do not have a usable root structure.

Carrot grows in 60-150 days depending on genotype and environmental conditions and does not bloom during the vegetative life cycle (Simon et al., 2008). Climate and especially temperature have quite a significant effect on carrot production. The optimum temperature for germination is 10°C. The most suitable carrot color is formed at temperatures between 15.5 - 21°C and the product gets a bad color at temperatures below and above this range of temperature. The longest roots are also formed at these temperatures (Günay, 2005).

In Turkey in 2021, carrot cultivation was practiced on 100 686 da land area and there was a production of 590 483 tons. Konya Region has 49.56% of these production areas and meets about 60% of total production (TÜİK, 2022a).

In Turkey, carrots are mostly produced in Central Anatolia and Konya Region. Yellow carrot is produced in Kaşınhanı Region of Konya and black carrot is produced in Ereğli and Karapınar Districts. Black carrot production is also practiced in Kırıkhan District of Hatay Province. In this region, local population black carrot seeds of Kırıkhan cultivar are used. It was reported that Kırıkhan cultivar had greater anthocyanin content than the other black carrot cultivars (Anonymous, 2019). Kırıkhan Chamber of Commerce and Industry obtained geographical indication registration for "Kırıkhan Black Carrot" on November 18, 2022 (Anonymous, 2022b).

Black carrots have a purple color because of high anthocyanins content. These anthocyanins have high light, heat and pH stability and are preferred as natural food colorants. Therefore, it is used as a natural colorant in food, textile, cosmetics and pharmaceutical in-

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dustries as an alternative of synthetic colorants. Black carrot extracts are used for coloration of fruit juice, jelly, candies, jams, canned and frozen desserts, ice cream, soft drinks and other fermented beverages (Ersus and Yurdagel, 2007; Barczak, 2005)).

In Hatay Kırıkhan Region, black carrots are generally sown in August - September and harvested in January - February. On the other hand, in Konya Region, black carrots are sown in April - May and harvested in November - December. In both regions, usually local populations are produced. Depending on climatic conditions, growth season is around 120-140 days for Kırıkhan local population and 140-150 days for Ereğli local population. The color value of black carrots of Kırıkhan local population is higher than that of black carrots of Ereğli population. Therefore, concentrate companies prefer the local population of Kırıkhan in Ereğli and Karapınar Districts. Seed production of Kırıkhan population is also practiced in the region. Black carrot seeds used by local producers of the region are only subjected to a sieving; cleaning and classification (calibration) are not practiced at all.

Previous studies on black carrot cultivation have mostly focused on Ereğli local cultivar seeds (Bülbül, 2017; Örnek et al., 2018, Arıkaymak, 2021). However, there is no research on seeds of Kırıkhan cultivar in Konya Region. In this study, some physical properties of black carrot seeds of local population of Kırıkhan cultivar were investigated under field conditions of Ereğli District of Konya Province. Contrary to local practices, bare seeds were cleaned, graded (calibrated) and also coated before planting. Vacuum type pneumatic precision seed drill able sow at narrow row spacing was used and field emergence characteristics were evaluated at three nominal sowing distances.

2. Material and Method

In present experiments, black carrot seeds of Kırıkhan cultivar, commonly grown by local farmers, were used (Figure 1). Classified (calibrated) bare seeds were first passed through 1.75 to 1.25 mm oblong sieves and classified based on their specific gravity (T_1). The classified bare seeds were coated with a special recipe created by processing (subjecting to special processes) materials with different properties in twice the amount of seed mass (T_2).

Figure 1
Bare and coated seeds used in experiments

Three groups of 100 each were formed from both seeds and 100 seeds were randomly selected from them. Length, thickness and width values of the bare seeds and length and largest diameter values of the coated seeds were determined with the use of “Image Tool version 3.0” image analysis software.

Geometric mean diameter and sphericity values of the coated and bare seeds were calculated with the following equations (Mohsenin, 1970; Önal, 2011).

$Dg=(L\cdot D^2)^{1/3}$ (Coated seeds)

$Dg=(L.W.T)^{1/3}$ (Bare seeds)

$Ø=Dg/L.\ 100$

Dg: Geometric mean diameter (mm)

L: Length (mm)

D: Largest diameter (mm)

W: Width

T: Thickness

Ø: Sphericity (%)

For seed mass measurements, 1000 randomly selected seeds were counted in a Contador brand seed counting device in three replicates and their masses were weighed on precision scales and averaged.

ISTA 2018 norms were taken into account in the germination tests of bare and coated black carrot seeds and the tests were carried out in a climate cabin (Anonymous, 2018).

From the coated seeds, 100 seeds were randomly selected in three replications. Selected seeds were broken and the number of seeds and empty coatings were counted.

Again, from the coated seeds, 100 seeds were randomly selected in three replications. Selected seeds were placed in water and the dissolution time of the coating material was measured in seconds with a chronometer and the averages were taken (Özcan, 2019).

A biological material test device was used to determine the fracture strength of coated black carrot seeds (Öğüt ve Aydın, 1992). The device has a fixed top and movable base, drive unit and data acquisition system. The coated seeds were placed on the movable table of the platform and pressed against the 1.20 mm diameter fixed upper probe at a loading speed of 50 mm min^{-1} (Figure 2). The breaking force of the seeds was measured with a 1 N precision force dynamometer and data acquisition system. The fracture resistance value of the seed was determined by dividing the measured force value by the area of the probe.

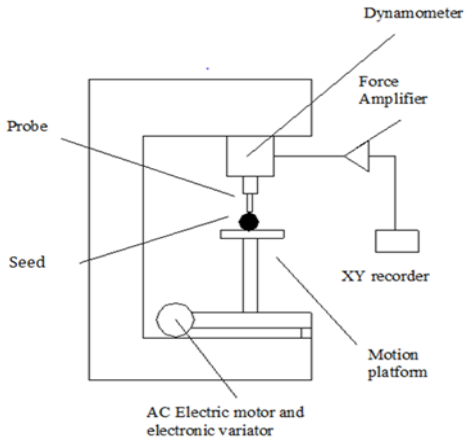

Figure 2
Biological material test unit

Field trials were carried out in Kuzukuyu neighborhood of Ereğli District in 2021. Experimental soils were loamy sand in texture with 86% sand, 4% clay and 10% silt. Soil pH was determined as 8.96, lime content as 39.2% and organic matter content as 1.31%.

In present experiments, a high precision vacuum type pneumatic precision vegetable planter with four planting units was used. Sowing was done in narrow row spacing with this seeding machine, and the schematic view of the unit, the used furrow opener and the planting disc is presented in Figure 3.,

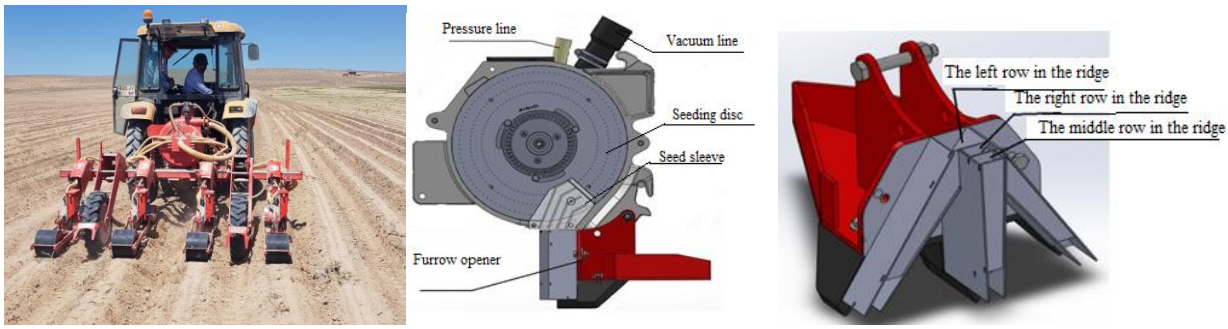

Figure 3
Pneumatıc precısıon planter (for vegetables and for small seed sowıng), schematic view of the unit and furrow opener

In the sowing process, a planting disc with a diameter of 235 mm and a thickness of 0.25 mm was used. There are 96 holes in the planter disc in the form of three rows. From the top row, the hole axes have diameters of 210, 185 and 155 mm. Although the linear velocity values of the three rows on the sowing disc are different, sowing is done at the same on-row plant spacing. In present experiments, planting discs with a hole diameter of 0.7 mm was used for calibrated bare seeds and a hole diameter of 1.2 mm was used for coated black carrot seeds of Kırıkhan cultivar. Sowing was carried out at an average vacuum pressure of 35 mbar and an air pressure of 15 mbar. In the present pneumatic precision seed drill, sheet metal pressure wheels were used in the front, rubber pressure wheels were used in the back and triple rubber pressure wheels were used in the middle.

From sowing (07.06.2021) to full germination (07.07.2021) of Kırıkhan black carrot seeds, daily average, minimum and maximum temperature values were respectively measured as 22.1 ^{0}C, 14.7 ^{0}C and 529.1 ^{0}C; mean, minimum and maximum soil temperature values at a depth of 5 cm were respectively measured as 29.6 ^{0}C, 24.4 ^{0}C and 34.9 ^{0}C and a total of 28 mm precipitation has occurred during this period (Anonymous, 2021).

Wheat was cultivated in experimental fields in previous year. Experimental fields were initially tilled with moldboard plow. Then, 50 kg da^{-1} DAP fertilizer was applied with a centrifugal fertilizer spreader and seed bed was prepared with a vertical spindle rototiller. Sowing ridges were formed with the use of a ridge making machine as to have 75 cm ridge distance 30 cm ridge width and 25 cm ridge height (Figure 4). The sowing process was carried out with a pneumatic precision vegetable sowing machine in three narrow rows on each ridge with 7.5 cm row spacing. On-row nominal sowing distances were 2.5, 5.0 and 7.5 cm. By taking into account the forward speed applied in farmer conditions, forward speed of the precision vegetable planter was set as 0.64 m s^{-1}.

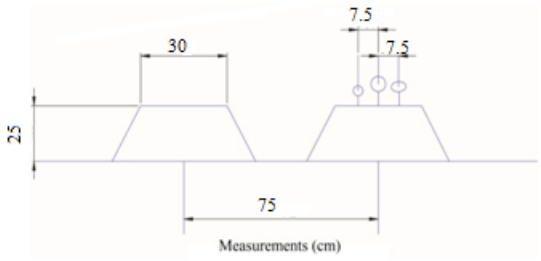

Figure 4
Schematic view of sowing ridge and dimensions (cm)

Irrigation water was supplied from a deep well and sprinkler irrigation system was used to apply

irrigation water to the land. In the sprinkler irrigation system used, the sprinkler and lateral spacing was arranged as 10x10 m. Average flow rate of the sprinklers was measured as 1.8 m^3 h-1. During the germination period, 8 sprinkler irrigations were applied to the experimental plots and a total of 432 mm of water was applied.

In present experiments, calibrated bare (T_1) and coated (T_2) local population standard black carrot seeds of Kırıkhan cultivar were used and sowing was practiced at three different nominal sowing distances (Z_1, Z_2 and Z_3). Experiments were conducted in "Randomized Blocks Design" with three replications. Plot length was 150 m and width was 2.8 m (350 m^2) and no space was left between the plots.

Soil samples were taken from the seed beds of randomly selected five plots at 0-5 cm, 5-10 cm and
10-15 cm depths in three replicates. Sampling cylinders made of stainless steel have a diameter of 5 cm and a volume of 100 $cm^{3.}$ Soil moisture content and bulk density values were calculated with the use of the following equations (Blake and Hartge, 1986).

$$W=\frac{M_W}{M_S} \text{ x } 100$$

W : Moisture content (dry-based) (%)
Mw: Mass of water in sample (g)
Ms : Oven-dried mass of sample (g)

$$P_b=\frac{M}{V_t}$$

P_b: Bulk density (g cm^{-3})

M: Oven-dried mass of sample (g)

V_t: Volume of sampling cylinder (100 cm^3)

Soil penetration resistance values were measured from the plots formed after the seed bed was prepared, from an empty ridge after the ridges were formed and from the footprint of pressure wheel on the ridge after planting. The base area of the cone used for this purpose is 2 cm^2 and the apex angle is 30°. The measuring range of the penetrometer is 0-250 N cm^{-2} and 5 measurements were made from randomly selected five plots.

To determine the germination values of the seeds, the carrot sprouts emerging to the soil surface were counted during the germination period from 1 m section of randomly selected three ridges of each plot. Following equations were used to calculate mean germination time (MET), germination rate index (GRI) and field emergence rates (FE) (Erbach, 1982; Isık et al., 1986).

$$MET=\frac{N_1.D_1+N_2.D_2+\ldots+N_n.D_n}{N_1+N_2+\ldots+N_n}$$

$$GRI=\frac{\text{Number of germinated seed in 1 m}}{MET}$$

$$FE=\frac{\text{Number of germinated seed in 1 m}}{\text{Number of seed planted in 1 m}}$$

N : Number of germinated seed in each counting

D : Number of days from seeding corresponding to N

MET : Mean germination time (day)

GRI : Germination rate index values [number $(m.day)^{-1}$]

FE : Field emergence rates (%)

The factorial (2x3) randomized plot design was used to examine the data (Düzgüneş et al., 1987). The GLM (ANOVA) procedure of MINITAB was used to conduct the statistical analysis. The Tukey test was used to determine the significant differences between the means. In all statistical analyses, the significance level was accepted as 0.05.

3. Results and Discussion

3.1. Seed physical properties

Some physical properties of seeds used in this study are provided in Table 1. The length, width, thickness, geometric mean diameter and sphericity values of the classified bare black carrot seeds at 3.53% moisture content were respectively measured as 3.52 mm, 1.56 mm, 0.86 mm, 1.65 mm and 47.49%.

Table 1
Physical properties of bare and coated black carrot seeds

Property	Bare seeds (calibrated)	Coated seeds
Moisture (w.b) (%)	%3.53	%4.97
Length (mm)	3.52±0.193	4.02±0.221
Width (mm)	1.56±0.092	-
Thickness (mm)	0.86±0.087	-
Maximum diameter	-	1.77±0.068
Geometric mean diameter (mm)	1.65±0.082	2.31±0.031
Sphericity (%)	47.49±2.031	58.73±0.808
Thousand-seed weight (g)	2.20±0.100	6.67±0.067
Germination ratio (%)	82.50±4.55	76.30±2.32
Fracture resistance (N mm^{-2})	-	14.89 ±0.601
Water dissolubility time (s)	-	18.48 ±2.12
Number of seeds in coating		
Empty seed ratio (%)	-	2.33±0.34
One-seed ratio (%)	-	96.0±0.58
Two-seed ratio (%)	-	1.67±0.33

Length, maximum diameter, geometric mean diameter and sphericity values of the coated seeds at 4.97% moisture content were respectively measured as 4.02 mm, 1.77 mm, 2.31 mm and 58.73%. Size characteristics of the coated seeds increased and the sphericity value increased by 1.24 times. Seed weights of the classified black carrot seeds of Kırıkhan cultivar increased with coating process and the average thousand-seed weight was determined as 2.20 g for bare seeds and 6.67 g for coated seeds. Germination rates of bare and covered seeds were determined as 82.50% and 76.30%. Certification conditions require the seeds to have a germination ratio greater than 75% (Anonim, 2022c). Differences in germination percentages of covered and bare seeds were at an acceptable level. Therefore, it was observed that sowing with seed coating was not an important factor that will make germinationdifficult.

The fracture resistance value of the coated seeds was determined as 14.89 Nmm^{-2}. This value is important for processing, packaging, transportation of the seeds, filling the seeds into the storage of sowing machine and not disintegrating the coating with the scraper effect. Dissolution of coating materials in water is a desired feature in coating processes. The less time the coating dissolves in water, the easier the plant emerge. Average water dissolution time of the coated black carrot seeds was found to be 18.48 s. Number of seeds in the coating is also an important criterion in coating studies. Seed consumption is especially important for the seeds to be planted with precision. In coated seeds, one-seed ratio was 96%, two-seed ratio was 1.67% and empty seed ratio was 2.33%.

3.2. Physical properties of seed beds

Bulk density and moisture contents of soil samples taken from seed beds before the formation of ridges are provided in Table 2. Bulk density and moisture levels were lower at 0-5 cm depth than at 5-10 and 10-15 cm depths. As the average of blocks, bulk densities at different depths were respectively measured as 1.42, 1.48 and 1.50 g cm^{-3} and moisture contents were measured as 7.56, 11.63 and 12.29% respectively.

Table 2

Bulk density and moisture content of soil

	Depth (cm)	I. Block	II. Block	III. Block	Average of blocks
Bulk density (g cm^{-3})	0-5	1.43	1.34	1.45	1.42
	5-10	1.48	1.46	1.51	1.48
	10-15	1.49	1.48	1.53	1.50
Moisture content (%)	0-5	7.79	7.85	7.03	7.56
	5-10	11.92	11.34	11.72	11.63
	10-15	12.27	12.12	12.49	12.29

The penetration resistance values measured in the seed bed are presented in Figure 5. The penetration resistance value measured at approximately 25 cm tillage depth exceeded 2 MPa. Higher bulk densities resulted in having higher penetration resistance since soil compaction is an indicator of bulk density

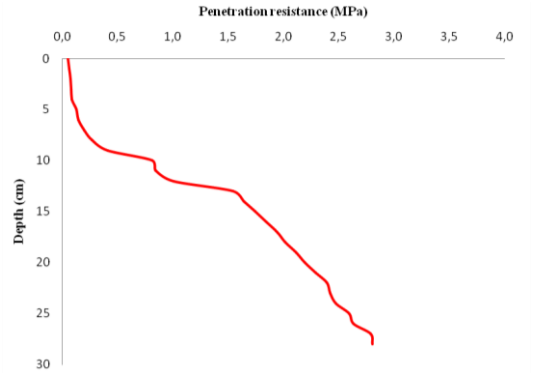

Figure 5
Penetration resistance curve for seed bed

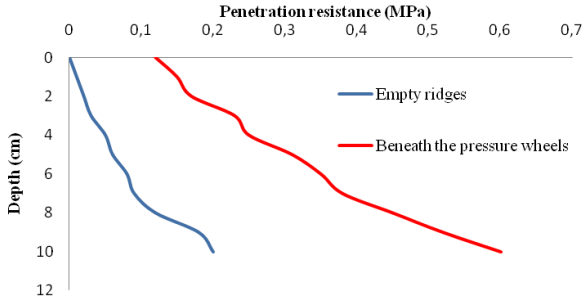

Figure 6
Penetration resistance curves for empty ridges and beneath pressure wheels

The penetration resistance values measured from the empty ridges and beneath the pressure wheels are presented in Figure 6. A penetration resistance of 0.15 MPa was determined at 1 cm sowing depth.

3.3. Seed germination parameters

Change in germination parameters with the experimental treatments is provided in Table 3.

Mean germination time (MET) was identified as 9.04 days for bare black carrot seeds (T_1) and 9.18 days for coated seeds (T_2). Although germination was completed later in T_2 seed due to coating, there was no significant difference between the mean germination times of the seeds. Fine-grained seed beds are known to form a sticky mud layer over the soil surface, thus eight time sprinkler irrigations were practiced throughout the germination period to keep the soil surface moisture and to prevent the formation of hard crusted layer. Such a case then resulted in having no difference between the average emergence times of the seeds. The mean germination time values decreased with increasing on-row seed spacing in both seed types. In T_1 and T_2 seeds, mean germination times were respectively measured as 10.67 and 10.53 days at Z_1 nominal planting distance, as 9.01 and 9.51 days at Z_2 nominal planting distance and as 7.43 and 7.49 days at Z_3 nominal planting distance. This difference in low nominal planting distance was

due to the higher planting disc circumference speed as compared to other planting distances. Seeds fall on the line at a higher speed, can be displaced in the line and change in depth, so the germination time values are prolonged. Bülbül (2017) found the mean germination time values of non-calibrated bare local population seeds of Ereğli cultivar as 18.82 days and 19.38 days in 2015 and 2016. Arıkaymak (2021) reported mean germination time of calibrated bare and coated local population black carrot seeds of Ereğli cultivar as 20.14 and 20.79 days. Low mean germination times of the present study could be attributed to seed cultivar and sowing time.

Maximum average germination rate index value was found to be 1.688 in T_1 seeds and 0.1547 [nummer (m day)$^{-1}$] in T_2 seeds. This difference was found to be significant. GRI values at Z_1, Z_2 and Z_3 nominal planting distances were determined as 1.672, 1.636 and 1.545 [nummer (m day)$^{-1}$], respectively and differences were found to be significant. High germination rate index values of T_1 seeds were mostly because of high field emergence rates and high germination rate index at low nominal planting distance was because of high number of plants per unit length. Örnek et al. (2018) determined the average ERI values of uncalibrated barse seeds at 22.36, 46.50 and 68.70 mm nominal planting distances as 1.007, 0.616 and 0.467 [plant (m days)$^{-1}$], respectively. Bülbül and Hacıseferoğulları (2016) conducted a study with different pressure wheels and reported germination rate index values as between 0.194 and 0.971 [nummer (m days)$^{-1}$]. Present germination rate index values were lower than those of the earlier studies. Such a case probably was resulted from low average mean germination time values of the present study.

Table 3
Germination parameters of base and coated black carrot seeds of Kırıkhan cultivar

		MET (day)	GRI [nummer (m day)$^{-1}$]	FE (%)
Seeds	T_1	9.04	1.688[a]	54.15
	T_2	9.18	1.547[b]	52.39
	SEM	0.1205	0.01872	0.6401
	P-value	0.429	0.000	0.075
On-row plant spacing	Z_1	10.59 [a]	1.672 [a]	35.50 [c]
	Z_2	9.26 [b]	1.636 [a]	5830 [b]
	Z_3	7.46 [c]	1.545 [b]	66.05 [a]
	SEM	0.1475	0.02293	0.7840
	P-Value	0.000	0.006	0.000
Seed x Spacing	T_1 x Z_1	10.67	1.759	36.84
	T_1 x Z_2	9.01	1.730	59.55
	T_1 x Z_3	7.43	1.573	66.07
	T_2 x Z_1	10.53	1.584	34.17
	T_2 x Z_2	9.51	1.542	57.06
	T_2 x Z_3	7.49	1.516	63.93
	SEM	0.2087	0.03242	1.1087
	P-Value	0.329	0.124	0.468

[a, b]Means with different superscripts within a column differ significantly ($P<0.05$), SEM: Standard error means, T_1: Calibrated bare seed, T_2: Coated seed, Z_1, Z_2 and Z_3 nominal sowing distances, MET: Mean germination time; GRI: Germination Rate Index; FE: Field emergence rate

Field emergence rates (FE) were found to be 54.15% in calibrated bare seeds (T_1) and 52.39% in coated seeds (T_2) (Table 3). The lowest field emergence rate (35.50%) was obtained from Z_1 nominal planting distance, 58.30% from Z_2 nominal planting distance and 66.05% from Z_3 nominal planting distance. On-row seed distance parameter was found to be significant. Such a case was due to the reduction in transmission ratio of the pneumatic precision vegetable seed drill, as well as the reduction of disc circumferential speed. Similar relationships were also reported by Tasbas (1994) for maize seeds, by Hacıseferoğulları (2005) for sugar beet seeds and by Bülbül (2017) for black carrot seeds. Bülbül and Hacıseferoğulları (2016) conducted a study with pneumatic precision vegetable planting machine with rubber pressure wheels in the front and back and three narrow rubber wheels in the middle and reported germination rate values as between 33.33 - 48.07%. Örnek et al. (2018) conducted a study at 0.84 m s^{-1} forward speed of pneumatic precision vegetable seed drill and at 22.36, 46.50 and 68.70 mm nominal planting distances and reported field emergence rates as 55.24%, 49.17% and 54.42%, respectively.

Interactions did not have significant effects on any of the investigated germination parameters.

4. Conclusion

In Konya Ereğli Region, Kırıkhan local cultivar seeds yielded satisfactory outcomes for field emergence characteristics. Local seed producers do not produce seeds under primitive conditions and the seeds used vary from producer to producer. Therefore, training should be provided to seed producers. Classification (calibration) of these seeds and sowing them by coating will increase sowing regularity and quality criteria. When sowing calibrated bare seeds, the top row holes of the disc cannot be singled effectively. This is because the rows of holes are singled through a whole singling unit. Research should be done on the singling organ of the domestically made pneumatic precision vegetable planting machine used in this study. Studies should also be carried out on planting disc hole diameters based on seed type. Research should be done by planting this seed as a second crop in the region.

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Evaluation of Turkey's Agricultural Support Policies in Terms of World Trends

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ABSTRACT

The agricultural sector seems to be overshadowed by the services sector in the globalizing world, but it still maintains its importance. Because agricultural products will continue to meet the basic needs of countries in the future as they do today. The most important problem faced by the sector, which is so important, is that it is overly affected by climatic conditions and the low income of the farmers operating in this field. Because of these features, agriculture has been a sector supported by various tools. The aim of this study is to reveal the evaluation of Turkey's agricultural support policies in terms of world trends implemented the world and to make necessary inferences by evaluating Turkey's agricultural support policies in terms of world trends in this context. For this purpose, agricultural support policy trends of the EU and USA were examined in this study. The main material of this study consisted of previous studies on the subject and material obtained from the web pages of the relevant institutes. The study was carried out as a compilation of studies containing analyzes and thoughts about the current situation and future of agricultural support policy trends in line with the determined purpose. Of the observed countries, only the United States has a positive CSE, that meaning its consumers are not taxed. On the other hand, Turkey recorded the highest negative CSE values in the observed period, which means that Turkish consumers are taxed the most.

1. Introduction

The agricultural sector is important for both developed and developing countries. This importance is due to the unique characteristics of agriculture. Also is an important sector in terms of contributing to a country in terms of labor, product and market, capital, and foreign exchange, as well as bringing balance to the state budget. The contribution of the agricultural sector to GDP in Turkey shows a decreasing trends. While the contribution of the agricultural sector to GDP was 9.03% in 2010, it decreased further in 2019 to 6.4%. In the EU, while the share of the agricultural sector in national income was 2.7% in 1991, it has decreased below 2% since 2005 (World Bank, 2020). Accordingly, while the share of the sector in GDP in the EU was 1.62% in 2010, it increased to 1.64% in 2019. The added value of agricultural production in Turkey reached 66.3 billion dollars by 2021. While agricultural production corresponded to 10.8% of GDP in 1995, this share decreased to 5.9% by 2021.

The history of agricultural support in the world dates back to BC it's seen that in the 18th century BC, it was supported by the storage of grain crops in Egypt and its supply in scarce periods. When we look at Europe's continent, the history of support goes back to the 19th century. It was supported by the maize Law enacted in England in 1815 (Anonim, (2016a). In the first quarter of the 1900s, as a result of the World Economic Depression that broke out in 1929 after the First World War, many countries took measures in order to encourage the increase in agricultural production. Agricultural support definition by OECD Total Support Estimate (measured as a percentage of GNP), Producer Support Estimate (measured as a percentage of gross farm income), Consumer Support Estimate (measured as a percentage of agricultural consumption), General Services Support Estimate (measured as a proportion of gross farm income), and also it includes 4 support estimates (Anonim, 2016b). After that, as can be seen, agricultural support is a concept that is given to producers and has a monetary function. According to 2014 published data by OECD, the Producer Support Estimate is 22.56% in Turkey, 18.36% on average in European Union (EU) countries, 9.8% in America, 0.99% in New Zealand, 58.37% in Norway (Anonim, (2016b). In other words, 22.56% of the 1100-unit income created for a producer in Turkey

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is given to the producers by the state, and the remainder is obtained by the producer. Almost every country in the world supports agriculture and takes it under some protection and each country in the world supports its farmers within limits of the possible (Arisoy, 2020).

In the European Union, roughly 77% of agricultural support of 56 billion Euros consists of direct payments, 20% of rural development expenditures, and 3% of market measures. In the United States of America, 79% of the budget of the last (2014-2020) Agriculture Law (Farm Bill) close to one trillion dollars is to the supplementary food support program as consumption support, 9% to crop insurance supports, 6% to crop supports, 5% is spent on protection supports, and 1% on other programs. While in Turkey Direct agricultural support has increased continuously in the last sixteen years, from approximately 1.8 billion TL in 2002 to 21.96 billion TL in 2020, and the livestock support within these supports has increased from 83 million TL to approximately 4 billion TL (Semerci et all, 2020). In addition to the increasing food demand, developments in food technologies and studies in the field of biotechnology have caused large-scale capital companies to invest in the sector. A country that wants to keep the agriculture sector alive, feed its population, and compete in the world markets has to maintain support, protection, and incentive practices in the agricultural sector (Yorgun, 2006). Agricultural support policies implemented in Turkey are carried out by using tools such as support purchases, input supports, low-interest agricultural loans, milk incentive premium payments, natural disaster payments, limitation of cultivation areas, and support premiums payments. With market price support, which has been the most widely used support tool in the past, the Council of Ministers determines the price at which any product will be purchased and determines the institution to purchase. In addition, methods such as agricultural infrastructure investments, research, education and publication, investment incentives, incentives for foreign trade, and sometimes import protection are used (DPT, 1999). In addition, when the agricultural policy is mentioned, agricultural support policies usually come to mind. However, apart from support, agricultural policies include agricultural environment, rural development, agricultural extension, agricultural law, cooperatives, etc and as well as areas of interest.

In this study, while considering the agricultural support trends in the world and the problems of the agricultural sector, the agricultural support policies in Turkey were evaluated and suggestions were made for agricultural support policy trends. In order to do this, the developments in the world and in Turkey, especially the changes in the agricultural support policy trends in the EU, and the USA have been examined and evaluated, especially the studies that are critical on this subject. The reasons for the selection of these countries are that the EU, USA, and China have a large place in the world agricultural products market, and the agricultural sector of China has been in the world economy in recent years. This is due to the fact that there is a visible vitality in the agricultural sector due to their prominence.

2. Materials and Methods

The main material of the study consists of scientific studies that evaluate agricultural policies in particular. Basically, domestic and foreign literature on support policies was used. In addition, the publications of the official institutions of the countries within the scope of the study and the official institutions in Turkey were used. Also, official data obtained from the units of the Ministry of Agriculture and Forestry in Turkey on agricultural support, the Turkish Statistical Institute (TUIK), the Organization for Economic Cooperation and Development (OECD), the European Union (EU), and the United States of America (USA) were used. In terms of a detailed evaluation of agricultural support policies, the time series of 2010 and 2021 were used. The fluctuations and changes in these series are interpreted to evaluate the policies in practice.

This study is a review study. New information cannot be reached by collecting original data or analyzing existing data with a method. By examining the previous scientific studies on the subject, inferences for the purpose of the study were tried to be made. It is assumed that the agricultural support policies in Turkey should be designed in accordance with the trends in the world and that these trends should be followed closely and implemented by adapting them to the conditions of the country. In fact, in order to be one step ahead, it has been tried to present predictions about what Turkey's agricultural support policies should be, with shortcuts for the future.

3. Findings

3.1. Agricultural Sector in The World

In order to better understand the importance of the agricultural sector, it is necessary to examine the share of agriculture in macroeconomic variables. In this context, the share of GDP, employment, and agriculture are mentioned below in light of Turkey and world data. It is possible to reveal the place and importance of the agricultural sector in the economy with a number of economic indicators. The shares of sectors in GDP play an important role in measuring the performance of the economy (TİM, 2016). According to the data from the World Bank, the total world GDP in 2020 was approximately 84.71 trillion dollars. On the basis of sectors, it is seen that the agriculture sector has made approximately 3.5 trillion dollars, the industrial sector approximately 23.5 trillion dollars, and the service sector has contributed the most with approximately 59 trillion dollars. According to the data of the World Bank, in 2018, 24% of the world GDP was in the USA, 21% in the EU, 15% in China, 6% in Japan, and 1% in Turkey.

The economic performance of the sectors is evaluated by their share in GDP. Agriculture has been the sector that was at the center of the economy until the

industrial revolution, but with the industrial revolution, the central position of agriculture in economic life began to lose its importance and its share in the economy decreased over time. Depending on the developments in the industry and service sectors, the share of the agricultural sector in GDP has decreased (Acar & Aytüre, 2014). In figure 1, the sectoral distribution of GDP in the world was given.

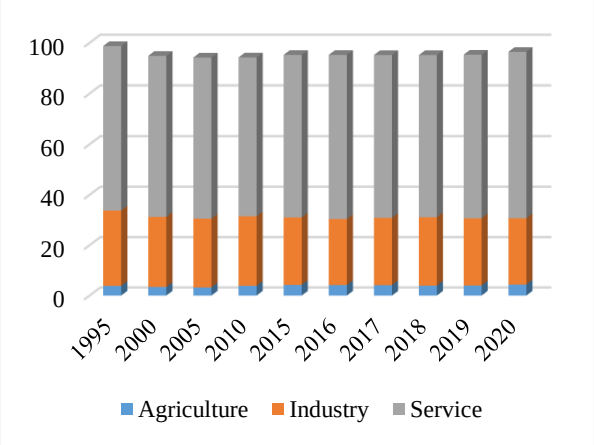

Figure 1
Distribution of World GDP by Sector (%), (Source: World Bank, 2022)

According to World Bank data, while Turkey's GDP in 2018 was approximately 778.4 billion dollars, it was realized as 720.1 billion dollars in 2020. On the basis of sectors, the agricultural sector was worth about 66 billion dollars, the service sector was worth about 542 billion dollars, and the industrial sector was worth about 280 billion dollars. It is seen that the agricultural sector is the sector that creates the least added value. However, in 1927, the agricultural sector comprised 60% of the GDP.

Turkey was an agricultural country in those years. While the industry sector was 10-11%, the service sector made up the rest (Bülbül, 2010). Until the 1950s, the share of agriculture in GNP was above 50%, and in the following years, this share decreased relatively. In 1960 it was over 30%; In the 1970s-80s, it was between 20-25% (Kepenek, 2012). In figure 2, the sectoral distribution of GDP in Turkey is given.

When Figure 2 is examined, it is seen that the share of agriculture in GDP decreased to 15% in 1995 and to 6.6% in 2020. In short, the share of agriculture in national income in Turkey has tended to decrease since 1950. It is observed that the agricultural sector is in decline, while the service sector has become the center of the economy.

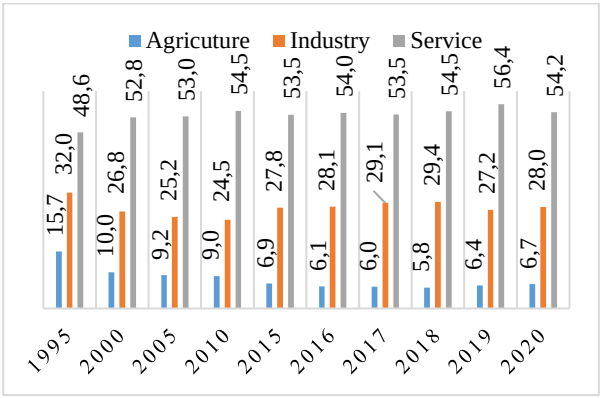

Figure 2
Sectoral Distribution of GDP in Turkey (%), (Source: World Bank, 2022)

This shows that the development rate of other sectors is higher than that of the agricultural sector. The figures above show the changes in the shares of three main sectors in GDP in the world and in Turkey. The share of the agricultural sector in GDP can be used as a measure to show the development level of countries. In this case, the agricultural GDP of various countries is given in Table 1.

Table 1
Agricultural GDP in Various Countries (2020)

	Country	Agricultural GDP (Million Dollars)	Share of Agriculture in Total GDP (%)	Share in World Agricultural GDP (%)
Developed countries	EU (28)	224.653,76	1,66	6,13
	USA	259.076,10	1,06	7,07
	Australia	82.801,82	2	2,26
Developing countries	Chinese	1.095.786,03	7,69	29,93
	India	431.169,34	18,23	4,98
	Indonesia	136.665,25	13,7	3,74
	Turkey	67.771,12	6,68	1,82
Less developed countries	Kenya	15.523,04	22,6	6,18
	Ethiopia	29.006,25	35,5	9,71
	Uganda	9.280,94	23,93	Haz.54
World		3.659.981,77	3,94	1,07

Source: World Bank, 2022

According to Table 1, the countries with the highest share of world agricultural GDP can be listed as China, Ethiopia, and the USA. These countries make the highest contribution to the world's agricultural GDP. The very low rate of agricultural GDP in the EU reveals the level of development of the country. When the agricultural GDP share of other developed countries is considered, it is seen that it is at very low levels. In other words, the share of agriculture in GDP is low in developed countries. In developing countries, the share of agricultural GDP is higher than in developed countries. Turkey, which is in the category of developing countries, has a lower share of agricultural GDP than the countries in the same category but is quite high compared to developed countries. It contributes 1.07% to the world GDP. In underdeveloped countries, the share of agricultural GDP is quite high, but its contribution to world agricultural GDP is quite high. This means that as the level of

development of countries increases, the share of agricultural GDP decreases.

4. General Trends of Agricultural Support Policy in the World

Agricultural policy is one of the economic regulation priorities all over the world. So the importance of this immanent component of economic policy is determined by the importance of the agricultural sector in the social and economic life of mankind, as well as the high degree of involvement of all countries in the global trade in agricultural products. Therefore, examining the historical developments of agricultural policies will provide a good understanding of the structure of the current agricultural policy and the policies that are planned to be implemented in the future. Therefore, before examining current agricultural policies, was tried to reveal what kind of developments in agricultural policy trends were implemented in the past of some selected countries.

4.1 EU Agricultural Support Policy Trends

European Union countries, agricultural policies, and agricultural supports aim to increase farmers' production, and farmer's incomes to keep agricultural production resources in agriculture, to support family businesses in order to survive by obtaining sustainable income and to ensure food security and safety of the society. In the European Union, approximately 77% of agricultural support of 56 billion euros is made up of direct payments, 20% of rural development expenditures, and 3% of market measures (OECD, 2022).

While the Common Agricultural Policy has been the agricultural policy framework of the European Union since its establishment in 1962, the composition of policy instruments has evolved significantly over time (Table 2). The first major reform of the Common Agricultural Policy took place in 1992, with conferences and negotiations on the General Agreement on Tariffs and Trade (GATT) and following the conclusion of the US-EU soybean board (Grant, 2020). The MacSharry Reform conveyed a major shift in how the public sector provides support to agriculture. Rather than supporting production (through intervention purchases and export subsidies), management has turned to directly supporting farmers' incomes, closing the gap between supply and demand, and reducing overall spending (European Parliament, 2021). This was followed by Agenda 2000 reform, which focused on reconciling EU and world prices, offsetting the decline in price support with increased direct assistance to producers (European Parliament, 2021). Subsequently, the 2003 Fischler Reform[2] further developed and consolidated these measures. And it saw the introduction of a single payment scheme (SPS), which separates most support from production (European Parliament, 2021). Reform programs for certain commodities (cotton, hops, olive oil, tobacco, sugar, fruit and vegetables, and wine), reducing corrupt payments and market-based incentives (OECD, 2011).

Then, measures were taken as part of the 2009 Health Check, which was necessary to continue the direction of the 2003 reform. It also further reduced market intervention for a number of agricultural products, eliminated set-offs, and phased out milk quotas (OECD, 2011). The 2013 Reform introduced a more global, integrated approach to agricultural support, undertaken through four lines of action, listed as follows (European Parliament, 2021):

1) Conversion of disaggregated help into a multifunctional support system with targeted assistance. Accordingly, the single payment scheme was replaced by a system of disaggregated payments with seven components: (a) a basic payment; (b) a greening payment for environmental public goods; (c) an additional payment for young farmers; (d) a 'redistributive' payment for first hectares of farmland; (e) support for areas with specific natural constraints; (f) aid coupled to production; and (g) a simplified system for small farmers.

2) Consolidation of the two pillars of the Common Agricultural Policy with market measures, mostly unbundled direct subsidiary and financed through Pillar 1, and rural development co-financed by Member States, financed through Pillar 2.

3) Consolidating Common Market Organisation tools into safety nets in case of market disruption or price crisis, and ending other supply control support measures, namely the sugar and milk quotas.

4) A more integrated, targeted and regional approach to rural development, including simplification of available tools to focus on specific key objectives. On 27 November 2020, a political agreement was reached in the Council between the European Parliament and the EU Member States on the transitional rules of the Common Agricultural Policy 2021-22. These transitional rules are based on the continuity of the Common Agricultural Policy 2014-2020.

Policy rules also incorporate new elements to ensure a smooth transition. From 2023-27, existing Pillar 1 and Pillar 2 systems will be included in the national strategic plans of the Member States' Common Agricultural Policy, although with an annual budget similar to the transition period. At the same time, the Common Agricultural Policy expenditures as a percentage of the total EU budget fell significantly, from 65.5% in 1980 to 35% in 2020.

Table 2. EU: Agricultural policy trends

Years	Main Milestones	Key policy features
Pre-1992	Coupled support phase Common Agricultural Policy financed by the European Agricultural Guidance and Guarantee Fund (EAGGF), European Union expansion to 15 members	Support prices are higher than world prices. Unlimited purchase guarantee Production quotas for certain products, including milk and sugar.
1992-1999	MacSharry Reform Common Agricultural Policy, EU Expansion 1995 (Austria Finland, Sweden), Uruguay Round Agreement on Agriculture	A shift from crop support through prices to producer support through income-supporting measures, with the reduction in intervention prices, offset by increased direct aid or per-hectare animal payments.
2000-2001	Agenda 2000 CAP Reform: Common Agricultural Policy (Rural Development) is divided into Pillar 1 and Pillar 2	Further lowering of EU market support prices in closer alignment with world prices. It is offset, in part, by direct assistance to producers in the form of the initial introduction of mandatory environmental cross-compliance.
2003-2008	Fischler Reform: Pillars 1 of the Common Agricultural Policy (funded by EAGF) and (funded by the European Agricultural Fund for Rural Development EAFRD), Enlargement of the EU 2004 (Malta, Cyprus[1], Estonia, Latvia, Lithuania, Poland, Czech Republic) , Slovakia, Slovenia, Hungary), and 2007 (Bulgaria and Romania)	Decoupling much of Common Agricultural Policy support from the volume of production, with a constant single farm payment (SPS) introduced based on historical references. Cross-compliance with environmental and public health objectives is Mandatory for receiving full payments. Single common market organization (CMO) reform programs launched for cotton, hops, olive oil, tobacco, sugar, fruit, vegetable, and wine regimens
2009-2013	Health Check Common Agricultural Policy Pillars 1 and 2	Further reduction of EU market intervention for certain products, Phase-out of milk quotas, Unbundling, Integration of almost all payments into SPS, New cross-compliance requirements introduced
2013-present	2013 Reform. Common Agricultural Policy Pillars 1 and 2, EU Expansion 2013 (Croatia) and Contraction 2020 (United Kingdom)	Support converted to discrete assistance or multifunctional support (including basic payment, greening payment, small farmer payment, etc.). Consolidation of direct payments and market measures and two pillars of the Common Agricultural Policy under the two pillars of Pillar 1 and Pillar 2.
2021-2022	Transitional rules	Continuity of the 2014-2020 CTP rules and incorporation of new elements to ensure a smooth transition

Source: (European Parliament, 2021); (OECD, 2011)

4.1.1. EU agricultural support

Support for agriculture in the European Union, one of which is measured by the PSE producer support estimate, is close to the OECD average. EU support to producers as a percentage of gross farm receipts stabilized in 2010 at 19.2% since it started to fall to its lowest level in 2021 at 15.9%. Policy reforms over the past three decades have significantly reduced support for the industry and transformed the composition of support into less disruptive measures to production and trade. Another support measurement indicator used by the OECD to aid policy analysis is the Consumer Support Estimate (CSE). As a result of the policies implemented within a year, the Consumer Support Estimate is obtained by calculating the margin consisting of the difference between the price at which the consumer reaches the agricultural goods and the market price that should be (Anonymous, 2008). When Table 3 is examined, it is seen that the EU's Consumer Support Estimate has negative percentage values. This means; refers to the relative tax imposed on the consumer. General Sector Service Expenses (GSSE) in 2019-21 averaged 12% of total support. While the relative importance of GSSE has slightly decreased over the past two decades, the composition of GSSE spending has changed. Spending on agricultural knowledge and innovation systems grew by nine percentage points to 51% of total spending in 2019-21. TSE's total support to the sector has decreased in relative terms in the last 20 years. In 2019-21, total support was estimated at 0.7% of GDP, compared to 1.0% in 2010-11.

Table 3. EU agricultural support by using Organization for Economic Cooperation and Development (OECD; 2022).

EU agricultural support EU- OECD - Total								
Years	Producer support (PSE), Million Euros	Producer support (PSE), % of gross farm receipts	Consumer support (CSE), Million Euros	Consumer support (CSE), % of agricultural consumption	General services support (GSSE), Million Euros	General services support (GSSE), % of total agricultural support	Total support (TSE), Million Euros	Total support (TSE), % of GDP
2010	188 393	19.2	75 724	-8.6	35 084	13.73	338 542	0.747
2011	186 655	17.8	76 773	-7.3	35 173	13.76	355 384	0.729
2012	207 695	18.2	84 910	-7.9	36 780	13.04	362 419	0.745
2013	187 198	16.9	89 526	-6.1	38 032	14.47	348 968	0.709
2014	180 789	16.4	78 194	-5.8	33 483	13.37	332 362	0.661
2015	198 856	17.0	84 977	-6.1	37 486	13.41	310 004	0.655
2016	205 281	17.8	86 240	-7.2	38 830	13.52	317 645	0.655
2017	198 457	16.9	87 183	-6.8	39 654	14.16	315 619	0.624
2018	203 196	17.6	92 504	-7.2	38 301	13.62	331 965	0.621
2019	217 893	18.1	93 906	-7.0	39 687	13.29	334 155	0.619
2020	221 527	18.2	91 254	-5.7	40 425	13.21	348 628	0.665
2021	207 477	15.9	82 848	-3.6	37 015	12.38	353 518	0.612

Source: OECD;2022

4.1.2. EU Domestic policy developments

EU members' agriculture and rural development budget in 2021 was €55.71 billion ($65.5 billion), a small increase of €310 million21 compared to 2020. Total expenditure under Pillar 1 was €40.4 billion ($47.5 billion), with €15.3 billion ($18 billion) (23.2%) and 76.8% allocated to Pillar 2. , The European Commission presented an Action Plan for the development of agricultural production (EC, 2021) on March 23, 2021. Its overall goal is to increase the production and consumption of organic agricultural products, to reach 25% of organic farmland by 2030, and to improve aquaculture. is to increase significantly.

23 actions have been proposed to ensure balanced growth in the sector, which is structured around three axes: increasing consumption, increasing agricultural production, and improving the sustainability of the agricultural sector. Some EU Member States have also announced initiatives or support for their national agricultural sectors. For example, Denmark has allocated Danish Kroner 3.6 billion (€484 million, US$569 million) to support farmland to help with its goal of doubling farmland by 2030. Its strategy with aim of doubling domestic consumption and agricultural exports.

4.2. USA Agricultural Support Policy Trends

The United States is one of the most important producers of agricultural commodities in the world, and have a large domestic market, and also it is the world's largest exporter of agricultural products. An omnibus legislative set of packages known as the Farm Bill primarily governs agricultural policy support in the United States. In the United States of America, 79% of the budget of the last (2014-2020) Agriculture Law (Farm Bill) is close to one trillion dollars and is to the supplementary food support program as consumption support, 9% to crop insurance supports, % to crop supports. 6, 5% is spent on protection support, and 1% on other sector programs (OECD, 2022).

Farm Bills let authorize agricultural and food policies in areas including nutrition assistance, crop insurance, commodity support, conservation, and agricultural research. Historically, the commodity support component of Farm Bills has focused on stabilizing and increasing farm income through price and income support for a particular group of commodities, including but not limited to corn, and soybeans, to aid economic recovery and development during the Depression and post-war periods, wheat, cotton, rice, peanuts, dairy products, and sugar (OECD, 2011).

Reforms continued and followed with subsequent Farm Bills. The 1996 Farm Bill reformed income support programs by replacing target prices, price-based deficit payments, and acreage controls with historically based direct payments independent of current agricultural production. The 2014 Farm Act ended these direct and countercyclical payments, but continued direct income support to farmers based on historical production, with programs that triggered payments based on reference prices or income criteria. Like this, it also ended the dairy price support program, by replacing it with a premium - based milk - to feed margin protection program. The 2018 Farm Bill continued these programs with only small adjustments (Table 4).

The largest of the farm programs in the Farm Bill is the Federal Crop Insurance Program (FCIP), which was established in the 1930s in order to cover yield losses from most natural causes. The program's current form was authorized by the Federal Crop Insurance Act of 1980 and then modified by subsequent Farm Bills and another legislation program.

The 1980 Act introduced federal premium subsidies program and brought in private insurance companies (Approved Insurance Providers, or AIPs) in order to deliver crop insurance policies. Followed by the catastrophic (CAT) coverage level was created in 1994, under which 100 % of the premium is subsidized and products pay a fee for coverage of yield loss greater than 50 % at 55 % of the base commodity price. It also followed the Agricultural Risk Protection Act of 2000, which expanded the geographically determined availability of insurance, increased premium subsidy levels, and lifted restrictions on livestock insurance products.

Table 4
United States: Main agricultural policy trends

Period	Framework	Changes in agricultural policies
1980	Federal Crop Insurance Act of 1980[1]	Introduced federal premium support for crop insurance (30% at the 65% coverage level) Created a public-private partnership with private insurance companies (Approved Insurance Providers), who became responsible for offering crop insurance policies crops
1985	Food Security Act of 1985	Marketing loans were created for cotton and paddy, market price support elements were removed from cotton and rice commodity loans, and Export Establishment. Development Program and Dairy Export Incentive Program. Established the Conservation Reserve Program (CRP)
1990	Food, Agriculture, Conservation, and Trade Act of 1990	Introduced 15 % " normal flex acres " and 10 % " flexible turning on demand. Marketing credit provisions were expanded to oilseeds in 1991 and to wheat and feed grains in 1993. Oilseeds and alternative crops were allowed to be planted on the land without loss of payment on the 0/85-92 schedule.
1994	Federal Crop Insurance Reform Act of 1994	Catastrophic crop insurance (CAT) coverage level set Higher premium subsidies (purchase coverage) for higher coverage levels

Table 4 (continue)
United States: Main agricultural policy trends

1996	Federal Agriculture Improvement and Reform Act of 1996	Crop shortage payments and benchmark prices have been replaced by fixed direct payments that are decoupled from current prices and production levels that will decrease over time. Removed most planting restrictions. Extended marketing credit provisions for most other covered crops and Alternative Direct Credit Deficiency Payments (LDP)
2000	Agricultural Risk Protection Act of 2000[1]	It expanded the geofigureic accessibility of crop insurance, increased premium subsidy levels, and lifted restrictions on the development of livestock insurance products.
2002	Farm Security and Rural Investment Act of 2002	Annual declining Production. Flexibility Contract payments have been replaced by a fixed Direct Payments program. Created a Counter-Circular Payments program that triggers additional direct income support payments when prices fall below targets.
2008	Food, Conservation, and Energy Act of 2008	Direct Payment Retained, Countercyclical Payment, and Marketing Assistance Loan programs. Established Average Crop Revenue Election (ACRE) as an income-based alternative to the Countercyclical Pay Program Milk price support program baseline changed from milk price to dairy prices
2014	Agricultural Act of 2014	Agricultural Risk Coverage (PLC) and Agricultural Risk Coverage (ARC), which created the repealed Direct Pay, Countercyclical Payment, and ACRE programs: Additional Cover Option (SCO) Stacked Income Protection Plan (STAX) for American cotton, Extended Uninsured Crop Assistance Program (NAP)) Reconstructed protection conditionality requirements.
2018	Agriculture Improvement Act of 2018	Continued and followed by 2014 Farm Bill programs with only minor changes, with some additions to programs for specialty crops, organic farmers, local and regional markets, and beginning, a military veteran and minority farmers.

Crop insurance law.
Source: Congressional Research Service (2018), OECD (2011; 2014 201951), USDA ERS (2020).

4.2.1. USA Support for agriculture

In the USA, the support provided to agricultural producers is below the OECD average. Producer support was on average 11% of gross revenues in 2019-2021, well below 20% measured in the mid-1980s and early 2000s, but higher than a decade ago. The share of the most potentially distorting transfers was 25% in 2019-2021, also below the OECD average, and half of its maximum value. The prices received by farmers in 2019-21 were 3% higher on average than in the world market, while they had been 11% higher in 2000-2002. US domestic food assistance programs that support consumers account for nearly half of total support to US agriculture Expenditures for general services (GSSE) were equivalent to 2.6 % of the value of production in 2019-21, and total support to agriculture was 0.5 % of GDP in 2019-2021. In the period from 2010 to 2021, there was a decrease in total support for agriculture (TSE % of GDP),0.530% to 0.454% respectively. On the other hand, the US records positive CSE rates, which means that its consumers are not taxed

Table 5
USA agricultural support by using Organization for Economic Cooperation and Development (OECD; 2022).

USA Support for agriculture								
Years	Producer Support (PSE), Million Euros	Producer Support (PSE), % of gross farm receipts	Consumer Support (CSE), Million Euros	Consumer Support (CSE), % of agricultural consumption	General Services Support (GSSE), Million Euros	General Services Support (GSSE), % of total agricultural support	Total Support (TSE), Million Euros	Total Support (TSE), % of GDP
2010	21 517	8.0	24 840	14.4	7 513	12.5	79 447	0.530
2011	21 957	7.5	28 655	14.9	4 136	7.0	81 642	0.525
2012	26 054	7.9	31 632	14.5	4 741	7.0	86 732	0.535
2013	21 042	6.7	34 383	17.4	7 682	11.8	86 340	0.514
2014	28 745	8.7	28 520	13.7	5 819	8.3	92 574	0.528
2015	32 540	8.9	32 670	14.2	7 834	9.5	91 523	0.502
2016	31 524	9.1	32 882	16.1	8 960	10.9	91 316	0.487
2017	28 396	8.2	30 401	14.1	9 437	12.0	88 730	0.454
2018	35 243	10.5	28 164	13.7	9 222	11.1	98 303	0.477
2019	44 909	12.7	29 455	13.2	10 048	10.6	106 492	0.497
2020	42 880	11.6	39 203	17.7	8 315	8.8	107 458	0.514
2021	44 852	10.5	49 863	21.1	8 848	8.2	127 087	0.554

Source: OECD;2022

4.2.2. USA Domestic policy developments

Policy developments in the United States in 2021 continued to focus largely on helping agricultural producers, consumers and the agri-food sector cope with the effects of the COVID-19 pandemic, with several new programs and initiatives launched to strengthen supply chains and address inequalities. in previous producer support and promoting food and nutrition security. After the recovery, new programs or initiatives were launched to help ensure that USDA programming is focused on ensuring that a more resilient industry emerges from the crisis by improving environmental sustainability and

changing the effects of climate change (OECD, 2021). The only policy change to direct payment schemes in 2021 was the establishment of the Additional Program in December 2021 to allow small and medium-sized dairy businesses weighing less than 5 million pounds (2,268 million kg). Established production history for registration. Formula based additive production using 2019 milk sales. Additional DMC coverage was available for calendar years 2021 and 2022 and will also be available in 2023 and participation operations will be eligible to receive retroactive additional payments for 2021.

4.3. Turkey Agricultural Support Policy Trends

When we look at the general structure of agricultural support in the world, it is seen that specially developed countries do not support it, but these countries provide serious support. However, within the framework of the World Trade Organization (WTO) Agriculture Agreement, a change is observed in the support instruments, and in this context, it is requested to remove the supports that distort the trade. It is observed that there is a shift towards support for the development of the environment and rural areas instead of support related to production.

When we look at the history of agricultural support in Turkey, it is possible to examine the subject in 3 periods: support before 1980, support between 1980-2000, and support after 2000.

1. Supports before 1980: - It can be said that the first application in terms of support in the agricultural sector was in the form of the refund of the tax collected from fuel and oil. In accordance with the Law enacted in 1926, the tax collected from the fuel spent in agricultural activities was returned to the producers. The first support application in terms of the product was in wheat in 1932 through Ziraat Bank. This support was later called market price support. With the establishment of the Turkish Grain Board (TMO) in 1938, this task was assigned to TMO (Yentürk et al. 2004). Another support was the subsidies given at the stage of input supply and product evaluation. In this period, support was made by giving important agricultural inputs such as chemical fertilizers, chemical pesticides, and seeds to producers at a lower price than the market price.

2. Supports between 1980-2000: - With the transition to a free market economy after 1980, the liberalization process started and the state's support for the agricultural sector decreased (Akbulut 2015). In particular, as a result of the Decisions taken on January 24, 1980, a foreign policy was followed in the Turkish economy. The agricultural sector was also affected by these policies. In Turkey, which has opened up to a market economy, the breezes of liberalization have shown themselves and it has been preferred to move away from supportive policies by reducing interventions in agriculture. As a result of the narrowing of interventions such as price support policies, input supports, low-interest loans, and the privatization of agricultural SEEs, the agricultural sector was tried to be reshaped. Another turning point in this period was the Decisions taken on April 5, 1994. The scope of supported products has been narrowed down to cereals, sugar beet, and tobacco. In 1993, 24 products, in 1994 8 products, and in 1995 7 products were included in the scope of support.

3. Supports after 2000: - In the 2000s, reforms were sought in the agricultural sector in Turkey. There are 4 elements in the search for reform: WTO Agricultural Agreement provisions, compliance with the EU Common Agricultural Policy, IMF and World Bank policy recommendations, and Turkey's own conditions and needs. Fundamental policy changes, initiated with the title of reform in agricultural policies, have been driven by external influences rather than internal reasons that have been valid for years. As a matter of fact, among the commitments made to the IMF for the stand-by agreement in December 1999, the direction of change in support policies in agriculture was determined (Olhan 2012).

In general, the measures proposed to Turkey were to reduce support purchases, lower support prices, strengthen the market economy, and provide support to producers through direct payments. In this period, reducing the intervention of the state in the market, reducing the public finance burden, and reducing income inequality were the main objectives of the support. TRUP, which started to be implemented in 2001, can be defined as the instrument that has had the greatest impact on Turkey's agricultural policies since the 2000s. TRUP was conducted in conjunction with the World Bank as a follow-up to the Economic Reform Loan. It is to use policies that will plan to improve a situation that can be given to agriculture for basic purposes, to provide financial support to producers in the transition process, and to accelerate the privatization process of organizations such as TEKEL (cigarettes and alcohol), ÇAYKUR, sugar factories, TMO, which started in 1998. In the context of monetary support, producers were supported with DGD (Demirdöğen and Olhan 2014). It has been decided to give DGD instead of price, input, and credit support. However, the loan supports, which were abolished with DIS, started again in 2006, and diesel and fertilizer support in 2007. The most important written document on agricultural support in Turkey is Agricultural Law No. 5488, which was enacted in 2006. It is seen that in an important part of the law, there are statements about support practices. While subjects such as the purpose and principles of agricultural support, agricultural support tools, and application principles are specified in the Law, it can be said that the most important point open to discussion is related to the support budget. Article 21 of the Law states that “Financing of agricultural support programs is provided from budget sources and external sources. The resource to be allocated from the budget cannot be less than 1% of the GDP.

However, when the ratio of the supports directly reaching the producer to the GDP is examined, it is seen that it changed between 0.5-0.67% between 2006 and 2014 (0.56% in 2014). Data for 2015 on this subject have not been disclosed yet. However, considering the GDP and the agricultural support amounts announced by

the Ministry of Food, Agriculture, and Livestock (MFAL) in the Central Government Budget for 2016 announced by the Ministry of Finance, it becomes clear that the support rate for 2016 will be 0.52%. When this calculation is made by zeroing VAT on agricultural loan subsidies, intervention purchases, and financing, of agricultural SEEs, fertilizer, and feed, it becomes 0.79%. As can be seen, the 1% rate envisaged in the Law will not be achieved in 2016.

4.3.1. Turkey's Support of agriculture

As a result of the developments in the world, there have been radical changes in agricultural policies in Turkey, but it is understood that there has not been enough change in the budget of support policies over the years, since the current value has increased by 8.05 times and the real value has increased by only 2.15 times. 2019. In Turkey, 13% of the gross production value obtained as a result of the agricultural policies implemented in the agricultural sector, 12% in the USA, and 19% in the EU are formed. Considering the shares of agricultural support groups in total supports, the ratio of supports in 2018 was 27.0% livestock supports, 26.0% difference payment support, 25.0% field-based supports, 8.0% other/ compensatory payments, 8.0% agricultural insurance supports, and 7.0% rural development supports. When Table 6 and figure 3 are examined; Turkey's producer support estimation (PSE) in 2021 shows that 15.1% of the gross production value obtained is a result of the agricultural policies implemented. Turkey recorded the highest level of PSE in 2010, which means that Turkey farmers are the most protected.

Therefore, the support level of the Total Support Estimate (TSE) of GDP varies from year to year and was decreasing, and it can be said that while it was above the EU in the period from 2010 to 2021, it decreased rapidly after 2017. General support to the sector (GSSE) was 15.6 % of the value of agricultural production in 2021, down from 17.86 % in 2013. Of the observed periods, Turkey has a negative value of CSE, which means that their consumers are more taxed. And the highest negative CSE value recorded in the observed period was in 2020 at 26.7%, which means that Turkey consumers are taxed the most

Table 6
Turkey's agricultural support by using Organization for Economic Cooperation and Development (OECD; 2022).

Turkey's Support of agriculture								
Years	Producer Support (PSE), Million Euros	Producer Support (PSE), % of gross farm receipts	Consumer Support (CSE), Million Euros	Consumer Support (CSE), % of agricultural consumption	General Services Support (GSSE), Million Euros	General Services Support (GSSE), % of total agricultural support	Total Support (TSE), Million Euros	Total Support (TSE), % of GDP
2010	18 743	30,2	-13 578	-26.7	2 086	10.02	27 587	3,54
2011	15 034	24,9	-9 873	-20.2	2 421	13.87	24 272	2,88
2012	14 772	23,4	-9 218	-18.4	1 722	10.44	21 200	2,40
2013	11 411	20,9	-6 372	-15.3	2 481	17.86	18 442	1,92
2014	13 289	26,1	-8 400	-21.5	2 290	14.70	20 670	2,20
2015	15 792	26,4	-10 066	-22.4	2 571	14.00	20 371	2,35
2016	17 060	29,4	-11 632	-24.5	2 428	12.46	21 551	2,48
2017	13 059	23,8	-8 382	-19.0	2 508	16.11	17 549	2,04
2018	7 065	15,2	-4 139	-10.7	1 852	20.77	10 523	1,35
2019	8 751	17,4	-5 455	-13.0	973	10.01	10 885	1,43
2020	13 738	26	-5 425	-13.3	894	6.11	16 673	2,31
2021	6 313	15,1	-4 637	-12.4	1 167	15.60	8 846	1,15

Source: OECD;2022

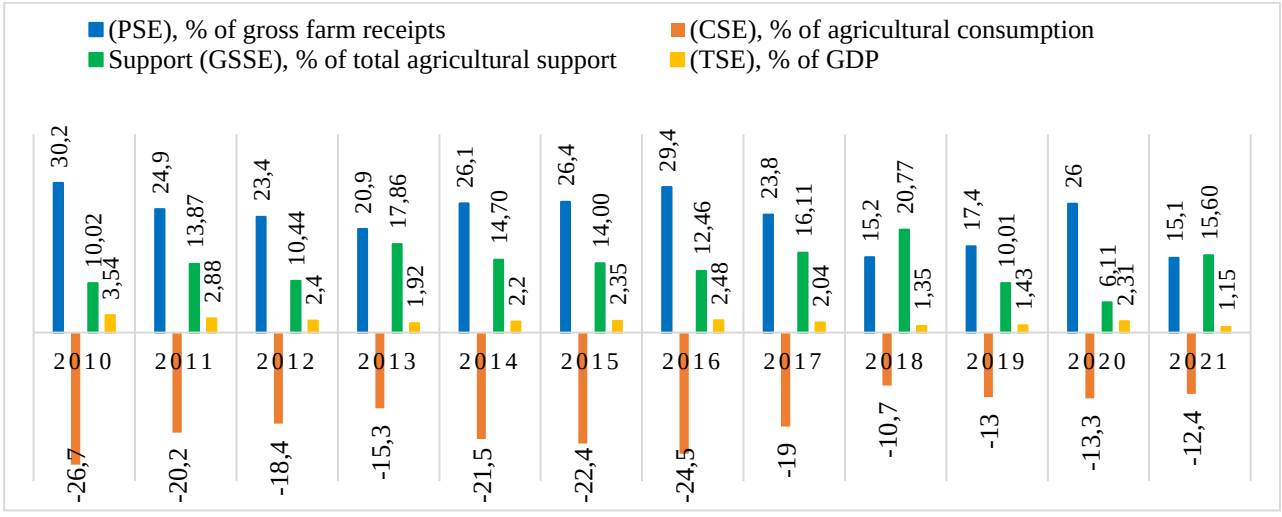

Figure3
Turkey's agricultural support by using Organization for Economic Cooperation and Development (OECD;2022).

On the other hand, when we look at it the resource allocated to agriculture by the Central Government Budget in 2019 increased to 26.5 billion TL. In this allocated resource; 16.1 billion TL for agricultural support programs, 5.3 billion TL for agricultural loan subsidies, intervention purchases, financing of agricultural SEEs and export supports, and 5.1 billion TL for agricultural sector investment appropriations (Anonymous 2020b).

Table 7
Resources Allocated to Agriculture in Turkey

Resources Reserved for Agriculture	2019 (Billion TL)
Agricultural Support Programs	16,1
Agricultural Credit Subsidies, Intervention Purchase, Export and Financing of Agricultural SOEs	5,3
Investments	5,1
Total	26,5

Source: Anonymous 2020b

4.3.2. Domestic policy developments

Global markets are becoming increasingly sensitive to environmental performance. In particular, the EU Green Deal will affect Turkey, both as a candidate country of the EU and as a Customs Union partner. In light of this, the government considers that the green transformation of the Turkish economy and industry is necessary and essential for sustainable growth, export competitiveness, and for preserving and deepening Turkey's integration with the EU market. In response to these international market changes, Turkey adopted its own Green Deal Action Plan, which was published in the official gazette in July 2021. This action plan includes goals and actions related to sustainable agriculture. Reducing the use of pesticides, antimicrobial and chemical fertilizers, improving organic production, increasing the use of renewable energy in agriculture, and better management of waste and residues are the main actions envisaged.

Turkey prepared Turkey's National Road in 2021 as part of the UN Food Systems Summit. Turkey's national path includes 117 actions linked to 10 key priority areas with five Summit action paths in order to transform food systems and achieve Sustainability Development Goals by 2030.

The main priority areas are:

- Promote equitable access to safe and nutritious food, especially for vulnerable groups.
- Improving public health and food safety and strengthening inspections and controls through innovative methods.
- Promote sustainable supply and value chain in the agri-food sector and reduce food loss and waste.
- To increase consumer awareness and promote sustainable consumption.
- To develop production models compatible with climate change.
- To increase using water resources more efficiently.
- To manage natural resources in a more sustainable way.
- To develop a more inclusive policy for disadvantaged groups in the agri-food sector.
- Increasing rural liveliness.
- Improve building the resilience of food systems and food security against climate change, natural disasters, and unexpected crises.

Coverage of state-supported agricultural insurance continues to expand Income Protection Insurance is offered as a pilot project to wheat producers in Konya as of 2021-22.

Turkey's Agricultural Drought Strategy and Action Plan, 2018-22" has entered its final year. Work continues under five headings: i) drought risk forecasting and crisis management; ii) sustainable water supply, iii) effective management of agricultural water demand, iv) Increasing support for R&D activities, training and extension service programs and v) strengthening institutional capacity As part of the strategy, drought management plans for 25 basins and 15 such plans between 2014 and 2021 to be completed by the end of 2023 were completed.

Responsible institutions should report on the implementation of the Management Plans semi-annually. Within the scope of the "Support Program for Investments in Rural Development", 50% support is provided for the installation of modern irrigation systems (drip or sprinkler). Until the end of 2021, approximately 330,000 producers were supported with grants and loans, and modern irrigation systems were installed on a total area of 1.12 million hectares. Since 2003, the use of closed system irrigation projects has accelerated to reduce losses and leaks. In 2003, only 6% of the irrigated area used piped irrigation networks, while in 2020 this rate increased to 29%.

During the 2021 irrigation season, a pilot study began charging higher water use service fees when more water was used. This pilot will be extended to all irrigation facilities with adequate infrastructure and suitable methods. Storage facilities and metering facilities of 500 hectares and above have been established on one hectare that is centrally monitored in irrigation networks. It measures the flow of water during storage, transmission, distribution and discharge. These plant installations will eventually support volume-based water pricing.

5. Results and Recommendation

The fact that the countries of the world have different economic structures can be considered as the reason for

the different agricultural support policies in force. Changes in the world economy and globalization trends in the 1980s also affected the agricultural sector and caused major transformations in agricultural policies throughout the world.

In most of the world's countries, the change in agricultural support in the 2000s occurred in the form of direct income support, support that reduces the effects of risk and uncertainty, rural development support and even the substitution of a single payment system instead of price and input supports that interfere with the market. EU countries and the USA have applied direct income payments independent of production, which do not direct the market, in order to prevent production surpluses and have gradually expanded this application area in the last 20 years. In addition, the EU has turned to environmental protection and rural development policies. In the EU, which has made long-term budget creation plans after 2013, the benefit of farmers from the support system since 2013 has been linked to the fulfillment of certain environmental, animal, and food safety standards. Policies that support food consumption in the world, especially in the USA, have objectives that both ensure the raising of healthy generations and indirectly support agricultural production by increasing domestic demand. Policies such as food subsidies, which have a large share in the support of the US Agricultural Law,

It is seen that the trends in support policies in the world do not interfere with the market, aim to improve the agricultural structure, and therefore aim to create a more competitive agricultural sector. It is known that developing countries, which go one step further, have achieved agriculture without support by making the necessary structural and institutional improvements and are in the position of important agricultural product exporters in the world. In the period from 2010 to 2021, there was a consequently decrease in total support estimation (TSE), producer support estimation (PSE), and, consumer support estimation (CSE) in all countries covered by the research (TR, EU, USA). On the other hand, there was an increase in allocations for general services in agriculture (GSE), primarily due to the obligation to reduce market-price support and support to farmers. In addition, Of the observed countries, only the USA has a positive value of CSE, which means that their consumers are not taxed. While Turkey recorded the highest negative CSE values in the observed period, which means that Turkey consumers are taxed the most.

Agricultural support should be in effect for a long time without changing in order to direct the farmers in the desired direction. If the support is determined by changing every year with annual regulations, farmers cannot make long-term plans, projects, and programs, and cannot make investment decisions. Therefore, as in the United States and the European Union, it can be ensured that the farmers are directed to structural improvements by planning and applying the support for 7 years or so, without changing.

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Review Article

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The Effect of Global Warming on Migration of Butterflies

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ABSTRACT

Certainly, global warming is one of the most important environmental problems of mankind today. Increased human activities, especially in the last few decades, like burning fossil fuels, increasing CO_2 emissions, deforestation, and other practices have exacerbated the global warming phenomenon. The increase in greenhouse gases leads to an increase in temperatures above the normal rate and this causes fires, droughts, sandstorms, high soil salinity, and fluctuations in precipitation. These changes in the environment affect not only humans but also all living organisms, including insects. Insects are the largest group of living organisms on earth. Therefore, one of the creatures that will be most affected by these changes is insects. Increasing temperatures, rising CO_2 levels, and changing rainfall patterns may affect the interaction between plants and insects. For example; the development of insects may accelerate, insect pests and insect-borne diseases, the number of generations in a year and winter survival may increase, the geographical distribution may expand, biological control of the pests may decrease, and as a result of all these, economic losses in crops may increase. Global warming may also affect the migration of insects, in particular, butterflies of which about 600 species have migratory behavior. This may be due to several factors, including the loss of the habitats on which the larvae feed, the nectar resources and the deterioration of their winter habitats, the adaptability and productivity problems in their new habitats, the attack of natural enemies, the disruption of migration signals and the change in wind patterns. In addition, the migration of butterflies may increase with the effect of global warming. Moreover, an increase in temperatures can also cause changes in butterfly morphology, e.g., a reduction in wing size that reduced their flight activity. In this review, we discussed the impact of global warming on butterfly migration.

1. Introduction

Insects are the largest group of living organisms on the earth's surface. They enter every ecosystem. Not all insects are considered pests. Some of them are useful like pollinators, bees, butterflies, and natural enemies (parasitoids, predators). Unfortunately, there is little interest in them while these organisms are affected by any changes that are occurring on earth. Today, the tangible effects of human activities such as the production and consumption of fossil fuels, industrial activities, deforestation, using of pesticides, and various chemicals are seen. Global warming, which was originally a natural event and not a problem, is warming the earth. Without it, the earth's temperature would be low and therefore life would be impossible. But some activities of humans have increased gases like carbon dioxide, nitrous oxide, and methane above their natural levels. These gases absorbed the infrared radiation emitted by the surface of the earth and became like a greenhouse. This greenhouse effect led to a sharp increase in temperature, the spread of fires, the occurrence of droughts and floods in different regions of the world, the occurrence of migrations of various species of humans, animals, and insects (Kweku et al., 2018).

Insects have migratory behavior and due to weather changes, they migrate either in search of food, when food decreases, or displacement begins. They affect the ecosystem and human life by breaking down organic matter, pollinating plants, and more during their migration (Jankielsohn, 2018). In this review, we discussed the importance of insects, especially butterflies, migratory behavior in insects particularly butterflies, then the impact of global warming on agriculture and insects in general, and also, we discussed the impact of global warming on butterfly migration based on previous studies.

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2. The Importance of Insects, Especially Butterflies

Insects are the largest group of living organisms on earth and very few of these insects are considered pests. Insects play a vital role in various ecosystems, for example, the movement of insects in and out of the soil increases the flux of N and P elements. Insects contribute to plant diversity through pollination, as two-thirds of all plant species depend on insects. Herbivorous insects are naturally controlled by predators and parasitoids. The order Hemiptera, Coleoptera, Diptera, and Hymenoptera are a large part of the predators and parasitoids. 4000 dung beetle species play an important role in the decomposition of manure (Jankielsohn, 2018). The role of butterflies is very important in pollination. They transport pollen to different places either through their mouthparts or the remnants of pollen grains on their legs or body. The migratory behavior of some of their species also helps with pollination and thus contributes to the restoration of damaged ecosystems by providing food. Moreover, an increase in the number of butterflies means an increase in the number of pollinators and an increase in the diversity of pollinated plants. They also contribute to the genetic variation of plants by collecting and distributing the pollen grain obtained from different plant species and spreading it to other plants. Since the plant that butterflies live on absorbs carbon dioxide, it is ingested by butterflies during feeding, thus removing carbon dioxide from the atmosphere. Butterflies are an ecological indicator of ecosystem health; more butterflies mean a better ecosystem. Butterflies respond to environmental stress; reproduction rates increase when the trophic level is low. They are considered more facilitated food for other animals such as birds and reptiles (Ghazanfar et al., 2016).

3. Migratory Behavior in Insects, Particularly Butterflies

In insects, migration is a movement in a given direction and distance. This may be long-range and seasonal. The main reason for migration is to provide sustainability of the species or organism for upcoming generations by dispersing their offspring to different places and times under different environmental conditions (Holland et al., 2006). The large geographic range is thought to help conserve the species from extinction. However, migratory species face many threats, for example, due to habitat destruction and human predators that have led to the extinction of a common migratory species such as the Rocky Mountain locust (*Melanoplus spretus* (Orthoptera: Acrididae)). Many migratory species have morphological, physiological, and behavioral characteristics that enable them to migrate. An internal biological clock enables them to migrate. Migration occurs in all insect species, but they vary in distribution, even within the same group there are differences (Ramesh, 2018). Migration occurs in pollinators, herbivores, predators, pests and insects that transmit human and plant diseases. Insect migration is imperceptible due to their small size and lack of mass aggregation compared to vertebrates. During migration insects have some strategies for example, their movement is enhanced and foraging and reproductive activities are reduced. Migration occurs pre-reproductively in adult insects. Since migration pre-reproductive, reproductive ability and ability to colonize are at or near maximum. They live in habitats that are temporary. In these habitats, population increase and therefore more colonization occur. Migratory insects influenced by environmental factors and adapted to prevailing conditions. Migrations are either daily or seasonal (long distances). In the northern hemisphere, movement occurs in the spring to north to provide food during the summer and south in the fall to provide food after the winter season. In some species, the migration occurs in one direction and they never turn back, like the Red Admiral butterfly (*Vanessa atalanta* (Lepidoptera: Nymphalidae)) and Painted Lady butterfly (*Vanessa cardui* (Lepidoptera: Nymphalidae)). They fly out of the Mediterranean Sea in summer, breed and die. Their offspring fly south in the fall and die resulting in offspring returning again (Dingle, 1972).

4. The Impact of Global Warming on Agriculture and Insects

Global warming has affected every life cycle on the planet. The reason is humans and the first affected are humans too. Also, agricultural production was affected because it directly depends on weather and climate factors. Any changes in precipitation rates, water resources, temperature, and CO_2 concentration affect agricultural production. Northwest India suffers from deteriorating soil fertility, rising salinity, changing water table, and irrigation water quality. South America, North Asia, and Central Asia experienced increases in precipitation. Since groundwater recharge and soil moisture can change, droughts and floods can occur (Allen et al., 2004). Rising temperatures lead to drought and thus slow down or destroy plants growing and this reduces overall agricultural production. A 100 mm decrease in precipitation reduces growth by 0.35% (Gupta et al., 2021). The quantity and quality of forage are also affected by temperature rise and therefore livestock is not spared from the effects of global warming. With climate change due to drought and rainfall, pest and disease patterns may vary according to this alteration. When the global temperature increases, the reproductive cycle of insects increases, increase in the species and numbers of insects, which means an outbreak of pests that leads to an increase in the use of harmful pesticides (Aydinalp and Cresser, 2008; Sangle et al., 2015).

Increasing temperatures, rising CO_2 levels, and changing rainfall patterns may affect the interaction between plants and insects. For example; the development of insects may accelerate, insect pests and insect-borne diseases, the number of generations in a year and winter survival may increase, the geographical distribution may expand, biological control of the pests may decrease, and as a result of all these, economic losses in crops may

increase. Global warming has caused pollinators to move some distances, leading to an increase in the food security issue, and hence farmers have been forced to grow specific crops to compensate for the lack of pollination. For instance, rising temperatures have led to a decline in large areas of coffee and chocolate acreage due to a lack of pollinators (Robinet and Roques, 2010).

5. The Impact of Global Warming on Butterflies and their Migration

Climate affects directly and indirectly, either negatively or positively on the migration route of butterflies. The effects of climate change resulting from global warming on humidity and temperature systems disrupt migration signals. Migratory species are threatened because the habitats for their migratory route have been compromised. In North America, the monarch butterfly, *Danaus plexippus* (Lepidoptera: Nymphalidae) population has declined by 80% in the last decade and may even disappear forever. This is due to several factors including loss of the habitats the larvae feed on, nectar resources and degradation of their winter habitats, attack by natural enemies, and changing wind patterns. The nectar plants were affected by drought due to the lack of rain. When monarch butterfly fed on irrigated *Liatris mucronate* (Asteraceae), it stored 80 mg fat, while when fed drought-affected *Verbesina virginica* (Asteraceae), it stored only 40 mg (Chowdhury et al., 2021). Habitat types affect the migration of butterflies. In forests, migration is less than in meadows, but meadows have also been destroyed due to human activities and global warming (Hoyle and James, 2005). The annual migration of the monarch butterfly (*D. plexippus*) in eastern America is between the summer breeding areas (in the north of the United States and southern Canada) and between the winter sites in central Mexico. But its annual migration has been affected by the high temperatures. The fall migrations in the month of September and October are delayed by six days per decade, due to the high temperatures in these two months. This led to a decrease in the arrival of migratory numbers to winter sites in Mexico, which in turn affected the success of their migration and thus the destruction of these species (Culbertson et al., 2022). Studies indicated that the climate works in conflicting ways during the spring and summer. The influence of the climate in Texas affected the activities of butterflies in Ohio, while the climatic conditions in Ohio did not affect the migration and activities of butterflies. Average temperatures and spring rains in Texas led to the arrival and growth of a greater number of monarch butterflies (*D. plexippus*) in Ohio. Rising temperatures can sometimes make winters warmer. This has led to some butterflies expanding their range rather than being negatively affected by the deadly cold temperatures. The warmer temperatures have been beneficial for many European butterflies, including migratory ones (Zipkin et al., 2012). The migration of 75 species of butterflies has increased with climate change in Portland between 1982 and 2005. For example, Dark Sword-grass, *Agrotis ipsilon* (Lepidoptera: Noctuidae), and the beautiful Painted Lady, *Cynthia cardui* (Lepidoptera: Nymphalidae) were recorded 23 and 20 years, respectively in Portland between 1982 and 2005. An increase of 1°C in temperature resulted in an increase in migrating species by 14.4 ± 2.4. Global warming may also threaten the adaptation of migrant butterflies. It poses a threat to resident species that are less mobile and more specialized in habitat requirements (Sparks et al., 2007). In China, increasing the average temperature in the last decades led to an advanced peak and increased proportion of high ovarian development levels of first generation *Mythimna separata* (Lepidoptera: Noctuidae) females. They suggested that rising temperatures due to global warming may impact *M. separata* migratory status and cause damage in corn production (Chen et al., 2019). Rising temperatures led to a reduction in the wing size of *V. cardui*. The larvae of *V. cardui* were reared at three different temperatures, 22, 28, and 33°C. It was determined that as the temperature increased the wing size of the adults got significantly smaller. All larvae used in the experiment did not complete their transformation and died which were reared at 33°C. It's known that *V. cardui* is a migratory species and migrate from Africa to Europe annually. But smaller wings due to global warming could prevent *V. cardui* from making this journey (Kennelly et al., 2017).

6. Conclusion

It is thought that global warming will affect the butterfly life cycle and therefore their migration. Warm temperatures are beneficial for many butterflies. However, the average temperature rises above the normal level affected their development as well as disrupted the signals of natural migration. Also, nectar resources that are necessary for adult butterfly feeding have been adversely affected by drought. The habitats on which species depend on their migration route, including winter habitats, have been endangered, and the meadows that butterflies prefer more for migration have been destroyed. Rising temperatures due to global warming have also affected the development of butterflies. Above the average temperatures caused an increase in the metabolism of butterflies that led to development faster and sometimes even death. In addition, increasing temperatures caused butterfly wings to become smaller which may cause butterflies to be unable to migrate. On the other hand, global warming has increased the migration of some species of butterflies which are considered pests. Butterflies are an ecological indicator of ecosystem health. Thus, the effect of global warming on butterflies should be carefully studied and necessary precautions should be taken.

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Review Article

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Proso millet (*Panicum miliaceum* L) Cultivation Form and Potentiality under Konya Conditions, Türkiye

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ABSTRACT

İncreasing climate change effect with decreaing and limation of food sources, alternative and well adopted pathway should used. Proso millet is one of human food alternative, its dry enviroment crops. *Panicum miliaceum* is used in human and animal nutrition. Recently it has been grown in the Konya region in an irrigated schemes for its grain. Proso millet grains have vital economic and nutrition potential. Previously were used to feed pet birds and poultary. Under Konya conditions, the farmer obtained about 150-200 kg/da grain yield. Crop seeds are harvested in 90-100 days, using a combined harvester. The crop possesses a vital capacity of being a promising crop that might contribute to human food security.

1. Introduction

Proso millet (Panicum miliaceum L.) is one of the 600 species of the millet (Panicum) genus in the millet subfamily (Panicoideae) growing in the warm and temperate regions of the world. It is an annual warm climate crop cultivated for its grain since prehistoric times. Its grains are important for humans and are used in Russia, the Near East, and India (Andrews et al 1996). Its low water requirement compared to other plants because it needs 308 liters of water to produce 1 kg of dry matter. Its grains are used as fodder in poultry and poultry farming. Although it is a delicious plant, it is not preferred by animals as green forage because the plant is covered with hairs. It is grown as a silage plant in Romania. The quality of dry grass obtained when mowing during the flowering period is usually low (Gençkan 1983; Avcıoğlu et al 2009; Habiyaremye et al 2017)

2. Botanical properties

The proso millet plant is an annual warm-season grain crop, with 30-120 cm in height (Figure 1, 3, 4). The stems are coarse/ rough, woody and hollow, roundish or flat, and 6.8 mm thick at the base. The stems are covered with hair. The stems and seed pods are yellowish or reddish-green during the seed maturity stage. The weight of a thousand seeds is 5-6 g. It is a tetraploid plant with a somatic chromosome number of 2n=36 and the plant is self-pollinated (Gençkan 1983; Serin and Tan 2014).

3. Environmental Requirement

Panicum miliaceum can grow in an area with an annual rainfall of 500-750 mm without supplementary irrigation, and where a significant part of the precipitation falls in the summer period. It is heat resistant crops. The minimum germination temperature is 10-12 °C. Nevertheless, rapid germination and initial development require around 20 °C of temperature in this period. During the 2-3 months when the proso millet grows, it is desirable that the temperature rises above 20 °C, and the total temperature of the crop from sowing up to the harvest is 2050-2550 C (Kün 1983). There is no soil selectivity which it mains the crop can be planted in each type of soil. However, it develops well on sandy loamy and clay loamy soils. The seeds are small; therefore, the cultivated soil should be well prepared, and sowing this crop should not be deeper than 2.5 cm (Gençkan 1983; Habiyaremye et al 2017).

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Figure 1
Plant general form views

4. Cultivated area and agriculture in Konya province

In a conducted study in Turkiye concluded that the crop in recent years has been preferred by the farmers and cultivated areas under expansion in Konya (Figure 2). It is very important and necessary to prepare seedbeds quite well since the seeds of the plant are small. To ensure strong germination and emergency of the seeds, it is important that the soil is smooth and free from stones. That is why it's strongly recommended intended cultivated area, the field should be plowed well before sowing. Then the disk-harrow is pulled out and the stones crash down. The crop is sowing in rows; a recommended spacing is 20-30 cm between rows. The recommended seeds to be used are 4 kg da^{-1} as seeds rate. The sowing date began from May up to mid of June. During seeding, it is suitable to apply DAP fertilizer 12 kg da^{-1} dose.

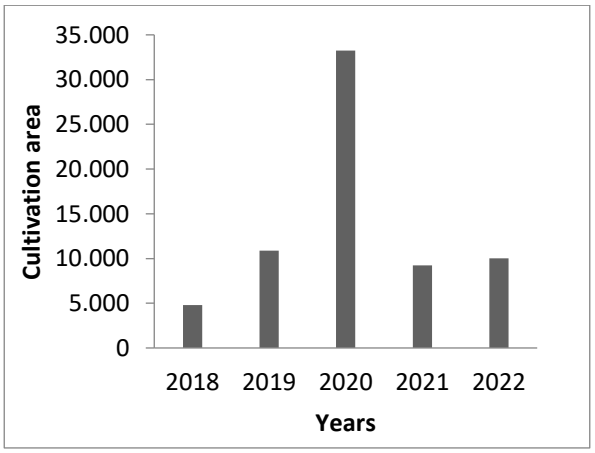

Figure 2
The cultivated areas of *Panicum miliaceum* in Konya in different years (da) Da = 1000 m^2 (Source: Ministry of Agriculture and Forestry (undated))

Irrigation is carried out by sprinkling when it is needed (usually 3 times). The first irrigation is applied in order to create a good crop growth, the second irrigation is carried out to ensure the development of the green part, and the third irrigation is irrigated during the milk production stage for grain filling and before harvest.

Figure 3
A view of field crop grown in Konya

According to climatic conditions and air temperatures forth irrigation is necessary when it's needed. However, it has been observed that irrigation is applied so many times. Meanwhile, along with irrigation, fertilizers containing urea (8 kg da^{-1}) and /or Ammonium Sulfate (15 kg da^{-1}) are preferred to be applied as upper fertilization in terms of plant development. From well seedling development up to flowering is 68 days. Between 90-100 days the seed reaches maturity. Seed harvesting can be done with a combined harvester. In Konya conditions, seed yields of 150-200 kg da^{-1} have been obtained by farmers (personal communication).

5. Conclusion

In Konya, the farmers cultivated the crop only for feeding pet birds. Since there are no different varieties of millet in Konya, a single type of seed (population) is used, varieties should be obtained and different varieties and cultivation should also be tried. In addition, different production methods should be tried for high yield and quality, and for different purposes (silage, legume mixed and dry grass, etc.) should also be considered at cultivation. The consumption of grain should be diversified, such as human and animal nutrition, and industrial raw materials, as is done in different countries of the world. This increases both productions and contributes to sustainability. Moreover, there is a need for more research in different parts of both Konya and Turkey regard of cultivation techniques and adaptability.

Figure 4
A view of field crop planting in Konya

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Review Article

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Some Classical Methods of Vegetation Attributes Measurements in Rangelands

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ABSTRACT

Around the world in every single country rangeland considers the first animals feed source. Many years ago these sources contributing, supplying and securing animals' feed, besides of, its environmental benefits. Due to misused or unwise utilization; rangeland characters and features facing tremendous changes and degradation. Therefore, management sound and wise plans should be arising to protect, improve and develop its characters sustainably. Undoubtedly, rangeland managers and environmental activists must their mandate and task be in these trends. Rangeland's management and monitoring are based on the evaluation of vegetation attributes (cover, species frequency, species composition, plant density, and carrying capacity). To estimate these attributes their are so many techniques and approaches designed for this purposes. However, the application and selection of suitable methods depend on rangeland characters and vegetation types. Each of those methods has a special considerations. According to this and vegetation features it is being selected. Therefore, this paper is introducing and focusing on the most common using rangeland vegetation attributes sampling methods. That will help young scientists and rangeland managers to pursue their work easily.

1. Introduction

Rangelands cover vast areas of the earth and play a fundamental role in providing feed, besides the cheapest animal fodder source and wildlife habitats. Rangelands are characterized by multi-functionality and play a vital role at economic, social, and ecological levels. Sustainable range management systems contribute to securing fodder and habitat for livestock, wildlife, and pastoral and local communities' livelihood. Nonetheless, inadequate policies, misuse, and over-exploitation of these resources, often in combination with inappropriate practices adopted by local communities, lead to the loss of these valuable resources (Holechek et al. 1995; FAO 2017). Natural rangelands should be exploited by their potential energy to maintain it sustainably. To achieve these goals it needs management sounds and plans to adopt the principles of sustainability and integration of natural resources to preserve and protect from the different degradation causes.

The significant objectives of rangeland management and conservation are maintaining native plant diversity, detecting invasive species, and monitoring rare species (Stohlgren et al. 1998; Severoğlu 2018). Generally, to detect, monitor, and apply range management programs, it should select proper methods or techniques suitable for the studied range conditions and site. Several methods have been used for a long time to sample rangeland vegetation attributes. The classical sampling methods are still used in vegetation sampling. These methods include quadrate, transect, point-frame, step, and loop methods (Çakmakçi et al. 2002). However, this method should be re-evaluated from time to time. Some of these methods focus on describing existing homogeneous plant communities. But most of the ecological patterns have changed. On the same hand, some methods might reduce the variance in some parameters due to correlation effects. Rangeland's management objectives have changed. Moreover, rangeland monitoring and inventory have increasingly needed, to detect and find decreasing species and some changed features in the rangelands. Conducted sampling techniques must be effective (time, cost, and labor needs) (Stohlgren et al. 1998; Tsalyuk et al. 2015).

Vegetation sampling techniques of rangeland must be tested and compared to detect the best one for rangeland management. Several years ago there is common

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rangeland techniques used for vegetation sampling and monitoring. Moreover, these techniques are expected accurately measure the conditions and trends of plant diversity at narrative and wide scales (Stohlgren et al. 1998). Nonetheless, still, a few methods are consistent and appropriate to estimate vegetation. Sampling methods in vegetation studies are related to the vegetation type, time, effort, and reliability. Therefore, it is very difficult to find and select a suitable method properly and can be generalized to all vegetation types (Tosun & Altin 1986). The restrictions of using classical methods are; it could not suitable for all kinds of vegetation and conditions. Meanwhile, field application of some sampling method on the same area revealed different results. On the other hand, modern methods are introduced using sophisticated and advanced tools (remote sensing and geographic information system) to measure range attributes (Zhou et al. 1998). The method to be applied should be approved and accepted and not be concluded wrongly. In recent years, statistical applications have gained importance for quantitative vegetation analysis.

To study vegetation and to analyze its conditions, structural and vegetation composition must be sampled (Cetik 1973). All of up to date using methods agreed; that rangelands should be measured or managed to achieve more accuracy and reflect rangelands conditions. Recently, the exploitation of remote sensing (RS) data has proved to be efficient for monitoring the earth's surface (Phiri & Morgenroth 2017). In such a situation, modern remote sensing and geospatial techniques have an important role to classify and map the vegetation cover of rangelands and forests (El-Hassan & El-Tayeb 2014). Land cover maps are increasingly used to define guidelines for environmental action, and they are used as a powerful tool for natural resources management (Gbenga 2008). Satellite data and advanced cross-cutting classification techniques are required to detect and produce land cover change maps. Therefore, this review introduces some used methods in sampling rangeland's vegetation attributes for prospective rangelands managers.

2. Vegetation Measurements

Rangeland vegetation measuring attributes

It is extremely important to decide which attributes are going to measure, and that reflect the real status of the rangeland. Moreover, separating rangeland vegetation into different units makes it easy to measure and follow its change accordingly. It is very important to be familiar with the vegetation parameters;

Biomass: The weight of vegetation materials per unit area. Production or yield is often used interchangeably with biomass. Measuring plant biomass is regarded as an indicator of response to ecological and management practices of vegetation in rangeland. An ecological indicator is measures the most dominant species within the vegetation. The indicator also reflects the amount of energy stored in the vegetation, which can indicate the potential productivity of the site. Management indicators provide a variety of indicators for rangeland management. It is a valuable tool to assess range conditions, for short-term stocking rate adjustments according to the number of forage reserves and residual biomass. Biomass is used to estimate primary productivity, measure plant response to changes in management and environment, and estimate herbivore carrying capacity. Determine units should be selected clearly (g m^{-2}, lb $acre^{-1}$, or kg ha^{-1}) so it's very easy to express a plant weight (Holechek et al. 1995; Muir & McClaran 1997; Elzinga Ph.D et al 1998). This parameter has a good correlation with the plant's high and developing stage besides estimating herbivore carrying capacity and utilization patterns in the rangelands in a specific period (Muir & McClaran 1997; Babalik 2004).

Cover: The parts or plant parts, living and non-living or dead, on the surface of the ground. There are so many definitions of cover, but the objectives of being measured are determined by the definition. In general, the cover is usually expressed as a percentage (USDA 1999). Basal cover, ground cover, canopy cover, and leaf area index are also terms related to vegetation cover. The basal cover is generally considered more accurate measurement than canopy cover to identify vegetation changes since it is less influenced by climate fluctuations and grazing patterns (Muir & McClaran 1997).

Density: A number of individual plants or species per specific area (Abdelrahim & Abdalla 2015).

Frequency: It describes the abundance and distribution of plant species; it is a useful parameter to detect changes in vegetation over time (USDA 1999). To determine the frequency, the observer is only observing the presence or absence of a species in a sampling unit. It is the relation between the number of sampling units in which the species is present and the total number of used sampling units. The attribute is determined as a percentage of total sampling units, the frequency value range from 0% to 100% (Jadalla et al. 2015).

Species composition: Species composition or botanical composition is a contribution of each species to the standard vegetation. Practically it's the contribution of plant hits for each species. Species composition is expressed as a percentage of the total number of points where vegetation was recorded as a hit. The signifies of this attribute come out of dominance and well distribution of species in rangeland, botanical composition is used relatively to determine range condition and range trend (Muir & McClaran 1997).

Sample size and shape

The optimum sample unit size for rangeland sampling depends on the described attribute, the size of plants present and their types, and the exits of special patterns within the vegetation. Sometimes the size selected in a rangeland inventory or monitoring program is depending on a convention or previous practices. In fact, it is important to continue using the same sample units with the same size for repeated measurements, especially in the same locations. Therefore, sample unit

size must be carefully considered in the planning stages because of its significant role in determining sample accuracy and detecting sampling bias. Sample unit size influences sample accuracy by controlling boundary decisions. Larger sample units have a lower perimeter: area ratio (Table 1), which reduces possible bias from incorrect boundary decisions (Muir & McClaran 1997).Sample size and sampling tool shape have a huge effects on observed data. For example; Brummer et al. (1994) showed that increasing quadrate size accounted for 68% or more of the observed decrease in variance. The effect of quadrate shape on reducing variance was inconsistent among vegetations. Rectangular quadrates were more efficient for reducing variance than square and circular shapes (ElzingaPh et al. 1998).

Table 1
Effect of size on perimeter: area ratios of sample units (Muir & McClaran 1997).

Dimensions	Perimeter: Area Ratio
1 x 1	4.0
2 x 2	2.0
3 x 3	1.3
4 x 4	1.0
5 x 5	0.8
6 x 6	0.7

The number of samples needed to obtain accuracy is determined by the variance of the quadrate. A large number of quadrates (sample size) must be sampled regardless of quadrate size or shape to estimate vegetation of individual species with high accuracy and precision. It is very important to consider effort and cost efficiency in combination with statistical efficiency when evaluating quadrates in different sizes and shapes. Small quadrates own significant variances but require less evaluation time. When time and statistical efficiency are considered for various sizes of quadrates, small quadrates are determined to be significantly more optimum (Brummer et al. 1994). Vegetation distributions (homogeneous or heterogeneous) have a great effect on the number of samples to be selected. Also, during vegetation sampling using different sampling tools, it is very important to sample sufficient samples for the highest degree of confidence (Cakal et al. 2012). Sample units should be large enough so that most of the areas completely covered, so that most dominant plants are included. Conversely, inefficient spending of time relative to the additional information acquired is apparent in sample units that are larger than necessary. Enought sample units are reguired to include different plant life forms. In contrast, smaller sample units are more convenient in full dense vegetation. An altirnative sampling system could be used to overcome problems faced when sampling species of different life forms or so many abundance species in the sampling area (USDA 1999).

3. Vegetation Sampling Methods

The most common and classical methods that are used to examine rangelands vegetation attributes;

1- Quadrate method

2- Transect (Line) method

3- Loop method

4- Point-Frame method

5- Line Intercept method

6- Step Point method

7- Daubenmire method

8- Estimation method

9- Remote sensing and Geographic Information System (GIS).

Quadrate method

Quadrate method in sampling techniques used to sample vegetation attributes in so many vegetation types. This technique has high efficiency in evaluating rangeland vegetation parameters. The quadrate sampling method is more efficient to analyze the species richness and abundance (Elina et al. 2015).

In this method, frames of certain sizes are used to examine rangeland areas. Quadrate is a two-dimensional sample unit of any size or shape. Sometimes, a tape might be laid on the ground level at the sampling area to represent the quadrate. Nevertheless, frequently the quadrate is a frame created from narrow steel or plastic and placed from one sampling site to another. The quadrate is applied in measuring most rangeland vegetation attributes in so many vegetation types (Muir & McClaran 1997). Quadrate size and shape differ according to the dominant species and measurement purposes. The size fills between 1 dm^2 and 1 m^2 or more, rarely with slight diameters. The most suitable quadrate size used in sampling rangeland is 0.5 m^2 and 1 m^2 (Erac & Ekiz 1986). Quadrate with a gird shape is used in different sizes e.g. 20 x 20 cm, 20 x 25 cm, and 1 x 1 m (Figure 1). Generally, the most suitable and common applied size is 0.5 m^2 and 1 m^2 in sampling rangeland. The fundamental of this method depended on counting or determining vegetation or plant species in a particular area. Mostly in terms of foliation, cover grades, or other quantitative consists of examining and identifying their characters (Muir & McClaran 1997; Babalik 2004).

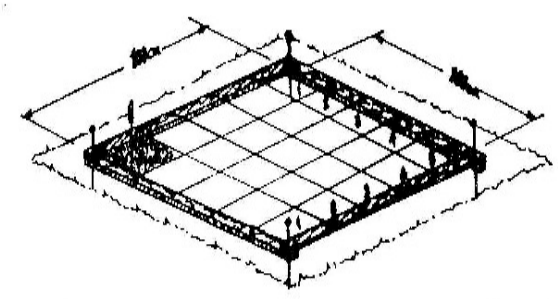

Figure 1
Quadrate shape (Gençkan 1985).

Study on vegetation with quadrates

Cover determination

Briefly, the observer is placing quadrate randomly or sometimes systematically in the specific sampling area. The examiner is looks in the quadrate and count and list each noted plant species inside the quadrate. Quadrate is placed and repeated so many times according to the study area and vegetation characters. Often gird could be used also. During the estimation process using gird, then the area covered by each species is estimated visually in every single gird, and then the total area covered by the species is summed, to represent a covered area of plant species. As the result, the sum estimate cover and the bare area should be 100%. The result is calculated as a percentage from the whole number of grids or direct visualization of the quadrate. Sampling cover with the quadrate method is very quick and easy to estimate.

Generally, the quadrate method is well adapted and widely used in sampling vegetation cover. It is induces reliable and accurate results in most vegetation types. However, to be applicable, the method is more suitable and practical in short plant vegetation. Estimating plant cover with this method depends on the vegetation density and species types.

Evaluation of frequency

Frequency is referred to the number of times that a species is appear within a used quadrate placed repeatedly across target vegetation. Frequency is expressed as a value between 0% and 100%, representing the proportion of quadrates where the particular species was found during sampling. It is generally expressed as a percentage of total placements of the quadrate and reflects a particular species at any location within the sampling stand. Only the occurrence sampled quadrates are recorded regardless of the number of species. Herbaceous plants must be rooted in the quadrate to be considered to exist (USDA 1999). Frequency is simple vegetation attribute to measure because it only requires identification of the species in each quadrate, and does not require that individuals are distinguished, measured, or counted. Therefore, data collection is usually a more rapid procedure than other vegetation attributes. However, quadrate size is very important to be considered regarding frequency sampling. The size influences the probability of occurring species within the quadrate. Where small quadrate results in low frequencies of most species and most species are not sampled. Whereas, a large one will include most species but it could not be the most common species that will eliminate the ability to detect the change in the abundance of these species. Therefore, choosing a suitable quadrate size and shape is a paramount function of the average abundance per area. Thus, in frequency sampling, more decision error is introduced in deciding if a plant is in or out of the quadrate boundaries (Despain et al 2021).

The field sheet to record frequency usually includes a species list and a tally is made for every quadrate where the species is recorded. Only a single tally is made for each quadrate, which represents the presence of the species regardless of its abundance. Once fieldwork is completed, data is summarized to estimate the frequency for each species in the sample. Procedures followed to summarize the data depend on the definition of the sample unit that was determined by the selected quadrate during the planning stages. The following formula is used to calculate frequency (Muir & McClaran 1997; Abuswar 2007).

$$\text{Frequency } \% = \frac{\text{Number of units occurrance of A species}}{\text{total number of used unit}} \times 100$$

Observing frequency with quadrate is very quick and effective. However, monitoring rangeland conditions is, overall, more a concern of abundance than distribution. Frequency data can show significant changes in percentage values whereas no real changes in abundance actually exist.

Density

Units to express density should be selected priory so that actual plant numbers are easy to visualize. Density is often used as a baseline inventory of the structure of rangeland or forest vegetation, by quantifying different species or various ages within a single species. Density data is also collected to monitor the effect of various land use treatments, such as plant survival following burning or overgrazing. Density measurements are sometimes unsuitable for the herbaceous, especially when there are so many plants to count or identification of individuals is difficult. Nonetheless, density is regularly used to evaluate seedling emergence and survival in a rangeland reseeding or rehabilitation program. Density can provide useful indicators in an inventory and monitoring program to determine range conditions and trends. Density is affected by range management especially grazing pattern and stocking rate (Bonham 1989; Muir & McClaran 1997; USDA 1999). Sampling density with the quadrate involves random and systematic sampling. Under the principles of random sampling, quadrats are located randomly, each quadrate represents a sample unit. And systematically using transect and placing the quadrate regularly along transect. Each transect represents a sample unit. The observer will count and list the occurrence plant inside each quadrate. A number of individuals per quadrate must be calculated for statistical analysis. Summarizing data involves adjusting values according to quadrate size, so density is expressed on a standardized area (i.e., m^2, ft^2, acres, and ha).

Botanic composition

Botanic composition in each rangeland site reflects the richness of this rangeland, and revealed the trends of management. Species composition can be expressed on either an individual species basis or by species groups that are defined according to the objectives of the study program. Species composition is commonly regarded as an important attribute in rangeland assessment, it is describing the characteristics of vegetation management during deeply detailed inventory programs. However, accurate determination of species composition can be hard, because all species must be sampled (Muir & McClaran 1997). To determine these attributes the observer is look in the quadrate and lists by tallying each

plant species found inside the quadrate**.** Ultimately, data is summarized and arranged to be analyzed according to the plant composition and species composition. Species composition is based on the percent of the various species. The following formula is used to determine botanic composition:

$$\text{Botanic composition} = \frac{\text{number of species A in the quadrate}}{\text{total number of species}} \times 100$$

Plants biomass

Biomass is one of the most commonly measured attributes in range inventory or monitoring programs. Biomass data may be collected on an individual species basis, as species groups, or as a total weight of the vegetation. Species composition may also be calculated as the contribution (percent by weight) that each species makes to the total biomass (Holechek et al. 1995; Muir & McClaran 1997).

Biomass is an attribute that is time-consuming and laborious to collect, but easy to interpret. Vegetation productivity is estimated with the quadrate by clipping the plant inside the quadrate. Clipping is the most common method used to determine herbage weight in rangeland. Consistency is needed in terms of clipping height and separation into live and dead components. Herbage weight is determined by clipping the vegetation within the quadrate. In spite of, the labor and time-consuming method it is still widely used in monitoring vegetation. Moreover, Biomass is usually determined on a dry matter basis, which is the weight of plant material after the moisture within the plant material has been extracted. Moisture content varies among species and during the year, according to the stage of growth and growth form. Summarizing weights on a dry matter basis facilitates comparisons of biomass among sites and over time by eliminating other confounding factors (Holechek et al. 1995; Muir & McClaran 1997). Dry matter content is determined by drying a sample in an oven, usually, at 60 – 70 ° C, for 72 hours, or until they reach a constant weight is obtained, after that the weight is taken with a suitable balance (Severoğlu 2018; Osman 2019). Since moisture levels differ among species, samples of individual species may have to be dried and weight separately. Dry matter weight is always obtained on the base of the standard unit (gr m^{-1}, kg $acre^{-1}$, or ton ha^{-1}).

Transect (line) method

Transect is a linear used for quantitative plant ecology characters. Sampling a floristic quantitative of herbaceous in rangeland in most conditions using various transect lengths. Generally, transect length description as 1 cm wide and 100 cm in length, in this miner it is quite sufficient for vegetation sampling. The basis of this method is laying a 100 cm^2 long tape. To evaluate vegetation attributes in rangeland 105 – 120 cm transects are stretched with 1 cm in width along the target area (Eraç & Ekiz 1986; Yilmaz et al. 2016). Practically it took the sample centered 100 cm^2, and two transect ends are left blank. Besides of transect strip steel (measuring stick) and fixed metal are required in this method. Strip steel is used to hit a plant species along transect and to distinguish it easily, fixed metal is to stick the transect end for more accuracy and to make it fixed without any movement during noted and sampling (figure 2) (Eraç & Ekiz 1986; Babalik 2004; Altin et al. 2011). However, 20 m transect length is well applied and proposed by so many researchers. A narrow and slight transect is preferred since, when looked at it from above the bottom of transect should be well visible and all plants and easily distinguished. The method is widely used in measuring vegetation attributes; its sampling error is very small. The transect method is used to examine all vegetation measurements in rangeland even shrubs and trees (Altin et al. 2011).

The application of this method includes throwing transects randomly on the vegetated area. With the aid of a fixed stick, the transect bar is sticked, so that the bar does not move during the measurement. For every 1 cm^2 it tallies vegetation along transect. The measuring stick is moving forward to determine what is touching the tape. If there is a plant in contact with the flat part of the measuring tape during the forward movement, the species is determined namely, and if there is none, it is recorded as bare soil (Uçar 2019). During sampling, the observer record each hit points to estimate vegetation attributes (vegetation cover, species composition, density, and frequency) (figure 3). Transect number and arrangement depending on the study purposes and vegetation dens. Besides of some considerations i.e. soli type, sloping, and most dominant species (Yilmaz et al. 2016). With this method, it can estimate vegetation cover, botanic composition, and frequency. Ultimately the data are organized and interpreted according to the target parameter.

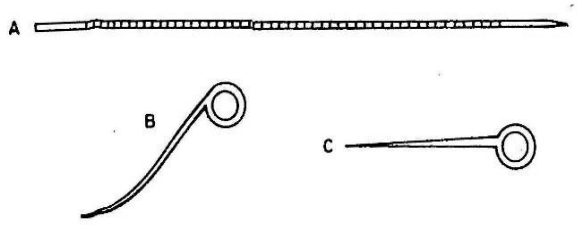

Figure 2
Transect method; A- transect tape, B- measuring stick, C- fixed stick (Altin et al. 2011)

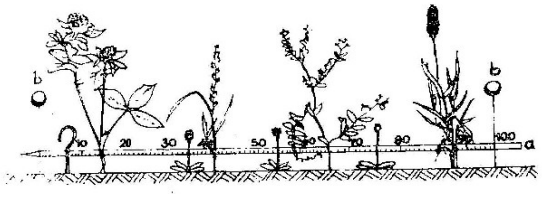

Figure 3
Application of transect method (Gençkan 1985).

Assessment vegetation attributes with transect method

The method consists stretching of 100 cm^2 of an area. To follow this method, points are taken every 1 cm^2 along with measuring tape, that is extended to create transect across the site. The tape could be stretched systematically or randomly in the study locations.

Defiantly, depend on some factor such as; species diversity and abundance, soil type, and slope. Each transect considers a sample unit, therefore it recommends to sample so many transects for statistical analysis. For each plant species, the sum of the hits found is given as a percentage of the area covered with vegetation. After the completion of fieldwork data is arranged and summarized to determine vegetation attributes;

a) Assess plant cover: The following formula used for this attributes.

$$\text{Plant cover} = \frac{\text{total hits on the plants}}{\text{total number of hits}} \times 100$$

b) Botanical Composition: it calculated with this formula;

$$\text{Species composition} = \frac{\text{No hits on the A species}}{\text{No hits on the plants}} \times 100$$

c) Frequency: Examined transect samples of a plant species how many times it's has been appeared in the sampling. It s simply calculated by this formula:

$$\text{Frequency} = \frac{\text{No of unit the A species is occurance}}{\text{No of used units}} \times 100$$

Loop method

The loop method is introduced by rangeland scientists to execute vegetation measurements. The method consists of a metal loop and measuring tape 20m in length. The loop contains a ring in the end which is used to direct and detect hits along transects. Briefly, the method consists of a 20 – 30 cm loop metal length with a 2 cm diameter ring, in the end, 20 m tape, or any type of measuring transect. In the direction of the loop every 20 cm a hit is taken, totally about 100 points are taken in each transects. This method is commonly used in vegetation sampling to evaluate range conditions and trends.

Practically, the method is based on the measurement of a plant with a directing loop on the line/tape at regular intervals every 20 cm. At every point from the beginning of the line, the loop is suspended in the vertical direction of the vegetation, and the plant, litter, rock or bare soil, etc., inside the ring, is recorded in the prepared relevant form (figure 4). Sometimes more than one plant might be noted in the same loop, in this case, only the strongest plant is considered present (Tosun & Altin 1986; Eraç & Ekiz 1986; Babalik, 2004; Altin et al. 2011).

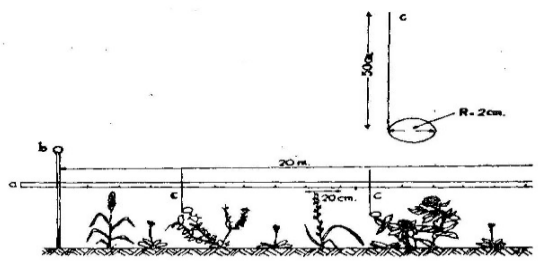

Figure 4
Application of loop method in the field

Determination of vegetation attributes with loop method

a) Cover: Since the hit points along measuring tape is recorded. Each hit point on the cover is automatically summarized and give the percentages of the vegetated area, by the following formula;

$$\text{Vegetation Cover} = \frac{\text{No of hits on the plant species}}{\text{total No of hits}} \times 100$$

b) Botanic composition: The parameter is determine according to this technique by summarizing the whole hit point on the specific plant species divided with the hit points on the vegetation. Here this formula used to determine a parameter;

$$Botanic\ composition = \frac{\text{hit on A species}}{\text{total hits on vegetation}} \times 100$$

c) Species frequency:

$$Frequency = \frac{\text{hit occurance on A species}}{\text{Total No of hits}} \times 100$$

Point-frame method

The point frame method is based on point sampling to determine range attributes. It consists of a standing frame that holds a set of vertically aligned pins, which are lowered as sampling points to record vegetation. The frame has about 10 pins consider a point. A common arrangement consists of 10 pins each 10 cm in the interval. The most suitable and common size of the point frame is 1m in height and width. So the same plant is not hit by all pins. Each point frame is usually considered a sample unit, so commonly cover data can be assessed in 10% intervals. Data from several frames are required for statistical analysis (Muir & McClaran 1997).

Generally, the method consists of a tool in frame shape that carries the pins. The frame width is 1 m horizontal axes length (standing on two legs in the side end) such that they can be movable fixes (figure 5). The frame carries about 10 pins (points), they are arranged on the frame 10 cm between each point (figure 5). The pins are passed through the holes on the vehicle (frame) the pins are placed in the vertical position and move up and down during sampling. The pins are made of metal, and the end of the point frame tool feet are tapered to ensure that remain in a fixed position in the ground (figure 5). The point-frame method is based on the analysis of the cover and botanical composition. In the process of application in the field, it is important to distribute the frame over the study area. It was proposed random distribution of the frame during sampling for more accurate results (Babalik 2004), and others propose to be applied across the field in sequence along a straight line. The number of points to be sampled in the range depends on the vegetation and the study area (Altin et al. 2011). The application of the technique depends on placing the frame at the interested measuring field, and then the pins are lowered down. These pins will hit the existent vegetation or (bare soil, rock, or litter) whatever it touches will be recorded (Tosun & Altin 1986).

The method provides significant accurate cover results, as long as enough points are observed. Somehow, eliminates much of the bias arising from subjective placing. The point frame is practically suitable for grasslands and other low-growing vegetation. However, the method becomes impractical in taller shrub lands and trees even with the mixed vegetation because of

difficulties in placing the point frame above tall plants. It is also not suited to sample dense vegetation (Muir & McClaran 1997).

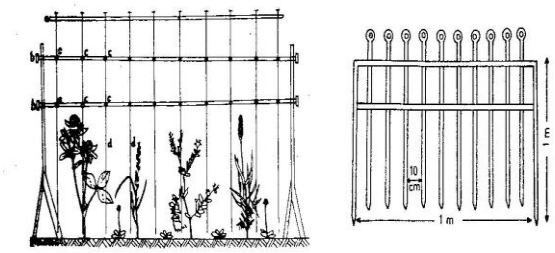

Figure 5
Point-frame shape and field application (Gençkan1985; Tosun & Altin 1986).

Line intercept method

The method consists of horizontal, linear measurements of plant intercepts along the course of tape (line). It is designed to measure grass or grass-like plants, forbs, shrubs, and trees (USAD 1999). The line intercept method was developed to estimate cover and botanical composition in arid and semi-arid grasslands.

To follow this method, a tape is extended to create transect across the site. The observer proceeds along the line transect, identify plants intercepted by the tape and records intercept distances. The cover is calculated by adding all intercept distances and expressing this total as a proportion of tape length. Each transect is represented as a sample unit, therefore several transects must be measured for more reliability of vegetation conditions and statistical analysis. Measurements can be made for either basal cover or canopy cover, according to the objectives of the study. Species composition is easily estimated from the relative proportional represent each species. Transect length depends on the vegetation and type of plants that are to be measured. In many sampling programs, 3 m is used (USDA 1999). However, 15 m transects have been found suitable in dense vegetation, while 30-50 m is needed to obtain a representative sample in spared vegetation area (Muir & McClaran 1997).

The line intercept method is well adapted to sampling variance densities and different types of vegetation and provides an accurate estimate of cover. In fact, the line intercept method is often used as the standard comparison when testing other methods to determine cover. However, the primary drawback of sampling with this method is time-consuming, particularly in dense vegetation (very difficult to recognize individual plants) or when intercept distances are difficult to define because of many gaps or irregular edges within the canopy. Therefore, the line intercept technique is best suited for vegetation characterized by discrete plants (Tosun 1972; Muir & McClaran 1997; USDA 1999).

To apply this method a baseline is established by stretching a measuring tape in a desired sampled area across vegetation. Sometimes for an extremely long baseline, intermediate stakes could be used to ensure proper placement of the tape. To collect vegetation data the observer will measure each intercepted area by the plant species along transects.

a) To estimate the percent cover for each plant species by tallying the intercept measurements for all individuals of that species along the transect line and converting this total to a percent.

b) Calculate the total cover measured on transect by adding the cover percentages for all the species. This total could exceed 100% when the intercepts of overlapping canopies are recorded in study.

$$\text{Cover} = \frac{C}{B} \times 100$$

C = Total intercepted area with all plants (cm)

B = Transect length (cm)

c) Botanical composition; species composition is based on the intercepted cover of each species. Determination of the parameter by measuring the covered proportion of transect with the plants (USDA 1999). The following formula shows how it can calculate:

$$\text{Botanic composition} = \frac{A}{B} \times 100$$

A= Target species intercepted area (cm)

B = Transect length (cm)

Step point method

A step point method is an approach based on point sampling to determine cover. To procedure this method, the observer uses a mark placed on the tip of his boot (often a pin or a notch) as the sampling point. Hits are recorded by identifying whatever falls directly under the mark along a placed transect. The step point method is regularly used for rangeland inventory or monitoring purposes because it is easy to apply and rapid to employ, allowing large areas to be quickly described. Nevertheless, undesirable variability often occurs among observers, caused by bias associated with point size and foot placement. Some modifications, including pointed tape that extends beyond the wheeled point apparatus, have been developed in an attempt to overcome the biases arising from subjective placing. Most relevant results are obtained by the step point method in open grassland. To implement this technique the observer is laying measuring tape along the study area. Then the sampler put a marker (usual pin) made of metal on the end of his boot and walk among transect, recording whatever hit the mark (plant, bare soil, litter, and rock) in the prepared form. The placed transect is considered the sample unit. Data from several transects are required for statistical analysis. It is used in loop or line-transect methods to determine vegetation attributes (Muir & McClaran 1997; USDA 1999; Altin et al. 2011).

Daubenmire method

The Daubenmire method consists of systematically placing a 20* 50 cm quadrate frame along measuring tape. The Daubenmire method is used to estimate vegetation cover, botanic composition, and frequency. The method is applicable in a wide variety of vegetation types especially in short grasses.

To implement this method a line tape is laid along the intended sample area. The quadrate is placed along the tape at the specified intervals, estimating the canopy coverage of each plant species. Recording the obtained data from each quadrate, to estimate cover class according to the Daubenmire form (see Table 2).

Table 2
Cover separate classes (Daubenmire 1959; USDA 1999)

Cover class	Range of covarege	Midpoint of range
1	0 – 5 %	2.5 %
2	5 – 25 %	15.0 %
3	25 – 50 %	37.5 %
4	50 – 75 %	62.5 %
5	75 – 95 %	85.0 %
6	95- 100 %	95.5%

The observer looks directly from above and estimates the cover class for all individuals of a plant species in the quadrate, all other plants species are considered separately according to:

a) Canopy Cover: Determine the percent canopy cover by species as follows:

- On the Daubenmire form count the number of quadrates in each of the six cover classes (by species) and record in the (Number column) on the Daubenmire summary form.

- Multiply this value with the midpoint of the appropriate cover class.

- Sum the result for all cover classes by species.

- Divide the sum by the total number of quadrates sampled on transects.

- Record the percent cover by species on the form.

b) Frequency: Calculate the percent frequency for each plant species by dividing the number of occurrences of a plant species (the number of quadrates in which a plant species was observed) by the total number of quadrates sampled along transect, multiply the resulting value by 100.

c) Species Composition: With this method, species composition is based on the canopy cover of the various plant species. It is determined by dividing the percent canopy cover of each plant species by the total canopy cover of all plant species (USDA 1999).

Estimation method

The method is based on the evaluation of the vegetation qualitative by observing the vegetation in a specific area, rather than measuring the characteristics of the plants. In this method, small plots are selected and estimated visually. Some estimation methods are used clipping for comparison with optical estimation. Estimation methods require considerable training and constant checking on the part of the estimator. The method consists of estimating the weight of the plants in the plot unit and then clipping it for comparison. The method is very quick and the result is achieved easily. However, the disadvantages of the method are a) the evaluation results change from person to person, b) the assessment of the same person on the same vegetation can change over time, and c) the impossibility of evaluating the recorded qualitatively by observation in this way by other observers later on (Tosun & Altin 1986).

The application of these methods on a field consists, of a small part of the vegetation being bounded by the frame (approximately 1m2quadrate) and examination done by looking directly at the top and performing the prediction process. Firstly the estimation is carried by species, each covered area with specific species is estimated by eyes, and then the sum covered area by all plant species is calculated. The method is well suitable in short grass or after grazing or mowing, but the application of this method is very difficult in tall grass or even shrubs. Moreover, the accuracy of the observer depends on experiences and training (Eraç & Ekiz 1986; Babalik 2004; Altin et al. 2011).

Remote sensing and GIS

Remote sensing is an advanced and sophisticated tool that is used to qualify rangeland. Remote sensing is a modern tool contributing to sampling and monitoring vegetation in rangeland; it allows characterizing the spatial and temporal variability of biophysical parameters by quantifying and analyzing the electromagnetic energy reflected by the vegetation. The initiation of new freely available satellite imageries such as Sentinel- 2 and Landsat-8 has offered new biodiversity assessment and monitoring opportunities. These new satellites' improved spatial and spectral resolutions are also renewing for algorithm or methodological protocol development, particularly for different landscapes (Junges et al. 2017). Recently, exploitation of remote sensing data has been used efficiently for monitoring vegetation in a wide area of rangeland. In particular, depends on the reliable and precise definition of the existing terrestrial vegetation. In such a situation, modern remote sensing and geospatial techniques have an important role in classifying and mapping the vegetation cover of rangelands and forests (El-Hassan & El-Tayeb 2014).

Remote sensing is defined as the observation of objects from a certain distance without any direct contact using a special instrument or electronic device. The vegetation of an area can be determined from satellite images. Satellite data and advanced classification techniques are carried out to detect and produce land cover /change maps. Remote sensing and geographic information system technologies are appropriate tools for providing practical and near-real-time analysis capabilities, which could help to assess and monitor vegetation of rangelands, degradation, and management features (Jong et al. 2004; Marsett et al. 2006; Mohamed 2006). Remote sensing offers biophysical variables like vegetation indices that are utilized to detect variability and changes in rangeland ecology in large areas over several years (Bastin 2006; Amiri and Shariff 2010; Chuvieco & Huete 2010). In addition, the integration of remote sensing and geographic information system in environmental studies has increasingly become common in recent years. Remote sensing imagery is an important data source for the environment. Geographic information

system capabilities are being used to improve image analysis procedures (Hinton 1996).

Remote sensing data and vegetation indices are effective tools to study rangeland and vegetation cover. Besides, it is used in large areas of rangeland to collect vegetation parameters. Combination of vegetation indices reflectance measurements from different portions of the electromagnetic spectrum to provide information about vegetation cover on the ground. The vegetation indices are radiometric measures of the spatial and temporal patterns of vegetation photosynthetic activity that are related to canopy biophysical variables such as leaf area index fractional vegetation cover and biomass (Jabbari et al. 2015; Ghorbani et al. 2012). More than 20 vegetation indices have been defined and used to detect change and estimate vegetation cover in rangeland. The Normalized Difference Vegetation Index (NDVI) is the most widely used in such studies. The NDVI values theoretically range from (-1) to (+1). In areas where there is a lot of green vegetation, the index value approaches +1, while in areas where there is little vegetation, it has minus NDVI values. Different image techniques are used in this technique for data processing and analysis which include geometric correction, radiometric correction, atmospheric correction, image enhancement, and false-color composite (Xue & Su 2017; Dharmawan et al. 2021).

The fundamental of this method is based on monitoring and/or measuring reflected spectral greenness or absorbed photo-synthetically active radiation and thus photosynthetic activity in the vegetation (Zhou et al. 2009). Extraction of information subsequently makes these extracted features available, and it is very easy to qualify without destruction or any type of damage to vegetation (El-Hassan & El-Tayeb 2014; Gandhi et al. 2015). This technique is very easy to apply to all types of vegetation without any restrictions. The method has a high degree of accuracy compared to the classical methods. Remote sensing systems provide more useful and practical data in determining the boundaries of grassland areas, detecting changes in vegetation over time, and generating classification of rangelands.

In conclusion sampling in rangeland is very important to the managers as a consequence of plans and monitoring programs. The selection of suitable and appropriate techniques is essential. The methods to be applied in the study and analysis of plant vegetation depend on the characteristics of plant vegetation. Observation and the purposes of the sampling should be considered. There are no standard techniques or methods that are recommended to sample or estimate rangelands. However, the methods and procedures to be used should give the most accurate data about the sampled vegetation. Likewise, the selected methods should be easy to apply during sampling and do not take so much time and labor. Moreover, the method must be approved, accepted, and well recognized. For the huge variation and differentiation in vegetation characters and rangeland conditions, the method and procedures should be adjusted to that condition.

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The Significance of Bokashi Compost Obtained from Beneficial Microorganisms on Sustainability and Waste Disposal

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ABSTRACT

It is known that the use of chemicals is one of the leading factors that cause soil pollution. Studies are carried out to developed new methods for reducing the damage caused by chemical inputs that continue to increase and to ensure the sustainability of wastes by creating awareness of nature protection in product cultivation and consumption. In addition, the irregular storage of household waste has become a serious problem in our country. This problem greatly affects climate change by causing environmental pollution. In order to reduce or even eliminate these effects, bokashi compost, which is obtained from organic wastes, has been produced for many years in the world with the aim of improving the physical and chemical properties of soils, increasing productivity and sustainability. The aim of this study is to determine the importance of bokashi compost, which is produced with the help of beneficial microorganisms, which is an effective soil conditioner to maintain the existence of our natural ecosystem that does not cause environmental damage, in terms of sustainability.

1. Introduction

Our country comprises a geography that has hosted the biodiversity of different cultures for centuries, where a wide range of agricultural activities are carried out until today and which has the most suitable climatic conditions in the world in terms of agricultural production. We owe it to the very fertile soil structure entrusted to us in order to bequeath a legacy to future generations and the existence of our unique ecosystem in order to carry out a wide variety of polyculture agricultural production in our lands. This will be possible by protecting our rich wealth and applying correct and programmed agricultural techniques by preserving soil fertility and quality for the sustainability of agricultural production. Accordingly, increasing the amount of organic matter in the soils is the first step to be taken. Since the past, the need for organic matter of the soils has been ignored and the chemical pollution experienced in our soils has caused serious problems due to the chemical inputs applied incorrectly and continuously with the idea of increasing the product yield.

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Although the fact that we have insufficient raw materials of fertilizer in our country causes us to be economically dependent on foreign countries, we are faced with a great loss within the scope of sustainability when we evaluate the income we will obtain in the short term in the long term by weakening and barren our highly fertile lands. In addition, human, animal, plant presents significant threats in terms of environmental health. When all these reasons are evaluated, the significance of environmentally friendly smart agricultural practices has increased in order to ensure the sustainability of organic wastes aimed at increasing the productivity of our heritage soils (Bellitürk and Goldmann, 2020; Çelik and Kılıç, 2020). Although the controlled disposal of organic wastes is more of a problem in developed countries compared to the population, both environmental and domestic wastes have reached serious dimensions in our country by drawing attention to the increasing consumption due to the rapidly rising population density in recent years (Kılbacak, Bellitürk and Çelik, 2021). Uncontrolled storage of waste plays an important role on the climate change in addition to revealing environmental problems. At this point, our duty is to separate all kinds of organic wastes, process them with completely natural methods and convert them into organic fertilizers that are both suitable for the balance of nature and have economic added value and ensure their sustainability.

In this direction, the importance of compost and biogas production facilities is increasing with the aim of recycling which has gained momentum in recent years and studies are carried out in accordance with the 100% natural ecosystem.

Bokashi compost

As seen in the world, bokashi compost obtained from organic wastes is produced in order to increase the fertility of the soils that have gained importance in recent years in our country and to improve the physical and chemical properties of the soil with the aim of sustainability.

Bokashi is a Japanese term for organic matter that has been fermented. Although there are many types of composting activities, the easiest and cheapest method is known as bokashi compost. In general sense, bokashi compost, which was developed in later periods by taking the old Japanese culture as an example, emerged as a result of the activities of EM (Active Microorganism) created by anaerobic conditions.

It has gained importance in recent years in the world and is widely used and produced although it displays differences according to countries. In bokashi compost, which is created from domestic organic wastes in Europe and the USA, the bokashi bran is obtained with EM first which is known as beneficial microorganisms. The resulting bokashi bran is added the organic parts of the kitchen wastes after separation and left to fermentation for about 21 days in the buckets that do not take air with the mouth closed. During fermentation, the drainage of the leachate accumulated at the bottom ensures the continuity of beneficial microorganism activities (Alattar and Popa, 2016). The production of bokashi compost is mainly to impregnate beneficial microorganisms in a dry dandruff and then dry them to preserve them under suitable conditions and store them for use. Unlike other composting processes, bokashi is similar to pickling made in homes. Since it can be easily made in a bucket that does not take air with its mouth closed, we can obtain bokashi compost even in our homes. Since EM completely undertakes composting, it does not require processes such as mixing, ventilation and turning as in other compost types. Citrus, animal products such as meat and dairy products and similar wastes, in short, materials that cannot be used in other composting processes, undergo a rapid fermentation and break down in bokashi. It is possible to produce at home lactic acid bacteria, which are necessary for the construction of bokashi compost and carry out the main decay process. Active microorganisms are organisms that were discovered and developed in the early 1980s by Dr. Teruo Higa.

The theory of Dr. Higa is presented that there are three kinds of microorganisms in any system such as the atmosphere, soil, and water: positive microorganisms, negative microorganisms, and opportunistic microorganisms. Regardless of the system, the healthy development of a formation depends on the equal and balanced harmony of positive and negative microorganisms in the environment. They are opportunistic microorganisms that change places depending on the multiplicity of other microorganisms in the environment. In the system, if negative microorganisms are in the majority, they are on their side, and if positive microorganisms are in the majority, they are on the positive side. The main goal of active microorganisms is to increase the presence of positive microorganisms in the system and to attract the attention of opportunistic microorganisms and to get their support.

Bokashi compost production activities constitute areas to maintain the process in the world effectively and continuously. However, it is still not a widely applied compost variety in Turkey. This leads to the fact that the exact method of composting cannot be determined. In recent years, research has been initiated and trials have been conducted. The positive effect of bokashi compost on the physical and chemical properties of the soil and its yield-increasing effects on plant growth have been stated as a result of the studies conducted worldwide.

Bokashi compost is a material that is considered as a soil conditioner and used as an organic fertilizer containing humus with a very high content of organic matter (Tanuğur, 2009).

In a pot trial in which they conducted (Guzman-Holst, Zaneva, Chessell, Creswell, and Bowes, 2022), they aimed to determine the effects of EM-bokashi, which is applied in different amounts during the development of radish (Raphanus sativus). As a result of the study, EM-bokashi treatment increased the average lump diameter, length and weight significantly. It has been observed that bokashi compost which was produced by using different organic wastes increases the chlorophyll levels and dry biomass values of cucumber (Cucumis sativus) and cabbage (Brassica napus subsp. pabularia) seedlings (Abo-Sido, Goss, Griffith, and Klepac-Ceraj, 2021). In an incubation study with bokashi compost was added to organic waste, chemical properties of the soil, nitrogen concentration and nitrogen mineralization were increased in the soil (Augusto, Luiz, and Beatriz, 2018). It was also found out that bokashi compost has an effect on the evaporation of water from the soil and a decrease in soil temperature (Lasmini, Nasir, Hayati, and Edy, 2018). In a study (Christel, 2017), the researcher thermophilic compost and vermicompost, respectively to the soil where spinach (Spinacia oleracea L.) is grown with bokashi. As a result, they observed that the application of bokashi improved the yield and quality of the plant and the application provided plants longer- lasting and accessible inorganic N support than vermicompost.

Bokashi application increased the nutritional

quality of spinach by increasing the concentrations of K, Fe, Mg and Zn in spinach leaves compared to other applications.

In addition, the second harvest showed a higher N content in the spinach leaf texture compared to the others. In a study (Erdoğdu, 2020) the effects of bokashi compost with beneficial microorganisms on yield and yield characteristics of silage corn was investigated. It was observed that the organic matter content increased in the soils where bokashi was applied, and the raw ash and cellulose content increased in the raw materials chopped with silage. In a 11-year study (Hu and Qi,2013), it was found out that the nitrogen and phosphorus ratio contained in the leaves was higher as a result of dry matter analysis the effects of bokashi compost and traditional compost application examined on wheat yield. According to the results of the research, it was reported that the positive effects of beneficial microorganism activities on the increase in yield in wheat were reflected due to the stimulating effects on nutrient mineralization.

2. Conclusion

Lack of organic matter which has an extremely important place in agricultural production activities is the main determining factor affecting the quality and yield of the product. Continuous and uncontrolled chemical fertilizer applications without providing organic matter supply to the soils increase the yield during the harvest period and causes mistakes and ignore the negativities they create in the soils in the name of sustainability of agricultural production in the long term. Chemical inputs used in agricultural activities carried out by traditional methods are applied unconsciously and in large quantities, affecting the natural balance of our soils completely negatively and accelerating the process of inefficiency. For this reason, it is inevitable to use bokashi compost in the name of sustainable agricultural production, especially in traditional and all agricultural productions, respecting the natural environment to protect the ecosystem, as well as considering soil and plant health, and evaluating all kinds of animal and vegetable organic wastes**.** The realization of all natural and organic fertilizers obtained from organic wastes with a sustainable agriculture in the cultivation of plant products in terms of human health should now be undertaken as a universal duty. It should become our main duty to organize and carry out sustainable agricultural techniques with supra-state agricultural policies on behalf of the generations that reproduce without disease without disturbing the biological balance of our soils, and to project and support them. In addition, unsupervised storage and uncontrolled disposal of household wastes has become a major problem in Turkey. Based on this problem, it was decided to establish and implement decisive criteria for the regular storage of domestic solid wastes in our country (T. Ç. M. Odası, "Hava kirliliği raporu,2018). In the declaration published after the 'Zero Food Waste Leaders' Network' meeting held in Ankara on 10 October 2018, it was announced that the average food waste in our country was 26 million tons and the idea of taking the necessary steps to reduce these wastes to the lowest levels was defended (Kılınç Şahin,2016). On average, the amount of organic waste in the USA annually is 30 million tons. Based on the announced figures, studies continue to be carried out to ensure the evaluation and recycling of organic wastes worldwide. With this goal, the United Nations General Assembly has decided to reduce the food and organic wastes sent to the burial disposal facility by half until 2030 within the scope of the 2030 Sustainable Development Goals (Lan, Sun, and Fan,2020).

If all these developments are taken into consideration, bokashi compost can be one of the effective methods that can be applied in solving the problems related to the storage of organic wastes and the recovery of the nutrient element in the content of foodborne wastes to the soil.

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