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Performance of Wheat (Tricticumavestium L.) as Influenced by Application of Single Super Phosphate Alone and In Combination with Different Organic Fertilizers in Calcareous Soil of Swabi, Pakistan

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ABSTRACT
The influence of Single Super Phosphate (SSP) alone and in combination with different organic fertilizers were evaluated in a field study on wheat (*Tricticumavestium* L.) production conducted at farmer field located in Swabi, Pakistan during 2017-18. Results exposed that among all the treatments, combined application of SSP at 100kg ha^{-1} along with 6 t ha^{-1} Poultry manure significantly improved the growth as well as yield parameters of wheat crop. On the other hand, spike length remained unaffected by all the treatments in the prevailing soil and environmental condition. Combined use of SSP and PM were strongly suggested for obtaining optimum yield of wheat crop.

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Pakistan'ın Swabi Bölgesindeki Kireçli Topraklara Uygulanan Süper Fosfat ve Super Fosfat ile Organik Gübre Kombinasyonlarının Buğdayın (Tricticum avestium L.) Performansına Etkisi

ÖZET
2017-2018 yıllarında Swabi (Pakistan)'da yetiştirici şartlarında yürütülen bu çalışmada, Sadece Süper Fosfat (SSP), Organik ve Süper Fosfat ile farklı organic gübre (SSP+Organic Manure) karışımlarının buğday verim ve performansına etkisi araştırılmıştır. Uygulanan gübre kombinasyonlarından hektara 100 kg SSP ve 6 t kümes hayvanı gübresi (SSP+PM) kombinasyonunun buğday verimi ve büyüme parametrelerini önemli ölçüde iyileştirdiği sonucuna varılmıştır. Diğer yandan, başak uzunluğunun mevcut toprak ve çevre koşullarında herhangi bir uygulamadan etkilenmediği görülmüştür. Çalışma sonucuna göre; optimum düzeyde bugday verimi elde etmek için SSP ve PM'nin birlikte kullanımı önerilmiştir.

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INTRODUCTION
Wheat technically known as *Tricticumavestium* L. belongs to the family Poaceae, one of the most important cereal crops grown all over the world. Pakistan ranked 6th among top wheat producing countries in the world and 3rd largest producer in Asia. In cereal crop production wheat ranked 1st in Pakistan, contributes greatly to growth and survival of peoples of the country (GOP, 2016). It is a predominant staple food and a major daily diet providing carbohydrates, dietary fibers, proteins and vitamins (Economic survey 2001; Hussain *et al.* 2004; FAO, 2009). About 80 % of Pakistani farmers cultivated wheat on an area of 9.23 million hectares with total production of 25.5 million tons during the winter season 2016. Wheat contributed 10 % to the total agriculture and 2.1 % to the total country gross domestic product (GDP) (MINFA, 2016).

Wheat yield in Pakistan is 2 tons ha^{-1} which is comparatively very low as compare to United Kingdom and Germany yield 8 and 7 tons ha^{-1} respectively. The major constraints of low wheat productivity in Pakistan are inappropriate nutrients application, intensive cropping system, unpredictable weather condition and erosion that considerably deplete the soil fertility and ultimately affect the wheat productivity. Continues use of chemical fertilizers and improper soil and nutrients management create catastrophic effects on our soil fertility (Arif *et al.* 2014). Moreover, Continuous application of chemical fertilizers causes soil health problems even if applied in balanced

proportion (Zia *etal.*, 2000). For this purpose, agriculture scientists are now trying to develop an agriculture system which not only lower the production cost but also conserve the natural resources (Abbas *et al.*, 2012). Organic fertilizers like FYM, compost and PM either in combination with each other or with mineral fertilizers render greater beneficial effects on growth as well as yield parameters of crop (Gowda, *et al.* 2010).

Pakistan soils are generally low in organic matter (less than 1 %) firstly because of the arid climate of the country and secondly because of very less amount of OM added during crop cultivation (Abbas *et al.*, 2012) and it can be increased through the utilization of both organic and mineral fertilizers in combination (Bodruzzaman *et al.* 2010). Organic fertilizers may be the best substitute for chemical fertilizers because the importance of organic fertilizers cannot be ignored. Organic fertilizers have many characteristics. They supply a variety of nutrients to the crop as well as add organic matter content to the soil which in turn improves the soil physical characteristics. The positive interaction between the combination of organic and mineral fertilizers was reported by (Pong and Laty, 2000). Now-a-day artificially synthesized fertilizers are the trend and commonly in use but it is also fact that increased the expenses of farmers to such a level that an average farmer can't avail those sources. Apart from these uses of artificially synthesized fertilizer badly affect the soil fertility from various angles and contaminates the environment at various levels. The combination of organic manures with chemical fertilizers can be helpful to wash out the worse effects of the long-lasting use of synthetically prepared fertilizes (Jama *et al.* 1997).

Keeping in mind the importance of organic fertilizers the present study was launched to evaluate the effect of SSP alone and in combination with different organic fertilizers on wheat crop yield.

MATERIALS and METHODS

Site Description

A field study was launched at farmer field in village Dagi, District Swabi, lies between 34° 7', 48" N and 72° 28', 11" E of Khyber PakhtunKhwa, Pakistan.

Experimental design and treatments

The experiment was laid out in randomized complete block design (RCBD) having three replications. Each plot size was kept to 20 m^2. A total of eight treatments (given below) were utilized in the experiment. Phosphorous (P) as Single Super phosphate (SSP) was applied at rate of 100 kg ha^{-1} alone and in combination with different organic fertilizers. Farm yard manure (FYM) and compost was applied at the rate of 10 t ha^{-1} and poultry manure (PM) was applied at the rate of 6 t ha^{-1} (Recommended doses for under study soil).

T1 Control (No. fertilizers)
T2 Single super phosphate (SSP) (at rate of 100kg ha^{-1})
T3 Compost (at rate of 10 t ha^{-1})
T4 Farm yard manure (FYM) (at rate of 10 t ha^{-1})
T5 Poultry manure (PM) (at rate of 6 t ha^{-1})
T6 SSP + Compost
T7 SSP + FYM
T8 SSP + PM

Methodology

The wheat variety Manthar 03 was used as test crop during the experiment and was sown with seed rate of 120 kg seed ha^{-1} and maintained row to row distance of 30 cm. P as SSP was applied at the rate of 100 kg ha^{-1}. A week before sowing of seeds, SSP and organic fertilizers were applied. At sowing time Recommended doses of nitrogen at the rate of 120 kg ha^{-1} and potassium as sulphate of potassium (SOP) was applied at the rate of 60 kg ha^{-1}. Nitrogen was applied in two splits, first dose at sowing time and second at the time of first irrigation in the form of urea. The crop was irrigated at continuous intervals according to the need of crop and the weeds which emerged during crop growth were manually pulled from whole of the experimental area. The growth parameters like plant height and spike length (cm) were recorded at maturity stage of crop. Wheat yield parameters like 1000- grain weight, grain yield and biological yield (t ha^{-1}) were recorded after harvesting of crop.

Analysis of soil and organic fertilizers

Before the experiment a composite soil sample was taken from the field at 0-15 cm depth and physiochemical properties likepH, EC (Richards, 1954), soil texture (Gee and Bauder 1986), lime content (U.S. Salinity Laboratory Staff. 1954), and OM (Nelson and Sommer, 1982) of the experimental soil were determined. The soil was also analyzed for total N (Bremner, 1996), AB-DTPA- extractable P and K, (Soltanpour, 1985). The under-study soil was found silty clay loam in texture, alkaline in reaction with pH value (8.12), EC (1.4 dsm^{-1}), low in organic matter (0.69) and highly calcareous in nature ($CaCO_3$ 16.8%). The available total N 0.05 %, available P 3.5 mg kg^{-1} and exchangeable K 120 mg kg^{-1} were recorded respectively (Table1). The same physiochemical characteristics of the same soil series was also reported by Jamal and Jamal (2018).

Statistical Analysis

The collected data were statistically analyzed and recorded. Least significant difference (LSD) at 5 percent probability level was computed to compare treatment means (Steel *et al.* 1997). Organic fertilizers were also subjected to nutrient analysis (Ryan *et al.* 2001) and the results are presented in (Table 2).

Table 1. Some soil physico-chemical properties (0-15 cm depth)

Property	Value
Clay (%)	19
Silt (%)	62
Sand (%)	19
Textural class	Silty Clay Loam (SCL)
pH (1:5; Soil:Water)	8.1
Organic matter (%)	0.69
EC (dsm^{-1})	1.4
Lime ($CaCO_3$) (%)	16.8
AB-DTPA P ($mg\ kg^{-1}$)	3.5
Total N (%)	0.05
AB-DTPA K ($mg\ kg^{-1}$)	120

Table 2. Chemical analysis of Organic fertilizers used in the study

Organic fertilizers	Nitrogen (%)	Phosphorous (%)	Potash (%)
Farm yard manure	0.55	0.39	0.62
Compost	0.62	0.4	0.56
Poultry manure	1.33	0.79	0.36

RESULTS and DISCUSSION

Plant height and Spike length (cm)

Application of single super phosphate alone and in combination with different organic fertilizers significantly increased wheat plant height as compared with control (Table 3). Maximum plant height of 78.33 cm was observed with the combined application of SSP +PM closely followed by SSP + compost application treatment. However, the spike length was not significantly affected by the applied treatments and the maximum spike length of 8.19 cm was observed in T2 and minimum of 8.03 cm in T6 (Table 3). Published literature revealed that crop growth parameters may be improved with organic and in organic fertilizers application (Dixit & Gupta (2000); Selvakumari *et al.* (2000) and Khoshgoftarmanesh and Kalbasi (2002). Delden, (2001) stated that wheat plant height can be increased with application of organic and inorganic fertilizers. However, the nonsignificant effect of organic fertilizers on wheat spike length was also reported by Jamaland Fawad (2018) in the prevailing soil and environmental condition.

Table 3. Wheat plant height, spike length, 1000-grain weight, grain yield and biological yield as influenced by Single Super Phosphate alone and in combination with different organic fertilizers.

Treatments	Plant Height (cm)	Spike length (cm)	1000-grain weight (g)	Grain Yield(t ha^{-1})	Biological yield (t ha^{-1})
T1= Control	52.33 c	8.15	30.00 d	2.11 d	5.5 e
T2 =SSP	71.66 ab	8.19	41.67 bc	4.08 abc	10.66 b
T3=Compost	65.33 abc	8.17	39.67 bc	3.66 bc	8.14 cd
T4=FYM	62.00 bc	8.08	38.00 c	3.41 c	7.37 d
T5=PM	67.33 ab	8.11	40.33 bc	3.98 abc	9.06 c
T6=SSP + Compost	74.33 ab	8.03	44.33 ab	4.48 abc	12.81 a
T7 =SSP + FYM	72.33 ab	8.19	42.67 abc	4.04 abc	11.88 ab
T8=SSP + PM	78.33 a	8.08	47.00 a	4.63 a	13.11 a
LSD at 0.05	13.64	N.S	5.19	0.88	1.50

*****Means with different letter (s) in columns are significantly different at $P<0.05$

1000-Grain weight (g)

Single super phosphate either alone or in combination with organic fertilizers significantly improved1000-grain weight of wheat as compared with control; however, the application SSP in combination with PM (T8) produced the maximum 1000-grain weight of 47 g followed by 44.33g produced by the T6 received the combination of SSP and compost (Table3). Published literature showed that PM along with chemical fertilizers increased wheat 1000-garin yield significantly. Abbas *et al.* (2012) reported that PM at 6 t ha^{-1} along with recommended doses of N, P, K significantly increased wheat 1000-grain weight, similarly in another study Akhtar *et al.* (2000) investigated that organic fertilizers and chemical fertilizers in combination significantly improved yield contributing factor in wheat than the chemical fertilizer applied alone.

Grain yield (t ha-1)

Wheat grain yield was significantly increased with application of SSP and organic fertilizers either alone or in combination as compared with the control treatment. The highest grain yield of 4.63 t ha^{-1} was observed in T8 (SSP + PM) which was followed by T6 (SSP + Compost) having grain yield 4.48 t ha^{-1}. The minimum grain yield 2.11 t ha^{-1} was observed in T1 (control) (Table 3). Maximum grain yield in SSP + PM plot might be due to higher nutrients content in PM than FYM and Compost (Jamal and Fawad 2018). The increase in grain yield was related to improvement in some of yield contributing factors (Table 3). Our result was in lined with (Khanam *et al.,* 2001; Rees and Castle, 2002; and Reddy *et al.* 2005).

Biological yield (t ha-1)

Similar to other parameters maximum biological yield 13.11 t ha^{-1} was observed in T8 (SSP + PM) which was followed by T6 (SSP + Compost) having biological yield 12.81 t ha^{-1} (Table 3), however no statistical difference was found for biological yield between T8 and T6. Among all the organic fertilizers, PM performed better in improvement wheat growth parameters as well as yield parameters. The highest biological yield in T8 may be due to the fact that PM directly supplies the essential nutrient like NPK to the plants more than other fertilizer source. Abbas *et al,* (2012) suggested that combine application of PM at 6 t ha^{-1} and recommended doses of NPK produced optimum wheat yield. Our result was also in lined with the findings of (Ghosh *et al.* 2004; Sarwer *et al.*, 2008). The significant effect of PM in increasing biological yield of wheat was also reported by Jamal and Fawad (2018) for the same soil and environmental condition.

CONCLUSION

It was clearly concluded from the study that application of Single Super Phosphate in combination with Poultry manure significantly increased wheat yield in the prevailing soil and environmental conditions. Both growth and yield parameters of wheat may be better improved with combination of SSP at 100 kg $ha^{-1}$and poultry manure at 6 t ha^{-1} respectively. Hence it is recommended that SSP + PM may be applied in combination for obtaining the optimum yield of wheat crop.

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