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Response of Wheat (*Triticum aestivum* L.) to FYM and Phosphorus Application in Alluvial Soil

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A B S T R A C T

A field experiment was conducted at the research farm of R. B. S. College Bichpuri, Agra during the Rabi season of 2012-13 to determine the effects of Farmyard Manure (FYM) and phosphorus application on wheat crop in alluvial soil. The experiment was laid out in the randomized block design (RBD) with four levels of FYM (control, 2.5, 5.0 and 10 t ha^{-1}) and four levels of phosphorus (control, 40, 80 and 120 kg P_2O_5 ha^{-1}) with three replications. Nitrogen, Phosphorus, and Potash (NPK) were applied in the form of urea, single super phosphate and muriate of potash respectively. Results revealed that the plant height, number of tillers (m^{-2}), number of spikes (m^{-2}), spike length (cm), number of grain $spike^{-1}$, 1000- grain weight and grain and straw yield of wheat crop improved by FYM and phosphorus application. The nutrient contents as N, P, K and Zn in grain and straw of wheat enhanced significantly with the application of FYM @10t ha^{-1} and phosphorus @ 80 kg P_2O_5 ha^{-1}.This treatment also recorded highest grain yield of 33.5 q ha^{-1} as compared to rest of other treatments. Hence the application of FYM @10 t ha^{-1} and phosphorus @ 80 Kg P_2O_5 ha^{-1} is recommended to the farmer for getting better production of the wheat crop.

Introduction

Wheat (*Triticum aestivum* L.) is one of the major cereal crops produced in the world (Anon 1971). India is the second largest producer of wheat in the world after China. Wheat is the second most important crop after rice in India. Production and productivity of wheat increased at a great level with the advent of the green revolution. Even the productivity increased at a good pace and was computed to be around 2989 kg/hectare in the report by the Indian Department of Agriculture (Agricultural Statistics at a glance 2011-12; https://eands.dacnet.nic.in) and Uttar Pradesh being the topmost contributor of wheat followed by Punjab and Madhya Pradesh. But in productivity, Uttar Pradesh ranks second after Punjab. In Uttar Pradesh wheat has its own significance in the total food grain production is being second in importance as a winter cereal crop. It is used mainly as human food and animal feed. Only a small portion of the produce is utilized in the industry for malting, brewing, pearling and baby food. In nutritive value, Wheat is superior because it possesses comparative higher protein, lysine and high digestibility in

the absence of gluten. The demand for good quality wheat for the malting and brewing is increasing fast.

Wheat has got special value keeping in view its industrial importance and its existence under problematic to grow successfully. Intensive cultivation has resulted in depletion of soil nutrients to a great extent, thus the nutrient requirement of the crops has increased considerably during the last years. Phosphorus is the backbone of the crop production and plays a key role in energy-related activities and development of root-system. The availability of phosphorus from soil to plants depends upon the equilibrium adjustment around the root zone. Most of the Indian soils have an inadequate supply of available phosphorus and hence need to supplement of P in the form of fertilizers for crop production.

The application of FYM in the soil helps in increasing the fertility of the soil as physical condition including its water holding capacity. Organic manures, which were perhaps the major sources of plant nutrients in traditional agriculture, receive less emphasis with the advent of high analysis chemical fertilizers.

The decision on the optimum use of fertilizer required knowledge of crop response to applied fertilizer, inherent nutrients by soil and its short or long-term fate effects (Dobermann *et al.,* 2003). Without detracting from the fact that chemical fertilizer will continue to be the main instrument for quickening the pace for agricultural production the recent researches indicate that a judicious combination of organic manures and fertilizer better maintain the long-term soil fertility and sustain high levels of productivity. Therefore, use of both organic manure and chemical fertilizers in appropriate proportion assume special significance as complementary and supplementary to each other in crop production.

Keeping in view the above perspectives, the present research work was taken up to find out the "Response of wheat (*Triticum aestivum* L.) to FYM and phosphorus application in Alluvial soil''.

Materials and Methods

A field experiment was conducted at the research farm of R. B.S. College, Bichpuri, Agra during Rabi season of 2012-13. The soil of the experimental field was sandy loam in texture with p^H 8.1 (1:2.5 soil : water, Jackson, 1973), organic carbon 0.34% (Walkley and Black, 1934), available N 167.50 Kg ha^{-1} alkaline permanganate oxidizable N (Subbiah and Asija, 1956), available P 10.0 Kg ha^{-1} 0.5 N $NaHCO_3$ extractable P (Olsen *et al.,* 1954), exchangeable K 130.0 Kg ha^{-1} neutral *N* ammonium acetate exchangeable K (Hanway and Heidel, 1934) and DTPA extractable Zn 0.50 ppm. The experiment was laid out with three replication in Randomized Block Design with four FYM levels as control (F_0), 2.5 (F_1), 5.0 (F_2) and 10 (F_3) t ha^{-1}, four levels of phosphorus as control (P_0), 40 (P_1), 80 (P_2) and 120 (P_3) Kg P_2O_5 ha^{-1}. FYM was incorporated a week before sowing. The recommended dose of nitrogen and potassium were supplied to every plot through urea and muriate of potash, respectively. Phosphorus and potassium were applied as basal and urea was applied in three equal splits as basal, at CRI stage and at third irrigation. The variety of wheat PBW-550 was grown up to maturity. The crop was irrigated by tube well water as when required at different growth stages. Data of plant height, number of tillers (m^{-2}), number of spikes (m^{-2}), spike length (cm), number of grain $spike^{-1}$, 1000- grain weight and grain and straw yield were taken on physical maturity at the time of harvesting. The data of field observations were recorded from ten plants in each plot selected randomly and grain and straw yield were determined by net area basis after border rows removed.

Grain and straw samples were washed with distilled water to clean impurities, separately air-dried and oven dried to remove the moisture until constant weight was attained. After grinding in a Wiley mill, the samples were stored in wide mouth glass stopped bottle with proper labeling and subjected to the chemical analysis. The P in the digest was determined by the spectrophotometer, K by the flame photometer and total nitrogen was analyzed by Kjeldahl method (Bremner and Mulvaney, 1982).

Results and Discussion

Plant growth

It is evident from Table 1 that the plant height and number of tillers (m^{-2}) enhanced significantly with increasing levels of FYM as compared to control.

The maximum plant height and number of tillers were recorded with the dose of FYM (10 t ha^{-1}) application.

It is clear that FYM proved more beneficial in case of plant growth of wheat crop, it may be due to gradual mineralization and availability of nutrients along with moisture holding capacity of soil by FYM.

Similar results were also reported by Yadav *et al.,* (2007), Bonde *et al.,* (2009) and Kumar *et al.,* (2010).

Further evaluations of data reflect that the plant height and number of tillers (m^{-2}) improved significantly with increasing doses of phosphorus as compared to control. However, the plant height and the number of tillers (m^{-2}) increased up to P_3 (120 Kg $P_2O_5ha^{-1}$) level of phosphorus but in plant growth, it was not significantly better over P_2 (80 Kg $P_2O_5ha^{-1}$) level of phosphorus. This increase might be due to the well-developed root system, which might have helped in the availability of nutrients to the plants. Similar to these findings are of Kumawat *et al.,* (2004) and Singh *et al.,* (2010).

Yield and yield attributes

The data (Table 1) indicates that yield attributes like the number of spikes (m^{-2}), spike length (cm), the number of grain $spike^{-1}$ and test weight increased significantly with each increasing dose of FYM over control. The maximum grain and straw yield of wheat was recorded with the highest level of FYM (10 t ha^{-1}). Kumar *et al.,* (2010) and Jaga *et al.,* (2011) reported similar to these findings.

There was a significant increase in the yield and yield attributes characters with the application of phosphorus. The grain and straw yield of wheat enhanced significantly up to 80 Kg P_2O_5 ha^{-1}. The phosphorus levels as control, 40, 80 and 120 Kg ha^{-1} result 14.50, 27.86 and 22.90 percent enhancement in grain yield over control, respectively. Similarly the 14.84, 19.60 and 21.00 percent enhancement in straw yield over control, respectively.

This favorable effect might be owing to the fact that phosphorus is well known for its role in development and energy transformation in various vitally important metabolic processes in the plant, the beneficial results of phosphorus application was also earlier reported by Pathan *et al.,* (2010) and Dixit *et al.,* (2011).

Nutrient composition

The Table 2 indicate that nutrient contents (N, P, K, and Zn) in grain and straw of wheat enhanced significantly with increasing levels of FYM as compared to control. The highest level of FYM (10 t ha^{-1}) gave better performance over rest of the treatment in case of the nutrient composition of the wheat crop.

Table.1 Effect of FYM and phosphorus on plant height (cm), number of tillers (m^{-2}), number of number of spikes (m^{-2}), spike length (cm), grain $spike^{-1}$, test weight (g), grain and straw yield (q ha^{-1}) of the wheat crop

Treatment	Plant height (cm)	Number of tillers (m^{-2})	Number of spikes (m^{-2})	Spike length (cm)	Grain $spike^{-1}$	Test weight (g)	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})
FYM level								
F_0	80.15	330	305.5	8.70	22.5	37.85	26.5	35.7
F_1	85.20	351	336.4	9.09	23.4	38.79	30.5	41.0
F_2	89.10	369	342.1	9.40	24.0	39.15	31.8	42.7
F_3	93.28	388	355.2	10.28	24.2	39.50	32.7	43.2
S. Em±	1.19	3.83	3.02	0.226	0.981	0.461	0.021	0.042
C.D. at 5%	3.37	10.82	8.55	0.64	2.77	1.30	0.06	0.12
Phosphorus level								
P_0	80.10	332	307.1	8.68	22.6	37.75	26.2	35.5
P_1	85.10	353	334.2	9.50	23.5	38.60	30.0	40.6
P_2	90.55	388	357.1	10.12	24.3	39.55	33.5	45.0
P_3	92.85	397	358.1	10.15	24.0	39.55	32.2	43.4
S. Em ±	1.19	3.83	3.02	0.226	0.981	0.461	0.021	0.042
C.D. at 5%	3.37	10.82	8.55	0.64	2.77	1.30	0.06	0.12

Table.2 Effect of FYM and phosphorus on nutrient composition of the wheat crop

Treatment	Nitrogen (%)		Phosphorus (%)		Potassium (%)		Zinc (ppm)	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
FYM levels								
F_0	2.40	0.403	0.55	0.042	0.42	1.52	12.6	11.0
F_1	2.56	0.433	0.57	0.048	0.49	1.87	14.5	12.7
F_2	2.70	0.460	0.60	0.052	0.54	2.18	17.0	14.0
F_3	2.88	0.471	0.64	0.056	0.60	2.46	20.7	16.9
S. Em±	0.050	0.0025	0.005	0.001	0.010	0.078	0.67	0.47
C.D. at 5%	0.14	0.007	0.015	0.003	0.03	0.22	1.88	1.35
Phosphorus levels								
P_0	2.40	0.402	0.54	0.044	0.43	1.50	13.0	11.3
P_1	2.54	0.432	0.58	0.047	0.50	1.90	15.3	12.5
P_2	2.84	0.466	0.66	0.057	0.61	2.52	20.8	15.5
P_3	2.68	0.458	0.62	0.051	0.58	2.20	18.5	13.8
S. Em ±	0.050	0.0025	0.005	0.001	0.010	0.078	0.67	0.47
C.D. at 5%	0.14	0.007	0.015	0.003	0.03	0.22	1.88	1.35

In general, the nutrient composition of wheat improved by the application of FYM. It might be due to greater availability of nutrients under adequate supply of available nutrients by FYM application. Pathan *et al.*, (2010) and Sisodia *et al.*, (2010) reported similar to these findings.

Further, it could be inferred from Table 2 that the N, P, K and Zn contents in grain and straw of wheat crop increased with higher levels of phosphorus application. It was interesting to note that the nutrient contents in grain and straw of wheat improved up to 80 Kg P_2O_5 ha^{-1}, which may be due to improvement in the nutritional environment of rhizosphere and uptake of nutrients by the wheat crop. Similar results were also reported by Patel *et al.*, (2005), Islam *et al.*, (2005) and Singh *et al.*, (2010).

The higher dose of FYM (10 t ha^{-1}) application significantly increased the grain and straw yield over the control besides improved the content and uptake of nitrogen, phosphorus, potassium, and zinc by wheat crop. And the similar result was recorded with 80 Kg P_2O_5 ha^{-1} (P_2) level of phosphorus application. Hence the application of FYM @10 t ha^{-1} and phosphorus @ 80 Kg P_2O_5 ha^{-1} is recommended to the farmer for getting better production of the wheat crop.

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