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Short Communication

Effect of phosphorus and manganese nutrition on yield and uptake of nutrients in wheat (*Triticum aestivum*) in alluvial soil

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Wheat (*Triticum aestivum L*) is the most important food grain crop among cereals and stands next only to rice in our country. It is an exhaustive crop which requires the major and micronutrients in adequate amounts for higher production. Wheat is quite responsive to phosphorus (Singh at al. 2020) and manganese (Singh and Patra, 2017) which plays important role in growth and development. Phosphorus is an important nutrient needed for normal growth and development of the plants. It plays an important role in energy transformation and metabolic processes in plants. Manganese plays a role in the synthesis of chlorophyll. Manganese deficiency occurs in well drained light textured soils with neutral or alkaline in reaction. Studies have indicated both synergistic and antagonisticrelationship between P and Mn but their relationship depends on their rate of application and crop species. Hence, an attempt was made to study the response of wheat to P and Mn nutrition in an alluvial soil.

Green house experiment was conducted during rabi season of 2016 at Bitchpuri Agra U.P. The site of this experiment is characterized by semi-arid climate with hot dry summers (48 to 48^0C) and very low temperature during winter (as low as 2^0C). The average rainfall is about 650 mm, of which a major portion of 546 mm (84%) is received from July to September and only 104 mm (16%) is received in the remaining part of the year. The soil was sandy loam in texture having pH value of 8.1, poor in available N (145 kg ha^{-1}), low in phosphorus (9.4 kg ha^{-1}) ,available K (108 kg ha^{-1})and DTPA-Mn(2mg kg^{-1}).Four levels each of P(0,15,30 ans 45 $mgkg^{-1}$) and mn(0,2.5,5.0 and10.0 $mgkg^{-1}$) were evaluated in complete randomized block deign with three replications.Ten seeds of wheat (PBW343) were sown in each pot on November 15,2016.Thinning was done 10days after germination and 5 plants in each pot were allow to grow.The experiment was conducted in earthen pots filled with 10kg soil. Magnises was applied through manganese chloride at the time of sowing. All amounts of phosphorus and potassium and half dose of nitrogen as per treatment were applied at the time of sowing and rest of nitrogen was top dressed at first irrigation. Urea, single superphosphate and muriate of potash were used as sources of N, P and K, respectively. At harvest grain and straw yields were recorded. The grain and samples were digested using di acid mixture of HNO_3 : $HClO_4$ (10 : 4). Phosphorus content in and extract was determined by vanadomolydo phosphoric yellow colour method (Jackson, 1973) and Mn in Mn by6 atomic by absordtion spectrophotometer. Nitrogen contain in grain and straw was determined by modified Kjeldahl method .The uptake of nutrients was computed from the data on nutrient concentration multiplied by yields of the crops.The data generated for the crop were statistically analyzed (Gomez and Gomez 1984).

Significantly highest grain (9.53 g/pot) and straw (13.02 g/pot) yields were recorded with 45 mg P_2O_5 kg^{-1} soil. The higher yields with increasing levels of P was mainly due to adequate supply of P to plants which in turn contributed to better growth and yield (Mishra *et al.*2017)and Chattopadhyay *et al.*(2020). The grain and straw yields of wheat increased significantly with increasing levels of Mn upto 5 mg kg^{-1} soil but further increase in Mn level up to 10 mg kg^{-1} soil had an adverse effect on the yields. The increase in grain and straw yield of wheat due to Mn levels over control may be due to a beneficial role of Mn in plant nutrition. In addition the soil did not have adequate amounts of Mn to meet the crop requirement; hence a significant response to Mn was not unexpected. The similar results have also been reported by Singh and Patra (2017).Nitrogen uptake by wheat grain and straw increased significantly with P application over control (Table 1). The maximum uptake of N by grain (160 mg/pot) and straw (90.2 mg/pot) was associated with 45 mg P_2O_5 kg^{-1}.

Application of Mn increased the nitrogen uptake by wheat grain and straw over control. The maximum utilisation of N by wheat crop was recorded at 5 mg Mn kg^{-1} soil. There was a reduction in N uptake by the crop with 10 mg Mn kg^{-1} soil over 5 mg Mn kg^{-1}. The improvement in N uptake due to 5 mg Mn kg^{-1} was mainly due to higher production of grain and straw of wheat.Similar results were reported by Singh and Patra (2017). The uptake of P by wheat crop increased significantly with its application. All the levels of P proved significantly superior to control in respect of P uptake by wheat grain and straw. The maximum value of P uptake by wheat grain (13.8 mg/pot) and straw (14.2 mg/pot) were recorded with 45 mg P_2O_5 kg^{-1} soil (Mishral el al.2017) Manganese application resulted in significant increase in P uptake up to 5 mg Mn kg^{-1} soil followed by a reduction at higher level of Mn (10 mg kg^{-1}). The decrease in P uptake with higher dose of Mn might be due to antagonistic effect between P and Mn. Phosphorus application resulted in significant increase in uptake of Mn by wheat grain and straw up to 30 mg P_2O_5 kg^{-1} soil over control (Table1). However, at higher levelof P application (45 mg P_2O_5 kg^{-1}), there was a reduction in Mn uptake by the crop.Application of Mn significantly increased its uptake by wheat crop over control and this effect was observed with all the levels of Mn application. This increase in Mn uptake may be attributed to increase its availability in soil (Singh and Patra, 2017).

Table 1: Effect of Phosphorus and manganese levels on yield and uptake of nutrients mg/pot in wheat

Treatment	Yield (g/pot)		Nitrogen		Phosphorus		Manganese	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
Phosphorus (mg/kg^{-1})								
0	5.44	7.09	111.0	67.6	6.7	7.1	0.29	0.37
15	6.78	9.11	127.0	76.5	8.6	8.9	0.33	0.41
30	8.58	11.89	140.0	85.6	12.5	11.1	0.33	0.44
45	9.53	13.02	160.0	90.2	13.8	14.2	0.28	0.33
CD(P=0.05)	0.58	1.21	10.51	4.27	1.54	1.58	0.02	0.03
Manganese (mg/kg^{-1})								
0	6.16	8.15	119.0	73.1	8.3	8.0	0.25	0.32
2.5	8.07	11.00	132.0	80.1	10.5	11.6	0.29	0.38
5.0	9.00	12.20	148.5	88.0	12.8	13.0	0.34	0.43
10.0	7.10	9.76	138.5	78.7	9.0	8.7	0.35	0.42
CD(P=0.05)	0.58	1.21	10.5	4.27	1.54	1.58	0.02	0.03

From the present study, it may be inferred that application of 45 mg P_2O_5 kg^{-1} soil and 5 mg Mn kg^{-1} in wheat resulted in higher yield and uptake of nutrients. Thus, application of 45 mg P_2O_5 kg^{-1} and 5 mg Mn kg^{-1}soil appears to the best doses of P and Mn for obtaining higher yield from wheat under Agra condition.

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