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Effect of Source and Time of Application of Phosphatic Fertilizers on Wheat (*Triticum aestivium* L.)

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Abstract: A field experiment was conducted on a clayey soil to assess the effect of sources and time of phosphatic fertilizers application on growth and yield of wheat, during 2003-2004 at the experimental field of Agricultural Chemistry Section, Agricultural Research Institute (A.R.I) Tando Jam, Pakistan. The plot size was 10.5 m x 14.5 m. The recommended doses of P_2O_5 (85 kg ha^{-1}) and N (168 kg ha^{-1}) fertilizers i.e. Di-ammonium phosphate (DAP), Mono-ammonium phosphate (MAP) and Urea fertilizers were applied. The experiment consisted of four fertilizer treatments (T1, T2, T3 and T4). For treatment T1, DAP was applied at sowing, for T2, MAP was applied at sowing, for T3, DAP was applied at 1st irrigation and for T4, MAP was applied at 1st irrigation. The fertilizer urea was applied in three splits (½ at basal, ¼ at 1st irrigation and ¼ at flowering stage). Experimental results revealed non significant effect of source (type of fertilizer), time or interaction of source* time on plant height, number of spikelets $spike^{-1}$, number of grains $plant^{-1}$, yield (grain and straw) ha^{-1} and P contents in grain and straw. Based on the results of this field study, it is recommended that, both DAP and MAP fertilizers can be used to apply phosphorus to wheat either at sowing or at 1st irrigation.

Key words: Phosphatic fertilizers · source · time · wheat

INTRODUCTION

Phosphorus plays a vital role in several key physiological processes viz; photosynthesis, respiration, energy storage, cell division, cell enlargement etc. Phosphorus is essential for seed formation and root development [1]. There are several kinds of inorganic phosphatic fertilizers manufactured by industries in different grades of elements essential for plant growth. These inorganic phosphatic fertilizers include single super phosphate (SSP), MAP, DAP and nitrophos (NP). In Pakistan, the major inorganic phosphatic fertilizers are: MAP, DAP, SSP and NP. Single super phosphate and NP are manufactured locally. However, DAP is imported from other countries such as Jordan, USA, Morocco etc.

Source [2, 3] and timing [4] of nutrient additions can have a variable effect on crop yields. It is evident from the reports of Alam *et al.* [5] that wheat plants fertilized with NP and SSP gave higher yield than DAP that might include MAP. Many nutrient interactions are time dependent [6]. Basal application of phosphatic fertilizers is the most common and preferable practice of farmers in Sindh. Once they missed its application at sowing they regret to apply it at later stages. This study was therefore conducted to investigate the effect of DAP and MAP applied to wheat crop at sowing and 1st irrigation.

MATERIALS AND METHODS

The study was conducted at the experimental field of Agricultural Chemistry Section, A.R.I., Tando Jam. The experiment was a factorial one laid in a Randomized Complete Block Design with three replications. Each experimental plot size was 10.5 m x 14.5 m = 152.25 m^2.

Land preparation: The land was ploughed 2 times followed by leveling to achieve fine seedbed. However, more emphasis was given to good soil tilth to ensure uniform distribution of seed, fertilizer and irrigation. The sowing of crop was carried out during November 2003 using an automatic drill at a depth of 3 cm.

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Fertilizer applications: Nitrogen was applied at the rate of 168 kg ha^{-1} in the forms of DAP, MAP and urea. The urea was applied in three splits (½ as basal, ¼ at 1st irrigation, ¼ at flowering stage). Phosphorus was applied at the rate of 84 kg P_2O_5 ha^{-1} in the forms of DAP and MAP in two splits as a basal dose and 1st irrigation (according to treatment). For T1 and T2, DAP and MAP were applied as basal dose, respectively while in the case of T3 (DAP) and T4 (MAP), they were applied at 1st irrigation.

Irrigation and weeding: The crop was irrigated by flooding based on its requirement. The crop was first irrigated at 25 days after sowing and subsequently at 25 days interval. In all, four irrigations were done. The experimental plots were kept weed free throughout the study.

Agronomic variables recorded: Five plants per treatment from each replication were selected at random, tagged and numbered separately to record the following observations: (i) plant height (cm), (ii) number of spikelets $spike^{-1}$, (iii) number of grains ($plant^{-1}$) and (iv) straw and grain yield (kg ha^{-1}).

Soil sampling and analyses: Composite soil samples were collected before sowing from the experimental plots at 0-15 and 15-30 cm depths. Samples were air-dried, crushed, sieved through 2 mm sieve and analyzed for texture by Bouyoucous Hydrometer method [7], EC_e (dSm^{-1}) and pH by electrode using Suntex digital meters, lime content by acid neutralization method [7], organic matter by Walkley-Black method [8], total nitrogen (N) by Kjeldahl method [8], available phosphorus by Olsen [9] method using spectrophotometer and exchangeable potassium (K^+) by flame photometery, following USSL [10] method.

Harvesting: At maturity all labeled plants from each plot were harvested by cutting at soil level. Ear-heads were separated from straw. Threshing was done by hand and grains were, counted and weighed by balance. The grain and straw samples were oven-dried separately at 82°C until constant weights were attained. Phosphorus contents in grain and straw were extracted by the wet digestion method and determined by the phosphomolybdate method [8].

Statistical analysis: All plant data were analyzed by performing analysis of variance using Minitab-12 statistical package on computer. The non-significant differences are denoted by N.S. in Table 2.

Table 1: Some physico-chemical properties of soil before sowing

	Depth (cm)	
Properties	0-15	15-30
Sand (%)	26.60	18.60
Silt (%)	28.50	29.00
Clay (%)	44.90	52.40
Textural class	Clay	Clay
pH	7.46	7.66
EC_e (dS m^{-1})	0.75	0.83
Organic matter (%)	0.88	0.74
$CaCO_3$ (%)	11.54	11.76
Total Nitrogen (%)	0.07	0.02
Available phosphorus (mg kg^{-1})	3.93	2.00
Exchangeable potassium (mg kg^{-1})	121.78	81.50

Table 2: Effect of source and time of P fertilizers application on growth and yield of wheat

	Time of application		
Source	Basal dose	1st irrigation	Mean
Plant height (cm)			
DAP	77.833	71.933	74.883
MAP	74.733	69.733	72.233
Mean	76.283	70.833	
L.S.D. (p<0.05) Time: N.S.	Source: N.S	Time*Source: N.S	
Number of spikelets $spike^{-1}$			
DAP	10.240	9.833	10.037
MAP	9.620	9.500	9.560
Mean	9.930	9.666	
Number of grains $plant^{-1}$			
DAP	183.960	189.890	186.93
MAP	169.390	176.380	172.89
Mean	176.680	183.140	
L.S.D. (p<0.05) Time: N.S.	Source: N.S	Time*Source: N.S	
Straw yield (kg ha^{-1})			
DAP	4526.700	4666.700	4596.700
MAP	4421.700	5156.700	4789.200
Mean	4474.200	4911.700	
Grain yield (kg ha^{-1})			
DAP	3617.000	3605.000	3610.800
MAP	3547.000	3803.300	3675.000
Mean	3581.000	3704.200	
L.S.D. (p<0.05) Time: N.S.	Source: N.S	Time*Source: N.S	
P (%) in grains			
DAP	0.320	0.273	0.297
MAP	0.300	0.293	0.296
Mean	0.310	0.283	
P (%) in straw			
DAP	0.103	0.110	0.106
MAP	0.100	0.093	0.097
Mean	0.100	0.101	
L.S.D. (p<0.05) Time: N.S.	Source: N.S	Time*Source: N.S	

N.S. = non-significant at the 0.05 level

RESULTS AND DISCUSSION

Some of the soil characteristics before sowing of the test crop are presented in Table 1. The results

revealed that at both depths (0-15 and 15-30 cm) the soil was clayey in texture, alkaline in reaction, non-saline, moderately calcareous in nature with medium to low available phosphorus [9]. The level of exchangeable soil potassium at both depths was adequate enough for wheat crop. This was possibly due to the potassium status of Sindh soils rich in micaceous minerals [11]. There was no marked difference in total N and organic matter contents with depth. The low organic matter and total nitrogen contents reflect the general characteristics of the alluvial soils [12].

The effects of source (DAP and MAP), time (sowing and 1st irrigation) and interaction of source*time on plant height, number of spikelets spike^{-1}, number of grains plant^{-1}, grain and straw yield ha^{-1} and phosphorus contents in grain and straw (Table 2) were not statistically significant ($p>0.05$). Non-significant effects were presumably because wheat plants were able to utilize phosphorus equally well from both (DAP and MAP) fertilizers at both stages.

Previous investigations [3] also showed non significant differences between triple-superphosphate (TSP) and DAP for sugarcane. Joseph [2] found that Christmas Island Rock Phosphate (CIRP) and Monocalcium phosphate (MCP) produced similar growth responses in pots for *Pueraria* plants.

CONCLUSIONS

The results of this study showed no significant effect of both source and timing of application of phosphatic fertilizes for all growth and yield variables. Hence, it suggests that wheat growers can select either of these two phosphatic fertilizers to apply either at sowing or at 1st irrigation if missed at sowing.

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