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A STUDY ON INFLUENCE OF MANAGEMENT PRACTICES ON PHOSPHORUS CONTENT AND UPTAKE IN WINTER MAIZE

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ABSTRACT

Field experiment with three types of mulches and three levels of irrigation were conducted on subtropical calcareous sandy loam soil in randomized block design with three replications to evaluate the effect of pre harvest application of mulching and irrigation on hydrothermal regime of soil with reference to content of phosphorus in winter maize and phosphorus uptake in post harvest grain and soil of winter maize. Variety Deoki of winter maize was used as the test crop. The recommended dose of NPK was applied with application of mulch and irrigation level the soil temperature raised towards optimum moisture and soil temperature influence the availability of soil phosphorus and other nutrients which is evidenced by significantly higher phosphorus uptake and significantly increased content of phosphorus in plants. The performance of mulch in sequence of polyethylene mulch > paddy straw > unmulched treatments. Similarly, the performance of irrigation level was in the order $I_3 > I_2 > I_1$ ratio. Favorable uptake envioronment ceated by mulch and irrigation for phosphorus in M_2 along with I_3 treatment i.e. (20.75 Kg/ha) and loest in unmulched (M_0) with, I_1 i.e. (11.00 kg/ha). The result obtained during the study indicates that mulch and irrigation level increased phosphorus concentration in grain, straw as well as phosphorus uptake significantly but interaction was found not significant.

Key words : *Mulch, irrigation levels, management practices, phosphorus content and uptake, maize.*

Maize is one of the most important cereal crop in agricultural economy both as food for human and feed for animal. Generally it has high yield potential, but after harvest of paddy it gets delayed than the optimum sowing time which gives lower yield of the crop due to lower winter soil temperature and lower availability of phosphorus and other nutrients. Apart from this germination is also delayed and affected adversely resulting purple colouration of young emerging leaves indicating phosphorus deficiency in plant due to lower soil temperature even after application of the recommended dose of phosphatic fertilizers. As the availability of nutrients specially phosphorus are depended upon the optimum soil thermal regime, lower or higher soil thermal regimes affect adversely the uptake of phosphorus and other nutrients which ultimately results in lower yield of maize. Its uptake in plant is mainly accomplished through the process of diffusion which depends upon the soil temperature and moisture (Kohnke *et al*.1963). to meet these twin conditions of reducing irrigation requirement and moderating temperature affect, mulching can be seen as a practical and economic measure. There are several evidences that mulching increases the soil temperature as well as it also conserve soil moisture (Kalaghtagi *et al*., 1988). Soil temperature was raised successfully in maize field for varying periods by polyethylene mulch (Cooper and Law, 1978). Mulching results in higher water use efficiency, which can reduce water use (Ghosh *et al.,* 2006); Favorable modification of the soil hydrothermal regime (Chalker-Scott, 2007). mulch treatment moderated soil temperature, improved water retention in the soil, increased biomass and enhanced crop yield (Chaudhary, 1988).Therefore, the present study have been undertaken with the objective to study the effect of mulch and irrigation on phosphorus content and uptake, in grain and straw of maize plant.

MATERIALS AND METHODS

A field experiment was conducted during *rabi* season, at Research Farm Dholi, a campus of RAU, Bihar, Pusa. Research Farm Dholi enjoy semi-humid, Sub-tropical climate with hot and dry summer moderate rainfall and cold winter. The soil is sandy loam in texture, having pH 8.4 (1:2) and deficient in zinc and

phosphorus. The variety Deoki of winter maize was used as test crop. The experiment was conducted with three irrigation Levels, based on IW/CPE ratio (Parihar *et at.,* 1974) of 0.6,0.9 and 1.2 and three mulch treatment viz., no mulch (M0), paddy straw mulch (M1) and polyethylene sheet mulch (M2) in factorial randomized block design with three replications. The depth of irrigation water (IW) was kept constant in each irrigation as 5 cm which was measured with a per shell flume installed in irrigation channel and to find out the Cumulative Pan Evaporation (CPE), pan evaporation value were recorded daily in mm of water evaporated from the class A Pan. The same values were summed up to find out the CPE for deciding the irrigation time.

Phosphorus content was determined after 60 and 100 days after sowing (DAS). The plants samples were oven dried at 65°C, powdered in warring blender and stored in paper bags for chemical analysis. The powdered grain was digested in the triacid mixture (HNO_3 : H_2SO_4 : HCl :: 20 : 1 : 3) as per the procedure of Jackson(1978). Total phosphorus was determined in the triacid digested sample by Vanado Molybolate yellow colour method (Jackson, 1978).and the available phosphorus in post harvest soil was determine by the ascorbic acid procedure using red (660 mm) filter (Watanabe and Olsen,1965).The phosphorus uptake was determined by multiplying phosphorus concentration to grain yield. The experimental data were subjected to statistical analysis to find out the differences among the treatments (Fisher's 1938). Method of analysis was followed to calculate the nature and magnitude of the effect revealed by 'F' test. Appropriate standard errors along with critical differences wherever needed were calculated for the statistical interpretation of the data.

RESULTS AND DISCUSSION

Effect of mulch and irrigation levels on phosphorus content in maize plants : The data on phosphorus content (%) in winter maize plants after 60 and 100 days after sowing as presented in table-1. It appears from the table that the phosphorus content in maize plants was significantly affected by mulch and irrigation levels at 60 days after sowing. The higher phosphorus content in maize plants under polyethylene mulch followed by straw and no mulch might have been caused due to increased soil temperature (table-1) and made towards optimum soil thermal regime during early stages of crop growth. The phosphorus concentration of maize plants at 60 days after sowing were 0.647 %, 0.575% and 0.51% in M_2, M_1 and M_0 mulch respectively whereas due to irrigation mean concentration of phosphorus were 0.606%,0.576% and 0.549% in I_3, I_2 and I_1 respectively. The higher concentration of phosphorus in maize plants seems to be the contribution of more favorable thermal regime created by polyethylene mulch followed by straw mulch as compared to control. The irrigation level had also created favourable soil moisture regime in I_3 followed by I_2 than the control. It might have favoured and created positive effect of phosphorus availability to maize plants (Khera *et al*., 1976). The interaction of mulch and irrigation levels towards higher concentration of phosphorus in maize plants had acted jointly and due to higher soil temperature which was continued in later stage. With the critical evaluation of the phosphorus concentration at 100 days after sowing similar results were found with the exception that at later stage when the soil temperature had increased (table-1) and modified the hydrothermal regime. The interaction of mulch and irrigation was however, non-significant at the later stage i.e. at 100 days after sowing.

Effect of mulch and irrigation levels on phosphorus uptake kg/ha maize grain : Table-2 Reveals that mulch and irrigation level affected P-uptake highly significantly whereas interaction was found non–significant. The highest mean value of phosphorus uptake (18.18 kg/ha) was found in M_2 followed by M_1 (13.96 kg/ha) and M_0 treatment (11.07 kg/ha). The irrigation level I_3 has been found for highest mean value of phosphorus uptake followed by I_2 and I_1 irrigation level i.e. 15.80,14.22 and 13.20 kg/ha respectively. In general among the irrigation and mulch level the highest value 20.75 kg/ha phosphorus uptake was found in M_2 and I_3 level and the lowest 11.00 kg/ha was in M_0 and I_1 irrigation level.

The phosphorus concentration in maize grain and straw are listed in table-3. While observing the phosphorus concentration in grain at harvest it was significantly affected by the levels of mulch i.e. M_1 M_2 and M_3 but effect of irrigation and its interaction were non-significant. It seems that at later stage the hydrothermal regime of soil has changed and mulch has only thermalise the soil environment to greater extent as compared to irrigation. The mean value of concentration was found i.e. 0.353, 0.308 and 0.267 percent in polyethylene mulch, straw mulch and no

Table-1 : Effect of mulch and irrigation levels on the total phosphorus content (%) in maize plants after 60 and 100 (DAS).

Time of sowing	Irrigation level	Mulch level			
		M_0	M_1	M_2	Mean
60 days after sowing (DAS)	I_1	0.482 (17.65)	0.530 (17.55)	0.635 (18.50)	0.549 (17.90)
	I_2	0.518 (17.85)	0.564 (17.45)	0.647 (18.50)	0.576 (17.93)
	I_3	0.529 (17.85)	0.630 (17.30)	0.658 (18.22)	0.606 (17.79)
	Mean	0.510 (17.83)	0.575 (17.43)	0.647 (18.40)	-
100 days after sowing (DAS)	I_1	0.402 (24.60)	0.495 (24.70)	0.512 (26.30)	0.469 (25.20)
	I_2	0.416 (24.88)	0.515 (24.50)	0.564 (26.05)	0.498 (25.13)
	I_3	0.430 (24.94)	0.501 (24.70)	0.589 (26.25)	0.507 (25.30)
	Mean	0.416 (24.80)	0.504 (24.62)	0.555 (26.20)	-
Source		CD at 5% (60 DAS)		CD at 5% (100 DAS)	
	Mulch	0.02		0.237	
	Irrigation	0.02		0.237	
	Interaction	0.29		NS	
	CV	-		-	

Figures in parenthesis represent average soil temperature (°C).

Table-2 : Effect of mulch and irrigation levels on phosphorus uptake kg/ha by maize grain under different treatment.

Irrigation level	Mulch level			
	M_0	M_1	M_2	Mean
I_1	11.00	13.10	15.49	13.20
I_2	11.06	13.30	18.30	14.22
I_3	11.16	15.48	20.75	15.80
Mean	11.07	13.96	18.18	
Source	CD at 5%			
Mulch	1.57			
Irrigation	1.57			
Interaction	NS			

Table-3 : Effect of mulch and irrigation levels on phosphorus content (%) in maize plants after harvest.

Time of sowing	Irrigation level	Mulch level			
		M_0	M_1	M_2	Mean
Grain	I_1	0.268	0.292	0.339	0.229
	I_2	0.266	0.309	0.357	0.311
	I_3	0.268	0.323	0.363	0.318
	Mean	0.267	0.308	0.353	-
	Source Mulch Irrigation Interaction			CD at 5% 0.03 NS NS	
Straw	I_1	0.160	0.121	0.152	0.130
	I_2	0.110	0.140	0.171	0.142
	I_3	0.124	0.142	0.181	0.153
	Mean	0.113	0.138	0.173	-
	Source Mulch Irrigation Interaction			CD at 5% 0.0064 0.0064 NS	

Table-4 : Effect of mulch and irrigation levels on phosphorus uptake (kg/ha) in soil after crop harvest.

Irrigation level	Mulch level			
	M_0	M_1	M_2	Mean
I_1	31.18	36.45	38.00	35.21
I_2	34.23	36.06	37.56	35.95
I_3	35.82	35.14	39.25	36.73
Mean	33.74	35.88	38.27	
Source	CD at 5%			
Mulch	2.23			
Irrigation	NS			
Interaction	NS			

mulch respectively. The effect of irrigation levels was found not at significant level. The phosphorus concentration in maize straw at harvest stage has been effected significantly by mulch and irrigation levels but the interaction of mulch and irrigation was not at significant level. The mean value of concentration were 0.113, 0.138 and 0.173 in no mulch, straw mulch and polyethylene mulch respectively. The mean value of concentration was highest in polyethylene followed by straw mulch and no mulch that is 0.153 followed by 0.142 and 0.130%. As the phosphorus requirement of maize plants in early stage (table-3) is more as compared to the later stage (table) and the concentration of phosphorus in straw mulch might have higher mass flow and diffusion in presence of higher moisture level along with favourable thermal regime.

It reveals that (Table-4) even after higher uptake by maize plants the residual available phosphorus level were significantly higher in M_2 plots as compared to M_1 and M_0 plots. This may be the contribution of the higher temperature and higher moisture content in these treatments. Although there is tendency of incresd residual available phosphorus in higher level of irrigation it may be caused by the higher moisture level maintained in higher irrigation level but it was not at significant level.

CONCLUSION

The results obtained during the course of investigation can be concluded that mulch and irrigation both raised significantly the soil temperature in winter maize. The favorable environment created for phosphorus uptake by higher moisture and higher soil temperature by irrigation and mulch had reflected in higher phosphorus concentration in maize plant and uptake by maize crop.

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