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PERFORMANCE OF MAIZE UNDER DIFFERENT PHOSPHORUS LEVELS AND PLANTING METHODS IN HIGH PHOSPHORUS SOILS IN NORTHEN TELANGANA ZONE

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ABSTRACT

A field experiment was conducted at Agricultural Research Station, Karimnagar, Northern Telangana Agro Climatic Zone of Telangana State during *kharif* 2018 and 2019 to study the effect of different levels of phosphorus on growth and yield of maize in high phosphorus soils (79 kgha^{-1})under raised and flat beds. The experiment was laid out in strip plot design for maize in *kharif* 2018 and 2019 with 2 main treatments *i.e.,* M_1 (Raised beds) and M_2 (Flat beds) and five phosphorus levels applied as basal dose as sub treatments *viz*., S_1: 100 % RDP (60 kg ha^{-1}), S_2: 75 % RDP (45 kg ha^{-1}), S_3: 50 % RDP (30 kg ha^{-1}), S_4: 25 % RDP (15 kg ha^{-1}) and S_5: 0 % RDP (0 kg ha^{-1})and replicated four times. The performance of the maizewas found superior whenplanted on raised beds with higher final plant population (per cent) and growth parameters viz., plant height (cm)and dry matter production (kg ha^{-1}) at 30, 60 DAS and at harvest. The highest grain, stover yield (kg ha^{-1}) and harvest index of maize were found significantly higher underraised beds (M_1) compared to the flat beds (M_2). In the sub treatments application of 100% RDP (S_1) and 75 % RDP (S_2) recorded higher plant height at different stages of crop growth that resulted highest dry matter accumulation at 30, 60 DAS and at harvest. The grain yield and stover yield were significantly higher with the 100 % RDP and was followed by the application of 75% RDP and 50 % RDP and which were at par with each other and superior over 25 % RDP and 0 % RDP. The interaction between planting methodsand different levels of phosphorus was found non significant.

Keywords: Maize, raised beds, flat beds, phosphorus levels and grain yield.

Maize (*Zea mays* L.) is one of the most important cereal crops next to wheat and rice in the world. In India, it ranks fourth after rice, wheat and sorghum. Maize is grown throughout the world under a wide range of climatic conditions. The major producers are USA followed by China, Brazil, Mexico, Argentina and India. Maize occupies more than 80 per cent area under rainfed conditions.In India, maize area and production have steadily increased during the past two decades and 75 per cent of the total production comes from the states of Bihar, Madhya Pradesh, Punjab, Rajasthan and Uttar Pradesh. In India it occupies in an area of 9.9 M. ha with 31.64 million tonnes of production and 2509 kg ha^{-1} productivity while in Telangana state respective figures are 0.57 M. ha, 1.74 million tonnes and 3199 kg ha^{-1} (Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare, Govt. of India 2020-21).For establishing a good crop stand the lack of adequate moisture in the seed zone is the major constraint and excess rain situations causing waterlogging at root zone which reduces palnt growth and results in lower grain yield in maize. Which requires adoption of location specific *in situ* soil moisture conservation techniques. Agronomic manipulations to soil such as raised planting enhance the establishment, crop growth, yield attributes and yield in maize. Phosphorus becomes an important nutrient in maize. It plays a key role in the vital energy transformation, cell division and meristematic growth in living tissues. It is an important constituent of nucleic acids, proteins, enzymes and phospholipids. Phosphorus nutrition in desired and balanced dose enhances root development, nodulation and hastens maturity. During 1990's use of DAP increased to such an extent that farmers using DAP as a source of nitrogen even for split application of nitrogen as a result there has been accumulation of phosphorus in soil as the use efficiency of applied P is only 15-20%. Therefore,

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phosphorus management in relation to land configuration practices and with particular reference to maize.

An experiment was conducted for two consecutiveyears, 2018 and 2019 at Agricultural Research Station, Karimnagar which is geographically situated at 18. 44 Latitude, 79.09Longitude and at an altitude of 259.15 m above mean sea level, covered under Northern Telangana Agro Climatic Zone of Telangana State.

MATERIAL AND METHODS

The experiment was conducted in D5 block of Agriculture Research Station, Karimnagar, Prof. Jayashankar Telangana State Agricultural University, Telangana State. The results of soil analysis indicated that the experimental site wassandy loam in texture, alkaline in reaction, low in organic carbon, medium in available nitrogen, high in available phosphorus with 79 kg ha^{-1} under high phosphorus soils and high in potassium. The field experiment was carried out during *kharif* 2018 and 2019 for maize, which was laid out in strip plot design during *kharif* season of 2018 and 2019 with raised beds and flat beds as main plot treatments and in phosphorus management, there were five treatments of phosphorus for application in maize with sub plot treatments as $S_{1:}$ 100 % RDP (60 kg ha^{-1}), S_2: 75 % RDP (45 kg ha^{-1}), S_3: 50 % RDP (30kg ha^{-1}), S_4: 25 % RDP (15 kg ha^{-1}), S_5: 0 % RDP (0 kg ha^{-1}) (Control). The source of phosphorus for maize is DAP. The calculated quantity of DAP for phosphorus were applied to the maize crop as basal application. Thus, there were ten treatment combinations replicated four times in *kharif* season. The land was ploughed once with mould board plough and harrowed twice to bring the soil to fine tilth after receiving pre-monsoon rain. Stubbles and weeds were removed from the experimental site. The raised beds were freshly prepared (both years) mechanically by a raised bed planterone day before sowing. The raised beds dimensions were 90 cm width and 15 cm height with the furrow of 30 cm. The layout of raised beds was depicted in fig 1.0.

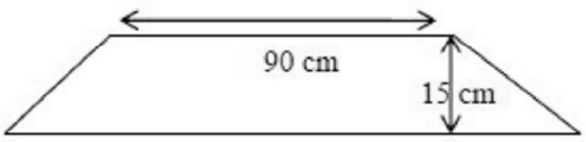

Fig 1.0. Layout of raised bed

The cultivar selected was Karimnagar makka (KNMH-4010141) is an early maturity, yellow semi flint grain single cross maize hybrid suitable for *kharif* season developed by PJTS Agricultural University at Agricultural Research Station, Karimnagar, Telangana State. This hybrid highly responsive to fertilizers and suitable for both early and late plantings. Duration of the hybrid is 95-100 days with an average yield potential of 6500-7000 kg ha^{-1}. Farm yard manure @ 10 t ha^{-1} was applied and incorporated into soil one week before sowing. The recommended dose of nitrogen and potassium fertilizers *i.e.*, 200 and 50 kg N and K ha^{-1} was applied through Urea and muriate of potash (MOP) respectively. Entire phosphorus as per treatments and potassium were applied in the form of DAP and MOP as basal by placement and covered with the soil. Nitrogen in the form of urea after calculating the proportion supplied through DAP, applied in three splits as per schedule *i.e.,* 1/3rd N as basal, 1/3rd N at 30 DAS and remaining 1/3rd N at 60 DAS. Entire phosphorusas per the treatments was applied basally by placement and covered with the soil. Maize crop was sown as hand dibbling by adopting 60x20 cm spacing between the rows and within the plants respectively. Five plants were randomly selected and tagged in the net plot of the all treatments for recording biometric observations in maize.

RESULTS AND DISCUSSION

The perusal of the data recorded on growth parameters, yield attributes and yield of *kharif* maize and in *rabi* groundnut crops, data pertaining to plant population, growth parameters, yield attributes, yield, nutrient uptake and economics along with phosphorus fractions as influenced by raised and flatbeds and phosphorus management in high phosphorus soils during 2018 and 2019 (Table.1-2).

Significantly higher plant height was recorded by raised beds (M1) at 30 (53.0 cm), 60 DAS (144.1 cm) and at harvest (168.6 cm) than flatbeds (M2) (47.0, 132.5, 156.3 cm) respectively during 2018. Similar trend was noticed in 2019 and mean of two years. Increase in plant height under the raised beds might be due to favorable conditions for establishment and availability of sufficient amount of moisture at vegetative growth resulting in higher plant height. These results are in line with those of Vishuddha Nand *et al.* (2022). At 60 DAS, significantly higher plant height registered with

Table 1. Plant height (cm) and dry matter production (kg ha^{-1}) in maize as influenced by phosphorus levels in high phosphorus soilsunder raised and flat beds.

Treatments	Plant height (cm)									Dry matter production (kg ha^{-1})								
	30 DAS			60 DAS			at harvest			30 DAS			60 DAS			at harvest		
	2018	2019	Mean	2018	2019	Mean	2018	2019	Mean	2018	2019	Mean	2018	2019	Mean	2018	2019	Mean
Maintreatments (Beds)																		
M_1: Raised beds	53.0	63.7	58.3	144.1	156.8	150.4	168.6	180.0	174.3	1224	1452	1338	6885	7293	7089	13685	14093	13889
M_2: Flat beds	47.0	50.8	48.9	132.5	137.7	135.1	156.3	166.5	161.4	959	1122	1040	5537	6318	5927	12802	12603	12553
SEm(±)	1.2	1.3	0.8	1.7	3.8	1.9	2.3	2.9	2.6	52	46	42	140	200	73	172	213	163
CD(P=0.05%)	5.4	5.8	3.8	7.8	17.0	8.7	10.5	13.0	11.7	236	209	190	631	899	330	776	960	736
Sub treatments (Phosphorus levels)																		
S_1: 100 % RDP	55.6	64.8	60.2	145.3	150.6	147.9	170.3	180.3	175.3	1411	1518	1464	6836	7284	7060	13757	13847	13802
S_2: 75 % RDP	54.3	62.4	58.3	141.0	150.1	145.6	166.0	176.0	171.0	1125	1329	1227	6565	7205	6885	13520	13768	13644
S_3: 50 % RDP	51.9	60.0	55.9	138.9	146.5	142.7	163.9	173.9	168.9	1059	1325	1192	6506	7001	6754	13438	13564	13501
S_4: 25 % RDP	45.8	51.5	48.6	134.4	145.3	139.8	156.9	169.4	163.1	957	1189	1073	5806	6410	6108	12996	13048	12647
S_5: 0 % RDP (Control)	42.4	47.5	44.9	131.9	143.5	137.7	155.0	166.6	160.8	904	1075	989	5341	6126	5734	12506	12514	12510
SEm(±)	1.9	1.3	1.5	3.3	2.7	2.5	2.9	3.5	3.1	36	40	28	228	136	141	271	290	302
CD(P=0.05%)	5.9	4.1	4.7	10.0	8.3	7.6	9.1	9.9	9.6	111	123	86	701	418	435	835	893	930
Interaction effect																		
Main at same level of sub treatment																		
SEm(±)	3.6	3.6	2.6	6.6	7.4	5.1	7.5	8.2	7.6	106	106	90	532	475	288	656	602	626
CD(P=0.05%)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Subatsame level of main treatment																		
SEm(±)	1.6	1.3	1.2	2.8	2.2	2.0	2.8	3.1	2.8	31	35	26	210	141	122	255	242	263
CD(P=0.05%)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 2. Girth of cob (cm), number of seed rows cob^{-1} and grain yield (kg ha^{-1}) in maize as influenced by phosphorus levels under raised and flat beds in high phosphorus soils

Treatments	Girth of cob (cm)			Number of seed rows cob^{-1}			Grain yield(kg ha^{-1})		
	2018	2019	Mean	2018	2019	Mean	2018	2019	Mean
Maintreatments (Beds)									
M_1: Raised beds	13.50	17.09	15.29	17.1	17.2	17.3	5888	6211	6299
M_2: Flat beds	11.63	14.05	12.84	15.2	15.8	15.8	5496	5660	5828
SEm(±)	0.15	0.44	0.28	0.3	0.3	0.3	84	89	78
CD(P=0.05%)	0.69	1.98	1.26	1.2	1.3	1.4	378	402	350
Sub treatments (Phosphorus levels)									
S1: 100 % RDP	13.75	17.19	15.47	17.5	17.3	17.4	6017	6186	6351
S2: 75 % RDP	13.31	17.00	15.16	17.0	17.3	17.1	5885	6114	6250
S3: 50 % RDP	13.19	16.66	14.92	16.5	17.0	16.8	5798	5963	6130
S4: 25 % RDP	11.63	14.25	12.94	15.3	15.8	15.8	5509	5791	5900
S5: 0 % RDP (Control)	10.94	12.75	11.84	14.5	15.3	15.5	5253	5622	5688
SEm(±)	0.22	0.72	0.37	0.5	0.3	0.3	119	93	88
CD(P=0.05%)	0.69	2.22	1.13	1.4	1.0	1.0	366	285	271
Interaction effect									
Main at same level of sub treatment									
SEm(±)	0.34	1.38	0.72	1.2	0.6	1.0	302	194	171
CD(P=0.05%)	NS	NS	NS	NS	NS	NS	NS	NS	NS
Subatsame level of maintreatment									
SEm(±)	0.16	0.59	0.29	0.5	0.2	0.3	114	72	67
CD(P=0.05%)	NS	NS	NS	NS	NS	NS	NS	NS	NS

S_1 (170.3 cm) over S_4 and S_5 but on par with S_2 (145.3 cm) and S_3 (138.9 cm) during 2018. Similar trend was observed at harvest and mean of two years. These results are in conformity with Vijaya Bhaskar Reddy *et al.* (2018).

Significantly higher dry matter production was recorded by raised beds (M_1) at30 (1224 kg ha^{-1}),60 DAS (6885 kg ha^{-1}) and at harvest (13685 kg ha^{-1}) than flatbeds(M_2)(959, 5537, 12802 kg ha^{-1}) respectively during 2018. Similar trend was noticed in 2019 and for mean of two years. These results are in conformity with the findingsofHarish *et al.* (2021). Among the phosphorus levels, S_1, S_2 and S_3 were recorded significantly higher dry matter production over S_4 and S_5 but among themselves they were on par with each other. Lowerdry matter production (904 kg ha^{-1}) recorded under S_5 which was on par with S_4 (957 kg ha^{-1}) at 30 DAS during 2018.

At 60 DAS, significantly higher dry matter production was registered with S_1 (6836 kg ha^{-1}) over S_4 and S_5which was on par with S_2 (6565 kg ha^{-1}) and S_3 (6506 kg ha^{-1}) during 2018. Similar trend was observed at harvest. Similar trend was noticed during 2019 and for mean of two years. Interaction effect at main at same level of sub treatments and sub treatments at same level of main treatments found to be non significant.

Girth of cob was significantly influenced by land configurations during both the years. Higher girth of cob (13.50 cm) recorded with raised bed over flatbed (11.63 cm) during 2018. Similar trend was noticed during 2019 and for the mean of two years. Similar results are in line with the findings of Kumar and Chawla (2015) where higher yield attributes in raised planted might be attributed to access of roots to nutrients and water resulting in good plant growth.With regard to phosphorus levels significantly higher girth of cobwasobtained with S_1 (13.75 cm) followed by S_2 (13.31 cm) and S_3 (13.19 cm) which were on par with each other and significantly superior over S_4 and S_5. While lowest girth of cob registered with S_5(10.94 cm) which was on par with S_4 (11.63 cm) during the year 2018. Similar trend was observed during 2019 and for mean of two years. Interaction effect at main at same level of sub treatments and sub treatments at same level of main treatments found to be non significant. Number of seed rows cob^{-1} was significantly influenced by land configurations during both the years. Higher number of seed rows cob^{-1} (17.1) recorded with raised bed over flatbed (15.2) during 2018. Similar trend was noticed during 2019 and for the mean of two years. Similar results are in line with the findings of Kumar and Chawla (2015). With regard to phosphorus levels significantly higher number of seed rows cob^{-1} was obtained with S_1 (17.5) followed by S_2 (17.0) and S_3 (16.5) which were on par with each other and significantly superior over S_4 and S_5. Grain yield was significantly influenced by land configurations during both the years. Higher grain yield (5888 kg ha^{-1}) recorded with raised bed over flatbed (5496 kg ha^{-1}) during 2018. The percentage increase in grain yield under raised bed over flatbed ranged from 7.13 to 9.73 during 2018 and 2019 respectively. These findings are in line with the findings of earlier studies conducted by Kumar and Chawla (2015). The increasing phosphorus levels resulted in significantly higher grain yield with S_1 (6017 kg ha^{-1}) followed by S_2 (5885 kg ha^{-1}) and S_3 (5798 kg ha^{-1}) which were on par with each other and significantly superior over S_4 and S_5. While lowest grain yield was registered with S_5 (5253 kg ha^{-1}) which was on par with S_4 (5509 kg ha^{-1}) during the year 2018. Similar trend was observed during 2019 and for mean of two years. Interaction effect at main at same level of sub treatments and sub treatments at same level of main treatments found to be non significant. The results are in conformity with the observations of Kumar *et al.* (2019) and Bekele *et al.* (2019).

CONCLUSION

Among planting methods, higher growth and yield of maize was recorded under raised bed method. Among phosphorus levels studied, 50 % RDP and 25% RDP recorded on par performance in terms of growth and yield of maize to that of 100 % RDP which indicated that phosphorus levels can be reduced to even 50% RDP to get equal yield of 100% RDP particularly in high phosphorus soils.

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