Response of mustard (*Brassica juncea* L. Czern & Coss) varieties to varied phosphorus fertilization levels in vertisols

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ABSTRACT: A field investigation was carried out at Regional Agricultural Research Station, Nandyal, Kurnool (Dist.) in Andhra Pradesh during rabi season of 2009 and 2010 to assess the performance of three mustard varieties (Sangam, JD 6 and SEJ 2) and their response to three levels of phosphorus fertilization (20, 30 and 40 kg P_2O_5/ha). The experiment comprised of nine treatments and was laid out in randomized design factorial with three replications. The results revealed that among the varieties, sangam resulted in significantly more number of branches plant^{-1}, number of siliqua/plant and thereby higher seed yield (1018 kg/ha during 2009 and 917 kg/ha during 2010) as compared to JD 6 and SEJ 2 during both the years of investigation. Even though application of phosphorus @ 40 kg P_2O_5/ha significantly increased yield attributes and seed yield as compared to 20 kg P_2O_5 /ha, but was statistically compared with that of 30 kg P_2O_5/ha. Hence, study clearly indicated that for realizing higher mustard seed yield, sangam variety can be grown with the application of 30 kg P_2O_5/ha.

Key words: Fertilization, mustard, phosphorus, seed yield, varieties

India is one of the important oilseed producing countries that accounts to more than 30 per cent of world acreage and 18-32 per cent of global annual seed production (AIRCPOC, 2004). To meet the oilseed requirement of burgeoning population, there is a necessity to bridge the gap between the demand and supply of edible oil seed production. Of the various oil seeds, rapeseed and mustard (Brassica sp.) crops stand next to soybean in terms of area and production and first in terms of vegetable oil supply in India (Kumar *et al*., 2017). In addition to oil extraction from rapeseed-mustard seed, the seed meal obtained after oil extraction can be used as animal feed and has also export value as it is a source of good quality proteins (Chauhan and Kumar, 2011). Mustard crop is sensitive to photoperiod and temperature, thus the performance of the crop is largely dependent on the environmental conditions (Neog and Chakravarthy, 2005; Meena *et al*., 2020). It is well documented that the growth response and performance of various genotypes vary with the climate and soil factors and hence selection of suitable cultivars to a particular environmental condition helps in realizing the maximum production potential of a cultivar and thereby increasing the productivity. However, the lower productivity of mustard crop was mainly attributed to poor soil fertility status and suboptimal nutrients supply especially nitrogen and phosphorus (Premi and Kumar, 2004). Phosphorous plays a key role in many of the chemical transformations that occur in plant as it is a structural component of cell organelle like chloroplasts, mitochondria and is a constituent of metabolic compounds like phytin, nucleic acid, protein, flavin nucleotides and several enzymes. Further, Phosphorus helps in root development, tiller formation and grain development processes in plants (Wang and Tillberg, 1998). Of late, the cultivated area under mustard crop is increasing in non-traditional areas like Andhra Pradesh thus promoting the horizontal growth of oil seed production. Many farmers in the scarce rainfall zone of Andhra Pradesh are showing interest to grow this crop keeping in view of good market demand. Mustard, being a non-traditional crop in the area, there is a necessity to select a variety suitable to the region and its optimum phosphorus requirement. This study was, thus planned to investigate the performance of different mustard varieties in terms of yield attributing parameters and yield; and their response to different phosphorus fertilization levels.

MATERIALS AND METHODS

A field experiment was conducted during rabi season of 2009 and 2010 at Regional Agricultural Research Station, Nandyal in Andhra Pradesh. The soil was clay loam, alkaline in reaction (8.5) with available nitrogen (210 kg/ha), phosphorus (14.2 kg/ha) and potassium (480 kg/ha). The experiment was laid out in Randomized Block design (Factorial). The treatments comprised of three varieties (Sangam, JD 6 and SEJ 2) and three phosphorus levels (20, 30 and 40 kg P_2O_5/ha) replicated thrice. The plot size was 3.6 m x 3.0 m. A spacing of 30 cm was adopted between the rows. Entire dose of phosphorus (As per treatments) and half dose of nitrogen (30 kg N/ha) was applied at the time of sowing. The remaining dose of nitrogen (30 kg N/ha) was applied in two equal splits at flowering and grain formation stages. The sources of nitrogen and phosphorus were urea and single super phosphate, respectively. The crop was sown during first week of November during both the years of study. Thinning was done at 10 days after emergence to maintain optimum plant population. The intercultural operations and manual weeding were taken up at 35 and 55 days after sowing. Agronomic characters (Plant height, number of branches/plant, number of siliquae/plant etc.) were recorded manually.

The plant height at maturity was measured from soil surface to the tip of the plant. The number of branches of three plants in each plot was counted and the mean values were taken. The siliqua plant^{-1} was determined by counting the total number of siliqua on five tagged plants and averaging them. After threshing and winnowing, the homogenous ground seed samples from gross produce of each plot were kept in the oven at 70^{o}C for 5-6 h. for removal of moisture. The test weight was determined by weighing 1000 seeds from each plot produce and was expressed in gram. The seed yield of net plot was weighed in gram and expressed in kg ha^{-1} after multiplying with appropriate conversion factor. All the data pertaining to the agronomic characters were subjected to Analysis of variance and if significant values were indicated, the treatment means were compared at 5% least significant difference (LSD) as per the procedure outlined by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

The results revealed that various varieties evaluated in the experiment exhibited considerable variation in terms of seed yield and yield attributes. During both the years of study, among the different varieties, maximum plant height was obtained with sangam followed by SEJ 2 and JD 6. Further, it was observed that plant height increased with increased level of phosphorus application i.e. from 20 to 30 kg P_2O_5/ha and 40 kg P_2O_5/ha, but was found to be statistically at par with each other. The slight increase in plant height might be due to increased efficiency of metabolism and formation of structural carbohydrates by increased soil available phosphorus (Ghosh and Gulati, 2001).

In both the years, among the varieties, sangam registered significantly higher seed yield (1018 kg/ha during 2009 and 917 kg/ha during 2010) as compared to JD 6 (650 kg/ha during 2009 and 513 kg/ ha during 2010) and SEJ 2 (640 kg/ha during 2009 and 539 kg/ha during 2010). Further, the seed yield obtained with JD 6 and SEJ 2 did not vary significantly in both the years. Even though the test weight of sangam was significantly lower (0.91 g during 2009 and 0.84 g during 2010) as compared to JD 6 (2.40 g during 2009 and 2.34 g during 2010) and SEJ 2 (2.50 g during 2009 and 2.52 g during 2010), the significantly higher seed yield with sangam was attributed to significantly higher branches/plant (14.7 during 2009 and 10.3 during 2010), number of siliqua/plant (510 during 2009 and 740 during 2010) (Table 1).

Among different levels of phosphorus fertilization, application of phosphorus @ 40 kg P_2O_5/ha registered significantly higher seed yield (868 kg/ha during 2009 and 759 kg/ha during 2010) as compared to 20 kg P_2O_5/ha (619 kg/ha during 2009 and 508 kg/ha during 2010), but was statistically on par with 30 kg P_2O_5/ha (820 kg/ha during 2009 and 702 kg/ha during 2010). Further, it was noticed that in 2009, phosphorus application @40 kg P_2O_5/ha significantly increased the number of branches/plant, number of siliqua/plant as compared 20 kg/P_2O_5 ha, but was statistically on par with 30 kg P_2O_5/ha (Table 1). Increased availability of phosphorus in soil resulted in higher P uptake, which might have enhanced net CO_2 fixation with increased rate of photosynthesis and thereby more photosynthates to develop more number of siliqua

Table 1: Influence of varieties and phosphorus levels on growth, yield attributes and seed yield of mustard during rabi 2009 and 2010

Treatments	Plant height (cm)		No. of branches/plant		No. of siliqua/plant		Test weight (g)		Seed yield (kg/ha)	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
Varieties										
Sangam	161	139	14.7	10.3	510	740	0.91	0.84	1018	917
JD 6	152	134	12.1	6.7	164	290	2.40	2.34	650	513
SEJ 2	156	136	13.4	6.6	208	307	2.50	2.52	640	539
SEm+	2.4	2.4	0.5	0.2	8.4	35	0.03	0.06	53	39
CD (p=0.05)	NS	NS	1.5	0.8	25	135	0.10	0.17	161	120
P levels (kg/ha)										
20	152	135	12.1	7.5	245	424	1.80	1.70	619	508
30	157	136	13.9	8.0	274	435	2.00	1.92	820	702
40	160	138	14.4	8.1	363	478	2.10	2.08	869	759
SEm+	2.4	2.4	0.5	0.2	8.4	35	0.03	0.06	53	39
CD (p=0.05)	NS	NS	1.5	NS	25	NS	0.10	0.17	161	120

plant^{-1} (Badsra and Chaudhary, 2001). During both the years, the test weight recorded with 40 kg P_2O_5/ha was significantly higher as compared to 20 kg P_2O_5/ha, but was statistically at par with 30 kg P_2O_5/ha. Phosphorus leads to synthesis and deposition of seeds reserves (starch, lipid, protein and phytin) that ultimately produce higher test weight (Jat *et al.,* 2000). Phosphorus application significantly increased the number of siliquae/plant (Premi and Kumar, 2004). The improvement in crop growth increased the yield attributes and thereby the seed yield of mustard. This could further be supported by the positive and significant correlation between yield attributes and yield (Rao *et al*., 2006).

CONCLUSION

Two year field investigation clearly indicated that among the varieties, sangam resulted higher seed yield as compared to JD 6 and SEJ 2. Application of phosphorus @ 40 kg P_2O_5/ha significantly increased yield attributes and seed yield as compared to 20 kg P_2O_5/ha, but was statistically at par with 30 kg P_2O_5/ha.

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