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Effect of land configuration and plant densities on yield and economics of Indian mustard (*Brassica juncea* L.)

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Abstract
To assess the effect of different land configurations and plant densities on yield and economics of Indian mustard an experiment was carried out during *Rabi*, 2020-21 at College Farm, Agricultural college, Jagtial, PJTSAU, Telangana. The experiment was laid out in split plot design with three land configurations as main plots (M_1- Flat bed, M_2- Ridge and furrow and M_3- Broad bed and furrow) and four plant density treatments as sub plots (S_1- 45 × 25cm, S_2- 45 × 20cm, S_3- 45 × 15cm and S_4- 45 × 10cm) replicated thrice. Thus from the results obtained from the present investigation it can be concluded that by adopting broad bed and furrow or ridge and furrow method of sowing with 45 cm × 10 cm or 45 cm × 15 cm plant density treatment, higher biological productivity and better monetary returns can be obtained in mustard cultivation during *Rabi* in Northern Telangana Zone.

Keywords: Land configurations, plant density, biological productivity, gross returns, net returns, B: C ratio

Introduction

India contributes about 6-7% of the world oilseeds production and India is the fourth largest oilseed economy in the world after the U.S., China and Brazil and it is the second largest importer after China.

Indian mustard is the second important oilseed crop in India next to groundnut. In Telangana, mustard is grown over an area of 4,000 hectares with a production of 0.776 Mt and productivity of 1940 kg ha^{-1} (INDIASTAT, 2018-2019). A poor yield of mustard in the country is mainly due to cultivation of mustard by adopting improper management practices. Plant density is an important cultural practice that determines yield attributes and consequently the yield (Johnson *et al*., 2003) [5]. Yield obtained from mustard is low due to adoption of poor agronomic practices, of which planting methods is one of the most important (Om *et al*., 2013) [10]. Therefore, a judicious management of soil moisture by *in-situ* conservation through proper land configurations can play an important role for easy and uniform germination as well as for better growth and development of mustard. An attempt was therefore, made to evaluate the effect of land configuration and plant densities on the yield and economics of mustard.

Materials and Methods

An experiment was conducted in the College farm, Agricultural College, Polasa, Jagtial, PJTSAU, during *Rabi* 2020-21. The farm is geographically situated at an altitude of 243.4 m above mean sea level on 18º 50'37.0"N latitude and 78º 57'00.6"E longitude. The soil was sandy clay loam, low in nitrogen (179.6 kg ha^{-1}), phosphorous (15.8 kg ha^{-1}), and high in potassium (389 kg ha^{-1}) with pH (7.8). The experiment was formulated with three land configurations (M_1- Flat bed, M_2- ridge and furrow and M_3- Broad bed and furrow) as main plots and four plant densities (S_1- 45 × 25cm, S_2- 45 × 20cm, S_3- 45 × 15cm and S_4- 45 × 10cm) were assessed in a split plot design with three replications.

Sowing of NRCHB-101 seed was done in the first fortnight of November. Thinning was done at 15-20 DAS by maintaining plant-to plant spacing of respective treatments. Half dose of nitrogen and full dose of phosphorous and potassium was applied as basal and remaining half of nitrogen was top dressed at flowering stage. The observations were recorded on the basis of 5 random plants and analyzed statistically by split plot technique and the significance was tested by F-test (Gomez and Gomez, 1984) [3] at 5 percent level of probability.

While computing the economics, different variable costs of items were considered. The expenditure on seeds, fertilizers, plant protection chemicals and labour charges were considered at the prevailing market price and presented as ₹ ha^{-1} (Appendix-A).

Gross returns were calculated by multiplying the grain with their respective prevailing market prices (4425/- Per quintal) and presented as ₹ ha^{-1}. The net returns were calculated by substracting the cost of cultivation from the gross returns and presented as ₹ ha^{-1}. Benefit- cost ratio was calculated for each treatment by using formula, gross income per hectare of each treatment was divided by the cost of cultivation of respective treatment.

Results and Discussion

Yield attributes

The yield attributes such as no. of siliqua $plant^{-1}$, no. of seeds $siliqua^{-1}$, seed yield were important yield attributing characters of Indian mustard. All these were significantly influenced due to land configurations. Crop sown on broad bed and furrow produced higher no. of siliqua per plant (181.08), seeds per siliqua (16.73), resulted in significantly higher seed yield (1261.8 kg ha^{-1}), which was on par with ridge and furrow (1196.3 kg ha^{-1}). The increased yield might be due to *in-situ* moisture conservation, improved root growth, nutrient access to the crop and thus increasing yield attributes and yield. Similar results were reported by Kaur (2003) [7], Kantwa *et al*. (2005) and Chiroma *et al*. (2006) [1] and Om *et al*. (2013) [10].

Among plant densities, 45 cm × 10 cm treatment recorded significantly higher seed yield (1277.8 kg ha^{-1}) which was on par with 45 cm × 15 cm (1212.3 kg ha^{-1}). This reveals that more plant density facilitated maximum utilization of nutrients and increased dry matter production which ultimately enhanced seed yield. Corroborative findings were also been reported by Saren *et al*. (2009), Kazemeini *et al*. (2010) [8] and Geetha *et al*. (2011) [2].

The interaction effect of land configuration and plant densities for seed yield and harvest index was found to be significant. Maximum interaction was found with treatment combination of broad bed with 45cm ×10 cm (M_3S_4) and was at par with ridge and furrow with 45 cm × 10 cm treatment combination (M_2S_4). The lowest interaction effect was observed with flat bed with 45 cm × 25 cm (M_1S_1).

Economics

Cultivation of mustard under broad bed and furrow recorded significantly higher gross returns (₹ 55836.13 ha^{-1}), net returns (₹ 26208.63 ha^{-1}) and B: C ratio (1.88) which was due to higher seed yield (1261.8 kg ha^{-1}) and stover yield (3243.6 kg ha^{-1}). It was found at par with ridge and furrow land configuration. Among different plant density treatments, 45 cm × 10 cm has performed better over other treatments in-spite of its highest cost of cultivation (₹ 30369.00 ha^{-1}). The plant density treatment, 45 cm × 10 cm fetched highest gross returns (₹ 56546.58 ha^{-1}) and net returns (₹ 26177.58 ha^{-1}) with highest B: C ratio of 1.86. This treatment was followed by 45 cm × 15 cm with cost of cultivation (₹ 29288.50 ha^{-1}), gross returns (₹ 53645.75 ha^{-1}), net returns (₹ 24357.25 ha^{-1}) and B: C ratio (1.83) which was on par with 45 cm × 10 cm treatment and it was followed by 45 cm × 20 cm. The results were in agreement with the findings of Lakra *et al*. (2018) [9] and Singh *et al*. (2018) [11].

The interaction between land configurations and plant densities for gross returns, net returns and B: C ratio was found to be significant. The highest interaction was noticed with combination of broad bed and furrow configuration with 45 × 10 cm treatment *i.e.* M_3S_4 (₹ 63602 ha^{-1} with B: C ratio 2.07) and was at par with M_2S_4. The lowest interaction was found with combination flat beds with 45 × 25 cm treatment *i.e.* M_1S_1 (₹ 33453 ha^{-1} with B: C ratio 1.02).

Summary and conclusions

Broad bed and furrows resulted in better yield attributes of mustard. However, ridges and furrows performed similar to broad bed and furrows for all yield attributes. Among the plant density treatments, 45 cm × 10 cm performed better over other treatments. However, 45 cm × 15 cm performed similar to 45 cm × 10 cm plant density treatments for certain parameters.

Raising mustard on broad bed and furrow registered higher gross returns, net returns and B: C ratio. However, ridges and furrows performed similar to broad bed and furrows for gross returns, net returns and B: C ratio. Among plant density treatments, 45 cm × 10 cm recorded higher gross returns, net returns and B: C ratio over other plant density treatments and lowest values were recorded in 45 cm× 25 cm plant density treatment.

Table 1: Show the main plots and sub plots

Treatment	No. of siliqua $plant^{-1}$	No. of seeds $siliqua^{-1}$	Seed yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Harvest index (%)	Cost of cultivation (Rs ha^{-1})	Gross returns (Rs ha^{-1})	Net returns (Rs ha^{-1})	B: C ratio
Main plots (Land configurations)									
M_1-Flat bed	161.42	14.82	1020.3	2907.6	25.81	28722.50	45149.75	16427.25	1.57
M_2- Ridge and furrow	174.75	15.73	1196.3	3076.0	27.96	29627.50	52937.75	23310.25	1.79
M_3-Broad bed and furrow	181.08	16.73	1261.8	3243.6	28.01	29627.50	55836.13	26208.63	1.88
S.Em ±	3.78	0.36	24.32	59.93	0.26	-	1076.11	1076.11	0.04
CD	14.84	1.42	95.49	235.3	1.02	-	4225.31	4225.31	0.15
Sub plots (Plant densities)									
S_1-45×25 cm	182.56	16.93	994.6	2870.6	25.53	28409.17	44014.00	15604.83	1.55
S_2-45×25 cm	174.44	16.33	1153.1	3019.5	27.63	29236.67	51025.17	21788.50	1.74
S_3-45×25 cm	170.78	15.27	1212.3	3158.0	27.79	29288.50	53645.75	24357.25	1.83
S_4-45×25 cm	161.89	14.51	1277.8	3255.0	28.08	30369.00	56546.58	26177.58	1.86
S.Em ±	4.81	0.59	32.80	82.04	0.33	-	1451.32	1451.32	0.05
CD	14.29	1.74	97.45	243.75	3.58	-	4312.10	4312.10	0.15
Interaction									
S.Em ± (M x S)	8.33	1.01	56.81	142.09	0.56	-	2513.76	2513.76	0.09
CD (P=0.05)	24.75	NS	168.79	NS	1.67	-	7468.78	7468.78	0.26
S.Em ± (S x M)	8.14	0.95	54.88	136.87	0.55	-	2428.43	2428.43	0.08
CD (P=0.05)	25.87	NS	173.35	NS	1.76	-	7670.78	7670.78	0.26

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