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Influence of Land Configuration and Nutrient Management on Productivity of Soybean [*Glycine max* (L.) Merrill] Under Rainfed Condition of Vidarbha Region

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ABSTRACT

Various land configuration techniques in combination with nutrient management in soybean were tried to study its influence on productivity of soybean. The present investigation on influence of land configuration techniques (Flat bed, opening of furrow in each row, after 2 rows and after 3 rows at 30 DAS) along with three nutrient management (100% RDF *i.e.* 30:75:00 kg NPK ha-1, FYM @ 10 t ha-1 + PSB + Rhizobium and 50% RDF + FYM @ 10 t ha-1 + PSB + Rhizobium) on soybean productivity was carried out in a split plot design at research farm of Department of Agronomy, Post Graduate Institute, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra. The experiment with four land configuration treatments as main plots and three nutrient management treatments as sub plots revealed that, opening of furrow in each row at 30 DAS and opening of furrow after two rows increased growth, yield and yield attributes, moisture use efficiency, GMR, NMR and B:C ratio as compared to flat bed sowing and opening of furrow after three rows while application of 100% RDF increased growth, yield and yield attributes, GMR, NMR and B:C ratio followed by 50% RDF+FYM@5t ha-1 + PSB + Rhizobium.

1. Introduction

Soybean [(*Glycine max* (L.) Merrill] with its about 40-42 per cent protein and 18-22 per cent oil emerging as one of the fast growing oilseed crop in the world (Masciarelli *et al.*, 2014). Soybean is being considered as a major oilseed crop in India as it is an important source of protein and oil; and the crop have the potential to fulfill the demand of pulse/protein requirements of the masses through diverse value added products and vegetable oil. Although the area under soybean cultivation during the last decade has been expanded continuously yet, its productivity has not followed the same trend due to uncertainty in rainfall patterns including the extremes of rainfall events (dry spell/waterlogged conditions). In case of heavy to medium soils, both dry spell (cracks in soil) and heavy rainfall (waterlogged condition) caused poor plant growth and low yield. Therefore, intermittent furrow opening could possibly facilitate in both ways *viz.* conserves the soil moisture during dry spell and helps in draining out excess water under water logging condition. Under Vidarbha region in Maharashtra (India), the climatic condition is suitable for soybean and the crop is being preferred over others by farmers. Other reasons for area expansion are its low cost of cultivation, short duration and high market prices. However, during the last 4-5 years, it was observed that erratic rainfall, gradual increase in temperature during its reproductive cycle, and occurrence of dry spell or excess rainfall during its critical growth stages (flowering, pod formation and pod filling) caused water stress (due to dry spell or waterlogged condition) that hampered both crop growth and agronomic (intercultural) operations in the field. This could be the reason for reduced seed yield in this crop. The long term use of inorganic fertilizers has resulted in deterioration of soil health and productivity.

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The long term experiment so far carried out elsewhere have clearly indicated that there is an urgent need to integrate organic manures and inorganic fertilizers for sustainable production, maintenance of soil productivity, soil fertility. Now a day's cost of fertilizers and manures are very high which increase the cost of cultivation and reduce the net returns per unit area. Hence there is ample scope for judicious use of chemical fertilizers in combination with organic manures to improve the soil health as well as achieve sustainable production with better returns.

Keeping this in view, an experiment was carried out to assess various land configuration techniques in combination with nutrient management for enhancing soybean productivity.

2. Materials and Methods

The present investigation on influence of land configuration techniques (Flat bed, opening of furrow in each row, after 2 rows and after 3 rows at 30 DAS) along with three nutrient management (100% RDF *i.e.* 30:75:00 kg NPK ha-1, FYM @ 10 t ha-1 + PSB + Rhizobium and 50% RDF + FYM @ 10 t ha-1 + PSB + Rhizobium) on soybean productivity was carried out in a split plot during 2019-10 at research farm of Department of Agronomy, Post Graduate Institute, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra with four replications. The observations like, Plant height, number of branches per plant, leaf area per plant, leaf area index, number of root nodules per plant, Dry matter weight per plant, number of pods per plant and test weight were recorded from 5 plants randomly selected from each treatment from each replication. Besides these, seed yield, straw yield and economics of treatments (gross monetary returns, net monetary return and B:C ratio) were also calculated. The data was subjected to statistical analysis using normal procedure. Moisture use efficiency and soil moisture content at 30 cm depth at seedling, flowering and pod filling stage were also recorded and percent increase over flat sowing was calculated. The results obtained after analysis is summarized and discussed in results and discussion.

Table 1. Effect of land configuration and nutrient management treatments on ancillary characters, yield and economics in soybean.

SN	Treatments/ Characters	Plant height (cm)	No. of branches/ plant	No. of pods/ plant	Test weight (g)	Dry matter weight (g)	Root nodules /plant	Leaf area/ plant	Leaf area index
A)	**Main Plot (Land Configuration)**								
L_0	Flat Bed	56.51	3.42	21.96	11.51	15.86	34.43	8.89	3.95
L_1	Opening of furrow after each row	62.44	4.57	26.61	12.31	18.82	40.20	11.73	5.21
L_2	Opening of furrow after two rows	60.54	4.18	25.00	11.77	17.98	39.50	10.79	4.80
L_3	Opening of furrow after three rows	58.95	3.88	24.29	11.40	16.82	36.96	9.70	4.31
	SE(m±)	0.78	0.12	0.37	0.27	0.40	0.52	0.33	0.15
	CD at 5%	2.50	0.39	1.17	NS	1.26	1.67	1.04	0.46
B)	**Sub plots (Nutrient management)**								
F_1	100% RDF	61.12	4.23	25.59	12.54	18.17	35.62	11.16	4.96
F_2	FYM @ 10 t ha^{-1} +PSB + *Rhizobium*	57.66	3.80	23.05	10.90	16.39	39.33	9.39	4.17
F_3	50 % RDF + FYM @ 5 t ha^{-1} +PSB + *Rhizobium*	60.05	4.01	24.70	11.81	17.50	38.37	10.28	4.57
	SE(m±)	0.78	0.09	0.32	0.25	0.35	0.38	0.32	0.14
	CD at 5%	2.26	0.25	0.93	0.79	1.01	1.12	0.96	0.43
C)	**Interaction (A x B)**								
	SE(m±)	1.55	0.17	0.64	0.55	0.69	0.77	0.66	0.29
	CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS

3. Results and Discussion

Results presented in Table 1 revealed that all the ancillary characters were significantly influenced due to land configuration and nutrient management treatments except test weight and NMR. In case of ancillary characters, opening of furrow after each row recorded maximum plant height (62.44 cm), number of branched per plant (4.57), number of pods per plant (26.61) and dry matter weight (18.58 g), leaf area per plant (11.73), leaf area index (5.21), number of root nodules per plant (40.20) which was at par with opening of furrow after 2 rows and significantly superior over flat bed and opening of furrow after 3 rows. Different land configuration treatments did not differ significantly among themselves in producing higher test weight. The lowest value of all ancillary characters was exhibited by flat bed treatment. The superior performance of ancillary characters in opening of furrow after each row indicated adequate moisture conservation in soil benefited to the crop during vegetative and critical growth stages like flowering and pod formation. Similar trend of observation was also noticed earlier by (Ingle *et al.*, 1999 and Jogdande *et al.*, 2003). Ancillary data depicted in Table 1 also revealed that, significantly higher plant height (61.12 cm), number of branches per plant (4.23), number of pods per plant (25.29), dry matter weight (18.17g) leaf area per plant (11.16), leaf area index (4.96), number of root nodules per plant (35.62) was noted in 100% RDF over FYM @ 10 t ha-1 +PSB + Rhizobium and at par with 50 % RDF + FYM @ 5 t ha-1 +PSB + Rhizobium.

In addition, test weight was also significantly higher under 100% RDF (12.54 g) followed by 50 % RDF + FYM @ 5 t ha-1 +PSB + Rhizobium. Land configuration techniques *i.e.* furrow opening after each rows however, resulted in realization of significantly higher seed yield (22.90 q/ha) and straw yield (31.66 q/ha) over furrow opening after 3 rows, and flat sowing and at par with furrow opening after 2 rows. The quality parameters like protein content (37.62%) and oil content (19.18%) was significantly higher in opening of furrow after each row than flat bed and opening of furrow after 3 rows. While under nutrient management, application of 100% RDF has produced significantly higher seed yield (21.92 q/ha) and straw yield (30.13 q/ha) over FYM @ 10 t ha-1 +PSB + Rhizobium and at par with 50 % RDF + FYM @ 5 t ha-1 +PSB + Rhizobium (Table 2). Similar findings were also reported earlier by (Patel and Chandravanshi 1988, Raut *et al.*, 2003, Chavan *et al.,* 2007).

Statistical analysis also revealed that economics of cultivation measured through monetary returns and B: C ratio was favored through nutrient management only (Table 2). It revealed that 100% RDF showed significantly higher gross monetary returns (38924 INR /ha), net monetary returns (25985 INR /ha) and B:C ratio (3.10) over FYM @ 10 t ha-1 +PSB + Rhizobium and 50 % RDF + FYM @ 5 t ha-1 +PSB + Rhizobium (Table 2). (Singh *et al.*, 2007) also found similar results in soybean. In case of Land configuration techniques, numerically higher net monetary returns (25536 INR/ha) and B:C ratio (2.79) was exhibited in furrow

Table 2. Effect of land configuration and nutrient management treatments on yield, quality and economics in soybean.

SN	Treatments/ Characters	Seed Yield (q/ha)	Straw yield (q/ha)	Protein content (%)	Oil content (%)	GMR (Rs./ha)	NMR (Rs./ha)	B:C ratio
A)	**Main Plot (Land Configuration)**							
L_0	Flat Bed	19.41	26.40	35.13	18.26	33926	20464	2.55
L_1	Opening of furrow after each row	22.90	31.66	37.62	19.18	40048	25536	2.79
L_2	Opening of furrow after two rows	21.92	30.51	36.41	18.61	38346	24184	2.74
L_3	Opening of furrow after three rows	20.19	28.15	35.36	18.39	35322	21510	2.59
	SE(m+)	0.74	1.05	0.49	0.20	1284	1284	-
	CD at 5%	2.35	3.36	1.56	0.65	4097	NS	-
B)	**Sub plots (Nutrient management)**							
F_1	100% RDF	21.92	30.13	36.39	18.39	38924	25985	3.10
F_2	FYM @ 10 t ha^{-1} +PSB + *Rhizobium*	20.34	28.17	35.85	18.58	35572	19937	2.27
F_3	50 % RDF + FYM @ 5 t ha^{-1} +PSB + *Rhizobium*	21.06	29.24	36.15	18.85	36835	22848	2.63
	SE(m+)	0.42	0.51	0.43	0.19	715	715	-
	CD at 5%	1.21	1.49	1.26	0.56	2083	2083	-
C)	**Interaction (A x B)**							
	SE(m+)	0.83	1.02	0.87	0.38	1431	1431	-
	CD at 5%	NS	NS	NS	NS	NS	NS	-

opening after each rows. Similarly the interaction of land configuration techniques and nutrient management was not significant so far for all the characters under study. Soil moisture observation also indicated that land configuration technique *i.e.* furrow opening after each rows recorded more soil moisture content at seed filling stage (32.00%) and flowering (29.31%) at 30 cm depth as compared to all other related treatments *viz.* furrow opening after 2 rows, 3 rows and flat sowing. Highest moisture use (320.44 mm) moisture use efficiency (6.84 kg/ha mm) was recorded in furrow opening after each row followed by opening of furrow after 2 rows and 3 rows (Table 3). Results are conformity with findings of (Lomte *et al.,* 2006) and Dikey, *et al.,* 2012) indicating that higher moisture use efficiency in opening of furrow treatment than flat bed.

From the above, it is concluded that furrow opening operation performed better in terms of seed yield and economics of soybean cultivation as compared to flat bed which could be recommended against uncertainty in rainfall patterns including the extremes of rainfall events under the above agro-eco system.

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Table 3. Soil moisture content (%) and Moisture use efficiency as affected by different land configuration treatments.

S. No	Treatments/ Characters	Seedling stage	Increase over flat bed	Flowering stage	Increase over flat bed	Seed filling stage	Increase over flat bed	Moisture use (mm)	Moisture use efficiency (kg/ha mm)
L_0	Flat Bed	24.64	--	24.89	--	27.28	--	303.75	4.59
L_1	Opening of furrow after each row	26.38	1.74	29.31	4.42	32.00	4.80	320.44	6.84
L_2	Opening of furrow after two rows	25.46	0.82	27.49	2.60	30.90	2.89	315.20	5.92
L_3	Opening of furrow after three rows	25.26	0.62	26.58	1.69	28.81	1.61	311.84	5.07