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Effect of planting method, inorganic fertilizers and FYM levels on yield attributes and quality parameters of soybean under western Maharashtra condition

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Abstract
In order to investigate the effects of planting methods, inorganic fertilizers and FYM levels on yield and quality parameters in soybean, an experiment was conducted during 2020 and 2021 on medium black soil of Instructional farm, Krishi Vigyan Kendra, Narayangaon to find out the response of planting methods, nutrient management and FYM levels on Soybean. Sowing on ridges and furrow recorded significantly the highest seed yield (2122.36 kg/ha), stover yield (5330.87kh/ha) and biological yield (7453.23 kg/ha). There were 12.68% higher seed yield over flat bed. Similarly ridges and furrow recorded significantly the highest protein content (19.54%) and oil content (19.45%) over the flat bed sowing. Among the different levels of fertilizers, 100% RDF out rightly dominated and established its significant performance in respect of Seed, stover and biological yield. Application of 100% RDF produced significantly the seed (2098.31 kg/ha) and stover yield (5317.33 kg/ha), protein content (37.12%) and oil content (19.45%). The result further revealed that seed yield as well as stover yield, protein content, and oil content were significantly increased by application of FYM @ 7.5 t/ha with rhizobium and PSB. Significantly the highest seed (2155.29 kg/ha) Stover (5473.76 kg/ha), Biological yield (7629.05 kg/ha) and protein content (37.20%), oil content (19.47%) was recorded with the application FYM @ 7.5 t/ha with rhizobium and PSB. This was 15.28% higher seed yield over control.

Keywords: Soybean, planting method, inorganic fertilizer, farm yard manure

Introduction
Planting method can play an important role for easy and uniform germination as well as growth and development of plant. In these circumstances, ridges and furrow method of sowing under such situation is advantageous as compared to flat bed sowing as it provides better aeration, root development and also protects the crop from water logging condition. Balanced use of organic and inorganic fertilization is advocated for the maximum return and maintenance of soil fertility. Fertilizer is costly but important input in crop productivity. In plant nutrition, organic matter of a soil is the key property that decides the availability status of essential nutrients. Plant nutrients can be supplied from different sources *viz*. organic manures, crop residues and chemical fertilizers. For better utilization of resources and to produce crops with less expenditure, integrated nutrient management is the best approach. With this background information the present experiment is planned.

Materials and Methods
The experiment were conducted during 2020 and 2021 on medium black soil of Instructional farm, Krishi Vigyan Kendra, Narayangaon. The soil of experimental field was clay in texture, low in total nitrogen, medium in available potash and fairly rich in available potassium. The experiment was conducted in factorial randomized block design with three replication. Having two levels of planting method *viz*. flat bed (P1), Ridges and furrow (F2), two levels of Inorganic fertilizers, 75% RDF (F1), 100% RDF (F1) and three levels of of FYM namely, control (M1), FYM @ 7.5 t/ha and FYM @ 7.5 t/ha + Rhizobium + PSB. The experiment was started from *kharif* season of 2020 with sowing of soybean cv. MACS-1188 at the spacing of 30x10 cm. sowing is done in the month of June. The land was cross cultivated by tractor drawn by cultivator during the month of June. The big clods were crushed and then field was leveled with the help of planking. Thereafter, the experiment was laid out and seed beds were prepared. The sequence of field operations was carried out as per recommendation.

Results and Discussion

Seed, Stover and biological yield

Planting method has significant effect on seed, Stover and biological yield. Sowing on ridges and furrow method recorded the highest seed, Stover and biological yield (Table 1). Significantly the highest seed (2122.36 kg/ha) stover (5330.87 kg/ha) and biological (7453.23) yield was obtained under ridges and furrow sowing over flat bed sowing. There were12.68% higher seed yield over flat bed sowing. This might be due to cumulative effect exerted from better improvement in drainage, soil environment, aeration, root development optimum moisture air equilibrium throughout the crop growth besides supply of available nutrients to the crops resulting in better growth and development ultimately reflected in better seed and stover yield. The present findings are in accordance with those of Motwani and Ashish (2018), Verma *et al*. (2020) [4, 6] in soybean.

Appreciably highest values of yield attributes, seed (2098.31 kg/ha), stover (5317.33 kh/ha) and biological (7415.64kg/ha) yield (Table 1) were noted with the application of 100% RDF than rest of levels. The increase in seed, stover and biological yield might be due to remarkable improvement in the yield attributes such as length of pods, pods per plant and text weight, better development of various growth parameters such as plant height, number of branches per plant which resulted in higher seed yield. The results were supported by the findings of Vyas and Kushwah (2015) and Ghodake *et al*. (2018) [9, 2] in soybean.

Application of FYM @ 7.5 t/ha with rhizobium and PSB recorded significantly highest seed (2155.29 kg/ha), stover (5473.76 kg/ha) and biological (7629.05 kg/ha) yield over control. Significantly highest seed and stover yield were due to favourable effect of FYM with rhizobium and PSB Biofertilizers in improvement of growth attributes such as plant height, length of pods and text weight. Similar results were obtained by Koushal, S, (2017) and Geetha *et al*. (2018) [3, 1] in soybean.

Protein and Oil content (%)

The Protein content and Oil content were significantly highest under ridges and furrow over flat bed sowing. The higher protein and oil content in seed under ridges and furrow sowing might be due to better availability of nitrogen to plant because of high root nodules formation under this treatment. The increase in protein yield is attributed to higher seed yield and protein content recorded under this treatment. The results are conformity with reported by Prajapati *et al*. (2018) and Verma *et al*. (2020) [5, 6] in soybean.

Inorganic fertilizers also had significant effect on protein and oil content. The protein content and oil content of soybean were maximum under treatment receiving 100% RDF over the other treatment. This was because of higher N content in seed (Table 18) which is an important constituent of protein. These results confirm the findings of Geetha *et al*. (2018) [1] and Ghodake *et al*. (2018) [2].

Application of FYM with rhizobium and PSB was found significant effect on protein and oil content. Protein and oil content was recorded significantly higher under treatment FYM @ 7.5 t/ha with rhizobium and PSB application over control. This might be due to multifarious role of FYM in supply of nutrients as well as improvement in physical, chemical and biological properties of soil. Finally, it was reflected in better growth of the plants with FYM. The results are in close conformity with those of Singh (2018) and Raghuwanshi *et al*. (2018) [8, 7] in soybean.

Table 1: Effect of different treatments on yield attributes and quality parameters of soybean

Treatment	Seed yield (kg/ha)	Stover yield (kg/ha)	Biological yield (kg/ha)	Protein content (%)	Oil content (%)
Planting method (P)					
P_1- Flat bed	1883.47	4659.68	6543.15	35.40	18.46
P_2- Ridges & furrow	2122.36	5330.87	7453.23	36.24	19.45
SE+	41.69	118.90	154.59	0.15	0.15
CD%	118.83	338.87	440.60	0.40	0.43
Inorganic Fertilizer levels (F)					
F_1 – 75% RDF	1883.47	4673.22	6580.75	36.10	18.72
F_2 – 100% RDF	2122.36	5317.33	7415.64	37.12	19.45
SE+	41.69	118.90	156.59	0.14	0.15
CD%	118.83	338.87	430.60	0.44	0.41
FYM levels (M)					
M_1 - No FYM (Control)	1869.47	4551.95	6421.41	35.20	18.50
M_2 - FYM @ 7.5 t ha $^{-1}$	1984.00	4960.11	6944.11	35.70	19.28
M_3 - FYM @ 7.5 tha^{-1} +Rhizobium +PSB	2155.29	5473.76	7629.05	37.20	19.47
SE+	51.06	145.62	189.33	0.12	0.18
CD%	145.54	415.04	539.62	0.46	0.53

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