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RESEARCH ARTICLE :

Effect of raised bed, zero and conventional till system on performance of soybean crop in vertisol

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SUMMARY : The study was conducted to evaluate the performance of raised bed planter, zero till seed cum fertilizer drill andseed cum fertilizer drill systems for the sowing of soybean crop in vertisol. The experiment was conducted at J.N.K.V.V., Research Farm, Jabalpur, India.Randomized Block Design was used for conducting the experiments. It was found that the total time and cost required for making raised bed and sowing operations by the raised bed planter was 1.85 h/ha and Rs. 395.8/ha, which was 4.60% less than conventional (seed cum fertilizer drill) but itwas 74.80% more time than zero till seed cum fertilizer drill. The average yield with the raised bed planter was obtained 31.37 q/ha, whereas, with seed cum fertilizer drill and zero till seed cum fertilizer drill it was 21.35 and 19.31 q/ha, respectively. The soil conditions were found to be better for raised bed planter.

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KEY WORDS :
Bulk density, Biometrics,Tillage, Raised bed planter, Field capacity, Field efficiency, Zero till drill, Vertisol

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BACKGROUND AND OBJECTIVES

Soybean is scientifically known as *Glycine max* L. It is a species of family "Leguminoceae" the most important and most widely cultivated legume cum oilseed crop of the world. It has a good adaptability to wide range of soils and climate. In addition, it constitutes an important source of high quality food. Protein content in soybean is the highest among all the food crops.

For improvement of agricultural productivity the package of improved implements, machines played important roles, besides high yielding varieties, fertilizer, irrigation and plant protection practices. In general, the harvesting of wheat starts from the mid of April to the mid of May. The total time available for timely sowing of soybean is about 15 - 20 days. Thus, wheat harvested fields are not tilled and sown timely. This results in delayed sowing of soybean and consequently lower yield. It has been estimated that about 16-25 per cent of the total energy available for rural sector is used for agricultural production (Singh, 1997) of which, about 20 per cent energy is consumed only in seedbed preparation (Anonymous, 1984). The time and energy for preparing the seedbed in soybean fields could be minimized by use of efficient implements and machines.

Reduction of labour requirements has been the principal motivating force in agricultural mechanization. The application of machines to agricultural production has been one of the outstanding developments in the developed countries. The expanding population of these countries has required and will continue to demand an ever-increasing agricultural production of feeds and fibres. The application of machines to agricultural production did not only reduce burden and drudgery of farm work, but also increased the output per worker.

RESOURCES AND METHODS

The field experiments were carried out at BSP research farm of J.N.K.V.V. during 2013-2014. The field beinglow laying area was poorly drained. The soil of the experimental field was classified as richclay-loam (vertisol). The clay, silt and other were inthe range of 54.75, 20.15 and 25.10 per cent, respectively. The field experiments were carried out in combine harvested wheat fields on April 22 and 27, 2013. The average initial bulk density, moisture content and coneindex were measured at depths of 0-150 mm before conducting the experiment. The field under each condition was divided in four blocks of 25.5 x 35m size. Each field was further divided into three equal parts of size7.5m x 35m. The experiments were conducted using Randomized Block Design. In combine harvested field the loose residue dropped bycombine was burnt and standing wheat stubbles were left as such in the field. The average height of standing stubble varied in the range of 10-12 cm. The treatments were raised bed planter sowing, conventional (seed cum fertilizer drill) and zero till seed cum fertilizer drill consisting of m.b. plough with one pass, followed by cultivator with one pass and disc harrow with one pass then sowing. The three replication was conducted at the time of raised bed planting and conventional (seed cum fertilizer drill). Timeand fuel required for operations were recorded. The recommended rate of 80kg/ha of seed and 20 kg/ha N, 60 kg/ha P_2O_5 kg/ha and 20 kg/ha K_2O was appliedat time of sowing. Further irrigations were not required due to rainfall during the crop season. Soil moisture content,bulk density and cone index were measured on o, 30, 60 and 90 days at 0- 150 mm depth. Time and fuel required foreach treatment were recorded. The seed germination, plant height, depth of root, number of nodules, pods/plant and yield were also recorded.

OBSERVATIONS AND ANALYSIS

The machines, soil and crop parameters were taken in account to compare the performance of three different system of sowing of soybean crop in vertisol. The Table 1 shows the results given as below:

Draft :

Table 1 shows the performance results of different sowing systems.The draft requirement was found to be maximum *i.e.* 3.47 kN for raised bed planter (T_1) and lowest in seed cum fertilizer drill (T_2) *i.e.* 2.32 kN. Whereas, for the zero till drill it was 3.03 kN.The draft requirement was more in the case of raised bed planter due to in weight and more soil handling capacity at depth 150 mm (*i.e.* volume of soil).

Effective field capacity :

The effective field capacity was measured 0.54, 0.43 and 0.41 h/ha for raised bed planter, seed cum fertilizer drill and zero till seed cum fertilizer drill, respectively. The effective field capacity of raised bed planter was 20.37 and 24.07% more than seed cum fertilizer drill and zero till seed cum fertilizer drill, respectively. Because, working width of raised bed planter more than seed cum fertilizer drill and zero till seed cum fertilizer drill so, less time require for turning and covering area.

Field efficiency :

The field efficiency was measured 79.5, 75.30 and 72.00% for raised bed planter, seed cum fertilizer drill and zero till seed cum fertilizer drill, respectively. The effective field capacity of raised bed planter was 5.28 and 9.43 % more than seed cum fertilizer drill and zero till seed cum fertilizer drill, respectively. The reason may be due to working width of raised bed planter was more

Table 1 : Soil bulk density at 0- 150 mm depth for different treatments

Treatments	Particulars	0 DAS	30 DAS	60 DAS	90 DAS at harvest
T_1	Raised bed planter	1.15	1.25	1.32	1.39
T_2	Seed cum fertilizer drill	1.13	1.29	1.37	1.45
T_3	Zero till seed cum fertilizer drill	142	1.49	1.58	1.66

(a) Raised bed planter (b) Seed cum fertilizer drill (c) Zero till seed cum fertilizer drill

Plate 1 : Perational view of different machineries

than seed cum fertilizer drill and zero till seed cum fertilizer drill so, enhanced increase field efficiency by raised bed planter. The pale no1 shows the operational view of different machineries.

Time :

The time duration required for sowing of soybean crop under various treatments for raised planter, zero till drill and seed cum fertilizer drill are shown in Table 1. In raised bed planter, seed cum fertilizer drill andzero till drill and required 1.85,2.32 and 2.43 h/ha, respectively. The raised bed planter was 20.25 and 23.86% less than seed cum fertilizer drill and zero till seed cum fertilizer drill, respectively.

The total time required for seed bed preparation and sowing operation was 10.36, 10.83 and 2.43 h/ha for T_1, T_2 and T_3 treatments, respectively. The saving of time in zero till drill seed cum fertilizer drill over raised bed planter and seed cum fertilizer drill were 76.54 and 77.56%, respectively.

Fuel consumption :

Fuel requirement was measured 39.14, 39.14 and 9.86 l/ha for raised bed planter, seed cum fertilizer drill and zero till seed cum fertilizer drill, respectively. The saving of fuel in zero till seed cum fertilizer drill over raised bed planter and seed cum fertilizer drill were 74.80 and 75.26 %, respectively.

Bulk density :

The bulk density was measured on 0, 30,60 and 90 (DAS) days after sowing and the data is given in Table 2 for different treatments. The bulk density was higher for zero till seed cum fertilizer drill compared to raised bed planter and seed cum fertilizer drill. This increasing trend *i.e.* sowing to harvesting was achieved because of the settlement of soil, this may be due to the rainfall, irrigation and other natural process of crop growth. In zero till seed cum fertilizer drill was virtually no change in bulk density after sowing as using this machine only a slit is formed for placing seeds in the field and there is no disturbance of soil.

Seed emergence :

The seed emergence data are given in Table 3. The seed emergence was highest (94.5) for raised bed planter

Table 2 : Biometrics of plants for different treatments

Treat-ments	Seed emergence (%)	Plant population, (m^2)		Plant height, (cm)		Depth of root/plant		No. of roots/plant		Nodules / plant		Pods/ plant	Seed yield (q/ha)	Straw yield (q/ha)	Weight of 100 grains
		15 DAS	90 at harvest	30 DAS	90 at harvest	30 DAS	60 DAS	30 DAS	60 DAS	45 DAS	60 DAS				
T_1	94.5	47.00	41.00	25.96	78.13	17.23	50.96	12.4	29.33	54.20	135.58	121.83	31.37	71.89	9.1
T_2	91.2	40.67	33.67	23.18	65.36	13.30	23.10	7.93	24.32	45.36	102.93	77.81	21.35	56.36	8.8
T_3	85.7	30.34	23.00	22.14	56.73	8.66	11.66	14.6	30.86	62.00	81.25	64.80	19.31	47.05	8.9

Table 3 : Performance of different machines

Sr. No.	Particulars	Treatment (T_1)				Treatment (T_2)				Treatment (T_3)
		M.B. plough	Cultivator x 1	Disc harrow x 1	RBP	M.B. Plough	Cultivator x 1	Disc harrow x 1	Seed drill	Zero till drill
1.	Date of operation	12th June 13	12th June 13	14th June 13	16st June 13	12th June 13	12th June 13	14th June 13	16st June 13	16st June 13
2.	Type of soil	Clay loam	Clay loam	Clay loam	Clay loam	Clay loam	Clay loam	Clay loam	Clay loam	Clay loam
3.	Topography	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain	Plain
4.	Av.Moisture content of soil, (%)	24.63	23.51	21.26	19.82	24.63	23.51	21.26	19.82	21.61
5.	Av. depth of operation, (cm)	28.5	12.3	11.1	4.8	28.5	12.3	11.1	5.2	4.9
6.	Av.width of operation, (cm)	67.8	190.4	106.9	226.7	67.8	190.4	106.9	178.5	175.2
7.	Av. speed of operation, (km/h)	3.8	4.1	4.9	3	3.8	4.1	4.9	3.2	3.3
8.	Duration of test, h/ha			10.36				10.83		2.43
9.	Draft, (KN)	6.53	5.69	5.05	3.47	6.53	5.69	5.05	2.41	3.23
10.	Field capacity, (ha/h)	0.21	0.65	0.45	0.54	0.21	0.65	0.45	0.43	0.41
11.	Time required for 1 ha, (h/ha)	4.76	1.53	2.22	1.85	4.76	1.53	2.22	2.32	2.43
12.	Theoretical field capacity, (ha/h)	0.25	0.78	0.52	0.68	0.25	0.78	0.52	0.57	0.57
13.	Field efficiency, (%)	82.3	84.5	86.5	79.5	82.3	84.5	86.5	75.30	72.0
14.	Fuel consumption, (l/h)	3.9	3.7	3.6	3.9	3.9	3.7	3.6	3.8	4.1
15.	Fuel consumption, (l/ha)	18.39	5.60	7.94	7.21	18.39	5.60	7.94	8.83	9.86

(T_1) followed by seed cum fertilizer drill (91.2) (T_2) and T_3 zero till seed cum fertilizer drill (85.7). The lowest seed emergence was with zero till seed cum fertilizer drill due to spoilage of seed by higher moisture percentage in the field.

Plant population, plant height, depth of root and number of root :

The plant population was highest (47) for raised bed planter as compared to seed cum fertilizer drill and zero till seed cum fertilizer drill. The plant growth was better in T_1 as compared to other treatments. Plant height, depth of root and number of roots was maximum for raised bed planter (T_1) and minimum for zero till seed cum fertilizer drill (T_3) and followed by seed cum fertilizer drill. The number of nodules was highest (135.58) in raised bed planter and lowest in zero till seed cum fertilizer drill (81.25) followed by seed cum fertilizer drill (102.93). In case of raised bed planter the upper surface of soil pulverization is more and bulk density, cone index was lower in treatment T_1 resulting the growth nodules were well as compare to other treatment.The pods were

(a) Raised bed planter (b) Seed cum fertilizer drill (c) Zero till seed cum fertilizer drill

Plate 2 : View of crop sowing with raised bed planter, seed cum fertilizer drill and zero till seed cum fertilizer drill

highest (121.83) in raised bed planter and lowest (77.81) zero till seed cum fertilizer drill and followed by seed cum fertilizer drill (64.80).The yield was highest (31.37 q/ha) in raised bed planter and lowest (19.31 q/ha) in zero till seed cum fertilizer drill and followed by zero till seed cum fertilizer drill (19.31q/ha). The straw yield was highest (71.89) and lowest (47.05) in zero till seed cum fertilizer drill and followed by seed cum fertilizer drill (56.36). The Plate 2 shows the crop views after 30 days with different sowing systems.

Conclusion :

These are the conclusion were drawn from the results:

The yield was significantly highest (31.37 q/ha) for treatment T_1 and was lowest (19.31 q/ha) for treatment T_3 and followed by T_2 with 21.35 q/ha. The seed emergence percentage was highest for T_1 (94.5%) followed by T_2 (91.2%) and T_3 (85.7%) were more germination and better drainage. The benefit cost ratio was maximum 3.32 for raised bed planter and minimum 2.17 for seed cum fertilizer drill and followed by T_3 with 2.33 the benefit cost ratio of raised bed planter was 34.63 and 29.81% more than seed cum fertilizer drill and zero till seed cum fertilizer drill, respectively.

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