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Evaluation of self propelled pneumatic planter for rain fed crops

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ABSTRACT : A proper placement of seed in field is most important operation in order to obtain optimum yield of crop. Considering limitation due to costly seed, traditional method of manual dibbling, labour and small marginal land holding pattern. A controlled seeding rate such as seeds per hectare is desired when planting in order to obtain the optimum yield of a crop. A study was conducted at Department of Farm Power and Machinery, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola to evaluate performance of pneumatic planter. The objective of the study was to test and evaluate the performance of the self propelled pneumatic planter for various crops likes sunflower, seasamum and soybean etc. It was observed that the field efficiency in the range of 75.86 to 59.5 % during the various crops sown. Saving in cost of operation was observed in the range of 50 to 67 % over the traditional method. Saving in seed cost per hectare was up to Rs. 1350 in case of cotton and Rs. 1000 in case of sunflower.

KEY WORDS : Field test, Pneumaticplanter, Performance evaluation, Self propelled

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Maharashtra has 86 per cent dry land agriculture and 90 per cent are the small and marginal farmers. To enhance the productivity of dry land agriculture through precision sowing, precision machines have greater importance. Similarly, it will help to save the national property through the saving of seed and energy. Mechanical metering mechanism metered the seed with the uncertainty and un-precisely. Pneumatic metering mechanism picks the single or twin seeds as desired and delivered from equal height and gives precision placement, which enhance the productivity. To reduce unnecessary cost of bullock pair and high risk of tractor to operate in the rainy seasons and it requires more headland to operate with increasing the soil compaction, the small machines have more importance. Bullock power is not suitable to operate the precision mechanization machineries. Tractor are not suitable for small and marginal farm size, soil condition of soil in rainy season and recommended cropping methods of dry land agriculture, hence, small precision machines are needed. Presently, to improve the economic condition of the villages, the village based enterprises on large scale have great importance. Custom services of the small machineries will provide the larger scale enterprise at village level. Presently most of the sowing work is done by traditional methods by means of bullock power. Sowing is the most important operation in the crop production. The precision sowing enhance the yield. Now a day the skill workers are not available. The labour requirement for planting cotton is high (15 %) which is next to harvesting operation (44 %) (Vaiyapuri, 2004). This results higher cost of cultivation. Similarly, the bullock power is day by day decreasing and the population of bullocks is reduced drastically. Tractors are also not suitable for sowing of some crops according to their sowing system and pattern. Due to fragmentation of land, the farm size is decreasing. In dry land system tractor creates the compaction problem in the rainy season. To overcome on above problems a self propelled pneumatic planter is developed by Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. Considering the facts of importance of sowing in crop production operation, this project was undertaken to test the self propelled pneumatic planter for sowing of *Kharif* and *Rabi* crops.

The planter has been a subject of interest for many scientists since the last five decades. The related review of evaluation and cost of planter have been reviewed.

Gupta *et al.* (1994) developed a single row power tiller operated potato planter cum fertilizer applicator. The planter could perform three functions simultaneously *viz.*, making ridges, sowing seeds, and applying fertilizer. The effective field capacity of the machine at an optimum speed of 1.33 kmph was about 0.04 ha/hr when compared with traditional

Table A : Area sown under various crop by self propelled pneumatic planter

Sr. No.	Name of crop	University field area (ha)	Test field	Farmers field area (ha)	Name of the farmers and village
1.	Cotton	2	Cotton project CRS	2	Mr. Sharad Patil, Gorwha, Akola
2.	Soybean	3	Malkapur Block CRS	2	Mr. Arun Pagrut, Ghusar Akola
3.	Green gram	1.3	Malkapur block, CRS	2	Mr. Ramkrishna Gawande, Kumbhari Akola
4.	Black gram	2	Malkapur block CRS	2	Mr. Arun Pagrut, Ghusar Akola
5.	Sorghum	4	Babulgaon block CRS	2	Mr. V. P. Thokad, Washimba, Akola
6.	Seasamum	1	Babulgaon block CRS	2	Mr. Arun Pagrut, Ghusar Akola
7.	Sunflower	2	Babulgaon block CRS	3.5	Mr. S. G. Kambe, Kamalni, Akola
8.	Wheat	--	--	2.5	Mr. Dinesh Dehenkar, Akola
9.	Chick pea	2	Babulgaon block CRS	3.0	Mr. Sanjay Thokal, Jambha, Akola

method, a net saving of 45 per cent in cost of planting potatoes and 50 per cent reduction in labour requirement was reported. Pradhan *et al*. (1997) evaluated a power tiller operated planter cum fertilizer applicator for groundnut to obtain optimum plant condition for higher productivity. Cup feed type seed metering device was used in the implement. The laboratory calibration showed that the maximum variation of seeds among the rows was 4.02 per cent and the deviation between actual and recommended rate was marginal. It was also observed that each cup took only the desired number of seed. The actual field capacity of the machine was 0.16 ha/hr and field efficiency was 80.94 per cent. A net saving of Rs. 237.47 was achieved per ha using the implement over conventional method.

Panning *et al*. (2000) investigated the performance of the seed-metering device of a pneumatic planter under laboratory and field conditions at disc speeds of 0.25 to 0.33 ms^{-1} peripheral velocity with disc hole diameter of 2.5 to 3.5mm and an operating vacuum pressure of 3 kPa, to optimize the design and operating parameters for cottonseed planting. The effect of operational speed of the disc, vacuum pressure and shape of the entry of seed hole were evaluated by examining the mean seed spacing, precision in spacing (co-efficient of variation), miss index, multiple index, and highest quality of feed index. Miss index values reduce as the pressure is increased but increase with increased speed; with lower vacuum pressure and at higher speeds, the metering disc does not get enough time to pick up seeds, resulting in higher miss indices. The multiple indices on the other hand are low at higher speed but increase as the pressure is increased.

METHODOLOGY

The test was conducted as per RNAM test code and procedure. The operating speed of self propelled pneumatic planter was maintained at the rate of to prevent fatigue. The pneumatic planter was tested on the University farm and on the farmer's field for important *Rabi* and *Kharif* crops. The test was carried out mainly in heavy black cotton soil. The soil moisture condition at the time of sowing was recorded. The operational condition of the soil was observed in the above stated field. A pneumatic planter was tested on farm at CRS, Dr. PDKV, Akola for the crops like sunflower and seasamum at Babhulgaon block and at Malkapur block for sowing of cotton, soybean, green gram and black gram. The test conducted at various blocks and villages, area of test and test conducted on various crop are shown in Table A.

During the test various parameters were recorded like condition of field and soil parameter. The tests conducted for the determination of effective field capacity and efficiency, average depth of placement of seeds, evenness of seed spacing in the field and ease of setting, operation and adjustments. Investigation into the field efficiency and effective field capacity of the planter involved continuous observation and timing of each activity involved in the planting operation. The average depth of seed placement was determined by running the planter to and fro over an area of 10 m^2 without the furrow covering devices and with medium setting of the furrow openers. During the process, the time taken to traverse the length of the field was recorded to determine the average speed of operation in the field. Along each furrow, five hills were randomly sampled and investigated for depth of placement. A steel tape was used to measure the required depth. During the field operation of the machine, all the operational and adjustment difficulties were recorded to assess the handling characteristics.

The operational cost of self propelled pneumatic planter was determined as per specification of BIS. Operational cost of machine was compared with traditional method.

RESULTS AND DISCUSSION

The results of field performance evaluation trials of self propelled pneumatic planter for *Kharif* crop are presented in Table 1, it was observed that maximum field efficiency was found 71.8 % for green gram sowing where as minimum was found 59.25% for sowing of sorghum crop. Furthermore, effective field capacities for the cotton, soybean, green gram, black gram and sorghum was found 0.35 ha/h, 0.29 ha/h,0.28

ha/h, 0.30 ha/h and 0.32 ha/h, respectively. The satisfactory result may be due to its maneuverability, which saves time in turning or moving the planter from one point to another. The average depth of placemat of seed was observed up to 5 cm depth. It is evident from Table 1, minimum seed rate was observed 8 kg/h for sorghum and where as maximum was observed 65 kg/ha for soybean. Seed rate variations are observed due to the rheological properties of seed and row to row spacing of crop adopted. In case of fuel consumption, it was found in the range of 1.10 to 1.25 l/h.

The results of field performance evaluation trials of self propelled pneumatic planter for *Rabi* crop are presented in Table 3, it was observed that maximum field efficiency was found 75.86 % for wheat sowing where as minimum was found 65.30% for sowing of sunflower crop. Furthermore, effective field capacities for the sunflower, seasamum, wheat and chick pea was found 0.32 ha/hr, 0.38ha/hr, 0.22ha/hr and 0.37 ha/hr, respectively. The satisfactory result may be due to its maneuverability, which saves time in turning or moving the planter from one point to another recommended by Anderson

Table 1 : Test results of self propelled pneumatic planter in various crops in *Kharif* season

Sr. No.	Parameters	Cotton	Soybean	Green gram	Black gram	Sorghum
1.	Sowing methods			Self propelled pneumatic planter		
2.	Area sown, ha	7	5	3.3	2	4
3.	Effective working width, cm	60	45	45	45	45
4.	Depth of seed placement, mm	50	40	45	50	40
5.	Seed rate, kg/ha	2 hill/m	65 kg/ha	12kg/ha	15 kg/ha	8 kg/ha
6.	Germination of seed no. of days after sowing	4	3	3	4	3
7.	Speed of operation, km/h	3	3	2.9	3.3	4
8.	Field capacity, ha/h	0.35	0.29	0.28	0.30	0.32
9.	Theoretical field capacity, ha/h	0.54	0.405	0.39	0.45	0.54
10.	Field efficiency, %	65	71.6	71.8	66.67	59.25
11.	Labour requirement, man-h/ha	2.85	3.45	3.57	3.33	3.125
12.	Soil moisture, db %	22.5	21	22	22.3	21.9
13.	Fuel consumption, l/h	1.25	1.20	1.10	1.20	1.20
14.	Cost of operation INR/ha	255	282	271	275	263
15.	Breakdown of equipment	Nil	Nil	Nil	Nil	Nil
16.	Cost of saving over traditional sowing, Rs/ha	535 (67.72)	278 (49.64)	289 (51.60)	285 (50.89)	297 (53.00)
17.	Labour saving, man-h/ha in per cent over traditional method	85.00	82.75	82.15	83.35	84.37
18.	Time saving over traditional method (%)	23	--	6	--	--
19.	Saving in seed cost INR/ ha (Approximately)	1350	700	100	--	--

Table 2 : Test results of self propelled pneumatic planter in various crops in *Rabi* season

Sr. No.	Parameters	Sunflower	Seasamum	Wheat	Chick pea
1.	Sowing methods		Self pneumatic planter		
2.	Area sown, ha	5.5	1.00	2.5	5.00
3.	Row spacing, cm	45	45	23	45
4.	Depth of seed placement, mm	50	35	40	80
5.	Seed rate, kg/ha	4 hills/m 5 kg/ha	8 hills/m 1 kg/ha	100 kg/ha	10 hills/m 50 kg/ha
6.	Germination of seed no. Of days after sowing	4	4	5	6
7.	Speed of operation, km/h	3.6	4.0	4.2	4.0
8.	Field capacity, ha/h	0.32	0.38	0.22	0.37
9.	Theoretical field capacity, ha/h	0.49	0.54	0.29	0.54
10.	Field efficiency, %	65.30	70.30	75.86	68.50
11.	Labour requirement, man-h/ha	3.2	2.6	4.5	2.7.
12.	Soil moisture, db %	20	19	20	21
13.	Fuel consumption, l/h	1.30	1.15	1.25	1.35
14.	Cost of operation INR/ha	285	220	390	255
15.	Cost of saving over traditional sowing, Rs/ha	145 (34 %)	205 (48 %)	--	85 (25%)
16.	Saving in seed INR/ ha (Approximately)	1000	300	--	–

Self propelled pneumatic planter | Bullock drawn

Plate 1 : Comparison of sowing of seasamum crop

Craig (2002). The range of depth of placement of seed was observed 3.5 cm to 8 cm. It is evident from Table 2, minimum seed rate was observed 1 kg/h for seasamum and where as maximum was observed 100 kg/ha for wheat. In case of fuel consumption, it was found in the range of 1.15 to 1.35 l/h.

Due to narrow furrow opener, low depth of placement of seed and furrow compaction the seed germination was earlier than the traditional method. This is the sign of better crop stand which is responsible for high yield. The field capacity was more than the traditional method. Similarly the field efficiency was also higher than the traditional method. This was due to the single worker. The labour required was drastically reduced which is most important for the present situation of labours. The results of the tests conducted on the various field in rainy and winter seasons at university as well on the farmers field are depicted in Table 1 and 2.

The reduction in cost of operation over traditional was due to less labour requirement and no bullock pair required. No thinning cost required as proper placement of seed achieved in case of self propelled pneumatic planter. Inspite of this saving in cost of operation it was as high as 67 per cent. The labour saving was observed to be 85 per cent over the traditional methods. The saving in time was not so effective due to similar effective working width. In crop like cotton and sunflower the saving in seed cost was very high *i.e.*, Rs. 1350 and 1000 per hectare, respectively. The comparison of between sowing by self propelled pneumatic planter and traditional method shown in Plate 1, it is clear that condition of crop which sown by planter is better.

Conclusion:

The self propelled pneumatic planter has been developed at Department of Farm Power and Machinery. Field tests were carried out on University farm and farmer fields. From the result of this study following conclusions could be drawn.

The self propelled pneumatic planter has been found suitable for precisely sowing of various crop in the dryland agriculture

The actual field capacity of planter for cotton crop was 0.35 ha/h. Similarly in *Rabi* it was 0.37 ha/h for chick pea and 0.22 ha/h for wheat which was higher than traditional method.

Saving in cost of operation was 50 to 67 per cent over the traditional method.

Saving in seed cost per hectare was up to Rs. 1350 in case of cotton and Rs. 1000 in case of sunflower.

The range of depth of placemat of seed was observed 3.5 cm to 8 cm.

Fuel consumption was found in the range of 1.10 to 1.35 l/h.

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