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Performance evaluation of power drawn six row groundnut planter

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ABSTRACT : A new power operated six row groundnut planter developed at the Division of Agricultural Engineering, UAS, Bangalore was evaluated for its performance by conducting lab tests and field trials. The tests comprised of the determination of average weight of seeds discharged, percentage damage of seeds, calibration of a planter, field performance studies and average depth of placement of seeds. Studies revealed that, the average weight of seeds discharged from hopper was 830.20 g and the percentage damage was found to be 2.5per cent. In field studies, the planter was having the field capacity of 0.25 ha/hr with row to row spacing of 300mm and seed to seed spacing of 100-140 mm. The performance of groundnut planter was satisfactory with calibrated seed rate of 113 kg/ha. The average depth of seed placement was observed to be 50mm. The average plant population was found to be 33 plants/m^2 with the overall planter efficiency of 86.80 per cent.

KEY WORDS : Groundnut planter, Performance evaluation, Spacing, Depth, Efficiency, Seed rate

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Groundnut (*Arachis hypogaea* L.) is one of the major oil seed crops of India. As it can withstand drought, it is suitable and most popular crop under dry land farming situations. In India, groundnut is grown on an area of 8 million hectares with total production of 7.5 million tonnes and 75 per cent of the productions are concentrated in the four states *viz.*, Gujarat, Andhra Pradesh, Tamil Nadu and Karnataka. Its average productivity is 1364 kg/ha in India, while in Karnataka, the yields are very low (380 kg/ha). In Karnataka groundnut covers an area of 0.86 million ha and a production of 0.60 million tonnes (CRIDA, 2004). One of the reasons attributed for poor yield is improper spacing between plants, besides the crop is grown under dry farming situations where in moisture is an additional constraints for achieving higher crop productivity (Anonymous, 2005). Therefore, to achieve optimum plant population, crops need to be sown immediately after the receipt of rains before soil moisture gets depleted with an improved seed drill. Existing practices of sowing with human labour is tedious and time consuming. Groundnut is a labour intensive crop and hitherto bullock drawn seed drills are being used in the country as well in the state to sow seeds. Regulation of spacing within and between the seed rows is one of the problem identified for poor crop yields. The existing animal drawn seed cum fertilizer drill for groundnut consist of separate seed and fertilizer bowls. Efficiency of seeds and fertilizers dropping depends on the skill of labour, soil condition, type of bullock man and draft animals used. Therefore, there exists a wide variation in spacing from seed to seed leading to sub-optimal reduction in plant population. Also in recent years, scarcity of draft animals has become acute and there is a need to develop such efficient seed drills suiting to the local conditions which are operated by a tractor. Tractors are available in good numbers and so far not much effort is made in developing such seed planters for groundnut in Karnataka. Introduction of power drawn seed planter would enable timely operation with an increased operational efficiency for establishing uniform and optimum plant population. Therefore, the present study was undertaken during the period 2009-2011 to address the problem through mechanized sowing.

Preliminary evaluation on a power tiller operated groundnut planter cum fertilizer drill (Pradhan *et al.*, 1997) showed that the optimum planting condition for productivity was attained with an actual field capacity of 0.160 ha/h. TNAU has developed tractor mounted cultivator seed planter during 1985-87 for sowing groundnut. The use of planter had reported the increased crop yield to an extent of 20 per cent with a 0.63ha/hr and78 per cent field capacity and field efficiency, respectively (Pandey *et al.*, 1997). The field trials of TNAU model planter in the mission mode project for dry land mechanization under AICRP during early part of this century in the groundnut growing regions had not given good impact.

Further, the inclined plate planter developed by CIAE, Bhopal (2007) with six rows had not realized well in the state. The CRIDA (2004) has also developed a nine row groundnut planter also not popularly used in the state though this low cost implement saves labour, time and suitable for precision farming in rain fed agricultural areas which has documented an average 20 per cent increased production.

The reviews on sowing of crop revealed that, as the average productivity of rainfed crop is less than one tonne/ha (CRIDA, 2004), it is necessary for timely sowing of seed with precision is not possible with indigenous tools of the farmers. Hence mechanisation during sowing of crop becomes essential factor for current rainfall pattern and recurring drought spells.

Keeping in view, the present study was proposed to evaluate the performance of power drawn six row groundnut planter with efficient mechanical metering mechanism to ensure optimum placement of seeds at right depth and spacing and to evaluate for its operational efficiencies.

METHODOLOGY

Description of the planter:

The six row groundnut planter was designed and developed at the Division of Agricultural Engineering, UAS, Bangalore consisted of feed hopper mounted on a rectangular frame, ground wheel, metering with depth control mechanism, coulters, furrow openers, metering plates and seed and fertilizer tubes. For bold seeds like groundnut, inclined cell plate metering system is recommended (Pandey *et al.*, 1997). The hopper box had two compartments for seed and granular fertilizers each having square cross section. The dimension of the hopper is 24 x18.5 x 20 cm^3. Power transmission is through ground driven wheel mounted on front side of the frame with drive sprocket and chains connected to seed and fertilizer shaft. The seed metering mechanism allows the flow of seed in to the seed tube at predetermined interval and draws power from drive wheel through gears. Seed metering plates are driven with 2:1 speed ratio, which gives two rotation of seed plate with one rotation of drive wheel. There is a provision to alter the row to row spacing by changing the position of tynes. The seed to seed spacing can be varied by changing sprocket mounted on metering shaft. The furrow opener is of shovel type which opens a uniform furrow to place the seed at appropriate depth. The specification of metering mechanism is given in Table A.

Table A : Specification of metering mechanism

Particulars	Specification
Type of metering mechanism	Inclined plate
Power transmission	Cain and sprocket with ground wheel
Number of tynes on ground wheel	12
Diameter of ground wheel, cm	26
Dimension of seed plate, diaxthickness, cm	15x0.5
Number of slots in seed plate	18

Laboratory tests:

The seed variety used for the testing was TMV-2 having moisture content of 12 per cent. In evaluating the performance of the machine, the standard code preferred for seed drills by Issac Bamgboye and Sunday Mofolasaya (2006) and RNAME test code was used. The laboratory and field tests were carried out at the Division of Agricultural Engineering, UAS, GKVK, Bangalore.

The machine was calibrated in the laboratory to determine weight of seeds discharged and seed damage. The planter was held with help of vice and depth control ground wheels to free the drive wheels. The hopper of the planter was loaded with one kg of groundnut seeds and polythene bag was placed on each of the discharge sprouts to collect the seeds discharged. The drive wheel was rotated 50 times and a stop clock was used to measure the time taken to complete the 50 revolutions. The seeds of each bag were weighed and the procedure was repeated for five times.

Damage test:

The test for percentage seed damaged was done with machine held in a similar position as explained above. The 1kg of seeds was loaded into each hopper. The wheels were rotated twenty times in turns and the time taken to complete the revolution was recorded with stop clock. The seeds discharged from each sprout were observed for any external damage and the procedure was repeated for five times.

Field test:

The field trials were conducted for the determination of effective field capacity, field efficiency and average depth of placement of seeds. Investigation on field capacity and field efficiency of the planter involved continuous observation and timing of each activity and time losses for turning at head lands, removal of clogs and adjustment.

Theoretical field capacity (TFC) is given by

$$\mathbf{TFC} = \frac{\mathbf{W \times S}}{\mathbf{10}}$$

where TFC in ha/h, W= width of the implement, m, S= speed of operation, km/h

The field efficiency is the ratio of effective field capacity to the theoretical field capacity expressed in percentage.

RESULTS AND DISCUSSION

Table 1 shows the results obtained from the calibration

Table 1 : Calibration of the mechanical metering mechanism

Trial	50 rev(min)	Speed (Rev/min)	Weight of seeds discharged(g)
1	4.13	9.88	814
2	4.51	9.05	840
3	4.05	10.07	823
4	4.23	9.60	832
5	4.62	8.83	842
		Average	830.2 g

of the machine. It could be seen from the Table 1 that the average weight of groundnut seeds discharged from the hoppers was 830.2g, while the seed rate was 113.0 kg/ha.

It was observed that the rate of discharge was affected by the speed of the machine. Also the weight of the seeds discharged was propositional to the time for 50 revolutions of the ground wheel. The planter was able to effectively meter out seeds at the rate 113.0 kg/ha which is as per the recommended package of practices of the state (113 kg/ha) and this could be regulated by adjusting metering device.

Table 2 shows the percentage of seed damage discharged from randomly selected hoppers. The trials taken from random hoppers showed the percentage seed damages of 2.42 per cent and 2.58 per cent from first and second hopper, respectively. The first hopper gave better result than the second hopper, due to clearance between seed plate and housing minor variations. The total average percentage of seed damage was 2.5 per cent which shows that planter could effectively perform the sowing operation with minimum seed damage.

The field performance of the planter like the effective field capacity and field efficiency was observed as 0.25 ha/h and 86.80 per cent, respectively. During field test the effective field capacity was lower. It was observed during field operation, the care taken to reduce the time for turning, clogging and adjustments of the planter resulted in higher field efficiency.

Further it was observed that the depth of seed placement was to be 50 mm with row to row spacing of 300mm. The depth of sowing was in accordance with tests carried in CIAE, Bhopal (2000). The seed rate was found to be 113.2 kg/ha which is as per the recommended package of practices of the state (113 kg/ha) for rain fed conditions. Also the observation

Table 2 : Percentage seed damage

Trial	Time for 20 Rev(s)	No. of seeds discharged from hopper		No. of damaged seeds discharged from hopper		Percentage damage (%)	
		H1	H2	H1	H2	H1	H2
1	45	223	220	6	5	2.2	2.7
2	40	221	215	4	2	0.9	1.8
3	40	216	207	5	6	2.7	2.4
4	42	234	221	4	6	2.5	1.8
5	41	210	212	9	8	3.8	4.2
		Average % damage				2.42	2.58

H1 - Hopper 1, H2 – Hopper 2

Table 3 : Field performance of six row groundnut planter

Sr. No.	Particulars	Observation
1.	Actual area covered, ha	0.2
2.	Traveled speed, km/hr	1.6
3.	Effective field capacity, ha/h	0.25
4.	Field efficiency, per cent	86.80
5.	Plant population/m^2	33
6.	Seed rate, kg/ha	116
7.	Depth of seed placement, mm	50
8.	Row to row spacing, mm	300
9.	Seed to seed spacing, mm	100 to 140

on germination and rate of emergence of seedling TMV-2 variety with respect to sowing depth were comparatively better than traditional method. Razzaque *et al.* (1994) showed that sowing depth had significant influence on rate of emergence and fractional emergence and out of four varieties Kadiri-3, Kadiri-71-1, TMV-2 and Gangapuri, TMV-2 had the highest rate of emergence at sowing depth greater than 50mm.

Conclusion:

The power operated groundnut planter developed at the Division of Agricultural Engineering, UAS, GKVK Bangalore to meet the need of the state farmers was found to operate at a field capacity of 0.25 ha/h with the depth of seed placement of 50 mm. The planter was effectively meter out the seeds with minimum seed damage of 2.5 per cent. During field and lab test, the calibration of seed drill showed similar seed rate of 113.0 ±3 kg/ha. It was observed that the planter could sow the seeds uniformly typically in row and allowing weeding with the hoe during the course of the growing season. The machine adjustment and maneuverability observed to be ease to the operator.

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