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Technical Note:

A MULTI-ROW BULLOCK DRAWN PLANTER FOR GROUNDNUT AND SOME OTHER DRYLAND CROPS

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A multi-row bullock drawn planter was developed and tested for sowing groundout and other dryland corps. It consists of a seed box with four inclined-plate, seed-metering devices, a ground wheel and four furrow-openers, mounted on a T-bar. Field tests showed that the planter performed very well in sowing groundnut, chickpea, pigeonpea, and sorghum. All the crops sown with the T-bar planter had 75% or more of their plant population in a good spacing range. The planter covers a width of 1 m and can sow up to four rows with variable spacings between them. Its performance and requirements were compared with two other seeders and manual dibbling for sowing groundnut. The field capacity of the planter is 0.33 ha/h and its draft requirement varies between 70-80 kg depending on soil conditions.

1. INTRODUCTION

Sowing is a critical operation for successful crop production. In order to achieve a uniform plant stand at a desired population, correct seed metering and placement is essential. Dryland crops in India, are generally sown by the traditional methods of dropping seeds behind a country plough, or using a hand-metering wooden bowl on local seed drills called "gorru" or "tippan". Sowing by traditional methods result in inadequate and non-uniform plant stand even though the farmers use 3 or 4 times the recommended seed rate (Soman et al., 1981). The traditional system also has the limitations of uneven depth of seed placement, delay in covering seeded rows, slow ground coverage, and high labor requirement (100-125 man h/ha for cereals and about 250 man h/ha for groundnut). The availability of a low-cost, easy to use mechanical planter for small-scale farmers could alleviate these problems substantially, and could also help to maintain timely seeding and reduce the farmers' drudgery.

Earlier work on planter development at ICRISAT Asia Center evolved designs of a planter fertilizer applicator to be used as an attachment to wheeled tool carriers (Bansal and Thierstein, 1982). However, the necessity of a wheeled tool carrier to operate the planter units was found to be a major constraint (Awadhwal et al., 1987). Therefore, a bullock-drawn mechanical planter that could be attached to a low cost T-bar was developed (Awadhwal, 1989). This paper reports the design features and performance of this planter.

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2. MATERIAL AND METHODS

The planter developed for sowing groundnut and such other crops as chickpea, pigeonpea and sorghum is shown in Figure 1. It consists of a T-bar (main frame), a seed box, a ground wheel-drive, four furrow-openers, and a pair of transport wheels. The T-bar consists of a square tool bar, formed by two joined angle irons (40x40x6 mm) and a beam made of iron pipe (50 mm dia). The angle of the beam to the ground can be adjusted to eliminate the effect of the height of bullocks on the working angle of the implement. There are four seed boxes each with an inclined plate seed-metering mechanism. Seeds of the same or different crops can be simultaneously metered from individual subsections. Crops can be sown at different desired seed rates by using appropriate metering plates. The furrow-openers are mounted on the T-bar with C-clamps and their spacing can be adjusted according to the row spacing requirement of the crops to be sown. The spouts of the metering mechanisms and the furrow-openers are connected by transparent plastic tubes. Seed discharged from the metering plates passes through the plastic tubes and furrow-openers and subsequently gets deposited into the soil. Seed placement depth can also be adjusted by varying the vertical position of the furrow-openers in relation to the transport wheels. The ground wheel-drive provides power to the seed-metering mechanism through a set of chain and sprockets. The ground wheel can be lifted to stop seed dropping when necessary, especially during transport and turning in the field.

3. TEST PROCEDURE

The planter was tested by using it to sow groundnut and sorghum in an Alfisol, and chickpea and pigeonpea in a Vertisol. The tests included: performance of seed metering units, intra-row seed distribution, and performance of the planter in the field on a well-prepared seedbed.

The seed metering mechanism was tested in a field trial with five replications. The planter was set for each of the crops and operated over a given distance. The planter unit was run with its furrow-openers raised, such that they simply slid on the ground and seeds were dropped on to the soil surface. For each crop the number of seeds dropped, and the spacing between them, were measured for 10 m row lengths.

Evaluation of intra-row placement of seeds was based on the actual plant-to-plant spacing achieved. Any planter is likely to give some variation in the spacing between successive seeds. Therefore, the planter was evaluated on the basis of the percentage of plants with optimum and good spacings defined as: 'Optimum spacing range' = 0.5 to 1.5 times the recommended ideal spacing, and 'Good spacing range' = 0.25 to 1.75 times the recommended ideal spacing. These spacing ranges were derived from information on the effects of plant-to-plant spacing variation on grain yield (Soman et al., 1987; Wade, 1990; Wade et al., 1988; Wanjura, 1980).

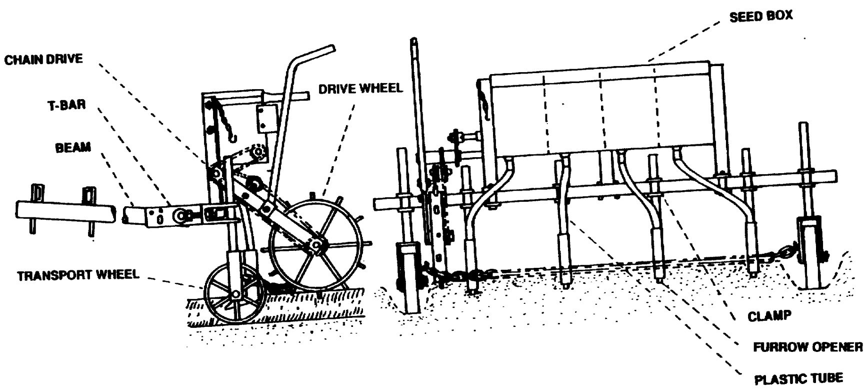

Fig. 1 T-bar planter for groundnut and other dryland crops

The field performance of the planter was evaluated by sowing an area of 4 ha with two varieties of groundnut (Robut 33-1 and TMV-2) that had approximately 92% germination. Field trials were also conducted by sowing chickpea, pigeonpea, and sorghum (germination 80-85%) in 150 m^2 plots with the planter fitted with appropriate metering plates. When crops emerged (20 days after sowing), plant-to-plant spacing in a 10 m row length and plant populations were recorded for all five replications in each trial. Measurements were taken to determine the field capacity (work rate) and draft requirement of the planter.

4. RESULTS AND DISCUSSION

Results of seed metering tests for different crops are given in Table 1. The field calibration tests show that the average number of groundnut (Robut 33-1) seeds dropped in a 10 m row length was 128, resulting in a mean intra-row spacing of 7.8 cm compared to the recommended spacing of 10 cm. It was noted that groundnut (TMV2) that has smaller seeds had more seeds in a 1 m row and a higher variation in the number of seeds dropped, than Robut 33-1. It was also observed that the inter-row variation in seed spacing was less than 2%. About 3% of Robut 33-1 seeds and less than 1% of TMV2 groundnut seeds suffered partial injury from bruising or splitting during metering. There was no damage to the seeds of the other crops.

Table 1 Seed metering performance of T-bar planter

Crop	Variety	100 seed mass (g)	Seed metering plate size	No.of seeds/m row length	Seed damage (%)
Groundnut	Robut 33-1	40.0	16G	12.8 (±0.51)*	3.3 (±0.32)
Groundnut	TMV2	34.0	16G	13.1 (±1.28)	0.7 (±0.24)
Sorghum	CSH5	2.2	10S	16.6 (±1.73)	0.0
Pigeonpea	ICPL6	14.0	24PP	13.6 (±1.53)	0.0
Chickpea	Annigeri	19.0	20C	10.8 (±0.68)	0.0

* Standard error values are given in parentheses

The plant populations of different crops achieved using the T-bar planter are given in Table 2. For all the crops except chickpea, the actual plant populations obtained deviated by no more than 15% from the recommended levels. The histograms of plant spacing frequency distribution (Fig. 2) and the data given in Table 3 indicate that for groundnut, sorghum and pigeonpea the mean plant spacing was in the range of 11.6 cm to 12.8 cm, about 63% of the plant spacing were in the optimum range, and more than 75% of the spacings were in the good range. In chickpea a high mean plant spacing (15.8 cm) prevailed and low proportions of the plant spacing were in the optimum range (59.4%) and good range (74.8%). This could be because chickpea was sown in the postrainy season, when there was considerable variation in the soil moisture at seeding depth. This could have reduced germination.

Table 2 Plant stand of crops sown with T-bar planter

Crop	No. of rows sown in a 1.5 m wide broadbed	Mean plant stand in 15 m^2 area	Plant population achieved (thousands/ha)	Recommended plant population (thousands/ha)
Groundnut	4	426.2 (±16.32)*	284.2	330
Sorghum	3	288.4 (±12.27)	192.2	180
Sorghum**	2	169.5 (±8.30)	113.0	120
Pigeonpea**	1	84.7 (±9.92)	56.5	50
Chickpea	4	318.0 (±11.72)	211.9	330

* Standard error values are given in parentheses

** One row of pigeonpea was inter-cropped with 2 rows of sorghum

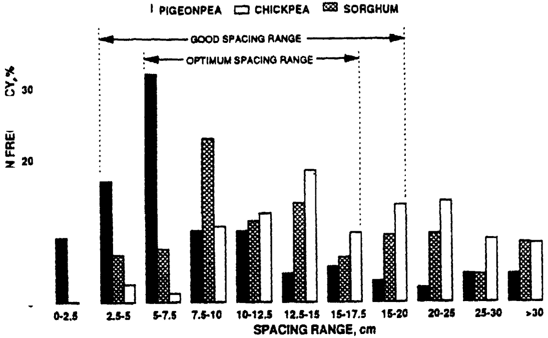

Fig. 2 Frequency distribution of plant spacing of different crops, sown with T-bar planter

Table 3 Plant spacing distribution of crops sown with T-bar planter

Crop	Mean plant spacing (cm)	Plant population with optimum spacing (%)	Plant population with good spacing (%)
Groundnut	11.7 (±2.88)*	70.1	77.2
Sorghum	11.6 (±1.89)	63.1	85.4
Pigeonpea	12.8 (±4.47)	69.1	82.4
Chickpea	15.8 (±0.57)	59.4	74.8

* Standard error values are given in parentheses

The distribution in plant-to-plant spacing of groundnut sown with the T-bar planter and two other seeders (Fig. 3) shows that a considerable number of plants had wide spacings, two to three times that of the mean spacing (10 cm) compared to manual dibbling of groundnut seeds (Table 4). The occurrence of these gaps is attributed to non-uniformity in placement of seeds.

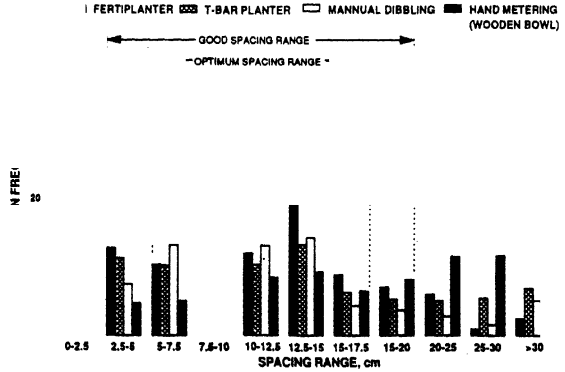

Fig. 3 Frequency distribution of groundnut plant spacing, sown with different seeders

Table 4 Plant spacing distribution of groundnut sown with different seeders

Seeding equipment	Plants at optimum spacing of 5-15 cm (%)	Plants at good spacing of 2.5-17.5 cm (%)	Plants at spacing of 20-30 cm (%)	% Plants at spacing of > 30 cm (%)
T-bar planter	71.4 (8)*	77.9 (9)	15.4 (35)	6.7 (62)
Fertiplanter	75.4 (11)	84.0 (5)	13.6 (22)	2.4 (85)
Hand metering with wooden bowl ("gorru")	41.0 (36)	47.8 (37)	30.4 (42)	24.2 (42)
Manual dibbling	83.2 (4)	87.5 (6)	7.7 (43)	9.0 (75)

* Coefficient of Variation (%) values are given in parentheses

Comparison of the T-bar planter with other methods for sowing groundnut (Table 5) shows that the draft requirement of the T-bar planter did not differ from the "gorru". However, its field capacity was about 73% higher and its labor requirement was 62% lower than that of the "gorru". The T-bar planter required a lower draft than the Fertiplanter (developed earlier at ICRISAT) but did not differ significantly in labor requirement or field capacity.

Table 5 Comparison of T-bar planter with other seeders for sowing groundnut

Seeding equipment	Pull required (kPa)	Actual field capacity (ha/h)	Labor required (man h/ha)	Seeding depth (cm)
T-bar planter	742.3	0.33	6.0	5.3
Fertiplanter	926.0	0.29	6.8	5.2
Hand metering with wooden bowl ("gorru")	788.0	0.19	15.8	5.4
Manual dibbling	-	-	34.5	3.3
SE ±	43.9	0.014	0.22	0.77

The field capacity or work rate of the T-bar planter was 0.33 ha/h, and its draft requirement ranged between 70-80 kg. It was observed that the draft of the T-bar planter did not overload the bullocks during the operations. The operators found that the planter was easy to use, and the ground-wheel lifting lever was located at a convenient position. During the tests the furrow-openers did not require frequent cleaning, but one extra person was needed during operations to check seed levels in the seed box.

5. CONCLUSIONS

The overall performance of the T-bar planter is very satisfactory. It require 4-6 hours to sow groundnut and a few other crops in one hectare and a pair of medium-sized bullocks can pull it easily. The estimated cost of the planter unit is approximately Rs. 6000 (approximately US$200).

A complete set of engineering drawings of the T-bar planter has been prepared and made available to several manufacturers in Andhra Pradesh, Maharastra and Gujarat. A manufacturer in Hyderabad has supplied several T-bar planters to farmers.

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