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Modification of Bullock Drawn Seed cum Fertilizer Drill for Intercropping System

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A B S T R A C T

Sowing is prime operation in cultivation practice of any crop which directly affects production. Therefore, timely sowing is necessary with available sources of power. Intercropping being one of the traditional practices of crop production and there are no seed drills to both main crop and inter-crop in a single pass. To overcome this problem, the present seed cum fertilizer has to be modified to suit the requirement of the intercropping practice. The seed drill was modified by partitioning into 3 compartments in the seed hopper to suit the 2:1 and 8:1 intercropping ratio using two MS plates which are movable within the hopper for a predetermined distance with the help of a screw a handle mechanism. The modified seed drill was calibrated in the laboratory to check the seed rate of Redgram and soyabean. The seed rate of the both type of seed were within the recommended rates. The variation of seed flow in different furrow openers were less than 10 % as recommended by the BIS. The modified seed drill was evaluated in the field condition to check its performance. The average field capacity was found to be 0.25 ha/h at a forward speed of 2.8 kmph. The average field efficiency was found to be 70 %.

Introduction

Planting refers to placing seeds in the soil, broadcasting seeds on the field surface or dibbling the seeds in the soil under optimum depth and moisture conditions. To get high yield, right amount of seed should be placed at the right time in a predetermined depth. Usually, the depth of sowing depends upon the moisture availability and emergence capacity. The spacing between the seeds is governed by plant growth and their distribution per unit area. However, the space requirement of a plant is so adjusted between the rows that the subsequent use of intercultural implements is made possible for the crops. In general the larger seeds are sown at comparatively greater depth and plants need wider spacing.

The seeding equipment for unirrigated areas are designed to place the seed in firm moist soil. The moisture from the surface layer of seed bed in arid areas is evaporated quickly and germination of seeds may be adversely affected if the seeds are sown at shallow depth of four to five centimetres as done in irrigated areas. The requirements of seed drills for unirrigated areas are that it should make a furrow and place the seed in firm moist soil below in the bottom of the furrow. The multi-row seed drills/planters with packer wheels (tractor drawn and animal drawn) are designed to obtain the optimum environment for the germination of seed and growth of seedlings under unirrigated condition. The seed boots are designed to place about the seed about 4 cm below the bottom of the furrow made in the dry soil. Packer wheels fixed to the rear of the machine pack the soil over seed or a chain driven toothed wheel fixed to the drive shaft of the seed dropping mechanism can be set to obtain the desired seed to seed distance during sowing. The wheel actuates the flap gates provided at dropping mechanism and the seeds drop out every time the gate is open. By fixing wheels with different spacing of teeth, any desired seed to seed distance can be obtained which makes the seed drill suitable for sowing close growing crops like wheat and row crops like maize, cotton and sorghum etc.

Intercropping is a method of crop production where an extra crop or an inter crop is grown in between the main crop. There is a necessity to mechanize the seeding operation. As the present seed cum fertilizer drills couldn't sow both main as well as intercrop at a time in a intercropping system of agricultural practice, overcome this issue the existing seed drills should be modified to suit the intercropping system of agriculture.

Singh (1971) revealed that by using a seed-cum-fertilizer drill for wheat crop there was an increase in yield by 13.25 percent when compared with the conventional method. Sharma *et al.,* (1989) concluded that using the animal drawn mechanical sowing has resulted in 49 per cent savings in the cost of operation in comparison with the traditional method of sowing wheat crop. The overall benefit was Rs.671.75 / ha. Srivastava and Dubey (1985) reported that the draft of a three row animal drawn seed-cum-fertilizer drill (planter) was in the 45-65 Kg range depending upon the soil type and moisture content. The field capacity of the machine ranged from 0.1 - 0.25 ha/h depending on the row spacing.

Materials and Methods

The bullock drawn seed cum fertilizer drill was modified as per the requirement of the intercropping practices. The seed drill was modified for the intercropping ratio of 2:1 and 8:1.

The specifications of the seed cum fertilizer drill as follows:

a. Dimensions (L X W X H) mm - 1015 X 900 X 950
b. Weight of the implement - 50 kg.
c. Row to row spacing - Adjustable (220 & 450 mm).
d. Number of furrow openers - 3
e. Seed metering mechanism- fluted roller of 4 cm diameter with 12 flutes
f. Fertilizer metering mechanism - fluted roller of 4 cm diameter with 8 flutes
g. Power transmission - Seed and fertilizer metering mechanisms are driven by ground wheel with chain and sprocket.
h. Hopper capacity = 0.048 cu.m (0.024 cu.m each i.e. both seed hopper and fertilizer).
i. Power source = A pair of bullock.

The seed drill was been equipped with fluted roller seed metering mechanism as shown in Fig. 1. The length of the roller exposed to the seeds can be controlled by a level to adjust the flow of seeds as well as for fertilizer to control the seed and fertilizer rate, respectively. The top view and side of the bullock drawn seed cum fertilizer drill are shown in Fig. 2 and Fig. 3, respectively.

The hopper was partitioned in 3 parts with two movable trapezoidal MS plates through a screw mechanism as shown in Fig. 4, where the centre portion was filled with the main crop where as either portions are filled with intercrop. The partitioned hopper is shown in Fig. 5. The MS plates provided in the hopper can be easily movable so as to allow the main crop seeds or the intercrop seeds to flow to the metering mechanism through a long threaded screw which is operated by a handle provided at the either side of the hopper. The modified and calibrated bullock drawn seed cum fertilizer drill was evaluated in the field to check its performance with a pair of bullock and a labour.

Results and Discussion

The modified seed drill was calibrated in the laboratory to determine the seed rate of redgam and soyabean. The calibration was done at two speeds i.e. 3 kmph and 5 kmph. The average seed rate of redgram at 3 kmph and 5 kmph were found to be 15.3 kg/ha and 14.5 kg/ha, respectively. The details of calibration of redgram at 3 kmph and 5 kmph are shown in Table 1 and 2, respectively. The variation of droppings of redgram in three different furrow opener were found to be less than 10 % as recommended by BIS.

Table.1 Summary of calibration of redgram at 3.0 kmph

Level of seed in hopper	Seed discharge setting	Weight of seed from furrow openers, (g)			Variation from mean, (%)			Seed rate kg/ha
		1	2	3	1	2	3	
Full	Minimum	76.5	75.8	82.4	1.1	2.0	-6.6	15.3
	Medium	76.2	75.8	75.4	-0.4	0.1	0.7	15.1
	Maximum	75.7	75.6	75.9	-0.4	-0.2	-0.6	15.2
3/4th	Minimum	75.1	75.6	74.5	0.3	-0.4	1.1	15.4
	Medium	74.5	74.6	75.1	0.4	0.2	-0.4	15.2
	Maximum	74.6	73.5	75.1	-0.5	1.0	-1.1	15.3
1/2	Minimum	73.5	73.6	74.5	0.4	0.3	-0.9	15.5
	Medium	73.2	72.8	73.6	-0.1	0.5	-0.6	14.9
	Maximum	72.8	72.6	73.4	0.4	0.7	-0.4	15.1
1/4th	Minimum	72.9	75.2	72.4	-0.2	-3.3	0.5	15.0
	Medium	72.2	72.6	71.6	0.0	-0.6	0.8	15.3
	Maximum	71.5	72.1	71.5	0.3	-0.5	0.3	15.2

Table.2 Summary of calibration of redgram at 5.0 kmph

Level of seed in hopper	Seed discharge setting	Weight of seed from furrow openers, (g)			Variation from mean, (%)			Seed rate kg/ha
		1	2	3	1	2	3	
Full	Minimum	78.9	78.6	78.4	-1.5	1.6	0.9	14.5
	Medium	78.2	78.4	77.6	-0.1	-0.4	0.6	14.6
	Maximum	77.8	78.1	77.4	-0.1	-0.5	0.4	14.4
3/4th	Minimum	77.6	77.4	78.5	-0.1	0.2	-1.2	14.7
	Medium	76.4	77.1	76.5	0.5	-0.4	0.4	14.3
	Maximum	76.2	76.4	75.8	-0.4	-0.7	0.1	14.5
1/2	Minimum	75.8	75.9	76.8	0.3	0.1	-1.1	14.7
	Medium	75.2	75.1	75.8	0.0	0.2	-0.8	14.3
	Maximum	74.5	74.2	73.8	-0.1	0.3	0.8	14.5
1/4th	Minimum	74.2	73.5	74.1	-0.5	0.4	-0.4	14.6
	Medium	73.8	73.8	73.4	-0.9	-0.9	-0.4	14.3
	Maximum	73.2	72.5	73.6	1.1	2.1	0.6	14.2

Table.3 Summary of calibration of soyabean at 3.0 kmph

Level of seed in hopper	Seed discharge setting	Weight of seed from furrow openers, (g)			Variation from mean, (%)			Seed rate kg/ha
		1	2	3	1	2	3	
Full	Minimum	42.5	43.6	43.8	2.2	-0.3	-0.8	45.6
	Medium	42.1	42.8	42.6	1.5	-0.1	0.3	45.2
	Maximum	41.5	41.6	42.8	1.1	0.9	-2.0	45.4
3/4th	Minimum	41.2	42.1	41.9	1.4	-0.7	-0.2	45.5
	Medium	39.5	41.7	41.2	3.2	-2.2	-1.0	45.4
	Maximum	39.5	39.8	39.4	0.6	-0.2	0.9	45.1
1/2	Minimum	39.2	39.5	39.8	0.8	0.1	-0.7	45.3
	Medium	38.2	38.6	39.4	2.0	1.0	-1.1	45.7
	Maximum	37.8	38.2	38.1	2.0	0.9	1.2	45.2
1/4th	Minimum	37.6	37.5	36.8	-0.4	-0.1	1.8	45.7
	Medium	37.5	37.1	37.6	0.1	1.2	-0.2	45.9
	Maximum	36.5	36.8	35.9	-3.4	-0.9	-1.7	45.1

Table.4 Summary of calibration of soyabean at 5.0 kmph

Level of seed in hopper	Seed discharge setting	Weight of seed from furrow openers, (g)			Variation from mean, (%)			Seed rate kg/ha
		1	2	3	1	2	3	
Full	Minimum	45.6	45.2	44.6	-0.4	0.5	1.8	44.5
	Medium	45.2	44.3	44.5	-0.8	1.2	0.7	44.1
	Maximum	44.2	44.6	44.9	1.2	0.3	-0.4	44.3
3/4th	Minimum	44.2	43.6	43.8	-0.5	0.9	0.4	44.5
	Medium	43.6	43.2	43.5	-0.2	0.7	0.0	44.8
	Maximum	43.2	42.5	45.2	0.5	2.1	-4.1	44.7
1/2	Minimum	43.1	42.6	42.8	0.2	1.3	0.9	44.9
	Medium	42.8	43.2	42.8	-0.2	-1.2	-0.2	44.1
	Maximum	42.6	43.5	41.5	0.1	-2.0	2.7	44.6
1/4th	Minimum	42.2	41.6	41.8	-0.6	0.9	0.4	44.2
	Medium	41.6	41.5	42.1	-0.1	0.1	-1.3	44.1
	Maximum	40.6	40.7	39.5	-0.2	-0.4	2.5	44.3

Table.5 Summary of calibration of urea at 3.0 kmph

Level of fertilizer in hopper	Fertilizer discharge setting	Weight of seed from furrow openers, (g)			Variation from mean, (%)			fertilizer rate kg/ha
		1	2	3	1	2	3	
Full	Minimum	48.5	49.4	48.6	-0.3	-2.2	-0.5	70.9
	Medium	48.2	47.2	46.5	-1.7	0.4	1.9	70.8
	Maximum	47.3	46.5	46.8	-0.9	0.8	0.1	70.5
3/4th	Minimum	46.8	45.9	46.7	-1.7	0.3	-1.5	70.2
	Medium	45.3	45.8	46.1	2.0	0.9	0.3	69.8
	Maximum	45.1	45.2	44.6	-0.3	-0.5	0.8	69.4
1/2	Minimum	44.9	44.8	45.2	-0.4	-0.2	-1.1	69.5
	Medium	44.8	44.1	43.5	-1.0	0.6	1.9	69.2
	Maximum	44.1	43.8	44.1	-1.3	-0.6	-1.3	68.5
1/4th	Minimum	43.8	44.1	43.6	-0.3	-1.0	0.1	68.2
	Medium	42.8	42.8	43.6	0.5	0.5	-1.3	68.0
	Maximum	42.1	42.9	43.8	1.6	-0.2	-2.3	67.2

Table.6 Summary of calibration of urea at 5.0 kmph

Level of fertilizer in hopper	Fertilizer discharge setting	Weight of seed from furrow openers, (g)			Variation from mean, (%)			fertilizer rate kg/ha
		1	2	3	1	2	3	
Full	Minimum	52.6	52.8	51.6	0.4	0.0	2.3	73.6
	Medium	51.6	52.9	53.4	1.6	-0.8	-1.8	73.4
	Maximum	51.2	52.6	52.4	3.5	0.8	1.2	73.2
3/4th	Minimum	50.6	51.6	51.8	2.8	0.8	0.5	72.6
	Medium	49.8	49.5	49.5	0.9	1.5	1.5	72.1
	Maximum	49.5	48.9	50.2	0.3	1.5	-1.1	72.0
1/2	Minimum	49.2	49.1	49.8	0.9	1.1	-0.3	71.9
	Medium	48.9	49.5	48.6	-0.7	-1.9	0.0	71.6
	Maximum	48.6	48.6	47.9	-0.1	-0.1	1.4	71.5
1/4th	Minimum	48.2	48.1	47.5	-0.3	-0.1	1.2	71.2
	Medium	48.1	47.2	47.6	-1.1	0.8	-0.1	71.1
	Maximum	47.5	49.1	47.6	0.6	-2.8	0.4	70.6

Fig.1 Fluted roller type metering mechanism

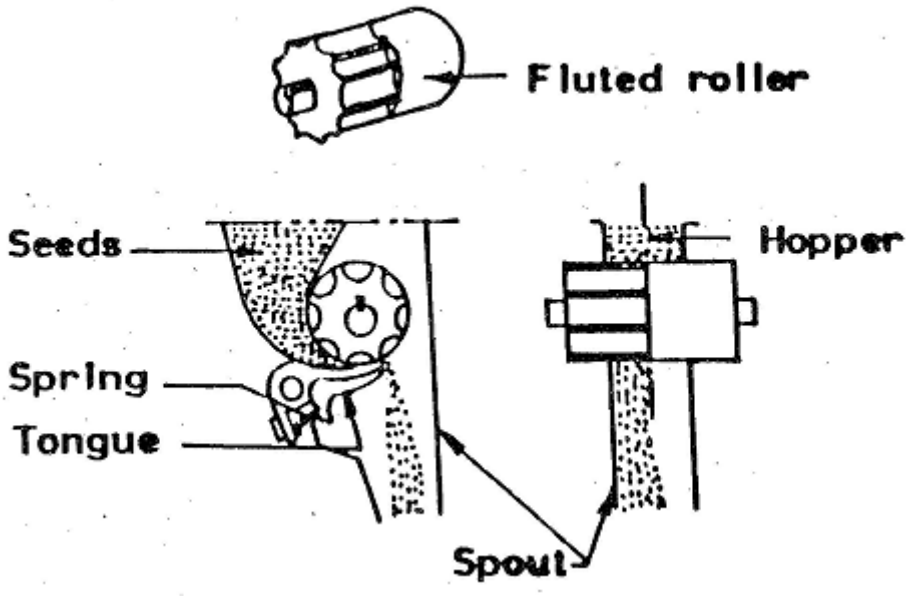

Fig.2 Top view of seed drill

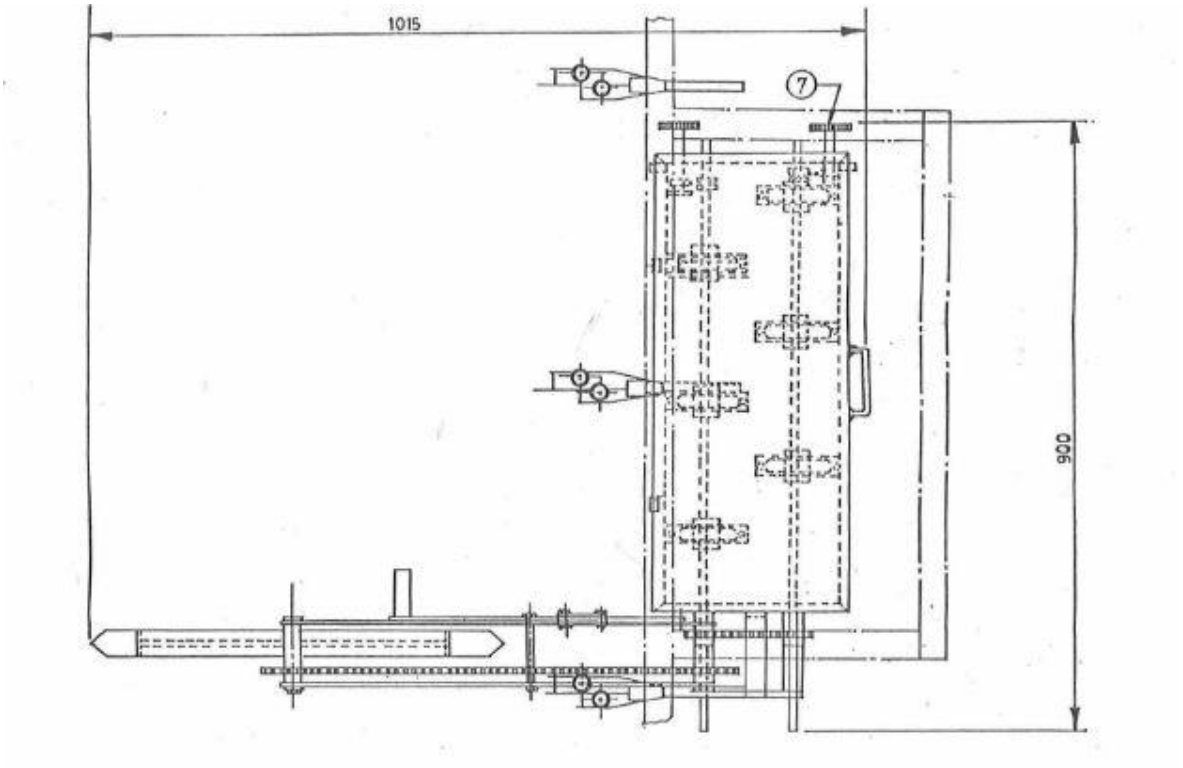

Fig.3 Side view of seed drill

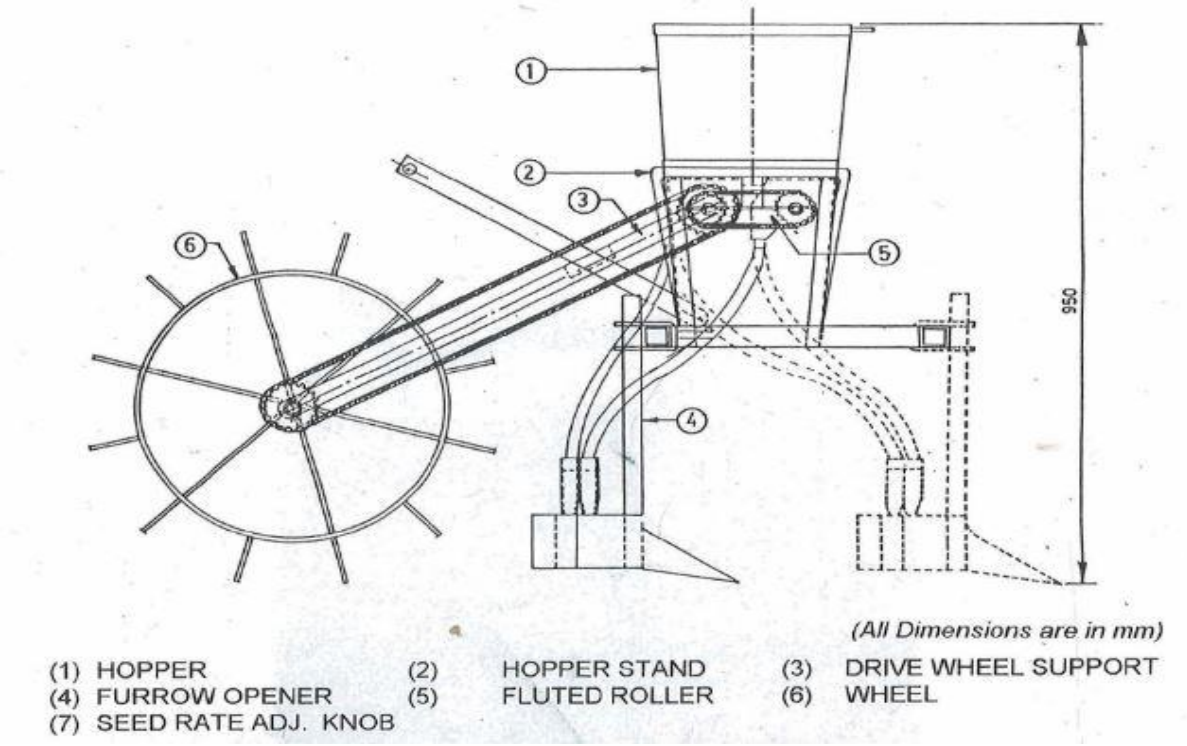

Fig.4 MS Plate

Fig.5 Top view of the partioned hopper

The average seed rate of soyabean at 3 kmph and 5 kmph were found to be 45.35 kg/ha and 44.5 kg/ha, respectively. The details of calibration of redgram at 3 kmph and 5 kmph are shown in Table 3 and 4, respectively. The variation of droppings of soyabean in three different furrow opener were found to be less than 10 % as recommended by BIS.

The flow of fertilizer was also calibrated using urea. The detailed calibration results of urea at 3 kmph and 5 kmph are shown in Table 5 and 6. The average urea rate were found to 69.5 kg/ha and 70.3 kg/ha for 3 kmph and 5 kmph, respectively. The variation of droppings of urea in three different furrow opener were found to be less than 10 % as recommended by BIS.

The modified seed cum fertilizer drill was evaluated in the field to check its performance. The average field capacity of

the implement was found to be 0.25 ha/h at a forward speed of 2.8 kmph with a field efficiency was found to be 70 %. The average draft requirement of the equipment was recorded as 900 N.

In conclusion, the seed cum fertilizer drill was successfully modified to suit inter cropping system. The seed rate and fertilizer rate of application were found to be within the acceptable limits. The overall performance of the equipment was found to be satisfactory and has gained popularity among the farmers in large extent.

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