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RESEARCH PAPER

Laboratory test of a seed metering device of manually operated multi-crop planter for red gram (*C. cajan*)

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Abstract : Seed metering device is the most important part of planter which distribute seeds uniformly at the desired application rates. Manual method of seed planting, results in low seed placement, more consuming time, non uniform seed spacing and serious back ache for the farmer and decrease the production. The objective of this study was to design a new seed metering device sowing for red gram to overcome seed damage, missing rate, seed loss and non-uniform distribution of seed.

Key Words : Metering device, Red gram, Seed uniformity

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INTRODUCTION

Traditional method of sowing is not good for growing the crop. This leads to very low productions. There are many faults in inter cultivation problems such as not proper seed rate, fertilizer rate, seed spacing and consume more time. Agricultural mechanization is the application of machinery, technology and increased power to agriculture, largely as a means to enhance the productivity of human labour and often to achieve results well beyond the capacity of human labour. Metering mechanism is the heart of planting machine and its function is to distribute seeds uniformly at the desired application rates and controls seed spacing in a row. Proper selection and/or design of the metering device an essential element for satisfactory performance of the seed planter.

Proper design of the metering device is an essential element for satisfactory performance of the seed planter. The seed metering device used for this work is the wooden roller type with cells on its periphery. The size and number of cells on the roller depends on the size of seed and desired seed rate. In this design, the wooden roller lifts the seeds in the cells and drops these into the seed funnel which is conveyed to the open furrow through the seed tube. For varying the seed rate and sowing different seeds (Ikechukwu *et al.*, 2014)

Precision type seed metering device select single seed from the seed hopper and deliver them from the meter at a preset time interval. If this time interval is maintained as the seed is being delivered to and placed in, the seedbed, the seeding pattern will be one where the seeds are equidistant along the furrow, *i.e.* a precision drilling pattern. A precision meter plus an accumulation

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device enables a hill drop pattern while a precision meter plus an accumulation and an indexing device will enable a check row planting pattern.

Sowing is one of the important agricultural operations for raising crops. Proper application of fertilizer and proper placement of seed at proper location has also a good effect on crop growth and yield. Developed and evaluated a manually operated cowpea precision planter for performance by laboratory and field investigations. The laboratory test was conducted to investigate the rate of seed discharge, uniformity of intra-row seed spacing and seed damage during operation, while the field test examined the field efficiency, field capacity, planting depth and average seed spacing within the row (Oduma *et al.*, 2014). A proper placement of seed in field is most important operation in order to obtain optimum yield of crop. Day by day the land fragmentation was increased and which resulted near about 65 per cent of the land holders are small and marginal land holding capacity in the region. Considering the limitations due to costly seed, traditional method of manual dibbling, labour shortage and small marginal land holding pattern there is need of small manual planter for small and marginal land holders (Kankal *et al.*, 2016). Precision planters accurately place single seeds or groups of seed almost equidistant apart along a furrow. They are typically used to plant crops that require accurate control of plant population and spacing between and along the rows. Crops in this category include almost all the horticultural crops and field crops such as sorghum, maize, sunflower, soybeans and cotton. Precision seed metering systems giving a precision drill, hill drop or check row planting pattern are used on this type of planting machine (Murray *et al.*, 2006).

MATERIAL AND METHODS

The developed seed metering device of a manually operated multi crop planter was evaluated for its performance in FMP laboratory SHUATS, Allahabad.

Calibration test:

The hopper of the manually operated multi-crop planter was fully loaded with the seeds. The planter was suspended on a voice and turning the drive wheels rotates the metering wheel. A paint mark was made on the drive wheel to act as a reference point to count the number of revolutions when turned, and a bag was placed on the discharge tube to collect the seeds discharged. The drive wheels were rotated 50 times at low speed. A stop clock was used to measure the time taken to complete the revolutions. The seed in the bag were weighed on a balance and the procedure was repeated five times. Similar test was carried out for each crop seed (Olajide and Manuwa, 2001).

Seed germination test:

Germination testing of seeds is considered as the most important quality test in evaluating the planting value of seed lot. The ability of seeds to produce normal seedling and plants later on is measured in terms of germination test. Testing of seeds under field conditions is normally unsatisfactory as the results cannot be reproduced with reliability. Laboratory methods then have been conceived where in the external factors are controlled to give the most uniform, rapid and complete germination. Testing conditions in the laboratory have been standardized to enable the test results to be reproduced within limits as nearly as possible those determined by random sample variations.

Seed germination test was done in seed germinator in the laboratory of Department of Genetics and Plant Breeding SHUATS, Allahabad. Count out 100 seeds (including damaged ones) and sow in 10 rows of 10 seeds, the rows make it easier to count seedlings. Seeds should be sown at normal seeding depth of 2-3 cm in seed germinator. Place the seeds on top of the sand or soil and push them in with a piece of dowel or a pencil and cover with a little more sand. Counting seedlings after 10 days when the majority of seedlings were up. Do not wait until the late ones emerge–these are the damaged, weak ones. Only normal seedlings were counted. Do not count badly diseased, discolored or distorted seedlings or, in the case of lupines, those missing a cotyledon. Remember, you want to know the total number of normal, vigorous, healthy seedlings. Similar test was carried out for each crop seed. In this study counted only normal seedlings and germination percentage calculated by following formula:

$$SG\,(\%) = \frac{GS}{TS} \times 100$$

where,

SG = Seed germination percentage.

GS = Germinated seeds in seed germinator.

TS = Total seed (Including damage seeds).

Mechanically damaged seeds:

The test for percentage seed damaged was done with the machine held in a similar position to that described above. The hopper of the manually operated multi-crop planter was fully loaded with seeds and rotates the drive wheel of planter at waking speed. The wheel was rotated 20 times in turns and the time taken to complete the revolution was recorded with the aid of stop clock. The seeds discharged from the seed tube were in polythene and counted broken seeds. Similar test was carried out by (Oduma *et al.*, 2014 and Singh *et al.*, 2018).

$$\text{Seed damage (\%)} = \frac{\text{Total no. of damaged seed}}{\text{Total no. of seeds}} \times 100$$

Uniformity of seed spacing in row:

Seed spacing accuracy is most important laboratory test. A 10 m thin layer of grease layer was laid out on the plain ground and the machine was run at walking speed of approximately 2.5 km/hr. A measuring steel tape was used to measure the distance between seed to seed in the row. Similar test was carried out by Oduma *et al.* (2014).

Missing rate:

The accurate missing rate of seed measurement during operation in the field was not easy task, keen attention is needed while operating the manually operated planter in the field (laboratory testing grease layer). So, during operation operator and one observer counted the number of seeds missed to drop into the seed tube. Then determined the actual number of seeds drop in experimental area if seed missing occurred used following formula (Singh and Singh, 2017).

$$\text{Per cent missing rate} = \frac{N_1}{N} \times 100$$

where,

N_1 = Number of seeds missing during pickup by metering wheel into seed tube.

N = Number of seed dropped by the metering wheel if no missing occurred and not more than one seed per cell.

Results and Discussion

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Calibrated seed rate:

During calibration of seed metering device of red gram have been presented in Fig. 1.

Weight (g) of seeds dropped by seed metering device in 50 r.p.m. of ground wheel in five replications were 26.44, 27.3, 24.7, 26.5 and 27.5 g for replications 1,2,3,4 and 5, respectively. There was 2.5 per cent of missing during calibration test. The average amount of seed in fifty revolutions of drive wheel was observed 26.54 g. After the calibration it found that the amount of the seeds required for one hectare that means calibrated seed rate without missing seeds was 25.77 kg and with 2.5 per cent missing seeds was 25.12 kg.

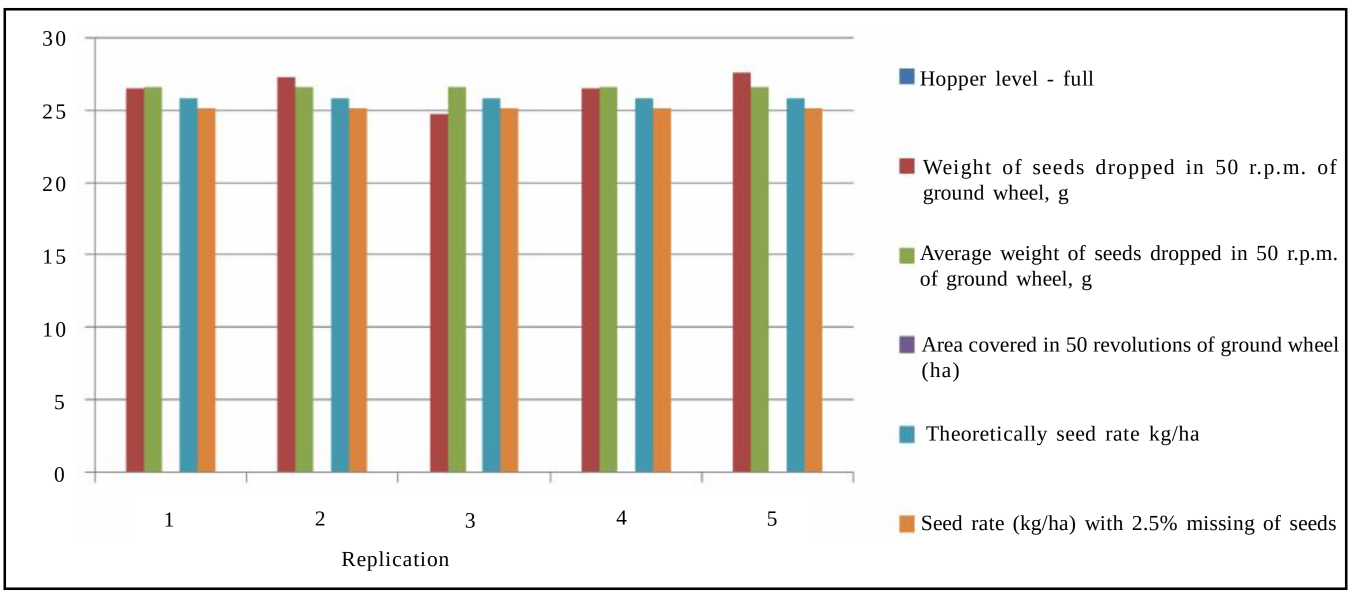

Fig. 1: Calibration of manually operated multi-crop planter for red gram seed metering device

Germination percentage of metered seed:

The average percentage of germinated seeds of the red gram was 84.8 per cent while the minimum germination percentage was found 84 per cent and maximum germination percentage in one sample was found 86 per cent. The results of the metered seed germination percentage in five samples were found 86, 84, 84, 85 and 85 per cent for replication 1,2,3,4 and 5, respectively, which have been presented in the Fig. 2. The reduction in the germination percentage was due to the immatureness of seeds as well as partly and fully damaged seeds. Similar result was found by Rahman (2014). Germination percentages for inclined plate seed metering device were found as 92.59 per cent, 96 per cent, 88 per cent, 92.31 per cent, 92.59 per cent and 92.31 per cent. For fluted type seed metering device, germination percentages were found as 86.21 per cent, 86.36 per cent, 91.30 per cent, 88.46 per cent, 89.47 per cent and 94.44 per cent.

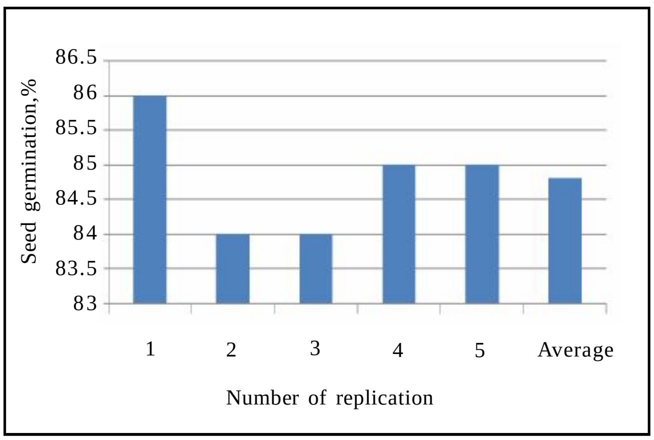

Fig. 2: Seed germination percentage of metered seeds

Mechanically damaged metered seed:

During damaged test of red gram seeds observed that some seeds were damaged due to the increasing speeds of the seed metering device, moisture and density of the seeds. The observations of the mechanically damaged seeds have been presented in the Fig. 3. Variation of seed damaged percentage were found 2, 2, 3, 3 and 1 for replications 1,2,3,4 and 5, respectively. The average percentage of the mechanically damaged seeds for okra seed was found 2.00 per cent. Similar test was found (Bamgboye and Mofolasayo, 2006) seed damage of 3.51 per cent observed in this work is probably due to the low speed at which the planter wheels were rotated during the laboratory tests.

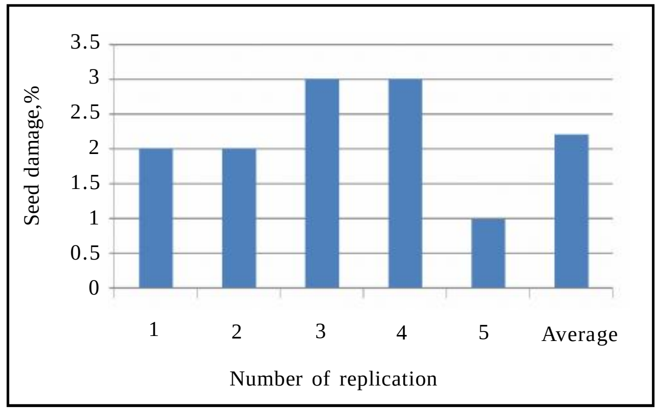

Fig. 3: Mechanically damaged seed percentage by seed metering device in laboratory

Uniformity of seed spacing:

The standard seed to seed distance of red gram was 20 cm (Empowering Indian Food and Agriculture). After the planting, a steel tape was used for measurement spacing between two seed. We observed that the planter should have to plant 50 seeds in 10 m long grease layer but due to missing seeds it planted less that was planted seed by the planter was varying from 45 to 46 seeds which presented in Fig. 4 and seed to seed distances were varying from 17cm to 40cm. The averaged seed to seed distance was found as 22 cm which is similar to standard seed distance.

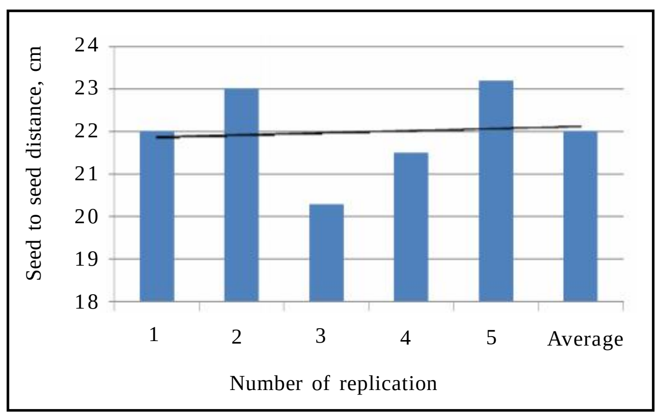

Fig. 4: Variation of seed to seed distance of seeds dropped of red gram on grease layer

Missing rate:

Missing rate of developed seed metering device by manually operated multi-crop planter for red gram seeds is presented in the Fig. 5. It was observed that the missing rate varies due to the changes in speed of the manually operated multi-crop planter. The missing rates were found 6 per cent, 4 per cent, 0 per cent, 2 per cent and 2 per cent for observations 1, 2, 3, 4 and 5, respectively. The average missing rate was 2.8 per cent. We observed less missing percentage compared to maize, pigeonpea and red gram due to shape and size of seeds. Missing rate was increased with increase speed. (Hossain, 2014) observed that the missing rate varies due to the changes in speed of the machine. The missing rates were found 14.92 per cent, 11.94 per cent, 13.43 per cent and 13.43 per cent for observation 1, 2, 3 and 4, respectively. The average missing rate was 13.43 per cent.

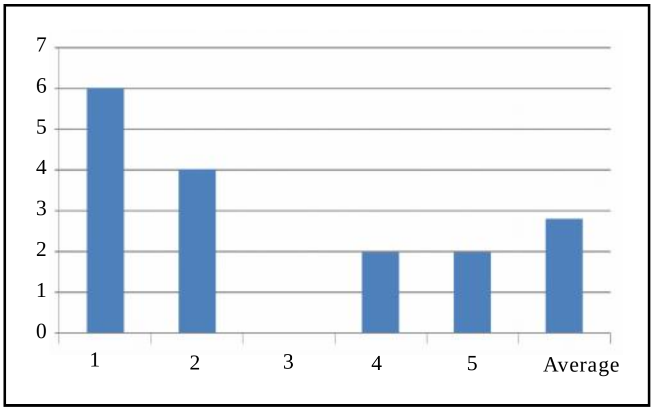

Fig. 5: Representation test of seed metering device for seed missing rate (%) during laboratory test

Conclusion:

The developed seed metering device for manually operated multi crop planter collect the single seeds from the seed lot and deliver them from the meter at a preset time interval. Uniformity of seed spacing in row was same, less missing rate, less mechanically damaged seed percentage and standard seed germination percentage of metered seeds.

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