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Performance evaluation of happy seeder for sowing chickpea in rice-chickpea cropping system of Chhattisgarh

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Abstract
Rice residue burning is a serious environmental issue in Chhattisgarh. The findings of the present study envisage that for feeding the ever growing population and to earn higher returns, farmers should adopt the recommended management practices for rice-chickpea cropping system in Chhattisgarh. This research work was carried out at the instructional farm of IGKV, Raipur to evaluation of different chickpea sowing technologies under paddy residue conditions were conducted in a combine harvested paddy field. Field of paddy variety (R-1) was harvested with combine. The stubble load was 7.16 t/ha at moisture content of 26.9 per cent. Chickpea variety (JG-130) was sown directly with happy seeder without any land preparation and sowing with conventional seed cum fertilizer drill after tillage practice (Conventional method, MB Plough + Cultivator + Rotavator) by several passes. In happy seeder, all the paddy straw was remained in the field itself and spreaded uniformly without requirement of any tillage practice. While in conventional methods the field was required for land preperation before sowing of seed. The maximum total yield of chickpea grain was obtained in happy seeder (1137.8 kg/ha) then conventional seed cum fertilizer drill, 1067.29 kg/ha.

Keywords: Performance evaluation, chickpea in rice-chickpea cropping

Introduction
Chickpea (*Cicer arietinum* L.) is an important winter season pulse crop of India and a key source of protein. In Chhattisgarh, chickpea is grown over an area of 393.78 thousand ha with an annual production of 433.158 thousand tones and an average productivity of 1100 kg/ha (Anonymous, 2016-2017). Sequential cropping after harvesting of winter rice is practiced in medium lands (Kushwaha and Ali, 1992) [4]. It is an important winter season pulse crop of India with drought condition as single most important abiotic constraints of higher productivity (Kumar *et al*., 2006) [3].

Multiple challenges associated with plough based conventional production practices that include deteriorating natural resources, declining factor productivity, yield plateau, shortages of water and labour and escalating costs of production inputs coupled with emerging challenges of climate change both in irrigated intensive systems as well as low intensity rainfed ecologies are the major threat to food security of South Asia (Jat *et al.*, 2009; Chauhan *et al.*, 2012) [2]. Direct drilling (seeding/ planting with zero tillage technology) is one such practice that potentially addresses the issues of labor, energy, water, soil health etc. and adaptations to climatic variability (Jat *et al.*, 2009) [2]. In Chhattisgarh region mostly combine harvested rice residues are burnt before planting of chickpea. The field burning of crop residues is a major contributor to poor air quality (particulates, greenhouse gases), human respiratory ailments, and the death of beneficial soil fauna and micro-organisms. Happy seeder is a technique which is used for sowing chickpea, without any burning of rice residue. This technology was eco-friendly with environment, for the health of soil as well as it also saves water. So for evaluation of machine the test was carried out for sowing chickpea in rice-chickpea cropping system of Chhattisgarh

Materials and Methods
Happy seeder consists of a rotor for managing the paddy residues and a zero till drill for sowing of wheat. Flail type straight blades were mounted on the straw management rotor which cuts the standing stubbles/loose straw coming in front of the sowing tine for proper placement of seed in soil. The rotor blades/flails guide/push the residues as surface mulch between the seeded rows. This PTO driven machine can be operated with 45 hp tractor and could cover 0.3-0.4 ha/ h. This machine could be used for direct drilling of wheat as well as chickpea (rabi crop) in combine harvested field with uniformly spreaded paddy straw.

Rotor was used to cut the straw and spread over the chickpea seed as mulch. It provides a suitable atmosphere for proper growth of wheat. To evaluate the performance of happy seeder & its comparison with the conventional cultivation practices under for chickpea crop. Sowing area and variety of chickpea were same for both method as happy seeder and conventional method. The variety selected of chickpea was JG-130. Seed material quality was improved by cleaning and grading. The size of cells or grooves of metering device is selected based on seed size. Thus grading and cleaning of seeds with variable sizes of Chickpea was desirable to select the proper seed rate. The measurement of length, width and thickness of grains were done with the help of a Vernier calipers having the least count of 0.01 cm. The size of chickpea seeds was in the range of 5.5 - 7.7 mm. During the sowing operation of chickpea with happy seeder zero tillage method the previous crop as well as rice stubble was cuts and spread uniformly on the drilled chickpea seeds which retain optimum soil moisture.

To compare conventional method practices (tillage before sowing) with happy seeder for chickpea cultivation. In the experiment, three different tillage treatments were selected for land preperation. The details of used tillage treatments are as below. (Fig. 2)

1. Happy seeder zero tillage machinery
2. Cultivator with two pass + Rotavator with two pass.
3. Mould Board Plough with one pass + Cultivator with two pass + Rotavator with two passes.

Fig 1: Sowing of chickpea with happy seeder

MB Plough | Cultivator | Rotavator

Fig 2: Land preparation (tillage) before sowing by conventional method.

Observations to be recorded

Moisture content and bulk density of soil

Moisture content (%) of soil was measured by oven dry method. The collected soil samples from each location were weighed initially and then kept in an oven for 24 hours at 105°c for obtaining dry weight of soil and moisture content was calculated as follows. (K.M. Sahay and K.K. Singh, 1994).

$$Mc = \frac{W_w - W_d}{W_d} X\ 100$$

Where,

W_w = weight of weight soil, g;
W_d = weight of oven dry soil, g and
M_c = moisture content of soil, % db

Bulk density

Bulk density is an indicator of soil compaction. It is calculated as the dry weight of soil particles and the volume of pores among soil particles. Bulk density is typically expressed in g/cm^3 (Singh *et al*., 2013) [8].

$$\text{Bulk density } (g/cm^3) = \frac{\text{Weight of dry soil } (M_{solids})}{\text{Total soil volume } (V_{soil})}$$

Where, $\text{Volume of sampler} = \pi r^2 xh$

Post-harvest parameters

Plant Population/m^2

The plant population of crop was counted at various days after sowing from in one-meter row length in five rows randomly and then averaged. After this, plant population per meter square was determined from each other.

Plant Height (cm)

The height of marked plant from the base (ground surface) to the tip of main stem with the help of meter scale was measured. This observation was recorded at various days after sowing (40,60,80).

Depth of Root (cm)

The depth of plant root was measured in centimeters from the base of the stem to the tip of the root. Soil was dugged to

proper depth and cut deep block of the soil from five different locations in each plot. The block with plant was soaked in water for 1 hour, root was separated carefully from adhering organic matter and soil particles, and five plants were selected from each plot to determine root length.

Number of Branches /Plant
The number of branches arising from main shoot per plant were counted on the five tagged plants in each replication at 20, 40 and 80 DAS in each plot and the mean was determined for each treatment.

Number of Pods/Plant
Pods were removed from five tagged plants in each plot and then counting of these collected pods was made for each plot. Finally, mean was computed by dividing the values with five.

Grain Yield (kg/ha)
The estimation of grain yield in various treatments was estimated by measuring the plot cutting yield. This was done by measuring the grain yield production/plot area under a particular treatment. The cutting of crop each plot and measure the yield in each treatment.

$$\text{Grain yield/ha} = \frac{Grain\ yield\ /\ treatment}{Area/treatment} \times Area/ha$$

Straw Yield (kg/ha)
The estimation of straw yield in various treatments was estimated by measuring the plot cutting yield. This was done by measuring the straw yield production/plot area under a particular treatment. The cutting of crop each plot and measure the yield in each treatment.

Test Weight (g)
100 number of chick pea grains were taken in a pan and weighed using by an electronic balance.

$$\text{Test weight} = \text{Weight with grains} - \text{weight without grains}$$

Result and Discussion
Soil moisture content and bulk density
The moisture content, and bulk density of the soil before sowing operation was the average moisture content at 15 cm depth was found to be 26.97% (db). Other researcher evaluates the machine at moisture content of 20.2% (db) Singh (2015). Table.1 shows average bulk density was observed 1.36 g/cc and porosity was measured 50.62% before sowing of chickpea by sowing machines and after 80 days of sowing the moisture content and bulk density of field was found to be 15.97% and 1.40g/cc.

Post-harvest Parameters
the 1000 grain weight is an important parameter which affects the seed rate, so it is very necessary to calculate the 1000 grain weight for precision sowing. The 1000 grain weight of chickpea seeds was 148 g. The germination of seed before sowing was measured using a seed germinator. The seed germination of chickpea seeds was 88%. Various physical properties of seeds and their fractions are dependent on moisture content and appear to be important in the design of seed metering mechanism. The moisture content of chickpea seeds was 11.3%. The bulk density of seeds is an important parameter for designing of box capacity and for optimizes the seed rate of the crop. The bulk density of chickpea seeds was 0.712 g/cc. The minimum seed rate was recorded in case of happy seeder as 38.34kg/ha. The speed of operation of happy seeder was 3.4km/h. The actual field capacity and field efficiency were 0.62ha/h and 81.70 %.

Table 1: Soil moisture content and bulk density at various stages

S. No.	Soil Parameters		Happy Seeder	Conventional Method
1.	Moisture content, %	At the time of sowing	26.97	26.10
		After 20 days of sowing	24.12	22.42
		After 40 days of sowing	21.73	19.16
		After 80 days of sowing	15.97	12.22
2.	Bulk density, g/cc	At the time of sowing	1.34	1.23
		After 20 days of sowing	1.36	139
		After 40 days of sowing	1.37	1.38
		After 80 days of sowing	1.40	1.41

Table 2: Parameters observed of chickpea at post-harvest stage

S. No.	Particular	Happy seed drill	Conventional Method
1	Plant Population/m^2	48.91	42.10
2	Plant Height (cm)	54.34	46.96
3	Depth of Root (cm)	14.58	14.21
4	Number of Branches /Plant	15.92	12.46
5	Number of Pods/Plant	72.60	60.24
6	Grain Yield (kg/ha)	1137.80	1032.41
7	Straw Yield (kg/ha)	3674.50	3723.32
8	Seed Emergence %	87.10	82.15
9	Depth of sowing, cm	3.22	2.80
10	1000 seed weight, g	148	143

Cost economics
The cost economics of the operation under different sowing techniques was varied due to different field capacity and fixed and variable cost of the implements. The lowest cost of operation of sowing was observed in happy seeder, 1506.01 Rs/ha whereas in conventional drill it was found to be 5042.55 Rs/ha. Through this study we have pointed out that happy seeder is one of the unique conservation technique for sowing of chickpea in rice-chickpea cropping system of Chhattisgarh.

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