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Evaluation tesing of inter row cultivator in broad bed furrow method of sowing for *Kharif* crops

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ABSTRACT : The feasibility study of tractor drawn inter row cultivator on broad bed furrow sown field was carried out at village Kutasa on farmers field for *Kharif* season during 2011- 2012. The green gram and soybean crop was sown by broad bed furrow planter which is developed by Department of Farm Power and Machinery, Dr. Panjabrao Deshmukg Krushi Vidyapeeth, Akola. The same implement was used for inter cultural operation by changing its furrow opener by the inter cultural sweep. The inter row cultivator was tested as per the RNAM test code 1995 for both green gram and soybean crop. The inter culture operation was carried out after the 20 days of sowing for both the crops. The inter cultivator was tested in the laboratory as well as in the field as per standard procedure. The working width and depth of inter row cultivator was recorded to be 136.9 cm and 2.73 and 2.46 cm for green gram and soybean, respectively. The weeding efficiency of inter row cultivator was found to be 86.19 per cent and 86.54 per cent for green gram and soybean, respectively with negligible plant damage during operation for both the crops. During inter row cultivation the speed was recorded which was 3.75 km/h and 3.69 km/h for green gram and soybean, respectively. The net saving of 12.45 per cent in green gram and 14.55 per cent in soybean was observed in cost of operation for mechanical inter culture operation over traditional practice. The energy requirement for interculture operation of green gram and soybean was found to be 73.38 kWh/ha and 77.32 kWh/ha and for traditional it was 22.10 kWh/ha and 22.67 kWh/ha, respectively. The per cent saving in cost of energy in BBF sown interculture operation was 74 and 74.97 over traditional method for green gram and soybean, respectively. The overall performance of inter row cultivator was found satisfactory. The BBF method of sowing was more feasible, reliable than the traditional method of sowing, which resulted in high yield and selective mechanization of farm.

KEY WORDS : Inter row cultivator, Broad bed furrow, Interculture operation, Cost of operation, Energy requirement

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Sustainable development in agriculture can be achieved by use of mechanization in agriculture. Mechanization can help in increasing the production by timely farm operation, reducing losses, reducing the cost of operations. It also ensures better management of costly inputs and enhances the productivity of natural resources. It also reduces drudgery in farm operations. (CRIDA, 2007).

Mechanization of different farm operations can increase the agricultural productivity by more work in less time, efficient use of inputs, by producing quality product, improving the safety of the farmers, reducing the loss of produce and drudgery of farmers thus, improving comforts of farmers (CIAE, 2009).

The broad bed marker (BBM) was developed in the late 1980s from the traditional dual ox-drawn plough, called as maresha by the Joint Vertisol Project. In vertisol soils it is difficult to work, cracking occurs when dry and becoming sticky and waterlogged when wet. The role of the broad bed furrow (BBF) was to make raised seedbeds and furrows more efficiently and effectively, thus, reducing water logging and encouraging early planting of crop (Rutherford, 2008).

In the rainy season when there is scarcity of labour, the sowing of crops delay and it ultimately results in reduction of yield. For timely operations and agriculture mechanization can be adapted which will improve the productivity. The implements, machines, tractors and power units can be owned

by farmers or available on custom hiring basis. So the effective use of these implements can results in to the economic progress of farmers.

The BBF farming is the technology which improve the effectiveness of drainage practice and resource conservation. BBF planter cum inter row cultivator has many advantages in regard to rain water conservation, mechanical weeding, fertilizer placement, less lodging and better crop stand.

Use of BBF can have several benefits depending on its use. Raised beds are primarily a field drainage tool aimed at decreasing water logging and increasing crop yield. When soil become saturated with water, then an anaerobic condition result in poor plant root growth, causing plants to become stressed and in some cases under prolonged water logging, plants will die. In such condition the soil drainage needs to be considered. This can be achieved by using BBF method of sowing. Many paddocks that were too risky to crop due to water logging problem can now be brought into production. BBF farming encourage implement to travel down the furrows, which reduces the amount of soil compaction occurring where the plants are growing. Soil which is not compacted has a greater ability to hold available water, allow for greater plant root growth and give higher plant yield.

A weed is defined as "any plant growing where it is not wanted" (Anderson et *al.,* 1996). The ability of the weed to compete with plants depends on several factors *viz.*, time of weed emergence, weed morphology and density of weeds that are present in crop. Higher weed infestation is a serious problem for the field crops. High soil temperature accompanied by the high humidity prevailing during early monsoon facilitates weed growth.

Weeding operation is one of the important intercultural tillage operation which control unwanted plants between the rows that consume more fertilizers and reduce the crop yield. Controlling weed is one of the serious problems faced by the farmers. Weed control in early stage of field crops is the most important operation and delay in weed control may not compensate losses which the crop suffers in early growth stages.

The BBF method sown crops can be inter cultured by the inter row cultivator by just replacing furrow openers by the inter culture sweeps. It is the mechanical method of weed controlling. Considering above discussion the inter row cultivator was tested in the field sown by broad bed furrow planter for *Kharif* crops namely green gram and soybean. The inter row cultivator was tested as per the RNAM test codes. The present paper involved all the results obtained after the testing of the implement and gives the feasibility of inter row cultivator for green gram and soybean crop.

METHODOLOGY

The methodology and experimental techniques adapted in studying performance and evaluation inter row cultivator for *Kharif* crops in laboratory and field is explained.

Study location :

The inter row cultivator was tested in the laboratory as well as in the field to evaluate its feasibility for *Kharif* crop. The laboratory tests were conducted in workshop of Department of Farm Power and Machinery, Dr. PDKV, Akola, during *Kharif* season of 2011. The field trials of inter row cultivator and traditional farm practice were carried out at the field of Shri Shivajirao Deshmukh at Kutasa Tal. Akot, Dis. Akola, Maharashtra State (India) for both the selected crop *viz.,* green gram and soybean.

Traditional farm practices for inter row cultivation of green gram and soybean was done with the help of bullock. The data of labour requirement and wages was recorded during the *Kharif* season 2011. The crop spacing was same in traditional and BBF sowing method for green gram and soybean. The parameters like cost of operation, energy requirement had been observed and comparison of inter row cultivator and traditional method was done.

Experimental details :

–Name of crop: Green gram, Soybean.
–Name of variety: Green gram - TKM AK04
Soybean – JS 335.
–Year of study: 2011.
–Plot size: Green gram – 0.41 ha.
Soybean- 0.42 ha.

Planting technique :

The traditional method of sowing of crops was as shown in Fig. A and the BBF method of planting was as shown in the Fig. B and the intercultural operation was carried out in the field. In traditional method the inter cultural operation was carried out with the help of bullock in the traditional way, and in the BBF planter sown field with the help of tractor drawn inter row cultivator.

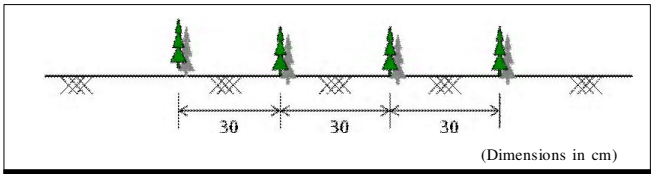

Fig. A:Traditional method of sowing for green gram and soybean

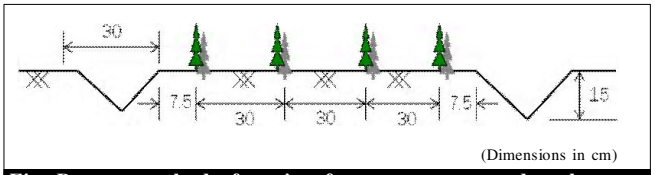

Fig. B: BBF method of sowing for green gram and soybean

The performance of BBF inter row cultivator was evaluated by taking the laboratory tests and field tests, as per RNAM test code (Anonymous, 1995).

Laboratory testing of tractor operated inter row cultivator :

Laboratory testing of tractor operated inter row cultivator carried out in the workshop of Department of Farm Power and Machinery, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola in order to study following performance characteristics.

Laboratory testing of tractor operated inter row cultivator was carried out in the workshop of Department of Farm Power and Machinery, Dr. PDKV, Akola in order to study following characteristics were recorded.

–Adjustment of working width

–Adjustment of working depth

Field testing of BBF planter :

Field performance tests were carried out to obtain actual data on overall performance of tractor drawn inter row cultivator and working capacity in field condition. The performance evaluation of inter row cultivator was evaluated in the experimental field. The observations such as weeding efficiency, plant damage during operation, speed of operation and turning time, effective field capacity, theoretical field capacity, field efficiency, fuel consumption, percentage of wheel slip were recorded. Cost economics and energy consumption was calculated for the tractor drawn inter row cultivator and it was compared with the traditional method of inter cultivation.

RESULTS AND DISCUSSION

The experimental findings obtained from the present study have been discussed in following heads:

Laboratory testing of inter row cultivator for *Kharif* crops (green gram, soybean) :

The laboratory tests had been carried out to evaluate the performance of inter row cultivator to know the performance characteristics like, adjustment of working width, adjustment of working depth .

Adjustment of working width and working depth of inter row cultivator :

The working width of inter row cultivator was determined with considering the sowing pattern of BBF sown green gram and soybean (Fig 1). The ridgers were set at 30 cm width, and the sweeps of 20 cm were selected for the 30 cm row distance. In this way the width of the implement was taken as 135 cm for both the crops green gram and soybean.

Fig.1: Inter culture operation in BBF planter sown green gram and soybean

The working depth of the inter row cultivator was also determined in the laboratory. The depth of ridgers was set at 15 cm depth as they were at the depth during sowing. The sweeps were adjusted at the depth of 3 cm for both the crops green gram and soybean.

Field testing of inter row cultivator for green gram and soybean :

The inter row cultivator was tested in same field where green gram and soybean was sown by BBF planter in the field

Table 1 : Weeding efficiency of inter row cultivator for green gram and soybean

Treatments	Replications										Treatment mean	
	R- I		R-II		R-III		R-IV		R-V			
	GG	Soy	GG	Soy	GG	Soy	GG	Soy	GG	Soy	GG	Soy
No. of weeds before operation	95	105	122	115	102	107	127	89	97	119	108.6	107
No. of weeds after operation	17	14	19	18	13	14	16	11	10	15	15	14.4
Weeding Efficiency, %	82	86.66	84.42	84.34	87.25	86.91	87.40	87.64	89.69	87.39	86.19	86.54

at village Kutasa Tal. Akot Dist. Akola on the farm of Shri. Shivajirao Deshmukh. The inter row cultivator was tested on the field of green gram (0.41 ha) and the soybean (0.42 ha).

Working width and depth of cultivation of inter row cultivator:

The working width of inter row cultivator and depth of cultivation of inter row cultivator was observed. The working width of the inter row cultivator ranged from 130 cm to 140 cm with average of 136.9 cm for green gram and for soybean it ranged from 135 cm to 141 cm with average of 138.65 cm. The depth of cultivation was ranges from 2.1 cm to 3.6 cm and 1.9 cm to 3.1 cm with average of 2.73 cm and 2.46 cm for green gram and soybean, respectively. Khambalkar *et al.* (2010) studied the pattern of sowing for safflower crop in broad bed furrow. They observed effective width of the sowing implement as 180 cm and row to row distance as 30 cm for safflower crop.

Weeding efficiency :

The weeding efficiency was determined for the inter row cultivator in BBF sown field for both green gram and soybean. From Table 1 it is evident that the weeding efficiency of inter row cultivator ranges from 82 per cent to 89.69 per cent for green gram and in average 86.19 per cent weeding efficiency was recorded for the green gram. For soybean the weeding efficiency was recorded in range of 86.66 per cent 87.39 per cent and 86.54 per cent average was recorded for soybean. The weeding efficiency was calculated on the observation number of weeds before and after the operation. Kankal (2011) found that the weeding efficiency of self propelled weeder in cotton and red gram were 87.19 per cent and 84.19 per cent, respectively. Rathod *et al.* (2010) developed a tractor drawn inter row rotary weeder having the wedding efficiency of 92.23 per cent.

Plant damage :

The plant damage after the intercultural operation was observed, there was least numbers of plants were damaged by the inter row cultivator. The average plant damage by inter row cultivator was observed as 0.6 for green gram and soybean, respectively for the five replications in 1 m x 1 m plot size.

Speed of operation and time loss in turning of tractor :

The observation of time required for inter row cultivation of 20 m length and travel speed and turning loss was observed for green gram and soybean.

The range of time required to cover a distance of 20 m was 18.46 sec to 20.93 sec for green gram and 19.35 sec to 20.34 sec for soybean, the average was 19.2 sec and 19.51 sec for respective crops. The speed of inter row cultivation in green gram was also calculated and was in range of 3.44 km/h to 3.9 km/h for green gram and average of 3.75 km/h. And for soybean it ranged from 3.54 km/h to 3.72 km/h with average of 3.69 km/h, the turning time during inter culture operation was in the range of 15 sec to 20 sec and 18 sec to 21 sec for green gram and soybean, respectively. The average time required to turn the tractor at head land was calculated as 17.4 sec and 19.2 sec for respective crops. Amonov *et al.* (2006) studied machine innovation for the inter row cultivation in Uzbekistan, they checked accuracy of different types of cultivator for cotton crop and speed was in range of 1.79 km/h to 5.29 km/h.

Effective field capacity of inter row cultivator :

The effective field capacity was calculated by considering the productive as well as non productive time required during inter cultural operation. The effective field capacity of tractor operated inter row cultivator for BBF planter sown green gram and soybean were 0.436 ha/h and 0.417 ha/h, respectively.

Theoretical field capacity :

The theoretical field capacity of inter row cultivator was calculated and it was found to be 0.506 ha/h and 0.498 ha/h for both green gram and soybean, respectively. The theoretical field capacity depends upon the speed of operation and theoretical width covered by the implement.

Field efficiency :

The field efficiency of inter row cultivator was calculated from the theoretical field capacity and effective field capacity. The field efficiency of tractor operated inter row cultivator was found to be 86.16 per cent for green gram and 83.73 per cent for soybean. The field efficiency of soybean field was low due to the shape of the field.

Fuel consumption :

The fuel consumption for inter row cultivation was found to be 4.21 l/ ha and 4.38 l/ha for green gram and soybean, respectively. The fuel consumption litre per hour was observed and found to be 1.31 l/h and 1.05 l/h for green gram and soybean, respectively.

Rathod *et al.* (2010) found effective field capacity and field efficiency as 1.43 ha/day and 86.34 per cent while working with tractor drawn inter row rotary weeder. Fuel consumption was 1.31 l/h and 1.05 l/h for green gram and soybean, respectively.

Tractor wheel slip :

The number of revolutions of tractor wheel with load and without load condition was counted for a 30 m length along a row.

The average tractor wheel slip occurred during field operation was found to be in the range of 8.44 per cent to 17.60 per cent for green gram and soybean with average of

11.24 per cent and 11.45 per cent for the green gram and soybean, respectively.

Economics of tractor operated inter row cultivator planter :

The cost of operation per hectare of tractor operated inter row cultivator for green gram and soybean crop were computed.

The total cost of operation of tractor operated inter row cultivator for inter culture operation of green gram and soybean per hour is the component of cost of operation of tractor and inter row cultivator per hour, respectively. The cost estimation depends upon fixed costs and operating costs.

The total cost of operation for tractor was Rs.229.73, Rs. 215.19 per hour and for planter it had been Rs. 56.57 per hour for green gram and soybean, respectively. The total cost of inter culture operation by using inter row cultivator on broad bed furrow were computed to be Rs. 656.65 and Rs. 651.70 per hectare, respectively.

Economics of traditional inter culture operation for green gram :

The cost of inter culture operation was determined by collecting the field data at the time of inter culture operations of traditionally sown green gram and soybean. The bullock operated hoe was used for the inter culture operation of green gram and soybean. For the crop green gram and soybean the per hour cost of inter culture operation was Rs. 112.5/- and cost per hectare for the inter row cultivation was Rs. 750/- and 762.71/- for green gram and soybean, respectively.

Energy requirement for inter row cultivation of green gram and soybean :

The energy requirement for tractor operated inter row cultivator was 74.38 kWh/ha and 77.32 kWh/ha required for green gram and soybean, respectively and by traditional inter cultural operation 22.10 kWh/ha and 22.67 kWh/ha energy requirement was observed for green gram and soybean, respectively.

Cost of energy of green gram and soybean :

In tractor operated inter row cultivator cost of energy for green gram and soybean was 8.82 Rs./kWh, 8.42 Rs./kWh and for traditional method 33.93 Rs./kWh and 33.64 Rs./kWh, respectively.

The overall performance of the tractor drawn inter row cultivator during the operation in the field was found to be satisfactory for green gram and soybean crop respectively as compared to the traditional method of inter row cultivation.

Conclusion :

The broad bed furrow method of sowing is already proven to be beneficial, inter cultural operation in the field is very important and it should be performed effectively. The tractor operated broad bed furrow inter row cultivator is effective and superior to the traditional method of inter culture. It will save labour, time and cost which will improve overall profitability of farmers.

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