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Performance of rotary cutter for harvesting of little millet *(Panicum sumatrense*) in tribal areas

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ABSTRACT

A study on demonstration of rotary cutter for little millet harvesting was conducted at farmers' field in tribal area of Yelagiri and Mangalem villages in Vellore district by Krishi Vigyan Kendra (KVK), Vellore, Tamil Nadu. Demonstrations were carried out at 20 farmer's field covering an area of 10 há during 2015-16 and 2016-17. The results of the study showed that harvesting of little millet using rotary cutter had overall labour saving of operation by 74.1 per cent, total labour dependency by 74.5 per cent and cost of cultivation by 27.5 per cent as compared to manual operation. Field capacity of little millet rotary cutter was found to be 0.06 ha/hr in comparison to manual operation. This experiment helped the farmers in creating awareness and inculcating the knowledge of the mechanization, which in turn can facilitate them to get more income. Farmer opined that motorized reaper was easy to function, can reduce drudgery and overcomes labour shortage during critical stage of operation.

1. Introduction

Nutri cereals are a cereal crop plant belonging to the grass family, Graminae. The term "millet" is used freely to refer to several types of small seeded annual grasses belonging to species under the five genera in the tribe Paniceae, viz., Panicum, Setaria, Echinochloa, Pennisetum and Paspalum, and one genus, Eleusine, in the tribe Chlorideae. Most of the genera are widely distributed throughout the tropics and subtropics of the world. Among the nutria cereals little millet (*Panicum sumatrense*) or samai is highly nutritious. The collected samples were found to be high in fat, iron and protein content than the other cereals. Little millet protein contains amino acids in balanced proportions and is rich in methionine, cysteine and lysine.

Mechanization acting a significant role to take out timely operation, reducing labour and drudgery in agriculture.

This operation is carried using in the neighbourhood available sickle which is time consuming and needs more number of labours per unit area. Migration of agricultural labours to hill tourism development, high labour wages, shortage of labour for harvesting little millet and more drudgery involved harvesting is becoming a costly activity Non-availability of labour during peak periods also accounts for more expenses. Majority of the farmers come under small and marginal group. These disjointed lands have lower efficiency due mechanization acting a significant role to take out timely operation, reducing labour and drudgery in agriculture. Yelagiri Village in Vellore district is primarily leaning with little millet crop covering an area of 650 ha. One of the important operations in little millet cultivation Mohammad, 2007 reported that production of suitable machinery is one of the major factors for reducing labour Yelagiri Village in Vellore district is primarily leaning with little millet crop covering an area of 650 ha. One of the

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important operations in little millet cultivation is harvesting necessities and production costs of second crop cultivation. The main objective of the study is to develop a low cost machine driven hand carried little millet harvester. Therefore, KVK Vellore demonstrated rotary cutter harvester for little millet harvesting with specific objectives are as follows:

- To assess technological operation of the developed little millet harvesting machine.
- To quantify the field capacity, filed loss and fuel use.
- To perform economic analysis to compute cost of process

2. Materials and Methods

Demonstrations were carried out at 20 farmers' field covering 10 ha in village's viz., Yelagiri and Mangalam of Vellore district. The weather of this region is dry moist, sub humid and area receives about 950 - 1050 mm rainfall yearly, out of which about 60% is received during south west monsoon (June to September) and 40 % during North eastern monsoon (October to February). Harvesting was carried out with rotary cutter repeatedly for two years 2015-16 and 2016-17. In adding together, awareness about the significance of mechanization was also fashioned through different extension activities like on campus and off campus training programmes, demonstrations, group discussions, cluster approaches, literatures and other extension activities. Harvesting of little millet using labourers was studied in assessment of mechanized harvesting of little millet using rotary cutter. Data regarding area coverage ha/man day (ha), time and cost of operation, labour charges and number of labourers, Saving in labours % over check (%) and Cost saving in % over check (%) required in harvesting were recorded.

A test crop of CO-4 variety of little millet was raised at Yelagiri and Mangalem villages. At the time of maturity of the plant properties like plant density, number of hills per unit area, plant height, stem thickness were measured by selecting 10 plants randomly at identified spots of the experimental area and averaged.

Field assessment

The specification of the rotary cutter for little millet harvester has been given in Table 1.

Actual Field capacity

Field capacity is the actual area covered by the machine or implement under actual time usually expressed in ha/hr. It is the quantum of work turned out by the machine. Field capacity should be the maximum with least effort for minimizing field losses (Hunt 1995). Actual Field capacity (ha/hr) = Actual area covered, ha/ time taken, ha

Table 1. Technical specification of rotary cutter harvester for little millet

Displacement	30.8 cm^3
Width of cutting (m)	1.4
Row spacing (m)	0.30
Number of teeth	108
No. of person required for operation	1
Power source	Petrol engine
Power output	1. 3kW/bhp
Weight	6 kg (Excluding fuel and harvesting tool)
Total length	1,77 m
Tank volume	0.64 lit

Harvest losses

In order to estimate harvesting losses in manual and reaper harvesting, the losses that occurred before harvesting (pre-harvest) must be considered. In this connection, in four parts of each plot with the use of wooden frame with 1m×1m dimensions, all grains fallen within the frame are collected and weighed and the mean of the four measured values are recorded.

Harvesting losses include shattering and uncut losses and were determined by the following equation (Pradhan *et al.*, 1998)

$H\,gt = H\,g_1 + H\,g_2 + H\,g_3$

Where, Hgt = Total losses (g/m^2),

Hg_1 = Pre harvest losses (g/m^2)

Hg_2 = Shattering losses (g/m^2) Wg_3 = Uncut losses (g/m^2)

After measuring the amount of losses at different stages, the percentage of harvest losses were determined by the following equation:

$$W = Hg1 - Hgt / Yg \times 100$$

Where,

W = Percentage of harvest losses (%)

Hg1 = Pre-harvest losses (gram/m^2)

Hgt = Total harvesting losses (gram/m^2)

Yg = Grain yield (gram/m^2)

Stubbles left in the field were also measured using scale and expressed in metric unit.

3. Results and Discussion

The results revealed that overall labour saving for harvesting of little millet by rotary cutter was reduced by 74.1 percentages compared to manual harvesting. Similar results were found by Shelke, 2011. Labour need to harvest one-hectare area of little millet using rotary cutter was reduced by 74.5 per cent while cost of cultivation was reduced by 27.5 per cent over manual operations, Thus there was a saving of an amount of Rs.4092/ha. The cost of the fuel was included to work out the cost of cultivation. The average fuel consumption recorded was 1.0 l/hr. The variation of fuel consumption may be due to the capacity of the engine fitted to the reaper, type of crop and crop conditions. The Actual field capacity of the reaper was created to be 0.06 ha/hr. The field efficiency of the machine can be increased with regular shape and size of the field with a standing crop. The effective field capacity of machine is a function of speed of travel, field efficiency and cutting width. In manual harvesting with sickle, a labour on average can harvest 48 m /h, but this amount can differ with respect to crop condition, labour ability and climate condition.

The harvesting losses were more than pre-harvest and manual harvesting but were in satisfactory limit (Kumar *et al.,* 2006). The measured values of pre harvest losses were found to be 4.52 per cent whereas post-harvest losses under manual and little millet harvesting with rotary cutter conditions were 10.5 and 14.4 per cent, respectively. This may be due to mechanical action of harvester and physiological maturity of crop. Delay in harvesting caused grains to shatter due to natural factors (rain and wind) and therefore losses increase. Therefore, it is necessary to assess the most suitable moisture content for harvesting and its relation to the amount of losses. The stubble height left over in the field after harvesting was 10 cm and in manual harvested plots, it was 5 cm the cost of cultivation under little millet was found to be Rs. 8120/ha against Rs. 10355/ha under manual harvesting. Therefore, it was evident that harvesting little millet with rotary cutter was the most economical.

4. Conclusion

Mechanical harvesting was found beneficial in terms of field capacity, cost of harvesting and human drudgery compared to manual harvesting. Actual field capacity and field efficiency increased with the increase of land size and operator's skill. Time and labour are critical property in cultivation of field crops. Acceptance of mechanization in cultural operations not only reduces drudgery but also saves time significantly resulting in reduces cost of cultivation also increases more returns per unit time and area.

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Table 2. Growth and yield parameters of little millet (CO- 4) at harvest stage

S.No	Particulars	Observations
1.	Variety of crop	CO-4
2.	Plant height (cm)	108
3.	No of tillers hill	14
4.	No of productive tillers/hill	8
5.	No of non-productive tillers/hill	6

Table 3. Comparative economics of operations between little millet rotary cutter and manual harvesting (Mean value of two years 2015-16 and 2016-17)

Operation	Area covered in unit time @ m2/h	No. of labours/ha	Cost of harvesting (Rs/ha)	Cost saving (Rs/ha)	% of labour saving	% of cost saving	Yield Q/ha	Gross cost (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	BCR
Rotary cutter	160	8.9	8120	2,234	74.1	27.5	9.42	19,324	32,977	13,653	1.71
Manual Harvesting	48	35	10,355	-	-	-	9.20	22,645	32,204	9,559	1.42