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Studies on the Status and Opportunity of Leafy Vegetable Crop Harvesting in Chhattisgarh

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ABSTRACT: Leafy vegetables have a very high protective food value and are very easy to grow. Due to its high nutritive value, it is very popular in India. The harvesting operation of green leafy vegetable crops is normally done manually. Manual harvesting method is very tedious and time taking operation. A purposive survey was conducted to know the status of adopted method for harvesting of leafy crops. Biometric characteristics and engineering properties of leafy crop were observed to know the behavior of the leafy crop in the field as well as after harvesting. In survey status overall discomfort rating also observed during harvesting of leafy crops by adopted harvesting method (manual harvesting and harvesting with sickle).

Keyword: Biometric properties, leafy vegetable harvesting, overall discomfort rating, body part discomfort score and cost of operation.

INTRODUCTION

Leafy green vegetables are an important part of a healthy diet. These type of vegetables are enrich in vitamins, minerals, carbohydrates, fats, important proteins, vitamins, essential amino acids, and fiber but having very low in calories (Sharma *et al.*, 2006). Eating a diet rich in leafy greens can offer numerous health benefits including reduced risk of obesity, heart disease, high blood pressure and mental decline. The leaves of a large number of wild and cultivated plants are used as vegetables in various parts of India. Many types of leafy vegetables available here which is grown in bed they are spinach, red spinach, amaranths, fenugreek leaves etc. Now horticultural crops are widely growing to meet the consumer demand, so it is necessary to do all the operation timeliness. After maturity of the leafy vegetable in time harvesting is important because after this stage the market value of the green leafy vegetables will be reduced.

Chickpea leaves also used as green leafy vegetable in India. Fifty one types of leafy vegetables were eaten by the tribal and local people of Chhattisgarh (Chauhan *et al.*, 2014). Leafy vegetables play a major role in the nutritional requirement of the tribal and local population in remote parts of the Chhattisgarh (Chandravanshi *et al.*, 2018). Leafy vegetables were quick growing crops that were harvested 4-6 weeks after sowing. Dieticians recommend daily consumption of at least 116 g of leafy vegetables in a balanced diet (Dhaliwal, 2017). In India Leafy vegetables were cultivated in an area of 9205 thousand hectare with an annual production of 162187 thousand MT (Indian Horticulture Database, 2014-15). Leafy vegetables were cultivated in an area of 7688 hectare with an average production of 72902 MT (CG State Horticulture Department, 2014). Year wise area and production of leafy crop vegetable of Chhattisgarh is given in Table 1.

Table 1: Year wise (2013-14 to 2017-18) area and production of leafy vegetables in Chhattisgarh.

Year	Area (Mha)	Production (Mt)
2013-14	257	1148
2014-15	270	2571
2015-16	283	2699
2016-17	297	2834
2017-18	318	3033

Source: Directorate, Horticulture and Farm Forestry, Chhattisgarh

India produces about 65% under the top 10 chickpea producer countries (Merga *et al.*, 2019). In Chhattisgarh cultivation area, production and productivity of chickpea in 2017-18 was 3.18 lakh hectare, 3.20 lakh tonne and 1010 kg per hectare respectively. Year wise area and production of chickpea in India is given in Fig. 1. It just grown in rabi season just after harvesting of rice. At the age of 4-6 weeks after sowing of chickpea crop, plucking of branches are being done known as nipping. It is very tedious and time consuming

operation. Labor requirement is more and expensive. Generally chickpea leaf harvesting done manually by hand and some small hand tools like sickle. Mechanization status is negligible for chickpea leaf harvesting. The time is most important factor to harvest the spinach, amaranthus, fenugreek etc. as it affected on the quality and quantity/unit area of the fresh vegetables.

MATERIALS AND METHODS

The study was conducted to know the practices involved in the leafy crop harvesting in the Chhattisgarh sate of India. A purposive survey was conducted to know the practice involved in harvesting of leafy vegetables from the crops. Biometrics of crop, different problems occurred during traditional harvesting operation.

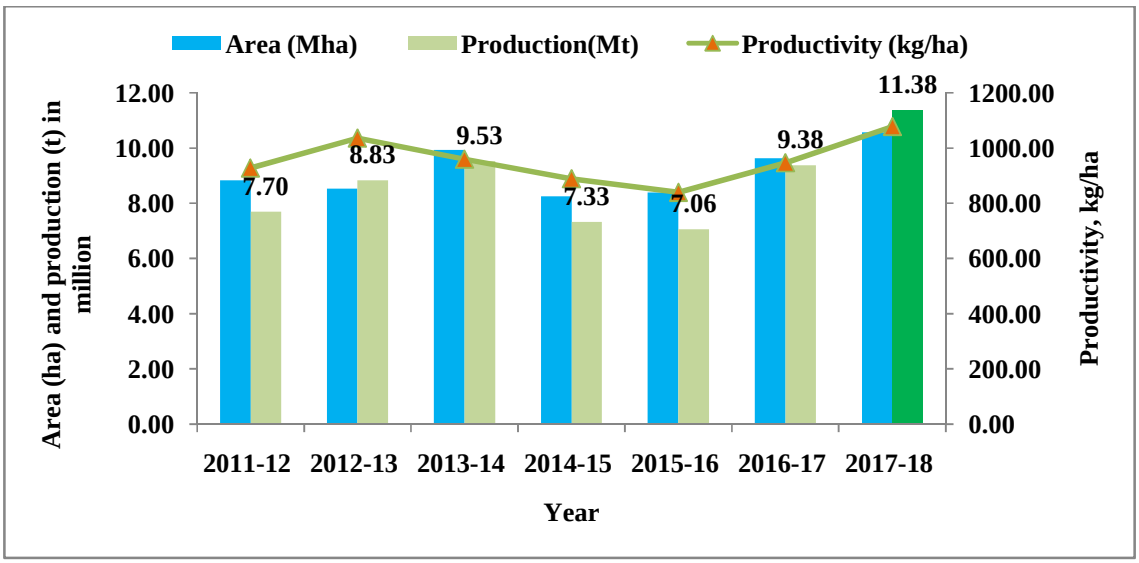

Fig. 1. Status of chickpea cultivation in India (*Source: Ministry of Agriculture & Farmers Welfare, Govt. of India. (ON 2001)).*

A. Biometric properties of leafy crop

It was essential to know the agronomical parameters of leafy crop to design a harvester. The agronomical parameters of selected crops were measured and (amaranthus, spinach, fenugreek and chickpea) are described below (Erum *et al.*, 2012, Parhe *et al.*, 2014, Guimaraes *et al.*, 2019; Tripathi, 2019; Rathod *et al.*, 2020 and Shahiba *et al.*, 2019):

(i) Plant height: Plant height was measured with the help of a steel ruler having least count of 1 mm. The randomly selected 10 plants were measured from ground to top of plant at maturity as given in Fig. 2.

(ii) Stem diameter: The stem diameter was measured with the help of a vernier caliper having least count of 0.01mm. The measurement was taken place at randomly selected 10 plants in each plot. It was done at the three points of the stem and the thickest part was noted for study as given in Fig. 3.

(iii) Numbers of branches: Number of branches was counted in whole plants. The branches were divided into primary and secondary according to its position. The branches near to the main stem are called as primary whereas, the branches appeared from the primary are termed as secondary branches. Both primary and secondary branches were counted together to determine the total number of branches in a plant.

(iv) Plant population: The plant population in unit area was measured with the help of a square frame having 1 m^2 area. The frame was placed diagonally along the line of planting to count number of plants per unit area.

(v) Spacing: It was the distance between continuous two plants. Row to row and plant to plant spacing of the different leafy crop was measured by the help of measuring scale with least count of 1 mm at the field.

(vi) Numbers of harvesting: The total number of harvesting in a season was termed as number of harvesting. Number of harvesting varied from crop to crop. Harvesting may either do by manual nipping, or plucking.

(vii) Period of harvesting: Harvesting of leafy crop was done in a specific interval period from day after sowing. It varies from crop to crop.

B. Leafy vegetable harvesting

A study was conducted to find out the adopted methods and problem associated with the harvesting of leafy crop. A purposive survey was conducted in various vegetable growers and the workers of nearby areas of Raipur and Mahasamund districts. A total number of 78 farmers field were surveyed with the help of a well-structured questionnaire. The study focused entirely on those farmers who cultivate and harvested leafy vegetable crops which are grown on flat bed and standing in nature. The answers were recorded by note taking method for further analysis and study (Paman *et al.*, 2014 and Dash *et al.*, 2021).

Fig. 2. Height measurement of chickpea.

Fig. 3. Stem diameter of red amaranthus.

C. Cost of harvesting

The cost of the operation of leafy crop harvesting was evaluated based on the working hour and labor wages (315 ₹/day). Firstly the time required to harvester per unit area was observed in the field. Then the operational time in hour and the labour wages per unit time (39.38 ₹/h) are multiplied to found cost of harvesting of leafy vegetable crops (Ghosh, 2002 and Paman *et al.*, 2014).

RESULTS

A. Biometrics properties

(i) Chickpea: Chickpea is one of the major leafy vegetable consumed in Chhattisgarh. Various types of biometric properties of chickpea are presented in Table 2. The row spacing and plant spacing between the plants were observed to be 30- 50 cm and 10-20 cm, respectively. Generally 2-3 harvesting was done for the chickpea leaves. In the purposive survey it was obtained that different crop parameter like row spacing, plant spacing, numbers of branches, plant population were measured about 29.80±0.73 cm, 11.20±0.73 cm, 15.80±1.69 and 42±1.39, respectively. Similar results observed by Qureshi *et al.*, (2004) and Parhe *et al.*, (2014).

(ii) Amaranthus: All biometric properties of red amaranthus are presented in Table 2. The row spacing between the plants was observed to be 15.38 cm. Generally 2-3 harvesting was required for the red amaranthus. Different crop parameters were row spacing, plant spacing, number of branches, plant population were measured to 15.38±0.606 cm, 5.24±0.45 cm, 11.20±1.14 and 78.20±13.56, respectively. Similar results observed by Erum *et al.*, (2012) and Sultana *et al.*, (2016).

(iii) Fenugreek: The biometric properties of fenugreek are presented in Table 2. The row spacing and plant spacing between the plants was observed to be 15 cm and 10 cm respectively. Generally 2-3 harvesting was required for the fenugreek leaves. Different crop parameters *viz.* row spacing, plant spacing, number of branches and plant population was measured to be 15.08±0.47 cm, 10.40±0.54 cm, 16.63±0.57 and 62.40±1.82, respectively. Similar results observed by Tarraf *et al.*, (2015).

Table 2: Biometric parameters of different leafy vegetable crops.

Sr. No.	Parameters	Chickpea	Amaranthus	Fenugreek	Spinach
1.	Variety	JG 74	Arka Samraksha	Rajendra Kanti	Arka Anupama
2.	Sowing method	Line sowing	Broadcasting on check basin	Line sowing	Broadcasting on bed
3.	Spacing				
	a) Row spacing, cm	29.80±0.73	15.38±0.60	15.08±0.47	10.31±0.57
	b) Plant spacing, cm	11.20±0.73	5.24±0.45	10.40±054	5.44±0.50
4.	Number of stems per plant				
	a) 10 DAS, cm	12.50±0.55	11.38±0.66	11.67±1.11	7.87±0.75
	b) 20 DAS, cm	16.96±0.88	22.33±0.70	23.22±1.72	11.07±0.54
	c) 30 DAS, cm	25.12±1.25	32.57±0.79	36.24±1.31	15.94±1.04
5.	Diameter of stem				
	a) 10 DAS, mm	2.43±0.23	2.31±0.16	2.91±0.69	2.69±0.26
	b) 20 DAS, mm	3.30±0.24	3.08±0.12	4.25±0.78	3.67±0.35
	c) 30 DAS, mm	4.18±0.29	2.47±0.51	5.51±0.83	5.35±0.62
6.	Number of branches	15.80±1.69	11.20±1.14	16.63±0.57	17.40±1.00
7.	Plant population	42±1.39	78.20±13.56	62.40±1.82	185±10.15
8.	Time of harvesting	2-3	3-5	3-5	2-3
9.	Temperature of soil, ^{o}C	37±2.48	38.60±1.33	38.80±0.73	38.40±1.82
10.	pH of soil	6.82±0.21	6.68±0.31	6.88±0.23	6.72±0.38

(iv) Spinach: Spinach crop biometric properties are presented in Table 2. The row spacing and plant spacing between the plants was observed to be 300 mm and 100 mm respectively. Generally 2-3 times harvesting was required for the spinach leaves. Different crop parameters were row spacing, plant spacing, number of branches and plant populations were measured to be 10.31±0.57 cm, 5.44±0.50 cm, 17.40±1.00 and 185±10.15, respectively. Similar results observed by Hossain *et al.*, (2005) and Farhana *et al.*, (2013).

B. Harvesting methods adopted in leafy crop harvesting

In the survey it was observed that about 62.82% farmers used manual harvesting for leafy crop harvesting in selected leafy crops where remaining 37.18% respondents used sickle for harvesting leafy crops. As given in Fig. 4 nipping of chickpea and harvesting of spinach was mostly done by manual harvesting method, which was observed 100% in Raipur for both crops. Mechanical harvesting was not reported by any farmers in the surveyed area

C. Cost of operation

Cost of operation of different harvesting methods were found to be 7875.00 ₹ ha^{-1} and 6562.50 ₹ ha^{-1} for manual harvesting and manual harvesting with sickle, respectively. Time required for harvesting one hectare area with different harvesting method also observed and presented in Table 3.

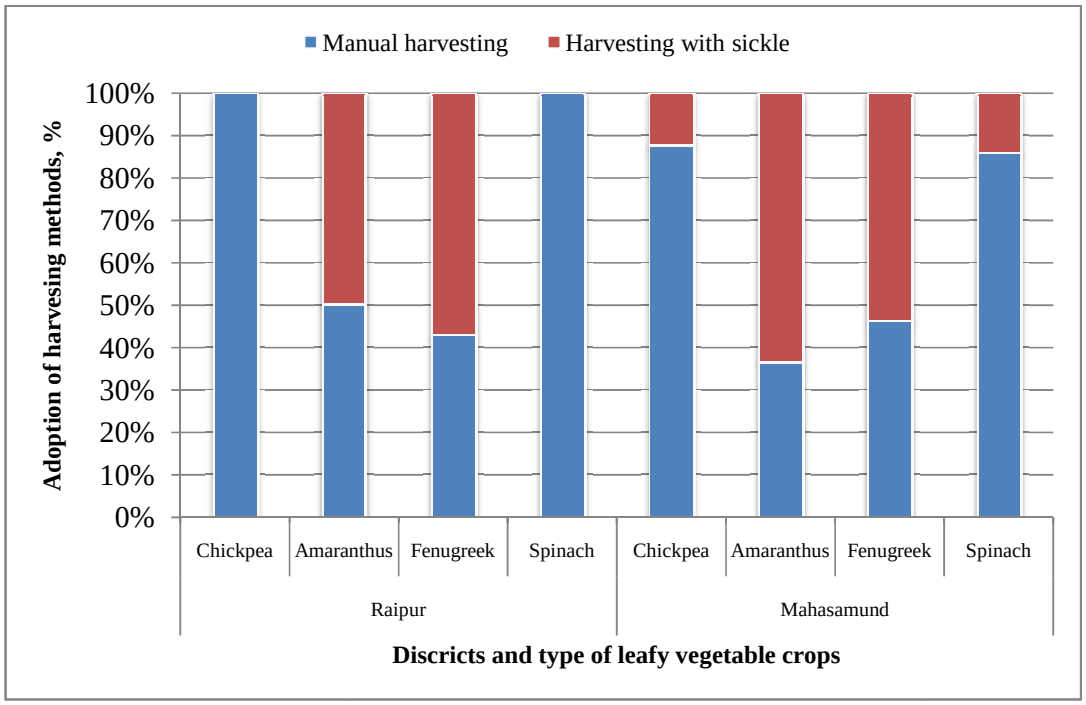

Fig. 4. Methods adopted for harvesting of leafy vegetables in Raipur and Mahasamund districts of Chhattisgarh.

Table 3: Cost of operation of different harvesting methods.

Sr. No.	Harvesting method	Time, h ha^{-1}	Cost of operation, ₹ ha^{-1}
1.	Manual harvesting (T1)	200.00	7875.00
2.	Manual harvesting with sickle (T2)	166.67	6562.50

D. Opportunity

It was observed that leafy crop harvesting mainly done by manual methods, which was found costly and time consuming. Drudgery involve in manual harvesting leafy vegetable crop also observed sever. Those all problems may be reduced with the mechanical approach of leafy vegetable crop harvesting. Many researches were found that mechanization in agriculture operation is more economical. Mechanical harvesting also able to reduce the time of operation, it may reduce the scarcity of delayed in harvesting.

CONCLUSIONS

Harvesting of leafy crop is generally done by manual harvesting. Nipping operation of chickpea in India done by manual hand plucking method, which was found uneconomical and time consuming operation. Amaranthus (*chulai*, *lalbhaji*), fenugreek and spinach were harvested by sickle and sometime whole plant uprooted from the field. Cost of operation of leafy crop harvesting in Chhattisgarh region was found to be 7875.00 and 6562.50 ₹ ha^{-1} for manual harvesting and manual harvesting with sickle, respectively. These

problems may be reduced with mechanical harvesting of leafy crops.

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