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Constraints in dry chilli cultivation practices and mechanization of harvesting in Southern India

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ABSTRACT

Dry chilli production in India condition faces many challenges apart from adverse weather conditions, labor-intensive production practices and higher overall production costs are limiting profitable dry chilli cultivation. Therefore, a study was carried to know the key constraints in current chilli production practices in eight major production districts of three states. A systematic research and development approach is essential to know the range of constraints and farmers preferences over technological options for field operations. The harvesting operation alone demands 43% of labour 360.5 man-days/ha. So, red chilli harvesting mechanization is a definite immediate requirement to reduce labour input. Farmers (47%) prefer small size self-propelled chilli harvester over tractor operated equipment. In the production catchments, farmer also inferred to change the cultivation practices to mechanize chilli production operations, but 18% of farmers hesitant to adopt one-time-harvesting chilli varieties due to suspicion about the yield potentials.

Keywords: Chilli harvester, mechanization and self-propelled machine.

INTRODUCTION

India is the world's largest producer, consumer and exporter of dry chilli. Dry chillies are widely cultivated in tropical and sub-tropical countries like India, Japan, Mexico, Turkey, United States of America and African countries (Asati and Yadav, 2004). Chilli (*Capsicum annuum L.*) is one of the important commercial crops of India, which belongs to the Solanaceae family. It is grown almost all agro-ecological sub regions of the country. The dry chillies are used in a number of culinary purposes such as vegetables, spice, condiments, sauce, pickles and chutneys (Patel *et al*., 2015). According to third advanced estimate of 2019-20, that in the country the area, production and productivity of dry chilli was reported to be 7.03 lakh ha, 17.52 lakh tones and 2.49 tones/ha, respectively. Among the states in India, Andhra Pradesh, Telangana, Karnataka, Madhya Pradesh, West Bengal and Orissa account for more than 75% of the area in cultivation and total dry chilli production (Spice Board of India, 2019-20). Red chilli cultivation plays an important role in economic conditions of farmers, especially marginal and small farmers at one side and help to meet out the nutritional requirements of the people on the others side.

India's agriculture produce market has entered into the ages of unlimited competition due to global market opening and increased competition of such as DDA agreement, FTA (Free trade agreement) expansion, a block economy. Although spice such as red chilli remained competitive in the market, but the production of this category of spice has been decreasing significantly due to many challenges, such as rapid reduction of labor force due to industrial and house hold products manufacture and ageing society, increased labour cost and particular growing condition. Considering the current agricultural system, we need to develop new mechanization technologies for chilli crops cultivation and engineering technology for production of high-quality products in order to win the international competition.

The present study aims to analyze the constraints in the conventional production system and to assess the mechanization needs in dry chilli harvesting. The mechanization urgency also arises partly due to new breeding hybrids which are in development stage to obtain synchronized fruiting for once-over harvesting operation to combat labour shortage in harvesting the produce.

MATERIALS AND METHODS

Andhra Pradesh state in India appeared as the largest regional dry chilli production site, followed by Karnataka and Telangana states. Present study was carried out during 2019 *kharif* season. The current status of dry chilli cultivation practices and constraints faced by the farmers was carried in these states covering total eight districts and a total of 100 farmers (Table 1). Farms producing chilli for self-consumption were excluded and farms that are producing for commercial purposes were included. The data collected pertaining to the production zones in the districts, where relatively large areas are in chilli cultivation. The data in Table1 represents the states, districts and the number of surveyed farmers in each district. We collected data and analyzed the information related to the cultivation practices, labour requirement for critical operations, possession of agriculture machinery, production cost and preference of prioritized new machines development. The farm categories were distinguished based on area in chilli production by each farmer i.e., into less than 0.5 ha, 0.5 ha-1 ha, and greater than 1 ha and analyzed them separately (Choi, *et al.,* 2010).

RESULTS AND DISCUSSION

Regional cultivation patterns and Overview of farms

In Guntur, Prakasham and Kurnool districts of Andhra Pradesh the Chilli is seeded or seedlings were transplanted in a row, mostly ridges and furrow pattern. Large farmers make beds and carryout planting in single and double row. Row spacing maintained for chilli cultivation are 60, 80, 90 and 100 cm and plant to plant spacing maintained are 30, 45 and 60 cm were common depending on soil type and its fertility status, irrigation facility and rainfed cultivation. Similar cultivation practices, row spacing and plant to plant spacings were followed in Karnataka and Telangana states also depending on farmers resources base. The data presented in Table 2 illustrates the summary of the various regions 'cultivation patterns for chilli Cultivation..

The data on land holding and percent cropped area of dry chilli growing farmers were recorded. Cultivation area < 0.5 ha was the most common and constituted 41.50% of chilli growers, whereas, area ranging 0.5-1 ha area contributes 31%. However, > 1.0 ha contributed 27.30% of chilli growers. The average cultivation area was about 0.86 ha/farmer.

The various machineries have been adopted by farmers for chilli production. The tractor, power tiller, mini tiller, trailers and cleaner equipments consume 49.50%, 105, 5.5%, 30% and 4%, respectively. More than 50% of the growers have basic tillage, seed bed preparation and to some extent interculture and weeding implements. However, none of the growers had postharvest machines like dryers, cleaner, grader etc. A small 4% of farmers reported that they were using winnower fans to clean the produce after drying. The operations viz., transplanting and harvesting of chilli are appeared as highly labour-intensive operations in dry chilli production.

Though semi-automatic indigenously developed seedlings transplanters are available, farmers are not adopting due to high initial cost of machine and lack of awareness. But farmers opined that, red chilli harvester is need of the hour, since farmers need to engage the labour multiple times for timely harvesting. Therefore, to create a design direction for chilli

Table 1. State and district wise distribution of the surveyed farms

Districts	Andhra Pradesh			Karnataka		Telangana		
	Guntur	Prakasham	Kurnool	Bellary	Raichur	Warangal	Khammam	Mahaboob Nagar
No. of farmers surveyed	20	10	10	15	10	15	10	10

Table 2. State and district wise cultivation patterns for Chilli

State / Districts	Districts	Cultivar	Pattern	Row to Row spacing (cm)	Plant to Plant space (cm)	Bed width (cm)
Andhra Pradesh	Guntur	Tejaswini, Bydagi and Syngenta 2043	Line sowing/planting, Ridge-furrow and planting on beds (Single and double row planting)	60 and 90	20, 30, 45 and 60 (Planting on bed only)	70 and 80
	Prakasham	Tejaswini, Aparna, Indo-5, LCA-206	Line sowing/planting, Ridge-furrow and planting on beds	60, 90 and 100		
	Kurnool	Aparna, super 10 and Tejaswini	Line sowing/planting, Ridge-furrow and planting on beds (Single and double row planting)	45, 60 and 90		
Karnataka	Bellary	Bydagi, Demon F_1 (East and West)	Line sowing/planting, Ridge-furrow and planting on beds (Single and double row planting)	45, 60 and 80	20, 30 and 45	70 and 80
	Raichur	Tejaswini, Syngenta 5531 and Bydagi	Line sowing/planting, Ridge- furrow and planting on beds	60, 80 and 90		
Telangana	Warangal	Tejaswini, Super-10 and Indo-5	Planting on beds, Ridge- Furrow method	80 and 90	30, 45 and 60	70 and 80
	Khammam	Tejaswini, Aparna and Superb-10	Line sowing/planting, Ridge-furrow method	80 and 90		
	Mahaboob Nagar	Bydagi, Tejswini, Demon F_1 (East West company)	Ridge-furrow, Line sowing/planting	80 and 90		

harvester, development of chilli harvesting machine matching to tractor or medium size power source is preferred over self-propelled imported pepper harvester, because it is easier to apply to India's chilli cultivation practices. It is deemed better developing the self-propelled chilli harvester machine as an add-on to considering the power requirement and sloppy field conditions.

HARVESTING PROCESS

The chilli production process was categorized into different unit operations and labor man days required for each operation wise accounted such as to raise seedlings, field preparation, transplanting, fertilizer and pesticide application, harvesting, and post harvesting processes etc.

Harvesting is a labor-intensive process that requires large amount of labor force, because it is a difficult for laborers to work continuously in a hot, humid confined space for a long period of time. In red chilli production practices, cultivar planted, number of runs the produce picked and yield potential of cultivar were the major cost determining factors in harvesting operation. Generally, in the surveyed production catchments of Andhra Pradesh, Karnataka and

Telangana States, Tejaswini and Byadagi predominantly grown hybrids. Normally recorded yields of Tejaswini and Byadagi hybrids were 7.41 to 9.88 tones ha^{-1} on dry chilli produce basis. The labor cost in harvesting season ranged from Rs. 250 –300/ day per person.

The data in Table 3 indicates the number of picking times, average yield per picking and harvesting labor costs as recorded by farmers. The number of picking times reported by majority of growers were three and the proportion of average produce picked 20%, 55% and 25%, respectively in first, second and third

Table 3. Picking wise chilli yield and harvesting costs

Picking 1st	2nd	3rd	Total	
Chilli yield (t/ha)	1.74	4.78	2.17	8.70
Yield in per cent	20%	55%	25%	—-
Harvesting cost (Rs./ha)	7,440	20,460	9,300	37,200

pickings. The data on cost of cultivation indicates that, the total production cost worked out was Rs. 1,39,668/ -ha^{-1} and harvesting alone single largest operation accounted 23% of input cost. The agriculture inputs namely, fertilizers and crop protection chemicals accounted Rs 41,708/-ha^{-1}. After the inputs cost, the harvesting cost was the second highest investment in dry chilli production and due to partial mechanization, the tillage and planting bed preparation come down to about Rs 13,000/-ha^{-1}

Manual labour involved and difficulties faced in hiring chilli cultivation practices

The data presented in Table 4 shows the comparison and analysis of drudgery felt and difficulties faced by the chilli crop growers in labor hiring at different stages of production operations as reported by the farmers in selected surveyed regions. The total average labour utilized was about 360.5 man-days/ha. Among various unit operations, the harvesting requires highest labour (43%), followed by crop management (29.54%)

Table 4. Drudgery proneness and labour deficiency (%) in chilli cultivation operations

Operation	Per cent labour engaged	Drudgery proneness of operation	Difficulty in labour hiring
Transplanting	7.62	22	6
Plant protection	Crop management	33	6
Fertilizing	29.54	14	6
Harvesting	43.0	94	82

and Transplanting (7.62%), respectively. Therefore, it is important to mechanize the harvesting operation and the second aspect is to change the present practice of individually raising seedling to community-based raising practice or implement plug seedling raising system to reduce the amount of labor force for dry chilli production. Harvesting operation was the most drudgery prone and difficult to get sufficient labour as opined by 94% and 82% farmers, respectively.

The data in Table 5 infers the survey result of farmers' preference for adoption of new technologies, adopting one-time-harvest variety of crop and development of chilli fruit harvesting machine. Majority of the farmers preferred mechanization with small power sources and matching machines such as power tiller (34%), rotary tiller (13%) and about 24% with tractor operated larger machines. About 78% of farmers responded positively to change cultivation practices towards more mechanized activities and 38% expressed willingness to adopt new cultivars and developed harvesting machinery. Other 44% of farmers answered to consider the issues after observing the efficiencies of the technologies in other farmers fields in two to three seasons. In contrast to Table 6, the farmers responded that, harvester (85.70%) was the most prioritized new machine for mechanization, followed by pest control devices, stakes installation and remover devices, dried chilli cleaner and seedlings transplanter. Therefore,

Table 5. Farmers preference for mechanization of red chilli cultivation

Operation and power sources preference		%
Major machines for mechanization	Power tiller	34
	Tractor	24
	Rotary tiller	13
	Other modes	29
Changes of cultivation method for mechanization	Yes	78
	No	22
Adoption of new one-time-harvest cultivar of chilli and developing machinery	Yes	38
	Consider	44
	No	18

Table 6. Priority and preference of developing new technologies (%)

Harvester	Plant protection	Staking remover	Staking installer	Cleaner	Transplanter
85.70	21.20	12.10	9.10	6	3

mechanized harvesting is the most prioritized developmental activity to reduce the amount of labor effort and production cost.

CONCLUSIONS

Dry chilli is one of the widely grown spice crops in the country. So, an investigation and analysis were carried out to know the labour requirement and farmers preferential pattern in mechanization of various operations for competitive production and reduce cost of cultivation. The investigation covered contiguous production catchments in eight districts in southern India. The cultivation area per farmer under chilli production was 0.83 ha in the catchments and most of the growers satisfied with the existing implements and machines in tillage, weeding and intercultural operations. Total labour required to meet all the field operations in chilli cultivation was 360.50 man-days/ha and 43% demanded by harvesting operation alone. In the surveyed districts 47% farmers preferred promotion of small farm mechanization and development of low horse power sources matching machines. Therefore, design of chilli harvester and development of self-propelled harvester were prioritized activities in production operations mechanization. About 85.70% of farmers responded positively to change the present manual picking to mechanized harvesting practices and 44% expressed willingness to adopt new one-time-harvest variety of chilli cultivars.

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