Original Research Article
Adopter categorization and level of adoption among protected cut flower growers

ABSTRACT

In India, Tamil Nadu occupies first position in terms of area under flower cultivation then followed by Karnataka and West Bengal. Out of the 33 districts in Tamil Nadu, Krishnagiri district ranks first in cut flower production due to its suitability to climatic conditions. The cut flowers are by and large cultivated under protected conditions (poly greenhouse structure) to meet the quality standards as expected in the global trade arena. The present study was conducted to identify the adopter categories and their level of adoption with respect to protected cut flower cultivation technologies. An ex-post facto research design was used for the study. The first two intensive blocks (Thally & Hosur) cultivating cut flower under protected method were purposefully selected for the present study. The results of the adopter categorization showed that 40.83 per cent of respondents belonged to early majority and only 5.00 per cent were innovators. The results regarding overall adoption of protected cultivation by each adopter categories reported that 54.17 per cent of respondents had medium level adoption, in that 44.61 per cent and 30.77 per cent were early majority and late majority respectively.

Keywords: Adopter categories, Adoption level, Cut flowers, Protected cultivation technology

1. INTRODUCTION

India is blessed with a variety of agro-climatic and ecological conditions that are conducive for cultivating every form of commercially important flowers typically seen in various regions of the world. Total area under flower cultivation in India is 267 thousand hectares. The average production of cut flowers is 791 thousand metric tonnes and loose flowers is 2095 thousand metric tonnes during 2021-22. India holds second position in production of flowers next to China. But India's flower export is not as expected, it is comparatively less. India ranks 14th position in exporting floriculture products by contributing 0.60 per cent of the world's floriculture exports, which may be the result of shortcomings in upholding international quality standards, a lack of integrated cold chain management, and an unorganised market and distribution system. We can meet the international quality criteria for exporting flower products by implementing protected cultivation practises in the production of cut flowers. Because the cut flowers cultivated under protected structure will results in enhanced yield and provide global quality standard products. According to the National Horticultural Database for 2014-15, In India, Tamil Nadu is top in flower cultivation area, next followed by Karnataka and West Bengal. Floricultural products account for 3.2 per cent of total horticultural crop exports.

In Tamil Nadu, Krishnagiri district holds the first place in protected cultivation (poly greenhouse structure). Though Krishnagiri district occupies first position in the state, only 1,300-acre land area is under protected cultivation. According to

the district statistics, the total land area under horticultural crops is to the tune of 95,034 hectares in this, the area under cut flower cultivation is 8247 hectares. Out of which, the area under protected cultivation is only 1,060 acres (almost 13 %). In such situation, the scope for enhancing area under protected cultivation is very high in near future. Government takes many initiatives to improve the adoption of protected cultivation practices among cut flower growers. In spite of all the initiative the adoption of protected cultivation practices among farmers is not satisfactory. For improving adoption level of protected cultivation technologies this study aims to categorize the adopters based on the rate of adoption of protected cultivation technologies, analyse the adoption level of technologies by each category of adopters.

2. MATERIAL AND METHODS

Krishnagiri district was purposively selected for the study. Secondary data on list of cut flower growers under protected cultivation was collected from Department of Horticulture, Hosur and Thally blocks of the district. From both blocks 12 villages were selected purposively. In those 12 villages, 120 respondents (cut flower growers with protected structure) were selected using simple random sampling technique. In that 120 respondents 42 were rose growers, 33 were carnation growers, 22 were chrysanthemum growers, 23 were gerbera growers. A well-structured interview schedule was framed keeping in view the objectives of the study was used for collecting primary data. Mean and Standard deviation were used for categorizing the protected cut flower growers into different adopter categories and cumulative frequency method was used for depicting innovative S- curve. Principal component analysis was used to find the composite technology adoption index (CTAI) Prakash *et.al.,* (2021) for measure the level of adoption of the protected cultivation technologies.

$$CTAI_i = \sum_{j=1}^{30} w_{ij} x_{ij}$$

Where, $CIAT_i$ is the composite technology adoption index of i^{th} farmer,

x_{ij} = adoption of recommended protected cultivation technology by i^{th} farmer,

If the farmer had adopted a suggested technology, the score would be 1; if none were adopted, the score would be 0.

w_{ij} = weight assigned to i^{th} technology through principal component analysis (PCA).

$$\mathbf{w_{ij} = m_i / \Sigma m_i}$$

m_i is the squared maximum eigenvalue of i^{th} technology,

Σm_i is the sum of squared maximum eigenvalue of all the technologies.

The squared value of the highest eigenvalue found in any of the principal components for a particular technology was calculated. The variance explained by each principal component, from which the largest eigenvalue for a given technology was derived and used to calculate the weighted eigenvalues. These weighted eigenvalues were standardised to have a total of one. The weight for a particular technology was determined by its standard eigenvalue.

3. RESULTS AND DISCUSSION

3.1. Adopter categorization based on rate of adoption

Rate of adoption is the relative speed of adopting the innovation by members of a social system. It is generally measured as the number of individuals who adopted new idea in a specified period, such as each year. In this study it was determined on the basis of the time taken by the cut flower growers in adopting the protected cultivation technologies after they got aware about it. The time was measured in years. The data on year of adopting the protected cultivation technology by cut flower growers since its introduction by government in 2009 was collected. The data was analysed using mean and standard deviation.

Table 1. Adopter categorization of respondents based on year of adoption of protected cultivation technology in cut flower production **n=120**

S. No.	Adopter categories	Year	Frequency	Percentage

1.	Innovators	≤ 2009	06	5.00
2.	Early adopters	2010-2012	16	13.33
3.	Early majority	2013-2016	49	40.83
4.	Late majority	2017-2019	28	23.33
5.	Laggards	2019-2023	21	17.50
Mean: 2016 & Standard deviation: 7.27				

From the results of the Table 1 , it could be found that majority (40.83 %) of respondents belonged to early majority category followed by late majority (23.33 %), laggards (17.50%), early adopters (13.33%) and only (5.00%) of innovators. Results showed that percentage of adopter categories deviate from the of Roger's adopter categories model in ideal condition. The results are in conformity with the findings obtained by Mahajan, Bagal *et al.* (2020).

Possible reasons for deviation from normal adopter curve profound by Rogers

- The diffusion pathways and adoption pattern of protected cultivation technology may vary from other technologies. So, the adopter categories of protected cultivation deviate from the Rogers adopter categories.
- The adoption of protected cultivation technologies may be affected by regional or community-specific cultural and environmental factors. These elements could influence adopters' attitudes, values, and behaviour. It also one of the possible reasons for deviation from ideal adopter categories.

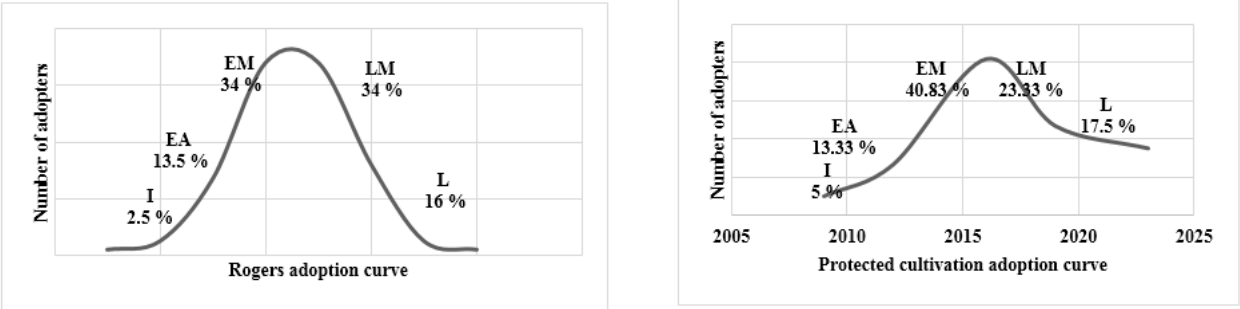

Fig.1. Normal Rogers curve vs Adopter curve (Study)

From Figure 1, it can be observed that there was an increase in innovators, deviating from the normal curve. This increase can be attributed to the training provided by the Centre of Excellence for Cut Flowers, Thally and the increased participation in social media, which have been the main driving forces behind the adoption of protected cultivation technology among innovators.

Similarly, the early majority category also experienced growth beyond the typical distribution of Rogers' normal curve. This can be attributed to the various governmental incentives offered, such as financial aid, technical training, and tax breaks, which have enticed people to adopt protected cultivation technology promptly. These incentives seem to have contributed to an increase in the number of early adopters compared to the ideal adopter category.

However, adoption by some farmers took more time due to the complexity of the technology and the high initial investment required. This delay in adoption might be the reason for the increase in the laggard category, which lies at the tail end of the adopter curve.

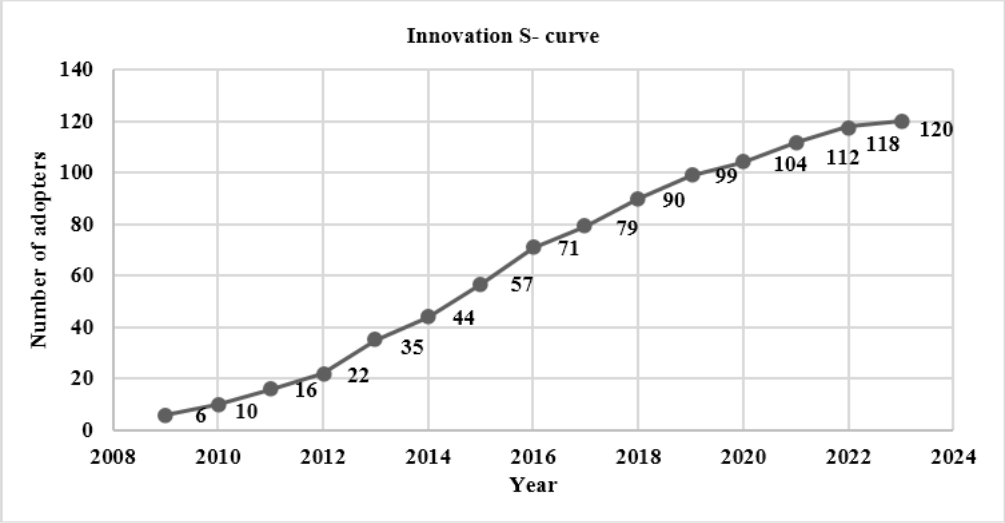

Fig.2. Distribution of respondents based on rate of adoption

3.2. Level of Adoption

Table 2. Distribution of respondents based on the adoption level of recommended technologies under protected cultivation

(n=120)

S. No.	Protected cultivation technologies	Number	Frequency of Adopters (%)
1.	Shape (Saw tooth type greenhouse)	120	100.00
2.	Covering material (Plastic film greenhouse)	120	100.00
3.	Green house construction related aspects		
	Location	99	82.50
	Topography of land	119	99.17
	Accessibility of the site for market	76	63.33
	Orientation	67	55.83
4.	Light control		
	Florescent light	94	78.33
	Screening material	79	65.33
5.	Pest and pathogen control		
	IPM	73	60.83
	Yellow Sticky trap	79	65.83
	Dusting	37	30.83

	chemical spraying	92	76.67
6.	Sterilisation material (or) fumigators		
	Formalin	77	64.17
	Hydrogen peroxide (H2O2) with silver	53	44.17
7.	Green house cooling		
	Fog evaporative cooling	68	56.67
	Exhaust fan in end wall	65	54.17
	Thermostat	52	43.33
	Maintaining air space between two covering material	110	91.67
8.	Enrichment of CO_2	71	59.17
9.	Humidity(hygrometer)	59	49.17
10.	Root media preparation	71	59.17
11.	Drip irrigation	120	100.00
12.	Mist and sprinkler irrigation	95	79.17
13.	Soil testing	98	81.67
14.	Thermometer	43	35.83
15.	Fertigation system	120	100.00
16.	Plastic polyethylene mulching	46	38.33
17.	Post-harvest management technique		
	Maturity indices & harvesting	112	93.33
	Grading& packing	69	57.50
	Pre-cooling unit	68	56.67

It could be observed from the table 2, that all the respondents (100 %) had adopted the saw tooth type green house and plastic film covering material. Cent per cent of the respondents (100 %) adopted drip irrigation and fertigation system, it is similar with the results of Prakash, Kumar *et.al.,* (2021). The possible reason may be due to the perceived advantages of efficient nutrient management through fertigation (Irrigation coupled with water soluble fertilizer) and regular contact with the extension officials of the state department of horticulture beside periodic follow-up by service providers and site inspection by the university scientist. Regarding greenhouse construction related aspects 99.17 per cent of respondents had adopted proper topography of land for constructing green house and 82.5 per cent of respondents completely adopted location aspect. The adoption rate of the correct orientation (north-south direction) was only 55.83 per cent among the respondents. This lower adoption rate could possibly be attributed to the presence of different land shapes, which may have posed challenges or limitations for some farmers to implement the recommended orientation. In case of control of light, 78.33 per cent of respondents had adopted florescent light and 65.33 per cent of them had adopted screening material. In case of pest and pathogen control, chemical spraying, yellow sticky trap, integrated pest management, dusting techniques 76.67 per cent, 65.83 per cent 60.83 per cent, and 30.83 per cent had

adopted respectively. Regarding sterilization material (or) fumigators use, formalin 64.17 per cent and hydrogen peroxide ($H_2 O_2$) with silver 44.17 per cent of respondents had adopted. Regarding greenhouse cooling aspect, maintaining air space between two covering material, fog evaporative cooling, exhaust fan in end wall, thermostat, 91.67 per cent, 56.61per cent, 54.17 per cent, 43.33 per cent of respondents had adopted respectively. 59.17 per cent of respondents had adopted enrichment of CO_2. For checking humidity 49.17 per cent of respondents had adopted hygrometer. 59.17 per cent of respondents had followed root media preparation properly. 79.17 per cent of respondents had adopted mist and sprinkler irrigation system. Other aspects like soil testing (pH &EC) 81.67 per cent of respondents had adopted. Only 35.83 per cent and 38.33 per cent of respondents had adopted thermometer and plastic polyethylene mulching respectively. In post-harvest management techniques, maturity indices and harvesting were properly adopted by 93.33 per cent of respondents. The possible reason for attaining a 93.33% adoption rate is probably because farmers need to harvest at the correct stage for exportation purposes. 57.5 per cent of respondents had adopted grading and packing practices. 56.67 per cent of respondents had adopted pre-cooling unit for increasing the shelf life of flower.

Adoption level of special horticultural practices for cut flower cultivation

Table 3a. Adoption level of special cultivation practices in rose n=42

S. No.	Special cultivation practices	Number	Per cent
1	Pruning (march-October)	42	100.00
2	Disbudding	23	54.76
3	De-suckering	40	95.23
4	Bending	03	07.14
5	Defoliation	24	57.14
6	Bud Capping	42	100.00
7	Soil loosening	25	59.52

From the Table 3a, it is evident that all the farmers (100%) adopted pruning and bud capping as these are well-known practices in rose cultivation. Consequently, these practices were adopted by all the growers. However, only 7.14 per cent of the farmers adopted the practice of bending. This low adoption rate can be attributed to the lack of awareness among most farmers regarding the benefits of bending and their limited knowledge of this practice.

Table 3b. Adoption level of special cultivation practices in Carnation n=33

S. No.	Special cultivation practices	Number	Per cent
1	Training (Netting)	33	100.00
2	Calyx banding	09	27.27
3	Pinching		
	Double pinching	04	12.12
	Single pinching	26	78.78
	Pinch and half	03	09.09
4	disbudding	17	51.51
5	De shooting	22	66.67

6	Tinting	01	03.03

The Table 3b, represents that the high adoption rate of netting among all carnation farmers (100%) can be attributed to its crucial role in carnation cultivation, providing essential protection to the plants. Additionally, the majority of growers (78.78%) adopting single pinching indicates the widespread recognition of its effectiveness in stimulating increased flower production, while the relatively low adoption rate of calyx banding (27.27%) and tinting (3.03%) may be due to limited awareness or knowledge of these practices among carnation growers.

Table 3c. Adoption level of special cultivation practices in Chrysanthemum n=22

S. No.	Special cultivation practices	Number	Per cent
1	Staking	22	100.00
2	Pinching		
	Soft pinching	18	81.81
	Hard pinching	04	18.18
3	Disbudding	09	40.90
4	Lighting	22	100.00
5	Darkening sheet	22	100.00

It can be observed from the Table 3c, that all the farmers adopted stalking, lighting, and darkening sheets, as these are the standard practices for chrysanthemum cultivation. Therefore, all the farmers adopted these practices. The majority (81.81%) adopted soft pinching only, as it is easier than hard pinching and helps promote bushier growth.

3.3. Overall adoption level of protected cultivation technologies by each category of adopters

Weights for each protected cultivation technology adopted by cut flower growers were calculated through principal component analysis. Cut flower growers adopted several technologies under protected cultivation, from that enrichment of CO_2 (0.0539) and integrated pest management practices (0.0524) recorded the maximum weights and maintaining air space between two covering material (0.0162) the least. Calculated composite technology adoption index (CTAI) for all cut flower growers using the weights obtained by PCA**.** The technology adoption index (TAI) ranges between 0.09 to 0.99. Then the adoption level of each category of farmer calculated using mean and standard deviation.

Table 4. Distribution of adopter categories according to their composite technology adoption index (CTAI) n=120

S. No.	Adoption level- CTAI	I	EA	EM	LM	L	Total
1.	Low (< 0.29)	0 (0.00)	0 (0.00)	10 (37.03)	6 (22.22)	11 (40.74)	27 (22.5)
2.	Medium (0.29-0.93)	2 (3.07)	6 (9.23)	29 (44.61)	20 (30.77)	8 (12.30)	65 (54.17)
3.	High (> 0.93)	4 (14.2)	10 (35.71)	10 (35.71)	2 (7.14)	2 (7.14)	28 (23.33)
Mean : 0.61 & SD : 0.32							

(I-Innovators, EA- Early Adopters, EM- Early Majority, LM- Late Majority, L- Laggards)

(Figures in parenthesis represents percentage)

It is evident from the Table 4 that in general, vast proportion of the cut flower growers had (CTAI 0.29- 0.93) medium level of adoption. Ruli, Goudappa *et.al.,* (2022), Singh, Rakesh *et.al.,* (2016) have also reported similar results. All the innovator and early adopter categories possessed medium to high level of adoption. 35.71 per cent of early adopters and early majority had high level of adoption, followed by, innovators (14.28 %). And 7.14 per cent of late majority and laggards also had high level of adoption. There was an increased tendency of adoption among laggard category but the delay in adopting was caused by the inadequacy of financial resources.44.61 per cent of early majority were possessed medium level of adoption. 30.77 per cent of late majority had medium level of adoption, followed by laggards (12.30%), early adopters (9.23%), innovators (3.07%). Majority (40.74%) of laggards had low level of adoption, followed by early majority (37.03%), late majority (22.22%). The results are similar with the findings obtained by Prema (1994).

4. CONCLUSION

The study revealed that the majority of cut flower growers belonged to the early majority category in the adoption of protected cultivation technologies. This is primarily due to various governmental incentives offered, such as financial aid, technical training, and tax breaks, which have enticed people to promptly adopt protected cultivation technology. Both central and state governments provide schemes to implement protected cultivation practices among cut flower growers. Despite that, the majority of cut flower growers had only a medium level of adoption. To increase the level of adoption, it is suggested that institutional support should be increased. Most farmers adopted protected cultivation through the NHM scheme, which provides subsidies solely for constructing the protected cultivation structure. However, certain cultivation practices like light control, greenhouse cooling, and pest management are also very cost-intensive. Therefore, farmers suggest that equipment used for these cost-intensive practices should be provided at a subsidized cost.

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