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A study on adoption of integrated insect management practices among small and big farmers cultivating grapes

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Abstract

The present study was carried out in Chikkaballapura district of Karnataka state to know the extent of adoption of integrated insect management practices followed by small and big farmers cultivating grapes. One hundred grape growers (60 small farmers and 60 big farmers) from 12 villages in two taluks of Chikkaballapur district were selected as sample for the research study. Ex-post facto research design was employed in the present research study. The results revealed that a large number of small farmers (36.66%) and big farmers (35.00%) were belonging to low and high level of adoption of integrated insect management practices. Further, the results revealed that there was no significant difference in mean adoption score of integrated insect management practices in grape cultivation between small farmers and big farmers.

Keywords: Adoption, integrated insect management practices, small farmers, big farmers

1. Introduction

India is a home to variety of horticultural crops which covers a wide range of fruits, vegetables, tuber crops, flowers, mushrooms, spices, medicinal and aromatic plants. India produces about 70 varieties of vegetables and an equally diverse variety of fruits, consisting 70 percent of tropical and sub-tropical type and 30 percent of temperate type. The importance of horticultural sector in Indian economy can be visualized from the fact that it accounts for 30 percent of India's agricultural Gross Domestic Product from only 8.5 percent of the cropped area. The major vegetable and fruits crops exported from India are mango, grapes, orange, apple, banana, sweet lime, onion, potato, tomato and pumpkin. The major share of India's exports of fresh fruits goes to Bangladesh, Nepal, United Arab Emirates, United Kingdom and Malaysia. (Angon *et al.*, 2023; Anonymous, 2024b) ^[2, 4]. Grape (*Vitis vinifera* L.) cultivation is one of the remunerative farming enterprises in India. It is widely consumed as fresh fruit in India and it is also used for producing raisins, wine, juice, juice concentrates, squash, beverages, jams and marmalades. Grapes are a good source of minerals like calcium, phosphorous and iron, besides rich in vitamins like B1 and B2. Its juice has wild laxative and acts as a stimulant to kidneys. The peel of grapes is the source

of essential oil and pectin and it can also serve as a raw material for the production of cattle feed and in preparation of candies. Raisins are rich source of sugar and antioxidants. Presently in India, about 78.00 percent of grape is used for table purpose, 17.20 percent is dried for raisin production, while 1.50 percent is used for juice and 0.50 percent is used for manufacturing of wine (Ashwini, *et al.*, 2018; Anand, *et al.*, 2024) ^[5, 1].

Integrated insect management is a dynamic process that makes use of an ecological systems approach and encourages the user or producer to consider and use the full range of best pest control options available given economic, environment and social considerations. Integrated insect management is based on ecology, the concept of ecosystems and the goal of sustaining ecosystem functions. It promotes the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms. It is the careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations. It combines biological, chemical, physical and crop specific (cultural) management strategies and practices to grow healthy crops and minimize the use of pesticides, reducing or minimizing risks posed by pesticides to human

health and the environment for sustainable pest management (Ashoori *et al.*, 2016; Samdariya *et al.*, 2023; Chetankumar *et al.*, 2026) [6, 12]. In this backdrop, the present study was undertaken with the following specific objectives:

1. To analyse the extent of adoption of integrated insect management practices followed by small and big farmers in grape cultivation
2. To find out the significant difference exist between the small and big farmers in respect of extent of adoption of integrated insect management practices in grape cultivation

2. Methodology

The study was carried out in Chikkaballapura and Sidlaghatta taluks of Chikkaballapura district in Karnataka state during 2023-2024. Grape was cultivated in an area of 2449.69 ha. in Chikkaballapura district during the year 2023. Out of the six taluks, Chikkaballapura (1849.80 ha.) and Sidlaghatta (453.16 ha.) taluks were purposively selected for the study since these taluks have recorded first and second positions in terms of larger areas under grape cultivation in the district during the year 2023 (Anonymous, 2024a; Dechamma *et al.*, 2022) [3, 8]. Six villages in Chikkaballapura taluk and six villages in Sidlaghatta taluk were randomly selected for the study. From each of the sampled village, five small farmers and another five big farmers growing grapes were again randomly selected for the study. Thus, the total sample

constituted 120 grape growers (60 small farmers and 60 big farmers) from 12 villages in two taluks of Chikkaballapur district. Ex-post facto research design was used in the present research study.

Adoption is a decision to continue full use of an innovation. In this study, adoption level refers to the recommended integrated insect management (IIM) practices followed in grapes by the respondents. The questions pertaining to adoption level were carefully designed in consultation with horticultural scientists who were specialized in grape cultivation. The following scores were assigned for full, partial and non-adoption of the recommended practices.

Response	Score
Full adoption	2
Partial adoption	1
Non adoption	0

The score of all the individual items were summed up to get the adoption score of the respondents. The summation of scores for a particular respondent indicates his adoption level. The maximum score a respondent could obtain is 55 and minimum score possible is 0. After computing the adoption score the respondents were grouped into low, medium and high categories by taking mean and half standard deviation as a measure of check.

Adoption category	Criteria	Grape growers (score)		
		Small farmers	Big farmers	Pooled sample
Low	< (Mean – ½ SD)	< 25.96	< 27.46	< 26.71
Medium	(Mean ± ½ SD)	25.96-30.16	27.46-31.90	26.71-31.03
High	> (Mean + ½ SD)	> 30.16	> 31.90	> 31.03
Mean		28.06	29.68	28.87
Standard deviation		4.21	4.45	4.33

The collected data was scored and analysed using frequency, percentage, mean, standard deviation and student 't' test.

3. Results and Discussion

3.1 Adoption of integrated insect management practices by grape growers

The findings with respect to adoption of integrated insect management practices by grape growers are presented in Table 1.

3.1.1. Thrips management

The data in Table 1 reveals that, with respect to cultural control, cent percent of the small farmers (100.00%) had managed thrips by destroying plant debris from the previous crop, while 85.00 percent of them had performed timely pruning to control thrips in grape cultivation and ten percent of the small farmers had exposed or raked soil in the vineyards for controlling thrips. With regard to biological control, spraying *Verticillium lecanii* or *Beauveria bassiana* @ 5 ml/L for controlling thrips was partially adopted by 8.33 percent of the small farmers, while a vast majority (91.67%) of them had not followed spraying of *Verticillium lecanii* or *Beauveria bassiana* @ 5 ml/L for controlling thrips. A majority of small farmers (51.67%) had completely followed spraying of NSKE 5% @ 0.5 ml/L or commercial neem formulations @ 2.5 ml/L to control thrips, while 38.33

percent of them had adopted partially adopted spraying of NSKE 5% @ 0.5 ml/L or commercial neem formulations @ 2.5 ml/L to control thrips. However, ten percent of small farmers had not followed spraying NSKE 5% @ 0.5 ml/L or commercial neem formulations @ 2.5 ml/L to control thrips. None of the small farmers had released the Australian ladybird beetle (*Cryptolaemus montrouzieri*) for controlling thrips. With respect to the mechanical control, only 6.67 percent of small farmers had installed light traps during the night for controlling thrips, while none of them had installed blue/yellow sticky cards for controlling thrips. With respect to chemical control, majority of the small farmers (63.33%) had completely adopted the spraying of recommended insecticides for controlling thrips, while 36.67 percent of them had partially adopted the spraying of recommended insecticides for controlling thrips in the vineyard.

Among big farmers, cent percent of them (100.00%) had managed thrips by destroying plant debris from the previous crop, while nearly three-fourth (73.33%) of the big farmers had performed timely pruning for controlling thrips and the remaining 16.67 percent of the big farmers had exposed or raked soil in vineyards for control of thrips. With regard to biological control, spraying *Verticillium lecanii* or *Beauveria bassiana* to control thrips was partially adopted by 18.33 percent of the big farmers, while a vast majority of them (81.67%) had not adopted spraying of *Verticillium lecanii* or

Beauveria bassiana for controlling thrips. None of the big farmers had released *Cryptolaemus montrouzieri* for thrips management. A majority of the big farmers (68.33%) had followed spraying of NSKE 5% or commercial neem formulations to control thrips, while 21.67 percent had partially adopted spraying of NSKE 5% or commercial neem formulations to control thrips and the remaining ten percent of the big farmers had not followed spraying of NSKE 5% or commercial neem formulations to control thrips. All the big farmers (100.00%) had not released Australian lady beetle @ 1500/acre to the vine yard. With respect to the mechanical control, 8.33 percent of the big farmers had installed light traps during the night to control thrips, while none of them had installed blue/yellow sticky cards for controlling thrips. With respect to chemical control, a majority of the big farmers (65.00%) had completely adopted the spraying of recommended insecticide to control thrips, while the other 35.00 percent of them had partially adopted the spraying of recommended insecticide to control thrips in the vineyard.

Cent percent of the grape growers (100.00%) in the pooled sample had destroyed plant debris from the previous crop for controlling thrips, while nearly four-fifth (79.17%) of them had performed timely pruning to manage the thrips. Only 13.33 percent of grape growers in pooled sample had exposed or raked soil in vineyards to control thrips. With regard to biological control, spraying of *Verticillium lecanii* or *Beauveria bassiana* to control thrips was partially adopted by five percent of the grape growers, while a great majority of them (95.00%) had not adopted spraying of *Verticillium lecanii* or *Beauveria bassiana* to control thrips. Sixty percent (60.00%) of the grape growers in the pooled sample had completely adopted spraying of NSKE 5% or commercial neem formulations for controlling thrips, while 30.00 percent had partially adopted spraying of NSKE 5% or commercial neem formulations for controlling thrips. However, ten percent of the grape growers had not followed spraying of NSKE 5% or commercial neem formulations for controlling thrips. None of the grape growers had released *Cryptolaemus montrouzieri* for thrips management. With respect to the mechanical control, 7.50 percent of the grape growers in the pooled sample had installed light traps during the night to control thrips and none of them had installed blue/yellow sticky cards to control thrips. A little less than two-third (64.17%) of the grape growers in the pooled sample had completely adopted chemical control measures to manage thrips, while 35.83 percent of them had partially adopted the chemical control measures to manage thrips in the vineyard.

3.1.2. Mealy bug management

In respect of cultural control, over three-fourth (78.33%) of the small farmers had managed mealy bugs by removing the mealy bug-infested bunches, while a majority (61.67%) of them had removed loose bark for controlling mealy bugs in grape cultivation and one-third (33.33%) of the small farmers had destroyed ant colonies in and around the vineyard for controlling mealy bugs. With regard to biological control, none of the small farmers had released the Australian ladybird beetle (*Cryptolaemus montrouzieri*) for controlling mealy bugs. Spraying *Verticillium lecanii* or *Beauveria bassiana* @ 5 ml/L for controlling mealy bugs was partially adopted by 8.33 percent of the small farmers, while 91.67 percent of them had not followed spraying *Verticillium*

lecanii or *Beauveria bassiana* @ 5 ml/L for controlling mealy bugs. More than half (51.67%) of the small farmers had completely adopted spraying neem oil 1% @ 2 ml/L to control mealy bugs, while 38.33 percent of them had partially adopted spraying neem oil 1% @ 2 ml/L to control mealy bugs and the remaining ten percent of the small farmers had not followed spraying neem oil 1% @ 2 ml/L for controlling mealy bugs. With respect to mechanical control, 6.67 percent of the small farmers had installed light traps at night for controlling mealy bugs, while half (50.00%) of them had performed jet spraying of water on the bunches to control mealy bugs. With respect to chemical control, nearly two-third (65.00%) of the small farmers had completely adopted spraying of recommended insecticide for controlling mealy bugs, while the remaining 35.00 percent of them had partially adopted the spraying of recommended insecticides for controlling mealy bugs in the vineyard.

Among big farmers, a majority of them (85.00%) had managed mealy bugs by removing the mealy bug-infested bunches, while three-fourth (75.00%) of them had removed loose bark for controlling mealy bugs. Forty percent of the big farmers had destroyed ant colonies in and around the vineyard for controlling mealy bugs. With regard to biological control, none of the big farmers had released the Australian ladybird beetle (*Cryptolaemus montrouzieri*) for controlling mealy bugs. Spraying *Verticillium lecanii* or *Beauveria bassiana* @ 5 ml/L for controlling mealy bugs was partially adopted by 18.33 percent of the big farmers, while a great majority (81.67%) of them had not followed spraying *Verticillium lecanii* or *Beauveria bassiana* @ 5 ml/L for controlling mealy bugs. More than two-third (68.33%) of the big farmers had completely adopted spraying neem oil 1% @ 2 ml/L for controlling mealy bugs, while 21.67 percent of them had partially adopted spraying neem oil 1% @ 2 ml/L for controlling mealy bugs and the remaining ten percent of the big farmers had not followed spraying neem oil 1% @ 2 ml/L for controlling mealy bugs. With respect to mechanical control, 8.33 percent of the big farmers had installed light traps at night for controlling mealy bugs, while over one-third (68.33%) of them had performed jet spraying of water on the bunches for controlling mealy bugs. With respect to chemical control, a majority (70.00%) of the big farmers had completely adopted the spraying of recommended insecticides for controlling mealy bugs, while the other 30.00 percent of them had partially adopted the spraying of recommended insecticides for controlling mealy bugs in the vineyard.

A vast majority (81.67%) of the grape growers in the pooled sample had managed mealy bugs by removing the mealy bug-infested bunches, while over one-third (68.33%) of them had removed loose bark for controlling mealy bugs. More than one-third (36.67%) of the grape growers had destroyed ant colonies in and around the vineyard for controlling mealy bugs. With regard to biological control, none of the grape growers in the pooled sample had released the Australian ladybird beetle (*Cryptolaemus montrouzieri*) for controlling mealy bugs. Spraying *Verticillium lecanii* or *Beauveria bassiana* @ 5 ml/L for controlling mealy bugs was partially adopted by five percent of the grape growers, while a great majority (95.00%) of them had not followed spraying *Verticillium lecanii* or *Beauveria bassiana* @ 5 ml/L for controlling mealy bugs. Sixty percent of the grape growers

had completely adopted spraying neem oil 1% @ 2 ml/L for controlling mealy bugs, while 30.00 percent of them had partially adopted spraying neem oil 1% @ 2 ml/L for controlling mealy bugs and the remaining ten percent of the grape growers had not followed spraying neem oil 1% @ 2 ml/L for controlling mealy bugs. With respect to mechanical control, 7.50 percent of the grape growers in the pooled sample had installed light traps at night for controlling mealy bugs, while a majority (59.17%) of them had performed jet spraying of water on the bunches for controlling mealy bugs. A little more than two-third (67.50%) of the grape growers in the pooled sample had completely adopted spraying of recommended insecticides for controlling mealy bugs, while the other 32.50 percent of them had partially adopted the spraying of recommended insecticides for controlling mealy bugs in the vineyard.

3.1.3 Mites management

The data in Table 1 also reveals that, with respect to cultural control, cent percent of the small farmers (100.00%) had managed mites by destroying plant debris after pruning, while a majority (71.67%) of them had followed proper irrigation scheduling to control mites in grape cultivation. With regard to biological control, spraying *Verticillium lecanii* or *Beauveria bassiana* @ 5 ml/L for controlling mites was partially adopted by 8.33 percent of the small farmers, while a vast majority (91.67%) of them had not followed spraying *Verticillium lecanii* or *Beauveria bassiana* @ 5 ml/L for controlling mites. More than half (51.67%) of the small farmers had completely adopted spraying different neem formulations 1% @ 2.0 ml/L to control mites, while 38.33 percent of them had partially adopted spraying different neem formulations 1% @ 2.0 ml/L to control mites and only ten percent of the small farmers had not followed spraying different neem formulations 1% @ 2.0 ml/L for controlling mites. With respect to mechanical control, half (50.00%) of the small farmers had performed jet spraying of water on the bunches for controlling mites. With respect to chemical control, a majority (53.33%) of the small farmers had completely adopted spraying of recommended insecticides to control mites, while the remaining 46.67 percent of them had partially adopted spraying of recommended insecticides for controlling mites in the vineyard.

Among big farmers, cent percent (100.00%) of them had managed mites by destroying plant debris after pruning, while a vast majority (86.67%) of them had followed proper irrigation scheduling for controlling mites in grape cultivation. With regard to biological control, spraying *Verticillium lecanii* or *Beauveria bassiana* @ 5 ml/L for controlling mites was partially adopted by 18.33 percent of the big farmers, while an overwhelming (81.67%) number of them had not followed spraying *Verticillium lecanii* or *Beauveria bassiana* @ 5 ml/L for controlling mites. More than two-third (68.33%) of the big farmers had completely adopted spraying different neem formulations 1% @ 2.0 ml/L to control mites, while 21.67 percent of them had partially adopted spraying different neem formulations 1% @ 2.0 ml/L to control mites and the remaining ten percent of the big farmers had not followed spraying different neem

formulations 1% @ 2.0 ml/L for controlling mites. With respect to mechanical control, a two-third of big farmers (68.33%) had performed jet spraying of water on the bunches for controlling mites. With respect to chemical control, a majority (60.00%) of the big farmers had completely adopted spraying of recommended insecticides to control mites, whereas the remaining 40.00 percent of them had partially adopted spraying of recommended insecticides for controlling mites in the vineyard.

Cent percent (100.00%) of the grape growers in the pooled sample had managed mites by destroying plant debris after pruning, while a vast majority (79.17%) of them had followed proper irrigation scheduling for controlling mites. With regard to biological control, spraying *Verticillium lecanii* or *Beauveria bassiana* @ 5 ml/L for controlling mites was partially adopted by five percent of the grape growers, a great majority (95.00%) of them had not followed spraying *Verticillium lecanii* or *Beauveria bassiana* @ 5 ml/L for controlling mites. Sixty percent of the grape growers had completely adopted spraying different neem formulations 1% @ 2.0 ml/L for controlling mites, while 30.00 percent of them had partially adopted spraying different neem formulations 1% @ 2.0 ml/L for controlling mites and only ten percent of the grape growers had not followed spraying different neem formulations 1% @ 2.0 ml/L for controlling mites. With respect to mechanical control, a majority (59.17%) of the grape growers in the pooled sample had performed jet spraying of water on the bunches for controlling mites. More than half (56.67%) of the grape growers in the pooled sample had completely adopted spraying of recommended insecticides for controlling mites, while the other 43.33 percent of them had partially adopted spraying of recommended insecticides for controlling mites in the vineyard.

3.1.4 Flea beetle management

It is also observed from Table 1 that, with respect to cultural control, 45.00 percent of the small farmers had managed flea beetles by collecting and destroying dried and fallen leaves, while a majority (61.67%) of them had removed loose bark after pruning to control flea beetles in grape cultivation and ten percent of the small farmers had raked the soil to expose the grubs and pupae to sunlight for controlling flea beetles. None of the small farmers had followed the biological control measure for controlling flea beetles. With respect to mechanical control, less than one-fourth (23.33%) of the small farmers had handpicked and destroyed the adults by shaking them into trays containing kerosinized water to control flea beetles. With respect to chemical control, a majority (51.67%) of the small farmers had completely adopted spraying of recommended insecticides for controlling flea beetles, while the remaining 48.33 percent of them had partially adopted spraying of recommended insecticides for controlling flea beetles in the vineyard.

Among big farmers, a majority (58.33%) of them had managed flea beetles by collecting and destroying dried and fallen leaves, while three-fourth (75.00%) of them had removed loose bark after pruning for controlling flea beetles.

Table 1: Adoption of integrated insect management practices by grape growers

Sl. No.	Particulars	Grape growers					
		Small farmers (n ₁ =60)		Big farmers (n ₂ =60)		Pooled sample (n=120)	
		No.	%	No.	%	No.	%
I	Thrips management						
A	Cultural control						
a.	Exposed/raked soil in vineyards	6	10.00	10	16.67	16	13.33
b.	Destroyed plant debris of previous crop	60	100.00	60	100.00	120	100.00
c.	Performed timely pruning	51	85.00	44	73.33	95	79.17
B	Biological control						
a.	Sprayed <i>Verticillium lecanii</i> or <i>Beauveria bassiana</i> @ 5 ml/L						
1.	Complete adoption	0	0	0	0	0	0
2.	Partial adoption	5	8.33	11	18.33	16	5.00
3.	Non adoption	55	91.67	49	81.67	114	95.00
b.	Sprayed NSKE 5% @ 0.5 ml/L or commercial neem formulations @ 2.5 ml/L						
1.	Complete adoption	31	51.67	41	68.33	72	60.00
2.	Partial adoption	23	38.33	13	21.67	36	30.00
3.	Non adoption	6	10.00	6	10.00	12	10.00
c.	Released the Australian ladybird beetle (<i>Cryptolaemus montrouzieri</i>) @ 1500/acre						
1.	Complete adoption	0	0	0	0	0	0
2.	Partial adoption	0	0	0	0	0	0
3.	Non adoption	60	100.00	60	100.00	120	100.00
C	Mechanical control						
a.	Installed 4-5 blue/yellow sticky cards/acre	0	0	0	0	0	0
b.	Installed light traps during the night	4	6.67	5	8.33	9	7.50
D	Chemical control						
a.	Sprayed Fipronil 5% SC @ 1.5 ml/L or Imidacloprid 7.8 SL @ 0.30 ml/L or Spinetoram 11.7 SC @ 0.9 ml/L						
1.	Complete adoption	38	63.33	39	65.00	77	64.17
2.	Partial adoption	22	36.67	21	35.00	43	35.83
3.	Non adoption	0	0	0	0	0	0
II	Mealy bug management						
A	Cultural control						
a.	Removed the mealybug- infested bunches	47	78.33	51	85.00	98	81.67
b.	Removed the loose bark	37	61.67	45	75.00	82	68.33
c.	Destroyed ant colonies in and around the vineyard	20	33.33	24	40.00	44	36.67
B	Biological control						
a.	Released the Australian ladybird beetle (<i>Cryptolaemus montrouzieri</i>) @ 1500/acre						
1.	Complete adoption	0	0	0	0	0	0
2.	Partial adoption	0	0	0	0	0	0
3.	Non adoption	60	100.00	60	100.00	120	100.00
b.	Sprayed <i>Verticillium lecanii</i> or <i>Beauveria bassiana</i> @ 5 ml/L						
1.	Complete adoption	0	0	0	0	0	0
2.	Partial adoption	5	8.33	11	18.33	16	5.00
3.	Non adoption	55	91.67	49	81.67	114	95.00
c.	Sprayed neem oil 1% @ 2 ml/L						
1.	Complete adoption	31	51.67	41	68.33	72	60.00
2.	Partial adoption	23	38.33	13	21.67	36	30.00
3.	Non adoption	6	10.00	6	10.00	12	10.00
C	Mechanical control						
a.	Installed light traps at night	4	6.67	5	8.33	9	7.50
b.	Performed jet spraying of water on the bunches	30	50.00	41	68.33	71	59.17
D	Chemical control						
a.	Sprayed Chlorpyrifos 20 EC @ 2.0 ml/L or Buprofezin 25 SC @ 1.5 ml/L or Spirotetramat @ 1 ml/L						
1.	Complete adoption	39	65.00	42	70.00	81	67.50
2.	Partial adoption	21	35.00	18	30.00	39	32.50
3.	Non adoption	0	0	0	0	0	0
III	Mites management						
A	Cultural control						
a.	Destroyed plant debris after pruning	60	100.00	60	100.00	120	100.00
b.	Followed proper irrigation scheduling	43	71.67	52	86.67	95	79.17
B	Biological control						
a.	Sprayed <i>Verticillium lecanii</i> or <i>Beauveria bassiana</i> @ 5 ml/L						
1.	Complete adoption	0	0	0	0	0	0
2.	Partial adoption	5	8.33	11	18.33	16	5.00

3.	Non adoption	55	91.67	49	81.67	114	95.00
b.	Sprayed different neem formulations 1% @ 2.0 ml/L						
1.	Complete adoption	31	51.67	41	68.33	72	60.00
2.	Partial adoption	23	38.33	13	21.67	36	30.00
3.	Non adoption	6	10.00	6	10.00	12	10.00
C	Mechanical control						
a.	Performed jet spraying of water on the bunches	30	50.00	41	68.33	71	59.17
D	Chemical control						
a.	Sprayed Fenazaquin 10 EC @ 2 ml/L or Propargite 57 EC @ 2 ml/L						
1.	Complete adoption	32	53.33	36	60.00	68	56.67
2.	Partial adoption	28	46.67	24	40.00	52	43.33
3.	Non adoption	0	0	0	0	0	0
4.	Flea beetle management						
A	Cultural control						
a.	Collected and destroyed dried and fallen leaves.	27	45.00	35	58.33	62	51.67
b.	Removed loose bark after pruning	37	61.67	45	75.00	82	68.33
c.	Raked the soil to expose the grubs and pupae to sunlight.	6	10.00	10	16.67	16	13.33
B	Biological control						
a.	Performed soil drenching of entomopathogenic nematode (EPN) <i>Heterorhadditis indicus</i> @ 1-2 lakh infective juvenile and irrigation of vines before and after the treatment						
1.	Complete adoption	0	0	0	0	0	0
2.	Partial adoption	0	0	0	0	0	0
3.	Non adoption	60	100.00	60	100.00	120	100.00
C	Mechanical control						
a.	Handpicked and destroyed the adults by shaking them into trays containing kerosinized water	14	23.33	11	18.33	25	20.83
D	Chemical control						
a.	Sprayed Chlorpyrifos 20 EC @ 2 ml/L or Quinalphos 25 EC @ 2ml/L						
1.	Complete adoption	31	51.67	38	63.33	69	57.50
2.	Partial adoption	29	48.33	22	36.67	51	42.50
3.	Non adoption	0	0	0	0	0	0

Nearly one-sixth (16.67%) of the big farmers had raked the soil to expose the grubs and pupae to sunlight for controlling flea beetles. None of the big farmers had followed the biological control measure for controlling flea beetles, while 18.33 percent of the big farmers had followed the mechanical control measures to manage the flea beetles. With respect to chemical control, a majority (63.33%) of the big farmers had completely adopted spraying of recommended insecticides for controlling flea beetles, while over one-third (36.67%) of them had partially adopted spraying of recommended insecticides for controlling flea beetles in the vineyard.

A little over half (51.67%) of the grape growers in the pooled sample had managed flea beetles by collecting and destroying dried and fallen leaves, while a majority (68.33%) of them had removed loose bark after pruning for controlling flea beetles and 13.33 percent of the grape growers in the pooled sample had raked the soil to expose the grubs and pupae to sunlight for controlling flea beetles. None of the grape growers in the pooled sample had followed the biological control measure for controlling flea beetles while 20.83 percent of the grape growers in the pooled sample had followed the mechanical control measures to manage the flea beetles. Majority (57.50%) of the grape growers in the pooled sample had completely adopted spraying of recommended insecticides for controlling flea beetles, while the remaining 42.50 percent of them had partially adopted spraying of recommended insecticides for controlling flea beetles in the vineyard.

3.2 Overall adoption of integrated insect management practices by grape growers

It is observed from Table 2 that a greater proportion of the small farmers (36.66%) had low level of overall adoption of

integrated insect management practices, whereas 33.34 and 30.00 percent of the small farmers had medium and high level of overall adoption of integrated insect management practices, respectively. With respect to big farmers, over one third (35.00%) percent of the grape growers had high level of overall adoption of integrated insect management practices, whereas 33.34 and 31.66 percent of the big farmers had low and medium level of overall adoption of integrated insect management practices, respectively. As high as 34.17 percent of the grape growers had a low level of overall adoption of integrated insect management practices, whereas 33.33 and 32.50 percent of the grape growers in the pooled sample had a medium and high level of overall adoption of integrated insect management practices. The findings of this study are in line with Kumar *et al.*, (2015) ^[10]; Grewal *et al.*, (2023) ^[9]; Samdariya *et al.*, (2023) ^[12]; Rathwa & Bochalya, (2023) ^[11]. The results in Table 2 reveals that over two-third of the small and big farmers belonged to low to medium overall adoption level of integrated insect management practices. Partial/non-adoption of biological and mechanical control measures could be the reasons for majority of small and big farmers falling under low to medium overall adoption level of integrated insect management practices.

Integrated insect management is one of the vital components of sustainable grape production, ensuring effective insect control, while minimizing environmental hazards. Important sub-components of integrated insect management include cultural, mechanical, biological, and chemical control measures. Therefore, there is a need to further promote awareness, training, and accessibility to these components among the grape growers by the extension personnel to enhance insect management efficiency and achieve sustainable grape production.

Table 2: Overall adoption of integrated insect management practices by grape growers

Sl. No.	Adoption categories	Grape growers					
		Small farmers(n ₁ =60)		Big farmers(n ₂ =60)		Pooled sample(n=120)	
		No.	%	No.	%	No.	%
1.	Low	22	36.66	19	31.66	41	34.17
2.	Medium	20	33.34	20	33.34	40	33.33
3.	High	18	30.00	21	35.00	39	32.50
Total		60	100.00	60	100.00	120	100.00

3. Test of significance of mean adoption score of integrated insect management practices between small and big farmers

The results in Table 3 reveal that the mean adoption score of big farmers (29.68) was slightly higher compared to the mean adoption score of small farmers (28.06) in respect of integrated insect management practices, however the 't' value (0.292) showed a non-significant difference in respect of mean adoption score of integrated insect management practices between small and big farmers in respect of grape cultivation.

Table 3: Test of significance of mean adoption score of integrated insect management practices between small and big farmers

Farmers	Mean adoption score	't' value
Small farmers (n ₁ = 60)	28.06	0.292 ^{NS}
Big farmers (n ₂ = 60)	29.68	

NS = Non-significant

4. Conclusion

It is evident from the results of the research study that majority of the grape growers had adopted the cultural and chemical control measures, while few of the grape growers had practiced biological and mechanical control measures. Knowledge about cultural and chemical control measures and conviction about these control measures might be the reasons for majority of grape growers adopting these control measures, whereas, lack of knowledge, lack of technical guidance and non-availability of bio-control agents might be the reasons for partial adoption of biological and mechanical control measures. Therefore, the extension workers should supervise the availability of bio-control agents and see that the grape growers have easy accessibility and ready availability in time to control the insects in the vineyards. It is also necessary that the grape growers need to be convinced about the integrated approach for controlling the insects in the vineyards. This could be done by making use of a combination of extension methods such as farm and home visits, conducting training programmes, farmer field schools and demonstrations coupled with mass media for greater utilization of the integrated control measures by the grape growers.

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