*Plant Archives* Vol. 26, No. 1, 2026 pp. 1396-1402 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2026.v26.no.1.190

# CONSTRAINTS OF GRAPE GROWERS IN THE ADOPTION OF INTEGRATED PEST MANAGEMENT PRACTICES

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(Date of Receiving : 13-01-2026; Date of Revision : 05-03-2026; Date of Acceptance : 26-03-2026)

**ABSTRACT**

The research study was carried out during 2023-2024 in Chikkaballapura district of Karnataka state to know the constraints of grape growers in the adoption of integrated pest management practices. One hundred and twenty grape growers were interviewed using a pre tested interview schedule (60 small farmers and 60 big farmers). Age, education, experience in grape cultivation, knowledge regarding IPM practices, economic orientation, innovativeness, mass media participation, extension participation and extension contact of grape growers had significantly contributed to the increased adoption of IPM practices. It was also found that the grape growers faced varied constraints in the management of weed, insect and diseases.

***Keywords*:** Grape growers, integrated pest management practices, constraints, adoption.

## Introduction

Karnataka is the second-largest producer of grapes in the country, with an area of 47.12 thousand hectares and a production of 1224.67 thousand metric tonnes in the year 2023-24, yielding an average productivity of 25.31 tonnes per hectare (Anon, 2024a). The state grows several grape varieties, with the three main ones being Thompson Seedless, Anab-E-Shahi (Dilkush) and Bangalore Blue. Grape cultivation is spread across 18 out of 30 districts in the state, with prominent growing regions such as Nandi Valley, Cauvery Valley, and Krishna Valley. The state's favorable climate is ideal for grape production, which supports a healthy industry with many vineyards and consistent production of high-quality grapes each year.

Integrated Pest Management (IPM) stands out as an environmentally sustainable and socio-economically appropriate approach for addressing insect pests, diseases, and weeds. IPM integrates various techniques and strategies to efficiently manage pests and diseases while promoting economic viability, sustainability, and environmental friendliness. It aims to minimize the reliance on chemical inputs by combining multiple pest control methods such as cultural practices, mechanical approaches, biological controls, and the judicious use of pesticides. IPM, as a holistic approach, takes into account the life cycle of pests and diseases as well as their interaction with the environment to provide effective and economical pest control while minimizing hazards to humans and the environment

(Nidhi and Kalsariya, 2017, Paudel *et al.*, 2020 and Shresta *et al.*, 2024). With this background, the present study is carried out with the following specific objectives:

1. To find out the contribution of profile characteristics of grape growers on the extent of adoption of integrated pest management practices
2. To document the constraints faced by grape growers in the adoption of integrated pest management practices in grapes
3. To obtain the suggestions of grape growers to overcome the constraints faced by them in the adoption of integrated pest management practices

## Materials and Methods

Chikkaballapura district in Karnataka is a major site for grapes, grain and silk cultivation. Hence, the study was carried out during 2023-2024 in Chikkaballapura and Sidlaghatta taluks of Chikkaballapura district of Karnataka state. Grape is 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, 2023b). 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. Data was collected from grape growers using a pre tested interview schedule.

Information regrading 15 profile characteristics were collected using a structured schedule with suitable scales. The collected data was scored and analysed using frequency, percentage, mean, standard deviation nd multiple regression analysis.

## Results and Discussion

**Table 1:** Contribution of profile characteristics of grape growers on the extent of adoption level of integrated pest management practices

| Sl. No. | Profile characteristics | Multiple regression analysis ( t value) | | |
|---|---|---|---|---|
| | | Small farmers ($n_1$=60) | Big farmers ($n_2$=60) | Pooled sample ($n_3$=120) |
| 1 | Age | 2.001* | 2.261* | 2.380* |
| 2 | Education | 2.111* | 2.112* | 2.261* |
| 3 | Experience in grape cultivation | 2.222* | 2.021* | 1.999* |
| 4 | Family size | $0.961^{NS}$ | $0.916^{NS}$ | $0.999^{NS}$ |
| 5 | Knowledge regarding IPM practices | 2.268** | 2.261* | 2.819** |
| 6 | Cropping intensity | $0.7810^{NS}$ | $0.7999^{NS}$ | $0.7819^{NS}$ |
| 7 | Material possession | $0.8800^{NS}$ | $0.9210^{NS}$ | $0.8888^{NS}$ |
| 8 | Annual income | $0.6916^{NS}$ | $0.7928^{NS}$ | $0.8925^{NS}$ |
| 9 | Cosmopoliteness | $0.8921^{NS}$ | $0.9111^{NS}$ | $0.996^{NS}$ |
| 10 | Economic orientation | 2.2490* | 2.9910** | 2.398* |
| 11 | Innovativeness | 2.2481* | 2.7770** | 2.962** |
| 12 | Risk orientation | 2.3390* | 2.5178* | 2.118* |
| 13 | Mass media participation | 2.6810* | 2.4184* | 2.089* |
| 14 | Extension participation | 2.4189* | 2.3332* | 1.999* |
| 15 | Extension contact | 2.3912* | 2.2224* | 2.111* |

NS= Non-significant, *=Significant at 5%, **= Significant at 1%; $R^2$ 0.788

**Contribution of profile characteristics of grape growers on the extent of adoption level of integrated pest management practices**

The results revealed that age, education, experience in grape cultivation, knowledge regarding IPM practices, economic orientation, innovativeness, risk orientation, mass media participation, extension participation and extension contact of grape growers had significantly contributed towards increasing the adoption of integrated pest management practices in grape cultivation (Table 1). All the 15 profile characteristics together contributed to the tune of 78.80 per cent to the adoption of integrated pest management practices.

**Constraints faced by grape growers in adoption of integrated pest management practices.**

This section deals with the constraints faced by grape growers in integrated weed, insect and disease management

**Weed management**

The findings in Table 2 presents that cent per cent of the small farmers (100.00%) had lack of knowledge about the biological control measures for weed management in grape cultivation, while a majority (58.33%) of the small farmers had lack of knowledge about the recommended quantity of herbicides to be used for weed management and nearly two-third of the small farmers (65.00%) found that high cost of herbicides as a major constraint in adopting integrated pest management practices for weed control. Similarly, cent per cent of the big farmers (100.00%) had lack of knowledge about the biological control measures for weed management, whereas an equal proportion (55.00% each) of the big farmers had lack of knowledge about the recommended quantity of herbicides and high cost of herbicides as constraints in adopting the integrated pest management practices for weed control. Cent per cent of the grape growers in the pooled sample (100.00%) had lack of knowledge about the biological control measures for managing weeds in grape cultivation. While, a majority of the grape growers in the pooled sample (56.67%) had lack of knowledge about the recommended quantity of herbicides and 60.00 per cent of the grape growers in the pooled sample considered that high cost of herbicides as a constraint in the adoption of integrated pest management practices for weed management in grape cultivation.

**Table 2:** Constraints faced by grape growers in the adoption of integrated pest management practices

| Sl. No. | Constraints | Grape growers | | | | | |
|---|---|---|---|---|---|---|---|
| | | Small farmers ($n_1$=60) | | Big farmers ($n_2$=60) | | Pooled sample ($n_3$=120) | |
| | | No. | % | No. | % | No. | % |
| I | Weed management | | | | | | |
| 1. | Lack of knowledge on the biological control measures | 60 | 100.00 | 60 | 100.00 | 120 | 100.00 |
| 2. | Lack of knowledge on recommended quantity of herbicides | 35 | 58.33 | 33 | 55.00 | 68 | 56.67 |
| 3. | High cost of herbicides | 39 | 65.00 | 33 | 55.00 | 72 | 60.00 |
| II. | Insect management | | | | | | |
| 1. | Lack of knowledge on the recommended quantity of bio-pesticides (*Verticillium lecanii/Beauveria bassiana*) | 60 | 100.00 | 60 | 100.00 | 120 | 100.00 |
| 2. | Non-availability of bio-pesticides (*Verticillium lecanii/Beauveria bassiana*) | 55 | 91.67 | 49 | 81.67 | 114 | 95.00 |
| 3. | Lack of knowledge on recommended quantity of botanical insecticides | 23 | 38.33 | 13 | 21.67 | 36 | 30.00 |
| 4. | Non-availability of botanical insecticides | 29 | 48.33 | 19 | 31.67 | 48 | 40.00 |
| 5. | Lack of knowledge on release of bio-control agents (*Cryptolaemus montrouzieri* beetles) | 60 | 100.00 | 60 | 100.00 | 120 | 100.00 |
| 6. | Non-availability of bio-control agents (*Cryptolaemus montrouzieri* beetles) | 60 | 100.00 | 60 | 100.00 | 120 | 100.00 |
| 7. | Lack of knowledge on the benefits of using sticky cards | 60 | 100.00 | 60 | 100.00 | 120 | 100.00 |
| 8. | Lack of knowledge on benefits of using light traps | 56 | 93.33 | 55 | 91.67 | 111 | 92.50 |
| 9. | Non-availability of light traps | 50 | 83.33 | 45 | 75.00 | 95 | 79.17 |
| 10. | Lack of knowledge on recommended quantity of insecticides to control thrips | 22 | 36.67 | 21 | 35.00 | 43 | 35.83 |
| 11. | High cost of insecticides to control thrips | 22 | 36.67 | 21 | 35.00 | 43 | 35.83 |
| 12. | Lack of knowledge on recommended quantity of insecticides to control mealy bug | 21 | 35.00 | 18 | 30.00 | 39 | 32.50 |
| 13. | High cost of insecticides to control mealy bug | 21 | 35.00 | 18 | 30.00 | 39 | 32.50 |
| 14. | Lack of knowledge on recommended quantity of insecticides to control mites | 28 | 46.67 | 24 | 40.00 | 52 | 43.33 |
| 15. | High cost of insecticides to control mites | 28 | 46.67 | 24 | 40.00 | 52 | 43.33 |
| 16. | Lack of knowledge on recommended quantity of insecticides to control flea beetle | 29 | 48.33 | 22 | 36.67 | 51 | 42.50 |
| 17. | High cost of insecticides to control flea beetle | 29 | 48.33 | 22 | 36.67 | 51 | 42.50 |
| III | Disease management | | | | | | |
| 1. | Lack of knowledge on recommended quantity of bio-pesticides | 19 | 31.67 | 27 | 45.00 | 46 | 38.33 |
| 2. | Non-availability of bio-pesticides | 41 | 68.33 | 33 | 55.00 | 74 | 61.67 |
| 3. | Lack of knowledge on recommended quantity of fungicides to control downy mildew | 16 | 26.67 | 9 | 15.00 | 25 | 20.83 |
| 4. | High cost of fungicides to control downy mildew | 16 | 26.67 | 9 | 15.00 | 25 | 20.83 |
| 5. | Lack of knowledge on recommended quantity of fungicides to control powdery mildew | 15 | 25.00 | 9 | 15.00 | 24 | 20.00 |
| 6. | High cost of fungicides to control powdery mildew | 15 | 25.00 | 9 | 15.00 | 24 | 20.00 |
| 7. | Lack of knowledge on recommended quantity of fungicides to control anthracnose | 18 | 30.00 | 10 | 16.67 | 28 | 23.33 |
| 8. | High cost of fungicides to control anthracnose | 18 | 30.00 | 10 | 16.67 | 28 | 23.33 |

**Insect management**

In respect of insect management, cent per cent of the small farmers had faced the constraints such as: lack of knowledge about the recommended quantity of bio-pesticides such as *Verticillium lecanii* and *Beauveria bassiana* (100.00%), lack of knowledge about the release of bio-control agents such as *Cryptolaemus montrouzieri* beetles (100.00%), non-availability of bio-control agents (100.00%) and lack of knowledge about the benefits of using sticky cards (100.00%). While, a vast majority of the small farmers had faced the constraints viz., lack of knowledge about the benefits of using light traps (93.33%), non-availability of bio-pesticides (91.67%) and non-availability of light traps (83.33%) and less than half of the small farmers had faced the constraints such as: non-availability of botanical insecticides (48.33), lack of knowledge about the recommended quantity of insecticides to control flea beetles (48.33%) , high cost of insecticides for flea beetle control (48.33%), lack of knowledge about the recommended quantity of insecticides to control mites (46.67%), high cost of insecticides for mite control (46.67%), lack of knowledge about the recommended quantity of botanical insecticides (38.33%), lack of knowledge about the recommended quantity of insecticides to control thrips (36.67%), high cost of insecticides for thrips control (36.67%), lack of knowledge about the recommended quantity of insecticides to control mealybugs (35.00%) and high cost of insecticides for mealybug control (35.00%).

Lack of knowledge about the recommended quantity of bio-pesticides such as *Verticillium lecanii* and *Beauveria bassiana* (100.00%), lack of knowledge about the release of bio-control agents such as *Cryptolaemus montrouzieri* beetles (100.00%), non-availability of bio-control agents (100.00%) and lack of knowledge about the benefits of using sticky cards (100.00%) were the constraints faced by cent per cent of the big farmers whereas, a vast majority of the big farmers had faced constraints such as: lack of knowledge about the benefits of using light traps (91.67%), non-availability of bio-pesticides (81.67%), and non-availability of light traps (75.00%). Less than half of the big farmers had faced constraints such as: lack of knowledge about the recommended quantity of insecticides to control mites (40.00%), high cost of insecticides for mite control (40.00%), lack of knowledge about the recommended quantity of insecticides to control flea beetles (36.67%), high cost of insecticides for flea beetle control (36.67%), lack of knowledge about the recommended quantity of insecticides to control thrips (35.00%), high cost of insecticides for thrips control (35.00%), non-availability of botanical insecticides (31.67%), lack of knowledge about the recommended quantity of insecticides to control mealybugs (30.00%), high cost of insecticides for mealybug control (30.00%) and lack of knowledge about the recommended quantity of botanical insecticides (21.67%).

In respect of insect management, cent per cent of the grape growers in the pooled sample had faced constraints such as: lack of knowledge about the recommended quantity of bio-pesticides such as *Verticillium lecanii* and *Beauveria bassiana* (100.00%), lack of knowledge about the release of bio-control agents such as *Cryptolaemus montrouzieri* beetles (100.00%), non-availability of bio-control agents (100.00%), and lack of knowledge about the benefits of using sticky cards (100.00%). A vast majority of the grape growers in the pooled sample had also faced constraints like the non-availability of bio-pesticides (95.00%), lack of knowledge about the benefits of using light traps (92.50%) and non-availability of light traps (79.17%). Less than half of the grape growers in the pooled sample had faced constraints such as: lack of knowledge about the recommended quantity of insecticides to control mites (43.33%), high cost of insecticides to control mites (43.33%), lack of knowledge about the recommended quantity of insecticides to control flea beetles (42.50%), high cost of insecticides to control flea beetles (42.50%), non-availability of botanical insecticides (40.00%), lack of knowledge about the recommended quantity of insecticides to control thrips (35.83%), high cost of insecticides to control thrips (35.83%), lack of knowledge about the recommended quantity of insecticides to control mealybugs (32.50%), high cost of insecticides to control mealy bugs (32.50%) and lack of knowledge about the recommended quantity of botanical insecticides (30.00%).

**Disease management**

In respect of disease management, a majority of the small farmers had faced the constraint of non-availability of bio-pesticides (68.33%), while less than one-third of the small farmers had faced the constraints such as: lack of knowledge about the recommended quantity of bio-pesticides (31.67%), lack of knowledge about the recommended quantity of fungicides to control anthracnose (30.00%), high cost of fungicides to control anthracnose (30.00%), lack of knowledge about the recommended quantity of fungicides to control downy mildew (26.67%) and high cost of fungicides to control downy mildew (26.67%). One-fourth of the small farmers had lack of knowledge

about the recommended quantity of fungicides to control powdery mildew (25.00%) and high cost of fungicides to control powdery mildew (25.00%) as constraints in disease management.

A majority of the big farmers had faced the constraints such as: non-availability of bio-pesticides (55.00%). While less than half of the big farmers faced the constraints like lack of knowledge about the recommended quantity of bio-pesticides (45.00%), lack of knowledge about the recommended quantity of fungicides to control anthracnose (16.67%), high cost of fungicides to control anthracnose (16.67%), lack of knowledge about the recommended quantity of fungicides to control downy mildew (15.00%), high cost of fungicides to control downy mildew (15.00%), lack of knowledge about the recommended quantity of fungicides to control powdery mildew (15.00%) and high cost of fungicides to control powdery mildew (15.00%).

A majority of the grape growers in the pooled sample had faced the constraint of non-availability of bio-pesticides (61.67%), while nearly two-fifth of the grape growers in the pooled sample had faced the constraint of lack of knowledge about the recommended quantity of bio-pesticides (38.33%) and less than one-fourth of the grape growers in the pooled sample had faced constraints such as: lack of knowledge about the recommended quantity of fungicides to control anthracnose (23.33%), high cost of fungicides to control anthracnose (23.33%), lack of knowledge about the recommended quantity of fungicides to control downy mildew (20.83%), high cost of fungicides to control downy mildew (20.83%), lack of knowledge about the recommended quantity of fungicides to control powdery mildew (20.00%) and high cost of fungicides to control powdery mildew (20.00%). The findings are in line with the findings of Nidhi *et. al.*, 2016, Karthikeyan *et al.*, 2020, Rathwa and Bochalya, 2023, Samdariya *et. al.*, 2023, Shresta *et. al.*, 2024 and Panda Shubhaom and Sharma Amita, 2025.

These constraints highlights the challenges faced by grape growers in the adoption of integrated pest management practices, hence the concerned authorities viz., State Department of Horticulture, ICAR institutes, Farm Universities and other concerned agencies should address the constraints faced by the grape growers in increasing the adoption of integrated nutrient and pest management practices.

**Suggestions of grape growers to overcome the constraints faced in adoption of integrated pest management practices**

The findings with respect to the suggestions offered by grape growers to overcome the constraints faced in the adoption of integrated pest management practices is presented in Table 3. With respect to weed management, cent per cent of the small farmers (100.00%) expressed the need for technical guidance on biological measures to control weeds, while a majority (65.00%) of the small farmers suggested to provide subsidies on herbicides and 58.33 per cent of the small farmers suggested the need for technical guidance on the recommended quantity of herbicides. In the case of insect management, cent per cent of the small farmers expressed the need for providing technical guidance on mechanical measures to control insects (100.00%) and biological measures to control insects (100.00%), whereas 41.66 per cent of the small farmers expressed the need for providing technical guidance on the recommended quantity of insecticides.

**Table 3:** Suggestions of grape growers to overcome the constraints faced in the adoption of integrated pest management practices

| Sl. No. | Suggestions | Grape growers | | | | | |
|---|---|---|---|---|---|---|---|
| | | Small farmers ($n_1$=60) | | Big farmers ($n_2$=60) | | Pooled sample ($n_3$=120) | |
| | | No. | % | No. | % | No. | % |
| I | Weed management | | | | | | |
| A. | Technical guidance required on: | | | | | | |
| 1. | Biological measures to control weeds | 60 | 100.00 | 60 | 100.00 | 120 | 100.00 |
| 2. | Recommended quantity of herbicides | 35 | 58.33 | 33 | 55.00 | 68 | 56.67 |
| B. | Providing subsidies on: | | | | | | |
| 1. | Herbicides | 39 | 65.00 | 33 | 55.00 | 72 | 60.00 |
| II | Insects management | | | | | | |
| A. | Technical guidance required on: | | | | | | |
| 1. | Mechanical measures to control insects | 60 | 100.00 | 60 | 100.00 | 120 | 100.00 |
| 2. | Biological measures to control insects | 60 | 100.00 | 60 | 100.00 | 120 | 100.00 |
| 3. | Recommended quantity of insecticides | 25 | 41.66 | 21 | 35.00 | 46 | 38.33 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| B. | Ensuring timely availability of: | | | | | | |
| 1. | Bio-pesticides | 55 | 91.67 | 49 | 81.67 | 114 | 95.00 |
| 2. | Botanical insecticides | 29 | 48.33 | 19 | 31.67 | 48 | 40.00 |
| 3. | Bio-control agents | 60 | 100.00 | 60 | 100.00 | 120 | 100.00 |
| 4. | Light traps | 50 | 83.33 | 45 | 75.00 | 95 | 79.17 |
| C. | Providing subsidies on: | | | | | | |
| 1. | Insecticides | 56 | 93.33 | 48 | 80.00 | 104 | 86.66 |
| III. | Disease management | | | | | | |
| A. | Technical guidance required on: | | | | | | |
| 1. | Recommended quantity of bio-pesticides | 19 | 31.67 | 27 | 45.00 | 46 | 38.33 |
| 2. | Recommended quantity of fungicides | 18 | 30.00 | 10 | 16.67 | 28 | 23.33 |
| B. | Ensuring timely availability of: | | | | | | |
| 1. | Bio-pesticides | 41 | 68.33 | 33 | 55.00 | 74 | 61.67 |
| C. | Providing subsidies on: | | | | | | |
| 1. | Fungicides | 56 | 93.33 | 48 | 80.00 | 104 | 86.66 |

Similarly, cent per cent of the small farmers emphasized the need for ensuring the timely availability of bio-control agents (100.00%), bio-pesticides (91.67%), light traps (83.33%) and botanical insecticides (48.33%). A vast majority (93.33%) of the small farmers suggested the government to provide subsidies on insecticides. In the case of disease management, less than one-third of the small farmers expressed the need for providing technical guidance on the recommended quantity of bio-pesticides (31.67%) and fungicides (30.00%), while a majority (68.33%) of the small farmers emphasized the need for ensuring the timely availability of bio-pesticides and a vast majority (93.33%) of the small farmers suggested the government to provide subsidies on fungicides to overcome the constraints faced in adoption of integrated nutrient management practices.

In respect to weed management, cent per cent of the big farmers (100.00%) expressed the need for technical guidance on biological measures to control weeds while an equal proportion (55.00% each) of the big farmers expressed the need for technical guidance on the recommended quantity of herbicides and subsidies to be provided on herbicides to overcome the constraints faced in adoption of integrated nutrient management practices. With respect to insect management, cent per cent of the big farmers expressed the need for providing technical guidance on mechanical measures to control insects (100.00%) and biological measures to control insects (100.00%), while 35.00 per cent of the big farmers expressed the need for providing technical guidance on the recommended quantity of insecticides. Similarly, cent per cent of the big farmers emphasized the need for ensuring the timely availability of bio-control agents (100.00%), followed by bio-pesticides (81.67%), light traps (75.00%) and botanical insecticides (31.67%). A majority (80.00%) of the big farmers also suggested the government to provide subsidies on insecticides. In case of disease management with respect to big farmers, as high as 45.00 per cent of them expressed the need for providing technical guidance on the recommended quantity of bio-pesticides while 16.67 per cent of them expressed the need for providing technical guidance on the recommended quantity of fungicides, respectively. More than half (55.00%) of the big farmers highlighted the need for ensuring the timely availability of bio-pesticides and a majority (80.00%) of the big farmers suggested the government to provide subsidies on fungicides to overcome the constraints faced in adoption of integrated nutrient management practices.

With regard to weed management, cent per cent of the grape growers (100.00%) in the pooled sample expressed the need for technical guidance on biological measures to control weeds, while a majority (60.00%) of the grape growers in the pooled sample suggested to provide subsidies on herbicides and 56.67 per cent of them suggested the need for technical guidance on the recommended quantity of herbicides. In the case of insect management, cent per cent of the grape growers in the pooled sample expressed the need for providing technical guidance on mechanical measures to control insects (100.00%) and biological measures to control insects (100.00%), while 38.33 per cent of the grape growers in the pooled sample expressed the need for providing technical guidance on the recommended quantity of insecticides. Similarly, cent per cent of the grape growers in the pooled sample emphasized the need for ensuring the timely availability of bio-control agents (100.00%), bio-pesticides (95.00%), light traps (79.17%) and botanical insecticides (40.00%). A majority (86.66%) of the grape growers suggested the government to provide subsidies on insecticides. In respect of disease management among the grape growers in the pooled sample, 38.33 and 23.33 per cent of them expressed the need for providing technical guidance on the recommended quantity of bio-

pesticides and fungicides, respectively. While a majority (61.67%) of the grape growers in the pooled sample emphasized the need for ensuring the timely availability of bio-pesticides and a vast majority (86.66%) of the grape growers in the pooled sample suggested the government to provide subsidies on fungicides to overcome the constraints faced in the adoption of integrated pest management practices. Similar findings were reported by Nidhi and Kalsariya, 2017, Sita Ram Bijarnia *et al.*, 2020, Rathwa and Bochalya, 2023, Samdariya *et al.*, 2023 and Anamika Sharma *et al.*, 2024.

## Conclusion

The State Department of Horticulture, Indian Council of Agricultural Research (ICAR) institutes, Farm Universities and other extension service providers should focus on conducting training programs on scientific weed, insect and disease management, ensure the timely availability of essential bio-control agents, bio-pesticides and light traps and providing financial assistance in the form of subsidies on insecticides, fungicides, and herbicides to improve the adoption of Integrated Pest Management (IPM) practices among grape growers. These measures will help in reducing pest infestation, minimizing chemical pesticide dependency, lowering production costs, and promoting eco-friendly and sustainable viticulture practices**.**

### Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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