

Evaluation Of Pesticide Residue Detection in Coriander Using LC–MS/MS and Biological Pest Management Through Plant-Derived Extracts.

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ABSTRACT

Coriander (*Coriandrum sativum*), is often referred to as Dhaniya. The fresh leaves of this plant are called cilantro. The seeds, leaves, and fruits of this plant are edible and have a fragrant aroma; they are used to spice up curries, soups, and other Indian dishes. The present study utilized LC-MS/MS to analyse pesticide residues in Coriander. The analysis revealed that the Coriander samples were contaminated with pesticide residues exceeding the Maximum Residue Limits (MRLs), rendering them unsafe for consumption. This contamination underscores the urgent need to implement biological management strategies as sustainable and safer alternatives to traditional pesticide use. This study also focused on the role of biological management strategies as sustainable alternatives. This study evaluated the efficacy of leaf extracts of five aromatic plants i.e. *Annona reticulata*, *Annona squamosa*, *Eucalyptus globulus*, *Adhatoda vasica* and *Curcuma longa* against the pathogens in Coriander. However, among all the tested leaf extracts *Eucalyptus globulus* shows the significant reduction in pest attack exhibited their potential use as biological control agents. This suggests their dual role in pathogen suppression and growth promotion. Notably, these treatments also significantly improved yield. It gives eco-friendly and natural, alternative to synthetic pesticides, with added advantage of minimal toxicity to the non-target organisms and biodegradability, this makes it a valuable asset in biocontrol and sustainable agriculture systems. The present work on the analysis of pesticides residue in Coriander and evaluation of biological control by using plant extracts has provided valuable insights into both sustainable agriculture and food security.

Keywords: Leafy vegetables, LC–MS/MS, pesticide residues, biological control, Coriander.

INTRODUCTION

Coriander (*Coriandrum sativum*) is an important dietary component worldwide because they are rich in minerals, vitamins, antioxidants and Fiber. They are often eaten as raw or cooked, they are highly valuable for health promoting and prevents chronic diseases (Slevin and Lloyd, 2012; Sharma et al., 2020). The WHO promotes the consumption of fruits and leafy vegetables as important source of minerals, antioxidants and vitamins (Lemos et al., 2016; Parron et al., 2014). These fruits and leafy vegetables contain active compounds that may reduce the impact of cardiovascular diseases also (Ivey et al., 2015). Leafy and fruit vegetables provide many minerals and vitamins essential for a balanced diet. In addition, epidemiological studies have shown that a healthy

lifestyle, including a lower risk of heart disease, obesity and cancer, may be associated with a higher intake of vegetables (Li et al., 2014; Mac et al., 2018).

The global demand for food is increasing daily due to the growing population and improving living standards. Most crops require the use of pesticides in modern agriculture to ensure food supply (Hernandez et al., 2013; Oerke and Dehne 2004; Kock Schulmeyer et al., 2013). However, Pest and disease infestations can affect the yield and quality of vegetables. Therefore, the use of pesticides during the production and storage of vegetables is essential. Due to their rapid action and low human resource requirements, the use of pesticides has increased in recent years to effectively control the pest complex of

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vegetable crops (Li et al., 2014; Mac et al., 2018). These leafy greens vegetables are more susceptible to pesticides and microbial contamination, resulting in the extensive use of pesticides during cultivation (Slevin and Lloyd, 2012; Sharma et al., 2020).

Fruits and leafy vegetables may be a source of pesticide residues contamination, as the consumption of pesticide residues can cause diseases and affect negative impact on human health (Lemos et al., 2016; Parrón et al., 2014). The inappropriate and excessive use of pesticides in agricultural processes has increased human health risks and environmental pollution (Hernandez et al., 2013; Oerke and Dehne 2004; Kock Schulmeyer et al., 2013).

MATERIAL AND METHODS:

Study area:

Nanded is a district in Maharashtra, India, bordering the states of Karnataka and Telangana. Geographically, the district is bordered by Karnataka in the south-west and Telangana in the south. The study region ranges from 18°15' to 19°55' north latitude and 77° to 78°25' east longitude. Nanded District covers 10,444 square kilometres, or 3.41% of the total area of Maharashtra state. The region has multiple huge fresh produce markets, and Leafy vegetables are widely accessible from street sellers, as well as various farms dedicated to raising fruit vegetables for consumption inside the neighbourhood. Furthermore, the district has a 30% urban population, which allows for a significant consumption of locally grown Leafy vegetables (Biswas, B., & Kaplay, R. D. 2012).

Collection of Coriander samples for screening of multi pesticides residue analysis

The Coriander samples were collected from selected locations and monitored twice a year for three consecutive years from January 2023 to July 2025. A total of 20 okra samples were collected from small farms, community markets, households and street vendors in Nanded district between January 2023 and July 2025. The coriander samples (1kg) were collected, packed and labelled from different locations. The samples brought in to the laboratory

and kept in cold until they used. The samples were collected and mixed and then ground.

Pesticide Residue Analysis by Ethyl Acetate Method.

The samples prepare start by weighing 10gm of the mixed leafy vegetable samples and place it in a 50ml tube. Add 10ml of solvent (ethyl acetate) to it and shake the tube vigorously for one minute. Then, add 10gm of drying powder (anhydrous sodium sulphate) and mix everything very vigorously for two minutes. Finally, spin the tube in a machine (centrifuge) for five minutes. This will separate the liquid part from the solid leaf pulp.

Samples prepare for LC-MS/MS Testing:

Take 5 ml of the clean liquid from the first step and pour it into a new tube that contains a special cleaning powder (PSA). Shake this new tube for 30 seconds and then spin it in a centrifuge. This cleaning step removes unwanted impurities. Now, take 2 ml of this cleaned liquid and pour it into a test tube with a small amount of auxiliary solution (diethylene glycol). Use nitrogen gas to gently blow all the liquid in the tube until it is completely dry. The material left behind is your sample. To prepare this dry sample for the machine, first add 1 ml of methanol, then 1 ml of a weak acid-water solution. It is very important to add them in this order. Use sound waves (sonication) to mix them, then shake it well. Give it one last spin in the centrifuge and then filter the liquid through a very fine filter into a small vial. The machine will then test a small amount of this liquid.

Cleanliness for GC-MS/MS testing:

For this separate test, take only 1ml of the initial clean liquid and pour it into a small tube containing the same clean powder (PSA). Shake it vigorously for 30 seconds and then spin it in a centrifuge. After this, take only the clean liquid and pour it directly into a special vial intended for the second test device.

Biological management of Pest

Biological Pest and Disease Management study was conducted in Gadegaon village, Nanded district, Maharashtra, during 2024 to 2025, to evaluate the



potential of different aromatic plant against Coriander (*Coriandrum sativum*) for controlling Vegetable pests and their diseases.

Collection of plant materials:

During 2024 to 2025, fresh leaves were collected from disease-free plants of potential biopesticides such as *Annona reticulata*, *Annona squamosa*, *Eucalyptus globulus*, *Adhatoda vasica* and *Curcuma longa*. The collected plant samples were later identified taxonomically by the Department of Botany, Yashwant College, Nanded.

Field Design

The selected vegetable crop seedlings i.e. Coriander (*Coriandrum sativum*), was planted by randomized block design with three replications. The size of plot was 3 x 2 square meter, with 20 plants / plot. Plant to plant and row to row distance was maintained 50 cm and 100 cm respectively. Standard agronomic and cultural practices were applied uniformly to all experimental plots.

Treatments and its application

Methanolic leaf extracts of all selected aromatic plant including *Annona reticulata*, *Annona squamosa*, *Eucalyptus globulus*, *Adhatoda vasica* and *Curcuma longa* and control (untreated) were sprayed twice with a Knapsack sprayer at weekly intervals.

Preparation of Plant extract and its application

The collected leaves were first washed with tap water, cut into small pieces and dried in the shade for two weeks. The dried material was then ground into a fine powder using an electric blender and stored in labelled

plastic bags. Then, crude extracts were obtained by using Soxhlet apparatus in methanol solvent over a period of 24 hours. The resulting extracts were collected and stored in sealed bottles at 4°C for future experimental use. The botanical solution was sprayed on selected vegetable plant experimental field twice a week with the help of a sprayer. The pest was monitored every day and damages were counted every 3 days in a week. The numbers of infested leaves were also recorded.

In this study, the effect of Methanolic leaf extracts of all selected aromatic plant including *Annona reticulata*, *Annona squamosa*, *Eucalyptus globulus*, *Adhatoda vasica* and *Curcuma longa* on reduction in foliage damage in coriander by pests was observed under field conditions. The results were expressed as the average number of holes (perforations) per leaf, percentage reduction in leaf damage and the efficacy rating compared to the untreated control. The results showed different levels of bio insecticidal efficacy with the Methanolic leaf extracts of all the selected plants. The extracts were applied to crop plants as a foliar-spray at a standard concentration of 15% per week. Each treatment was replicated three times under a randomized block design. Percentage reduction was calculated using the following formula:

$$\% \text{ Reduction in Damage} = [(C - T) / C] \times 100$$

where, C = damage in control, T = damage in treatment.

RESULT AND DISCUSSION:

Evaluation of Coriander a Leafy Vegetable for Multiple Residual Analyses.

Table 1: Evaluation of pesticide residue levels with maximum residue limits (MRLs) in Coriander.

Sr. No.	Name of Pesticides	Observed Values (mg/kg)	MRL Values (mg/kg)	LOQ (mg/kg)	Above MRL (mg/kg)	Method
1.	Difenoconazole, and	0.371	0.05	0.1	Yes	LC-MS/MS
2.	Dimethomorph,	4.516	NA	0.1	NA	LC-MS/MS
3.	Fluopyrum	0.730	NA	0.1	NA	LC-MS/MS
4.	Spirotetramat and Spirotetramat- enol.	0.443	NA	0.1	NA	LC-MS/MS

Note: - LOQ: Limit of Quantification, NA: MRLs Not Available.



The evaluation of multi-residual analysis of Coriander has been carried out by LC-MS/MS /GC-MS/MS. The data of multi-residual analysis of coriander leafy vegetable are presented in Table 1. It exhibited total four pesticide residues, includes Difenconazole, Dimethomorph, Fluopyram and Spirotetramat and Spirotetramat- enol. Difenconazole was present at 0.371 mg/kg, which is higher than its MRL of 0.05 mg/kg, meaning that the levels found are above the permissible safety limit and may pose a potential risk to the consumers.

Dimethomorph was detected at 4.516mg/kg, Fluopyram found at 0.730mg/kg and Spirotetramat

and Spirotetramat-enol was at 0.443 mg/kg. All these three residues were present very high above the LOQ (Limit of Quantification) i.e. 0.1 mg/kg. However, there is no established MRL value is available for this pesticide, so comparisons could not be made. The high residue loads were observed in Coriander samples, with difenoconazole clearly exceeding the safety standards, while other pesticides found, although not MRLs, were present at high levels and therefore require careful monitoring. A graphical representation of multi-residua analysis of coriander leafy vegetable, chromatogram and compound graphics has been depicted in Figure 1, 2, 3 respectively.

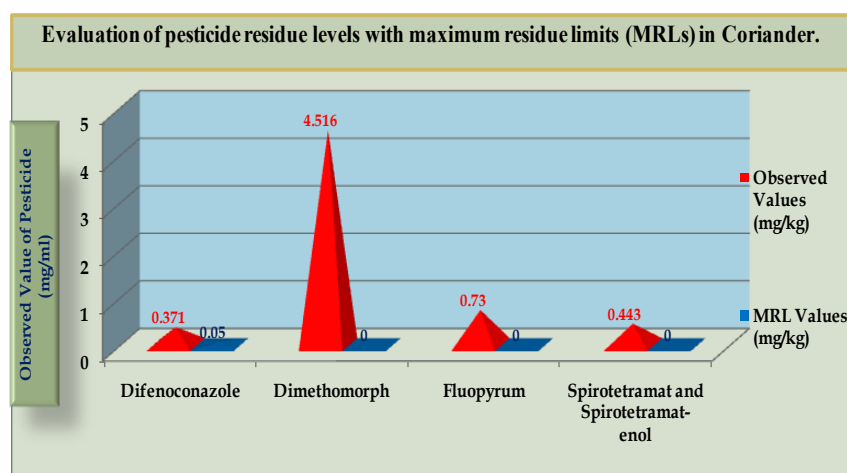


Figure 1. Evaluation of pesticide of pesticide residue levels with maximum residue limits (MRLs) in Coriander.

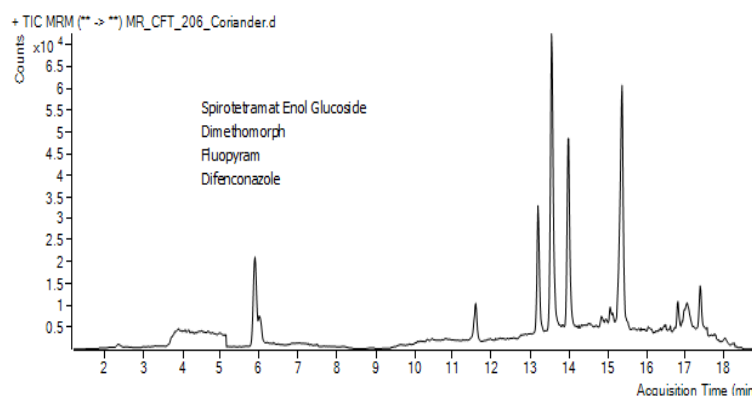


Figure 2: Chromatogram of coriander sample obtained by GC-MS and LC-MS.

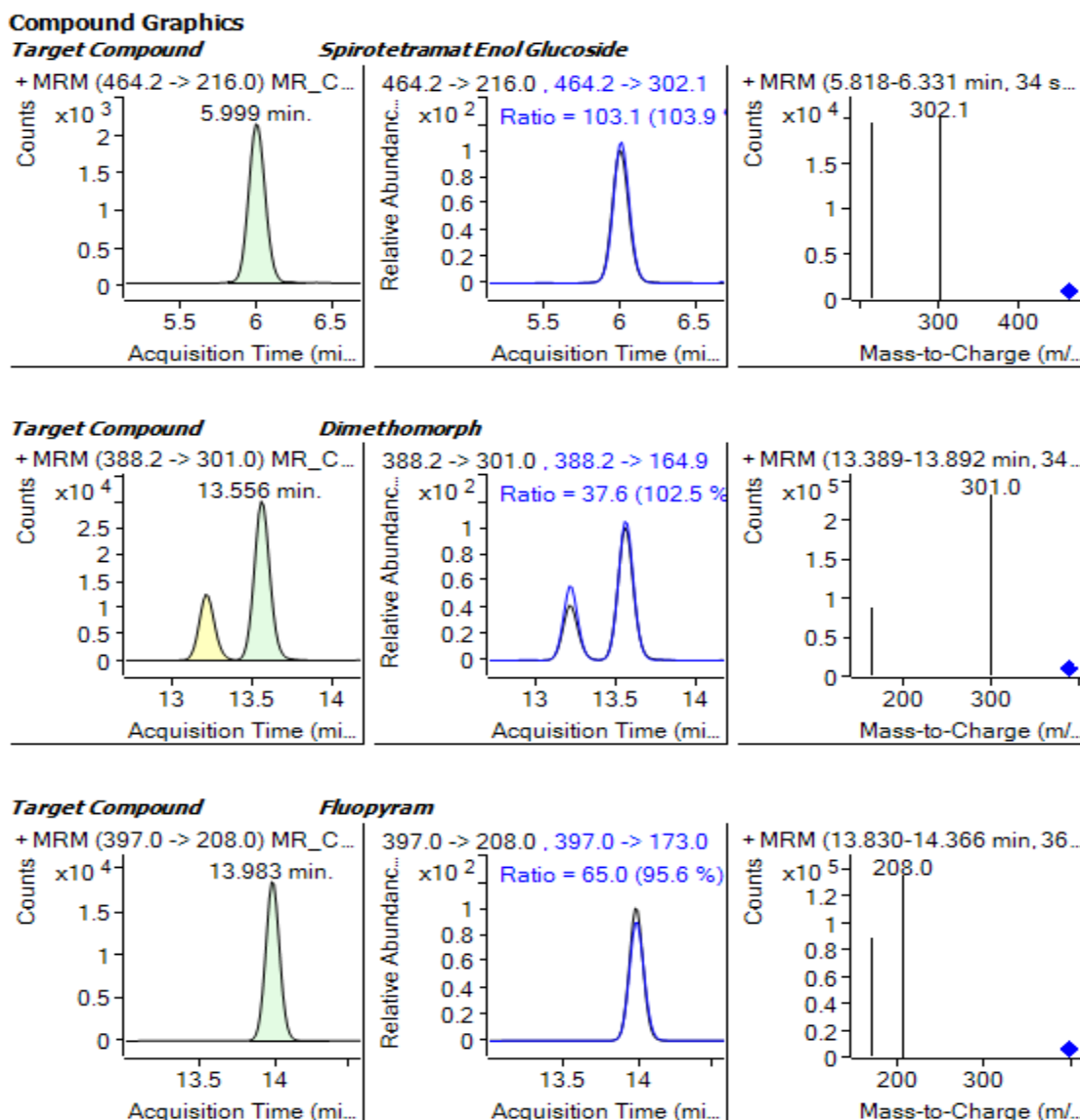


Figure 3: Compound graphics of coriander sample obtained by GC-MS and LC-MS.

Evaluation of Methanolic Leaf Extracts of Selected Plants for Pest Management and Yield Enhancement in Coriandrum Crop.

Coriander (*Coriander sativum*), is a very popular leafy and spice vegetable crop. Its fresh leaves are used for flavouring, while the dried seeds are used as an important spice in pickles, curries and condiments. It is rich in vitamins C, A, and K, essential oils, and antioxidants. Coriander supports immunity, digestion

and overall health. It is a short duration, cold season crop that matures in 75 to 100 days and grows best in well-drained soil. It is susceptible to pests include thrips, aphids and powdery mildew. By sustainable management with plant extracts like *Annona reticulata*, *Annona squamosa*, *Eucalyptus globulus*, *Adhatoda vasica* and *Curcuma longa* offer environment friendly pest control. They are biodegradable, protect nature, safer for humans, and reduce dependence on synthetic pesticides and help to produce healthy cabbage for future generations.

Table 2: Evaluation of methanolic leaf extracts of selected plants for infestation of Coriander (*Coriandrum sativum*) crop.

Sr. No.	Treatments of Methanolic Leaf Extracts	Methanol Leaf Extract Conc.	Mean Number of Leaf Infested Leaves
1	<i>Annona reticulata</i>	15%	8.33±0.72
2	<i>Annona squamosa</i>	15%	7.66±1.45



3	<i>Eucalyptus globulus</i>	15%	4.00±0.57
4	<i>Adhatoda vasica</i>	15%	10.33±0.88
5	<i>Curcuma longa</i>	15%	8.66±0.92
6	Control (Untreated)	15%	25.00±1.15

As shown in Table 2, effect of methanolic leaf extracts of selected five plants like *Annona reticulata*, *Annona squamosa*, *Eucalyptus globulus*, *Adhatoda vasica* and *Curcuma longa* on Coriander (*Coriandrum sativum*) leaf infestation was evaluated. The control (untreated) showed the highest (25.00±1.15) number of infected leaves per plant. In other treatments, the plants *Annona squamosa* and *Eucalyptus globulus* were exhibited more effects in reducing leaf the infestation in Coriander crop, with 7.66±1.45 and 4.00±0.57 values per plant, indicates best ant pesticidal potential. Out of these, the methanol extract of *Eucalyptus*

globulus exhibited the highest activity, causing the least infestation. *Annona reticulata*, *Adhatoda vasica* and *Curcuma longa* showed weak efficiency, with 8.33±0.72, 10.33±0.88 and 8.66±0.92 infected leaves per plant, respectively, which were close to the untreated control. These finding indicates that the potential of methanolic extracts of all five plants was varied according to the plant species. However, the significant reduction in infection by some extracts exhibited their potential use as biological control agents. Such biological controls may serve as a sustainable and ecofriendly alternative to the chemical pesticides in Coriander cultivation crop.

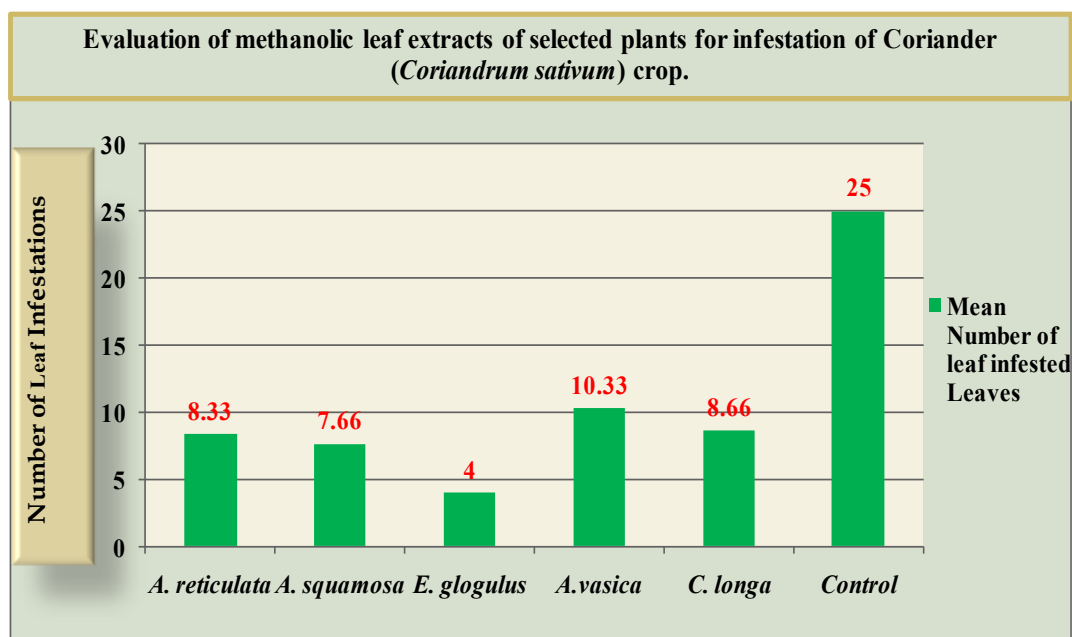


Figure 4: Evaluation of methanolic leaf extracts of selected plants for enhancement in total yield of Coriander (*Coriandrum sativum*) crop.

Table 3: Evaluation of methanolic leaf extracts of selected plants for pest attack on Coriander (*Coriandrum sativum*) crop.

Sr. No.	Treatments of Methanolic Leaf Extracts	Leaf Perforation /Plant	Damage reduction in % /Plant	Rank of Effectiveness
1	<i>Annona reticulata</i>	11.66±0.92	23.93	4
2	<i>Annona squamosa</i>	9.33±0.33	39.13	2
3	<i>Eucalyptus globulus</i>	6.00±0.57	58.70	1
4	<i>Adhatoda vasica</i>	9.33±0.16	39.13	2
5	<i>Curcuma longa</i>	10.33±0.57	32.61	3



6	Control (Untreated)	15.33±0.88	-	-
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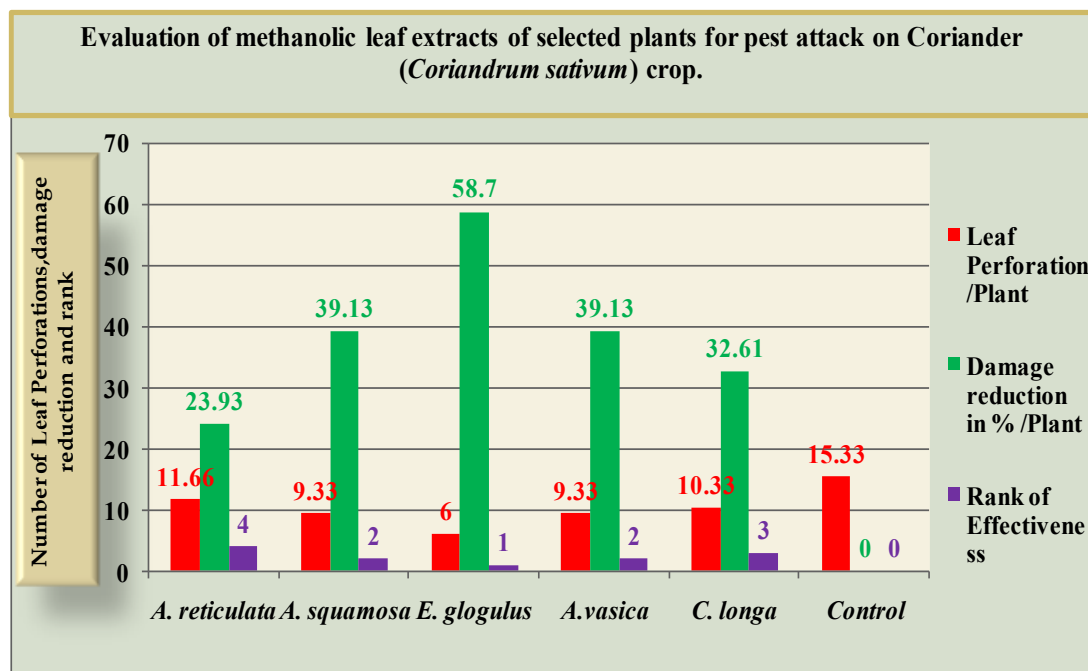


Figure 5: Evaluation of methanolic leaf extracts of selected plants for pest attack on Coriander (*Coriandrum sativum*) crop.

In the presented Table 3, the effect of methanolic leaf extracts of selected five plants like *Annona reticulata*, *Annona squamosa*, *Eucalyptus globulus*, *Adhatoda vasica* and *Curcuma longa* was evaluated for pest attack and reduction in damage on Coriander (*Coriandrum sativum*) crop. Evaluation of 15% methanolic leaf extracts showed significant differences in their ability to reduce leaf perforations and damage to Coriander crop. The highest average perforations (15.33 ± 0.88 /plant) were observed in untreated control plants, which served as a baseline for comparison. Among other extracts, *Eucalyptus globulus* was exhibited the highest potential, with values 6.00 ± 0.57

holes per plant and a 58.70% reduction in damage, ranking 1st. *Annona squamosa* and *Adhatoda vasica* also exhibited equal significant effects, with 39.13% damage reduction, ranking 2nd. *Annona reticulata* and *Curcuma longa* showed limited activity, reducing losses by only 23.93% and 32.61%, ranking 3rd and 4th, respectively. These findings indicate that the potential of methanolic extracts of all five plants were varied according to the plant species. However, the significant reduction in pest attack by some extracts (*Eucalyptus globulus*) exhibited their potential use as biological control agents. Such biological controls may serve as a sustainable and ecofriendly alternative to the chemical pesticides in Coriander cultivation crop to reduce the damage caused by pest attack.

Table 4: Evaluation of methanolic leaf extracts of selected plants for enhancement in length, in leaf number and total fresh biomass of Coriander (*Coriandrum sativum*) crop

Sr. No.	Treatments of Methanolic Leaf Extracts	Length of Plant (cm)	Leaf Number /Plant	Total Fresh Biomass /Plant (gm)
1	<i>Annona reticulata</i>	39.5±2.51	35.33±0.72	2.46±1.37
2	<i>Annona squamosa</i>	41.6±1.31	58.66±0.57	3.16±1.56
3	<i>Eucalyptus globulus</i>	40.8±0.81	41.00±1.15	3.18±0.82
4	<i>Adhatoda vasica</i>	39.2±0.67	34.50±1.04	2.51±0.16
5	<i>Curcuma longa</i>	38.6±0.46	36.33±0.88	2.83±2.43
6	Control (Untreated)	35.1±1.82	31.33±0.16	1.33±1.67



As shown in Table 4, the effect of methanolic leaf extracts of selected five plants like *Annona reticulata*, *Annona squamosa*, *Eucalyptus globulus*, *Adhatoda vasica* and *Curcuma longa* was evaluated for enhancement in length, in leaf number and total fresh biomass of Coriander (*Coriandrum sativum*). The methanolic leaf extracts of all tested plants showed differences in their activity. Untreated (control) plants showed the lower growth, with an average plant height 35.1 ± 1.82 cm, 31.33 ± 0.16 number of leaves per plant (excluding head) and 1.33 ± 1.67 gm of fresh biomass per plant.

On the other hand, treatment with *Annona squamosa* extract resulted in the most vigorous growth,

producing taller plants (41.6 ± 1.31 cm), higher leaf number (58.66 ± 0.57) and the highest fresh biomass (3.16 ± 1.56 gm/Plant). *Annona reticulata* and *Eucalyptus globulus* also enhanced growth effectively, with moderately increased in height, number of leaves and fresh biomass as compared to the control plants. In contrast, *Adhatoda vasica* and *Curcuma longa* showed a slight improvement over the control, with relatively low values of all measured parameters. These results indicate that the extract of *Annona squamosa* not only provided effective protection against insect infestation but also increased the growth and yield of Coriander, exhibiting its efficacy as a bio-control and growth promoter.

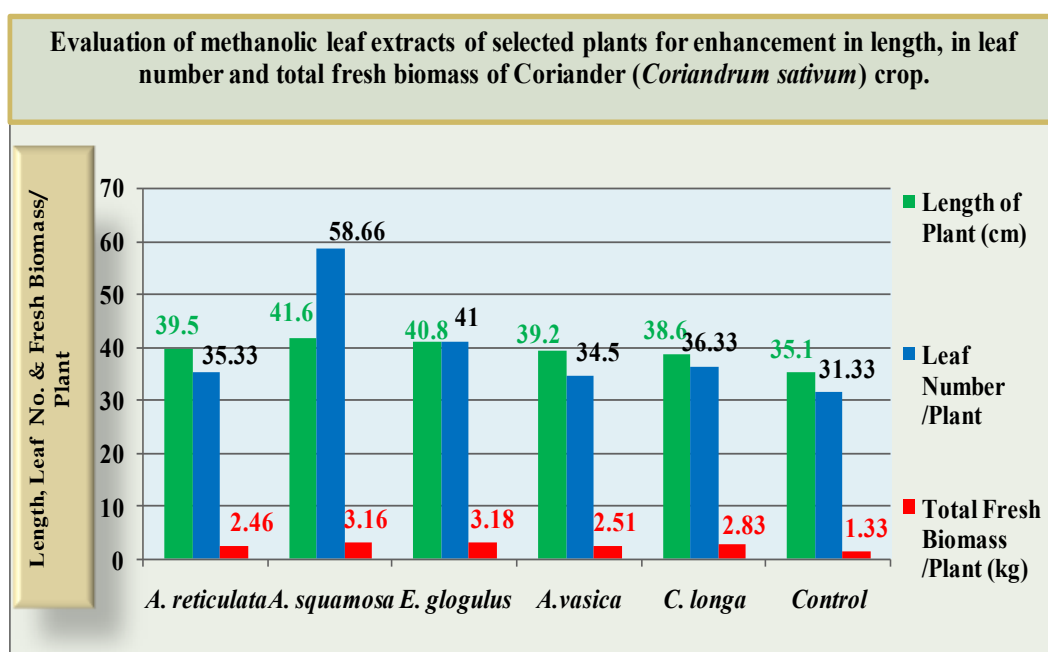


Figure 6: Evaluation of methanolic leaf extracts of selected plants for enhancement in length, in leaf number and total fresh biomass of Coriander (*Coriandrum sativum*) crop.

Table 5: Evaluation of methanolic leaf extracts of selected plants for enhancement in total yield of Coriander (*Coriandrum sativum*) crop.

Sr. No.	Treatments of Methanolic Leaf Extracts	Total Yield (Kg/Plot)
1	<i>Annona reticulata</i>	9.85 ± 2.41
2	<i>Annona squamosa</i>	9.46 ± 2.68
3	<i>Eucalyptus globulus</i>	10.62 ± 2.43
4	<i>Adhatoda vasica</i>	8.79 ± 2.71
5	<i>Curcuma longa</i>	8.62 ± 3.46
6	Control (Untreated)	8.12 ± 2.37

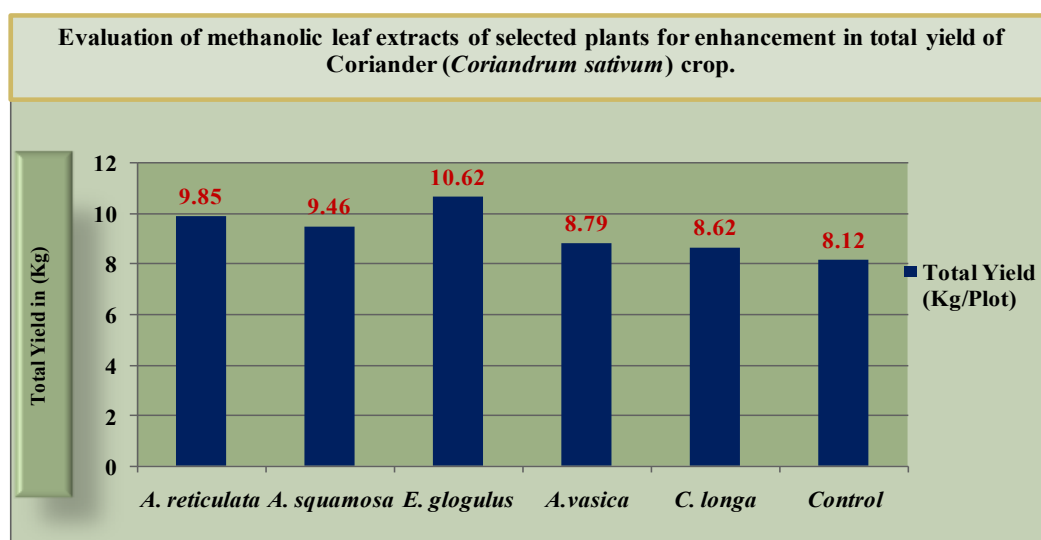


Figure 7: Evaluation of methanolic leaf extracts of selected plants for enhancement in total yield of Coriander (*Coriandrum sativum*) crop.

Table 5 presented the effect of methanolic leaf extracts of selected five plants like *Annona reticulata*, *Annona squamosa*, *Eucalyptus globulus*, *Adhatoda vasica* and *Curcuma longa* was evaluated for total yield of Coriander (*Coriandrum sativum*). The methanolic leaf extracts of all tested plants showed differences in their activity. Untreated (control) plants showed the lower yield 8.12 ± 2.37 Kg/ plot.

Significant differences were observed among treatments in the yield assessment per 10x10 feet plot. The use of extracts of *Annona reticulata* and *Annona squamosa* increased the yield to 9.85 ± 2.41 kg and 9.46 ± 2.68 kg respectively, indicating their positive effect on plant growth, development and productivity. The extract of *Eucalyptus globulus* yielded the highest yield (10.62 ± 2.43 kg/plot), proving its excellent effectiveness not only in reducing pest infections but also in improving crop performance. In contrast, treatments of *Adhatoda vasica* and *Curcuma longa* yielded 8.79 ± 2.71 kg and 8.62 ± 3.46 kg less per plot, which is slightly higher than the control. These results showed that, *Eucalyptus globulus* stands out as the most promising biological control option with significant yield benefits, further strengthening its potential as an ecofriendly alternative to the synthetic pesticide-based management in Coriander crop cultivation.

CONCLUSION:

The present study highlighted the importance of pesticide residue detection in Coriander (*Coriandrum sativum*) crop. It highlighted how pesticide levels in some products can exceed permissible limits, making them unsafe for consumption. Coriander showed the highest overall contamination, with Dimethomorph, Fluopyram and Spirotetramat and spirotetramat-enol exceeding the MRL, in addition to very high levels of pesticides that were beyond regulatory standards. In the present work, five aromatic plants viz., *Annona reticulata*, *Annona squamosa*, *Eucalyptus globulus*, *Adhatoda vasica* and *Curcuma longa* were studied as biocontrol properties. Each extracts showed unique bioactive potential, and together they demonstrated that natural products can successfully suppress pest growth and activity without leaving harmful residues. This study helps to contribute to develop a natural, sustainable pest management strategy that can reduce dependence on chemical pesticides and also helps to promote healthy agricultural practices.

Credit authorship contribution statement

A. D. Bokharepatil: Conceptualization, Writing – review & editing, Writing – original draft, Validation, Software, Methodology, Investigation, Formal analysis, Data curation. **C. D. Ghorband:** Writing – review & editing, Writing – original draft, Visualization, Validation. **M. M. Maindargikar:** Writing – review & editing, Writing – original draft, Visualization. **Saheb L. Shinde:** Supervision,



Funding acquisition, Formal analysis, Data curation, Conceptualization, Visualization.

Declaration of competing statement

The authors declare that they have no known competing financial interests or personal relationships that might have influenced the work reported in this paper.

REFERENCES

1. Hernandez A.F., Parron T., Tsatsakis A.M., Requena M., Alarcón R. and Lopez-Guarnido O. (2013). Toxic effects of pesticide mixtures at a molecular level: their relevance to human health. *Toxicology*. 307:136-145.
2. Ivey, K.L., Hodgson, J.M., Croft, K.D., Lewis, J.R. and Prince, R.L. (2015). Flavonoid intake and all-cause mortality. *Am J Clin Nutr*. 1:1012-1020.
3. Kock-Schulmeyer, M., Villagrasa, M., Lopez De Alda M., Cespedes Sanchez R., Ventura, F. and Barcelo, D. (2013). Occurrence and behavior of pesticides in wastewater treatment plants and their environmental impact. *Sci Total Environ*. 458:466-476.
4. Lemos, J., Sampedro, M.C., Arino, A, Ortiz, A. and Barrio, R.J. (2016). Risk assessment of exposure to pesticides through dietary intake of vegetables typical of the Mediterranean diet in the Basque Country. *J Food Compost Anal*. 49:35-41.
5. Li, W., Tai, L., Liu, J., Gai, Z. and Ding, G. (2014). Monitoring of pesticide residues levels in fresh vegetable from Heibei Province, North China. *Environmental Monitoring and Assessment*, 186(10):6341-6349.
6. Mac Loughlin, T. M., Peluso, Ma. L., Etchegoyen, Ma. A., Alonso, L. L., de Castro, Ma. C., Percudani, Ma. C. and Marino, D. J. G. (2018). Pesticide Residues in Fruits and Vegetables of the Argentine Domestic Market: Occurrence and Quality. *Food Control*, 93:129-138.
7. Oerke, E.C. and Dehne, H.W. (2004). Safeguarding production - losses in major crops and the role of crop protection. *Crop Prot*. 23:275-285.
8. Parron, T., Requena, M., Hernandez, A.F. and Alarcon R. (2014). Environmental exposure to pesticides and cancer risk in multiple human organ systems. *Toxicol Lett*. 230:157-165.
9. Sharma, A., Kumar, V., Shahzad, B., Tanveer, M., Sidhu, G. P. S., Handa, N. and Bali, A. S. (2020). Worldwide pesticide usage and its impacts on ecosystem. *SN Applied Sciences*, 2:1446.
10. Slavin, J. L. and Lloyd, B. (2012). Health benefits of fruits and vegetables. *Advances in Nutrition*, 3(4):506-516.

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