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Integrated Management of Pomegranate Fruit Borer (Virachola Isocrates) Through Chemical and Botanical Intervention

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Abstract

The pomegranate fruit borer (Virachola isocrates) is one of the most destructive pests of pomegranate, causing severe yield losses in major production areas. A field and laboratory experiment was conducted in Swat District during the 2024 growing season to evaluate the efficacy of chemical and botanical interventions against this pest. The study employed a randomized complete block design with three replications on 24 pomegranate trees (cv. Kandahari Anar). Four chemical insecticides (lambda-cyhalothrin, cypermethrin, indoxacarb, and bifenthrin), three botanical extracts (10% aqueous neem, water pepper, and eucalyptus), and a water-spray control were tested. Results revealed that chemical treatments, particularly lambda-cyhalothrin and cypermethrin, achieved the lowest fruit infestation (3.7-4.5%), complete larval mortality (100%), and the highest yields (15-16 t/ha). Botanicals provided moderate suppression, with neem and water pepper reducing infestation to 7-8% and achieving up to 81% larval mortality, significantly outperforming the control (15.6% infestation, 7.2 t/ha, 0% mortality). These findings suggest that while chemical insecticides remain the most effective option for rapid control, botanical extracts hold promise as eco-friendly alternatives and should be integrated into a sustainable pest management framework.

INTRODUCTION

Pomegranate (Punica granatum L.), a member of the family Lythraceae, is an attractive shrub or small tree, typically[6-9] meters in height, much-branched, spiny, and long-lived. Its leaves may be evergreen or deciduous, and the showy flowers appear singly or in clusters of up to five[1]. The crop grows best on deep, heavy loam soils but can adapt to a range of soil types from sandy to clayey textures, though growth in alkaline soils is generally poor. Optimal growth is achieved in deep, moist soils with a pH between 5.5 and 7.0[2]. It is widely cultivated across the Middle East, Caucasus, North and Tropical Africa, the Indian subcontinent, Central Asia, and drier regions of Southeast Asia. In recent years, its cultivation and commercial demand have expanded into Europe and the Western Hemisphere[1]. Globally, pomegranate is cultivated on approximately 0.3 million hectares with an annual production of 3.0 million tons (Sharma et al., 2014). In Pakistan, the crop covers an area of 9,434 hectares with an annual production of 42,641 tons[3]. Within Khyber Pakhtunkhwa, pomegranate is grown on 254 hectares with an output of 2,656 tons[3]. Cultivation in Swat is still at an initial stage, though farmers are increasingly investing in its commercial production due to its economic potential[4].

Nutritionally, pomegranate is rich in proteins (1.7%), fats (6%), carbohydrates (14%), minerals, and vitamins[5]. Beyond nutrition, the fruit and its derivatives have notable functional and medicinal properties, including antioxidant activity[6], anti-tumoral potential[7], anti-hepatotoxic effects[8], and cardiovascular health benefits[9]. Moreover, pomegranate exhibits antimicrobial, anti-inflammatory, antiviral, and antidiabetic properties [10-12], and has been reported to support treatments for oral ailments[13] and dermatological disorders[14]. Remarkably, it also plays a role in preventing neurodegenerative diseases[15].

MATERIALS AND METHODS

The study on managing the pomegranate fruit borer (Virachola isocrates) was carried out in Swat District during the 2024 growing season, using a randomized complete block design with three replications on 24 uniform pomegranate trees of the Kandahari Anar variety. The trial consisted of four chemical insecticides (lambda-cyhalothrin, cypermethrin, indoxacarb, and bifenthrin), three botanical extracts prepared as 10% aqueous solutions (neem, water pepper, and eucalyptus), along with a water-spray control. Treatments were applied twice at 15-day intervals during peak pest activity with a knapsack sprayer. To assess field efficacy, 100 fruits per tree were sampled randomly to estimate infestation percentage, and total yield was recorded and expressed in tons per hectare. In parallel, a laboratory bioassay was performed where neonate larvae were introduced onto treated fruits maintained at 27 ± 2°C and 70 ± 5% RH, with mortality observed up to 72 hours. Data on infestation, yield, and larval survival were subjected to ANOVA, and treatment means were compared using LSD at 5% significance, providing a clear evaluation of chemical and botanical interventions against the control

Data Analysis: The received data was analysed using computer statistics software Statistic. 8.1 version. Means were separated at alpha level=5% after applying LSD test

RESULTS AND DISCUSSIONS

The results demonstrated that chemical insecticides were highly effective in suppressing Virachola isocrates compared to botanicals and the untreated control. Among them, lambda-cyhalothrin produced the lowest fruit infestation (3.7%) and the highest yield (16.0 t/ha), while cypermethrin also achieved complete larval mortality under laboratory conditions. Bifenthrin and indoxacarb provided comparable control with slightly higher infestation levels (3.9-4.3%) and strong yield responses. In contrast, botanical extracts offered moderate protection, with eucalyptus, water pepper, and neem reducing infestation to 7-8% and recording larval mortality between 75-81%, which was still significantly better than the control (15.6% infestation, 7.1 t/ha yield, and 0% larval mortality). Overall, the study confirmed that chemical treatments gave the most rapid and reliable control, while botanicals contributed eco-friendly suppression, making them valuable components in an integrated pest management strategy.

The results clearly show that chemical insecticides outperformed botanicals in suppressing the pomegranate fruit borer. Lambda-cyhalothrin and cypermethrin were the most effective, with the lowest fruit infestation (˜3.7–4.5%), complete larval mortality (100%), and the highest yields (15–16 t/ha). Bifenthrin and indoxacarb also performed strongly, reducing infestation to below 5% and boosting yields above 15 t/ha. Among botanicals, neem, water pepper, and eucalyptus extracts provided moderate control, lowering infestation to 7–8% and achieving 75–81% larval mortality, which was still far better than the untreated control (15.6% infestation, only 7.2 t/ha, and no larval kill). The combined evidence highlights that while chemicals ensure rapid and reliable control, botanicals can play a supplementary role in sustainable integrated pest management.

The present study clearly demonstrates that chemical insecticides, particularly lambda-cyhalothrin and cypermethrin, are highly effective in reducing Virachola isocrates infestation and improving yield

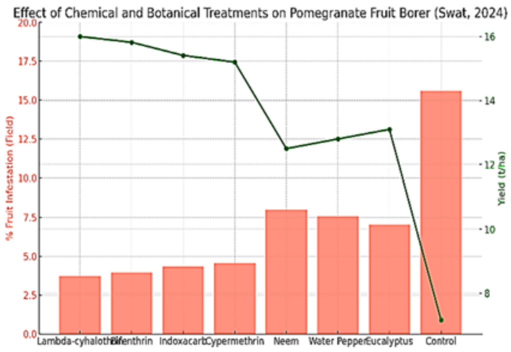

Fig. 1: Effect of chemical and botanical treatment on pomegranate fruit borer (Swat 2024)

Table 1. Effect of Chemical and Botanical Treatments of Pomegranate Fruit Borer (Virachola isocrates) under Field and Laboratory Conditions

Treatment	% Fruit Infestation (Field)	Yield (t/ha)	Larval Mortality % (Lab, 72h)
Lambda-cyhalothrin	3.74 ± 0.36	16.00 ± 0.49	100%
Bifenthrin	3.95 ± 0.32	15.82 ± 0.52	95–98%
Indoxacarb	4.35 ± 0.28	15.41 ± 0.44	92–95%
Cypermethrin	4.55 ± 0.28	15.20 ± 0.40	100%
Neem (Azadirachta indica)	8.00 ± 0.50	12.50 ± 0.38	81%
Water Pepper (P. hydropiper)	7.56 ± 0.27	12.80 ± 0.41	78.8%
Eucalyptus (E. globulus)	7.04 ± 0.70	13.10 ± 0.45	75–77%
Control (Tap Water)	15.57 ± 1.24	7.17 ± 0.43	0%

under field conditions, with both achieving complete larval mortality (100%) in laboratory bioassays. These findings align with earlier reports by Patel *et al*. (2012), who found pyrethroids to be highly effective against pomegranate fruit borer, and by Satpathy and Rai (2002), who emphasized the superior efficacy of synthetic insecticides over botanicals.

While chemical insecticides consistently delivered the highest yield gains (15-16 t/ha compared with 7.2 t/ha in untreated control), the risk of resistance development and environmental contamination underscores the importance of integrating botanical alternatives. In this trial, neem, eucalyptus, and water pepper extracts reduced fruit infestation to 7-8% and achieved 75-81% larval mortality, confirming the moderate but eco-friendly efficacy of botanicals. Similar results have been documented by Jat et al. (2017), who observed neem seed kernel extract suppressing fruit borer damage significantly in pomegranate orchards.

The control plots showed the highest infestation (15.6%) and the lowest yield (7.2 t/ha), reinforcing the economic importance of pest intervention. Seasonal studies further suggest that pest population peaks occur during July–August and January–February (Shinde et al., 2021), which corresponds well with the timing of sprays in this experiment, highlighting the role of phenology-based intervention.

Thus, an integrated pest management (IPM) framework that combines selective chemical applications with botanical extracts, along with cultural practices such as fruit bagging and orchard sanitation, can provide sustainable control of V. isocrates. Such strategies minimize pesticide overuse, delay resistance, and support eco-friendly cultivation-a critical need in fruit-growing regions like Swat.

REFERENCES

1. Aslam, M. N and J. Varani. 2006. Pomegranate as a cosmeceutical source: pomegranate fractions promote proliferation and procollagen synthesis and inhibit Matrix Metalloproteinase-1 production in human skin cells. J. Ethnopharmacol. 103:311-318.
2. Atwal, 1976. Agricultural pests of India and South-East Asia. Kalyani Publishers, New Delhi., 529 pp.
3. Agriculture extension department swat. 2015-16. Bulletin.
4. Balikai, R. A., Y. K. Kotikal and P. M. Prasanna.2011. Status of pomegranate pests and their management strategies in India. Acta Hort. 569-583.
5. Banker, G. J. 1988. Nutritive aspect of arid zone fruits and vegetables. In: Proceedings of training course on management of arid horticulture, conducted by CAZRI Jodhpur. 11-20.
6. Bhut, J. B., P. K. Borad and S. R. Vasava. 2015. Effect of bagging on incidence of anar butterfly, Virachola Isocrates Fab in pomegranate. Bioinfolet. 12: 338-339.
7. Butani, D. K., 1976. Insect pests of fruit crops and their control, pomegranate. Pesticides., 10: 23-26.
8. Cam, M. Y. Hisil and G. Durmaz. 2009.
9. Classification of eight pomegranate juices based on antioxidant capacity measured by four methods. Food Chem. 11: 721-726.

10. Chhetry, M. Gupta and J. S. Tara 2015. Bionomics of Deudorix isocrates Fab (Lepidoptera: Lycaenidae), a new potential host of sweet orange, Citrus sinensis L. Osbeck in J & K, India. I.J.S.N. 6(2): 238-241.
11. Cleik, I., A. Temur and I. Sik. 2009.
12. Hepatoprotective role and antioxidant capacity of pomegranate (Punica granatum) flowers infusion against trichloroacetic acid-exposed rats. Food Chem Toxicol. 47(1): 145-149.
13. Kambrekar and Cyazypyr 2015. For themanagement of grape flea beetle and thrips. Ind. J. of P. Prot.; 43: 411-415.
14. Davidson, M. H., K. C. Maki., M. R. Dicklin., S. B.Feinstein., M. S. Witchger and M. Bell. 2009. Effects of consumption of pomegranate juice on carotid intima-media thickness in men and women at moderate risk for coronary heart disease. Am. J. Card. 104: 936-42.
15. Patel, B. H., Patel, J. R., and Korat, D. M. (2012). Evaluation of insecticides against fruit borer, Deudorix (= Virachola) isocrates in pomegranate. Pesticide Research Journal, 24: 163–166.
16. Satpathy, S., and Rai, S. 2002. Efficacy of insecticides and neem formulations against pomegranate fruit borer (Deudorix isocrates). Indian Journal of Entomology, 64: 80–84.
17. Jat, R. K., Ameta, O. P., and Sharma, K. K. (2017). Field evaluation of insecticides and neem seed kernel extract against anar butterfly (Deudorix isocrates) in pomegranate. Journal of Applied and Natural Science, 9: 755–758.
18. Shinde, V. D., Patil, S. B., and Gokhale, N. B. (2021). Seasonal incidence and management of pomegranate fruit borer (Deudorix isocrates). Journal of Entomology and Zoology Studies, 9: 123–127.