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Strategies for effective integrated pest management of mango gall midge *Procontarinia matteiana* kieffer & cecconi and white mango scale insect *Aulacaspis tubercularis* newstead

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Abstract

"IPM means considering all available pest control techniques and other measures that discourage the development of pest populations, while minimizing risks to human health and the environment". Mango *(Mangifera indica* L.) is a popular fruit in tropical and subtropical climates. It is India's national fruit and is referred to as the "King of fruits". Midges are difficult to control with pesticitdes because of the galls; hence resistant cultivars can be used to manage them. "The genus Procontarinia Kieffer & Cecconi has 15 known and numerous nameless species, all of which feed on mango and some of which are pests of farmed mango over the world." *Aulacaspis tubercularis* Newstead (Hemiptera: Diaspididae) is a tropical, cosmopolitan, Polyphagous shielded scale which is viewed as one of the critical irritations of mango crops. Four insecticides were investigated for their efficacy in reducing larval population and gall development: Others include Bifenthrin (100 g/L EC), Nitenpyram (100 gft, SL), Emamectin Benzoate (14.21 EC), and Imidacloprid (2001 EC). The results indicated that Nitenpyram insecticide had the most elect on larval populations reduction (87.97 percent) and Emamecectin benzoate had the least effect (71.31 Percent). Developing rearing techniques and conducting effectiveness studies on indigenous natural enemies (Chilocorus beetles spp.) to determine control alternatives. The toxicity of residual pesticides in fruits and the impact of insecticides on the natural enemy complex.

Integrating indigenous and exotic natural enemies with suitable management techniques provides a sustainable and environmentally beneficial management alternative. Biological approach is the term used to describe the employment of live creatures, often natural enemies (e.g. parasites and parasitoids), to manage the *A ruberculis* pest. These species occur naturally in the environment, but can also be imported or boosted in abundance in a given location. As a result, Folimat is determined that manually spraying white mango scale on large mango trees, mostly at the small-scale fanner level, after a major infestation is extremely difficult. As a result, it is prudent to undertake frequent pruning, keep the plantation's overall stature controlled, and include the application of Integrated Pest Management techniques to the management of white mango scale infestations on mangoes.

Keywords: ***Procontarinia matteiana, Aulacaspis tubercularis,*** IPM, mango

Introduction

Mangoes are only found in South and Southeast Asia. They are one of the most loved natural products eaten-through internationally, with a generally speaking assessed utilization. However, pests that attack the organic product, stem, root, or mango leaf might have a significant impact on the mango's favourable to duction (Kusrini et al., 2020)[19]. In tropical and subtropical climes, the mango *(Mangifera indica L.)* is a popular fruit. Because of its flavour and nutritional value, mango is renowned as the "King of Fruits." Mangoes come in over 1595 different variations across the world, but only 25 to 30 cultivars are commercially farmed (Memon et al., 2017) [211. Mango *(Mangifera indica* L.) is India's national fruit and is referred to as the "King of fruits" owing to its adaptability, appealing colour, outstanding taste, unique flavour, and superb nutritional content, diversity, attractive look, and widespread popularity. This perennial crop, which thrives in a variety of agroclimatic settings, is subjected to a variety of biotic and abiotic stresses that restrict its production and productivity. The primary abiotic restrictions on low mango production and quality are water scarcity and nutritional deficits. Similarly, a variety of insect pests target many sections of the plant, including the trunk, branch, twig, leaf, petiole, inflorescence, and fruit (Bhut et. al.,2017)[4].

(Johnson et al., 2002)[17] stated that, due of the galls, midges are difficult to control with pesticides; thus, resistant cultivars can be employed to manage them. "The genus *Procontarinia Kieffer &* Cecconi contains 15 named and several unnamed species, all of which feed on mango, with several being pests of cultivated mango worldwide".

A. tuberculosis, where a higher degree of precision is necessary, but for bug the executives programmes, a 15% level of precision is acceptable. Furthermore, the dispersion, several mango cultivars, and inspection convention described here might be used as a platform for future research into board-level methods for this annoyance. (Bakry & Abdel-Baky, 2020)[2]. *Aulacaspis tubercularis* Newstead *(Hemiptera: Diaspididae) is* a tropical, cosmopolitan, polyphagous shielded scale that is considered one of the most serious pests of mango crops around the world, as it causes prominent pink imperfections on mango natural products, lowering their market value and making them unsuitable for trade markets. (del Pino et al., 2020)[9].

Integrated Pest Management (IPM)

Integrated pest management, often known as integrated pest control, is a broad-based strategy that integrates cost-effective and ecologically acceptable pest control tactics. IPM aims to maintain pest populations below the threshold where they pose a financial threat. "The careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest population and keep pesticide and other intervention to levels that are economically justified and reduce or minimize risks to human health arid the environment,* according to the Food and Agriculture Organization of the United Nations. 1PM emphasizes the creation of a healthy atop with the last amount of disruption to agro-ecosystems while promoting natural Mat management mechanisms," Entomologist and ecologists have lobbied for the introduction of IPM pest management since the 1970s. 1PM allows for safer pest management. IPM may also be used to prevent invasive species from being introduced and spreading by reducing asks while enhancing benefits and cutting costs. IPM is used m agriculture, horticulture, forestry, human habitations, cultural property preservation, and general pest control, which includes structural pest management, turf Pest management, and ornamental pest management (Steenberg. 2017, Dara,2019)[8].

IPM refers to the selection and execution of pest control strategies that have positive economic, ecological, and social consequences, and it applies to the majority of agricultural, public health, and amenity pest management scenarios. The initial phase in the 1PM process is monitoring, which includes inspection and identification, followed by determining economic damage thresholds. The economic harm levels define the economic threshold level. When the cost of treatment surpasses the cost of pest management, you've arrived at this stage. This can also be used as a non-economic action threshold level for identifying an undesirable amount In structural pest control, action thresholds are more prevalent than economic harm levels in traditional agricultural pest management. One fly in a hospital operating room, for example, is not acceptable, yet one fly in a kennel is. Once the pest population has passed a certain threshold, measures must be done to minimize and manage the pest In integrated pest management, cultural controls such as physical barriers, biological controls such as importing and conserving natural predators and adversaries of the insect, and chemical controls like as pesticides are all employed. Because it is based on knowledge, experience, observation, and the integration of many techniques, IPM is well suited for organic farming. The Organic Materials Review Institute's materials may or may not be included. Organic pesticides, especially insecticides, are frequently safer than synthetic pesticides, although they are not always safer or more environmentally friendly, and they can damage people. On traditional farms, IPM can reduce human and environmental exposure to hazardous pesticides while also potentially lowering costs. (Karuppuchamy and Venugopal, 2016, Hagstrurn and Flinn, 2018)[14,18]

An IPM program is a long haul, diverse framework to oversee bugs. Utilization of pesticides is a momentary answer for bug issues and ought to be utilized just when different parts neglect to keep up with the pest problems or their harm under a satisfactory level. Fruitful IPM specialists are educated with regards to the science of the plants and bothers and effective 1PM programs basically use mixes of social practices just as a blend of physical, mechanical and natural controls (City of Fountain Valley, n.d.). According to the United Nations' Food and Agriculture Organization (PAO). "IPM melee considering all available pest control techniques and other measures *that* discourage the development of pest populations, while minimizing risks to human health and the environment" (Bruneau et al., 2015) [5].

"Integrated Pest Management (IPM) is an environmentally friendly approach That integrates different practices and strategies for control of pests. 1PM aims to suppress pest populations below the economic injury level (EIL). EIL is the lowest pest population density that will cause economic damage. IPM is a method for analysis of the egro-ecosystem and the management of its different elements to control pests and keep them at an acceptable level with respect to the economic, health and environmental requirements (FAO)" (Murthy, 2019)[22]

Management of *Procontarinia mattelana*

Procontarinia was first identified based on the type species, P. *mattelana*, which is now known as a common mango pest throughout Asia and Africa. (Harris & Schreiner, 1992)[5]. A field explore was directed at Navsari Rural College AES Pavia, Gujarat, in randomized block design with three replications for assessment of various bug sprays against leaf nerve midge on mango cv. Kesar. Out of seven insect sprays assessed, ltnidaeloprid 0.005% was observed to be best over rest of the medicines showing least leaf harm (2.02%), best return (74.48 kg/tree and 2483 kg/ha), and greatest expense Advantage proportion (1:17.15). Thiamethoxam 0.008,4% and DDVP 0.05% were found next viable medicines for controlling the bug (Patel & Saxena, 2020). Social practices appear to somewhat stifle the bug, considering that *P. mangiferae* populaces were altogether higher on mango trees in business plantations than detached trees at all review areas (Rehman et al., 2016) [27], The pesticide Nitenpyram was shown to be relatively efficient against the larval population of mango gall midges, although plants treated with Bifenthrin had *the* least amount of gall growth. The use of insecticides to combat mango gall midges can be beneficial (Memon et al., 2017)[21].

Although infection levels in South Africa are far greater than in other areas of the world, *P. matteiana* has not yet caused significant harm to mangoes, necessitating the use of control measures. The economic costs of *P, matteiana* galling have never been calculated, and in South Africa, no chemical control techniques against *P. mattelana* have been registered. The pesticides tested against *P. matteiana* (methyl parathion, Malathion, monocroptophos and others) since they will have a deleterious effect on natural enemy complexes linked with mango and other insect pests of mango. The results reported here suggest that host-plant resistance may be a useful tool for controlling *P. matteiana*, If the mechanism underlying sensation's resistance could be uncovered, resistant characteristics may be incorporated into susceptible cultivars. Further research is needed to ascertain the percentage of susceptible cultivars' leaves and possibly fruits that are damaged, to demonstrate patterns of susceptibility in other mango-growing regions of South Africa, and to quantify *the* economic impact of *P. matteiana* damage in order to determine the feasibility of instituting control measures (Githure et al., 1998)[13].

(Javed et al., 1888) done to assess pesticides' efficacy in controlling mango midges in field circumstances. Four insecticides were investigated for their efficacy in reducing larval population and gall development: Imidacloprid (200 g/L SL), Bifenthrin (100 g/L. EC), Nitenpyram (100 g/L.SL), Emamectin Narrate (14.2 g/l.EC). The results indicated that Nitenpyrnm insecticide had the most effect on larval population reduction (87.97 percent) and (71.31 percent). Midge infestations persisted following treatment, however Biferithrin-boated trees developed galls at a rate of 0.27 4 81% to 1.16 k 27%. Where as Imidacloprid and Nitenpyram-treated trees developed galls at the same rate for all seven weeks. These discoveries might help to efficiently manage mango gall midges.

Management of *Aulacaspls tuberculais*

According to (del Pino et al., 2020)[9], A. tuberculosis is controlled by using a limited number of pesticides, the bulk of which are ineffectual and harmful to beneficial insects. Given existing European constraints on the long-term usage of phytosanitary treatments, it is necessary to prioritise alternate management tactics such as cultural control measures or biological control agents. Despite its economic importance, little is known about A. tubercularis management strategies, with the majority of studies concentrating on its life cycle and natural enemies in different mango-growing regions.

(Djirata, 2020)[10] experiment shown that, Folimat was the highly effective at reducing the population of white mango scales on mango. However, such very toxic pesticides should not be used to control white mango scales for ecological reasons. It was very hard to completely cover the indigenous tall and bushy mango trees with pesticide during the spray. As a result, it is determined that manually spraying white mango scale on large mango trees, mostly at the small-scale fanner level, after a major infestation is extremely difficult. As a result, it is prudent to undertake frequent pruning, keep the plantation's overall stature controlled, and include the application of Integrated Pest Management techniques to the management of white mango scale infestations on mangoes. Developing rearing techniques and conducting effectiveness studies on indigenous natural enemies (Chilocorus beetles spp.) to determine control alternatives. Control level and economic impact of cultural techniques used to combat the pest. The toxicity of residual pesticides in fruits and the impact of insecticides on the natural enemy complex. The introduction of the promised exotic natural enemies. An integrated pest control method that is both successful and ecologically benign is required for high-quality mango fruit production for export. Integrating indigenous and exotic natural enemies with suitable management techniques provides a sustainable and environmentally beneficial management alternative (Daneel, M.S. and Joubert, 2021)[7].

Biological Control

Biological approach is the term used to describe the employment of live creatures, often natural enemies, to manage the *A. tuberculls* pest. These species occur naturally in the environment, but can also be imported or boosted in abundance in a given location. To regulate insect populations, the approach makes use of processes such as predation, parasitism, and herbivory. Numerous natural enemies *have* been shown to be quite efficient in controlling white mango scale. "*Cybocephalus binotatus, Aphytis chionaspis, Aphytis mytilaspidis, Encarsia* citrine, Chilocorus, Scymnus syriacus, Sukunahikona prapawan, Rhyzobus pulchellusm, Rhyzpbius lophanthoe. Pteroptrix Koebelei and Aleurodothrips". Biological approaches provide sustainable pelt management since predators are capable of reproducing and proliferating in agricultural fields once introduced. A review of prior Cybocephalus releases, insect-proof tent testing, and lengthy field experiments in South Africa revealed that the predators successfully controlled scale populations to levels of 2-3 percent scale infestation. To efficiently remove white mango scale insects, the author proposes releasing these beetles at a rate of 500-1000 beetles per hectare. (Otieno. 2021). *Aulacaspis* tubercular's, the mango scale. It is a pest in all of South Africa's mango-producing areas. Scales consume the fruit, leaving sores on the outside that make it unfit for export. It was chosen to introduce an exotic biological control agent and try to establish it in various mango-producing regions because this pest is under good biological control in the majority of other mango-producing nations. As a result, the ectoparasitoid Aphytis chionaspis Ren (Hymenoptera: Aphelinidae) was imported from Thailand in 1995, mass-produced, released, and established in the bulk of mango-producing areas. During the years that followed, parasitoids were regularly monitored and retrieved at release locations, where they were determined to have successfully spread across these and neighboring orchards. High levels of parasitism were seen in specific areas following the discharge of A. chionaspis. A ten-year survey was conducted to analyze the presence and proportion of parasitism in the majority of mango-producing areas, with results that were quite similar to those obtained during the first three years of the study. This beneficial bug is widely known for contributing greatly to the biocontrol of A. tuberculosis in South Africa. (Daneel, M.S. and Joubert, 2021) PI. Mango production and productivity have recently been hampered by a variety of pests, particularly the invasive white mango scale insect pest. White mango scale has been a new insect pest and a severe concern in mango production in Western Oromia's East Wollega Zone Guto Gida area since 2010. Under field circumstances, the interaction impact of various pesticides and pruning did not reveal a significant difference in terms of white mango scale suppression during the first and second applications. However, there was a considerable difference in the major impacts (insecticides and pruning) after the first treatment. Movento 150 OD (60m1/15L13 trees) was proven to be beneficial in the control of WMS scale after the first and second applications. In terms of WMS suppression, dimethoate 40 percent EC (50m1/15L/3 trees) was likewise modestly effective after the first treatment and significantly effective after the second application. Movento 150 OD treated plots had the lowest mean number of WMS (1.57), followed by Dimethoate 40 percent EC (11.8) after first application and Dimethoate 40 percent EC (2.3) after second application, whereas mineral oil plus white oil bad lower mean numbers of WMS (15.97 and 8.2) after first and second applications, respectively, Similarly, following the initial application of mineral oil plus ordinary vegetable, a substantial percent reduction of WMS (59.9 percent) was seen in the plot treated with mineral oil plus ordinary vegetable (Atnafu, 2020) [1].

Literature from Previous Studies

Implementing an integrated pest control approach for mango pests requires a robust sample and monitoring programme for insects and mites. While individual species have made maven, accurate and proactive sampling procedures in mango agroecosystem$_s$ are still In their infancy, Midges, leafhoppers, caterpillars, thrips, and mites all damage mango blooms, A sequential sampling technique for monitoring hopper populations has been developed in India, but sampling procedures for Erosomyia mangiferae Felt and Dasyneura mangiferae (Felt), the mango blister and mango gall midges, are unknown. Pheromone traps am an easy way to keep track on fruit fly numbers, yet trap catches haven't been linked to crop danger in different places. *Sternochetus mangiferae (F.)* and *Sternochetus mangiferae (F.)* are mango seed weevils. Gravis (F.) has developed tactics for dissemination and sampling inside the tree, Protocontarinia matteiana Kieffer and Cecconi, Erosomyia spp., and Protocontarinia schreineri Harris are among the leaf and bud pests that are seldom tested. Aceria mangiferae Sayed, the mango bud mite, attacks terminal buds. Due to the difficulty of detecting mite densities in the field, the relationship between bud proliferation and densities might be used to predict intervention levels. Geographical distribution of Rastrococcus invadens Williams, a polyphagous mealybug that infests foliage, flowers, and fruits, was studied and binomial sampling procedures were developed to determine population counts. Because many mangoes are exported, the sampling intensity and knowledge of action thresholds must be considered in order to assure a high-quality product Consumer perceptions of the fruit's health and aesthetic qualities, as well as contemporary mango pest control, are determined not just by the fruit market, i.e., domestic consumption vs export, but also by consumer perceptions of the fruit's health and cosmetic qualities. In the management of mango pests, pesticides have a vital role. (Balock and Kozuma, 1964; Shaw, 1961; Goiez, 1991; Nachiappan and Basakrart, 1986b; Pea, 1993; Cunningham, 1989). Pest management expenses have increased, and in certain cases, higher quantities of pesticides are required to control a large number of pest species. Mangoes have a high value as an export fruit, with undamaged, high-quality fruit commanding the greatest prices. (Pella, 2002, Flint and Vanden Bosch, 2012)[26]

Mangoes cultivated for internal consumption, on the other hand, are inexpensive. As a result, the economic thresholds for pests that attack fruit, especially in impoverished countries, will be low for export fruit and frequently rather high for domestic fruit. Flint and van den Bosch (1981) 1121 established the foundation for integrated pest management in agroecosystems by emphasising sampling, economic thresholds, and natural mortality. However, there aren't enough sampling methodologies for some pests.

Pests that fit under this group include scales, trunk borers, and lepidopteran flower feeders. Linking sampling data to fruit infection at harvest is one of the most problematic parts of current sample protocols for fruit-feeding species. At the same time, measuring damage from fruit feeders during harvest is a rather simple operation. For organisms that destroy foliage or flowers, establishing economic thresholds is more challenging. It will be necessary to create and standardise an acceptable technique to ensure maximum benefit from an investigative study of the mango systems. Selection of sampling units, monitoring equipment, sample size determination, and random sample selection methods for various pest species. Current sampling procedures may not be enough to achieve survey objectives, such as assessing the pest's economic state or establishing whether a natural enemy is capable of reducing pest population density, as well as statistical analysis. Regardless of the sample method used, it must be efficient and time-saving. The difficulty is that researchers must invest time. energy, and money to develop an effective sample programme, and manufacturers must back these efforts, (Barzrnan et al., 2015, Chandler et al., 2011)[3,6].

Ornamental tree nurseries are plagued by exotic ambrosia beetles. Although these beetles are said to move into nurseries in the early spring from nearby wooded regions, few studies have looked at how far they travel to infest new host trees or whether mass trapping can safeguard a nursery crop. Nursery managers in the Southeast may need to be aware of a second, late-summer flight, in addition to the well-known spring flight peak. Captures from traps placed in a nursery at various distances (25 to 200 m) from the forest nursery interface in South Carolina revealed a significant linear and quadratic trend in decreasing numbers of beetles captured as distance from the forest increased, whereas significant linear, quadratic, and cubic trends were detected in Louisiana and Mississippi. Despite the fact that captures were lower along the nursery border than in the forest, traps placed at the nursery boundary may still be the ideal instrument for both monitoring and mass-trapping operations due to convenient access by workers. When susceptible tree cultivars are put deeper into nursery interiors and baited traps line nearby nursery boundaries, they may receive additional protection. (Werle et al., 2015, Parsa et al., 2014) [30. 24]

On the other hand, the other 1PM is expected to remain a dominant topic in agriculture. This method will include increased use of low-risk pesticides and genetically modified crops with built-in insecticides. Quick remedies are simple to implement and provide the farmer or pest consultant with the path of least resistance; however, actual IPM is complex, involves an ecological understanding of pest problems, and can be difficult to implement Those who insist on practicing actual IPM must develop: • a valid definition that incorporates the primary components of [PM; and • a set of performance standards based on this definition that will allow for quantitative evaluation of 1PM implementation in the field. This will prevent the other IPMs from succumbing to "mission creep." Policymakers and funding entities at all levels should be aware of the differences between these two types of [PM. (Ehler, 2006, Matyjaszczyk, 2018)[12°]I

Other gall midge species produce generations all year, especially in the warm, damp parts of the neotropics, but usually on herbaceous or bushy host plants. Another method for sustaining permanent populations is host change. On three Nyctaginaceae plant species in Jamaica, this gall midge grows roughly 17 generations every year. *P. mangiferae* populations varied substantially in size, from large numbers of individuals during mango flowering in the winter to hardly measurable levels during mango vegetative growth in the summer, despite their continual presence. A factor that diminishes genetic diversity is the considerable fluctuation in population size. In the populations taken at different sites and months, however, genetic tests showed no signs of a bottleneck. As a result, the genetic variety of *P. mangiferae* was retained throughout the year. *Anopheles arabiensis* Patton and *Anopheles junestus Giles* have both been found to lack a genetic bottleneck despite a substantial fall in effective population size during poor circumstances. According to these scientists, this was due to the small number of generations produced during the terrible season, but with a large effective population size on a large regional scale, as well as migration. Because of its short lifespan and limited capacity to migrate, these activities are unlikely to be implicated in the preservation of genetic variation in our case, a preliminary possibility is that a portion of the *P. Mangiferue* population goes into diapause every generation. Throughout summer generations, backcrosses between gall midges that emerge after diapause and those in the middle of their typical brief life cycle would occur. Another idea is that the nutrients offered by young mango leaves support enough populations for considerable genetic diversity to be maintained despite low individual density.

Immigrants must complete four objectives in order to successfully establish invasive populations: discover a habitat that can withstand abiotic circumstances; have access to materials necessary for their upkeep, development, and reproduction; find a spouse; and avoid reproductive death *P. mangiferae* possesses the necessary capabilities to fulfill the first two tasks, according to our findings. First, the mango blossom gall midge's ecological adaptability implies that it might thrive in habitats with favourable abiotic circumstances. Second, because larvae may feed on both mango inflorescences and immature leaves, they may be able to get the nutrients needed for reproduction regardless of the invaded nation's mango phonological season. Furthermore, 'founder effects,' which include genetic bottlenecks that result in severe genetic diversity losses, affect imported species. Despite its limited genetic diversity, P.mangiferae may feed on a variety of organs, demonstrating the species' phenotypic plasticity. It helps the gall midge's ability to spread and become invasive in new locations. *P. mangiferae* also has other adaptive qualities that help it endure and spread, such as 'r-selected' characteristics including a fast rate of reproduction and a short generation time. Our studies demonstrated that *P. mangiferae* has a lot of characteristics that indicate it is a good invader, which might explain its global distribution in mango-growing countries.

Conclusion

An IPM programme is a long-term, varied structure for bug administration. Pesticides are a temporary solution for insect concerns and should be used only when other measures fail to limit pest problems or their harm to a reasonable level. Fruitful IPM professionals are educated in the science of plants and pests, and effective IPM programmes primarily employ a combination of social behaviours as well as a combination of physical, mechanical, and natural controls. Tropical and subtropical climes enjoy the abundance of the mango *(Mangifera indica* L.), which is a popular fruit In India, it is referred to as the "King of Fruits" since it is the national fruit of the country. Because of the galls, midges are difficult to eradicate with insecticides; as a result, resistant cultivars may be employed to regulate their populations." *Procontarinia* is a genus that has 15 recognized species and an unknown number of unnamed species and some of which are pests of mango orchards across the globe." *Aulacaspis tubercsdaris* is a tropical, worldwide, polyphagous protected scale that is one of the most damaging pests to mango trees. It may be found in tropical and urban places across the world. Develop rearing procedures for indigenous natural enemies (Chilocorus beetles app.) and perform efficacy research on them in order to discover alternate control strategies. Insecticides' impact on the natural enemy complex, as well as the toxicity of residual pesticides in fruits, have been studied. Integrating indigenous and exotic natural enemies with appropriate management approaches results in a management option that is both ecologically friendly and long-term sustainable. In the management of the *A. tubercul1s* pest, The utilization of live organisms, most commonly natural adversaries, is referred to as a "biological approach" (e.g., parasites and parasitoids), In conjunction with other methods. These species may be found naturally in the ecosystem, but they can also be introduced into a new habitat or increased in population density in a specific place. Folimat's manually spraying white mango scale on big mango trees after a severe infestation is exceedingly difficult, especially at the small-scale fanner level.

As a consequence, it is essential to do periodic pruning, maintain the plantation's overall stature under control, and include Integrated Pest Management techniques into the management of white mango scale infestation on mango trees and fruit. According to this study, despite its limited genetic diversity, the invasive pest P. mangiferae demonstrated significant ecological and phenotypic flexibility by adapting to a variety of ecological contexts and feeding on numerous portions of a single host plant. Genetic diversity was also observed to be maintained throughout the year, despite the reduced population size in the summer.

Geographical localization, agricultural techniques, and climatic circumstances were discovered to organize populations.

The minimal genetic diversity revealed that the species had just recently arrived on Reunion Island. The capacity of this species to form permanent populations with a fraction of disabled individuals that conserve genetic variety in the face of severe conditions, as well as its ecological adaptability, are factors favouring its spread in new places and contributing to its global invasive success.

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