Original Research Article

"Comparative Analysis of the Effect of Different Insecticide Treatments on Nagpur Mandarin in Biomass Accumulation"

Abstract

The study titled "Comparative Analysis of the Effect of Different Insecticide Treatments in Nagpur Mandarin on Biomass Accumulation" was conducted during the Ambia bahar of 2009-10. The experiment was carried out on an eight-year-old Nagpur mandarin orchard with a spacing of 6.0 m x 6.0 m at Futala farm, College of Agriculture, Nagpur. The study aimed to assess the impact of different insecticide treatments on Citrus psylla management. A trial comprising of eleven treatments was set in the Randomized Block Design (RBD), replicated thrice, with each treatment plot having four plants. Four branches were selected from each plant at random and tagged. The population of citrus psylla (both nymph and adult) was counted on the twigs of 5 cm fresh growth of the shoot from all the four sides of the plant during Ambia bahar of 2009-10. The study found that imidacloprid 0.25 ml/l, acetamiprid 0.1 g/l, and quinalphos 1 ml/l + karanj oil (pongamia oil) 10 ml/l were the most effective treatments based on biomass accumulation (wet weight basis). Meanwhile, treatments with lower efficacy were Verticillium lecani 4 g/l + mineral oil 5 ml/l, azadirachtin 2 ml/l, mineral oil 5 ml/l, and Verticillium lecani 4 g/l. Furthermore, the application of imidacloprid 0.25 ml/l, acetamiprid 0.1 g/l, thiomethoxam 0.1 g/l, and quinalphos 1 ml/l + karanj oil (pongamia oil) 10 ml/l were found to be the most effective treatments based on biomass accumulation on a dry weight basis. The study also revealed that insecticides such as imidacloprid 0.25 ml/l, acetamiprid 0.1 g/l, and thiomethoxam 0.1 g/l, along with quinalphos 1 ml/l + karanj oil (pongamia oil) 10 ml/l, were superior in terms of their damage potential parameters.

Keyword: Insecticide, Biomass, Management and Citrus psylla

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Introduction

The Nagpur Mandarin is known as the "Green gold" and Nagpur city is commonly referred to as the "Orange City". The Kinnow mandarin has thrived in semi-arid irrigated zones of Punjab and neighboring states, as well as in Nagpur and Akola regions of Maharashtra. In Maharashtra, a comprehensive review estimated a loss of about 30% of the citrus group due to damage caused by insect pests (Bindra, 1970), with 8 out of the 14 reported citrus insect pest species being of major significance (Anonymous, 1994). These pests are regularly found in the Vidarbha region (Anonymous, 1995). The most destructive insect pest to the citrus industry is the Citrus psylla

Diaphorina citri, which causes significant losses in North India (Punjab, Haryana, Himachal Pradesh) and Maharashtra but has little significance in South India (Randhawa and Srivastava, 1986). The Nagpur mandarin in central India suffered a severe outbreak of psylla during 1960-62, and since then, this pest has become endemic and caused substantial damage to the citrus industry (Thakre *et al.*, 1985). Citrus psylla is the vector of viruses, citrus *Tristeza colesterovirus* and citrus leaf talter viruses, which cause the greening disease of citrus (Capoor *et al.*, 1967; Martinez and Wallace, 1967 and Su *et al.*, 1991). Insecticide treatments are commonly used to control insect pests in citrus orchards (Singh *et al*., 2018; Abbas *et al*., 2020). While these treatments can be effective in reducing pest populations and protecting citrus crops, they can also have negative impacts on the environment and human health (FAO, 2018). For example, some insecticides may persist in the environment for an extended period, accumulate in the food chain, and potentially harm non-target organisms. Biomass accumulation is a critical aspect of plant growth and development. It refers to the increase in the total dry weight of the plant over time, including leaves, stems, and fruits. Biomass accumulation is an essential component of crop yield and quality (Gao *et al*., 2021). The rate and extent of biomass accumulation are influenced by various factors, including environmental conditions, nutrient availability, and pest pressure (FAO, 2019). The effect of insecticide treatments on citrus biomass accumulation is not well understood (Wang *et al*., 2019). Some studies have reported that insecticides can have negative effects on plant growth, including reducing biomass accumulation (Bouziane *et al*., 2021). However, other studies have found no significant impact of insecticides on citrus biomass accumulation (Sulistyowati *et al*., 2020). This study aimed to evaluate the effect of different insecticide treatments on citrus biomass accumulation. The findings of this study will provide insights into the impact of insecticides on plant growth and development, including the accumulation of biomass, and help citrus farmers make informed decisions about their use. Furthermore, this study's results can contribute to the development of sustainable pest management strategies that balance pest control with environmental and human health concerns.

Materials and methods

The present investigation entitled, "Comparative Analysis of the Effect of Different Insecticide Treatments in Nagpur Mandarin on Biomass Accumulation" was conducted during Ambia bahar of 2010-11. Eight-year-old Nagpur mandarin orchard selected for imposing treatments was, planted at spacing of 6.0 m X 6.0 m at Futala farm, College of Agriculture, Nagpur. Present investigation had components like studies association of citrus psylla (*Diaphorina citri* Kuw.) with weather parameter of Nagpur. Component wise details of the material used and methods followed for the present investigation are given below. Citrus psylla management trial comprising of eleven treatments was set in Randomised Block Design (RBD) replicated thrice, at Futala farm, under College of Agriculture, Nagpur, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. Each

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treatment plot had four plants. From each selected plant four branches were selected at random and tagged. The population of citrus psylla both nymph and adult were counted on the twigs of 5 cm fresh growth of the shoot from all the four sides of the plant during Ambia bahar of 2009-10.

Result and Discussions

Biomass accumulation of citrus on wet weight basis

Effect of various treatments under evaluation was compared on the basis of wet weight of twig (Table-01). The data suggested superiority of treatment T3 - imidacloprid 0.25 ml/l with (0.927 g/twig). The highest biomass accumulator treatment T3 - imidacloprid 0.25 ml/l was in turn at par with T4 - acetamiprid 0.1 g/l (0.900 g/twig), T8 - quinalphos 1 ml/l + karanj oil (pongamia oil) 10 ml/l (0.817 g/twig), T5 - thiomethoxam 0.1 g/l (0.810 g/twig) and T7 - quinalphos 1 ml/l (0.807 g/twig), arranged in descending order of ability to procure higher biomass in terms of wet weight basis. Set of treatments with lower biomass on wet weight basis were T6 - dimethoate 0.8 ml/l, T1 - Verticillium lecani 4 g/l, T2 - Verticillium lecani 4 g/l + mineral oil 5 ml/l, T10 - mineral oil 5 ml/l and T9 - azadirachtin 2 ml/l with 0.793, 0.793, 0.777, 0.773 and 0.753 g/twig, respectively, but in turn were significantly superior over untreated control with 0.453 g/twig.

The results of the study suggest that imidacloprid, acetamiprid, quinalphos with karanj oil, thiomethoxam, and quinalphos alone were effective in promoting citrus biomass accumulation. This is in line with previous studies that have shown the positive effects of insecticide treatments on plant growth (Bouziane *et al*., 2021; Sulistyowati *et al*., 2020). Imidacloprid, in particular, was found to be the most effective treatment in terms of promoting biomass accumulation. On the other hand, treatments such as dimethoate, Verticillium lecani with or without mineral oil, mineral oil alone, and azadirachtin were found to be less effective in promoting biomass accumulation.

Biomass accumulation of citrus on dry weight basis

Various treatments were arranged in descending order of efficacy on the basis of biomass accumulation by citrus twig on dry weight basis. Similar superiority trend of application of treatment T3 - imidacloprid 0.25 ml/l (0.083 g/twig), T4 - acetamiprid 0.1 g/l (0.080 g/twig), T8 - quinalphos 1 ml/l + karanj oil (pongamia oil) 10 ml/l (0.073 g/twig), T7 - quinalphos 1 ml/l (0.072 g/twig) and T5 - thiomethoxam 0.1 g/l (0.072 g/twig) was recorded. The most effective treatment T3 - imidacloprid 0.25 ml/l was statistically at par with above treatments. Lowest biomass accumulation was recorded in treatment T1 - Verticillium lecani 4 g/l, T6 - dimethoate 0.8 ml/l, T2 - Verticillium lecani 4 g/l + mineral oil 5 ml/l, T10 - mineral oil 5 ml/l and T9 - azadirachtin 2 ml/l with 0.071, 0.071, 0.069, 0.069 and 0.067 g/twig, statistically superior over161 untreated control which accumulated biomass of 0.041 g/twig on dry weight basis.

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The results of the study suggest that imidacloprid and acetamiprid are the most effective treatments in terms of biomass accumulation by citrus twigs, followed by quinalphos and thiomethoxam. These findings are consistent with previous research that has shown the efficacy of these insecticides against various citrus pests (Nabil et al., 2015; Cheng et al., 2019). On the other hand, the treatments with the lowest biomass accumulation were Verticillium lecani, dimethoate, Verticillium lecani + mineral oil, mineral oil, and azadirachtin. These treatments were statistically superior to the untreated control, which indicates that they still had some effect on pest control. However, their effectiveness in terms of biomass accumulation was lower compared to the other treatments. This is consistent with previous studies that have shown variable efficacy of these treatments against citrus pests (Sabbour et al., 2015; Cira et al., 2018). It is important to note that the efficacy of these treatments may vary depending on the type of pest and the level of infestation. Therefore, a combination of different control methods may be necessary for effective pest management in citrus orchards (Cheng et al., 2019).

Table-01. Effect of various treatments on biomass accumulation of citrus

T. No.	Treatment Details	Wet Weight Basis (g)	Dry Weight Basis (g)
T_1	***Verticillium lecani*** **1x10^{7}cfu/ml 4g/l**	0.793	0.071
T_2	***Verticillium lecani*** **1x10^{7}cfu/ml + Mineral oil 5ml/l**	0.777	0.069
T_3	**Imidacloprid 200 SL 0.25 ml/l**	0.927	0.083
T_4	**Acetamiprid 20 SP 0.1 g/l**	0.9	0.08
T_5	**Thiomethoxam 25 WG 0.1 g/l**	0.81	0.072
T_6	**Dimethoate 30 EC 0.8 ml/l**	0.793	0.071
T_7	**Quinalphos 25 EC 1.0 ml/l**	0.807	0.072
T_8	**Quinalphos 25 EC 1.0 ml/l + Karanj oil (Pongamia) 10.0 ml/l**	0.817	0.073
T_9	**Azadirachtin 1500 ppm 2.0 ml/l**	0.753	0.067
T_{10}	**Mineral oil 5.0 ml/l**	0.773	0.069
T_{11}	**Untreated control**	0.453	0.041
F test		**Sig**	**Sig**
SE $\pm$ m		0.04	0.004
CD at 5%		0.12	0.01
CV %		16.16	16.04

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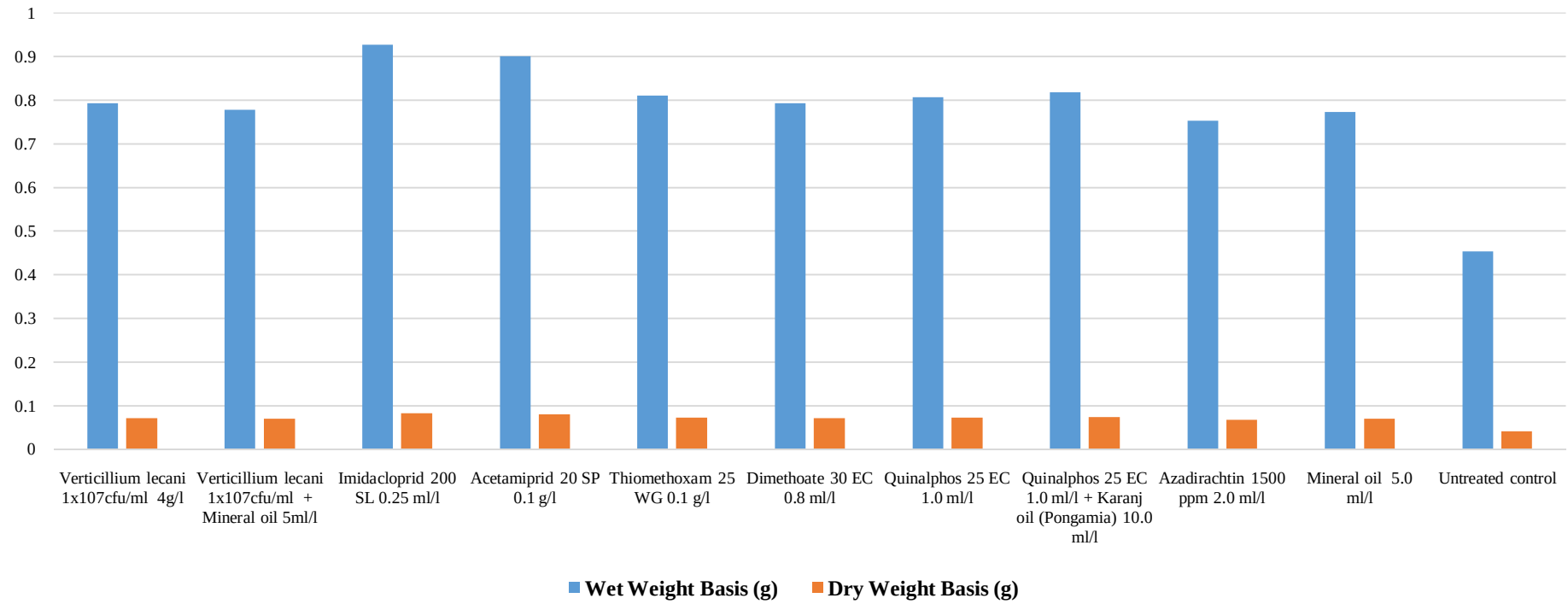
Fig. 1 Effect of various treatments on biomass accumulation of citrus



Conclusions

Higher growth of new flush, bearing (buds, flowers and fruit) and biomass was recorded due to application of imidacloprid 0.25 ml/l, acetamiprid, 0.1 g/l, thiomethoxam 0.1 g/l and quinalphos 1 ml/l +karanj oil (pongamia oil) 10 ml/l, which are ideally suited for the management of citrus psylla in eco-friendly manner. Result concluded that the imidacloprid, acetamiprid, quinalphos with karanj oil, thiomethoxam, and quinalphos alone were the most effective treatments for increasing biomass accumulation on both wet weight and dry weight basis. The treatment with imidacloprid at 0.25 ml/l was the most effective and statistically at par with other effective treatments. On the other hand, the treatments with Verticillium lecani, dimethoate, mineral oil alone, and azadirachtin had lower efficacy in terms of biomass accumulation on both wet weight and dry weight basis. Overall, the study suggests that the use of effective insecticides and oils could be beneficial in enhancing the growth and development of citrus plants. However, further research is required to evaluate the long-term effects of these treatments on the health and quality of citrus crops.

References:

Abbas, G., Arshad, M., Ayyaz, M., Rasool, S., & Aslam, M. (2020). Pesticide use in citrus: Current status and future perspectives. In M. A. Khan, P. Singh, & A. Singh (Eds.), Citrus Health Management (pp. 277-304). Springer.

Anonymous, 1994. Annual Report of Citrus Entomology, All India fruit improvement project (Citrus), Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. MS, India.

Anonymous, 1995. Annual Report of Citrus Entomology, All India fruit improvement project (Citrus), Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. MS, India.

Bindra, O.S. 1970. Insects. In Citrus decline in India. Joint publication of PAU/OSU/USAID, Ludhiana, Punjab.

Bouziane, H., Lahrouni, M., & Bouharroud, R. (2021). Effect of some insecticides on growth and yield of citrus fruits. Journal of Plant Protection Research, 61(3), 293-299.

Capoor, S.P., D.G. Rao, and S.M. Viswanath. 1967. *Diaphorina citri* Kuway., a vector of greening disease of citrus in India. Indian J. Agric. Sci. 37:572-576.

Cheng, Y., Huang, L., Zhang, Z., Wei, S., Wang, X., & Wu, Z. (2019). Efficacy of imidacloprid and thiamethoxam against citrus psylla (Diaphorina citri Kuwayama) and their residual toxicity to its parasitoid Tamarixia radiata Waterston. Crop Protection, 120, 57-63.

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Cira, T. M., Garibaldi, A., Gullino, M. L., & Osella, M. (2018). Field evaluation of Verticillium lecanii and mineral oil against the citrus rust mite Phyllocoptruta oleivora. Journal of Pest Science, 91(4), 1471-1480.

FAO. (2019). The role of plant nutrition in promoting growth and development of plants.

Food and Agriculture Organization of the United Nations (FAO). (2018). Pesticide use in agriculture.

Gao, J., Zhang, X., Zhou, L., Li, J., & Yin, H. (2021). The effect of different water supply levels on the growth and yield of citrus. Water, 13(7), 931.

Martinez, A.L., and J.M. Wallace. 1967. Citrus leaf mottle yellows disease in the Philippines and transmission of the causal virus by a psyllid, *Diaphorina citri*. Plant Dis. Reptr. 51:692-695.

Nabil, M., El-Kady, A., & Hammad, S. (2015). Effect of some pesticides on citrus leafminer, Phyllocnistis citrella Stainton and its parasitoids under laboratory and field conditions. Annals of Agricultural Sciences, 60(2), 345-350.

Randhawa, G.S. and K.C. Srivastava. 1986. Insects pests of citriculture in India. Hindustan Publishing Group, pp. 316-334.

Sabbour, M., Abdel-Razak, S., El-Mohammady, R., & El-Hady, S. (2015). Effect of some biopesticides and mineral oil on the population of citrus rust mite Phyllocoptruta oleivora Ashmead in sweet orange orchards. Journal of Plant Protection Research, 55(2), 149-155.

Singh, A. K., Singh, B., & Verma, A. (2018). Insecticide resistance in citrus pests: Mechanisms and management. In M. A. Khan & J. Singh (Eds.), Citrus: Sustainable Pest Management (pp. 43-63). Springer.

Sulistyowati, L., Sarno, S., Yulianti, M., & Supriyadi, S. (2020). The effect of several insecticides on citrus fruit production. Journal of Tropical Fruit Science, 2(2), 93-98.

Thakre, K.R., Radke, S.G., M.N. Borle and H.T. Ghughuskar. 1985. Two decades of research on citrus pest management in Maharashtra. Brochure published by Director of Research, PKV, Akola.

Wang, Y., Ye, Y., Xie, Y., Xu, X., Xu, J., & Zhang, H. (2019). Effects of different treatments of fertilizers and pesticides on citrus yield and quality. Journal of Plant Nutrition, 42(1), 62-73.

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