Journal of
Current Opinion in Crop Science
Journal homepage: www.jcocs.com; ISSN(O):2583-0392

SHORT COMMUNICATION

An effective dosage of neem (*Azadirachta indica* Juss) and aloe vera (*Aloe barbadensis* Miller) extracts against adult aphid (*Myzus persicae* Sulzer) and melon flies (*Bactrocera cucurbitae* Coquillet)

Happiness Stephano Malolo[1*], Lilian Fanuel Shechambo[1], & Martin John Martin[2]

[1]Department of Crop Science and Horticulture, Sokoine University of Agriculture, Morogoro, Tanzania.
[2]Institute of Pest Management, Sokoine University of Agriculture, P.O Box 3110, Morogoro, Tanzania.

Edited by:

Prisila Andrea Mkenda, Department of Biosciences, College of Natural and Applied Sciences, Tanzania.

Reviewed by:

G. Rajadurai, Department of Agricultural Entomology,Tamil Nadu Agricultural University, Coimbatore-3, TN, India.

T. Sathyan, IART, NMV University, Aruppukottai, Tamil Nadu, India.

Article history:

Received: July 15, 2024
Accepted: September 01, 2024
Published: September 30, 2024

Citation:
Malolo, H. S., Shechambo, L. F., & M. J. Martin. (2024). An effective dosage of neem (*Azadirachta indica* Juss) and aloe vera (*Aloe barbadensis* Miller) extracts against adult aphid (*Myzus persicae* Sulzer) and melon flies (*Bactrocera cucurbitae* Coquillet). *Journal of Current Opinion in Crop Science, 5*(3), 157-163
https://doi.org/10.62773/jcocs.v5i3.252

ABSTRACT

The objective of the study was to evaluate the efficaciousness dosage of aqueous extracts of neem (*Azadirachta indica* Juss) and aloe vera (*Aloe barbadensis* Miller) at different concentrations (40%, 60%, and 80%) against adult melon flies (*Bactrocera cucurbitae* Coquillet) and aphids (*Myzus persicae* Sulzer) in laboratory conditions. The experiments were designed and conducted from April to June 2023 at Sokoine University of Agriculture, Tanzania. The study found that as extract concentrations increased, there was a noticeable drop in insect survival. The dosage of 80% at 48 hours and 60% at 72 hours were observed to perform better as few were observed to survive. At the highest dosage of 80% and 60%, extracts from neem and aloe vera both resulted to 100% insect mortality. The results highlight the potential of aloe vera and neem extracts to have a positive effect on insect pest management rather than untreated crops.

Keywords: *Aloe barbadensis,* aphids, aqueous extracts, *Azadirachta indica*, infestations, melon flies

*Corresponding author e-mail address: malolo.hapnes@yahoo.com
(Happiness Stephano Malolo)

INTRODUCTION

Neem (*Azadirachta indica* Juss) is a small to medium-sized tree in the Meliaceae family, widely distributed in tropical and semitropical regions, including America, Tanzania, Nigeria, Pakistan, India, and Nepal (Ujah et al., 2021). It is a 23-meter-tall evergreen tree with a 10 meter diameter base. Each of the compound, imparipinnate leaves have five to fifteen leaflets. *A. indica* trees can begin to fruit and flower as early as 4–5 years old, but they don't start producing enough seed to be economically viable until 10–12 years old. Insects like honeybees are responsible for pollination. Its green drupe fruits

mature into golden yellow from June - August (Alzohairy, 2016). It serves as human food, animal feed, charcoal fuel, and gum. It is utilized as neem tea, medicine, fuel (as charcoal), food for humans, animal feed, lipids, gum or resin, tannin or dyestuff, and as a pesticide (as azadirachtin) to kill crop pests like beetles, thrips, grasshoppers, termites, aphids, moths, and flies (Mondal and Chakraborty, 2016). Azadirachtin causes incomplete ecdysis in immature insects by inhibiting the prothoracic gland's ability to synthesise and release molting hormones, or ecdysteroids. A similar mechanism of action results in sterility in adult female insects (Isman, 2006).

Aloe vera, scientifically known as *Aloe barbadensis* Miller, is a member of the Liliaceae family including thick, short-stemmed plants that retain water in their leaves (Mallavadhani et al., 2016). The plant is perennial, xerophytic, succulent, shrubby, or arborescent, and typically has a pea-green colour. The leaves of the Aloe plant mature in a rosette shape, beginning at the base. The maximum height of mature plants is within the range of 2.5 inches to 4 feet, while their average length falls between 28 and 36 inches. The average number of mature leaves produced by a plant is between 12 and 16, with a maximum weight of three pounds. The plant's medical, cosmetic, medicinal, and skin care advantages have been acknowledged and employed for millennia (Sharma et al., 2014). The substance comprises minerals such as calcium and potassium, vitamins A, B12, C, and E responsible for antioxidant activity, enzymes like cellulase and amylase that facilitate the hydrolysis of carbohydrates and fats, sugars like glucose and glucomannans, and anthraquinones, which serve as laxatives. Salicylic acid, possessing anti-inflammatory and antibacterial properties, is present in hormones such as auxins and gibberellins, fatty acids with anti-inflammatory, antiseptic, and analgesic effects, as well as in aloin and emodin, which display analgesic, antibacterial, and antiviral activities (Kar and Bera, 2018; Sivakumar et al., 2019). Parikshit et al. (2019) reported that extracts derived from neem and aloe vera are effective in managing insect pests that affect several crops including cabbage, tomatoes, tea plants, and soybeans. Bioactive substances such as alkaloids, flavonoids, steroids, terpenoids, glycosides, polysaccharides, and tannins are present in both neem and aloe vera leaves. Furthermore, these chemicals possess pesticidal, antibacterial, and anti-inflammatory characteristics (Raphael, 2012).

The region of Morogoro, Tanzania, presents significant obstacles to sustainable crop production due to the detrimental effects of pests, namely aphids (*Myzus persicae* Sulzer) and melon fly (*Bactrocera cucurbitae* Coquillet), which endanger both crop yield and livelihoods. Aphids are a common insect pest that infests cucumber plants and can transmit infectious viruses such as the papaya ringspot virus and the yellow mosaic viruses, which specifically target cucumbers, watermelon and zucchini. Common indications of aphid infestation include leaf curling, wilting, yellowing, and plant stunting (Liang et al., 2017). Conversely, the Melon fruit fly (*B. cucurbitae*) attacks the immature, green, and delicately textured fruits. Subsequently, the fruit undergoes decay or distortion (Sharma et al., 2016). Chemical insecticides were extensively employed in agricultural fields to control these bug infestations. The chemicals have a rapid onset of action and efficacy in the control of insect pests. However, they may also lethally affect non-targeted creatures, including beneficial insects such as pollinators, predators, and parasitoids. Furthermore, the extensive use of synthetic insecticides has been documented to cause resistance (Ahmed et al., 2020), thereby posing challenges for farmers in managing insect pests and resulting in increased production expenses. Hence, the utilisation of these substances has generated apprehensions regarding the long-term viability of the environment, the well-being of humans, and the development of pesticide-resistant pests, so underscoring the necessity for employing alternate, environmentally friendly methods for pest control (Mamiro et al., 2015).

In recent years, the exploration of botanical extracts as biopesticides has gained momentum, offering a promising avenue for sustainable agriculture. Neem (*Azadirachta indica* Juss) and aloe vera (*Aloe barbadensis* Miller) have emerged as noteworthy candidates due to their ecological friendliness. Neem, with its active compound azadirachtin, has demonstrated potent insecticidal properties, disrupting various physiological processes in pests (Isman, 2006). Aloe vera, rich in secondary metabolites, has exhibited insecticidal and repellent effects against agricultural pests (Kumar et al., 2017). Despite the potential insecticidal properties of these plants, the correct dosage of application is not well exploited and thus, farmers lack this information. So, the present study investigated the appropriate dosage of aqueous extracts of neem (*A. indica*) and aloe vera (*A. barbadensis*) against aphids (*M. persicae)* and melon flies (*B. cucurbitae)* infestation of the crop. This information helps researchers to test the performance of these effective doses under field conditions.

MATERIALS AND METHODS

The study was carried out at the Edward Moringe campus of Sokoine University of Agriculture (SUA) in Morogoro, Tanzania at the Institute of Pest Management, from April to June 2023. Weighing balance was used to measure 40, 60 and 80g of fresh aloe vera and neem leaves. Aqueous extracts were prepared by washing and chopping fresh leaves, followed by blending and maceration. Later 40, 60, and 80g macerated materials were dissolved in 100 ml of water respectively for 48 hours to prepare 40, 60, and 80 % solution for spraying purpose. The extracts were then filtered by using polypropylene cloth ready for use. The diagrammatic representation of experimental activities is presented in Figures 1 & 2.

The colony of the aphid (*Myzus persicae*) was obtained from diseased leaves of cucurbit crops at the Crop Museum of Sokoine University of Agriculture and thereafter dehydrated at ambient temperature. Species identification was accomplished by meticulous examination of their unique attributes. Peach aphids possess a black head and thorax, a yellowish-green abdomen sporting a prominent dark patch on the dorsal side, and a length ranging from 1.8 to 2.1 mm. The diseased foliage was placed in the insect-rearing enclosures overnight for 24 hours. Subsequently, all adult aphids were extracted and euthanised to initiate a fresh generation. To facilitate aeration and prevent aphid escape, the enclosures were covered with muslin material and secured with a rubber band. Each two days, the aphids were given fresh, un-infested Chinese cabbage (*Capsicum annuum* L.) seedlings. The insects were kept at a temperature of 21 ± 1°C and a relative humidity of 70 ± 5%.

Melon flies (*B. cucurbitae*) were obtained from infested cucumber fruits collected from local farmer's fields. The fruits were placed in the cages provided with a small amount of sandy soil to facilitate pupation in the laboratory. The emerged young fruit flies were fed with Vitaminor (brewer's yeast and biergist) mixed with sugar. Two to three spoons of food were mixed with one spoon of sugar per petri dish. Water was provided in a separate petri dish with gravel to facilitate landing. Identification of the specie was done by considering their distinctive characteristics like wing pattern, black T pattern abdomen, reddish yellow thorax with light yellow markings and the head yellowish with black spots. After, ten days, 20 adult females were mixed with 10 males in one cage to allow mating. In the cage, young cucumber fruit sliced to facilitate oviposition was exposed. The incubation period was 4-5 days.

A population of 50 adult aphids of five days were sprayed with 40,60, and 80% concentrations of the plant extracts using a hand sprayer (Potter tower method) on infected Kale (*Brassica napus* Premier) grown in a plastic jar. Each test was replicated 3 times. Survival of the insects was recorded for 24, 48, and 72 hours. A total of 50 adult flies of seven days per cage were exposed to the petri dishes containing the extract of different concentrations (40, 60, and 80%) by dipping method in a petri dish to test the efficacy of neem and aloe vera. Each test was replicated 3 times. Survival of the insects was recorded for 24, 48, and 72 hours.

Figure 1. Infected seedlings in plastic jars, hand sprayers, and Aphids infest kale leaves, as observed during experimental activities.

Figure. 2. Infected cucumber fruits in plastic container, weighing balance and melon flies reared during experimental activities.

The dead and alive insects were counted to calculate the efficacy percentage. Efficacy (%) = Insect's mortality number/ Total number of insects × 100. The experimental design employed a Completely Randomized Design with treatments including neem and aloe vera extracts at 40%, 60%, and 80% doses, alongside a control (water), each replicated three times. Each treatment group received botanical extracts applied while control groups received only water. Data on insect survival were collected at 24, 48, and 72 hours post-exposure. Data were analyzed using GENSTAT 16th edition 32. One-way ANOVA was used to test the differences between mean concentrations of the botanicals while multiple comparisons were performed using Tukey's HSD test at a significance level of 5%.

RESULTS AND DISCUSSION

Neem and aloe vera aqueous extracts at a concentration of 80% (80g of fresh leaves in 100mls of water) reduced aphids by 100% at 48hrs, followed by a concentration of 60% at 72hrs, and finally, a concentration of 40%, which reduced aphids by 43% at 72hrs. In contrast, in the control groups, the aphid population increased by 2% with time (Figure 3). The findings indicate a significant reduction in aphid populations in the treatment groups compared to the control. The higher doses demonstrated increased efficacy, indicating a potential concentration-dependent impact on pest control. The consistent trend observed in the study, indicated the effectiveness of these extracts increases with the increase of concentration as Kabir (2023) described a dose dependent increase in toxicity of *Aloe vera* leaf powder against adult *C. maculatus* in cowpea. As noted by previous research (Hikal et al., 2017), the efficacy of botanical extracts in pest management can vary significantly based on factors such as concentration. The observations' dose-dependent character aligns with the concepts of pharmacology and toxicology, which have shown a close relationship between the effectiveness and safety of a chemical and its concentration and application method (Guedes et al., 2016). The careful selection of an addition is crucial for enhancing the consistency of a product and minimising the observed variations in its effectiveness (Juma et al., 2022). This knowledge is crucial for fine-tuning application recommendations, ensuring maximum pest control benefits while minimizing any potential risks associated with higher concentrations. The study's insights are intended to address unique challenges, focusing on dose-dependent responses and minimizing environmental and non-target species impacts on field settings (Elhamalawy et al., 2024).

Both plant extracts at a concentration of 80% reduced adult melon flies by 100% at 48hrs, followed by a concentration of 60% at 72 hrs, and finally, a concentration of 40%, which reduced melon flies by 45% at 72hrs. There is no significance difference observed at 72hrs in both 60% and 80% concentrations of both extracts because these are the two effective dosages. Insects exposed to control remained constant or decreased due to natural deaths by 0.04% (Figure 4). The findings indicate a dose-dependent reduction in melon fly populations in the treatment groups compared to the control. All concentrations of aqueous neem and aloe vera leaf extracts reduced the survival of the melon flies *(B. cucurbitae)* but the difference was the number of insects killed per time. The shorter time after exposure indicates the best performance of the extract. The use of neem and aloe vera extracts aligns with the principles of sustainable agriculture, providing an eco-friendly alternative to synthetic pesticides. This approach addresses concerns related to environmental impact, human health, and the development of pesticide-resistant pests the same result as reported by Haldhar et al. (2017). Neem, containing azadirachtin, disrupts physiological

processes in insects, while aloe vera has insecticidal and repellent effects against agricultural pests (Mallavadhani et al. 2016). The efficacy of these treatments was often higher than negative controls (Gacheru, 2015)

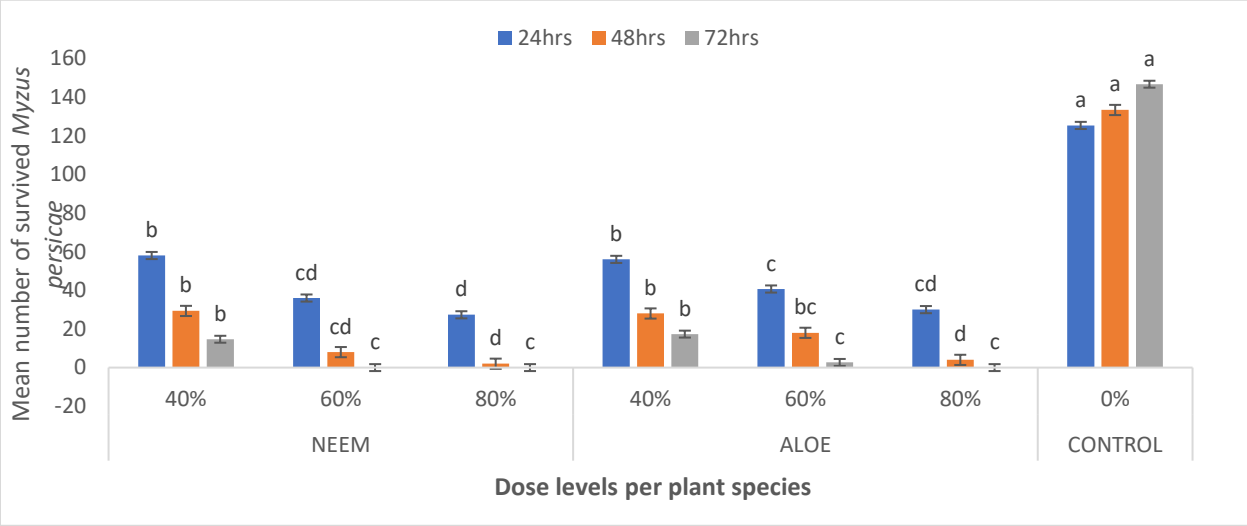

Figure 3. Exposure of adult aphids (*Myzus persicae*) to different dosage of neem and aloe vera. The bars show means number of survivors. Bars with the same letters are not statistically significantly different at P<0.05.

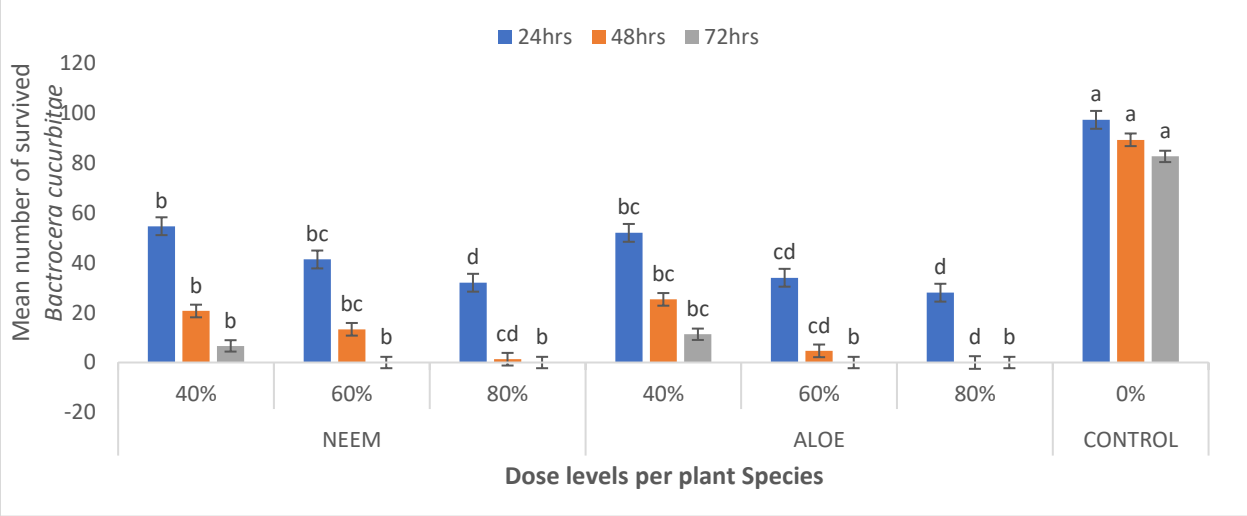

Figure 4. Exposure of adult melon flies (*Bactrocera cucurbitae*) to different dosage of neem and aloe vera. The bars show means number of survivors. Bars with the same letters are not statistically significantly different at P<0.05.

CONCLUSION

The efficacy dose of aqueous extracts of neem and aloe vera against aphids (*M. persicae*) and melon flies (*B. cucurbitae*) that was tested provides insight into the management of these insect pests. To test for phytotoxicity, the longevity of the effects, the potential effects on organisms that are not the target, and the economic feasibility of large-scale application in field settings, additional research is required.

ACKNOWLEDGMENT

The author wishes to thank all collaborators at Sokoine University of Agriculture (SUA) for their technical and guidance support during the development of this study.

FUNDING

No funds were obtained for this study.

AUTHORS CONTRIBUTION STATEMENT

All authors made contributions to the conception, design and execution of the study as well as to the analysis of the results and drafting of the manuscript.

CONFLICT OF INTERESTS

The authors declare no conflict of interest.

REFERENCES

Abubakar, A. R., & Haque, M. (2020). Preparation of medicinal plants: Basic extraction and fractionation procedures for experimental purposes. *Journal of Pharmacy & Bioallied Sciences, 12*(1), 1-10. https://doi.org/10.4103/jpbs.jpbs_175_19

Alim, M. A., Song, J., Lim, U. T., Choi, J. J., & Hossain, M. A. (2017). Bioassay of plant extracts against Aleurodicus dispersus (Hemiptera: Aleyrodidae). *Florida Entomologist, 100*(2), 350-357. https://doi.org/10.1653/024.100.0234

Dively, G. P., Patton, T., Barranco, L., & Kulhanek, K. (2020). Comparative efficacy of common active ingredients in organic insecticides against difficult to control insect pests. *Insects*, *11*(9), 614. https://doi.org/10.3390/insects11090614

Elhamalawy, O., Bakr, A., & Eissa, F. (2024). Impact of pesticides on non-target invertebrates in agricultural ecosystems. *Pesticide Biochemistry and Physiology*, 105974. https://doi.org/10.1016/j.pestbp.2024.105974

Frelier, J., Cummins, D., & Motsenbocker, C. (2021). Sustainable Gardening for School and Home Gardens: Cantaloupe and Watermelon, pp1-17.

Gacheru, J. M. (2015). Efficacy of neem formulations for controlling aphids and whiteflies on cabbage and tomatoes. Master of Science dissertation, (pp1-120), Kenia.

Guedes, R. N. C., Smagghe, G., Stark, J. D., & Desneux, N. (2016). Pesticide-induced stress in arthropod pests for optimized integrated pest management programs. *Annual Review of Entomology 61*(1), 43-62. https://doi.org/10.1146/annurev-ento-010715-023646

Haldhar, S. M., Jat, G. C., Deshwal, H. L., Gora, J. S., & Singh, D. (2017). Insect pest and disease management in organic farming. *Towards Organic Agriculture; Gangwar, B., Jat, NK, Eds*, (pp 359-390).

Hikal, W. M., Baeshen, R. S., & Said-Al Ahl, H. A. H. (2017). Botanical insecticide as simple extractives for pest control. *Cogent Biology, 3*(1), 1-16. https://doi.org/10.1080/23312025.2017.1404274

Isman, M. B. (2006). Botanical insecticides, deterrents, and repellents in modern agriculture and an increasingly regulated world. *Annual Review of Entomology 51*, 45-66. https://doi.org/10.1146/annurev.ento.51.110104.151146

Juma, P., Njau, N., Micheni, C. M., Khan, H. A., Mitalo, O. W., & Odongo, D. (2022). Trends in Neem (Azadirachta indica)-Based Botanical Pesticides. In *New and Future Development in Biopesticide Research: Biotechnological Exploration* (pp. 137-156). Singapore: Springer Nature Singapore. https://doi.org/10.1007/978-981-16-3989-0_5

Kabir, N. (2023). Evaluation of the Insecticidal Efficacy of Aloe vera L. Leaf Powder on Adult Bean Weevil (*Callosobruchus maculatus* (F.)). *Sahel Journal of Life Sciences FUDMA 1*(1), 32-38. https://doi.org/10.33003/sajols-2023-0101-004

Kar, S. K., & Bera, T. K. (2018). Phytochemical constituents of Aloe vera and their multifunctional properties: A comprehensive review. *International Journal of Pharmaceutical Sciences and Research, 9*(4), 1416-1423.

Kumar, S., Das, A., Mandal, S., & Mukherjee, A. (2017). Aloe vera: A potential herb and its medicinal importance. *Journal of Chemical and Pharmaceutical Research, 9*(2), 187-192.

Mallavadhani, U. V., Prasad, B. R., Soujanya, P. L., Rao, M. B., & Ratanlal, M. (2016). Aloe vera (L.) Burm. f.: A highly useful Indian traditional plant for the management of maize storage pest, *Sitophilus oryzae* L. (Coleoptera: Curculionidae). *Journal of Biopesticides, 9*(2), 157.

Marina, A. A. N., Nondenot, A. L. R., Landry, O. C., & Christian T. D. K. (2018). Entomofauna of cucumber *Cucumis sativus* (L.), damage assessment caused by insect pests in Dabou in south of Côte d'Ivoire. *International Journal of Fauna and Biological Studies, 5*(6), 27-34.

Mondal, E., & Chakraborty, K. (2016). Azadirachta indica-A tree with multifaceted applications: An overview. *Journal of Pharmaceutical Sciences and Research, 8*(5), 299-306.

Mukherjee, P. K., Nema, N. K., Maity, N., & Sarkar B. K. (2013). Phytochemical and therapeutic potential of cucumber. *Fitoterapia 84*, 227-236. https://doi.org/10.1016/j.fitote.2012.10.003

Mwatawala, M., Kudra, A., Mkiga, A., Godfrey, E., Jeremiah, S., Virgilio, M., & De Meyer, M. (2015).

Preference of Zeugodacus cucurbitae (Coquillett) for three commercial fruit vegetable hosts in natural and semi natural conditions. *Fruits, 70*(6), 333-339. https://doi.org/10.1051/fruits/2015034

Mwatawala, M., Maerere, A., Makundi, R. H., & De Meyer, M. (2010). Seasonality and host plant preference of Bactrocera cucurbitae in Central Tanzania. *International Journal of Pest Management 56*(3), 256-273. https://doi.org/10.1080/09670871003596792

Nietupski, M., Ludwiczak, E., Olszewski, J., Gabryś, B., & Kordan, B. (2022). Effect of Aphid Foraging on the Intensity of Photosynthesis and Transpiration of Selected Crop Plants in Its Early Stages of Growing. *Agronomy, 12*(10), 1-14. https://doi.org/10.3390/agronomy12102370

Rahman, M. S., Ahmed, A. U., Jahan, K., & Khatun, F. (2020). Management of Cucumber Mosaic Virus (CMV) infecting cucumber in Bangladesh. *Bangladesh Journal of Agricultural Research 45*, 65-76.

Raphael, E. (2012). Phytochemical constituents of some leaves extract of *Aloe vera* and *Azadirachta indica* plant species. *Global Advanced Research Journal of Environmental Science and Toxicology, 1*(2), 014-017.

Sharma, A., Rana, C., & Shiwani, K. (2016). 19 Important insect pests of cucurbits and their management. pp. 327-359.

Sharma, P., Kharkwal, A. C., Kharkwal, H., Abdin, M. Z., & Varma, A. (2014). A review on pharmacological properties of Aloe vera. *International Journal of Pharmaceutical Sciences Review and Research, 29*(2), 31-37.

Sivakumar, P., Ashokkumar, K., Rajalakshmi, K., Sangeetha, R., Muthumalai M. (2019). A review on in vitro propagation of miraculous physician *Aloe vera* (L.). *Research Journal of Biotechnology, 14*(9), 126 – 130.

Ujah, I. I., Nsude, C. A., Ani, O. N., Alozieuwa, U. B., Okpako, I. O., & Okwor, A. E. (2021). Phytochemicals of neem plant (Azadirachta indica) explains its use in traditional medicine and pest control. *GSC Biological and Pharmaceutical Sciences*, *14*(2), 165-171. https://doi.org/10.30574/gscbps.2021.14.2.0394

Uthpala, T. G. G., Marapana, R. A. U. J., Lakmini, K., & Wettimuny, D. C. (2020). Nutritional bioactive compounds and health benefits of fresh and processed cucumber (*Cucumis Sativus* L.). *Sumerianz Journal of Biotechnology, 3*(9), 75-82.