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Comparative Effect of Biopesticides on Sucking Insects and Yield of Bitter Gourd

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Abstract

The effect of different botanical extracts on the population density of aphids, whiteflies, and thrips in bitter gourd (*Momordica charantia*) was studied at the Agricultural Research Institute, Tarnab, Peshawar, Pakistan, during 2017–18. The experiment was conducted in a Randomized Complete Block Design (RCBD) with three replications and five treatments: Cypermethrin, *Azadirachta indica* (Neem), *Parthenium hysterophorus*, *Eucalyptus globus*, and a control. Results showed that both cypermethrin and botanical extracts significantly reduced pest populations and increased yield. The lowest number of aphids (0.88/leaf), whiteflies (0.90/leaf), and thrips (0.93/leaf) was recorded in cypermethrin-treated plots, followed by neem extract. In contrast, the highest numbers of pests were observed in control plots, with aphids (5.60/leaf), whiteflies (8.89/leaf), and thrips (5.96/leaf). The maximum number of fruits per plant (22.79) and yield (24.80 kg per treatment) were obtained with cypermethrin, followed by neem extract, whereas the control treatment produced the lowest yield (10.81 kg per treatment). Among botanicals, neem extract was the most effective in suppressing pest populations, performing better than eucalyptus and parthenium extracts. These results suggest that neem extract can be a valuable component of Integrated Pest Management (IPM) programs for bitter gourd. The findings highlight the potential of combining eco-friendly botanicals with reduced reliance on synthetic insecticides for sustainable crop protection.

Keywords: Bitter gourd pest management using *Azadirachta indica*, Cypermethrin, and control of whiteflies and thrips.

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Introduction

Bitter gourd (*Momordica charantia*), commonly known as karela, bitter melon, and balsam pear, is an essential vegetable crop in Southeast Asia, celebrated for its high nutritional and medicinal value. It belongs to the Cucurbitaceae family, alongside other important crops like squash, watermelon, muskmelon, and cucumber (Palada and Chang, 2003). Bitter gourd is rich in vitamins and minerals and is particularly known for its high concentrations of Vitamin C and Vitamin A, which are significantly higher compared to other cucurbits (Palada and Chang, 2003). Additionally, it is widely recognized for its medicinal properties, particularly in managing diabetes, due to its bioactive components such as antioxidants (Krawinkel and Keding, 2006). Bitter gourd is not only a food source but also serves as a traditional medicine in many cultures for treating a variety of ailments, including digestive disorders, skin diseases, and liver problems (Kubola and Siriamornpun, 2008). In terms of cultivation, bitter gourd is an annual crop grown in tropical and subtropical regions. It is typically sown from January to June in regions with mild winters, although in colder climates, it is often grown as a summer crop (Singh et al., 2006). Bitter gourd thrives in well-drained, sandy loam soil, and its cultivation requires moderate temperatures and sufficient sunlight. In Pakistan, bitter gourd is cultivated on 6017 hectares, yielding approximately 56949 tons of produce. In the Khyber Pakhtunkhwa province, 528 hectares are dedicated to bitter gourd cultivation, producing 4713 tons annually (MINFAL, 2018-19). The crop is an important part of the agricultural landscape in Pakistan, providing both food and income for many farmers. Despite its numerous benefits, bitter gourd is highly susceptible to a range of pests, including aphids, whiteflies, thrips, fruit flies, and mites, which attack various stages of plant growth and cause significant yield losses. These pests are known to cause damage by feeding on the plant, leading to reduced photosynthesis, wilting, and in severe cases, the death of the plant (Hussain and Ahmad, 2012). The damage caused by these pests can lead to crop losses ranging from 30% to 80%, severely affecting the productivity of bitter gourd farms. Aphids, such as *Myzus persicae*, are one of the most common and damaging pests in bitter gourd cultivation. They are sap-sucking insects that feed on the leaves, young shoots, and stems, leading to wilting and deformation of plant parts. Aphids also excrete a sugary substance called honeydew, which encourages the growth of sooty mould on the leaves, further reducing the plant's ability to photosynthesize (Capinera, 2005; Barbercheck, 2014). Aphids are known to carry and transmit several plant viruses, including the Cucumber mosaic virus and the Tobacco mosaic virus, which can severely reduce plant vigour and yield. Thrips (*Thrips tabaci*) are another major pest affecting bitter gourd. These tiny insects are known to damage flowers, leading to reduced fruit set and deformation of the plant's structure. Female thrips lay their eggs inside the flowers, and the larvae feed on the plant tissues, which can reduce flower production by up to 60% (GPP, 2009). Thrips can also transmit viral diseases, further compounding the problem. The feeding activity of thrips leads to significant yield losses in bitter gourd crops. Whiteflies (*Bemisia tabaci*) are also significant pests of bitter gourd. These small, sap-sucking insects spend most of their life cycle on the underside of leaves. Whiteflies are known to cause damage by

feeding on the plant's sap, leading to yellowing of the leaves, reduced plant vigour, and stunted growth. Whiteflies also excrete honeydew, which can cause the development of sooty mould on the leaves, further inhibiting photosynthesis (Mustafa, 1995; Nyoike, 2007). In addition to direct feeding damage, whiteflies are vectors for several plant viruses, including the Tomato yellow leaf curl virus, which can cause severe damage to crops (Abrahamian and Abou-Jawdah, 2014). Fruit flies, such as *Bactrocera cucurbitae*, are notorious for attacking the fruits of bitter gourd. These pests lay their eggs inside the fruits, and the larvae feed on the fruit pulp, causing it to rot and leading to significant crop loss. The presence of fruit flies can make the harvested produce unmarketable, reducing the overall yield of bitter gourd crops (Singh et al., 2006). To mitigate the damage caused by these pests, a variety of pest management strategies have been developed. Traditional pest management approaches include the use of chemical insecticides, cultural practices, and biological control methods. However, chemical insecticides, while effective, have significant drawbacks, including the development of resistance in pest populations and harmful effects on non-target organisms, including beneficial insects and humans (Sarwar, 2015). Moreover, many of these chemicals are not environmentally friendly and can accumulate in the food chain, posing risks to human health and the ecosystem (Kumar and Thakur, 2017). Cultural practices such as crop rotation, mulching, and the use of reflective mulches have been employed to reduce pest populations and improve crop health. Mulching, in particular, has been shown to reduce the infestation of whiteflies and other pests by preventing their colonization of the plant (Frank and Liburd, 2005). Other cultural practices include the removal of infected plant debris and the use of sticky traps to monitor pest populations (Basu, 1995). Biological control methods have also gained popularity as a more sustainable alternative to chemical pesticides. Natural enemies of aphids, such as ladybird beetles and parasitic wasps, can help suppress pest populations (Kos et al., 2008). Fungal pathogens like *Beauveria bassiana* and *Metarhizium anisopliae* have shown promise in controlling whiteflies and thrips, providing a more environmentally friendly pest management solution (Faria and Wraight, 2001).

Objective of the Study:

Given the challenges posed by pests in bitter gourd cultivation and the potential harm caused by chemical pesticides, this study aims to evaluate the effectiveness of natural plant extracts and a synthetic insecticide (Cypermethrin) in controlling the population density of aphids, whiteflies, and thrips in bitter gourd crops.

Results

The experiment regarding "effect of different plant extracts on the population density of aphids, whitefly and thrips on Bitter gourd *Momordica charantia* was conducted at the Agricultural Research Institute, Tarnab, Peshawar, Pakistan, during 2017-18. Randomized Complete Block Design (RCBD) was used in this trial, having five treatments (Cypermethrin ®25% EC (Sipermethrin 80-120 ml/ha), *Azadirachta indica* 10 Kg/ha, *Parthenium hysterophorus*. L. leaves extract 10 Kg/ha, *Eucalyptus globus* leaves extract 10 Kg/ha and Control (Water spray) that was replicated three times. Data on the relevant parameters are as follows. The experiment conducted in 2017-18 at the Agricultural Research Institute Tarnab, Peshawar, comparing Cypermethrin and various plant extracts (*Azadirachta indica*,

Parthenium hysterophorus, Eucalyptus globus, and a control) on pest control in Bitter gourd, showed significant differences across treatments. Cypermethrin was the most effective, reducing aphid, whitefly, and thrips populations significantly, with the lowest mean values observed for pests and the highest fruit yield (22.79 fruits/plant and 20670 kg/ha). Among plant extracts, *Azadirachta indica* was the most effective botanical treatment, significantly reducing pest populations and resulting in 18.55 fruits/plant and 16126 kg/ha yield. *Parthenium hysterophorus.* And Eucalyptus Globus was less effective, with yields of 13411 kg/ha and 13374 kg/ha, respectively. The control treatment showed the highest pest populations (aphids: 5.60, whiteflies: 7.91, and thrips: 5.96), and the lowest yield (9008 kg/ha). These results highlight that while Cypermethrin provided the best control, *Azadirachta indica* performed comparably in pest management, making it a viable alternative in Integrated Pest Management (IPM) strategies.

Table: Comparison of Natural Plant Extracts and Cypermethrin on Different Parameters in Bitter Gourd Crop

Treatments	Aphids/ Leaf	Whiteflies/ Leaf	Thrips/Leaf	Fruits/Plant	Yield per Treatment (kg)	Yield (kg/ha)
Cypermethrin (T1)	0.88 d	0.90e	0.93 d	22.79a	24.80a	20670a
***Azadirachta indica* (T2)**	2.60c	2.18d	2.66 c	18.55b	19.35b	16126b
Parthenium	3.00 b	2.66c	3.12 b	15.20c	16.05c	13411c
***hysterophorus.* (T3)**						
Eucalyptus globus (T4)	3.22 b	2.82b	3.16 b	15.38c	16.04c	13374c
Control (T5)	5.60a	7.91a	5.96 a	9.62 d	10.81d	9008 d

The population density of aphids was significantly lower in the Cypermethrin-treated plots (0.88) compared to all the plant extracts and the control. The control had the highest aphid population (5.60). Statistically, the treatments showed significant differences, with Cypermethrin being the most effective in reducing aphid density. Cypermethrin also showed the lowest whitefly population (0.90), while the control had the highest (7.91). The results showed significant differences between the treatments, with Cypermethrin outperforming all plant extracts, followed by *Azadirachta indica* and *Parthenium hysterophorus.*. Similarly, Cypermethrin was the most effective treatment in reducing thrips (0.93), while the control again showed the highest thrip population (5.96). Statistically significant differences were observed among the treatments. Cypermethrin-treated plants had the highest mean number of fruits per plant (22.79), followed by *Azadirachta indica* (18.55). The control plants had the lowest mean (9.62). Statistical differences were observed among all treatments, with Cypermethrin showing the best result. Cypermethrin-treated plants had the highest yield per treatment (24.80 kg), significantly higher than the other treatments. The control plants had the lowest yield per treatment (10.81 kg). Statistical analysis confirmed that Cypermethrin was the most effective in terms of yield. The yield per hectare

followed similar trends, with Cypermethrin having the highest yield (20670 kg/ha) and the control having the lowest (9008 kg/ha).

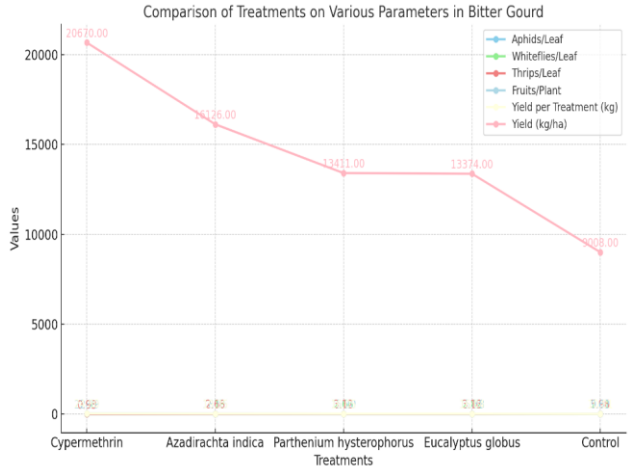

Fig: aphid, whitefly, and trip population density, fruits per plant, yield per treatment, and yield per hectare),

Discussion

An experiment was conducted at the Agricultural Research Institute, Tarnab, Peshawar, Pakistan, during 2017-18 to evaluate the effect of different plant extracts and Cypermethrin on the population density of aphids, whiteflies, and thrips on Bitter gourd *(Momordica charantia)*. The experiment utilized a Randomized Complete Block Design (RCBD) with five treatments: Cypermethrin (25% EC), *Azadirachta indica* (10 Kg/ha), *Parthenium hysterophorus*. (10 Kg/ha), Eucalyptus globus (10 Kg/ha), and Control (water spray), replicated three times. The results showed that Cypermethrin was the most effective in reducing the population of aphids, whiteflies, and thrips, leading to significantly higher fruit yield. This is because Cypermethrin attacks the insect nervous system and inhibits sodium ions, leading to rapid pest reduction (Rahman et al., 2014; Kumar and Thakur, 2017; Sharma and Tayde, 2017). These findings are consistent with Ali et al. (2011), who reported the effectiveness of chemical insecticides over natural extracts. Among the natural plant extracts, *Azadirachta indica* was the most effective against aphids, whiteflies, and thrips, resulting in higher fruit numbers and yield. Azadirachtin, the active compound in *Azadirachta indica*, has anti-feeding and growth-regulating properties, which hinder insect growth (Sarwar, 2015). This is supported by previous studies, including those of Kumar and Thakur (2017) and Kuswaha and Painka (2016). *Parthenium hysterophorus*. It was also noted for its anti-feeding action, which minimizes pest damage (Datta and Saxena, 2001). The results for *Azadirachta indica* in controlling whitefly align with findings by Ali et al. (2011), who reported the lowest whitefly populations in plots treated with *Azadirachta indica*, followed by *Parthenium hysterophorus*.. Similarly, Rashid et al. (2016) observed the lowest pest populations in *Azadirachta indica*-treated plots. Regarding yield, Nehra et al. (2019) found that Spinosad-treated plots produced the highest marketable yield, followed by Neem treatments, which is consistent with the findings of this study.

Conclusion,

Cypermethrin was the most effective for pest control and increased yield, while *Azadirachta indica* was the best-performing botanical extract among the tested treatments. All plant extracts performed better than the control in suppressing pest populations.

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