INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print), 2222-5234 (Online)
http://www.innspub.net
Vol. 14, No. 1, p. 293-299, 2019

RESEARCH PAPER OPEN ACCESS

Management of *Bemisia tabaci* (*Hemiptera: Aleyrodidae*) through plant based derivatives on *Abelmoschus esculentus* under field conditions in District Mardan, Khyber PakhtunKhwa, Pakistan

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Key words: Whitefly, Management, Okra, Neem oil, Garlic oil.

http://dx.doi.org/10.12692/ijb/14.1.293-299 Article published on January 26, 20199

Abstract

Okra is an important vegetable sown all over the globe due to its nutritional value and taste. It is attacked by a tiny fly known as Whitefly. It suck the sap and also transmit Begomovirus to the okra. Whitefly being the major pest of Okra cause decline in the yield therefore, for the management this research was conducted. The efficacy of naturally occurring plant based derivatives were tested against whitefly population dynamics on Okra. Okra was sown in Randomized Complete Block Design (RCBD) having five replications. Treatments included Neem oil (5%), Garlic oil (5%), Castor oil (5%), *Datura innoxia* extract (2.5%), and *Tegetes patella* extract (2.5%) and Confidor were evaluated against whitefly population dynamics. A total of two sprays were applied with interval of 15 days. The results revealed that after 1st spray, neem oil showed high efficiency by having minimum number (0.11) of whitefly followed by confidor (0.12). After the 2nd spray, the effectiveness of all treatments increased with the exposure time. All the treatments showed high mortality by having less numbers of whitefly. Maximum shoot length was achieved with neem oil and confidor 148 cm respectively followed by castor oil 147cm. Most number of fruits (18 per plot) were found in neem and garlic oil treated plants followed by confidor 17. Maximum fruit weight was achieved with all the treatments over check. It is therefore, concluded that due to the hazardous effects of insecticides on ecosystem, these naturally occurring safe plant based insecticides should be applied for whitefly management

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Introduction

Okra (*Abelmoschus esculentus*) belongs to family *Malvaceae*, locally named as "BINDI" and the common English name given is Lady Finger. Okra is originated from the Ethiopian region of Africa, but now widely grown in Africa, Asia, Central and South America (George, 1985). It is one of the most important vegetable of Pakistan. Okra is commonly cultivated in the plain areas of Punjab and Sindh provinces (Anwar *et al.,*2011).

Okra is a nutritious fruit bearing vegetable. It provides us a cheap source of vitamins, calcium, potassium and some important mineral constituents for our diet which are often lacking in the diet intake of developing countries (IBPGR, 1990).

In Pakistan, this crop is grown during warmer season and approximately its total production is 2.86×10^6 tons (Hussain *et al.,* 2012).

Okra production is lowered due to many biotic problems like insect pests and pathogens. Some of the important pests are i.e. cotton aphid (*Aphis gossypii*), spotted bollworm (*Earias insulana*), American bollworm (*Helicoverpa armigera*), jassid (*Amrasca devastans*) and Whitefly (*Bemesia tabaci*) (Sardana *et al.,* 2004). Whitefly has been found responsible for damaging many cultivated crops as well as wild species of plants, however, the intensity of attack and damage vary according to the climate and plant species.

Whitefly is having sucking type of mouth parts that is it sucks the cell sap of the plant. The other damage which whitefly causes is the transmission of viral diseases and secretion of honey-dew which hinder the photosynthetic process (Inayatullah *et al.,*1985).

Farmers generally uses very toxic petro-chemicals for pest management and getting the desired higher yield. Indiscriminate use of insecticide leads to the problems of insect pest resistance, resurgence, bioaccumulation and magnification, destruction of beneficial insects like bees and bioremediation.

Globally due to the efforts of environmentalists, because of the negative impact of pesticides, a voice is echoed for lowering the indiscriminate use of these petro chemicals and thus scientists are shifting to safer naturally occurring ways of pest managements like botanicals and biological control. Several botanicals have been checked for toxic properties which have the potential to become alternatives to persistent insecticides. Since, botanicals give decent control and also they are environmental friendly, so now the trend is shifting from petro chemicals to safer botanicals to deal with pest problems.

Thus, this study was designed to evaluate the efficacy of some naturally occurring botanicals essential oils against Whitefly on Okra crop.

Materials and methods

The experiment was carried out at the newly developed agriculture research farm of Abdul Wali Khan University, Mardan, Pakistan. Okra (cv. Rama Krishna) crop was sown in the spring (March. 2018). A total of seven treatments were included in the trial. These treatments are mentioned in the Table 1. Each treatment was replicated five times. Treatments were laid out in Randomized Complete Block Design (RCBD).

Essential oil and insecticide were purchased from District Peshawar, Khyber Pakhtunkhwa local market (GhurMandi) while plant extracts were prepared using the method of Ali *et al.,* (2016). Plot size was 3 × 3m. Seed were sown at the ridges. The distance between "plants to plant" was 30cm while "row to row" distance was kept 60cm. The recommended cultural practices like weeding and irrigation were done as per requirement. The first spray was done before the debut of the whitefly. The first spray was followed by a second spray. A total of 15 days gape was kept between the two sprays. The data of the treatments were recorded 24 hour (h) before the application of treatments and 24, 48, 72 and 168 hours (H) after the spray. The populations of whitefly were recorded per leaf at random from top, middle and bottom section of plant (Jha and Kumar, 2017).

Data on plant growth parameters was also recorded before termination of the experiment. Shoot and fruit length was measured using measuring tape while numbers of fruits per plot were also counted.

Data analysis

Analysis of variance (ANOVA) was used for data analysis and mean of the treatments were separated by Duncan's Multiple Range Test (DMRT) using the statistical software STATISTIX (8.1).

Results and discussion

First spray

Twenty four hours after 1st spray the results revealed that garlic and castor oil showed the least population of whitefly 0.26 and 0.25 per leaf, respectively (Table 2), followed by neem oil and plant extract of *T. patula* 0.28 whitefly per leaf, plant extracts of *D. innoxia* got 0.32 whitefly per leaf. While highest population was observed in control (0.43).

Table 1. List of treatments sprayed against Whitefly population on Okra at field conditions.

S.No	Treatment	Type	Dose
1	Neem	Plant Based Essential oil	5%
2	Garlic	Plant Based Essential oil	5%
3	Castor	Plant Based Essential oil	5%
4	*Datura innoxia*	Plant Extract	2.5%
5	*Tagetes patula*	Plant Extract	2.5%
6	Confidor	Imidochloprid (Neonicotinoid Insecticide)	Standard
7	Simple Distal Water (SDW)	-	-

After 48H of the 1st spray, highly effective treatment was neem oil (0.16 per leaf) which was highly significant from other treatments, followed by castor oil (0.18 per leaf) and then followed by garlic oil and *D. innoxia* 0.20 and 0.21 respectively as shown in Table 2. Plants treated with confidor contained 0.32 whitefly per leaf which was highly significant from control (0.42).

Table 2. Effect of plant based essential oils and extracts against Whitefly population dynamics after 1st spray in Okra field.

Treatment	Pre Data (24 H before	24 H After	48 H After	72 H After	168 H After
Neem oil	0.26 D[a]	0.28 D	0.16 F	0.12 E	0.11 E
Garlic oil	0.22 E	0.26 E	0.20 D	0.18 BC	0.18 B
Castor oil	0.19 F	0.25 E	0.18 E	0.17 C	0.18 B
D.innoxia	0.31 C	0.32 C	0.21 D	0.14 D	0.14 D
T. patula	0.26 D	0.28 D	0.23 C	0.18 BC	0.16 C
Confidor	0.37 B	0.39 B	0.32 B	0.19 B	0.12 E
Control	0.41 A	0.43 A	0.42 A	0.44 A	0.43 A

Each Value is the mean of five replications

a, Means followed by same letters do not differ significantly by DMRT at P = 0.05.

After 72H, neem oil was highly significant among other treatments as only 0.12 whitefly per leaf was observed followed by plant extracts of *D. innoxia* (0.14) and then followed by castor oil (0.17 per leaf). No statistical difference was observed between garlic oil and plant extracts of *T. patula* as shown in Table 2. After 168H, no statistical difference was found between neem oil and confidor, however they were highly significant from other treatments. *D. innoxia* was also highly significant as only 0.14 whitefly per leaf was found.

All the treatments were highly significant from control (0.43 per leaf) as shown in Table 2.

Second spray

Twenty four hour after the 2nd spray, all treatments were statistically significant from control (0.35 per leaf). Non statistical significance were observed in plants treated with neem oil, garlic oil, *D. innoxia* and Confidor, however they were highly significant from castor oil (0.14 per leaf) and *T. patula* (0.15 per leaf) as shown in Table 3.

Table 3. Effect of plant based essential oils and extracts against Whitefly population dynamics after 2nd spray on Okra field.

Treatment	Pre Data (24 H before	24 H After	48 H After	72 H After	168 H After
Neem oil	0.14 B[a]	0.11 C	0.13 B	0.00 B	0.0 A
Garlic oil	0.11 C	0.12 C	0.17 B	0.00 B	0.0 A
Castor oil	0.11 C	0.14 B	0.18 B	0.03 AB	0.0 A
D.innoxia	0.12 C	0.12 C	0.15 B	0.00 B	0.0 A
T. patula	0.11 C	0.15 B	0.18 B	0.33 AB	0.03 A
Confidor	0.12 BC	0.11 C	0.17 B	0.00 B	0.0 A
Control	0.41 A	0.43 A	0.35 A	0.06 A	0.03 A

Each Value is the mean of five replications

a, Means followed by same letters do not differ significantly by DMRT at P = 0.05.

After 48H of the 2nd spray, all treatments were statistically significant from control which got 0.35 whitefly per leaf, however no statistical significance difference were observed among all the treatments as shown in Table 3. After 72H of the 2nd spray, highest whitefly population was observed in control (0.0.6 per leaf) as compared to other treatments.

Plant parameters

Highest shoot length was achieved in plants treated with neem oil and confidor (148cm) followed by castor oil (147 cm) and then followed by garlic oil (146.1 cm), all the treatments were significantly higher then check (141 cm) (Fig. 1).

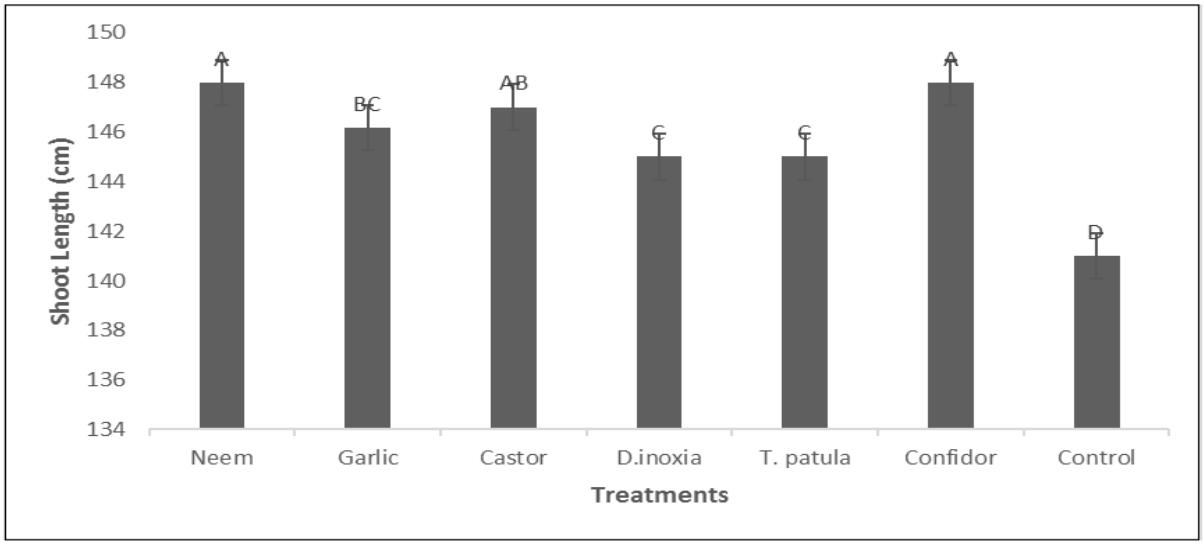

Fig. 1. Mean shoot length (cm) of Okra after application of treatments.

Maximum number of fruits were found in plants treated with neem and garlic oil (18) respectively, followed by confidor (17) and *D. innoxia* (16.3) (Fig.2). Least number of fruits were found in check (8). No significance difference was observed among the treatments in the fruit weight, however all the

treatments were statistically significant from check (Fig.3).

Discussion

Results revealed that Castor oil and *T. patula* contained 0.33 whitefly per leaf. Neem oil, Garlic oil, *D. innoxia* and Confidor successfully reduced the population to 0.0 per leaf. Results indicated that after 168H, all the whitefly population reached to minimum level as no statistical significance difference were observed in all the treatments.

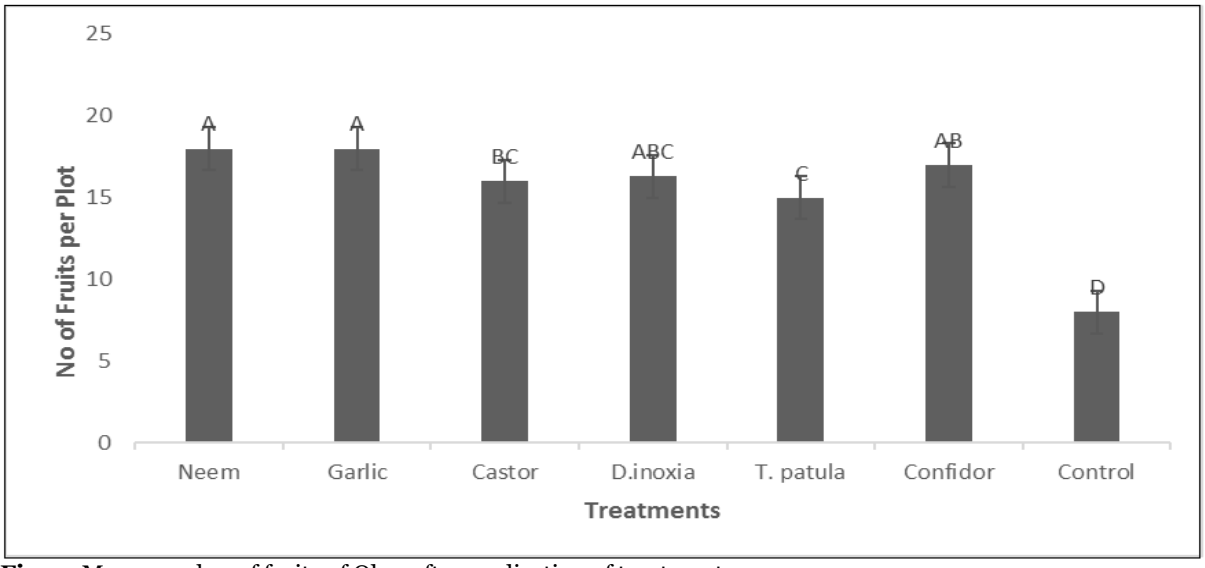

Fig. 2. Mean number of fruits of Okra after application of treatments.

The effect of all sprayed treatment were statistically significant against the population dynamics of whitefly at 48, 72 and 168 hours after 1st spray and 24, 48, 72 and 168 hours after 2nd spray of treatments.

The current results also indicate that significant reduction in whitefly population occurred in the above stated durations as compared to control treatment. It was also observed that effectiveness of all the treatments enhanced with the passage of time. Neem oil gave promising results as was highly effective treatment after 48H, 72H and 168H after 1st spray and 24H, 48H, 72H and 168H after the 2nd spray. Garlic oil and *D. innoxia* was also effective in lowering whitefly population at 2H, 48H and 168H hours after the 1st spray and remained effective till the termination of experiment. Confidor activity enhanced with the time.

After 24H of the 1st spray, its effectiveness increased till the end of the experiment. Current results are in conformity with those of Irum *et al.,* (2014) who also exploited naturally occurring plant derivatives for the successful management of
whitefly in okra field.

The high activity of neem could be due to the presence of its active ingredient *Azadirachtin* which is also previously reported for its significant role against whitefly and also increasing the yield.

The current study results are in conformity with those of Amjad *et al.,* (2009). There results achieved a total of 86% mortality of whitefly with confidor, similar results were also achieved by Mustafa (2000), and they achieved 72.76% mortality of whitefly with Confidor. Garlic oil also showed promising results against whitefly in current experiment.

It's positive activity could be due the presence of it's toxic insecticidal compound called *Alliin*. Current garlic results are in conformity with Hyun *et al.,* (2011), out of 92 essential oils used in there experiment, garlic oil stand out to be the best by giving 100 percent mortality. Current results also

confirm the previous finding of Patil (2009), they achieved 86 percent mortality with 3 percent leaf extract. Previous finding from literature suggests that *T. patula* could be used as barrier and thus prevent the main crop from insect attack, from past times farmers are sowing *T. patula* as intercrop because of the presence of toxic active ingredients like *calendulin, Flavonoids* and *saponins*.

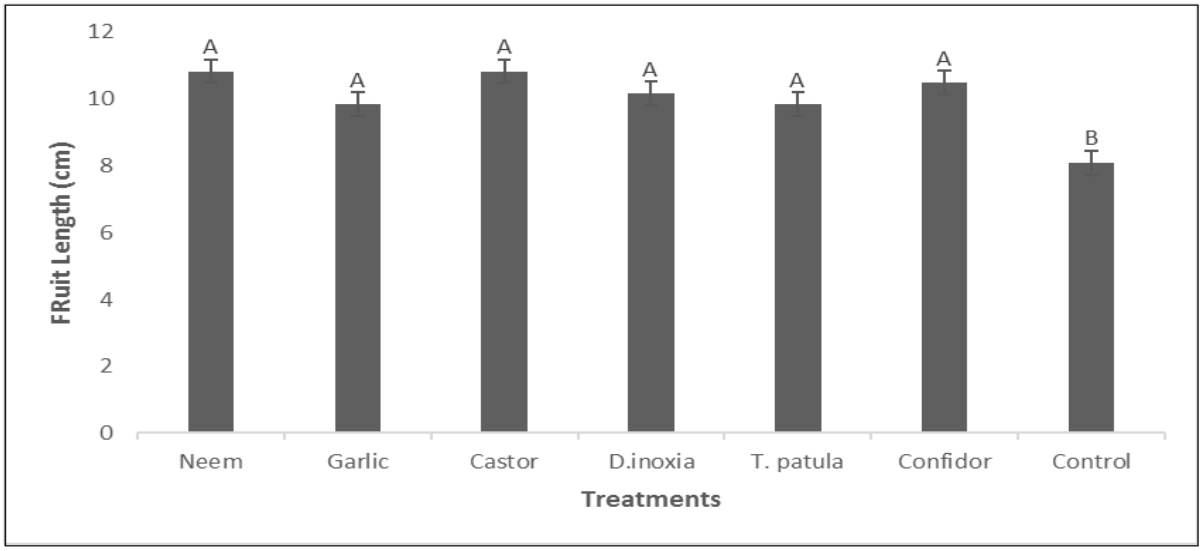

Fig. 3. Mean fruits length (cm) of Okra after application of treatments**.**

Conclusion

It is concluded from the current results that essential oils i.e; neem and garlic gave best results by killing (0.11 and 0.18 whitefly) after 1st spray and 100% results after 2nd spray. Plants extracts i;e, *D.innoxia* and *T. patula* gave the best results by killing (0.16 and 0.16 respectively) numbers of whitefly after 1st spray while 100% mortality after 2nd spray.

Recommendation

Keeping in view the results, it is advised that vegetables should be sprayed with these plant based naturally occurring constituents at least once a month in order to remain the pest under threshold level and avoid any loss in yield. Present study results also give clear indication that in vegetables cropping the use of pesticides should be lowered as plant derivatives give competitive results also in fact, neem oil was more effective than confidor.

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