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# Insecticidal Activity of Some Botanicals against the Sucking Insect Pests of Cotton

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**Abstract:** Jassid (*Amrascadevastans*), thrips (*Thripstabaci*) and whitefly (*Bemisiatabaci*) have become major pest due to invasion of Bt cotton. Insecticidal resistance by these pests is another threat, keeping in view these facts seven botanicals viz., peppermint (*Menthapiperita*), turmeric (*Curcuma longa*), hot pepper (*Capsicum annuum*), ginger (*Zingiberofficinale*), akk (*Calotropis procera*), bitter gourd (*Momordicacharantia*) and mehandi (*Lawsoniainermis*) were tested for their efficacy against population of jassid, thrips and whitefly in cotton. Eight treatments including control were maintained following RCBD with three replications. The treatments were administered twice during the cotton growing season and observations were recorded after 24, 72 and 168 hours of treatment. The results revealed that extract of ginger was most efficient bringing about highest percentage mortality (83.3%) in the population of jassids followed by hot pepper (78.3%) and bitter gourd (68.2%). Similar effect of these extracts was found against thrips and whitefly. Turmeric and peppermint were found to be least effective although both caused significant reduction in the population of sucking pests as compared to the control. Higher yield was recorded in plots treated with ginger (2304.4 kg $ha^{-1}$), hot pepper (2082.2 kg $ha^{-1}$) and bitter gourd (2000 kg $ha^{-1}$) as compared to that in control (1302.2 kg $ha^{-1}$).It is concluded that all the used botanicals were effective to reduce the population of jassid, thrips and whitefly on cotton; however, ginger and hot pepper performed comparatively better than others.

**Keywords:** Insecticidal Activity Sucking Insect Pests of Cotton

## 1. INTRODUCTION

Cotton (*Gossypiumhirsutum*) is also recognized as silver fiber owing to its economic significance. About 145 species of insect pests are known to attack this crop. In Pakistan cotton suffers from 20-40% reduction in yield due to insect pests (Wilson *et al*., 1980; Bo, 1992; Ahmad, 1999). Jassids, thrips and whitefly are the key insect pests of cotton. These pests reduce the quantity and quality of yield directly by feeding and indirectly by acting as vector of different diseases (Mamoon-ur-Rashid *et al*., 2012). In order to control cotton pests, farmers mostly rely on the use of pesticides (Hassan *et al*., 2007). During last two decades, the use of pesticides has tremendously increased in Pakistan reaching from 13,030 tons in 1990 to 36,180 tons in 2011 (GOP, 2012).

Cotton crop is the major recipient of the total pesticides (61.92%) followed by fruits and vegetables (11.9%), rice (11.86%), sugarcane (6.14%), maize (4.83%) and oilseeds (2.21%) (Khan *et al*., 2010). The use of pesticides in high quantity results in severe adverse effects on human, animals and environment. Simultaneously, side effects are observed on beneficial communities including decomposers, natural enemies and pollinators. Pesticides and other plant protection techniques also promote the resistance development due to the high selection pressure on pest population (Metcalf, 1986; Kogan, 1998; Pimentel, 2005). These concerns emphasize the development and use of novel, safer and environment friendly pest control techniques.

Naturally occurring plant products may be used as an alternative to synthetic insecticides for the control of insect pests, as they constitute a great proportion of bioactive chemicals (Daoubi *et al*., 2005). Various botanicals or plant products with a series of significant properties such as insecticidal, repellent, antifeedant, chitin synthesis inhibition, growth inhibition and eco-friendly nature stimulated the researchers to use them in the pest management programs (Prajapati *et al.,* 2003; Lee *et al.,* 2004; Murugesan and Murugesh, 2008; Swamina than *et al.,* 2010; Ghosh and Chakraborty, 2012). A number of studies have documented various prospects of the plant extracts like antifeedant, larvicidal, growth and reproduction inhibitory characteristics against different pests of economic importance (Singh and Saratchandra, 2005; Rahman and Talukdar, 2006; Sharma and Rajguru, 2009).

It has been documented that more than 2000 species of plants from 170 natural families are known to have insecticidal properties (Feinstein, 1952). Therefore, this study was initiated to evaluate the efficacy of some botanicals against the sucking insect pests of cotton.

## 2. MATERIALS AND METHODS

The study was conducted under Randomized Complete Block Design (RCBD) at the experimental area of Nuclear Institute of Agriculture, Tando Jam to assess the relative efficacy of seven botanicals against sucking insect pests of cotton. For this purpose,

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different botanicals viz. peppermint (*Menthapiperita*), turmeric (Curcuma longa), hot pepper (*Capsicum annuum*), ginger (*Zingiberofficinale*), akk (*Calotropisprocera*), bitter gourd (*Momordicacharantia*) and meh and (*Lawsoniainermis*) were tested. Turmeric, hot pepper and mehandi were obtained in powdered form. The leaves of peppermint and akk plants were collected, washed and dried under shade.Then the leaves were cut into small pieces and grounded with commercial grinder to fine powder. Bitter gourd and ginger were purchased from local market and also grounded. Twenty gram of each sample was dipped in 100 ml water and kept overnight for 24 hours at room temperature with frequent stirring. Each sample solution (100 ml) was then diluted by adding 900 ml of distilled water to prepare 2% solution (Sarwar *et al*., 2005).Bt cotton variety IR-NIBGE-901was sown under field conditions during kharif, 2015 with row to row and plant to plant distance maintained at 75 cm and 30cm, respectively. A buffer zone of 1 meter between each plot was retained in order to prevent spray drift to adjacent plots. Each treatment and control was replicated thrice. Recommended agronomic practices were carried out at proper time. The field was regularly visited and observed for pest status. The botanicals were sprayed twice with hand operated knapsack sprayer when the pest attack reached economical threshold level (ETL). Data were recorded after 24, 72 and 168 hours after each application from five randomly selected plants in every replicate. The insect populations were recorded from upper, middle and lower leaves of these plants and averaged as per leaf number of the insect.

The mean population of target pests from treated plots was considered to be indirect reflection of relative efficacy of these botanicals, thus lowest mean values reflected highest efficacy of the botanicals used and vice versa. The percentage mortality was calculated by using following formula:

$$\text{Percentage Mortality} = \frac{\text{Population in Control} - \text{Population in each Treatment}}{\text{Population in Control}} \text{ x } 100$$

To determine the effect of botanicals on the seed cotton yield, the pickings of raw cotton was done in the months of October and November. Results were analyzed through standard statistical procedure of LSD test at 5% probability level using Statistix 8.1.

## 3. RESULTS

### Jassid

All the tested botanicals caused significant mortality of jassid even at 168 hours of first application. The results presented in **(Table-1)** revealed that after 24 hours of application of ginger, hot pepper and bitter gourd were statistically equal and highly effective with mortality of 72.60%, 68.49% and 63.69% followed by mehandi, turmeric, akk and peppermint with 58.90%, 54.79%, 50.00% and 41.09% mortality, respectively. After 72 hours of application the mean population of jassid in ginger, hot pepper, mehandi, bitter gourd and akk treated plots were statistically at par with 83.33%, 78.33%, 72.50%, 66.66% and 55.83% mortality, respectively. While after 168 hours of application, ginger was highly effective with mortality of 80.45% followed by hot pepper, bitter gourd, akk, mehandi, peppermint and turmeric with 69.92%, 65.41%, 54.88%, 52.28%, 50.37% and 45.11% of mortality, respectively.

The mean population of jassidin all the botanical treatments had non-significant difference with each other after 24 hours of second application(Table 2). Ginger was superior over others with 64.60%of mortality and it was followed by hot pepper, bitter gourd and mehandi, akk, turmeric and peppermint with percent mortality of 59.29%, 53.09%, 46.90%, 41.59% and 35.39%, respectively. After 72 hours of application efficacy was increased and highest percent mortality was observed in plots treated with ginger (79.36%), hot pepper (73.80%), bitter gourd (68.25%) and mehandi (63.49%) having non-significant difference with each other. After 168 hours of application, ginger (75.47% mortality) ranked first among all the treatments. The next best were hot pepper (62.26%) and peppermint (56.60%) both being statistically similar followed by mehandi, bitter gourd, akk and turmeric with 50.00%, 43.39%, 37.73% and 31.13% of mortality, respectively.

### Whitefly

The botanicals caused significant mortality of whitefly at 24, 72 and 168 hours after first application **(Table 3).** The maximum percentage mortality 68.37% was observed in the plots treated with ginger which was statistically at par with 63.24%, 59.28% and 55.33% mortality of jassids in plots treated with hot pepper, bitter gourd and mehandi. Akk, turmeric and peppermint were least effective with mortality of 52.56%, 46.04% and 39.52%, respectively. Ginger, hot pepper, bitter gourd and mehandi were statistically equally effective with mortality of 77.07%, 75.65%, 66.32% and 64.90%, respectively at 72 hours after application. The maximum mortality (72.70%) in the whitefly population at 168 hours after application was recorded with ginger while peppermint and akkwere less effective with mortality of 52.04% and 49.31%, respectively.

The effect of botanicals against whitefly on cotton in second application was identical to the results in firs application. Ginger showed highly significant percent mortality of 72.18%, 79.17% and 75.51% compared to that in control even at 24, 48 and 168 hours after

application, respectively thereby minimizing the pest infestation **(Table 4).**

**Thrips**

The results showed significant differences in the mean percentage mortality of thrips after 24, 72 and 168 hours of two applications. It is evident from Table-5 that all the botanicals caused significant mortality of thrips even at 168 hours of first application. Ginger, hot pepper, mehandi and bitter gourd were statistically at par with mortality of 77.60%, 75.43%, 67.39% and 60.86%, respectively at 24 hours after application. Ginger and hot pepper showed better results with mortality of 82.74% and 79.55%, respectively at 72 hours after application, followed bybitter gourd, mehandi, akk, peppermint and turmeric with mortality of 69.26%, 64.53%, 63.82%, 55.91% and 52.00%, respectively. After 168 hours of application, the maximum percent mortality was recorded on ginger (76.74%) and hot pepper (73.70%) treatments. However their mean population did not differ significantly with each other. The next best treatments were bitter gourd and mehandi with 66.93% and 62.41% mortality, respectively.

In the second application of botanicals the trend was again similar and significant percent mortality of 73.90%, 78.89% and 77.85% in the population of thrips was achieved with the gingerat 24, 72 and 168 hours after application followed by hot pepper. Turmeric and peppermint though produced significant results as compared to untreated control however peppermint was less effective in suppressing thrips population **(Table 6).**

**Seed Cotton Yield**

The results presented in Table 7 reveal that seed cotton yield varied significantly among the treatments with enhanced yield as compared to control (1302.2 kg $ha^{-1}$). However, highest yield of 2304.4 kg $ha^{-1}$ was obtained in plots treated with ginger followed by hot pepper (2082.2 kg $ha^{-1}$) and bitter gourd (2000 kg $ha^{-1}$). It is also evident yield in peppermint (1526.7 kg $ha^{-1}$) and turmeric (1682.2 kg $ha^{-1}$) were non-significantly different from each other and also failed to surpass the control.

## 4. DISCUSSION

The results of the present study showed that all the tested botanicals gave significantly high mortality of sucking insect pests of cotton at different intervals as compared to control. Among the tested botanicals ginger was the most potent recording the highest percent mortality of jassid, thrips and whitefly population. Its insecticidal properties have been reported against aphids, american bollworm, plant hopper, thrips and whitefly (Anderson and Gardner, 1999). These findings are in agreement with those of Abou-Yousef *et al*. (2010) who tested the toxicity of *Ammimajus* (lace flower) and *Z. officinale* (ginger) either as formulation or as crude extracts against the nymphs of whiteflies and indicated that whiteflies can be effectively controlled with the application of the two extracts and their formulations. Zhang *et al*. (2004) reported increase in repellency against whitefly by increasing concentration of ginger oil when leaves were dipped in the oil. Similarly, Schuster *et al*. (2009) also concluded that application of ginger oil on the leaf disks of tomato reduced the oviposition rate of whiteflies.

Many workers like Rahuman *et al*. (2008), Abdel (2008), Amuji *et al*. (2012), Ahmad *et al*. (2013), Chaubey (2013), Okonkwo and Ohaeri (2013), Asawalam and Onu, (2014) carried out investigations on ginger against insect pests other than those included in the study and reported encouraging results. Xu*et al*. (2007) reported that 10% concentration of ginger had high acute toxicity to *Drosophila melanogaster* with 100% cumulative mortality of male and female adults. Al-Qahtani *et al*. (2012) tested powder of three plants i.e. *Z. officinale*(ginger), *Elettariacardamomum* (Hail) and *Foeniculumvulgare* (Shammar) against *Oryzaephilussurinamensis*. They indicated that *Z. officinale* was most effective and recorded the minimum $LC_{50}$value (0.14 mg/g) followed by *E. cardamomum*and *F. vulgare* with $LC_{50}$ value 0.4 and 0.7 mg/g, respectively.

Hot pepper (*Capsicum annuum*) was also found significantly effective against sucking insect pests of cotton. Similarly, Iqbal *et al*. (2011) found reduction in the aphid population after the application of hot pepper. El-Shereif and Kazem (2009) reported increase in toxicity of boiled linseed oil formulation when capsicum xylene extract was added as constituent against second instar larvae of cotton leaf worm as compared with boiled linseed oil only. Capsicum extracts were also proven to be repellent against some species of stored product beetles such as *Triboliumcastaneum* and *Sitophiluszeamis* (Hosh and Halidh, 1997).

The present study revealed that bitter gourd also gave effective control of target pests after ginger and hot pepper. These findings are in conformity with the Fiaz *et al*. (2012) who reported that bittergourd extract was quite effective and reduced jassid population 54.32%, 54.68%, 52.80% and 52.88% at 24, 48, 72 and 168 hours after application. While it proved to be most effective against thrips followed by bakain leaf extract and neem leaf extract.

In our study, turmeric and peppermint were found least effective against the sucking insect pests of cotton. This finding is similar to the result of Said and Inayatullah (2015) who reported that *C. longa*,

*Partheniumhysterophorus* and*Alliumsativum*did not give efficient control of whitefly. Matter *et al*. (2008) documented that wheat seeds treatment with turmeric extracts were not effective in causing high mortalities of the *Sitophilusoryzae* adults. Contrary to our findings, Sinthusiri and Soonwera (2013) reported that ten percent concentrations of *M. piperita* (peppermint), *Cymbopogoncitratus* (lemongrass) and *Lavandulaangustifolia* (lavender) were the most effective, showing 100% knockdown at 30 and 60 minutes. These essential oils caused 100% mortality of houseflies after 24 hours of exposure. This contradiction might be due the application of peppermint in high concentration and difference in the target pest

**Table 1: Mean percentage mortality of jassid at different time intervals after first application**

| Treatments | | Mean percentage mortality of jassid | | |
|---|---|---|---|---|
| | | **After 24 hours** | **After72 hours** | **After 168 hours** |
| $T_1$ | Peppermint 2% | 41.09 (0.86) b | 45.00 (0.66) b | 50.37 (0.66) b |
| $T_2$ | Turmeric 2% | 54.79 (0.66) cd | 50.00 (0.60) bc | 45.11 (0.73) b |
| $T_3$ | Hot pepper 2% | 68.49 (0.46) ef | 78.33 (0.26) cd | 69.92 (0.40) bc |
| $T_4$ | Ginger 2% | 72.60 (0.40) f | 83.33(0.20) d | 80.45 (0.26) c |
| $T_5$ | Akk 2% | 50.00 (0.73) bc | 55.83 (0.53) bcd | 54.88 (0.60) bc |
| $T_6$ | Bitter gourd 2% | 63.69 (0.53) def | 66.66 (0.40) bcd | 65.41 (0.46) bc |
| $T_7$ | Mehandi 2% | 58.90 (0.60) cde | 72.50 (0.33) bcd | 52.28 (0.53) bc |
| $T_8$ | Control | (1.46) a | (1.20) a | (1.33) a |

Values depict percentage mortality in a respective treatment. Values in parenthesis represent mean population at different time intervals. Means in a column sharing same letter are not significantly different at $p<0.005$.

**Table 2: Mean percentage mortality of jassid at different time intervals after second application**

| Treatments | | Mean percentage mortality of jassid | | |
|---|---|---|---|---|
| | | **After 24 hours** | **After72 hours** | **After 168 hours** |
| $T_1$ | Peppermint 2% | 35.39 (0.73) b | 47.61 (0.66) b | 56.60 (0.46) cde |
| $T_2$ | Turmeric 2% | 41.59 (0.66) b | 52.38 (0.60) bc | 31.13 (0.73) b |
| $T_3$ | Hot pepper 2% | 59.29 (0.46) b | 73.80 (0.33) d | 62.26 (0.40) de |
| $T_4$ | Ginger 2% | 64.60 (0.40) b | 79.36 (0.26) d | 75.47 (0.26) e |
| $T_5$ | Akk 2% | 46.90 (0.60) b | 52.38 (0.60) bc | 37.73 (0.66) bc |
| $T_6$ | Bitter gourd 2% | 53.09 (0.53) b | 68.25 (0.40) cd | 43.39 (0.60) bcd |
| $T_7$ | Mehandi 2% | 53.09 (0.53) b | 63.49 (0.46) bcd | 50.00 (0.53) bcd |
| $T_8$ | Control | (1.13) a | (1.26) a | (1.06) a |

Values show percentage mortality in a respective treatment. Values in parenthesis represent mean population at different time intervals. Means in a column sharing same letter are not significantly different at $p<0.005$.

**Table 3: Mean percentage mortality of whitefly at different time intervals after first application**

| Treatments | | Mean percentage mortality of whitefly | | |
|---|---|---|---|---|
| | | **After 24 hours** | **After72 hours** | **After 168 hours** |
| $T_1$ | Peppermint 2% | 39.52 (3.06)b | 46.04 (2.66) b | 52.04 (2.46) b |
| $T_2$ | Turmeric 2% | 46.04 (2.73) bc | 54.15 (2.26) bc | 57.11 (2.20) bc |
| $T_3$ | Hot pepper 2% | 63.24 (1.86) de | 75.65 (1.20) d | 68.81 (1.60) de |
| $T_4$ | Ginger 2% | 68.37 (1.60) e | 77.07 (1.13) d | 72.70 (1.40) e |
| $T_5$ | Akk 2% | 52.56 (2.40) bcd | 56.79 (2.13) bc | 49.31 (2.60) b |
| $T_6$ | Bitter gourd 2% | 59.28 (2.06) cde | 66.32 (1.66) cd | 66.27 (1.73) de |
| $T_7$ | Mehandi 2% | 55.33 (2.26) cde | 64.90 (1.73) cd | 63.74 (1.86) cd |
| $T_8$ | Control | (5.06) a | (4.93) a | (5.13) a |

Values are percentage mortality in a respective treatment. Values in parenthesis represent mean population at different time intervals. Means in a column sharing same letter are not significantly different at $p<0.005$.

**Table 4: Mean percentage mortality of whitefly at different time intervals after second application**

| Treatments | | Mean percentage mortality of whitefly | | |
|---|---|---|---|---|
| | | **After 24 hours** | **After72 hours** | **After 168 hours** |
| $T_1$ | Peppermint 2% | 48.56 (2.33) b | 50.12 (2.06) b | 47.80 (2.26) b |
| $T_2$ | Turmeric 2% | 55.84 (2.00) bc | 61.25 (1.60) bcd | 63.04 (1.60) bcd |
| $T_3$ | Hot pepper 2% | 66. 22 (1.53) cd | 74.33 (1.06) cd | 73.90 (1.13) d |
| $T_4$ | Ginger 2% | 72.18 (1.26) d | 79.17 (0.86) d | 75.51 (1.06) d |
| $T_5$ | Akk 2% | 50.11 (2.26) b | 58.11 (1.73) bc | 52.42 (2.06) bc |
| $T_6$ | Bitter gourd 2% | 63.35 (1.66) cd | 69.49 (1.26) bcd | 72.28 (1.20) d |
| $T_7$ | Mehandi 2% | 57.39 (1.93) bc | 67.79 (1.33) bcd | 70.90 (1.26) cd |
| $T_8$ | Control | (4.53) a | (4.13) a | (4.33) a |

Values depict percentage mortality in a respective treatment. Values in parenthesis represent mean population at different time intervals. Means in a column sharing same letter are not significantly different at $p<0.005$.

**Table 5: Mean percentage mortality of thrips at different time intervals after first application**

| Treatments | | Mean percentage mortality of thrips | | |
|---|---|---|---|---|
| | | **After 24 hours** | **After72 hours** | **After 168 hours** |
| $T_1$ | Peppermint 2% | 45.65 (5.00) b | 55.91 (3.73) bc | 44.35 (4.93) b |
| $T_2$ | Turmeric 2% | 49.34 (4.66) bc | 52.00 (4.06) b | 57.90 (3.73) bc |
| $T_3$ | Hot pepper 2% | 75.43 (2.26) d | 79.55 (1.73) d | 73.70 (2.33) de |
| $T_4$ | Ginger 2% | 77.60 (2.06) d | 82.74 (1.46) d | 76.74 (2.06) e |
| $T_5$ | Akk 2% | 59.45 (3.73) bcd | 63.82 (3.06) bc | 59.36 (3.60) cd |
| $T_6$ | Bitter gourd 2% | 67.39 (3.00) cd | 69.26(2.60) cd | 66.93 (2.93) cde |
| $T_7$ | Mehandi 2% | 60.86 (3.60) bcd | 64.53 (3.00) bc | 62.41 (3.33) cde |
| $T_8$ | Control | (9.20) a | (8.46) a | (8.86) a |

Values show percentage mortality in a respective treatment. Values in parenthesis represent mean population at different time intervals. Means in a column sharing same letter are not significantly different at $p<0.005$.

**Table 6: Mean percentage mortality of thrips at different time intervals after second application**

| Treatments | | Mean percentage mortality of thrips | | |
|---|---|---|---|---|
| | | **After 24 hours** | **After72 hours** | **After 168 hours** |
| $T_1$ | Peppermint 2% | 43.87 (4.86) b | 47.71 (4.46) b | 39.36 (4.93) b |
| $T_2$ | Turmeric 2% | 63.04 (3.20) c | 60.96 (3.33) c | 42.68 (4.66) b |
| $T_3$ | Hot pepper 2% | 70.78 (2.53) c | 77.37 (1.93) de | 71.34 (2.33) d |
| $T_4$ | Ginger 2% | 73.90 (2.26) c | 78.89 (1.80) e | 77.85 (1.80) d |
| $T_5$ | Akk 2% | 60.73 (3.40) c | 64.83 (3.00) c | 52.52 (3.86) bc |
| $T_6$ | Bitter gourd 2% | 66.16 (2.93) c | 72.68 (2.33) cde | 69.74 (2.46) d |
| $T_7$ | Mehandi 2% | 64.66 (3.06) c | 66. 47 (2.86) cd | 67.28 (2.66) cd |
| $T_8$ | Control | (8.66) a | (8.53) a | (8.13) a |

Values depict percentage mortality in a respective treatment. Values in parenthesis represent mean population at different time intervals. Means in a column sharing same letter are not significantly different at $p<0.005$.

## 5. CONCLUSIONS

In this study, the respective botanicals proved to be effective in reducing the population of jassid, thrips and whitefly below economic threshold level. However, ginger, hot pepper and bitter gourd recorded the highest percentage mortality of the target pests. The present study clearly indicated that use of botanicals for the management of insect pests can be good alternative to insecticides with less residual action, eco-friendly nature, environmental safety and specific toxicity to target pest.

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