Efficacy of Bio-Pesticides for Managegement of Sucking Insect Pests of Cotton, *Gossipium hirsutum* (L.)

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Abstract: The studies were conducted consecutively for two years, 2006 and 2007 for management of cotton insect pests through eco-friendly measures. Bio-pesticides Neem seed extract, Neem oil, Asafoetida (Hing) and Tobacco leaf extract were evaluated against sucking complex. The experiment regarding evaluation botanical pesticides showed that among all bio-pesticides, the highest percent reduction of thrip (67.65%) was recorded in Neem seed extract followed by Neem oil (60.00%), Tobacco (63.59%) and Hing (Asafoetida) (52.68%) after 96 h. of application. Overall maximum mean reduction (64.69%) was recorded in Neem seed extract followed by Neem oil (57.74%), Tobacco (52.91%) and Asafoetida (46.52%). The highest reduction of jassid (71.97%) was recorded followed by Neem oil (70.06%), Hing (Asafoetida) (68.15%) and Tobacco (23.56%) after 96 h., of application of pesticides. With regards to reduction percent of whitefly revealed that maximum reduction (60.18%) was recorded in Hing (Asafoetida) followed by Neem oil (59.78%), Neem extract (59.38%) and tobacco (40.61%) after 96 h., of spray application. The botanical pesticides started reducing their toxicity after 96 h. However, the effective reduction of pests was recorded up to one week. Integrated pest management (IPM) model was developed for the control of sucking insect pests of cotton, for benefit of farming community through seminars, trainings and pamphlets. Using the safe botanical pesticides remained effective against sucking pests and is recommended against cotton pests, which showed less effective to natural enemies and environment friendly.

Keywords: Bio-pesticides, cotton, Hing (Asafoetida).

INTRODUCTION

Cotton is a natural fiber of great economic importance as a raw material for cloth; and is predominantly cultivated in most of the cotton producing countries of the world including Pakistan [1]. During the year 2011-12, the world total cotton production was 26.96 million tons, and China remained the main contributing country with production of 7.40 million tons, followed by India, USA, Pakistan and Brazil with production of 5.69, 3.39, 2.35 and 2.00 million tons, respectively. The area under cotton cultivation in Pakistan during the year 2011-12 was 2835 thousand hectares showing 5.4 percent increase over 2010-12; while the total cotton production in the country was 13595 thousand bales showing a tremendous increase of 18.6 percent over the preceding year. The average seed cotton yield during the year 2011-12 was 815 kg per hectare showing an increase of 12.6 percent over the yield of 724 kg per hectare during the year 2010-11 [2].

It has been well established that insect pests are major factors constraining achievement of yield potentials in Pakistan [3]. The major insect pests of cotton such as thrips, *Thrips tabaci* (Lind.); jassid, *Amrasca devastans* (Dist.); whitefly, *Bemisia tabaci* (Genn.); aphid, *Aphis gossypii* (Glav.); mite, *Tetranychus cinnabarinus* (Boise); spotted bollworm, *Earias insulana* (Boise); pink bollworm, *Pectinophora gossypiella* (Saund) and American bollworm, *Helicoverpa armigera* (Hub.) [4]. Heavy reliance on costly pesticides has brought numerous problems like resurgence of non target pests and resistant races of targeted insects/pests. Elimination of useful and beneficial fauna of predators, parasites and pollinators besides indiscriminate use of chemicals has created pollution problems as well as human health hazards [5, 6]. It is imperative to reduce risk of economic losses by insect pest through integration of several crop and pest management techniques and to maintain pest population below economic threshold levels in the field; vegetables and fruits crops in Sindh province of Pakistan [7]. The answers to these problems have to be find-out by evolving alternate methods of pest control, which are less injurious to human health and are environment friendly.

The experimentation in the recent past has produced considerable evidence that questions whether routine chemical treatment for insect control is necessary to protect the yields [8]. Many pesticides used are ecologically disruptive, adversely affect the environment, and can seriously harm farmers' health.

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Poor farmer health has a negative impact on rural productivity [9]. Using plant extracts as bio-pesticides offers many unique benefits to the growers. Generally, plant-based compounds degrade quickly, reducing the risk of residual effects on food. Many of these products have very short pre harvest intervals. Most commodities show wide windows of crop safety and resistance to these compounds is not developed as rapidly as with synthetic pesticides due to multiple action modes. Many plant extracts used as insecticides are fast acting, rapidly deterring insect feeding and additional crop injury. And, because they act on the gut of insect and rapidly decompose in the environment; numerous plant extract insecticides are more selective to insect targets and safer to helpful insects [10]. Hence, bio-pesticides are been expended in the agriculture and other fields for many years against many insect pests. One of the major causes of crop losses, where the yield is expected high or is not obtained is probably due to pest infestations. Crop production is dependent on the rational management of pest complex. Integrated pest Management (IPM) techniques promote management decisions and emphasize on low cost plant protection technologies through pest management approaches and use of sacrificial crop/plants in Sindh. Keeping above points in view; the bio-pesticides were evaluated under the cotton crop for better management.

MATERIAL AND METHODS

The experiment was carried on one acre at Entomology section, Agriculture Research Institute, Tandojam for two years studies. The cotton variety NIAB-78 was sown during the month of April 2006 and 2007. All the recommended cultural operations of weeding, hoeing, irrigation and fertilizer application were carried out from sowing till harvest. Four botanical pesticides i.e. Neem (*Azadirachtin*) oil, Neem extract, Hing (*Asafoetida*, a strong tenacious, sulfurous odor, bitter, acid and alliaceous in taste which consists of 4% to 20% of volatile oil, 40% to 65% of resin, 20% to 25% of gum, organic sulphur compounds and other impurities) and Tobacco(Nicotine) were tested against cotton pests. The dozes used were Neem (*Azadirachtin*) seed extract 3 kg/acre, Neem (*Azadirachtin*) oil 250 ml/acre, Hing (*Asafoetida*) 250 grams/acre and Tobacco 250 grams/acre spray twice in 15 days intervals. Sucking pests i.e. Thrips, Jassids, Whitefly was noted. The pest counting method was split. The experiment was laid out in a Randomize Complete Block Design (RCBD) having plot size as (100 × 100 sq: ft.) and sub plot size (30 × 40. sq: ft.) Pre-treatment observations were recorded one day before application of the bio-pesticides. For recording the effect of bio-pesticides on sucking pests post treatment observation were recorded after 48 hrs, 96 hrs, one week and two weeks of spray. ANOVA statistical method was applied.

RESULTS

The data on the reduction percentage of whitefly population in (Figure **1**) revealed that maximum reduction percentage of whitefly population (77.53%) was recorded in Asafoetida 96 hrs. after spray followed by (75.20%), in Neem extract and (73.85%) in Neem oil. Minimum reduction (69.13%) was observed in to

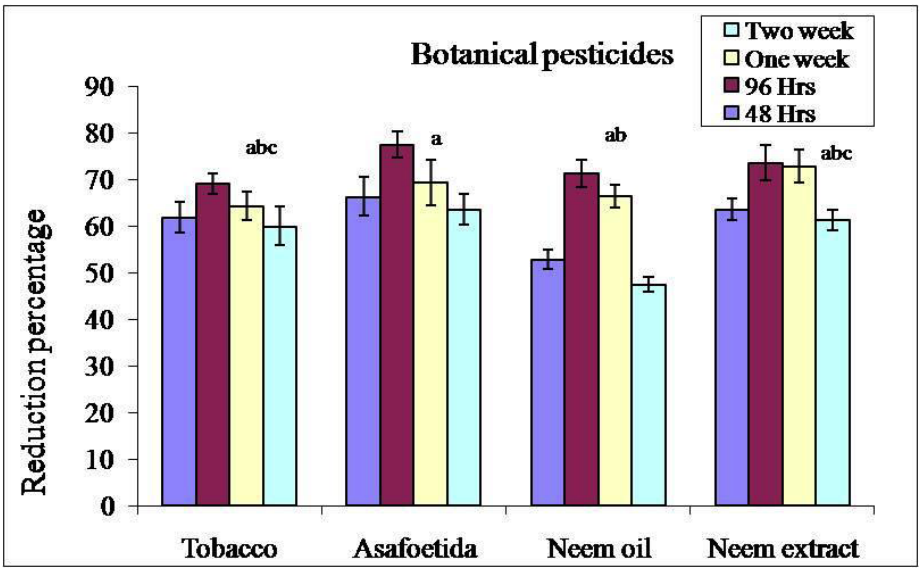

Figure 1: Reduction percentage of whitefly populations after application of botanical pesticides in cotton during 2006.

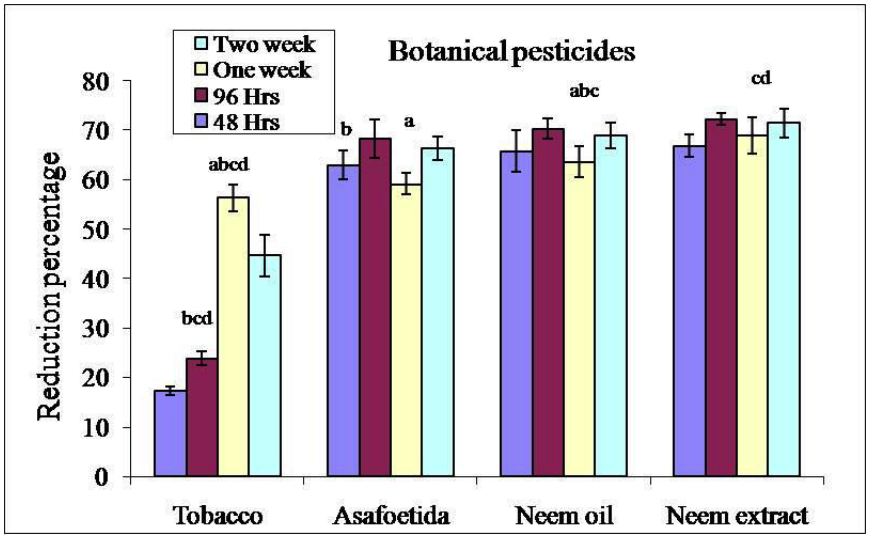

Figure 2: Reduction percentage of whitefly populations after application of botanical pesticides in cotton during 2007.

tobacco after 96 hrs. of spray application 2006. However, reduction percent in whitefly population at different intervals i.e. 24 hrs, one week and 2 weeks did not vary in other treatments except tobacco treatment in which population reduction was minimum as compared with other treatments.

Similar, pattern of whitefly population reduction percentage shown in (Figure **2**) indicate that maximum reduction percentage (59.03%) of whitefly population was recorded in Asafoetida followed by Neem oil (61.85%), Neem extract (60.20%) and the least mean reduction percentage (40.38%) of whitefly population was recorded in tobacco application during 2007. Over all the maximum reduction percentage (77.14) of whitefly population was recorded in Asafoetida after 96 hrs. spray followed by (72.00%) and (66.00%) in Neem extract and Neem oil. The least reduction percent of whitefly population (60.00%) was recorded in tobacco (Figure **3**). The ANOVA results showed that the mean reduction percent between treatments did not vary from each other. However, reduction percentages at different intervals were found statistically different. Whitefly population reduction decreased after 96 hrs, but their toxicity was close to peaks of reduction percent up to one week. This shows that the botanical pesticides started detoxifying after 96 hours of spray and showed maximum effect on whitefly population reduction up to one week after spray. The reduction percentages of whitefly population development during different periods and years varied significantly ($F_{3,111}$ =18.47; P= 0.0001 periods) and ($F_{3,111}$= 0.08; P=0.9709 years). This could be due to warm temperature and evaporation effect which degraded / detoxified the botanical pesticides in cotton. On the basis performance of botanical pesticides which reduced the pest population upto about one week, it is recommended that botanical pesticides may be

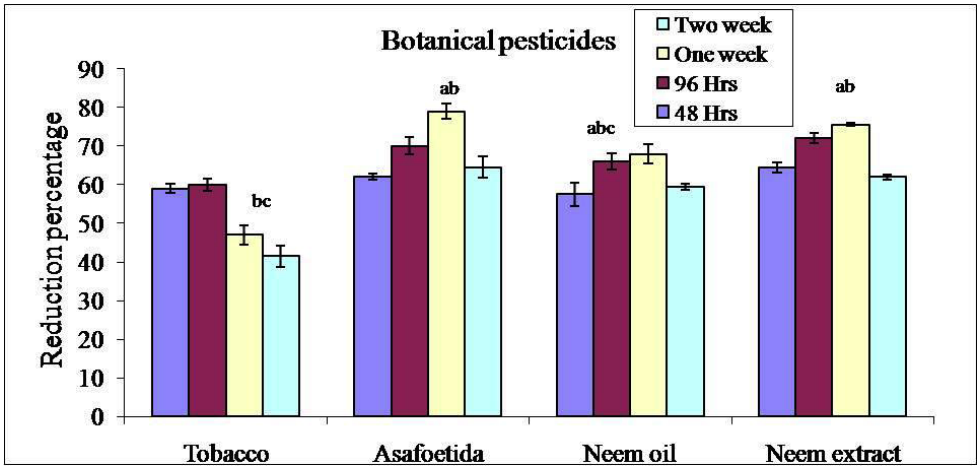

Figure 3: Overall percentage of whitefly populations after application of botanical pesticides in cotton during 2006-07.

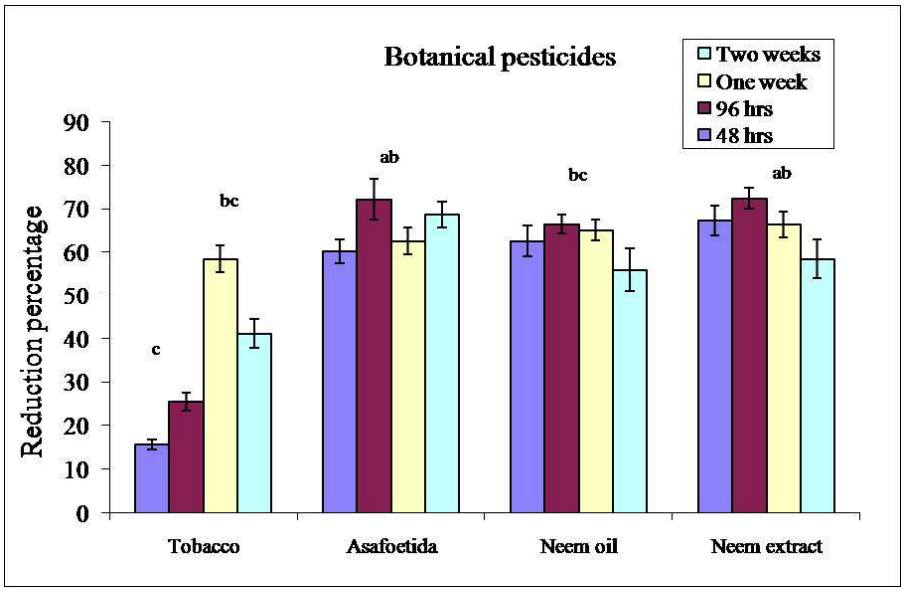

Figure 4: Reduction percentage of jassid after application of botanical pesticides in cotton during 2006.

repeated at intervals of 8 – 10 days if there is whitefly population pressure on cotton crop.

The results on reduction percentage of jassid population on cotton crop during 2006 shown in Figures **4** & **5** depict that all the botanical insecticides reduced the jassid population. Maximum reduction percent (71.97%) was recorded in Neem extract after 96 hrs. of botanical pesticides application followed by (70.06%), (68.15%) and (23.33%) in Neem oil, Asafoetida and tobacco respectively. The data further show that overall maximum mean reduction (66.00%) of whitefly population was recorded in Neem extract and minimum mean reduction percent (60.00%) was recorded in tobacco. Almost similar results of botanical pesticides against jassid on cotton were recorded during 2007. Overall, maximum mean reduction (72.21%) was recorded in Neem extract followed by Neem oil (68.68%), Asafoetida (70.50%) and tobacco (24.41%) during 2006-7 (Figure **6**). The ANOVA results showed that treatment means were not significant.

The results of percent investigation revealed that all the botanical pesticides remained effective in reducing jassid population up to one week. However, maximum reduction was noticed after 96 hours after spray. The reduction percentages of jassid population development during different periods and years varied

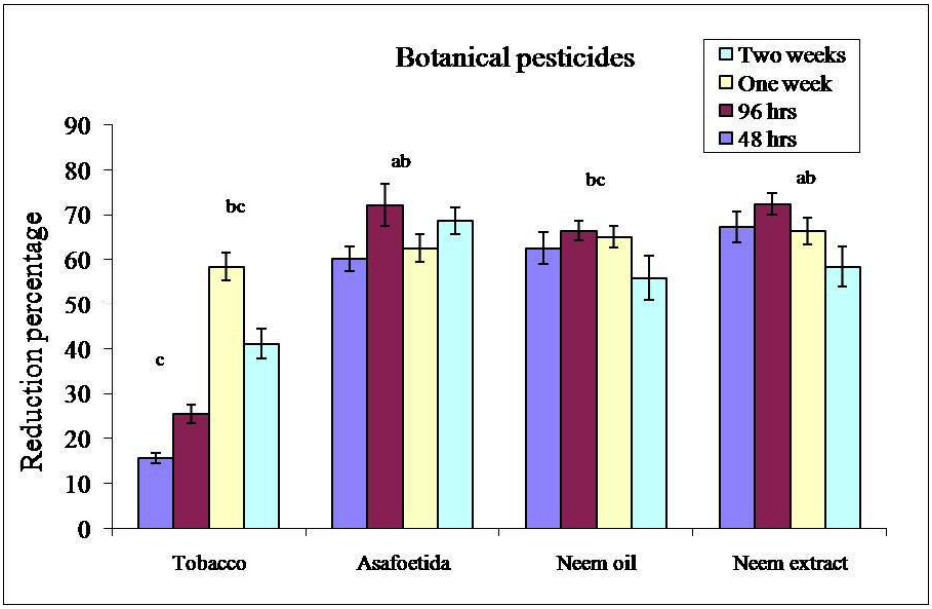

Figure 5: Reduction percentage of jassid after application of botanical pesticides in cotton during 2007.

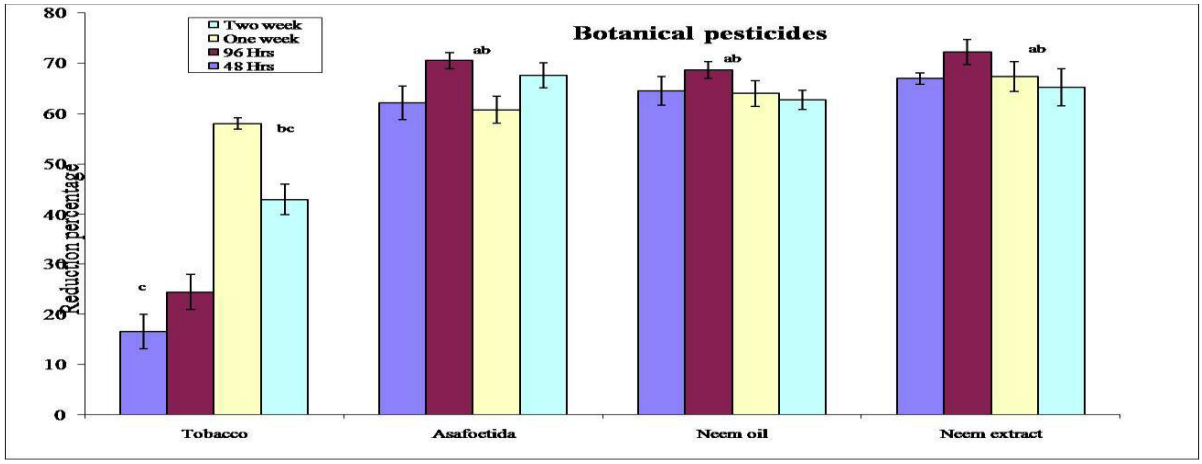

Figure 6: Overall percentage of jassid after application of botanical pesticides in cotton during 2006 and 2007.

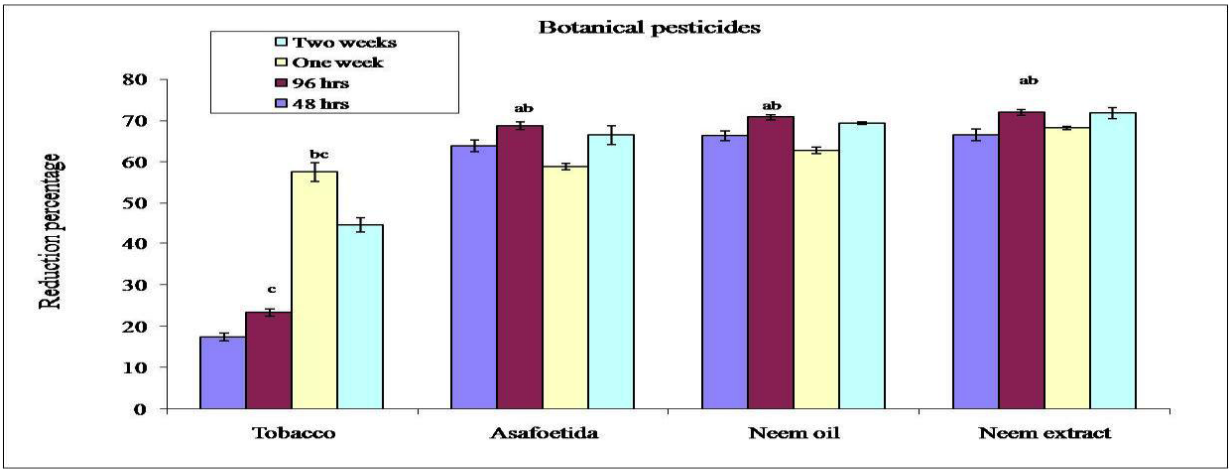

Figure 7: Reduction percentage of Thrips after application of botanical pesticides in cotton during 2006.

significantly ($F_{3,111}$ =2.99; P= 0.0406 periods) and ($F_{3,111}$= 0.07; P=0.9775 years).

The applications of Neem extract and Neem oil showed better performance against jassid and are recommended for the control of jassid. In case of jassid population reaches ETL. The second application may be repeated after 8 to 10 days after 1st spray.

The data on the effectiveness of different botanical pesticides against thrip in cotton shown in Figure **8** revealed that maximum reduction (67.65%) of thrips population was recorded after 96 hrs. of spray in Neem extract followed by (63.59%), (60.00%) and (52.68%) in tobacco, Neem oil and Asafoetida pesticides respectively. The reduction percentage in thrips population decreased gradually after 96 hrs of spray but remained effective up to one week in all the botanical pesticides.

During 2007, the pattern effectiveness of different botanical pesticides against thrips was almost similar. The pesticides showed maximum reduction of thrips population (60.32%), (56.01%), (55.47%) and (54.21%) in Neem extract, Neem oil tobacco and Asafoetida, respectively. The effectiveness in reduction of thrip population was recorded up to one week. The data in Figure **9** further revealed that maximum overall reduction of thrip was recorded in Neem extract (52.28%) followed by Neem oil (46.81%), Asafoetida (45.02%) and tobacco (43.40%) on cotton crop. ANOVA results also showed that pesticides means did not vary from each other. The reduction percentages of thrips population development during different periods and years varied significantly ($F_{3,111}$ =45.13; P= 0.0001 periods) and ($F_{3,111}$= 0.83; P=0.4820 years). However, the reduction percentage of pest at different intervals varied significantly.

The findings of the present investigation showed that the botanical pesticides showed effectiveness in reducing thrip population up to one week with maximum reduction percent after 96 hrs of spray.

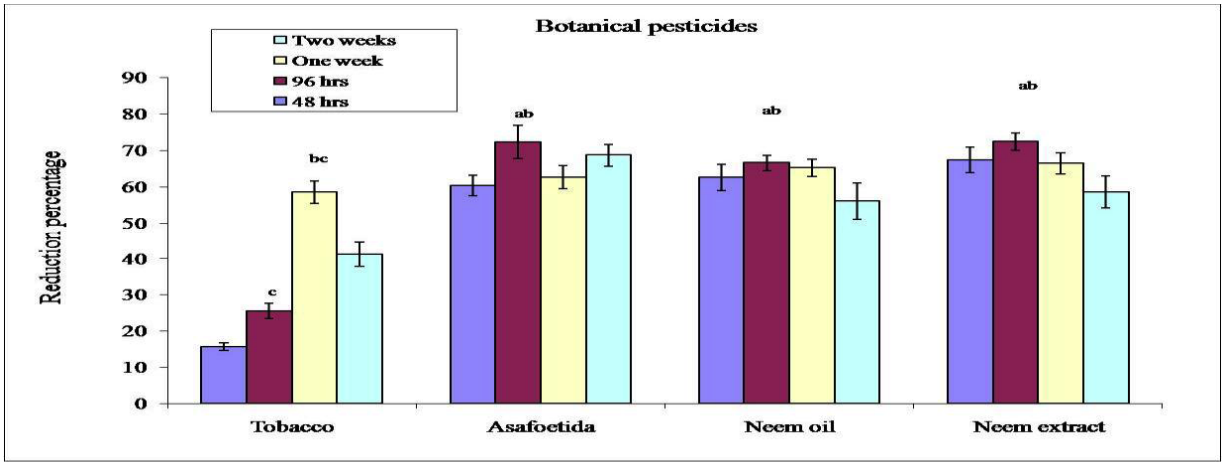

Figure 8: Reduction percentage of Thrips after application of botanical pesticides in cotton during 2007.

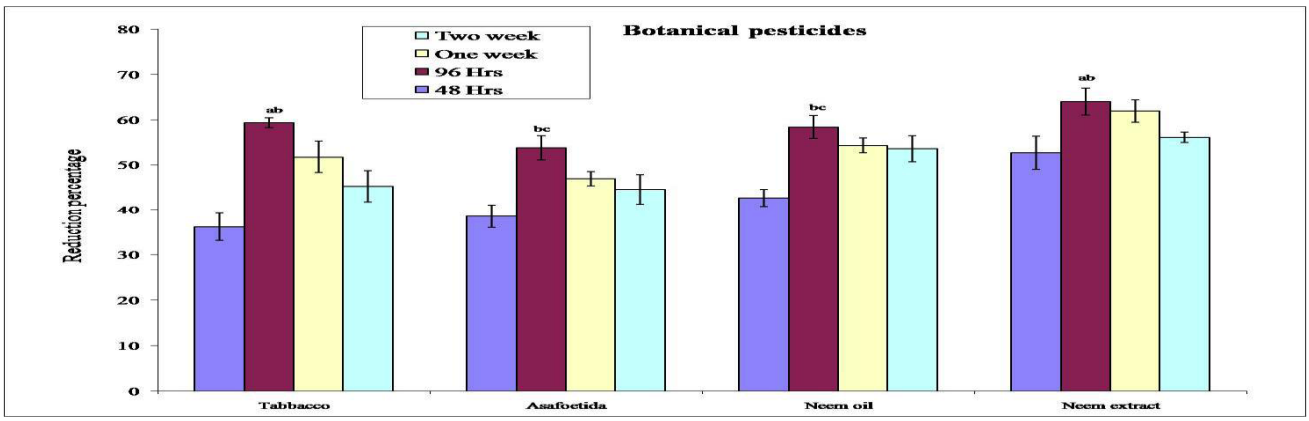

Figure 9: Overall percentage of Thrips after application of botanical pesticides in cotton during 2006 and 2007.

Therefore, based on the present investigation Neem extract and Neem oil are recommended against thrips.

DISCUSSION

Whitefly population reduction decreased after 96 hrs. but their toxicity was close to peaks of reduction percent up to one week. This shows that the botanical pesticides started detoxifying after 96 hours of spray and showed maximum (79.0%) effect on whitefly population reduction up to one week after spray. Overall, maximum mean reduction (72.21%) was recorded in Neem extract followed by Neem oil (68.68%), Asafoetida (70.50%) and tobacco (24.41%) during 2006-7. The results of percent investigation revealed that all the botanical pesticides remained effective in reducing jassid population up to one week. However, maximum (72.12%) reduction was noticed after 96 hours (hrs) after spray. Reduction of thrip was recorded in Neem extract (52.28%) followed by Neem oil (46.81%), Asafoetida (45.02%) and tobacco (43.40%) on cotton crop. It is generally observed that synthetic pesticides reduce insect infestation immediately but after development resistance against these pesticides the cotton farmer is helpless. However, biopesticides are natural substances and the insects never tolerate the efficacy of biopesticides. The results of the present study were further supported by Sivakumar (2004) [11] who reported that *Meranoplus bicolor* was found effective to control insect feeding on the flowers and at the base of immature bolls of cotton. Application of Neem oil, garlic emulsion at 2% and tobacco decoction deterred the ants for 4-5 days in severely affected plots. Ali *et al.* (2005) [12] reported that bio-pesticides were most effective to control sucking complex population on cotton.

The findings of the present investigation further showed that the botanical pesticides showed effectiveness in reducing thrip population up to one week with maximum reduction (52.28%) after 96 hrs of spray. Therefore, based on the present investigation Neem extract and Neem oil are recommended against thrips. Praveen and Dhandapani (2001) [13] reported that spraying biopesticides i.e. using Neem, dhatura, tobacco

and eucalyptus extracts has proved to be highly beneficial in multiple dimensions. The *Azadirachta indica* produces the biodegradable and insecticidal liminoid [14]. Botanical insecticides have been found effective against mealy bug, partiazadirachtin [15]. The insecticidal activity of azadirachtin has been demonstrated against numerous cotton insect pests [16], and its various modes of activity could include disruption of feeding, tobacco based products and garlic extracts [17]. Use of these natural compounds in place of conventional insecticides could reduce environmental pollution, preserve non-target organisms, and avert insecticide-induced pest [18]. Tobacco extract proved to be most effective against mealybug which caused highest mortality (98.60%) after 24 hours of treatment; while Neem oil and Neem extract with mortalities of 89.32 and 80.37 percent, respectively; while the least efficacy was recorded in case of garlic extract which caused insect mortality of 75.82 percent [19]. The efficacy of Neem oil against thrips has also been reported by (Arain, 2008) [20]. Singh *et al.* (2002) [21] determined the efficacy of Neem based pesticides against thrips and on the basis of cost: benefit ratio, NSKE (3%) ranked first (1:10.70) among all pesticide treatments. Khaskheli (2007) [22] applied botanical products for controlling thrips population on cotton found Neem oil as an effective control of thrips. The above discussion leads to conclude that priority adoption of botanical pesticides in cotton is necessary, not only to control the insect pests, but also to save the natural enemies i.e. predators etc. and to protect the environment from pollution due to synthetic pesticides. The farmers in Sindh province are also becoming familiar of the biocontrol of insect pests in cotton. Khushk and Mal (2006) [23] reported that various Neem and tobacco based botanical products have been reported successful in controlling the mealy bugs in cotton. An application must be practiced early in the season and 3 more ~3 to 4 weeks separately. Benefits were security, odor less and low cost. Some recent studies indicated that bioinsecticides were appreciably effective to control the American Bollworm population on cotton [24].

CONCLUSION

The botanical pesticides started detoxifying after 96 hours of spray and showed maximum (79.0%) effect on whitefly population reduction up to one week after spray. The botanical pesticides remained effective in reducing jassid population up to one week. Maximum (72.12%) reduction was noticed after 96 hours (hrs) after spray. Reduction of thrip was recorded in Neem extract (52.28%) followed by Neem oil (46.81%), Asafoetida (45.02%) and tobacco (43.40%) on cotton crop. The botanical pesticides showed effectiveness in reducing thrip population up to one week with maximum reduction (52.28%) after 96 hrs of spray. The Neem extract and Neem oil are recommended against thrips. Therefore, it is suggested that botanical pesticides may be applied against sucking complex of cotton at 10 days interval.

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