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Population Dynamics of Sucking Pest Complex and Their Natural Enemies in Cotton Eco-system

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An experiment was carried out to evaluate twenty different treatments comprising NSE 5% (Neem Seed Extract), neem oil 1%, azadirachtin 1500 ppm @ 2 ml/lit, CASE 5% (Custard Apple Seed Extract) against sucking pest complex. The application of neem oil 1% emerged as the most effective treatment in recording minimum population of aphids and whitefly, while NSE 5% was observed to be most promising in recording the lowest population of leaf hoppers and thrips. In general, the botanicals were effectual up to 3 days after treatment. Amongst natural enemies of sucking pests, syrphid larvae, larvae and adults of lady bird beetle and Chrysopa eggs played important role in sucking pest management programme. NSE 5% and azadirachtin 1500 ppm were found safer to natural enemies. The population of natural enemies was observed to gradually increasing in each observations and the maximum population has been recorded on 10th day after spray, which was proportional to the increasing population trend of sucking pest complex.

Keywords: Cotton, Sucking Pest Complex, Natural Enemies, Botanicals.

Introduction

Cotton (*Gossypium* spp.) is an important cash crop of India and oftenly referred as 'White Gold' of India. Besides serving as a source of natural fibre, it is also a oilseed crop, providing raw material to the oil and textile industries and performs a key role in the national economy and trade. After 2002, cultivation of *Bt* cotton in India is started for increasing the productivity of cotton, but its falls short of world's average productivity of 620 kg lint /ha (Basu and Taweer, 2008). Despite substantial improvement during 2004-05 in *Bt* cotton to reduce the cost of protection for bollworm complex, sucking pest complex and other minor pest emerged as new threat in *Bt* cotton. Besides many farmers believes on non-*Bt* cotton in era of *Bt* cotton.

Amongst several factors responsible for low productivity due to the sucking pests, aphid (*Aphis gossypii* Glover), leaf hopper (*Amrasca biguttula biguttula* Ishida), thrip (*Thrips tabaci* Linn.) and whitefly (*Bemisia tabaci* Genn.) are of regular occurrence on non-*Bt* as well as *Bt* cotton. The losses in cotton due to sucking pests were reported as up to 8.37% non-*Bt* cotton by Banerjee (2002).

Aim of Study

Pest management continues to be an important effort to deal with pests in a manner compatible with both environment and production economics. The botanicals and bio-pesticides involve conservation of natural enemies like coccinellids, syrphids, chrysopa, spiders etc. in cotton field that feed on soft bodied insects like aphids, whiteflies, thrips, mites, eggs and early instars larvae of bollworms and thereby help in managing the cotton pests. The global concern about the harmful effect of pesticides on the environment and need of organic cotton in the world, necessitated to undertake the present investigation to evaluate the performance of different botanicals like neem seed extract, neem oil, commercial azadirachtin and custard apple seed extract for the management of sucking pest complex and their natural enemy fauna in cotton ecosystem.

Materials and Methods

The research project on management of sucking pest complex of cotton with plant products was carried out in Central Research Scheme, Dr. Deshmukh Krishi Vidyapeeth, Akola for two consecutive years 2004-05 and 2005-06 with a view to evaluate the efficacy of herbal extracts, their

formulated products against cotton sucking pests. Twenty different treatments consisting of NSE (5%), neem oil (1%), synthetic neem formulation (azadirachtin 1500 ppm) @ 2ml/lit, CASE (5%) and untreated control were evaluated for management of sucking pest. The treatments of botanicals were undertaken for sucking pests comprising four treatment plots of each botanical. Out of four plots, three plot were continued for bollworms managements comprising HaNPV 250 LE/ha, *Bt* 1000 g/ha and spinosad @ 0.01% along with untreated control as well as fourth plot was kept continued under same application of botanical treatment for bollworm.

To prepare 5% solution, 5 kg dried, and crushed neem and custard apple seeds were taken in 100 lit of water. To this extract, soap powder @ 0.2 % (200 g/100 lit water) was added to have a better coverage of material on the crop. Neem oil spray solution @ 1% was prepared by adding 10 ml per litre of water and soap powder was added @ 0.2 %.

The observation on the population of sucking pests *viz*., aphids, leaf hoppers, thrips and whitefly were recorded from three leaves each from top, middle and bottom canopy of randomly selected five plants from each net plot at 3, 5 and 10 days after each treatment and the average population of sucking pests per leaf was worked out. The first treatment for sucking pest was undertaken at 15 days after emergence (DAG) and was repeated at an interval of 10 days. The observations on sucking pests were recorded up to 60 DAG.

Regarding natural recorded observations were recorded on the population of larval and adult population of lady bird beetle, eggs of Chrysopa and syrphid larvae. Population of these predators was recorded on randomly selected five plants from each net plot on whole plant at 3, 5 and 10 days after each treatment during both the years.

The data collected from each year of experimentation were averaged out for respective parameter and subjected for analysis of variance. Similarly, the results of both the years were further pooled and averages were worked out.

Results and Discussion

The results on efficacy of all botanicals *viz.,* NSE, neem oil, Azadirachtin and CASE revealed that these botanicals effective on the sucking pests of cotton up to 3 days of application. Later the effect has been found to decline gradually, since the population of all sucking pests were found gradually increasing on 5th and 10th day after spraying (Table 1-2).

Among the botanicals, neem oil 1% was found promising against aphids and recorded minimum population in the range of 1.49 to 1.73 aphids/leaf at 3 days after spray which further increased to 2.49 to 2.67 and 3.07 to 3.10 aphids/leaf at 5th and 10th day after spraying (Table 1). Earlier, Sarangdevot *et al*. (2006) obtained considerable effect on aphids due to the treatment of neem oil and thus support the present results. The application of NSE (5%) was also found to have effect on aphid, but was inferior to neem oil (1%) and recorded 2.19 to 2.48 aphids/leaf at 3 days after application. The effectiveness of NSE 5% has also been demonstrated by Banbote *et al*. (1995) and Tayade (2007) against aphids.

The application of commercial neem preparation of Azadirachtin 1500 ppm showed the aphid population in the range of 2.95 to 3.33 per leaf reducing the population of aphids. Similar kind of effectiveness of azadirachtin has been reported by Banbote *et al*. (1995).

The treatment of NSE (5%) has shown better performance against cotton jassids and the incidence of 0.44 to 0.59 leaf hoppers/leaf was recorded and proved effective up to 3 days after spray and increased on 5th and 10th day after spraying (Table 1). The effectiveness on NSE (5%) against cotton leaf hoppers is authenticated with the reports of several workers like Banbote *et al*. (1995) and Sreenivas and Patil (2001^{a}) who found better results of NSE in reducing jassid population over other botanicals. The application of Azadirachtin 1500 ppm was found to be the next best treatment which recorded 0.85 to 0.93 leaf hoppers/leaf at 3 days after spray and increased thereafter. The performance of Azadirachtin neem based product against leaf hoppers on cotton is supported by the work of Banbote *et al*. (1995) and Tayade (2007) who reported minimum infestation of leaf hoppers on cotton. Similarly, the efficacy of Azadirachtin 1500 ppm has also been reported by Sreenivas and Patil (2001^{a}) who showed the promising results by recording the lowest population of cotton leaf hoppers at 3 days after spray as compared to 7 and 10 days after spray, respectively and found agreement with the present results.

The observations on the efficacy of different botanicals against thrips revealed that the treatment of NSE 5% was found superior against thrips with population of 1.30 to 1.64 thrips/leaf at 3 days after spray (Table 2). Although the population has increased gradually but treatment has kept the population well below the range of 2.98 to 3.42 thrips/leaf up to 10 days after spray and offered the good protection to cotton crop from the infestation of thrips in field. Such effectiveness of NSE (5%) against thrips has also been reported previously by Banbote *et al*. (1995) who found NSE (5%) effective in managing the thrips population to the extent of 70.05%. Similarly, Tayade (2007) also observed the lowest thrips population in NSE (5%) treated plots.

Based on the data, neem oil (1%) was found to be the most promising against whitefly population and recorded the lowest incidence of 1.50 to 1.82 whitefly/leaf on 3rd day after application (Table 2). The whitefly population increased further to the tune of 2.87 to 3.11 per leaf on 10th day after spray. The neem seed extract (5%) has also exhibited positive influence against whitefly by recording the minimum population in the range of 2.93 to 3.25 whiteflies / leaf at 3 days after spray. The potentiality of NSE (5%) in managing the whitefly population on cotton has been shown by the workers like Banbote *et al*. (1995) who studied the 36.68% mortality. Similarly, Tayade (2007)

reported the good influence of NSE (5%) against cotton whitefly to the tune of 0.26/3 leaves.

Population dynamics of natural enemies:

Amongst natural enemies, syrphid larvae, lady bird beetle (*Cheilomenes sexmaculatus*) and Chrysopa (*Chrysoperla carnea*) play important role in sucking pest management programme. The data on syrphid larvae, coccinelids and Chrysopa eggs were recorded to study the impact of botanical applications on population of these natural enemies on 3rd, 5th and 10th day after sprays. Since the population of natural enemies were found to gradually increasing in each observations and the maximum population has been recorded on 10th day after spray (Table 3-4).

The two years pooled data (Table 3) on larval population of lady bird beetle (LBB) at 10 days after spray revealed that all the botanicals showed maximum larval population in untreated control (1.02 to 1.06 LBB larvae/plant) on 10th day after spray which was slightly lower on 3rd and 5th day after application. Maximum population of LBB in untreated plot observed in the present investigation was also reported by Biradar *et al.* (2002), Paul and Kadam (2003), Udikeri *et al.* (2004) and Tayade (2007) thus do find support the present finding.

Among the botanicals, the applications of NSE (5%), Azadirachtin 1500 ppm and CASE (5%) recorded 0.42-0.47, 0.33-0.36 and 0.33-0.36, respectively and the lowest population of 0.25 to 0.28 LBB larvae/plant was noticed in Neem oil (1%), Ramamurthy *et al.* (2000) observed that neem oil had minimum effect on mortality LBB larvae/plant of coccinellids in cotton. Likewise, Tayade (2007) obtained the population of LBB larvae by the application of Azadirachtin 1500 ppm and NSE 5%, respectively.

The LBB adult population the pooled data (Table 3) revealed that the highest population of 2.43 to 2.46 LBB adults/plant was recorded in the untreated control at 10 days after spray. This type of results in untreated plot was reported by Biradar *et al.* (2002), Paul and Kadam (2003), Udikeri *et al.* (2004) and Tayade (2007), which confirm the current findings.

Amongst the botanicals, maximum LBB population was noted in NSE 5% (1.96-2.03 LBB adults/plant) being more Biosafer, which was followed by Azadirachtin 1500 ppm and CASE 5%. Similarly, Sreenivas and Patil (2001[b]) showed the highest LBB adult population in biointensive module comprised of neem based biopesticides. Also, Tayade (2007) reported LBB adult per plant in the treatment of NSE 5%, thus supports the present findings.

The pooled results of each botanical indicated that unsprayed plots were most safer for Chrysopa eggs (0.88 to 0.91 eggs/plant) (Table 4). Tayade (2007) reported that the natural population of Chrysopa eggs in cotton was maximum in unsprayed plot, which is in conformity with the present investigation.

Among the botanicals, the application of NSE (5%) recorded the maximum population of Chrysopa eggs in the range of 0.57-0.60 per plant, which followed by the application of Azadirachtin 1500 ppm (0.40-0.43 egg per plant). Schmutterer (1996) reported the eggs of Chrysopid were not sensitive to neem seed extract. Rajaram *et al*. (2001) observed the maximum Chrysopa eggs in the IPM fields consisted of NSKE (5%), thus supports the present findings. The treatment of neem oil (1%) noticed the population in the range of 0.30 to 0.35 eggs/plant and found at par with the application of CASE 5%, in which the lowest population (0.30 to 0.33 egg/plant) on 10th day after spray.

Maximum syrphid larvae were noticed in an untreated control plots, however, all the botanicals have also shown comparative biosafety for syrphid larvae with varying degree (Table 4). The maximum population in the range of 1.38-1.42 syrphid/plant was recorded in the untreated control on 10th day after application which recorded minimum on 3rd and 5th day after spray. Such results in untreated check plot were also reported by Udikeri *et al*. (2004) which confirm the present findings. The population of 0.94-0.98 syrphid larvae per pant was observed in NSE 5% found safer over others, which was followed by the application of Azadirachtin 1500 ppm and CASE 5%.

Conclusion:

Considering the above facts, it can be concluded that, neem oil (1%) could be considered as the most effective against aphids and whiteflies, while NSE (5%) was proved promising in minimizing the population of leaf hopper and thrips. Similarly, NSE (5%) and Azadirachtin 1500 ppm were also observed to be safer to natural enemies. The population trend of natural enemies was found increasing at 10 days after spray, which was proportional to the population of sucking pest complex.

Suggestions:

The spraying of the botanicals for sucking pest of cotton can reduce the population of soft bodies insect as well as save the natural enemies in cotton eco-system. This schedule will also benefit in reducing the egg and early instar larval damage of bollworm in proceeding days.

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