Management of Sucking Pests of early Season Cotton by Application of different Seed and Soil Insecticides in Pakistan

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Abstract:
Cotton is cash crop of Pakistan and sucking insect pests are serious issue especially in early cotton season. To cope with the issue, a field experiment was conducted to investigate the post emergence effectiveness of two seed and two soil applied insecticides on populations’ development of sucking insect pests in cotton. The seed applied insecticides i.e. Imidacloprid (Confidor 70 WS) and Thiamethoxam (Actara 70 WS) were applied to the seed before sowing. Two granular insecticides i.e. Aldicarb (Temik 10 G) and Carbaryl (Sevin 10 D) were applied in furrows with a modified applicator that was calibrated to deliver the desired rate. The results showed that all the tested insecticides were very effective in controlling the targeted sucking insect pests i.e. thrips, whiteflies and jassids as compared to untreated cotton. Conversely, the seed applied insecticides i.e. Imidacloprid and Thiamethoxam showed more effectiveness compared to soil applied granular insecticides i.e. Aldicarb and Carbaryl in reducing sucking pests’ populations. Such systemic insecticides applied as treated seed can be present in sufficient quantity in germinating plants leading to toxicity to pests, and helpful for safety of natural enemies. The population trends of the three principal sucking insect pests namely thrip, whitefly and jassid were varied significantly over the study months thereby indicating that the population build up was favoured by certain factors. Consequently, the use of seed applied insecticides can be a major component to put into practice in the integrated pest management technology of cotton.

Keywords: Cotton, Pest management, Sucking insects, Chemical control

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Introduction:

Pakistan took front rank in the cotton production and its industry during the previous some decades. The inhabitants of the country grew the cotton plants extensively and produced sufficient lint or made clothes to fulfill their own needs and to supply local traders, who carried these items to foreign lands. Great damage to the cotton crop is caused by certain pests in spite of all the efforts to control them (Frisbie, 1989). Cotton production is adversely affected by many pests, managed
with different pesticides (Sarwar et al., 2011). Numerous species of insects infest the cotton plant; but there are a number of species of sucking or piercing insects that are injurious to this crop. During the early stages of cotton development, heavy losses to yield of seed cotton can occur and fiber quality is also impacted as a result of premature shedding of its leaves and fruiting bodies.

For the management of cotton crop study of developmental stages of pests, population dynamics and methods of control are important (Matthews and Tunstall, 1994). In subtropical areas various mite species and more than seventy insect pests infest cotton plants. The cropping pattern and climatic conditions in the region varies according to the pest species (Gahukar, 1991). Among all insect pests of cotton crop, pests of sucking complex such as thrips, jassids and whiteflies cause primarily economic damage (Sarwar, 2013 a). To reduce the crop damage, application of integrated pest management (IPM) strategies such as release of bio-control agents, cultural practices, mechanical tactics, use of microbials, different botanicals and chemical control is effective (Syed et al., 2012 and Sarwar and Sattar, 2016).

To suppress the pest population and for reduction of infestation level, various groups of pesticides have been sprayed alone or in combination. Cotton is a cash crop, broadly cultivated in various regions; the use of different pesticides to control insects has become widespread. Chemical control by employing insecticides in cotton has a number of rewards over other means of insect’s management. The intensive use locally is the only reason that this crop meets the basic lint and cotton seed requirements for the expanding population of the country (Ahmad and Sarwar, 2013).

The insecticides used for cotton protection are instant and positive in action, and insect outbreaks can be solved within hours by their applications. Alternative pest control practices are less effective as insecticides at economic threshold (ET) levels (Deguine et al., 2008). As a result, the pests have challenged to the cotton growers and thus necessitated a deep insight into the issue of insecticide managing to incorporate in the integrated pest management (IPM) strategy. So, pesticide application and formulation must be both efficacious and safe (Dover, 1985). Cotton growing has continued on the use of fast acting pesticides for managing pests at different stages of crop. To supress the sucking pests mostly farmers apply foliar pesticides at early stages. As a result, these sprays distrub natural control. Seed treatment with Thiamethoxam and Imidacloprid protect the crop from sucking pests (Maienfisch et al., 2001).

The existing study is an endeavor in this trend to cope with sucking insects without polluting the environment due to foliar application of insecticides. The current research highlights the
perspective for the use of the examined insecticides in sucking insect pests’ management in cotton. The results achieved can be successfully utilized in the context of local conditions in Pakistan as well as may also possibly be exploited at global spots for cotton plant protection purposes. The objective of present research is to craft newer information generally not available in published form to include as a component of integrated pest management (ipm) of early season sucking pests in cotton.

Materials and Methods:

Experimental Technique for Pests Control

Two seed and two soil applied insecticides (registered for use in Pakistan) were evaluated for their efficacy against piercing and sucking insects i.e., thrips, whiteflies and jassids in a cotton field at Sindh Agriculture University, Tando Jam. The commercial cotton variety, SLS-1 was cultivated according to locally prevailing agronomic practices. Pre-soaked and delinted cotton seed was used for raising the crop. Two granular insecticides of Carbamate group i.e. Aldicarb (Temik 10 G Carbamate group i.e. Aldicarb (Temik 10 G and Carbaryl (Sevin, 10 D) were applied in furrow prior to crop sowing, at the dose 5.0 kg/acre and 1.5 kg/acre, respectively. The seed applied insecticides; Imidacloprid (Confidor 70 WS) and Thiamethoxam (Actara 70 WS) (Neonicotinoid Group) were applied at 5 g/ kg of seed and 3 g/ kg of seed and mixed thoroughly before sowing. For this purpose, the insecticide and cotton seeds were rotated and shaken in plastic transparent bags, and then treated seeds were dried under the shade. Whereas, the untreated seeds were used as control treatment. The seed treated with the neonicotinoids along with untreated control seed (without insecticide) were sown by dibbing method. The net plot sizes measuring 5x4.5 meters were arranged in a Randomized Complete Block Design with three replicates.
Population Dynamics of Sucking Insect Pests

Monitoring of all sucking pests was started by sampling cotton plants ten days after seedlings emergence and continued until most of pests reached above economic injury level for further treatments. Assessments of efficacy of insecticides were made by visual counts on the number of sucking pests on cotton leaves. Populations of thrip, *Thrips tabaci* (Thysanoptera: Thripidae), whitefly, *Bemisia tabaci* (Hemiptera: Aleyrodidae) and jassid, *Amrasca devastans*, (Hemiptera: Cicadellidae) were particularly recorded. For each observation, the live adult and nymph individuals of each species were counted. Observations for a standard sampling on the pest’s incidence concerned were recorded from 5 randomly selected plants in each replicate at a weekly interval. For this purpose the first plant was selected at random and then checked the four plants next to it. The population of the pest complex was counted physically on leaves from top, middle and bottom portion of each plant to determine their populations on per leaf basis. Other parts of plants were also thoroughly examined for detailed insects’ counts if any pest visible. After 50 days from plant emergence, when pest populations exceeded above the tolerable level, insecticidal applications were made at whatever time these needed.

**Data analysis:**

The populations of piercing and sucking insects recorded in the cotton fields were analyzed by using Statistics 8.1 computer software. The data were statistically analyzed by analysis of variance (ANOVA) and Duncan’s Multiple Range Test, was used to observe the differences between the treatment means.

**Results:**

The numbers of live individuals (adults and nymphs) for thrips, whiteflies and jassids) in treated (protected) plants were found significantly lower compared to untreated cotton crop (unprotected plants) as confirmed by Duncan’s Multiple Range Test. A glance of data, based on the overall performance of the test compounds reflected that the seed applied neonicotinoids were sharply superior in control of sucking pests (thrips, whiteflies and jassids) compared to soil applied conventional insecticides (Table 1).

The mean numbers of thrips in plots treated with Imidacloprid, Thiamethoxam, Aldicarb and Carbaryl were found significantly as 2.50, 3.66, 5.76 and 6.30 individuals/ leaf, respectively,
whereas, it was 11.33 individuals/ leaf in the untreated plots. Whiteflies population was significantly found as 1.66, 2.33, 3.20 and 3.60 individuals/ leaf in treated plots by Imidacloprid, Thiamethoxam, Aldicarb and Carbaryl, correspondingly, while, 6.66 individuals/ leaf counted inside untreated plots. Jassids population was also lower at the same time as 0.20, 0.30, 0.53 and 0.56 individuals/ leaf in protected plots (pesticides used) treated with Imidacloprid, Thiamethoxam, Aldicarb and Carbaryl, respectively, in comparison to 1.33/ leaf from unprotected plants (pesticides not used).

Table 1: Mean number of live individuals after treatments of different seed and soil applied insecticides for the control of piercing and sucking insects in cotton,

| S. Nr. | Type of Insecticides | Treatments                        | Nr. of Thrips/leaf | Nr. of Whiteflies/leaf | Nr. of Jassids/leaf |
|-------|----------------------|-----------------------------------|--------------------|------------------------|---------------------|
| 1.    | Seed applied         | Imidacloprid (Confidor 70 WS)     | 2.50 d             | 1.66 d                 | 0.20 c              |
|       |                      | Thiamethoxam (Actara 70 WS)       | 3.66 c             | 2.33 cd                | 0.30 c              |
| 2.    | Soil applied         | Aldicarb (Temik 10 G)             | 5.76 b             | 3.20 bc                | 0.53 b              |
| 3.    |                      | Carbaryl (Sevin 10 D)             | 6.30 b             | 3.60 b                 | 0.56 b              |
| 4.    | Check                | Unprotected                       | 11.33 a            | 6.66 a                 | 1.33 a              |
| 5.    | LSD value            |                                    | 0.79               | 0.94                   | 0.22                |

Means followed by different letters within column are significantly different from each other.

Results depicted that all insecticides had higher initial pests killing effects (thrip 2.5-6.3, whitefly 1.6-3.6 and jassid 0.20-0.56 population/leaf), their toxicities decreased gradually as the time after insecticides application passed compared to untreated plants. The target sucking insects appeared on cotton 10 days after seedlings emergence at the vegetative stage of the crop and their activities remained below the economic threshold levels until 40 days after emergence in the control. However, plots treated with Imidacloprid showed a 2 weeks further delay in pests’ abundance and the peak population was observed near flowering formation period of crop.
Population Dynamics of Sucking Insect Pests

Density of whitefly on cotton in June was 3 individuals per leaf; it gradually increased in the subsequent months and peaked in August to a highest of 11 individuals per leaf. Density of the pest gradually declined in the subsequent month and reached to a minimum number of 6 individuals per leaf in October. The population of thrip was started to increase in June, and the highest noted (20 per leaf) in the July, but abruptly declined in the subsequent two months, and the pest disappeared in October. Density of jassid remained the minimum in June, but increased subsequently in July and peaked (2 individuals per leaf) in August to September, and declined at the end of the cropping season in October.

Discussion:

This study assessed the effectiveness of systematic pesticides Imidacloprid and Thiamethoxam for seed treatment and soil applied granular insecticides Aldicarb and Carbaryl on population development of sucking insects in cotton. The results of this study indicated more effectiveness of the seed applied insecticides, Imidacloprid and Thiamethoxam compared to soil applied granular insecticides, Aldicarb and Carbaryl in reducing sucking insects’ population. Overall, the treatments of insecticides gave significantly good control of target sucking insects, thrips, whiteflies, and jassids compared to the untreated check. However, seed treated with Imidacloprid showed better pest control compared to Thiamethoxam and untreated check. Torres and Ruberson (2004) studied that Thiamethoxam and Imidacloprid showed significant control of whitefly as comparison with check. Sreelatha and Divakar (1997) also reported the similar findings concerning effectiveness of Imidacloprid as seed treatment. Imidacloprid was found very effective against...
sucking insect pests and may be used as a seed treatment or as a foliar systemic, providing control for several weeks as stated by Bradley (2000). Attique and Ghaffar (1996) proved the effective control of early season of thrip, whitefly and jassid upto 4 weeks by seed treatment with seed protecting insecticides. It was further reported that, these insecticides can greatly improve environmental profiles and possess a minimal threat on the populations of natural enemies of cotton insects. At the period of increasing population, foliar treatments must be applied to slow their growth rate to the tune of tolerable limit till the crop fully matured.

The performance of the seed applied neonicotinoids was superior in declining the abundance of sucking pests compared with the soil applied conventional insecticides. This proclamation can also be confirmed by the published data of other authors of the earlier past. Imidacloprid is a neonicotinoid that acts on the nicotinic receptor and appears to function as acetylcholine agonist (Mullins, 1992). Similarly, Thiamethoxam, a neonicotinoid insecticide (thianicotinyl) has been reported to control a wide spectrum of sucking and chewing insects through contact and stomach activity. Thiamethoxam may be applied to seeds, soil and foliage, and exhibits rapid plant uptake and is xylem-transported. Due to the methods of application (e.g., seed treatments) and its systemic nature (uptake and translocation within the plant), it is considered to have minimal impact on beneficial species and should be well suited for including in IPM program (Lawson et al., 1999; Hofer and Brandl, 1999).

In the present research work, the population dynamics of different insect pests of cotton were studied during the whole crop season. Whitefly, jassid and thrips were the major insect pests, while their densities generally peaked from June to October and the pests normally disappeared after October. Various previous workers had also reported the densities of sucking pests reached to the highest numbers variably during whole growing months or throughout the cotton growth period (Solangi et al., 2008: Sana et al., 2011; Ahmad et al., 2011; Sarwar, 2103 b). Thus, in the present research, at par overall mean minimum and maximum populations studied previously were found from beginning of crop till the end of season in unprotected cotton.

The present study proved that the selective use of tested pesticides would seem a reasonable strategy to control sucking insect pests and to maintain their total populations below economic damage levels in cotton. In this case, the advantage of the low impact of neonicotinoids to natural enemies is possible, so that the population of natural enemies increase from their normal low to high levels. These insecticides provide better control of insect pests on a variety of crops including
cotton through contact, stomach and systemic activity. Systemic insecticides applied either in granules or treated seed can lead in sufficient doses in germinating plants for successful control of the target insect pests, and minimize the high risk associated with exposure of natural enemies due to foliar treatments. Still further studies are needed to prove their low impacts on the natural enemies of the cotton insect pests. However, the indiscriminate use of pesticides can produce several undesirable effects including; pest resistant, residues on seed and lint, environmental polution, hazaradous to living organisms. To reduce the number of sprays, emphasis on safe and eco-friendly technologies of Integrated Pest Managements is best (Sundaramurthy and Gahukar 1998).

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