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SHORT COMMUNICATION

COMPARATIVE EFFICACY OF SOME NEONICOTINOIDS AND TRADITIONAL INSECTICIDES ON SUCKING INSECT PESTS AND THEIR NATURAL ENEMIES ON BT-121 COTTON CROP

S. Ahmed, [1]M. S. Nisar, M. M. Shakir, M. Imran and K. Iqbal

Department of Entomology, University of Agriculture, Faisalabad. Pakistan
[1]University College of Agriculture, Dera Ghazi Khan, Sub-campus University of Agriculture, Faisalabad. Pakistan
Corresponding author e-mail: saha786_pk@yahoo.com

ABSTRACT

An experiment was conducted to determine efficacy of four neonicotinoids viz; nitenpyram 10SL, thiacloprid 480SC, imidacloprid 200SL, acetamaprid 20SL and four traditional insecticides such as profenofos 50EC, methidathion 40EC, bifenthrin 10EC, λ-cyhalothrin 2.5EC at their recommended field doses against sucking insect pests of cotton and their natural enemies on cotton variety Bt-121 at a farmers' field in Multan. The data on post spray number of insect per leaf was taken to find difference among treatments. The results showed that nitenpyram, thiacloprid and imidacloprid were safer to natural enemies and toxic for the sucking pests as compared to conventional insecticides. The range of percent survival of the green lacewings (42.5-87.5 and 37.5-57.5), lady bird beetle (50.0-60.0 and 26.6-46.6) and pirate bug (28.0-60.0 and 24.0-57.0) was in neonicotinoids and conventional insecticide treated plots, respectively. The use of neonicotinoids for compatibility into integrated pest management is discussed.

Key words: predators, OPs, pyrethroids, neonicotinoids, sucking insects, Bt cotton, field.

INTRODUCTION

A significant change in cropping scheme in the cotton growing areas has been witnessed with the introduction of Bt varieties of cotton in Pakistan (Ahsan and Altaf, 2009; Abdullah, 2010). The conditions of a shift in the sowing time, from July to February, and long duration has exposed the crop to a number of insect pests. The sucking insect pests have warranted monitoring and intervention with insecticides in the early stage of the crop (Kilpatrick *et al*., 2005). The conventional OPs and carbamates have shown resistance to whitefly and jassid in Pakistan (Ahmad *et al*., 2010).

The use of growth regulators and neonicotinoids followed the insecticides which were rendered ineffective against sucking insect pests (Aheer *et al*., 2000; Aslam *et al*., 2004; Solangi and Lohar, 2007; Asi *et al.*, 2008; Frank, 2012). These insecticides are to-date recommended on Bt cotton against sucking insect pests to farmers, so far these insecticides are considered less toxic to the predators of sucking insects pests. Though laboratory or semi-field trials have demonstrated this property against whitefly, jassid and thrips (Bethke and Redak, 2008; Lopez *et al.*, 2008) but a few studies have addressed side effects of neonicotinoids under the field conditions (Naranjo and Akey, 2004), however, field studies under natural conditions are proposed in the recent literature (Prabhakar *et al*., 2011). Acetamiprid and imidacloprid along with lufenuron, and triflumuron were harmless (class 1) to *Trichogramma pretiosum* Riley and are recommendable for integrated pest management programs aiming at the preservation of this parasitoid species (Carvalho *et al*., 2012). The toxicity of conventional insecticides to the natural enemies present in various agro-ecosystem has been demonstrated in laboratory tests and most of them were harmful to the different parasites and predators (Michaud and Grant, 2003. Balakrishnan *et al*., 2009; Sahito *et al*., 2011; Sabry and El-Sayed, 2011).

Keeping in view importance of sucking insect pests on Bt cotton and use of toxic insecticides for their control, present studies were undertaken to compare effect of application of neonicotinoids and conventional insecticides on sucking insect pests and their natural enemies on cotton at Farmers' field in Multan, Punjab, Pakistan.

MATERIALS AND METHODS

The four neonicotinoids insecticides (nitenpyram, thiacloprid, imidacloprid and acetamaprid) and equal number of conventional insecticides (profenofos, methidathion, bifenthrin and λ-cyhalothrin) were chosen against sucking insect pests of cotton and their natural enemies on a cotton variety, Bt-121, at a Farmers' filed in Multan. Details of the insecticides used in the experiment are given in Table 1.

Table 1. Details of the insecticides used in the experiment.

Treatments	Common name	Trade name	Group	Dose
T_1	Nitenpyram	Pyramid 10 SL	Neonicotinoid	200 ml acre^{-1}
T_2	Thiacloprid	Talent 480 SC	Neonicotinoid	50 ml acre^{-1}
T_3	Imidacloprid	Confidor 200-SL	Neonicotinoid	100 ml acre^{-1}
T_4	Acetamaprid	Rani 20 SL	Neonicotinoid	125 ml acre^{-1}
T_5	Profenofos	Curacron 50 EC	Organophosphate	800-100 ml acre^{-1}
T_6	Methidathion	Supracide 40 EC	Organophosphate	600-700 ml acre^{-1}
T_7	Bifenthrin	Talstar 10 EC	Pyrethroid	250 ml acre^{-1}
T_8	λ-cyhalothrin	Karate 2.5 EC	Pyrethroid	325 ml acre^{-1}
T_9	Control	Water only		

The nine treatments consisted of eight insecticides and a control treatment were arranged in RCBD (Randomized Complete Block Design) with a plot size 7 m × 5 m. All recommended agronomic practices were done.

- The treatments were applied at economic threshold level of these insect pests as prescribed by Directorate of Pest Warning and Quality Control of Pesticides, Multan, Pakistan.
- The spray materials were prepared at their recommended doses mentioned on the label of insecticides after calibration. Knapsack sprayer was used to spray the insecticides.
- The data of thrips, jassid, and whitefly and their natural enemies' form each plot were recorded 24 hours before and 24, 72 hours and 7 days after spray of insecticides from 5 randomly selected plants.
- The populations of thrips, jassid and whitefly as well as their natural enemies were recorded from top, middle and bottom leaves of the plants and averaged as per leaf number of the insect.
- The difference in mean population of insect pests and their natural enemies in various treatments was analyzed by (SAS) Statistical Analysis Systems 2002.

RESULTS

The minimum number of whitefly was recorded in thiacloprid treated plots (2.03) which was statistically different from number of whitefly (2.33) in nitenpyram treated plots. However, number of jassid and thrips in nitenpyram and thiacloprid treated plots had non-significant difference between one another. Imidacloprid, acetamiprid, profenofos, bifenthrin and λ-cyhalothrin treated plots had statistically similar number of jassid. Imidacloprid treated plots had non-significant lowest number of thrips with nitenpyram and thiacloprid (Table 2).

Table 2. Comparison of mean number of whitefly jassid and thrips leaf $^{-1}$ in various insecticide treatments.

Treatments		Whitefly	Jassid	Thrips
T_1	Nitenpryram 10SL	2.33^{g}	0.50 ^{c}	1.71 ^{e}
T_2	Thiacloprid 480 SC	2.03 ^{h}	0.53 ^{c}	1.76 ^{e}
T_3	Imidacloprid 200SL	3.01 ^{de}	0.95 ^{b}	1.98 ^{de}
T_4	Acetamiprid 20SL	2.63 ^{f}	0.91 ^{b}	2.66 ^{bc}
T_5	Profenofos 50EC	3.35 ^{bc}	1.00 ^{b}	3.25 ^{b}
T_6	Methidathion 40EC	2.83 ef	0.87 ^{b}	2.56 ^{cd}
T_7	Bifenthrin 10 EC	3.46 ^{b}	0.98 ^{b}	2.64 ^{bc}
T_8	λ-cyhalothrin 2.5 EC	3.11 ^{cd}	1.05 ^{b}	2.48 ^{cd}
T_9	Control	7.90 ^{a}	3.15 ^{a}	5.76 ^{a}
Statistic		F, 432; LSD, 0.25	F, 65.28; LSD, 0.29	F, 36.39; LSD, 0.61

Values are means of two sprays and three post spray intervals. Means in a column sharing same letter are not significantly different at $p<0.001$.

The number of green lacewings in nitenpyram (1.05) and thiacloprid (1.03) treated plots had significant difference with control treatments (1.20). The number of lady bird beetle and true bug in the control plots had significant difference with those in insecticide treated plots. Neonicotinoids treated plots have shown numerically high number of predators than in conventional insecticides treated plots (Table 3).

Table 3. Comparison of mean number of Green lacewings, Lady bird beetle and true bugs leaf^{-1} in various insecticide treatments.

	Treatments	Green lacewings	Lady bird beetle	True bugs
T_1	Nitenpryram 10SL	1.05 (87.5) ^{ab}	0.70 (58.3) ^{b}	0.41 (56.2) ^{bcd}
T_2	Thiacloprid 480 SC	1.03 (85.8) ^{ab}	0.73 (60.8) ^{b}	0.44 (60.6) ^{b}
T_3	Imidacloprid 200SL	0.84 (70.0) ^{bc}	0.67 (55.8) ^{bc}	0.42 (57.5) ^{bc}
T_4	Acetamiprid 20SL	0.51 (42.5) ^{d}	0.60 (50.0) ^{bcd}	0.21 (28.0) ^{de}
T_5	Profenofos 50EC	0.46 (38.3) ^{d}	0.35 (29.2) ^{de}	0.18 (24.0) ^{e}
T_6	Methidathion 40EC	0.61 (50.0) ^{dc}	0.32 (26.6) ^{e}	0.23 (31.0) ^{cde}
T_7	Bifenthrin 10 EC	0.45 (37.5) ^{d}	0.42 (35.0) ^{cde}	0.22 (30.0) ^{cde}
T_8	λ-cyhalothrin 2.5 EC	0.69 (57.5) ^{dc}	0.56 (46.6) ^{bcde}	0.42 (57.0) ^{bc}
T_9	Control	1.20 a	1.20 a	0.73 a
	Statistic	F, 10.66; LSD, 0.25	F, 9.18; LSD, 0.26	F, 6.22; LSD, 0.20

Values are means of two sprays and three post spray intervals. Values in parenthesis represent percent survival of predator in a respective treatment. Means in a column sharing same letter are not significantly different at $p<0.001$.

DISCUSSION

The present results showed that neonicotinoids have effectively kept level of sucking insect pests of cotton below economic threshold levels proved less toxic to natural enemies in comparison with conventional insecticides. Imidacloprid in the earlier studies has been found efficacious over insecticides tested along with, in a number of trials (Aheer *et al*., 2000; Aslam *et al*., 2004; Solangi and Lohar, 2007). In another study imidacloprid and acetamiprid were the most effective against cotton jassid (Raghuraman and Gupta, 2006).

The side effects of neonicotinoids against non-target insects especially predators has been demonstrated in the tests under laboratory conditions (Mizell and Sconyers, 1992; Awasthi *et al*., 2013). The results of a field study have also reported less toxicity of these insecticides for a variety of predators (Mensah, 2002). The toxicity of neonicotinoids varied with not only method of application, but also feeding behavior of the predators in the laboratory. Field sprayed leaves exposure proved imidacloprid the least toxic insecticide. In residual film method, acetamiprid was the least toxic but most toxic in glass vial method against *Coccinella undecimpunctata* (Ahmad *et al*., 2011). The two predators, *Geocoris punctipes* (Say) and *Orius insidiosus* (Say), were variably susceptible to imidacloprid and thiamethoxam after 96-h exposure. However, toxicity to these predators may be related to their feeding on foliage and not just contact with surface residues. These laboratory results contradict suggestions of little impact of these systemic neonicotinoids on parasitoids or predators (Prabhakar *et al*., 2011). Indirect way of effecting parasitoids negatively by neonicotinoid insecticides is suggested because foliar, drench or granular applications may decrease host population levels so that there are not enough hosts to attack and thus sustain parasitoid populations (Cloyd and Bethke, 2011). The non-selective organophosphate and pyrethroids insecticides can bring serious problems of reduction in the population of beneficial insects on the crops all over the world. Hence, in order to preserve natural enemies, selective insecticides compatible with biocontrol agents should be available to include in the programs of integrated pest management (IPM) (Fernandes *et al*., 2010). The present studies have shown that neonictinoids can be suitable candidates for inclusion in Integrated Pest Management of sucking insect pests in major cotton growing areas because these have proved comparatively less toxic to predators ac compared to non-selective insecticides.

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