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ROLE OF BIO-RATIONAL INSECTICIDES IN CONTROLLING *AMRASCA DEVASTANS* DIST. ON *SOLANUM MELONGENA* L. CROP

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ABSTRACT

Pesticides differ in their toxicity and potential to cause detrimental environmental impacts. Pest control materials that are comparatively non-toxic with few ecological side-effects are called "bio-rational" pesticides. The major categories of bio-rational pesticides include botanicals, microbials, minerals, and synthetic materials. Azadirachtin based insecticides are eco-friendly and are well known for their varied pest control properties in contrast to synthetic insecticides. They work by inhibiting development of immature stages of many insects and by deterring feeding by adults. But their use is limited due to the instability of azadirachtin. Whereas, spinosad derived from a soil born bacterium- *Saccharopolyspora spinosa*, is also being used as an environmentally safe product. Nicotine based imidacloprid, highly systemic and translaminar and the most widely used insecticide in the world has been used for many years to control pests of agricultural crops, turf grass, and landscape plants; because of its low toxicity to mammals, it is also used to control fleas and ticks on pets. Present study was carried out to find out the effectiveness of bio-rational insecticides (biosal, spinosad and imidacloprid) in comparison with organochlorine (OC) and organophosphate (OP) insecticides (endosulfan and profenofos) against jassid on brinjal crop. All the tested insecticides were effective against jassid except spinosad. The effectiveness of both the imidacloprid and biosal proved to be a good alternative to endosulfan and profenofos.

Key words: Bio-rational insecticides, Organochlorine, organophosphate, *Amrasca devastans,* brinjal.

INTRODUCTION

Brinjal (*Solanum melongena* L.) also recognized as eggplant or aubergine, is a vital vegetable crop and the third most important crop in the family Solanaceae after potato and tomato (FAO, 2000), grown all over the world (Daunay *et al.*, 2001). A number of insect pests attack the brinjal crop. Amongst sucking insects jassids (*Amrasca devastans* Dist.), (Patel and Patel, 1998; Sudhakar *et. al.*, 1998; Borah, 1995; Ratanoara *et al.*, 1994; Naik *et al*., 1993), whitefly (*Bemisia tabaci* Genn.) and thrips (*Thrips tabaci* Lind.) are of significant importance (Marimuthu *et al*., 1981; Atwal, 1994). They not only suck the plant sap but simultaneously transmit certain viral diseases. Several attempts have been made to control jassid (Akbar *et al*., 2005, 2006, 2007, 2012b) on different crops including brinjal. Since the insect pests cause 35-40% yield losses and the extent of damage varies with favorable weather conditions, pest population and available alternate hosts; ultimately the damage may reach up to 60-70% in all optimum conditions (Salim, 1999). Hence, the use of insecticides renders the only rapid solution to control the pest (Mehmood *et al*., 2001). However, in Pakistan approximately 27% of the total insecticides are being used on fruits and vegetables (Hussain *et al*., 2002). Nevertheless, as a crucial component of Integrated Pest Management (IPM), insecticides can considerably reduce yield losses caused by the insect pests; however, indiscriminate use of the insecticides could causes negative effects on the non-target organisms (Akobundu, 1987) and human health as well (Soomro *et al*., 2008). Masud and Hassan, (1992) analyzed market samples of different vegetables, collected from various markets of Pakistan including Karachi. They found higher level of insecticide residues in vegetables above maximum residue limits (MRLs based on Codex, 1983). Before them, Parveen and Masud, (1987; 1988a, 1988b) found remnants of chlorinated insecticides in the samples of milk, cattle drinking water, fodder and feed, drawn from cattle colony Karachi. Akbar *et al.* (2010b, 2012a) have reported the residues of organochlorine and organophosphate insecticides higher then MRLs set by EU and codex. To face the challenges of food contamination different sources of bio-rational insecticides are being used as safe alternatives to synthetic insecticides. Therefore, plant derivatives are used as insect control agent as these are supposed environment friendly and safe to human and other non-target organisms. At least 46 families of flowering plants have insecticidal activities (Feinstein, 1952), among these neem tree provides a good source for the control of different insects in the form of neem oil extract and even seed water extract (Jacobson, 1988). Neem based insecticides are well known for their safety and good performance (Schmutterer, 2002). Many researchers have reported their effectiveness in controlling sucking pests like jassid (Ambedkar *et al*., 1999) aphid (Akbar *et al*., 2008, 2014), whitefly (Akbar *et al*., 2009) flea beetle (Emosairue and Ukeh, 1997) spider mite (Rai *et al*., 1993), (Kumar and Sharma, 1993; Singh and Singh, 1999) and fruit borer (Shukla *et al*., 1996). Whereas Spinosad®, composed of spinosyns A and D, substances derived from

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naturally occurring soil bacterium *Saccharopolyspora spinosa* by aerobic fermentation of this actinomycete species. This rare species was found in soil samples from an island in the Caribbean in 1982. Spinosad possesses both contact and stomach poison activity against a wide range of insect groups including members of Coleoptera, Diptera, Hymenoptera, Isoptera, Lepidoptera, Siphonoptera and Thysanoptera (Elzen, *et al*., 1998), with little effectiveness against sucking insects (Thompson *et al*., 2000; Cowles *et al*. 2000; Tjosvold and Chaney, 2001). Neonicotinoid-based agrochemicals are extensively used to control sucking pests (Palumbo et al. 2001; Ishaaya *et al*., 2007). In fact, the US Environmental Protection Agency (US EPA) classified neonicotinoids as bio-rational insecticides being compatible with arthropod natural enemies and adequate compounds within Integrated Pest Management (IPM) programs (Ishaaya *et al*., 2007).

Keeping in view the commercial and export value of brinjal, economic losses caused by jassid and the OC and OP insecticides' threat to environment; present study was planned to evaluate the efficacy of bio-rational insecticides as a substitute to conventional insecticides to avoid ecological contamination and for sustainable vegetable production.

MATERIALS AND METHODS

The research trial was carried out in the agricultural fields of District Malir Karachi. Brinjal plants were transplanted (after 35 days of nursery raising) in a randomized complete block design (RCBD) with three replicates, each replicate consisting 6 treatment plots of 5X3 meters size including control plot, with a row to row distance of 75 cm and plant to plant distance 60 cm. Three meter distance was maintained between each treatment as a buffer to avoid spray drift of other insecticides and same distance was kept between the replicates to separate them from each other. For insect count 10 plants were randomly selected and tagged from each treatment.

Insecticides were sprayed at the recommended doses (Table 1) in the morning before 10 a.m. Pre-treatment counts were made before 24 hours of each spray and post-treatment data were recorded after 24, 72 and 168 hours of each spray. The insect population reduction percentage was computed through Henderson-Tilton's formula i.e. % efficacy= [1-Ta/Ca*Cb/Tb]*100, (Henderson and Tilton, 1955). The data thus obtained were subjected to statistical analysis through analysis of variance (ANOVA) by using SPSS Version 14.0. Significant differences among treatment means were tested with least significant difference (LSD) using 5% significant level. The pest population in various treatments was used as an indicator of insecticide efficacy i.e. lower population of insect pest represent higher toxicity and vice versa.

Table 1. Insecticides used against jassid on brinjal crop.

Insecticides		**Type**	**Source/Procured from**	**Dose***
Common Name	**Trade Name**			**g ha^{-1} a.i**
Imidacloprid	Imidacloprid 25 WP	Neonicotinoid	Arysta Life Sciences	49.4
Endosulfan	Thiodan 35 EC	Organochlorine	Bayer Crop Science	642.2
Profenofos	Curacron 500 EC	Organophosphate	Syngenta	988
Spinosad	Tracer 240 SC	Derived from soil bacterium (*Saccharopolyspora spinosa)*	Dow Agro Sciences	35.5
Azadirachtin	Biosal 10 EC	Neem formulation containing 0.32% Azadirachtin	HEJ, Institute of Chemistry, University of Karachi	15.8

*Active ingredients in grams per hectare

RESULTS AND DISCUSSION

Reduction in jassid population (Table 2) depicted that all the under test insecticides were significantly effective against jassid except spinosad. The percentage reduction over pre-treatment was higher with imidacloprid and endosulfan followed by profenofos then azadirachtin which showed moderate effectiveness. In case of conventional insecticides imidacloprid reduced 67% jassid population after 24 hours of application with increasing trend in effectiveness as 76 and 82% after 72 and 168 hours, respectively, followed by endosulfan 62, 72 and 70% reduction, while profenofos gave 56, 69 and 68% jassid mortality after 24, 72 and 168 hours of application. Misrah and Senapati (2003) also found significant superiority of imidacloprid 200 SL amongst different insecticides against the okra jassid (*Amrasca biguttula biguttula*). Santharam (2003), assessed the performance of different doses of imidacloprid as seed treatment and root dip of seedlings and found it effective up to 45 days after treatment. Foliar sprays at different dose rate were reported to be significantly reducing the thrips population on chilli crop. Akbar *et al*., (2008, 2010, 2014) found imidacloprid most effective against *Myzus persicae* (Sulzer) on mustard, cabbage and cauliflower as compared to endosulfan. They also reported its excellent efficacy against *Bemicia tabaci* Genn. on okra (Akbar *et al.,* 2009, 2011) and *Amrasca devastans* Distt. on potato and okra (Akbar *et al.*, 2012a, 2012b). Sabitha *et al*. (1994) assessed the relative toxicity of different insecticides including monocrotophos, quainalphos, endosulfan and carbaryl against *Amrasca biguttula biguttula* (Ishida) and found carbaryl to be more toxic whereas Patel *et al*., (1997) found the endosulfan to be the most effective against jassids on okra. Akbar *et al*. (2006, 2007) evaluated the effectiveness of endosulfan and profenofos against jassid on okra and brinjal crops at different time intervals and found endosulfan to be more effective than profenofos on brinjal crop and vise versa in case of okra crop against jassid.

Plant based insecticides seems to have some superiority over synthetic insecticides, as about more than 2400 plants have been reported having pest control properties (Grainge and Ahmed, 1988). Unlike synthetic insecticides, azadirachtin-based neem insecticides are supposed to be safe and are well known for their diverse pest control properties. However, their use is limited due to the instability of azadirachtin, and needs its application at short intervals. Biosal (containing 0.32% Azadirachtin) gave 38% jassid mortality with increasing trend in effectiveness as 57 and 62% after 72 and 168 hours respectively. Adilakshmi *et al*., (2008), experienced various neem based readymade products against sucking pests. Although, they found neem comparatively less effective than endosulfan, however, it gave good control as compared to untreated control; these results are almost in line with the present findings. Dhingra *et al* (2008) assessed the field efficacy of Azadirachtin-A, its stable derivative tetrahydroazadirachtin-A (THA) and NeemAzal (NZ) insecticides in comparison with endosulfan against the complex pests of okra including jassid and whitefly and they found Azadirachtin-A effective up to 7 days where as THA had the potential to control the pests up to 10 days. Endosulfan being most effective with 82.9% reduction in whitefly population followed by THA, Aza-A and NZ 60%, 58.7% and 57.5% respectively. While, against jassid it was 62% with endosulfan followed by THA, Aza-A and NZ as 40.2, 35.1 and 31% respectively. Akbar *et al*. (2007), evaluated the effectiveness of biosal in comparison with endosulfan and profenofos against jassid on brinjal at different time intervals and found moderate effect of biosal against jassid with 47% mortality. Spinosad reduced only 3% of jassid population after 24 hours and 7 and 9% after 72 and 168 hours respectively, which shows its inefficiency against jassid as it endorsed the previous findings of various researchers who reported its little effectiveness against sucking insects (Thompson *et al*., 2000; Cowles *et al*., 2000; Tjosvold and Chaney, 2001).

After three successive sprays the mean efficacy of all the five insecticides viz; imidacloprid, endosulfan, profenofos, biosal and spinosad against jassid (Table 2) was 83, 67, 63, 57 and 13%, respectively.

During the present study an overall performance of the bio-rational insecticides against jassid has proved them as good alternative to OC and OP insecticides, as both these groups have detrimental effects on environment and the human health. Hence, the bio-rational insecticides may confidently be used against sucking insects as a part of integrated pest management (IPM) strategy.

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Table 2. Percent reduction in jassid population on brinjal crop**.**

Treatment	**24 Hr**	**72 Hr**	**168 Hr**	**Mean**
1st Spray				
Imidacloprid	67 ± 8.00[a]	76 ± 7.35[a]	82 ± 5.52[a]	75 ± 8.80[a]
Endosulfan	62±9.69[a]	72±7.16[a]	70±9.14[ab]	68±8.86[ab]
Profenophos	56±9.08[a]	69±7.39[ab]	68±9.50[ab]	64±9.80[b]
Spinosad	3±7.35[c]	7±5.98[c]	9±10.01[c]	6±7.37[d]
Biosal	38±7.46[b]	57±7.26[b]	62±5.58[b]	52±12.50[c]
Values sharing the same letter (s) in a column are not significantly different at P<0.05				
2nd Spray				
Imidacloprid	85 ± 5.71[a]	85 ± 4.42[a]	86 ± 7.23[a]	85 ± 5.15[a]
Endosulfan	65±5.50[b]	71±5.36[b]	68±6.57[b]	68±5.64[b]
Profenophos	60±6.91[b]	67±6.24[b]	64±6.16[b]	64±6.26[bc]
Spinosad	12±9.68[c]	14±9.11[c]	16±7.88[c]	14±7.90[d]
Biosal	55±7.77[b]	61±6.39[b]	59±5.66[b]	58±6.23[c]
Values sharing the same letter (s) in a column are not significantly different at P<0.05				
3rd Spray				
Imidacloprid	88± 6.46[a]	90± 6.09[a]	92± 5.94[a]	90±5.61[a]
Endosulfan	66±7.44[b]	68±8.06[b]	63±5.03[b]	66±6.38[b]
Profenophos	59±5.77[b]	65±7.19[b]	61±6.85[b]	62±6.32[b]
Spinosad	17±8.70[c]	20±8.93[c]	22±9.82[c]	20±8.24[c]
Biosal	56±7.75[b]	65±6.61[b]	62±7.46[b]	61±7.53[b]
Values sharing the same letter (s) in a column are not significantly different at P<0.05				
Overall Percent Efficacy				
Imidacloprid	83± 9.11[a]			
Endosulfan	67±6.90[b]			
Profenophos	63±7.42[c]			
Spinosad	13±9.40[e]			
Biosal	57±9.55[d]			

Values sharing the same letter (s) in a column are not significantly different at P<0.05

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