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MANAGEMENT OF *BEMICIA TABACI* GENN. ON *SOLANUM MELONGENA* L. THROUGH ENVIRONMENTAL FRIENDLY BIO INSECTICIDES

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ABSTRACT

Various methods are being sought to manage the insect pests by following the safe and environment friendly practices including the minimal and justified use of pesticides. Bio insecticides have a significant pest controlling capability. Additionally, being environment friendly and highly degradable, they have low persistency and residual effects. Neem based insecticides have significant pest controlling properties. However, their use is limited due to the instability of azadirachtin that requires its application at short intervals. Conversely, bacterial derived spinosad also used as an environmentally safe product. Present study was carried out to evaluate the effectiveness of two bio-insecticides the biosal 10EC and spinosad 240SC in comparison with three conventional insecticides the imidacloprid 25WP, endosulfan 35EC and profenofos 500EC against whitefly (*Bemicia tabaci Genn*.) on brinjal crop. All the three conventional insecticides were found effective against whitefly. The effectiveness trend was found as imidacloprid> endosulfan> profenophos i.e. 79, 67 and 65% respectively. Azadirachtin based biosal performed well with 58% reduction, whereas, spinosad was found least effective with 41% reduction in whitefly population. Higher yield of brinjal crop indicates the higher effectiveness of insecticides and vice versa.

Key words: Bio-insecticides, conventional insecticides, *Bemicia tabaci*, brinjal.

INTRODUCTION

Vegetables have a key role in the national economy and one of the major sources of income for the farmers. Besides, they play an important role in the food security of the underprivileged (Burney and Akmal, 1991). In addition, they are the vital source of vitamins, minerals, and proteins in human diet, for both rural and urban communities (Belitz and Grosch, 1999; Grivetti and Ogle, 2000; Ogle *et al.*, 2001). Brinjal (*Solanum melongena* L.), also known as aubergine or eggplant, is an important vegetable crop, grown all over the world (Daunay *et al*., 2001) and the third most important crop in the family Solanaceae after potato and tomato (FAO, 2000). It is attacked by a number of insect pests including leaf suckers and shoot, stem, and fruit borers (Sardana *et al*., 2004). Among leaf sucking insects jassids (*Amrasca devastans* Dist.), (Iqbal and Reddy, 1980; Ahmad and Verma, 1984; Shah *et al*., 1984; 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 considerable importance (Marimuthu *et al*., 1981).

Pesticides are supposed to be a quick solution as they are the essential tool in enhancing agricultural production (Mehmood *et al*. 2001). In Pakistan, around 27% of the total of pesticides are applied on fruit and vegetables (Hussain *et al*. 2002), but their haphazard use is bringing harmful effects on human health (Soomro *et al.*, 2008) and the non-target organisms in the environment (Akobundu, 1987).

Keeping in view the economic and nutritional value of brinjal crop and adverse effects of synthetic insecticides on human health and environment, the non synthetic pest control approaches were followed in the present study. Bio-insecticides like azadiractin based biosal and bacterial derived spinosad were selected as safer substitutes of crop protection as compared to synthetic insecticides viz; imidacloprid, endosulfan and profenofos for the effective control of whitefly, in order to support sustainable vegetable production and to avoid environmental hazards.

MATERIALS AND METHODS

Experiments were conducted in the agricultural fields of District Malir and experimental field of University of Karachi as a part of Ph. D. study. Brinjal (*Solanum melongena* L.) 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 at the recommended doses (Table 1) were sprayed in the morning before 10 a.m. Pre-treatment counts were made before 24 h of each spray and post-treatment data were recorded after 24, 72 and 168 h of each

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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% significance 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.

RESULTS AND DISCUSSION

Whitefly has become one of the most injurious pests in the tropics and sub-tropics. The results for effectiveness of five different insecticides against whitefly on brinjal crop are shown in Table 2. All the insecticides tested were greatly effective against whitefly population except spinosad which was comparatively least effective. The data reveal that imidacloprid showed excellent results with 71% reduction in whitefly population after 24 h of 1st spray and continued its effectiveness with increasing trend as 77 and 81% reduction after 72 and 168 h. Endosulfan and profenofos gave 65, 70 and 76% and 63, 69 and 74% reduction after 24, 72 and 168 h, respectively.

Biosal was initially less effective with only 41% reduction in whitefly population after 24 h of 1^{st} spray, but the effectiveness increased gradually and found effective as 47 and 57% after 72 and 168 h of 1^{st} spray. Spinosad was least effective with 8, 24 and 33% reduction after 24, 72 and 168 h respectively. After 2^{nd} spray imidacloprid continued to maintain its superiority over rest of the insecticides till 168 h of 3^{rd} spray, followed by endosulfan and profenofos. Among bio-insecticide, biosal proved better as it was comparable to profenofos. Spinosad showed appreciated results against whitefly on brinjal crop as compared to previous findings.

Table 1. Insecticides used against whitefly on brinjal crop.

Insecticides Common Name	Trade Name	Type	Source/Procured from	Dose* 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

The results on reduction in whitefly population showed the significant variation among various treatments. In a bioassay study on susceptibility of *Bemisia tabaci* Genn., Hameed *et al.* (2010) found whitefly highly susceptible towards endosulfan as it showed very low resistant (up to 3.6 folds) against endosulfan, whereas, in case of imidacloprid it was even very low (< 2) than endosulfan for most of the test population. Narottam, (2006), studied the effect of different insecticides, including imidacloprid, endosulfan, monocrotophos and azadirachtin against jassid, *Amrasca biguttula biguttula* (Ishida) on okra and found imidacloprid and monochrotophos highly effective insecticides followed by endosulfan 35 EC. Among conventional insecticides, profenofos was less effective later than imiacloprid and endosulfan. Profenofos was found in a moderate category of effectiveness when used in combination with some other insecticides against aphids and jassids on okra crop (Misrah, 2002), but comparatively more effective than neem product (azadirachtin). Where as, in present study, the results of profenofos and azadirachtin are comparable to each other. Soliman and Kazem (2006), tested profenofos in combination with garlic, capsicum and boiled linseed oil as additives and found highly effective against aphid and whitefly on squash leaves. Another study reveals that profenofos was less effective against whitefly on cotton crop (Anonymous, 2006) as compared to imidacloprid 25 WP in the field trials.

Table 2. Percent reduction in whitefly population on brinjal crop.

Treatment	24 Hr	72 Hr	168 Hr	Mean
		1st Spray		
Imidacloprid	71± 6.36^{a}	77± 6.43^{a}	81± 5.11^{a}	76± 6.67^{a}
Endosulfan	65±6.12^{a}	70±7.47^{a}	76±7.57^{a}	71±7.87^{ab}
Profenophos	63±5.23^{a}	69±8.26^{a}	74±8.21^{a}	69±8.12^{b}
Spinosad	8±8.18^{c}	24±7.46^{c}	33±7.21^{c}	22±12.76^{d}
Biosal	41±4.87^{b}	47±7.80^{b}	57±7.84^{b}	49±9.47^{c}

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

		2nd Spray		
Imidacloprid	74±6.03^{a}	78±5.20^{a}	82±5.93^{a}	78±6.01^{a}
Endosulfan	63±7.73^{ab}	69±6.86^{ab}	68±6.06^{b}	67±6.74^{b}
Profenophos	62±7.65^{ab}	68±5.39^{ab}	67±8.87^{b}	66±7.01^{b}
Spinosad	35±8.62^{c}	43±7.35^{c}	51±5.06^{c}	43±9.03^{d}
Biosal	54±6.27^{b}	58±6.09^{b}	59±4.79b^{c}	57±5.51^{c}

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

		3rd Spray		
Imidacloprid	77±6.71^{a}	82±4.24^{a}	85±7.24^{a}	82±6.41^{a}
Endosulfan	60±5.65^{b}	66±5.79b^{c}	64±9.30^{b}	63±6.57^{bc}
Profenophos	60±9.28^{b}	64±8.23b^{c}	60±5.36^{b}	61±7.00^{cd}
Spinosad	54±6.74^{b}	56±6.03^{c}	60±4.83^{b}	57±5.69^{d}
Biosal	62±6.60^{b}	71±4.30^{b}	72±4.05^{b}	68±6.37^{b}

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

	Overall Percent Efficacy
Imidacloprid	79± 6.50^{a}
Endosulfan	67±7.45^{b}
Profenophos	65±7.72^{b}
Spinosad	41±17.23^{d}
Biosal	58±10.79^{c}

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

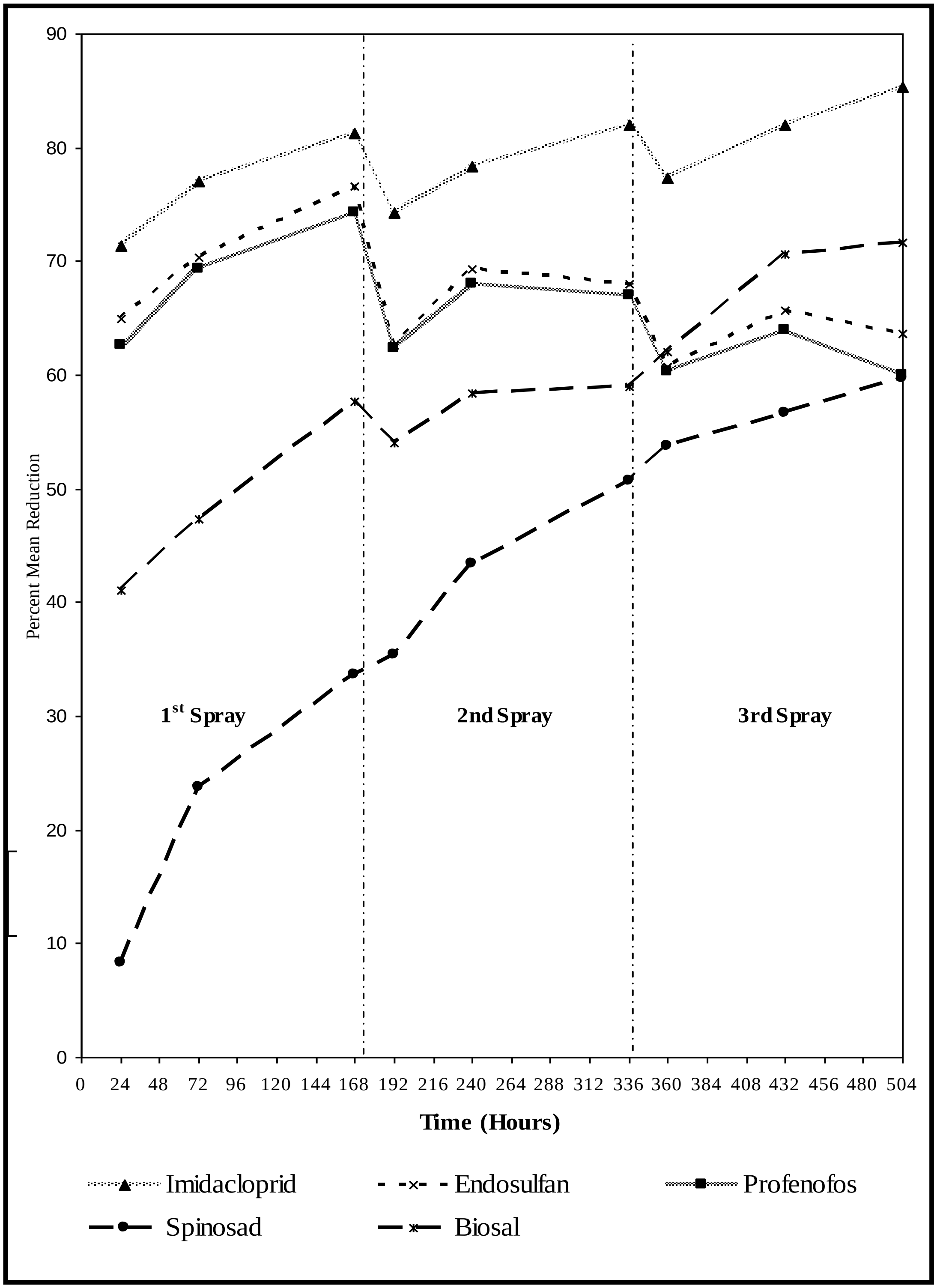

Fig. 1. Time and spray-wise effect of different insecticides against whitefly on brinjal crop.

Santharam, (2003), assessed the performance of different doses of imidacloprid as seed treatment and root dip of seedlings and found effective up to 45 days after treatment, whereas foliar spray at different dose rates significantly reduced the thrips population on chilli crop. Sarwar *et al*. (2003), found endosulfan the most effective against canola aphid when used in comparison with fenpropethrin and dimethoate. Narottam, (2006), studied the effect of endosulfan and azadirachtin and found azadirachtin in the middle order of effectiveness, when used alone, whereas, it varied in efficacy when used in combination as endosulfan + BT (*Bacillus thurigenesis*) and azadirachtin + BT.

Azadirachtin based neem pesticides having diverse pest control properties as they affect as insect growth regulators, disturb adult fertility and different physiological processes in insects like metamorphosis and also having anti-feedant and oviposition deterrent effects (Naqvi, 1996). According to Schmutterer (1990 a,b), neem based pesticides seems to have some superiority over synthetic pesticides in view of their role as environmental friendly. Besides that they are effective against a variety of sucking insects (Akbar *et al.*, 2005, 2006, 2007, 2008, 2009, 2010a, 2011, 2012, 2014) and degrade rapidly (Akbar *et al*., 2010b, 2012a). Moreover, a variety of plant species with diverse types of controlling effects are available as more than 2400 plants have been identified with pest control properties (Grainge and Ahmed, 1988). During the present study biosal performed well and found in the middle order of effectiveness and as a whole it reduced 58% whitefly population with a gradual increasing trend from 1st to 3rd spray. A number of researchers have reported efficacy of neem based pesticides as Adilakshmi *et al*. (2008), practiced the performance of neem based readymade formulations and found it moderately effective against sucking pests. Gandhi *et al*. (2006), tested the efficacy of neem oil as seed treatment against sucking insects on okra crop and reported excellent results up to 45 days. Azadirachtin based formulations Neem-Azal T/S and Neemix were found very effective against mature and immature stages of bean aphid (*Aphis fabae* Scop.) as both the formulations caused significant effects on adult aphid when used as systemic insecticide, while Ahmed *et al*., (2007) observed no toxicity when used as contact poisons. Although, Mordue (Luntz *et al*. (1996), conferred that the low level application of neem formulation as systemic insecicide possibly give the added benefit because it will not harm the beneficial insects. Aslam and Naqvi (2000), found neem extract more effective against sucking insects on cotton as it was persistent up to 6 days as compared to perfekthion which lost its effectiveness after 4 days. All these reports are in agreement with present findings as biosal (containing 0.32% azadirachtin) was effective against the sucking insects up to 7 days, while neem products are much safer and non-polluting.

As for the spinosad is concerned it is being used to control the lepedopterous pests effectively, however, reduction in whitefly population has also been reported (Anonymous, 2006; Akbar *et al.*, 2011).

Fig. 1 reflects the increasing trend of Imidacloprid and biosal as they maintained their increasing trend till 3rd spray followed by spinosad that gave good results against whitefly in the present study. Endosulfan and profenofos decreased their effectiveness after 2nd spray as compared to imidacloprid which showed excellent results throughout the experiment with increasing trend.

CONCLUSION

The findings of the present study led to conclude that azadirachtin containing biosal and microbial based spinosad can effectively be integrated as a part of pest management plan without having the sole dependence on conventional insecticides, as both the bio insecticides are safe and environment friendly. While, Imidacloprid being biorational (low risk) insecticide could also be a better choice than Endosulfan and Profenofos.

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