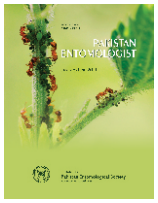
Pakistan Entomologist

Journal homepage: www.pakentomol.com



MANAGEMENT OF CAULIFLOWER APHID (*MYZUS PERSICAE* (SULZER) APHIDIDAE: HEMIPTERA) THROUGH ENVIRONMENT FRIENDLY BIOINSECTICIDES

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ARTICLE INFORMATION

Received: November 6, 2013
Received in revised form: December 16, 2013
Accepted: December 20, 2013

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ABSTRACT

Azadirachtin based insecticides have a significant pest controlling ability. Additionally, they are environment friendly, highly degradable and have low persistency as well as residual effects. The use of azadirachtin based insecticides becomes limited due to instability of azadirachtin and requires their repeated application at short time intervals. On contrary the bacterial derived spinosad is also being used as an environmentally safe product. Present study was carried out to evaluate the performance of two bioinsecticides (biosal 10EC and spinosad 240SC) in comparison with three conventional insecticides (imidacloprid 25WP, endosulfan 35EC and profenofos 500EC) for aphid (*Myzus persicae*; Sulzer) management on cauliflower crop. The crop was sown in a randomized complete block design (RCBD) with three replicates each having six treatments including control. The crop was sprayed when the insect population reached economic threshold level (ETL). Pre-treatment data were recorded before 24 hours and post treatment data were collected after 24, 72 and 168 hours of each spray. All of the three conventional insecticides were found effective against cauliflower aphid. The order of effectiveness in decreasing sequence was found to be imidacloprid> endosulfan> profenophos demonstrating 81, 72 and 67% reduction in aphid population, respectively. Azadirachtin based biosal performed well with 57% reduction, where as spinosad was found least effective with 15% reduction in aphid population. Higher yield of cauliflower indicates the more effectiveness of insecticides and vice versa.

Keywords: Bio-insecticides, Cauliflower, Conventional insecticides, *Myzus persicae*

INTRODUCTION

Brassicaceae or Cruciferae also called the mustard family is a family of flowering plants (Angiosperms). Cauliflower, *Brassica oleracea* being important member of the family is the most cultivated vegetable crop in Pakistan. It is an annual plant, reproduces by seed and its head-the white curd is used as vegetable. In 2011, Pakistan produced 227591 tonnes of cauliflower and broccoli cultivated on 13103 hectares as compared to the year 2000 which were 196892 tonnes from 10555 hectares (FAOSTAT, 2011). Sharma *et al.* (1992) reported that cauliflower and cabbage were found to be the most remunerative vegetable crops.

Both the crops are seriously attacked by different insects, resulting in severe crop yield and quality losses (Patel *et al.*, 1997). The per acre cauliflower yield may be increased by following Good Agricultural Practices (GAP) and suitable pest management strategies. Crucifers are attacked by a number of insect pests including green peach aphid, *Myzus persicae* (Sulzer). It the most diverse and polyphagous agricultural pest which causes the major losses in crop yield due to its severe infestation (Von-Dohlen *et al*., 2006; Farag and Gesraha, 2007; Lu *et al*., 2008). Though this species is mostly found on the underside of the oldest leaves on Cole crops; however, it is also common on seedlings, young plants, and lower leaves of older plants. Despite all, green peach aphids are rarely found in the heads of cauliflower, broccoli, cabbage, or Brussels sprouts (Flint, 1985). Precisely the economic importance of aphids may be figure out as; wilting and curling of the leaves due to the removal of cell sap, toxic

Cite this article as: Akbar, M.F., H.U. Rana and F. Perveen, 2014. Management of cauliflower aphid (*Myzus persicae* (Sulzer) Aphididae: Hemiptera) through environment friendly bioinsecticides. Pak. Entomol., 36(1): 25-30.

action of their salivary secretions causing galls on leaves, stems and roots, while honeydew excretion favors the secondary growth of fungus and moulds which further damages the growth of leaves and young shoots. It also acts as a virus vector and transmits many diseases to the plants (Toper-Kaygın *et al*., 2008)

As a quick solution, pesticides are the key tool in enhancing agricultural production (Mehmood *et al*., 2001). About 27% of the total pesticides used in Pakistan are applied on fruits and vegetables (Hussain *et al*., 2002), but their indiscriminate use is imposing negative effects on non-target organisms in the environment (Akobundu, 1987) and human health as well (Soomro *et al.*, 2008).

Keeping in view the economic and nutritive importance of cauliflower and adverse effects of synthetic insecticides on human health and environment, the non synthetic natural pest control approaches seems to be the novel alternatives of chemical insecticides. Bio-insecticides like azadiractin based biosal and bacterial derived spinosad were selected as safer alternatives for effective control of *Myzus persicae*, in order to support sustainable vegetable production with least environmental pollution.

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. Cauliflower plants were transplanted (after 35 days of nursery raising) in a randomized complete block design (RCBD) with three replicates, each replicate consisting of six treatment plots of 5 m ×3 m area including control plot, with a row-to-row distance of 75 cm and plant-to-plant distance of 60 cm. Three meter distance was maintained between each treatment as a buffer to avoid spray drift of other insecticides. Same distance of 3 m was kept between the replicates to separate them from each other. For insect count, 10 plants were randomly selected and tagged from each treatment. Apical 15 cm length of each leaf was gently beaten 10 times with a stick of 15 cm length and 7 mm diameter/thickness, and aphids collected on the plastic sheet were counted (Aslam and Ahmad, 2001).

Insecticides at the recommended doses (Table 1) were sprayed 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 analysis through 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 represents higher toxicity and vice versa (Akbar *et al.* 2010a).

RESULTS AND DISCUSSION

The results for effectiveness of five different insecticides against aphid on cauliflower crop are shown in Table 2. All the insecticides tested against aphid population were greatly effective except spinosad. The data reveal that imidacloprid showed excellent results with 70% reduction in aphid population after 24 hours of 1st spray and continued its effectiveness with increasing trend as 76 and 80% reduction after 72 and 168 hours. Endosulfan and profenofos gave 60, 67 and 69% and 59, 62 and 65% reduction after 24, 72 and 168 hours, respectively.

Biosal was initially less effective with only 30% reduction in aphid population after 24 hours of 1st spray, but the effectiveness increased gradually to 51 and 55% after 72 and 168 hours of 1st spray. Spinosad was least effective with 4, 9 and 10% reduction after 24, 72 and 168 hours, respectively. After 2nd spray, imidacloprid continued to maintain its superiority over rest of insecticides up to 168 hours of 3rd spray, followed by endosulfan and profenofos. Among bio-insecticides, biosal proved better as it was comparable to profenofos. Spinosad remained least effective against aphid on cauliflower crop. Similar results were documented by Aslam and Ahmad (2001, 2002) who used imidacloprid and endosulfan against mustard and turnip aphid, *Lipaphis erysimi* (Kalt.) and found imidacloprid the most effective insecticide up to 10 days followed by endosulfan which was comparatively less effective and vice versa in case of another aphid species *Brevicoryne brassicae* (Linnaeus). Santharam *et al*. (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, whereas, foliar spray at different dose rates significantly reduced the thrips population on chilli crop. Akbar *et al. (*2008, 2010a) found imidacloprid the most effective against *Myzus persicae* on mustard and cabbage, whereas endosulfan ranked second followed by biosal (containing Azadirachtin) which also gave satisfactory results. Joshi and Sherma (2009) found imidacloprid (Confidor 200 SL) very effective against two species of wheat aphids *Sitobion avenae* (F.) and *Rhopalosiphum maidis* (Titch) when used alone, whereas the efficacy declined when used by mixing with a fungicide (Tilt). Rana *et al*. (2007) also used different insecticides including imidacloprid against mustard aphid and found Advantage (carbofuran) the most effective against aphid with 95% reduction followed by Talstar (bifenthrin) and Confidor (imidacloprid) explaining 94 and 92% mortality, respectively. 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 endosulphan + BT (*Bacillus thurigenesis*) and azadirachtin + BT. 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.

Azadirachtin based pesticides have diverse pest control properties and act as insect growth regulators, disturb adult fertility and different physiological processes like metamorphosis in insects and have anti-feedant as well as oviposition deterrent effects (Naqvi, 1996). According to Schmutterer (1990a,b), azadirachtin based pesticides seems to have some superiority over synthetic pesticides in view of their role as environment friendly as they 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 in this respect (Grainge and Ahmed, 1988). In present study, biosal performed well and found in the middle order of effectiveness as it reduced 57% aphid population with a gradual increasing trend from 1st to 3rd spray. Various scientists have reported effectiveness of azadirachtin based pesticides. For example, Adilakshmi *et al.* (2008) experienced the performance of neem based formulations and found moderately effective against sucking pests. Gandhi *et al.* (2006) tested the effectiveness of neem oil as seed treatment against aphid and jassid on okra crop and reported excellent results up to 45 days. Azadirachtin based formulations like, 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 insecticides, while no toxicity was observed when used as contact poisons (Ahmed *et al.,* 2007). While, Mordue (Luntz) *et al.* (1996) discussed that the low level application of neem formulation as systemic insecticide perhaps gave the added benefit because it had no harmful effects on beneficial insects. Lowery and Isman (1994) discovered vulnerability of nine aphid species to the insect growth regulating behavior of neem seed oil or AZA, because mortality mostly occurred due to failure in molting. 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 line 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 lepidopteron pests effectively, however, reduction in whitefly population has also been reported (Akbar *et al.,* 2011; Anonymous, 2006). In the present study spinosad was found less effective against aphid with only 15% reduction. Since it endorsed the previous findings of Thompson *et al.* (2000), Cowles *et al*. (2000), Tjosvold and Chaney (2001) and Akbar *et al.* (2012b) about the inefficiency of spinosad against sucking insects including aphid.

Fig. 1 discloses that imidacloprid and biosal maintained their increasing trend of effectiveness up to 3rd spray followed by spinosad which proved less effective and statistically non significant against aphid. Effectiveness of Endosulfan and profenofos decreased after their 2nd spray as compared to imidacloprid, but was relatively better than that of 1st spray.

Fig. 2 represents the mean effectiveness of all the insecticides against aphid on cauliflower crop. Imidacloprid ranked the most effective with 81% reduction in aphid population, followed by endosulfan, profenofos, biosal and spinosad demonstrating 72%, 67%, 57% and 15% reduction in aphid population.

Percent increase in the yield over control plot as an effect of five insecticides is shown in Fig. 3 which reflects the relation of insecticides in terms of effectiveness to the yield obtained. Higher yield was achieved from the plots treated with imidacloprid (83%) followed byendosulfan (72%), profenofos (62%), biosal (62%) and spinosad (9%). This ultimately supported the performance of insecticides.

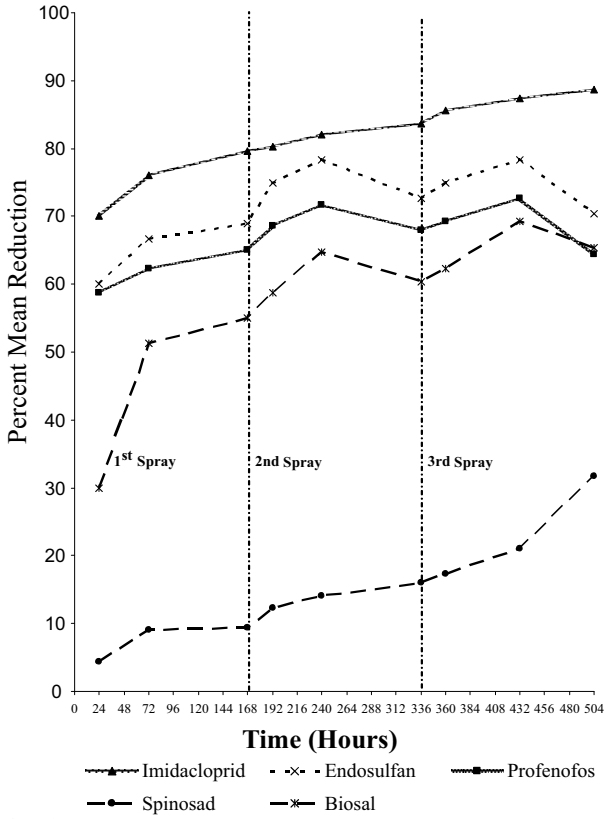

Fig. 1
Time and Spray-wise effectiveness trend of insecticides against aphid on cauliflower crop.

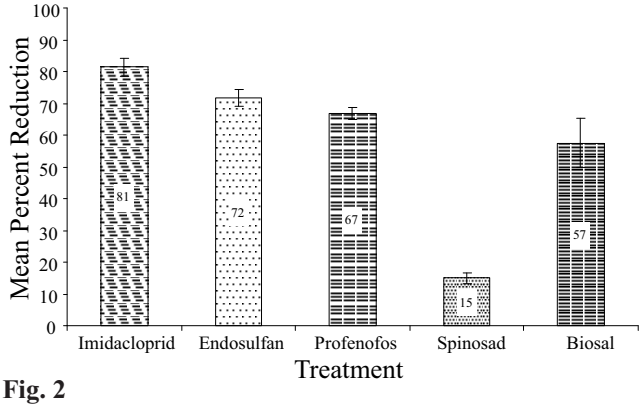

Fig. 2
Mean Percent population reduction of aphid on cauliflower crop.

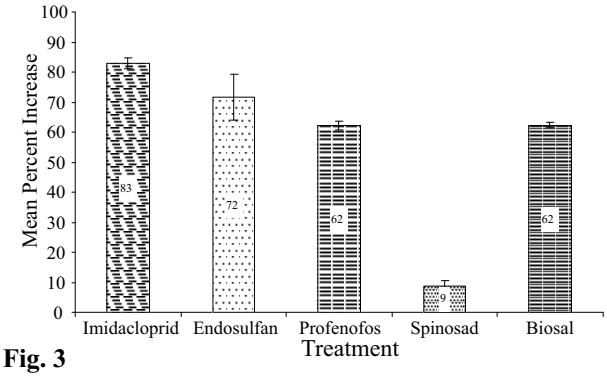

Fig. 3
Percent increase in cauliflower yield over control plot

Table 1
Insecticides used against aphid on cauliflower crop.

Common Name	Trade Name	Type	Source/Pro cured 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

Table 2
Percent reduction in aphid population on cauliflower crop.

Treatment	24 Hr	72 Hr	168 Hr	Mean
1st Spray				
Imidacloprid	70± 6.96^{a}	76±5.71^{a}	80± 7.73^{a}	75±7.22^{a}
Endosulfan	60±7.36^{a}	67±9.43^{ab}	69±4.66^{ab}	65±7.56^{b}
Profenophos	59±7.54^{a}	62±5.47^{bc}	65±4.15^{bc}	62±5.82^{b}
Spinosad	4±6.45^{c}	9±7.95^{d}	10±7.90^{d}	7±6.94^{d}
Biosal	30±7.84^{b}	51±5.66^{c}	55±5.57^{c}	45±12.8^{c}
2nd Spray				
Imidacloprid	80±3.76^{a}	82±4.87^{a}	84±6.21^{a}	82±4.63^{a}
Endosulfan	75±8.47^{a}	79±8.66^{ab}	73±4.89^{ab}	75±6.98^{ab}
Profenophos	69±5.76^{ab}	72±7.03^{ab}	68±5.29^{b}	69±5.52^{b}
Spinosad	12±7.92^{c}	14±11.09^{c}	16±8.22^{c}	14±8.12^{d}
Biosal	59±8.33^{b}	65±8.73^{b}	60±7.37^{b}	61±7.62^{e}
3rd Spray				
Imidacloprid	86±5.09^{a}	87±5.57^{a}	88±5.89^{a}	87±4.91^{a}
Endosulfan	75±9.16^{ab}	79±8.69^{ab}	70±6.73^{b}	75±7.99^{b}
Profenophos	69±5.57^{b}	72±5.99^{b}	64±7.59^{b}	69±6.63^{bc}
Spinosad	17±8.76^{c}	21±9.80^{c}	32±4.79^{c}	23±9.56^{d}
Biosal	62±7.43^{b}	69±5.23^{b}	65±7.17^{b}	66±6.53^{c}
Overall Percent Efficacy				
Imidacloprid	81±7.40^{a}			
Endosulfan	72±8.62^{b}			
Profenophos	67±6.71^{c}			
Spinosad	15±10.37^{e}			
Biosal	57±12.67^{d}			

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

Higheryield of cauliflower reflects the higher efficacy of insecticides and vice versa. Biosal gave better yield which was equal to profenofos.

The findings of the present study reveal that azadirachtin based biosal® may successfully be incorporated in pest management program, as neem based bio insecticides are more safe and environment friendly. Whereas, Imidacloprid being biorational (low risk) insecticide could also be a better alternative than Endosulfan and Profenofos.

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