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# EFFICACY OF ECO-FRIENDLY PESTICIDES ON THE MANAGEMENT OF CABBAGE APHID (*MYZUS PERSICAE* SULZER) ON CABBAGE

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**ABSTRACT**
A field trial was conducted to find out the efficacy of eco-friendly pesticides (*Bacillus thuringiensis* 5% WP @ 0.2% *a.i.*, *Beauveria bassiana* @ 0.5% *a.i.* and 1.0% *a.i.*, azadirachtin -10000 ppm. @ 0.002% *a.i.*, NSKE @ 5.0% *a.i.*, diflubenzuron + deltamethrin 22% SC @ 0.022% *a.i.*, spinosad 45% SC @ 0.01% *a.i.* and mittimax @ 0.15% *a.i.*) against cabbage aphid (*Myzus persicae* Sulzer) population vis-a-vis their effect on coccinellid beetle. Mittimax recorded the highest (58.90%) aphid population reduction followed by azadirachtin-10000ppm and diflubenzuron + deltamethrin 22% SC, with population reduction of 54.48% and 54.40% respectively. On coccinellid beetle, mittimax recorded the lowest (3.30%) adult population reduction and proved to be the safest treatment, followed by spinosad 45% SC with 5.10% population reduction. The percent increase of yield over control ranged from 11.41% to 50.13% in pesticide treatments with the highest yield (49.23t/ha) in spinosad 45%SC as against 32.79t/ha in untreated control. The research indicated that mittimax and spinosad 45%SC were most effective against cabbage aphid and safe to coccinellid beetle in cabbage.

## INTRODUCTION

Among the cruciferous vegetables Cabbage (*Brassica oleracea* L. var. *capitata*) is the most popular and grown throughout India. It is used as salad, boiled and dehydrated vegetable as well as in cooked curries and pickles. Main edible part of cabbage is head/ card *i.*e. leaf is good source of protein 1.6%, vitamins A, $B_1$, $B_2$ and C, sulfur, amino acid, minerals (calcium, iron, magnesium, phosphorus and potassium), low amount of calories 2.4%, fat 0.2%, carbohydrate 4.8% and substantial amount of b carotene (Hanif *et al.,* 2006). Insect pests, diseases and weeds are the major constraints limiting agricultural productivity growth. It is estimated that herbivorous insects eat about 26 percent of the potential food production (Singh and Sharma, 2004). The cabbage crop is attacked by a number of insect pests, among them most destructive polyphagus sucking pest is cabbage aphid, *Myzus persicae* (Sulzer). It causes direct damage through sucking of vital plant sap resulting in stunted growth or deformation of plant parts finally affecting the overall yield. Besides, it is able to transmit more than 100 viral diseases on about 30 different families including major crops (Van Emden *et al.,* 1969). Cabbage growers depend on chemical pesticides to combat aphid. Continuous and indiscriminate use of chemical pesticides resulted in resistance development to these insecticides, environmental pollution, health hazards, harmful residues on food crop and adverse effect on activity of parasites and predator of crop pests. To overcome this problem, it has necessitated the use of alternative eco-friendly pesticides to sustain the management of aphid. The efficacy of neem products and microbial insecticides like *B. thuringiensis, Beauveria bassiana* has been reported by several workers (Patil and patel, 2013; Prasannakumar *et al.*, 2014; Bharani *et al.,* 2015). Microbial pesticides, IGRs and botanical insecticides have long been considered as acceptable alternatives to synthetic chemical insecticides for pest management as they have low persistence in the environment, little mammalian toxicity and resulting in good selectivity and wide public acceptance (Digilio *et al.*, 2008).

The current trends of modern society towards 'green consumerism' and growing awareness of health and environmental issues associated with the intensive use of chemical pesticides has lead to interest in alternate forms of pest management technique in the world. Keeping this in view, the present investigation was aimed at studying the efficacy of eco-friendly pesticides (Botanical, microbial and IGR) against the aphid, *Myzus persicae* infesting cabbage under field conditions and their effect on natural enemy coccinellid beetle.

## MATERIALS AND METHODS

Field experiments were conducted at the Central Research Farm, BCKV, Gayeshpur, Nasia, West Bengal during rabi season of 2008 to 10. The experiment was laid out in a randomized block designed, 9 treatments including untreated control with three replications. Twenty five days old cabbage (cv Green Express) seedlings were transplanted in the plot of

4m x 3m area with 50cm rows and plant spacing during winter season. Recommended management practices were followed for raising the crop.

The insecticides evaluated were $T_1$ = *Bacillus thuringiensis* 5% WP @ 0.2% *a.i.*, $T_2$ = *Beauveria bassiana* ($2 \times 10^9$ spores/g) @ 0.5% *a.i.*, $T_3$ = *B. bassiana* ($2 \times 10^7$ spores/g) @ 1.0% *a.i.*, $T_4$ = Azadirachtin -10000 ppm. @ 0.002% *a.i.*, $T_5$ = NSKE (Neem Seed Kernel extract) @ 5.0% *a.i.*, $T_6$ = Diflubenzuron + deltamethrin 22% SC @ 0.022% *a.i.*, $T_7$ = Spinosad 45% SC @ 0.01% *a.i.*, $T_8$ = Mittimax (extract of onion, garlic, ginger and cow urine) @ 0.15% *a.i.* and $T_9$ = Untreated control. The pesticides were applied by the back pack hydraulic sprayer (Aspee, Mumbai) a hollow cone nozzle, with the spray fluid of 500-600lt/ ha depending on the stage of the crop growth. The treatments were applied at an interval of 15 days starting from 25 days after transplanting. Two sprayings were applied in each year.

Population data of aphid and coccinellid beetle were recorded as described by Patra *et al.,* (2013) from 10 randomly selected plants per plot at regular intervals according to spray schedule. The counting was made one day before as pretreatment, 1, 3, 7 and 10 days after treatment. The per cent efficacy was calculated on the basis of mortality of nymph/adult at the above intervals after treatments. Reduction per cent of aphid and beetle was calculated by applying a correction factor given by Henderson and Tilton (1995). The data on population of the aphid and coccinellids were subjected to square root transformation before statistical analysis following Gomez and Gomez (1984) to test the significance of treatment effects. The effectiveness in terms of yield was recorded from the whole plot as total yield of the marketable cabbage head. The critical difference (CD) at 0.05% level of significance were worked out from the data of per cent reduction population of replication before treatment and various days interval after treatment of two consecutive sprays per year. The data analyzed in RBD were subjected to Duncan's Multiple Range Test (DMRT) at 5% level after making square root transformation.

## RESULTS AND DISCUSSION

### Comparative efficacy of eco-friendly pesticides on *Myzus persicae* (Sulzer) infesting cabbage during 2008-10

On the basis of three years (2008, 2009 and 2010), pooled mean has been presented in table-1 Perusal of the data revealed that all the treatments used in the experiment were significantly superior over untreated control from 1st day after spraying to last day (10th day after 2nd spraying) of observation. Among the treatments, *B. bassiana* @ 0.5% *a.i.* and organic pesticide mittimax (extract of onion, garlic, ginger and cow urine) @ 0.15% provided higher population reduction of aphid on the 10th day after 1st and 2nd spray *i.e.*, 78.11% and 76.39% respectively. On the basis of overall mean data, mittimax @ 0.15% provided highest (58.90%) population reduction and it proved to be the most effective pesticide for aphids management. It was followed by Azadirachtin 10000 ppm @ 0.002% *a.i.*, Diflubenzuron+ deltamethrin-22% SC @ 0.022% *a.i.*, *B. bassiana* @ 0.5% *a.i.* and *B. thuringiensis* @ 0.2% *a.i.* which recorded 54.48%, 54.40%, 52.91% and 51.37% population reduction respectively.These results are in agreement with those of Meena *et al.,* (2013) who reported that the per cent reduction of aphid population after 10 days of spray was maximum under dimethoate 30 EC @ 300 g a.i/ ha (91.00%) followed by NSKE @ 5% (83.20%), *B. bassiana* @ 5 g per litre of water (78.00%), cow urine @ 50 litre per ha (76.33%), onion extract @ 5% (76.00%) and tobacco extract @ 5% (75.40%). The insecticide NSKE applied as a 5% solution caused highest insect mortality of 73.7%, 8 days after application (Pavela *et al.,* 2002). (Chandrasekharan and

**Table 1: Effect of eco-friendly pesticides on aphid, *Myzus persicae* (Sulzer) infesting cabbage (polled data of 2008, 2009 and 2010).**

| Treatments | PC | Mean percent efficacy at different days after spraying. | | | | | | | | Mean |
|---|---|---|---|---|---|---|---|---|---|---|
| | | After 1st Spray | | | | After 2nd Spray | | | | |
| | | 1st day | 3rd day | 7th day | 10th day | 1st day | 3rd day | 7th day | 10th day | |
| $T_1$ | 458.78 | 24.58 (30.02)$^{d}$ | 41.55 (40.42)$^{e}$ | 67.17 (55.36)$^{d}$ | 75.93 (61.04)$^{bc}$ | 25.72 (30.64)$^{cd}$ | 38.83 (38.81)$^{d}$ | 61.94 (52.29)$^{c}$ | 75.22 (60.64)$^{a}$ | 51.37 |
| $T_2$ | 425.08 | 29.12 (32.93)$^{c}$ | 41.22 (40.23)$^{e}$ | 68.38 (56.11)$^{d}$ | 78.86 (63.03)$^{a}$ | 26.50 (31.17)$^{c}$ | 42.06 (40.68)$^{c}$ | 61.72 (52.14)$^{c}$ | 75.44 (60.76)$^{a}$ | 52.91 |
| $T_3$ | 414.15 | 16.44 (24.26)$^{e}$ | 21.73 (28.09)$^{f}$ | 33.14 (35.43)$^{f}$ | 66.80 (55.20)$^{d}$ | 18.56 (25.67)$^{e}$ | 20.83 (27.45)$^{e}$ | 30.50 (33.80)$^{e}$ | 58.72 (50.54)$^{c}$ | 33.34 |
| $T_4$ | 424.91 | 28.02 (32.21)$^{c}$ | 50.25 (45.51)$^{d}$ | 71.72 (58.22)$^{c}$ | 75.40 (60.62)$^{c}$ | 23.94 (29.46)$^{d}$ | 40.94 (39.96)$^{c}$ | 70.72 (57.64)$^{b}$ | 74.81 (60.27)$^{a}$ | 54.48 |
| $T_5$ | 477.20 | 15.93 (23.89)$^{e}$ | 61.50 (52.50)$^{a}$ | 80.75 (64.35)$^{a}$ | 33.00 (35.32)$^{e}$ | 16.72 (24.42)$^{e}$ | 46.39 (43.20)$^{b}$ | 79.33 (63.50)$^{a}$ | 51.50 (46.62)$^{d}$ | 48.14 |
| $T_6$ | 462.59 | 37.03 (37.77)$^{a}$ | 53.91 (47.54)$^{c}$ | 62.41 (52.49)$^{c}$ | 68.92 (56.43)$^{d}$ | 34.67 (36.34)$^{a}$ | 48.50 (44.42)$^{a}$ | 59.72 (50.93)$^{d}$ | 70.06 (57.22)$^{b}$ | 54.40 |
| $T_7$ | 432.57 | 4.58 (12.98)$^{f}$ | 10.59 (19.29)$^{g}$ | 15.56 (23.52)$^{g}$ | 18.71 (25.70)$^{f}$ | 4.83 (13.26)$^{f}$ | 8.44 (17.29)$^{f}$ | 11.67 (20.29)$^{f}$ | 21.50 (27.71)$^{e}$ | 11.99 |
| $T_8$ | 454.76 | 33.35 (35.57)$^{b}$ | 58.70 (50.43)$^{b}$ | 73.64 (59.44)$^{b}$ | 78.11 (62.46)$^{ab}$ | 30.33 (33.68)$^{b}$ | 49.50 (45.00)$^{a}$ | 71.17 (57.88)$^{b}$ | 76.39 (61.33)$^{a}$ | 58.90 |
| $T_9$ | 456.63 | 0.00 (4.05)$^{g}$ | 0.00 (4.05)$^{h}$ | 0.00 (4.05)$^{h}$ | 0.00 (4.05)$^{g}$ | 0.00 (4.05)$^{g}$ | 0.00 (4.05)$^{g}$ | 0.00 (4.05)$^{g}$ | 0.00 (4.05)$^{f}$ | |
| SEm ± | | 0.35 | 0.33 | 0.41 | 0.60 | 0.44 | 0.27 | 0.33 | 0.51 | |
| CD at 0.05% | | 0.98 | 0.94 | 1.16 | 1.70 | 1.26 | 0.76 | 0.92 | 1.44 | |

* Figures in parentheses are angular transformed values. * PC = Pre treatment count.* Means followed by common letter are not significantly different by DMRT (p = 0.05).

**Table 2: Effect of eco-friendly pesticides on coccenellid predators in cabbage (pooled data of 2008, 2009 and 2010).**

| Treatments | PC | Mean percent efficacy at different days after spraying. | | | | | | Mean |
|---|---|---|---|---|---|---|---|---|
| | | After 1st Spray | | | After 2nd Spray | | | |
| | | 3rd day | 7th day | 10th day | 3rd day | 7th day | 10th day | |
| $T_1$ | 0.74 | 11.9 (18.19)[a] | 10.17 (17.41)[ab] | 17.26 (23.85)[a] | 3.92 (10.26)[abc] | 6.54 (13.92)[ab] | 13.65 (19.99)[a] | 10.57 |
| $T_2$ | 0.78 | 11.05 (18.00)[a] | 9.64 (17.87)[ab] | 14.86 (22.42)[a] | 2.72 (8.80)[bc] | 4.93 (12.88)[b] | 6.43 (14.69)[ab] | 8.27 |
| $T_3$ | 0.88 | 4.23 (11.37)[bc] | 7.52 (15.91)[bc] | 10.44 (18.57)[ab] | 4.32 (11.02)[abc] | 6.59 (15.37)[ab] | 7.7 (15.70)[ab] | 6.8 |
| $T_4$ | 1.62 | 3.67 (11.13)[bc] | 6.08 (13.87)[bc] | 6.71 (14.89)[bc] | 6.33 (13.48)[ab] | 8.42 (15.80)[ab] | 9.91 (17.11)[ab] | 6.85 |
| $T_5$ | 1.08 | 7.32 (13.69)[ab] | 13.33 (21.01)[a] | 9.6 (16.95)[b] | 9.2 (16.68)[a] | 10.8 (19.39)[a] | 11.6 (18.75)[a] | 10.31 |
| $T_6$ | 1.28 | 3.29 (10.15)[bc] | 4.33 (11.84)[cd] | 9.45 (16.42)[b] | 7.22 (14.87)[ab] | 7.47 (14.97)[ab] | 8.81 (17.04)[ab] | 6.76 |
| $T_7$ | 1.47 | 3.66 (10.58)[bc] | 5.13 (13.07)[bcd] | 3.88 (10.87)[c] | 5.07 (11.72)[ab] | 7.79 (15.99)[ab] | 5.07 (13.13)[b] | 5.1 |
| $T_8$ | 1.68 | 1.1 (6.60)[cd] | 2.05 (8.43)[dc] | 5.74 (13.93)[bc] | 3 (9.18)[bc] | 3.61 (10.27)[b] | 4.29 (11.81)[b] | 3.3 |
| $T_9$ | 1.89 | 0 (4.05)[d] | 0 (4.05)[e] | 0 (4.05)[d] | 0 (4.05)[c] | 0 (4.05)[c] | 0 (4.05)[c] | 0 |
| SEm ± | | 1.85 | 1.57 | 1.77 | 2.3 | 1.93 | 1.7 | |
| CD at 0.05% | | 5.25 | 4.47 | 5.03 | 6.54 | 5.49 | 4.84 | |

* Figures in parentheses are angular transformed values. * PC = Pre treatment count;* Means followed by common letter are not significantly different by DMRT (p = 0.05).

**Table 3: Cabbage fresh yield and per cent increase in yield over control**

| Treatments | Dosage | Cabbage yield (tons/ha) | |
|---|---|---|---|
| | | Fresh Yield | % increase over control |
| $T_1$ | 0.2% | 43.96[b] | 34.06 |
| $T_2$ | 0.5% | 40.31[d] | 22.92 |
| $T_3$ | 1.0% | 41.13[d] | 25.41 |
| $T_4$ | 0.002% | 42.59[c] | 29.89 |
| $T_5$ | 5.0% | 39.04[e] | 19.06 |
| $T_6$ | 0.022% | 48.52[a] | 47.96 |
| $T_7$ | 0.01% | 49.23[a] | 50.13 |
| $T_8$ | 0.15% | 36.54[f] | 11.41 |
| $T_9$ | 00 | 32.79[g] | |
| SEm ± | | 0.24 | |
| CD at 0.05% | | 1.20 | |

* Means followed by common letter are not significantly different by DMRT (p = 0.05).

Balasubramanian, 2002) reported efficacy of neem based formulations against aphid viz. *Aphis craccivora* on green gram, neemazol gave an efficacy of 34.58% and 50.83% mortality at 5 and 10% concentrations respectively (Bijaya *et al.,* 2005).

**Comparative efficacy of eco-friendly pesticides on Coccinellid beetle on cabbage during 2008 to 2010.**

The results of the pooled mean data (table-2) on the toxic effect of ecofriendly pesticides on the population of *Coccinella septempunctata* revealed that mittimax @ 0.15% *a.i.* and spinosad 45%SC @ 0.01% *a.i.* proved to be the safest insecticide with the lowest (3.30 and 5.10) per cent population reduction respectively. The highest (10.57) per cent of beetle population reduction was observed in *B. thuringiensis* @ 0.2% *a.i.* which was at par with neem seed kernel extract @ 5.0% *a.i.,* recording the 10.31% mean population reduction over untreated control. The mean per cent of adult population reduction in the rest of the pesticide treatments ranged from 6.76% to 8.27%.

A field trial on neem (*Azadirachta indica*) - based pesticides, azadirachtin, azadirachtiniodine, NSKE and neem oil to study the impact on the population of predatory beetles (*Coccinella septempunctata* and other *Coccinella* sp). All the formulations were found to be safe to the lady bird predators, even at the highest concentrations (9 ml *a.i.*/litre) which produced a mortality percentage of 17.9% - 29.1%. (Chakraborti and Chatterjee, 1999) and the safety of ecofriendly pesticides on the population of coccinellid beetle are also reported by Singh *et al.*, (2007) who determined the pesticidal effect of *Bt* product and neem product and observed that all the tested pesticides were found to be safe and did not show any adverse effect on the beetle population. Nawrocka, 2008 indicated that there was no influence of spinosad (SpinTor 480 SC) and azadirachtin (Neem Azal T/S) on beneficial fauna naturally occurring on cabbage crops or the reduction due to direct contact of adult of Coccinellid and moreover the number of beneficial fauna occurring on treated cabbage plants was similar to those present on control plots. Meena *et al.,* (2013) found the maximum population of coccinellid (*C. septempunctata*) in the treatment of *Verticillium lecanii* @ 5g/l followed by Cow urine @ 50 l/h, NSKE @ 5%, Tobacco extracts @ 5%, *B. bassiana* @ 5g/l and Onion extract @ 5%. Akmal *et al.*, (2013) reported that the entomopathogenic fungus, *B. bassiana* showed little or no detrimental effects to *C. septempunctata* and Bharani *et al.,* (2015) also reported that maximum coccinellids population was recorded in untreated control (3.53 coccilnellids/5 plants) which was followed by bio pesticide plots, *B. bassiana* (3.26 coccilnellids/5 plants), which is in conformity with the present findings.

**Marketable yield and yield increased by different treatments on cabbage**

The results of different treatments were reflected in the yield of cabbage. Treatment wise average saleable yield (tons/ha) and

per cent yield increase over control (pooled mean 2008, 2009 and 2010) are presented in table 3. All the treatments provided higher yields than that of control. From the three year pooled mean value highest cabbage yield (49.23 tons/ha) was obtained from spinosad 45%SC @ 0.01% followed by (48.52tons/ha) diflubenzuron + deltamethrin 22%SC @ 0.022% and lowest yield (32.79 tons/ha) was recorded in untreated control. In the yield percent increased point of view the highest per cent (50.13%) increase in yield was obtained from spinosad 45% SC @ 0.01% followed by 47.96% in diflubenzuron + deltamethrin 22%SC @ 0.022% and 34.06% in *B. thuringiensis* @ 0.2%.

Prasannakumar *et al.,* (2014) reported that cabbage yield 34.93, 29.19 and 27.13 tonns/ha were obtained from Neem seed powder extract 4%, Spinosad 45 SC (0.013%) and Neem cake @ 100kg/acre respectively. Higher yield (42.4 tonns/ha) of cabbage from *B.t.* (Halt) treated plot was earlier reported by Ghosh *et al.* (2001) which is in conformity with the present studies.

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