Asian Jr. of Microbiol. Biotech. Env. Sc. Vol. 22, No. (4) : 2020 : 670-675

ISSN-0972-3005

IMPACT OF BIOFERTILIZERS AND BIOPESTICIDES ON THE POPULATION OF MAJOR INSECT PESTS OF JASMINE (*JASMINUM SAMBAC* L.)

MURUGAN A. AND RAVI C. *

Department of Zoology, Thiagarajar College, Madurai 625 009, Tamilnadu, India

(Received 20 March, 2020; accepted 10 August, 2020)

***Key words**: Jasmine, Biopesticides, Biofertilizers, Insect pests.*

Abstract–A field study was conducted at Seeragampatti village (10º16′55′′ N and 77º85′25′′ E), Nilakottai Taluk, Dindigul district, Tamilnadu, India to assess the impact of biofertilizers and biopesticides on the population of major insect pests of *Jasminum sampac* L. from September 2017 to August 2018. The study was categorised into experiment I (different biopesticides treatment) and experiment II (different biofertilizers treatment) respectively and conducted in randomized block design with 3 replications and 10 treatments for each category including control. The obtained results in experiment Iindicated that in E_8treatment, the infestation of budworms, red mites and white flies were reduced with the application of biopesticides (*Trichoderma* sp., *Bacillus* sp. and *Paecilomyces* sp.) and in combination with biofertilizers (*Azospirillum* sp. and *Phosphobacterium* sp. along with vermicompost). In experiment II, T_7 treatment (*Azospirillum* sp. and *Phosphobacterium* sp. along with vermicompost) displayed low population of budworms, red mites and white flies over the other categories.

INTRODUCTION

Floriculture has become an integral part of agricultural industries across the globe (Prakash and Muniyandi, 2014). Jasmine belongs to the family Oleaceae and the genus *Jasminum* contains around 200 species throughout the world (Manimaran *et al*. 2018). Among them, only three species such as *Jasminum sambac, J. grandiflorum* and *J. auriculatum* have commercial importance. Jasmine is one of the traditional flowers of India which has got importance in all religious, social and cultural ceremonies (Thakur *et al*., 2014). In India, the largest area under jasmine cultivation is in Tamilnadu, followed by Karnataka and being cultivated in more than 8,000 ha with an annual production of flowers worth Rs. 80 to 100 million in India (Suryavanshi and Parvez, 2014; Nirmala *et al*., 2017). Tamil Nadu is the leading producer of jasmine flowers in the country with an annual production of around 77,247 tonnes (Prakash and Muniyandi, 2014).

J. sambac like other plants require well balanced nutrition for optimum growth and flower production. Proper amount and application of compound fertilizers increases yield by enhancing the number and size of flowers. Nitrogen enhances the vegetative growth, increases the number of flower buds and yield (Qasim *et al.* 2003, Tovika *et al.* 2017).The impact of plant growth promoting rhizobacterium *Pseudomonas fluorescens*, the antagonistic fungus *Trichoderma viride,* the egg parasitic fungi *Paecilomyces lilacinus* and nematicides viz., carbofuran and phorate, in the growth and flower yield of jasmine has been studied (Seenivasan and Poornima, 2010). Jasmine is attacked by around 50 insect pests belonging to more than eight orders harbouring varied microhabitats of jasmine. The production of jasmine is affected by various insect pests and around 10 different potential pests are quite common which affect flower yield throughout year (Hemalatha, 2009). With this back drop, the present study has been undertaken to investigate the impact of biofertilizers and biopesticides on the population of the major insect pests of jasmine.

MATERIALS AND METHODS

The field experiment was conducted in Seeragampatti village (10º16'55'' N and 77º85′25′′ E), Nilakottai Taluk, Dindigul district, Tamilnadu, India

during September 2017 to August 2018. The altitude of the study area is 320 m above mean sea level.

The study was conducted in two years old jasmine plants. The study was categorised into experiment I (different biopesticides treatment) and experiment II (different biofertilizers treatment) respectively and conducted in randomized block design with 3 replications and 10 treatments for each category including control. The treatments were allocated randomly to each replication and each treatment consisted of 9 plants, from which 3 plants were subjected for the present investigation. The plants were planted with 1m X 1m space. The treatment details have been provided in Table 1.

100 random flowers were chosen and checked for the presence of budworm in that and the average number per flower was worked out. Whiteflies were collected by sweep net; ten such sweeps were made and divided by number of flies in each sweeps. For red-mites, 100 leaves were selected randomly and counted the number of mites present in those leaves. All data were statistically analyzed using SPSS (Statistical Package for the Social Sciences).

RESULTS AND DISCUSSION

Seasonal incidence of budworms

In the present study, it was found that, there was an increase in budworm population from September to October and during November 2017, very less population was observed. There was no budworm during January 2018 and a gradual increase in its population was observed in the subsequent study period (Table 2). In experiment I (biopesticides treatment), it was noted that, in E_9 (59.70) and E_0 (68.30), there was a significant difference in the population of budworm when compared to the untreated plants. The E_7 (combined inoculation of biopesticides only) treated plants showed very low population of budworms in the month of December (0.30). Highest infestation of budworms was noted in the plants of E_0 (untreated) during the October 2017 (68.30) and highest infestation was observed during the same month in E_1 (65.30). In experiment II, the budworm population was very high in October 2017 T_0 69.30 during and in June 2018 T_2 39.33, no incidence of budworm was observed during January 2018 (Table 3). These results are in agreement with the findings of Vanitha (2001) who also reported maximum budworm infestation during September in Jasmine. Hemalatha (2009) also reported high number of budworm infestation during September in *J. Sambac* plants. On the other hand, the results of Amutha (1994) revealed that the budworms are prevalent throughout the year, which might be due to climatic variations present in that region and the suitability of crop for pest multiplication.

Seasonal incidence of white flies

From the recorded data it was revealed that the number of white flies was high during September 2017 and subsequently decreased towards the month of October and no population was noted in November 2017. Thereafter, the population gradually increased from December 2017 to February 2018 (Table 4). In experiment I, the number of white flies was high during the month of September in E_0 (66.30). No whiteflies population was observed in the month of November 2017 and

Table 1. Experiment details

Experiment I Treatment	Experiment II Components	Treatment	Components
E_0	Control (untreated)	T_0	Control (untreated)
E_1	*Trichoderma viride*	T_1	*Azospirillum*
E_2	*Bacillus thuringiensis*	T_2	*Phosphobacterium*
E_3	*Paecilomyces lilacinus*	T_3	Vermicompost
E_4	$E_1 + E_2$	T_4	$T_1 + T_2$
E_5	$E_1 + E_3$	T_5	$T_1 + T_3$
E_6	$E_2 + E_3$	T_6	$T_2 + T_3$
E_7	$E_1 + E_2 + E_3$	T_7	$T_1 + T_2 + T_3$
E_8	E_7 + Pb + AZ + VC	T_8	T_7 + Chemical pesticide (Triazophos)
E_9	E_7 + Chemical fertilizer (Factamfos)	T_9	Chemical pesticide (Triazophos) + Chemical fertilizer (Factamfos)

****AZ – *Azospirillum* Pb – *Phosphobacterium* VC – Vermicompost**

Table 2. The number of budworms recorded in the experiment I (biopesticides treated jasmine plants)

Treatment	2017				2018							
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
E_0	38.00^{a}	68.30^{a}	0.00^{b}	01.70^{b}	0.00	29.00^{a}	13.00^{a}	12.07^{a}	32.66^{a}	38.00^{ab}	40.33^{a}	21.33^{a}
E_1	30.70^{ab}	65.30^{ab}	0.00^{b}	01.70^{b}	0.00	16.70^{b}	03.00^{b}	03.00^{b}	25.33^{bc}	29.00^{cde}	25.00^{cd}	18.33^{b}
E_2	31.70^{ab}	64.70^{ab}	0.00^{b}	01.30^{b}	0.00	13.70^{dc}	02.07^{b}	02.03^{b}	20.66^{cd}	38.33^{ab}	37.00^{a}	14.33^{cd}
E_3	19.70^{b}	54.70^{ab}	0.00^{b}	01.00^{b}	0.00	12.00^{bcd}	03.00^{b}	02.07^{b}	27.00^{b}	31.00^{cd}	23.33^{de}	15.66^{bc}
E_4	23.30^{b}	55.30^{abc}	08.30^{a}	05..00^{a}	0.00	06.00c^{de}	03.00^{b}	02.07^{b}	13.66^{e}	32.33^{bc}	28.33^{bc}	10.66^{ef}
E_5	28.30^{ab}	54.30^{abc}	0.00^{b}	0.00^{b}	0.00	12.00^{bcd}	03.00^{b}	02.03^{b}	21.33^{cd}	23.00^{c}	21.00^{e}	13.33^{cde}
E_6	29.70^{ab}	60.70^{abc}	05.00^{ab}	01.00^{b}	0.00	09.70^{bcde}	02.03^{b}	02.00^{b}	19.66^{f}	25.66^{bde}	27.33^{bc}	14.66^{c}
E_7	22.70^{b}	45.00^{bc}	08.00^{a}	0.30^{b}	0.00	04.33^{de}	03.03^{b}	03.00^{b}	14.33^{e}	23.00^{e}	22.33^{de}	11.33^{def}
E_8	23.00^{b}	44.00^{c}	06.70^{ab}	0.70^{b}	0.00	04.00^{e}	02.07^{b}	04.00^{b}	12.00^{e}	30.00^{cd}	26.00^{bcd}	09.66^{f}
E_9	27.70^{ab}	59.70^{abc}	0.00^{b}	01.00^{b}	0.00	28.30^{a}	03.00^{b}	03.07^{b}	27.00^{b}	41.33^{a}	29.66^{b}	11.00^{fe}
$F_{9, 29}$	5.00***	3.81***	6.22***	4.02***	0.00***	28.01***	3.31***	15.00***	13.00***	10.06***	25.53***	13.15***

Significance level @ 0.05*, 0.01**, 0.001*** or NS - Not Significant

E_0 - Control (Untreated) E_1–*Trichodermaviride* E_2 - *Bacillus thurungiensis*

E_3–*Paecilomyceslilacinus* E_4 - $E_1 + E_2$ E_5 - $E_1 + E_3$

E_6 - $E_2 + E_3$ E_7 - $E_1 + E_2 + E_3$ E_8 - $E_7 +$ Pb + AZ +VC

E_9 - $E_7 +$ Chemical fertilizer (Factamfos)

*AZ – AzospirillumPb – Phosphobacterium*VC–Vermicompost

Table 3. The number of budworms recorded in the experiment II (biofertilizers treated jasmine plants)

Treatment	2017				2018							
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
T_0	33.70^{a}	69.30^{a}	0.00^{b}	01.70^{a}	0.00	43.70^{a}	23.00^{a}	13.00^{a}	36.00^{a}	38.33^{ab}	31.00^{a}	19.33^{a}
T_1	11.70^{bcd}	58.30^{a}	01.30^{b}	01.70^{a}	0.00	14.00^{de}	04.00^{b}	04.00^{b}	25.33^{cb}	30.00^{bcd}	19.33^{b}	17.66^{b}
T_2	20.70^{abc}	51.30^{a}	0.00^{b}	02.70^{a}	0.00	26.30^{b}	04.07^{b}	02.07^{b}	32.33^{a}	39.33^{ab}	16.66^{bc}	11.33^{ef}
T_3	18.30^{abcd}	49.70^{a}	0.00^{b}	01.70^{a}	0.00	12.30^{de}	03.00^{b}	04.03^{b}	27.33^{b}	34.66^{abc}	15.33^{bc}	13.66^{cd}
T_4	10.70^{bcd}	55.70^{a}	0.00^{b}	02.30^{a}	0.00	14.30^{de}	04.00^{b}	03.00^{b}	27.33^{b}	33.33^{abcd}	16.66^{bc}	11.33^{ef}
T_5	03.70^{d}	56.00^{a}	15.70^{a}	01.70^{a}	0.00	06.30^{e}	03.07^{b}	03.03^{b}	19.33^{d}	25.00^{cd}	11.66^{c}	12.33^{de}
T_6	03.30^{d}	57.00^{a}	04.70^{b}	02.00^{a}	0.00	06.00^{e}	03.03^{b}	02.07^{b}	23.66^{c}	26.66^{cd}	12.00^{c}	14.66^{c}
T_7	05.00^{cd}	48.00^{a}	19.30^{a}	01.30^{a}	0.00	07.30^{e}	03.00^{b}	04.00^{b}	15.33^{c}	24.00^{d}	11.66^{c}	10.66^{ef}
T_8	21.30^{abc}	50.00^{a}	0.00^{b}	01.30^{a}	0.00	18.00^{cd}	06.07^{b}	03.03^{b}	27.33^{b}	33.33^{bcd}	10.66^{c}	11.00^{ef}
T_9	24.30^{ab}	53.00^{a}	0.00^{b}	02.00^{a}	0.00	23.00^{bc}	03.03^{b}	04.00^{b}	32.00^{a}	40.00^{a}	12.66^{c}	10.33^{f}
$F_{9, 29}$	7.88***	0.72***	16.77***	0.55***	0.00***	39.64***	30.61***	32.56***	19.55***	3.89***	9.59***	32.26***

Significance level @ 0.05*, 0.01**, 0.001*** or NS - Not Significant

T_0 - Control (Untreated) T_1-*Azospirillum* T_2 - *Phosphobacteria*

T_3 -*Vermicompost* T_4 - $T_1 + T_2$ T_5 - $T_1 + T_3$

T_6 - $T_2 + T_3$ T_7 - $T_1 + T_2 + T_3$ T_8 - $T_7 +$ Chemical Pesticides (Triazophos)

T_9 - Chemical Pesticides (Triazophos) + Chemical fertilizer (Factamfos)

*AZ – AzospirillumPb – Phosphobacterium*VC - Vermicompost

May 2018 (Table 4). In experiment II, no population of white flies was observed in the month of November 2017 and May 2018 and very high number of whiteflies was noted in the month of January 2018 in T_0 (33.30) (Table 5). Neelima (2005) has reported that *Tetranychus* sp. infest the leaves of *J. sambac* to the maximum during May and minimum during April. She also reported that no infestation was found during July and March. The observations made in current work contradicted with the above findings, where the red mite population was very less and not found in September 2017 and August 2018 respectively which might be due to the climatic and edaphic factors prevalent in the study site. The results of present investigation also revealed that the combined inoculation of biofertilizers along with Triazophos (T_8 of EII) proved to be highly effective against whiteflies. Neelima (2005) stated that Triazophos was very effective in controlling

Table 4. The number of whiteflies recorded in the experiment I (biopesticides treated jasmine plants)

Treatment	2017				2018							
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
E_0	66.30^{a}	02.70^{a}	0.00	03.00^{a}	37.30^{a}	34.60^{a}	25.07^{a}	17.00^{a}	0.00	17.33^{d}	13.66^{a}	13.33^{a}
E_1	47.30^{ab}	01.00^{a}	0.00	0.00^{a}	32.00^{ab}	31.70^{ab}	11.03^{b}	04.00^{b}	0.00	05.00^{b}	06.00^{dbc}	09.00^{b}
E_2	10.70^{b}	0.00^{a}	0.00	01.30^{a}	32.00^{ab}	23.70^{bc}	09.00^{b}	03.00^{b}	0.00	04.33^{b}	04.00^{de}	06.33^{b}
E_3	06.70^{b}	0.70^{a}	0.00	0.70^{a}	24.00^{bc}	29.45^{ab}	13.03^{b}	03.03^{b}	0.00	05.33^{b}	04.66^{cde}	06.00^{b}
E_4	07.00^{b}	0.00^{a}	0.00	0.00^{a}	11.30^{d}	14.70^{de}	09.00^{b}	03.07^{b}	0.00	03.33^{b}	06.33^{bcd}	06.00^{b}
E_5	09.70^{b}	0.70^{a}	0.00	0.00^{a}	24.70^{bc}	25.70^{bc}	06.07^{b}	01.03^{b}	0.00	05.33^{b}	05.00^{cde}	05.66^{c}
E_6	09.00^{b}	0.70^{a}	0.00	0.70^{a}	21.33^{c}	19.00^{cd}	12.00^{b}	02.00^{b}	0.00	06.33^{b}	02.00^{e}	06.33^{b}
E_7	07.70^{b}	0.00^{a}	0.00	0.30^{a}	04.70^{d}	14.00^{de}	06.07^{b}	02.00^{b}	0.00	04.66^{b}	08.00^{bc}	04.33^{c}
E_8	07.70^{b}	0.00^{a}	0.00	0.00^{a}	03.00^{d}	07.70^{e}	04.00^{b}	02.03^{b}	0.00	05.66^{b}	04.66^{cde}	03.66^{cd}
E_9	74.30^{a}	01.30^{a}	0.00	0.70^{a}	30.30^{ab}	31.70^{ab}	22.00^{a}	02.00^{b}	0.00	04.66^{b}	08.66^{b}	02.66^{f}
$F_{9, 29}$	4.52***	6.12***	0.00***	5.93***	8.06***	23.74***	6.10***	20.46***	0.00***	5.69***	9.85***	9.56***

Significance level @ 0.05*, 0.01**, 0.001*** or NS - Not Significant

E_0 - Control (Untreated) E_1 - *Trichodermaviride* E_2 - *Bacillus thurungiensis*

E_3 - *Paecilomyceslilacinus* E_4 - $E_1 + E_2$ E_5 - $E_1 + E_3$

E_6 - $E_2 + E_3$ E_7 - $E_1 + E_2 + E_3$ E_8 - $E_7 +$ Pb + AZ +VC

E_9 - $E_7 +$ Chemical fertilizer (Factamfos)

*AZ – AzospirillumPb – Phosphobacterium*VC - Vermicompost

Table 5. The number of white flies recorded in the experiment II (biofertilizers treated jasmine plants)

Treatment	2017				2018							
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
T_0	32.00^{a}	10.70^{a}	0.00	01.30^{a}	33.30^{a}	25.30^{a}	28.07^{a}	19.00^{a}	0.00	17.33^{a}	11.66^{a}	13.33^{a}
T_1	05.70^{b}	0.00^{b}	0.00	0.30^{a}	13.60^{cd}	14.70^{bc}	08.00^{bc}	02.07^{b}	0.00	08.33^{bc}	01.33^{c}	09.00^{b}
T_2	07.30^{b}	0.30^{b}	0.00	0.00^{a}	31.60^{a}	25.70^{a}	09.07^{b}	02.03^{b}	0.00	07.33^{dc}	02.33^{bc}	06.33^{bc}
T_3	02.30^{b}	0.00^{b}	0.00	0.30^{a}	07.30^{de}	14.70^{bc}	09.00^{b}	02.00^{b}	0.00	10.00^{bc}	03.33^{b}	05.33^{cd}
T_4	02.20^{b}	0.00^{b}	0.00	0.30^{a}	17.70^{bc}	14.70^{bc}	08.07^{bc}	01.07^{b}	0.00	07.00^{cb}	02.66^{bc}	04.33^{cd}
T_5	02.30^{b}	0.00^{b}	0.00	0.70^{a}	03.30^{e}	07.00^{c}	04.03^{cd}	0.03^{b}	0.00	06.00^{c}	02.00^{bc}	06.33^{bc}
T_6	02.30^{b}	0.00^{b}	0.00	01.00^{a}	05.70^{de}	11.70^{bc}	08.03^{bc}	02.00^{b}	0.00	09.66^{bc}	03.00^{bc}	08.66^{b}
T_7	0.70^{b}	0.00^{b}	0.00	0.30^{a}	02.30^{e}	05.70^{c}	03.03^{d}	01.03^{b}	0.00	07.66^{bc}	02.66^{bc}	04.66^{cd}
T_8	08.00^{b}	0.00^{b}	0.00	02.00^{a}	23.30^{b}	06.30^{c}	09.00^{bc}	01.07^{b}	0.00	07.66^{bc}	03.33^{bc}	02.66^{d}
T_9	05.00^{b}	0.70^{b}	0.00	01.70^{a}	23.00^{b}	21.00^{ab}	08.03^{bc}	02.07^{b}	0.00	10.66^{b}	04.00^{b}	03.33^{d}
$F_{9, 29}$	18.89***	2.90***	0.00***	2.42***	12.59***	13.06***	22.33***	44.08***	0.00***	5.71***	13.95***	12.74***

Significance level @ 0.05*, 0.01**, 0.001*** or NS - Not Significant

T_0 - Control (Untreated) T_1 - *Azospirillum* T_2 - *Phosphobacteria*

T_3 - *Vermicompost* T_4 - $T_1 + T_2$ T_5 - $T_1 + T_3$

T_6 - $T_2 + T_3$ T_7 - $T_1 + T_2 + T_3$ T_8 - $T_7 +$ Chemical Pesticides (Triazophos)

T_9 - Chemical Pesticides (Triazophos) + Chemical fertilizer (Factamfos)

*AZ – AzospirillumPb – Phosphobacterium*VC - Vermicompost

whitefly population in jasmine and it was at par with the findings of present study.

Seasonal incidence of red mites

In all the twelve months of the study period, the population of red mites has been noted. In experiment I, the number of red mite population was low in the month of March 2018 in E_8 (0.7) and very high population was noted in the month of October 2017 in E_0 (103.00) (Table 6). In experiment II, the number of red mite population was high in November 2017 in T_0 (93.30) and no red mite was observed during August 2017 in T_6 (0.00) (Table 7). Kiran *et al*., (2017) investigated and reported 13 species of insect and mite pests in jasmine which was dominated by *Elasmopalpus jasminophagus, Hendecasis duplifascialis*, *Nausinoe geometrialis*, *Tetranychus* sp. and *Thrips florum* respectively. The present investigation revealed that budworm *Hendecasis duplifascialis*, white fly *Aleuro clavajasmini* and red spider mites *Tetranychus* sp. caused extensible damage during the study period. The

peak occurrence of bud worm was found during September and October 2017. Shobitha (2002) and Roopini (2016) reported that the population of budworm was prevalent throughout the year and maximum incidence was noticed during August and minimum incidence during February which contradicts the present results where they observed budworm population during September to October and red mite *Tetranychus* sp. population was recorded maximum during September.

The data on major insect pest population indicated that the chemical pesticide treatment (T_9) was slightly superior over untreated control (T_0). This might be due to the efficacy of inorganic pesticides on reduction of the population of major insect pest by their capability of penetrating the parts where the insect pests habiting and affect them (Osborne *et al*., 2001). Meenatchi *et al*., (2011) used vermiculture and vermiwash on jasmine plants to suppress *Hendicasis duplifacialis* and *Thrips orientals* (Bagn.). Based on the obtained results, it has been concluded that combined inoculation of bio-

Table 6. The number of red mites recorded in the experiment I (biopesticides treated jasmine plants)

Treatment	2017				2018							
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
E_0	14.66^{a}	103.00^{a}	82.70^{a}	36.00^{a}	20.30^{a}	42.70^{b}	02.03^{a}	04.03^{a}	35.07^{a}	39.66^{a}	36.00^{a}	07.00^{a}
E_1	06.30^{ab}	86.00^{ab}	62.70^{ab}	33.00^{a}	12.70^{ab}	32.70^{abc}	01.07^{a}	03.03^{ab}	29.00^{abc}	20.66^{c}	15.33^{b}	02.00^{b}
E_2	04.00^{b}	63.70^{abcd}	40.30^{bc}	31.30^{ab}	12.00^{ab}	15.70^{de}	01.00^{a}	02.03^{ab}	26.33^{bcd}	26.33^{b}	11.00^{b}	02.00^{b}
E_3	04.00^{b}	80.30^{abc}	60.00^{abc}	29.30^{abc}	06.70^{a}	26.00^{bcd}	02.03^{a}	02.07^{ab}	32.66^{ab}	14.66^{de}	12.66^{b}	01.00^{b}
E_4	03.70^{b}	52.70^{bcd}	54.00^{abc}	26.70^{abc}	07.70^{b}	10.00^{e}	01.07^{a}	03.07^{ab}	18.66^{e}	18.00^{cd}	12.00^{b}	03.00^{b}
E_5	03.70^{b}	74.00^{abcd}	65.30^{ab}	08.70^{bc}	20.70^{ab}	23.30^{cd}	02.03^{a}	03.03^{ab}	27.00^{bcd}	16.00^{cd}	12.33^{b}	01.33^{b}
E_6	03.00^{b}	55.70^{bcd}	52.00^{abc}	29.30^{abc}	07.70^{b}	11.70^{e}	17.00^{a}	03.00^{ab}	22.00^{cde}	17.66^{cd}	15.33^{b}	01.33^{b}
E_7	03.00^{b}	43.60^{cd}	35.00^{bc}	22.00^{abc}	12.00^{ab}	10.00^{e}	10.00^{a}	12.06^{ab}	15.00^{e}	11.00^{e}	10.00^{b}	01.00^{b}
E_8	04.00^{b}	35.00^{d}	24.30^{c}	17.30^{c}	02.30^{b}	07.00^{e}	0.07^{a}	02.00^{b}	19.66^{d}	20.00^{c}	10.33^{b}	02.33^{b}
E_9	14.66^{a}	74.00^{abcd}	64.00^{ab}	16.30^{c}	13.00^{ab}	36.70^{ab}	01.03^{a}	03.07^{ab}	26.00^{bcd}	20.33^{c}	11.00^{b}	03.00^{b}
$F_{9, 29}$	6.71***	2.43***	4.79***	2.04***	08.06***	23.69***	1.20***	1.39***	1.39***	24.26***	26.71***	2.86***

Significance level @ 0.05*, 0.01**, 0.001*** or NS - Not Significant

E_0 - Control (Untreated) E_1 - *Trichodermaviride* E_2 - *Bacillus thurungiensis*

E_3 - *Paecilomyceslilacinus* E_4 - $E_1 + E_2$ E_5 - $E_1 + E_3$

E_6 - $E_2 + E_3$ E_7 - $E_1 + E_2 + E_3$ E_8 - $E_7 +$ Pb + AZ +VC

E_9 - $E_7 +$ Chemical fertilizer (Factamfos)

AZ – Azospirillum Pb – Phosphobacterium VC - Vermicompost

Table 7. The number of red mites recorded in the experiment II (biofertilizers treated jasmine plants)

Treatment	2017				2018							
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
T_0	31.00^{a}	70.30^{a}	93.30^{a}	29.30^{a}	20.30^{ab}	31.00^{a}	09.03^{a}	06.07^{a}	34.66^{a}	41.33^{a}	29.00^{a}	04.66^{a}
T_1	07.00^{c}	34.70^{b}	68.30^{ab}	23.30^{ab}	11.70^{bca}	15.00^{ad}	04.03^{b}	03.00^{b}	16.33^{b}	21.33^{c}	13.66^{bc}	0.66^{b}
T_2	20.70^{b}	38.00^{ab}	88.30^{a}	23.30^{ab}	24.00^{a}	27.70^{ab}	03.07^{bc}	01.07^{b}	19.66^{de}	29.66^{b}	12.66^{bc}	0.66^{b}
T_3	06.70^{c}	38.70^{ab}	77.70^{ab}	20.30^{ab}	04.7.00^{a}	11.30^{cd}	01.07^{cd}	03.00^{b}	09.66^{d}	22.00^{c}	15.33^{b}	01.33^{b}
T_4	11.00^{c}	50.00^{ab}	75.70^{ab}	20.70^{ab}	12.30^{bc}	17.70^{bc}	02.07^{bcd}	03.03^{b}	12.33^{c}	20.00^{c}	14.33^{b}	01.33^{b}
T_5	07.3.00^{c}	34.00^{b}	37.70^{c}	12.70^{ab}	03.30^{cd}	9.70^{cd}	01.03^{cd}	03.00^{b}	11.33^{d}	20.33^{c}	13.66^{bc}	01.33^{b}
T_6	09.00^{c}	43.70^{ab}	54.00^{bc}	21.70^{ab}	04.30^{cd}	10.70^{cd}	01.03^{cd}	03.03^{b}	11.00^{d}	19.66^{c}	8.66^{c}	0.00^{a}
T_7	07.70^{c}	44.00^{ab}	75.30^{ab}	20.70^{ab}	15.00^{ab}	21.00^{abc}	01.00^{d}	01.00^{b}	10.00^{d}	10.20^{c}	10.00^{bc}	01.00^{a}
T_8	05.70^{c}	26.30^{b}	10.00^{bc}	10.00^{c}	01.66	06.00^{cd}	03.00^{bcd}	03.00^{b}	16.00^{b}	21.66^{c}	14.00^{bc}	0.66^{a}
T_9	27.00^{ab}	51.30^{ab}	80.00^{ab}	22.30^{ab}	17.30^{ab}	28.00^{ab}	2.07^{bcd}	02.07^{b}	17.66^{b}	33.33^{b}	15.00^{b}	0.66^{a}
$F_{9, 29}$	25.54***	4.47***	7.82***	1.74***	34.98***	10.29***	11.41***	4.63***	7.69***	17.94***	10.97***	09.95***

Significance level @ 0.05*, 0.01**, 0.001*** or NS - Not Significant

T_0 - Control (Untreated) T_1 - *Azospirillum* T_2 - *Phosphobacteria*

T_3 - *Vermicompost* T_4 - $T_1 + T_2$ T_5 - $T_1 + T_3$

T_6 - $T_2 + T_3$ T_7 - $T_1 + T_2 + T_3$ T_8 - $T_7 +$ Chemical Pesticides (Triazophos)

T_9 - Chemical Pesticides (Triazophos) + Chemical fertilizer (Factamfos)

AZ – Azospirillum Pb – Phosphobacterium VC - Vermicompost

fertilizers and bio-pesticides with organic fertilizers like vermicompost proved to be more effective in the reduction of insect pest population and better growth and yield of jasmine plants.

ACKNOWLEDGEMENT

The authors are thankful to the authorities of Thiagarajar College, Madurai for the institutional facilities.

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