Original Research Article

EFFECT OF CERTAIN BIOPESTICIDES ON SUCKING INSECT PESTS OF TOMATO, SOLANUM *LYCOPERSICUM* L.

ABSTRACT

Aims: To evaluate the effectiveness of some bio-pesticides against sucking pests of tomato

Study design: Field trial, Randomized Block Design

Place and duration of study: The study was conducted at the experimental farm for PG research, Biswanath College of Agriculture, Sonitpur during *Rabi*, 2022-23.

Methodology: The population of aphid, *Aphis craccivora* Koch; whitefly, *Bemisia tabaci* (Genn) and jassid, *Amrasca biguttula biguttula* (Ishida) were recorded on five plants selected randomly in each plot, considering three leaves upper, middle and lower. The population of coccinellid and spider were recorded by counting their numbers on five plants selected randomly in each plot. For the study of effectiveness of various bio pesticides, the pest infestation was recorded one day ahead of each application (pre-treatment record) and third, seventh and fifteenth days after the application of bio pesticides (post treatment record).

Results: A field experiment was conducted to evaluate the efficacy of some bio pesticides *viz,* neem oil @ 5ml/lit, garlic extract @ 5ml/lit, biogreen-L @ 5ml/lit, neem oil @ 5ml/lit + garlic extract @ 5ml/lit, neem oil @ 5ml/lit + biogreen-L @ 5ml/lit, garlic extract @ 5ml/lit + biogreen-L @ 5ml/lit, neem oil @ 5ml/lit + garlic extract @ 5ml/lit + biogreen-L @ 5ml/lit against major sucking pests of tomato and their impact on natural enemies. Among different treatments, *Aphis craccivora* population found to be significantly lower in neem oil @ 5ml/l + biogreen-L @ 5ml/l treated plot followed by neem oil @ 5ml/l + garlic extract @ 5ml/l, biogreen-L @ 5ml/l after first spray and second spray. After both first and second spray *Bemisia tabaci* population was recorded lowest in neem oil @ 5ml/l + biogreen-L @ 5ml/l treated plot followed by neem oil @ 5ml/l + garlic extract @ 5ml/l and neem oil @ 5ml/l treated plot, respectively. Among different treatments, *Amrasca biguttula biguttula* population was recorded to be lowest in neem oil @ 5ml/l + garlic extracts @ 5ml/l treated plot followed by neem oil @ 5ml/l + biogreen-L @ 5ml/l treated plot after first and second spray. Garlic extracts @ 5ml/ l + Biogreen-L @ 5ml/ l was found least effective against all the insect pests. The population of natural enemy (coccinellid) was more in neem oil @ 5ml/l treated plots after first and second spray. However, no significant different was observed among the treatments in maintaining spider population. From the present investigation, it was found that all the bio-pesticides were congenial for population build-up of natural enemy.

Conclusion: To confront various environment and health hazards caused by these persistent and non-biodegradable insecticides it is indispensable to use bio-pesticides as these are biodegradable in nature and also proved to be safe for the population build-up of natural enemies.

Keywords: Tomato, Aphis craccivora, Bemisia tabaci, Amrasca biguttula biguttula, Coccinellid, spider, biogreen, neem oil, garlic extract

1. INTRODUCTION

Tomato, *Solanum lycopersicum* L. is one of the most widely grown commercial vegetable crop in the world after potato. It is said to be a native of tropical America. In India, Assam has the highest production of tomato in North East India which produces 396.24 MT with an area of 18.28 Ha (Saxena *et al*., 2018). Tomato production has been intensified over the years; however, yields continue to be low due to several production constraints such as pests, diseases and environmental factors. The incidence of insect pests may vary from season to season and different growth stages of the crop. Among different sucking insect pests, whitefly alone can cause 10-90% damage depending upon the severity of the infestation and it also transmits tomato yellow curl viruses (Rataul and Brar, 1989). Aphids are among the most serious agricultural insect pests which causes major economic losses to crops, both directly through cell destruction from their feeding and indirectly by transmitting plant diseases such as viruses (Subba and Das, 2017). Tomato crop is severely harmed by jassids resulting in heavy yield losses. Besides direct feeding, jassids are potential vector of various viruses and their honeydew attracts black sooty mould which inhibits photosynthesis thus reducing the yield (Das and Islam 2014). Among the various methods of pest management use of chemical insecticides is most popular. The increasing concern for environment awareness of pesticides hazard has evoked a worldwide interest in the development of new, safer, biodegradable insecticides and known insecticidal alternatives that could be feasible and effective for insect pest management. Botanicals like neem and garlic being practically non-toxic to man and relatively harmless to beneficial insects are very suitable for biological and integrated pest control programme. Pesticide should be compatible with natural enemies which are already present in the particular crop ecosystem. Therefore, those pesticides which have no or minute adverse effect on beneficial organisms should be used. Keeping in view the above facts on importance of the crop, tremendous losses caused by various insect pests and to reduce the pesticide hazards, the present study is undertaken to assess the effectiveness of various bio pesticides and to evolve a technically feasible environmentally sound and economically viable pest management practices.

2. MATERIAL AND METHODS

Field experiment was conducted at the experimental farm for PG research, Biswanath College of Agriculture, Sonitpur during *Rabi* season of 2022-23 using tomato variety swaraksha. There were 24 numbers of plots with individual size 3.0 m × 3.0 m and plant to plant spacing was 60cm x 45 cm. All recommended agronomic practices were followed. The crop was regularly inspected from the transplanting till the harvesting of the crop for the population dynamics of the insect pests, and these were collected and brought to the laboratory for identification. Observations on their incidence were recorded at weekly intervals from randomly selected five plants/ plot; the populations of aphid, whitefly and leaf hopper were recorded on five plants selected randomly in each plot, considering three leaves upper, middle and lower. The population of coccinellid and spider were recorded by counting their numbers on five plants selected randomly in each plot.

For the study of effectiveness of various bio pesticides, the pest infestation was recorded one day ahead of each application (pre-treatment record) and third, seventh and fifteenth days after the application of bio pesticides (post treatment record) from five randomly selected plants of each plot.

2.1 TREATMENT DETAILS

There were all together eight treatments including untreated control. The details of the bio pesticides used in the experiment are given below.

T_1	Azadirachtin (Neem oil @ 5ml/l)
T_2	Garlic Extracts @ 5ml/ l
T_3	Biogreen-L @ 5ml/ l
T_4	Neem oil @ 5ml/ l + Garlic extracts 5ml/l
T_5	Neem oil @ 5ml/ l + Biogreen-L @ 5ml/ l
T_6	Garlic extracts @ 5ml/ l + Biogreen-L @ 5ml/ l
T_7	Neem oil @ 5ml/ l + Garlic extracts @ 5ml/ l + Biogreen-L @ 5ml/ l
T_8	Control

The experiment was conducted in Randomized block design (RBD) with three replications and eight treatments. The experimental data were converted into mean values which were further transformed into square root. The transformed data were statistically analysed. Significance of difference due to treatment effects in field were estimated by calculating the respective 'F' values (Gomez and Gomez, 1984) and by comparing the treatment means with appropriate CD values.

3. RESULT AND DISCUSSIONS

In a field experiment conducted at the experimental farm for PG research, Biswanath College of Agriculture, Sonitpur during Rabi, 2022-23, 11 insect pests from four orders and eight families were recorded as pests of tomato (Bora, *et al*., 2024). Out of these pest the important sucking pests were *Bemisia tabaci*, *Aphis craccivora* and *Amrasca biguttula biguttula* which were found to be the dominant species throughout the investigation (Bora, *et al*., 2024).The bio pesticides when evaluated against these insect pests revealed that there are significant reductions of sucking pests incidence at three, seven and fifteen days after first as well as second spray.

Table 1: Effect of different treatments on *A. craccivora* population after first and second spray during *Rabi* 2022-23

Treatments	*A. craccivora* population per leaf							
	1st spray				2nd spray			
	1 DBT	3 DAT	7 DAT	15 DAT	1DBT	3 DAT	7 DAT	15 DAT
T_1= Neem oil @ 5ml/l	12.76 (3.64)	8.98 (3.08)	8.13 (2.94)	8.98 (3.08)	11.82 (3.51)	8.11 (2.93)	6.31 (2.61)	7.04 (2.75)
T_2= Garlic extract @ 5ml/l	13.04 (3.68)	9.88 (3.22)	8.98 (3.08)	9.77 (3.20)	12.32 (3.58)	8.77 (3.04)	7.38 (2.81)	8.11 (2.93)
T_3= Biogreen-L @ 5ml/l	12.54 (3.61)	8.33 (2.97)	7.36 (2.80)	7.96 (2.91)	11.91 (3.52)	6.52 (2.65)	4.96 (2.34)	6.68 (2.68)
T_4= Neem oil @ 5ml/l + Garlic extract @ 5ml/l	12.38 (3.58)	6.92 (2.72)	5.71 (2.49)	6.18 (2.58)	11.72 (3.49)	5.11 (2.37)	3.48 (1.99)	4.13 (2.15)
T_5= Neem oil @ 5ml/l + Biogreen-L @ 5ml/l	12.11 (3.55)	6.18 (2.58)	4.61 (2.26)	5.08 (2.36)	11.56 (3.47)	3.13 (1.91)	2.78 (1.81)	3.27 (1.94)
T_6= Garlic extract @ 5ml/l + Biogreen-L @ 5ml/l	14.83 (3.92)	14.64 (3.89)	12.83 (3.65)	13.32 (3.72)	12.00 (3.54)	10.33 (3.29)	9.04 (3.09)	9.82 (3.21)
T_7= Neem oil @ 5ml/l + Garlic extract @ 5ml/l + Biogreen-L @ 5ml/l	12.88 (3.66)	11.73 (3.50)	10.11 (3.26)	10.98 (3.39)	13.86 (3.79)	9.43 (3.15)	8.48 (2.99)	8.98 (3.08)
T_8= Control	14.16 (3.83)	17.88 (4.28)	17.28 (4.22)	16.92 (4.17)	12.88 (3.66)	14.46 (3.87)	13.88 (3.80)	12.80 (3.65)
S. Ed. (±)	0.10	0.14	0.12	0.16	0.08	0.11	0.15	0.14
$CD_{0.05}$	NS	0.38	0.33	0.44	NS	0.30	0.41	0.39

DBT = Days before treatment

DAT = Days after treatment

NS = Non-significant

Data based on mean of 3 replication (3 leaves/plant and 5 plants/plot)

Figure within the parenthesis indicated square root transformed values

Aphid (*Aphis craccivora*): All the treatments were found to be effective in reducing *A. craccivora* population over control (Table 1). After first spray the lowest population of 6.18, 4.61 and 5.08 *A. craccivora* per leaf were recorded from the plot treated with neem oil @ 5ml/l + biogreen-L @ 5ml/l at three, seven and fifteen days after treatment. Similar trend of results were also obtained after second spray with 3.13, 2.78 and 3.27 *A. craccivora* per leaf from neem oil @ 5ml/l + biogreen-L @ 5ml/l treated plot at three, seven and fifteen days after treatment This findings were in conformity with Bhamat et al. (2022), who reported that NSKE5%, neem oil 0.5% and *L. lecanii* 1% WP were most effective in reducing *Aphis craccivora* population in Indian bean. Wade et al. (2020) also reported that *L. lecanii* was found to be best treatment in reducing *A. craccivora* population which was at par with azadirachtin, *B. bassiana*, *M. anisopliae* and *B. thuringiensis*. The effectiveness of azadirachtin 0.0006%, neem oil 0.3% and garlic extract 3% were also reported by Sarvaiya et al. (2018) which corroborates with the present investigation. Since, *B. bassiana, M. anisopliae* and *B. thuringiensis* were the components of the treatment Biogreen-L @5ml/l therefore, Biogreen-L might also be effective against aphid. Moreover, Halder et al. (2021) reported the compatibility of neem oil with entomopathogenic fungi like *B. bassiana, M. anisopliae, B. thuringiensis* and *P. fluroscence* against major sucking insect pests of vegetable. Hence, the combination of neem oil @5ml/l and biogreen-L @ 5ml/l might be performed best in lowering *A. craccivora* population.

Table 2: Effect of different treatments on *B. tabaci*, population after first and second spray *Rabi* 2022-23

Treatments	*B. tabaci* population per leaf							
	1st spray				2nd spray			
	1 DBT	3 DAT	7 DAT	15DAT	1DBT	3 DAT	7 DAT	15 DAT
T_1= Neem oil @ 5ml/l	9.63 (3.18)	6.70 (2.68)	5.91 (2.53)	3.96 (2.11)	7.91 (2.90)	2.67 (1.78)	2.15 (1.63)	1.66 (1.44)
T_2= Garlic extract @ 5ml/l	10.05 (3.25)	7.92 (2.90)	7.38 (2.81)	5.71 (2.49)	8.12 (2.94)	4.16 (2.16)	3.72 (2.05)	3.08 (1.90)
T_3= Biogreen-L @ 5ml/l	11.21 (3.42)	7.28 (2.79)	6.73 (2.69)	4.52 (2.24)	8.18 (2.95)	3.38 (1.97)	2.78 (1.81)	2.28 (1.67)
T_4= Neem oil @ 5ml/l + Garlic extract @ 5ml/l	9.44 (3.15)	6.08 (2.56)	4.91 (2.33)	3.38 (1.97)	7.62 (2.85)	2.08 (1.61)	1.62 (1.46)	1.18 (1.29)
T_5= Neem oil @ 5ml/l + Biogreen-L @ 5ml/l	10.62 (3.33)	5.46 (2.44)	4.28 (2.18)	2.73 (1.80)	7.38 (2.81)	1.59 (1.45)	1.13 (1.27)	0.72 (1.10)
T_6= Garlic extract @ 5ml/l + Biogreen-L @ 5ml/l	11.46 (3.46)	9.63 (3.18)	8.93 (3.07)	8.28 (2.96)	8.56 (3.01)	6.57 (2.66)	5.39 (2.43)	4.72 (2.28)
T_7= Neem oil @ 5ml/l + Garlic extract @ 5ml/l + Biogreen-L @ 5ml/l	10.92 (3.38)	8.77 (3.04)	8.41 (2.98)	6.92 (2.72)	8.33 (2.97)	4.96 (2.34)	4.35 (2.20)	3.78 (2.07)
T_8= Control	11.88 (3.52)	11.06 (3.40)	11.10 (3.41)	10.66 (3.34)	10.27 (3.28)	10.18 (3.27)	10.08 (3.25)	9.38 (3.14)
S. Ed. (±)	0.07	0.06	0.03	0.04	0.07	0.05	0.03	0.06
$CD_{0.05}$	NS	0.16	0.08	0.11	NS	0.14	0.08	0.16

DBT = Days before treatment

DAT = Days after treatment

NS = Non-significant

Data based on mean of 3 replication (3 leaves/plant and 5 plants/plot)

Figure within the parenthesis indicated square root transformed values

Whitefly (*Bemisia tabaci*): Almost similar trend in efficacies of different treatments against *B. tabaci* were observed during the investigation (Table 2). The lowest *B. tabaci* population of 5.46, 4.28 and 2.73 whiteflies per leaf recorded in the plot treated with neem oil @ 5ml/l + biogreen-L @ 5ml/l at three, seven and fifteen days after first spray. Similarly, after second spray the lowest number of 1.59, 1.13 and 0.72 *B. tabaci* per leaf was observed in the plot treated with neem oil @ 5ml/l + biogreen-L @ 5ml/l at three, seven and fifteen days after second spray which was closely followed by neem oil @ 5ml/l + garlic extract @ 5ml/l with 2.02, 1.62 and 1.18 *B. tabaci* per leaf. The findings are in close relation with Wade et al. (2020) who reported that *B. bassiana* was found to be best in reducing *B. tabaci* population which was at par with azadirachtin 1% EC and *M. anisopliae* which corroborates with the present findings. Our findings are in accordance with Nanza and Mashela (2012), according to whom neem oil and garlic mixture was most effective in reducing *B. tabaci* population in tomato. Iqbal et al. (2015) previously said that garlic contains lectins that bind with the proteins of an insect's midgut and disrupt the detection of food, leading to physiological issues and ultimately death. . It was reported that garlic has an antifungal compound allicin therefore it might reduce the effect of Biogreen-L. Therefore, garlic extract @ 5ml/l + Biogreen-L @ 5ml/l was found to be the least effective in reducing *B. tabaci* and other pests population.

Table 3: Effect of different treatments on *A. biguttula biguttula* population after first and second spray during *Rabi* 2022-23

Treatments	*A. biguttula biguttula* population per leaf							
	1st spray				2nd spray			
	1 DBT	3 DAT	7 DAT	15 DAT	1DBT	3 DAT	7 DAT	15 DAT
T_1= Neem oil @ 5ml/l	3.46 (1.99)	2.76 (1.81)	2.16 (1.63)	2.43 (1.71)	3.28 (1.94)	1.94 (1.56)	1.47 (1.40)	1.70 (1.48)
T_2= Garlic extract @ 5ml/l	3.70 (2.05)	3.25 (1.94)	2.66 (1.78)	3.05 (1.88)	3.17 (1.91)	2.70 (1.79)	2.09 (1.61)	2.36 (1.69)
T_3= Biogreen-L @ 5ml/l	3.41 (1.98)	3.12 (1.90)	2.44 (1.71)	2.73 (1.80)	3.07 (1.89)	2.44 (1.71)	1.87 (1.54)	2.11 (1.62)
T_4= Neem oil @ 5ml/l + Garlic extract @ 5ml/l	3.54 (2.01)	2.30 (1.67)	1.79 (1.51)	1.93 (1.56)	3.06 (1.88)	1.39 (1.37)	1.08 (1.26)	1.26 (1.33)
T_5= Neem oil @ 5ml/l + Biogreen-L @ 5ml/l	3.17 (1.91)	2.58 (1.75)	1.92 (1.56)	2.16 (1.63)	2.98 (1.86)	1.66 (1.47)	1.29 (1.34)	1.43 (1.39)
T_6= Garlic extract @ 5ml/l + Biogreen-L @ 5ml/l	3.73 (2.06)	3.46 (1.99)	2.90 (1.84)	3.18 (1.92)	3.33 (1.96)	2.87 (1.84)	2.20 (1.64)	2.57 (1.75)
T_7= Neem oil @ 5ml/l + Garlic extract @ 5ml/l + Biogreen-L @ 5ml/l	3.21 (1.92)	2.91 (1.85)	2.32 (1.68)	2.59 (1.76)	2.86 (1.83)	2.23 (1.65)	1.61 (1.45)	1.93 (1.56)
T_8= Control	3.96 (2.11)	3.92 (2.10)	3.30 (1.95)	3.54 (2.01)	3.92 (2.10)	3.28 (1.94)	2.54 (1.74)	2.84 (1.83)
S. Ed. (±)	0.30	0.14	0.11	0.07	0.07	0.08	0.05	0.08
$CD_{0.05}$	NS	0.38	0.30	0.19	NS	0.22	0.14	0.22

DBT = Days before treatment

DAT = Days after treatment

NS = Non-significant

Data based on mean of 3 replication (3 leaves/plant and 5 plants/plot)

Figure within the parenthesis indicated square root transformed values

Jassid (*Amasca biguttula biguttula*): All the treatments exhibited significant effect on the population reduction of *A. biguttula biguttula* after both first and second spray (Table 3). The lowest *A.*

biguttula biguttula population, 2.70, 1.79 and 1.93 per leaf was recorded from the plot treated with neem oil @ 5ml/l + garlic extract @ 5ml/l at three, seven and fifteen days after first spray. After second spray also lowest *A. biguttula biguttula* population of 1.39, 1.08 and 1.26 per leaf was recorded in the plot treated with neem oil @ 5ml/l + garlic extract @ 5ml/l at three, seven and fifteen days after treatment. The present findings were in conformity with Solangi et al. (2013), according to them neem oil + beneficial microorganism found effective against *A. biguttula biguttula* population followed by neem oil. The present findings are in accordance with that of Iqbal et al. (2017), who reported that after second spray bio-pesticides like neem oil, neem extracts, tobacco, garlic and ginger performed best against reducing *A. biguttula biguttula* population in okra. The results of the present study got support from Halder et al. (2021), according to whom combination of neem oil + *L. lecanii* was found to be best in reducing *A. biguttula biguttula* population followed by neem oil+ *B. bassiana* and neem oil+ *M. anisopliae*. Since, the bio-pesticides were individually effective in reducing pest population; therefore the effectiveness of their combinations might be more in reducing the infestation of *A. biguttula biguttula*.

Table 4: Number of Coccinellid predators under different treatment after first and second spray during *Rabi* 2022-23

Treatments	No. of Coccinellids per plant					
	1st spray			2nd spray		
	3 DAT	7 DAT	15 DAT	3 DAT	7 DAT	15 DAT
T_1= Neem oil @ 5ml/l	2.40	2.27	2.40	2.20	2.07	2.20
T_2= Garlic extract @ 5ml/l	2.17	2.07	2.17	2.07	1.93	2.13
T_3= Biogreen-L @ 5ml/l	2.06	1.93	2.57	1.93	1.73	2.40
T_4= Neem oil @ 5ml/l + Garlic extract @ 5ml/l	1.67	1.53	1.87	1.57	1.33	1.73
T_5= Neem oil @ 5ml/l + Biogreen-L @ 5ml/l	1.27	1.13	1.43	1.17	1.06	1.27
T_6= Garlic extract @ 5ml/l + Biogreen-L @ 5ml/l	1.43	1.33	1.67	1.40	1.20	1.47
T_7= Neem oil @ 5ml/l + Garlic extract @ 5ml/l + Biogreen-L @ 5ml/l	1.93	1.73	2.06	1.73	1.57	1.87
T_8= Control	2.73	2.53	2.73	2.53	2.40	2.63
S. Ed. (±)	0.10	0.07	0.08	0.07	0.06	0.05
$CD_{0.05}$	0.27	0.19	0.22	0.19	0.16	0.14

DAT = Days after treatment

Data based on mean of 3 replication (5 plants per plot)

Table 5: Number of spiders under different treatment after first and second spray during *Rabi* 2022-23

Treatments	No. of spiders per plant					
	1st spray			2nd spray		
	3 DAT	7 DAT	15 DAT	3 DAT	7 DAT	15 DAT
T_1= Neem oil @ 5ml/l	0.87	0.86	0.90	0.93	0.89	0.85
T_2= Garlic extract @ 5ml/l	0.91	0.87	0.89	0.91	0.91	0.88
T_3= Biogreen-L @ 5ml/l	0.80	0.82	0.82	0.82	0.83	0.83
T_4= Neem oil @ 5ml/l + Garlic extract @ 5ml/l	0.82	0.84	0.87	0.84	0.8	0.82
T_5= Neem oil @ 5ml/l + Biogreen-L @ 5ml/l	0.78	0.75	0.78	0.79	0.76	0.77

T_6= Garlic extract @ 5ml/l + Biogreen-L @ 5ml/l	0.77	0.78	0.8	0.82	0.78	0.8
T_7= Neem oil @ 5ml/l + Garlic extract @ 5ml/l + Biogreen-L @ 5ml/l	0.84	0.88	0.85	0.87	0.85	0.86
T_8= Control	0.94	0.92	0.91	0.98	0.93	0.93
S. Ed. (±)	0.12	0.05	0.04	0.1	0.04	0.04
$CD_{0.05}$	NS	NS	NS	NS	NS	NS

DAT = Days after treatment

NS = Non-significant

Data based on mean of 3 replication (5 plants per plot)

Natural enemies: Two coccinellid predators *viz*., *Micraspis discolor* (Fabricius) and *Cheilomenes sexmaculata* (Febricius) and two spider species *Lycosa tista* Tikader, *Anyphaena accentuata* (Walckenaer) were recorded as natural enemies, previously reported by Bora *et al.* (2024).The population of natural enemy (coccinellid) was more in neem oil @ 5ml/l treated plots after both first (2.40, 2.27 and 2.40 predators per plant at three, seven and fifteen days after treatment, respectively) and second spray (2.20, 2.07 and 2.20 predators per plant at three, seven and fifteen days after treatment, respectively) (Table 4). Since all the bio-pesticides safe to the population build-up of natural enemy therefore, the reduction in predators population might be due to the reduction in aphid population in neem oil @ 5ml/l + biogreen-L @ 5ml/l treated plot. This findings were in conformity with *Borah et al*. (2017), according to them highest population of coccinellid recorded from neem oil @ 3ml/l treated plot after first application. Previously, Gaikwad *et al.* (2020) also reported that *B. bassiana* 0.4%*,* neem oil 0.4% and *M. anisopliae* + *B. bassiana* 0.4% found to be beneficial in the population build-up of coccinellid on okra. However, no significant difference was observed among the treatments in maintaining spider population (Table 5). The present findings were in conformity with Ghosh (2020), according to him none of the treatments significantly reduce the population of spider and coccinellids. From the present investigation, it was found that all the bio-pesticides were congenial for population build-up of natural enemy.

4. CONCLUSION

The tomato crop have been ravaged by a variety of insect pests at different stages of the crop, which needs serious attention of researchers. With the reference of the above results of bio pesticidal management of sucking pests of tomato it can be concluded that among the seven treatments tested, neem oil @ 5ml/lit + biogreen-L @ 5ml/lit was found to be the best treatment in reducing *A. craccivora* and *B. tabaci* population which was closely followed by neem oil @ 5ml/lit + garlic extracts @ 5ml/lit. In case of *A. biguttula biguttula* neem oil @ 5ml/lit + garlic extracts @ 5ml/lit showed best result in reducing the population build-up of the pest species followed by neem oil @ 5ml/lit + biogreen-L @ 5ml/lit. The population of natural enemy (coccinellid) was more in neem oil @ 5ml/l treated plots. However, no significant different was observed among the treatments in maintaining spider population. These bio-pesticides are safer for the environment and also proved to be safe for the population build-up of natural enemies which is very helpful to regulate the pest population. Therefore, we should emphasize more on the use of bio-control agents or bio pesticides to overcome the excessive use and misuse of chemical pesticides as well as to increase the quality yield of tomato.

COMPETING INTERESTS

The work has been done on sucking insect pests of tomato and to evaluate effectiveness of bio-pesticides to minimize the population build-up of pest species. The results in this manuscript are on the basis of original research conducted at Biswanath College of Agriculture, Assam Agricultural University, Assam, India. No conflict of interest is involved during experimentation.

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