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MANAGEMENT PRACTICES OF APHID (*Rhopalosiphum maidis*) IN INFESTED MAIZE FIELD

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ABSTRACT

With a view to find out the comparative field evaluation of different approaches for controlling aphid infesting maize, a field trial was conducted in the Entomology Field Laboratory, Department of Entomology, Bangladesh Agricultural University (BAU), Mymensigh. The experiment was laid out during Rabi season of 2016-17 following the complete block design (RCBD) with three replications. Maize *var.* BARI Hybrid Butta-09 variety was used as experimental variety. The efficacies of eight insecticides *viz.* Carbofuran 5G @ 20g/L (T_1), Chloropyriphos 50% + Cypermethrin 5%@ 1.2ml/L (T_2), Emamectin benzoate 5 SG@ 1g/L (T_3), Imidacloprid 20SL@ 0.3ml/L (T_4), Abamactin 1.8EC@ 2.0ml/L (T_5), Spinosad@ 0.4ml/L (T_6), Imidacloprid 25% + Thiram 20%@ 0.4g/L (T_7) and untreated control (T_8) were used as experimental treatments. The study explored that all the tested insecticides significantly reduced the plant infestation caused by maize aphid, *R. maidis* and thereafter increased the grain yield of maize compared to control. However, treatment T_4 (Imidacloprid 20SL@ 0.3ml/L) was found as the most effective insecticides due to ensuring the highest reduction of infested plant (80.40%), the highest plant height (212.24cm), cob length without husk (22.26cm), no. of grain cob-1 (626.44), 100 grain weight (38.05g), grain yield (10.36 t ha^{-1}), percent increase of yield over control (51.45%) and the lowest cumulative mean of plant infestation (18.53%) in maize. The best performance of imidacloprid was due to causes block the receptor, nervous system & stomach system of aphid directly and causes disrupt the cell of the aphid's body as imidacloprid is a contact, systemic and stomach barrier insecticides. On the other hand, control treatment showed the worst performances for above parameters. However, the performances of other insecticides ranked as T_7> T_2> T_5> T_1> T_6> T_3> T_8. Imidacloprid 20SL@ 0.3ml/L as treatments, therefore, could be recommended to the maize grower for the effective management of *R. maidi*.

Key words: Maize, *Rhopalosiphum maidis*, insecticides, management.

Introduction

Maize (*Zea mays* L.) is the second important cereal crops after rice in Bangladesh (The daily star, 26thSeptember, 2016) as well as the world. It is a plant belonging to the family of grasses (Poaceae). Maize, known as corn, Bengali called as Bhutta. It is considered as a staple food in many countries of the world. In Bangladesh, the production of maize is about 2.81 MT annually in 2018-2019. About 90% of the home grown maize is feeding a burgeoning poultry and fish feed industry and rests are used as human food (Alam *et al.*, 2019a, c). It can be processed into a variety of food and industrial products, including starch, sweeteners, oil, beverages, glue, industrial alcohol, and fuel ethanol. Colorful kernel of maize is used as different purpose, such as a dent, flint, waxy, flour, sweet, pop and pod corn (Alam *et al.*, 2019c). It is also cross-pollinating but self-fertile crop, so it can be grown all year round in Bangladesh and can therefore be fitted in the gap between the main cropping seasons without affecting the major crops. But it is the matter of worried that maize production is hindered by aphid infestation. Aphid, *Rhopalosiphum maidis* is a major agricultural pest and polyphagous attacking more than 182 plant species (Alam *et al.*, 2014). The larvae of aphid feed on all parts of plant. This damage prevents pollination and introduces various fungi into the cobs

and plant. Maize aphid infested resulting in a yield loss of 0.876% in bean, sorghum, barley, cotton and mustard (Alam *et al.*, 2015a, b, c). However, insecticides are considered essential for management of aphid infesting maize in Bangladesh. Maize grower in Bangladesh and other countries are adopted with the use of synthetic chemical insecticides of different groups like organophosphate, pyrethroids, nicotinoids to control maize pest (Patil *et al.*, 2018a). Farmers usually use a lot of insecticides indiscriminately and frequently as result abatement in biodiversity of natural enemies, outbreak of secondary pests, development of resistance to pesticides, pesticide induced resurgence and contamination of food and eco-system. Therefore, to skip the environment pollution and safe eco-system, a bio-remediation is necessary to develop & adopt eco-friendly and sustainable management system of maize production. Of the many options, use of new generation insecticides is the alternative in respect of satisfactory yield and safe food products. From the above scenario, in this present research, we have managed several new generation insecticides that are available in the local market from different groups for the management of aphid, *R. maidis* using maize crop under field conditions and their effect on maize grain yield.

Materials and Methods

A field trial was carried out on maize at Entomology Field Laboratory under Department of Entomology, Bangladesh Agricultural University (BAU), Mymensingh during Rabi season of 2016-17. The site of experiment belongs to the Sonatola series of the dark grey floodplain soil type under Old Brahmaputra Floodplain Agro-Ecological Zone (AEZ-9) (Alam *et al.*, 2019a). The field was a medium high land with well drained silty-loam texture having pH value 6.5 and moderate fertility level with 1.67% organic matter content and other nutrient components well. The condition of climate was moderately cold and high humid with frequent wind during the vegetative stage. The land was prepared well through six (06) ploughing. All fertilizers were applied during land preparation except urea and Muriate of Potash (MOP). One-fourth of urea and MOP were applied at the time of final land preparation. The nitrogen, phosphorus, potassium, sulphur and zinc fertilizers were applied in form of urea, triple super phosphate, muriate of potash, gypsum and zinc sulphate at the rate of 260, 80, 140, 50 and 4.5 kg ha^{-1}, respectively (FRG, 2012). Maize *var.* BARI Hybrid Butta-09 variety was used as experimental crop. The seed of maize (BARI Hybride Butta-09) was sown on 05 November, 2016 in line. Remaining urea and MOP were applied three equal installments at pre-vegetative stage, full vegetative stage and early corn formation stage. Weeding, irrigation and other intercultural operation were done properly as and when necessary for better growth and development of maize. The efficacies of seven (07) insecticides *viz.* Carbofuran 5G@ 20g/L (T_1), Chloropyriphos 50% + Cypermethrin 5%@ 1.2ml/L (T_2), Emamectin benzoate 5 SG@ 1g/L (T_3), Imidacloprid 20SL@ 0.3ml/L (T_4), Abamactin 1.8EC@ 2.0ml/L (T_5), Spinosad@ 0.4ml/L (T_6) and Imidacloprid 25% + Thiram 20%@0.4g/L (T_7) were selected as experimental treatments. All chemical insecticides were collected from the local market of Mymensingh Sadar. The details of seven new generation insecticides are presented in Table 1.The field experiment was laid out in randomized complete block design (RCBD) with three replications with eight treatments including control. The seed of maize (BARI Hybride Butta-09) was sown on 05th November, 2016, which is the normal sowing date being practiced at the experimental fields with a plot size of 10 m^2 (4m×2.5m), spacing of 60×30cm between row to row and plant to plant, respectively and the distance was 70cm between the two plots. Total number of plots was 39. Applications of mentioned seven insecticides were sprayed in the plot according to treatments, when the population of aphid was sufficient at all stages i.e. vegetative, inflorescence and cob formation stage. In field experiment, 1st sprayed in treatment wise at the time of vegetative stage, 2nd sprayed in treatment wise at the time of inflorescence and 3rd sprayed in treatment wise at the time of the cob formation stage. Spraying was started at morning time to avoid bright sunshine and drift caused by strong wind. To evaluate the efficacy of different insecticides, observation of infested plants was identified and counted from randomly selected five plants from each treated plots before and after spraying of treatments. The grain yield was received from each treatment along with control, were weighed and recorded, and data were converted into yield per hectare basis according to treatments. At the time of applied treatments, different data were collected in different parameter wise. All data of all stages were collected and compiled into average value. Data on percent

infested plants before & after spray, percent reduction of infested plants over control, plant height, length of cob without husk, no. of grain cob^{-1}, 100 grain weight, grain yield and percent increase of yield over control were recorded in treatments wise. The percentage infestation of the plant due to attack of maize aphid and yield were calculated by using the following formula (Alam *et al.*, 2019a, b):

$$\text{Infestation of plant (\%)} = \frac{\text{Total number of plants per plot} - \text{total number of healthy plants per plot}}{\text{Total number of plants per plot}} \times 100$$

$$\text{Reduction of infested plant over control (\%)} = \frac{\text{Infestation (\%) of control} - \text{infestation (\%) of respestive treatment}}{\text{Infestation (\%) of control}} \times 100$$

$$\text{Yield increase over control (\%)} = \frac{\text{Yield of control} - \text{yield of respestive treatment}}{\text{Yield of control}} \times 100$$

Before statistical analysis, the data obtained was transformed to arc sine transformation. All the recorded data were compiled and tabulated for statistical analysis. The obtained data were statistically analyzed to find out the significance of differences among the treatments. The mean values of all the characters were evaluated and analysis of variance (ANOVA) following Randomized Complete Block Design was performed by using R statistics software version 3.5.3 to see the treatment effect, and the mean differences were adjudged by Duncan's Multiple Range (DMRT) Test (Gomez and Gomez, 1984).

Table 1. Details of insecticides tested against aphid, *R. maidis*of maize

Trade Name	Active Ingredients	Nature of Insecticides	Group	Dose	Company name/ Manufacturer
Imidagold 20 SL	Imidacloprid 20SL	Systemic, contact & stomach	Insecticides	0.3 ml/L	United Phosphorus (Bangladesh) Limited.
Hadak 45WP	Imidacloprid 25% + Thiram 20%	Contact & systemic	Insecticides	0.4 g/L	Intefa
Chlorocyrin 550EC	Chloropyriphos 50% + Cypermethrin 5%	Contact & stomach	Insecticides	1.2ml/L	Square Company Limited
Ambush 1.8 EC	Abamactin 1.8EC	Contact & stomach	Miticides	2.0 ml/L	Haychem (Bangladesh) Limited
Ecofurun 5G	Carbofuran 5G	Systemic	Insecticides	20g/L	Square Company Limited
Tracer 45 SC	Spinosad	Contact & stomach	Microbial bio-pesticide	0.4ml/L	Auto Crop Care Limited
Suspend 5 SG	Emamectin benzoate 5 SG	Contact & Stomach	Insect Growth Regulator	1g/L	Haychem (Bangladesh) Limited

Results and Discussion

The performance of seven insecticides on the reduction of percent plants infestation of maize by maize aphid, plant height, cob length without husk, number of grain per cob, 100 grain weight and grain yield which are presented in Tables 2-3. It was found that the application of insecticides showed significant ($P \leq 0.01$ and $P \leq 0.05$) on different mentioned parameters compared to control. In the study, the lowest (18.53%) plant infestation was obtained in T_4 which was followed by 26.49%, 35.24%, 44.16%, 49.47%, 56.12% and 61.40% in T_7, T_2, T_5, T_1, T_6 and T_3, respectively, whereas the highest (94.55%) plant infestation was found in T_8. With a view of the overall insecticidal effect on maize aphid, in case of percent reduction of infested plants over control, the highest (80.40%) percent reduction of plant infestation was recorded in T_4 which was followed by T_7 (71.98%), T_2 (62.73%), T_5 (53.29%), T_1 (47.68%) and T_6 (40.65%), respectively, whereas the lowest (35.06%) percent reduction of plant infestation was obtained in T_7. This result is in conformity with the findings of Ahmed *et al.,* (2017) and David *et al.,* (2009).

On the other hand, from the Table 2 and Fig. 1, the plant height differed significantly among the treatments. The plant height was recorded in the range of 212.24 to 190.25cm. Among the different tested insecticides, the maximum (212.24cm) plant height was observed from treatment T_3 and the minimum (190.25cm) was found in T_8 (untreated control). The results of the present study are also similar to the study of Kumar *et al.,* (2019); Alam *et al.,* (2018) and Ahmed *et al.,* (2017). They reported that plant height was directly increased with the increase of reduction of plant infestation during production of maize and other crops.

As the results showed, there were significant ($P \leq 0.05$) differences among the length of cob without husk of different insecticides at 5% level of probability. The highest (22.26cm) cob length without husk was obtained from T_4 which was followed by T_7 (19.54cm), T_2 (18.63cm), T_5 (16.10cm), T_1 (15.98cm), T_6 (14.69cm) and T_3 (14.02cm), respectively, whereas the lowest height (13.17cm) without husk was found in T_8 (untreated control). Similar result was found by Gaikwad *et al.,* (2014) and Ahmed *et al.,* (2017).

Table 2: Effect of some new generation insecticides on aphid infestation in maize during Rabi season of 2016-2017

Treatments	Mean percentage of infested plants	Reduction (%) of infested plants over control	Plant height (cm)
T_1	49.47d	47.68	201.78de
T_2	35.24f	62.73	206.13c
T_3	61.40b	35.06	195.67fg
T_4	18.53h	80.40	212.24a
T_5	44.16de	53.29	203.21d
T_6	56.12bc	40.65	197.44f
T_7	26.49g	71.98	208.36b
T_8	94.55a	-	190.25h
Level of significance	*	-	**
CV (%)	7.12	-	6.45
LSD	5.35	-	2.01
SE (±)	1.09	-	1.13

Table 3. Effect new generation insecticides on yield and yield attributes of maize during Rabi season of 2016-2017

Treatments	Cob length without husk (cm)	No. of grain cob^{-1}	100 grain wt. (g)	Grain yield (t ha^{-1})	YI (%) over control
T_1	15.98de	410.15e	24.41e	7.00def	28.14
T_2	18.63bc	512.37c	26.54bc	8.10c	37.90
T_3	14.02fgh	365.95g	20.69fg	5.87fg	14.31
T_4	22.26a	626.44a	38.05a	10.36a	51.45
T_5	16.10d	465.82d	26.31bcd	7.31d	31.19
T_6	14.69f	397.41f	21.75f	6.12f	17.81
T_7	19.54b	570.63b	30.13b	8.85b	43.16
T_8	13.17h	311.27h	16.37h	5.03h	-
Level of significance	*	**	**	*	-
CV (%)	6.57	7.49	5.23	7.23	-
LSD	1.01	4.45	1.15	0.45	-
SE (±)	0.96	1.11	0.97	1.02	-

In column, means followed by different letters are significantly different, *means at 5% level of probability, **means at 1% level of probability, CV= Coefficient of variation, LSD= Least significant difference, SE (±) = Standard error and YI (%) = Percent yield Increase over control

Based on number of grain cob^{-1}, the number of grain per cob had significantly (P≤0.01) influenced due to effect of application of different insecticides. The highest number of grain cob^{-1} was 626.44 from the treatment of T_4 and the lowest (311.27) from the untreated control (T_8). This result was in agreement with Patil *et al.*, (2018b) and Preetha *et al.*, (2012).

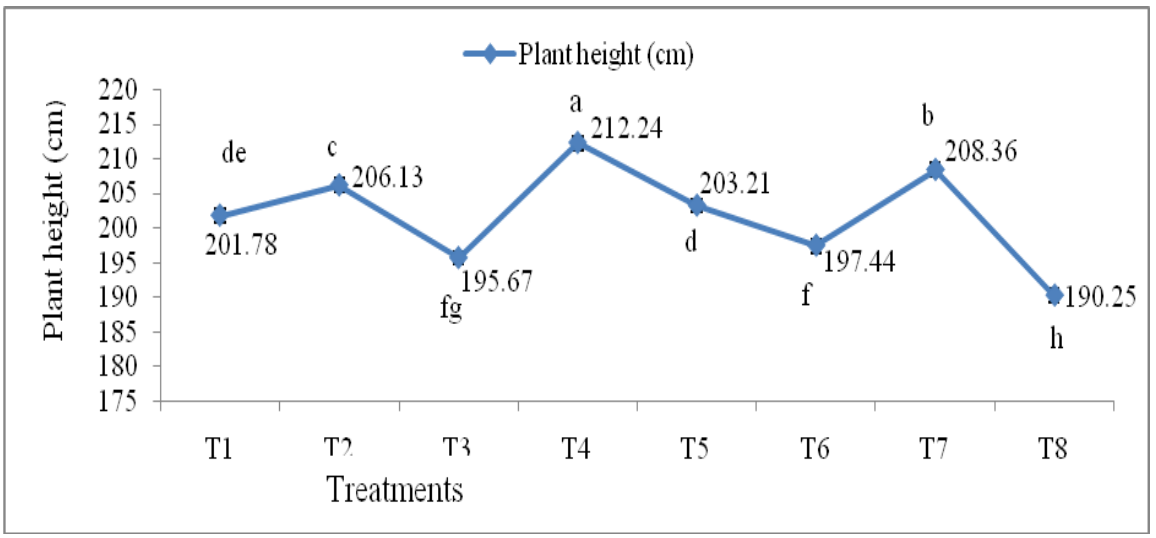

Fig.1: Effect of some insecticides on plant height of aphid infesting maize under field condition

In case of 100 grain weight, the highest 100 grain weight (38.05g) was observed in T_4. It was significantly (P≤0.01) different from the all other treatments. The lowest (16.37g) 100 seed weight was obtained from untreated control (T_8). Similar observations were made by Zewar and Zahoor (2007) and Sarwankumar (2017). Grain yield is the ultimate goal of maize cultivation. The final grain yield of maize is the expression of combined effect of various yield components. The effect of different insecticides on the grain yield was found significant where the infested maize treated with T_4 produced the highest grain yield (10.36 tha^{-1}) and the lowest (5.03 t ha^{-1} grain yield was recorded from T_8(untreated control) (Table 3). Otherwise, based on percent increase of yield over control, the highest (51.45%) percent increase of yield over control was obtained in T_4, whereas the lowest (14.31%) percent increase of yield over control was recorded from T_3. The reason of the highest grain yield might be due to the highest value at all the yield contributing characters such as percent reduction of infested plants over control, plant height, length of cob without husk, number of grain per cob, 100 grain weight, grain yield and percent increase of yield over control. This result was in agreement with Bora *et al.* (2016) and Shinde *et al.* (2018).

Conclusion

Considering the findings from the present study, it may be concluded that among all tested insecticides, the application of imidacloprid 20 SL@ 0.3ml/L is more effective for controlling maize aphid, *R. maidis* returning, which also confirms the best maize yield in Mymensingh region of Bangladesh.

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