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Relative efficacy of insect growth regulators and some new generation acaricides against red spider mite, *Tetranychus urticae* (Koch.) on marigold

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Abstract
In the present study, effectiveness of chitin synthesis inhibitor (Heron 5 EC), juvenile hormone analogue (Pyrifen 10.8 EC) and some new generation acaricides (Oberon 240 SC, Mite Scavenger 10 EC and Omite 57 EC) were evaluated against red spider mite, *Tetranychus urticae* (Koch.) under laboratory condition. All the selected molecules had two concentrations and sprayed directly on the marigold plants. Data were collected on abundances of mite populations per leaf, percent reductions of curled or infested leaf, formation of webs or silk ball (cm^2) and number of fresh or marketable flowers per plant. Mite populations were counted at 1, 3, 7 and 10 days after spray (DAS), curled leaves and webs were counted at 10 DAS after given 3rd or final spray. Marketable flowers were counted when flowers were attained the perfect size for picking or selling. All the selected chemicals were found significant compared to untreated control (P<0.05). Among the acaricides, Omite 57 EC @ 1.5 ml/L performed the best efficacy considering all the parameters studied which was followed by 1.0 ml/L of water (P<0.05). This result was closely followed by Oberon 240 SC and Mite Scavenger 10 EC respectively. The chitin synthesis inhibitor, Heron 5 EC was found highly effective compared to untreated control (P<0.05) but the juvenoid, Pyrifen 10.8 EC was found comparatively less effective against *T. urticae*.

Keywords: Acaricides, effectiveness, IGRs, mite, marigold

Introduction
Commercial floriculture in Bangladesh is a new dimension in farming culture. Evidences from all civilizations reveal that mankind has historical interest in gardening and culturing flowers to satisfy aesthetic need. But, in the present world, flower becomes important not only for its aesthetic social values, but also for its economic contribution [1-3]. Cut flower industry in Bangladesh started in a small-scale range with tuberose. The large scale commercial production started from mid-80's in Jhikargacha upazila of Jashore district, Bangladesh. Since it was profitable, many farmers became interested in this business. Within a short period of time, Jashore, Savar, Chuadanga, Mymensingh and Gazipur turned to be a major flower production belt of Bangladesh [4]. At present, 10,000 hectares of land covers flower cultivation taking the lead by Jashore district. More than 5000 resilient farmers are growing flower and foliage in the country and about 150,000 people are directly or indirectly involved in floriculture business [5]. Bangladesh exports a large number of cut flowers and ornamental foliage to foreign countries. Tube rose, rose, orchid and marigold are among the major flowers that make up Bangladesh's floral basket for exports. Flowers are exported to different countries of the world in the form of bouquets, fresh or dried. Even though Bangladesh is not one of the top 10 cut flowers-exporting countries, this industry is growing every year and is showing more potentials as a larger contributor to the economic development of the country. After starting to produce flower commercially in the mid-80s, Bangladesh has generated lots of economic benefits from this sector through local and export sales. In 2013-14 fiscal years, flower export generated $39.34 million of foreign earnings for the country, which is slightly lower than $42.88 million in 2010-11 fiscal years [6].
Marigold cultivation is now a profitable enterprise to the farmers but the socio-economic data and information of this flower are very scarce in Bangladesh. Although marigold was observed to be a profitable crop, there are several constraints to its higher production like lack of technical knowledge, poor transportation, lack of HYV variety, insect pests and diseases etc. More than 75% marigold growers opined that they are severely facing insect/mites infestation during marigold cultivation [4]. Among the insect or mite pests, red spider mite,

Tetranychus urticae (Koch.) is the most destructive pest of marigold. The red spider mite generally suck the cell sap from the lower surface of the leaves, as a result the infested leaves initially show speckling and later turn yellowish, finally leading to defoliation. The mites spread to all parts of the plants as the population increases especially during day periods and produce webbing over the entire plants. Moderate population may greatly affect flower production and heavy infestation results in death of the plants [7-8]. Several chemicals are currently using indiscriminately against red spider mite infesting marigold but the outcome is not satisfactory. Insect growth regulators (IGRs) are becoming very promising management tools day by day in IPM strategies as they are highly effective against insects/mites and safe for environment, bio-control agents and human beings.

Therefore, the present laboratory study was designed to evaluate the effectiveness of chitin synthesis inhibitor (Heron 5 EC), juvenile hormone analogue (Pyrifen 10.8 EC) and some new generation acaricides (Oberon 240 SC, Mite Scavenger 10 EC and Omite 57 EC) against red spider mite, *Tetranychus urticae* (Koch.) In laboratory condition.

Materials and Methods

Raising of host plants and mass-rearing of *T. urticae*

Experiments were conducted at the laboratory of Department of Entomology, Bangladesh Agricultural University (BAU), Mymensingh from the period of September 2018 to March 2019.

30-35 days old and uninfested marigold seedlings along with polythene bag were collected from the local nursery and used as experimental host plants. After collection, seedlings were kept in the laboratory for about 15 days for settlement or adaptation and thereafter seedlings were used as experimental purposes. The unfit or abnormal seedlings were discarded and only healthy seedlings were selected for experiment. For rearing, mites were collected from the research field of Bangladesh Agricultural University, Mymensingh through infesting marigold leaf or twig. Then mites along with leaf or twigs were placed in sterilized petridishes (150 mm diameter). After that mite infested leaves or twigs were carefully released on some previously grown marigold plants (4-5 plants only). Once transferred, mites were spreaded on whole marigold plants from infested leaves or twigs. All kinds of practices have been provided for further multiplication of mite populations. Few days later, huge numbers of nymphs and adults were developed. Then 4-5 adult female mites with almost same aged were carefully transferred on experimental marigold plants using fine hair brush and magnifying glass. Then, necessary time was allowed for the settlement and proper multiplication of mites on the plants.

Specifications of treatments

In this study, two insect growth regulators and three acaricides were evaluated against *T. urticae* under laboratory condition. Their trade name, active ingredients, chemical group and doses of specifications are given below:

Specifications of treatments

S. No.	Trade name	Active ingredients	Chemical group	Doses
1	Oberon 240 SC	Spiromesifen	Ketoenols (Acaricide)	0.5 & 1.0 ml/L
2	Mite Scavenger 10 EC	Hexythiazox	Thiazolidionone (Acaricide)	0.5 & 1.0 ml/L
3	Omite 57 EC	Propergite	Organosulfite (Acaricide)	1.0 & 1.5 ml/L
4	Heron 5 EC	Lufenuron	Chitin Synthesis Inhibitor	1.0 & 1.5 ml/L
5.	Pyrifen 10.8 EC	Pyriproxifen	Juvenile Hormone Analogue	1.0 & 1.5 ml/L

Bioassay

Treatments were applied on mite infesting marigold plants through direct or topical application method using micro-sprayer. A total of three sprays were given at 10 days interval. Care was taken during spray so that mites are not become injured or washed away from the experimental plants. Fresh water was sprayed on control plants following same technique. Data were collected on several parameters like reductions of mite populations (treated versus control), %infested or curled leaf, Web or silk balls formations on the plants (cm^2) and number of marketable flowers per plant. Abundances of mite populations were counted at 1, 3, 7 and 10 days after given each spray using magnifying glass to count accurately**.** Percent infested or curled leaves were counted and silk ball or webs (cm^2) were measured at 10 days after given final or 3rd spray. Finally, numbers of fresh or marketable flowers were counted per plant in treated and untreated condition.

Statistical analysis

The recorded data were compiled and tabulated for statistical analysis. Analysis of variance (ANOVA) was done with the help of computer package MSTAT. The mean differences among the treatments were adjudged with Duncan's Multiple Range Test (DMRT) and Least Significant Difference (LSD) when necessary.

Results

Abundances (number) of mite populations per leaf of marigold following treated with different treatments after given different spray

All the selected treatments viz. Oberon 240SC @ 0.5 ml/L and 1.0 ml/L, Mite Scavenger 10 EC @ 0.5 ml/L and 1.0 ml/L, Omite 57 EC @ 1.0 ml/L and 1.5 ml/L, Heron 5 EC @ 1.0 ml/L and 1.5 ml/L and Pyrifen 10.8 EC @ 1.0 ml/L and 1.5 ml/L had significant effect on the reduction of mite populations per marigold leaf after given first spray ($P<0.05$, Table-1). Data were collected on 1, 3, 7 and 10 days after spray (DAS). Pre–treated data were also collected to compare with treated data. Till 3 DAS, no significant effect was found but mite populations were reduced significantly from 7 DAS and onward. There had 4-5 mites per leaf in case of pre-treated condition but these populations were gradually decreased when plants were treated with different treatments. No significant changes were observed at 1 and 3 DAS compared to control but reduced significantly at 7 DAS and onward. Among the treatments, Omite 57 EC @ 1.5 ml/L was found to be very effective to reduce mite populations compared to control that was followed by 1.0 ml/L. This result was closely followed by Oberon 240 SC, Mite Scavenger 10 EC and Heron 5 EC, respectively. In contrast, the juvenoid, Pyrifen 10.8 EC was found less effective compared to control and other chemicals.

A significant difference was found between two concentrations of each of the acaricides. It was also found that the mite populations were gradually increased in absence of acaricides/IGRs application and leaf became discoloured or yellowish (Table-1, Fig.5). It is not clear why the juvenoids i.e. Pyrifen 10.8 EC performed weakly compared to other chemicals but raises the possibility of differences mode of action among the tested chemicals.

Mite populations were further reduced after given 2nd spray of different selected treatments (Table-2). It was clearly observed that mite populations were gradually increased in the plants those were left untreated (Fig.5). Like as 1st spray, Omite 57EC @ 1.5 ml/L was found superior that was followed by Oberon 240 SC and Mite Scavenger 10EC respectively. Heron 5EC was found highly effective @ 1.5 ml/L as well as 1.0 ml/L but Pyrifen 10.8EC was found moderately effective. Consistent result was found with high efficacy after given 3rd spary (Table-3).

Table 1: Abundances of mite populations per leaf of marigold following treated with selected treatments (after first spray)

Treatments	Pre-treated Number (per leaf)	Mean number of mites per leaf at different DAS			
		1 DAS	3 DAS	7 DAS	10 DAS
Oberon 240 SC @ 0.5 ml/L	4.0	5.45	5.01	5.34b	4.25c
Oberon 240 SC @ 1.0 ml/L	3.0	5.21	4.67	4.34b	3.12b
Mite Scavenger 10 EC @ 0.5 ml/L	4.0	4.67	5.12	4.22b	3.87b
Mite Scavenger 10 EC @ 1.0 ml/L	4.0	4.11	5.34	4.00b	3.23b
Omite 57 EC @ 1.0 ml/L	3.0	4.67	4.23	4.00b	3.67b
Omite 57 EC @ 1.5 ml/L	4.0	4.23	4.11	3.23c	3.01b
Heron 5 EC @ 1.0 ml/L	5.0	5.12	5.01	4.23b	4.12b
Heron 5 EC @ 1.5 ml/L	4.0	4.50	4.12	3.56b	3.34b
Pyrifen 10.8 EC @ 1.0 ml/L	3.0	4.50	5.12	4.11b	3.01b
Pyrifen 10.8 EC @ 1.5 ml/L	4.0	4.34	4.12	4.00b	3.23b
Control	4.0	5.45	5.67	6.23a	6.66a
SD	0.56	1.02	0.89	1.22	0.95
CV (%)	7.70	6.87	7.12	5.67	6.81
P-level	NS	NS	NS	*	*

In a column, means having similar letter (s) are statistically identical at 5% level of significance. Values are the mean of three replications. NS; Not significant. *P<0.05.

Table 2: Abundances of mite populations per leaf of marigold following treated with selected treatments (after 2nd spray).

Treatments	Mean number of mites per leaf at different DAS			
	1 DAS	3 DAS	7 DAS	10 DAS
Oberon 240 SC @ 0.5 ml/L	4.01c	3.88	3.67b	3.70d
Oberon 240 SC @ 1.0 ml/L	3.10b	3.67b	3.34b	2.22b
Mite Scavenger 10 EC @ 0.5 ml/L	3.67b	4.72b	4.12b	3.37d
Mite Scavenger 10 EC @ 1.0 ml/L	3.13b	4.34b	3.00b	2.13b
Omite 57 EC @ 1.0 ml/L	3.17b	3.22c	3.00c	3.12d
Omite 57 EC @ 1.5 ml/L	3.02b	2.45d	2.00c	1.45c
Heron 5 EC @ 1.0 ml/L	3.12b	4.09b	3.12c	2.45b
Heron 5 EC @ 1.5 ml/L	3.04b	3.12c	2.56c	2.00b
Pyrifen 10.8 EC @ 1.0 ml/L	3.01b	4.12b	4.23b	3.11d
Pyrifen 10.8 EC @ 1.5 ml/L	3.13b	4.12b	3.44b	2.56b
Control	7.11a	7.88a	9.34a	9.44a
SD	0.88	1.45	1.56	1.89
CV (%)	6.80	7.23	8.34	8.74
P-level	*	*	*	*

In a column, means having similar letter (s) are statistically identical at 5% level of significance. Values are the mean of three replications. NS; Not significant. *P<0.05

Table 3: Abundances of mite populations per leaf of marigold following treated with selected treatments (after 3rd spray)

Treatments	Mean number of mites per leaf at different DAS			
	1 DAS	3 DAS	7 DAS	10 DAS
Oberon 240 SC @ 0.5 ml/L	2.01b	2.00b	1.87e	1.34d
Oberon 240 SC @ 1.0 ml/L	2.00b	1.78c	1.56e	1.01d
Mite Scavenger 10 EC @ 0.5 ml/L	2.33b	1.67c	1.45d	1.34d
Mite Scavenger 10 EC @ 1.0 ml/L	2.13b	1.23c	1.00e	1.11d
Omite 57 EC @ 1.0 ml/L	3.12d	1.67c	1.55d	1.34d
Omite 57 EC @ 1.5 ml/L	1.45c	1.20c	1.00e	0.78c
Heron 5 EC @ 1.0 ml/L	2.35b	2.21b	1.66d	1.45d
Heron 5 EC @ 1.5 ml/L	2.00b	1.88b	1.67d	1.21d
Pyrifen 10.8 EC @ 1.0 ml/L	3.11d	2.78b	3.01c	2.89b
Pyrifen 10.8 EC @ 1.5 ml/L	2.56b	2.67b	2.34b	2.12b
Control	9.84a	10.23a	12.34a	12.89a
SD	1.23	1.34	1.22	1.56
CV (%)	7.34	8.13	9.34	8.56
P-level	*	*	*	*

In a column, means having similar letter (s) are statistically identical at 5% level of significance. Values are the mean of three replications. NS; Not significant. *P<0.05

Effect of selected treatments on the reduction of curled leaves

All the selected treatments *viz*. Oberon 240SC @ 0.5 ml/L and 1.0 ml/L, Mite Scavenger 10 EC @ 0.5 ml/L and 1.0 ml/L, Omite 57 EC @ 1.0 ml/L and 1.5 ml/L, Heron 5 EC @ 1.0 ml/L and 1.5 ml/L and Pyrifen 10.8 EC @ 1.0 ml/L and 1.5 ml/L had significant effect on the percent reduction of infested or curled leaves (Fig.1, $P<0.05$). A total of three sprays were given and data were presented after given 3rd or final spray (Fig.1). After 30 days of releasing of mite populations on marigold plant, about 73% leaves were found to be severely curled or infested in case of untreated condition while only 7-15% infested leaves were counted when plants were treated with selected IGRs or acaricides except Pyrifen 10.8 EC. Specifically, about 7% infested leaves were recorded when plants were treated with Omite 57 EC @ 1.5 ml/L that was followed by 1.0 ml/L (9%). This result was closely followed by Oberon 240 SC, Mite Scavenger 10 EC and Heron 5 EC respectively. The Juvenoid, Pyrifen 10.8 EC was found less effective compared to untreated control. About 40% leaves were found to be infested when plants were treated with Pyrifen 10.8 EC @ 1.5 ml/L that was followed by 1.0 ml/L (55%). About 89.56% leaves were protected from infestation over control when leaves were sprayed with Omite 57EC @ 1.5 ml/L that was followed by 1.0 ml/L (85.38%). Similarly, 83.75% infestation was reduced over control due to the application of Mite Scavenger 10 EC @ 1.0 ml/L that was followed by 0.5 ml/L (77.49%), 85.98% infestation was reduced through Oberon 240 SC @ 1.0 ml/L and 78.98% @ 0.5 ml/L. Almost similar reduction was found due to the application of Heron 5 EC. On the other hand, 45.58% infestation was reduced over control when plants were sprayed with Pyrifen 10.8 EC @ 1.5 ml/L that was followed by @ 1.0 ml/L (23.69%) (Fig. 2).

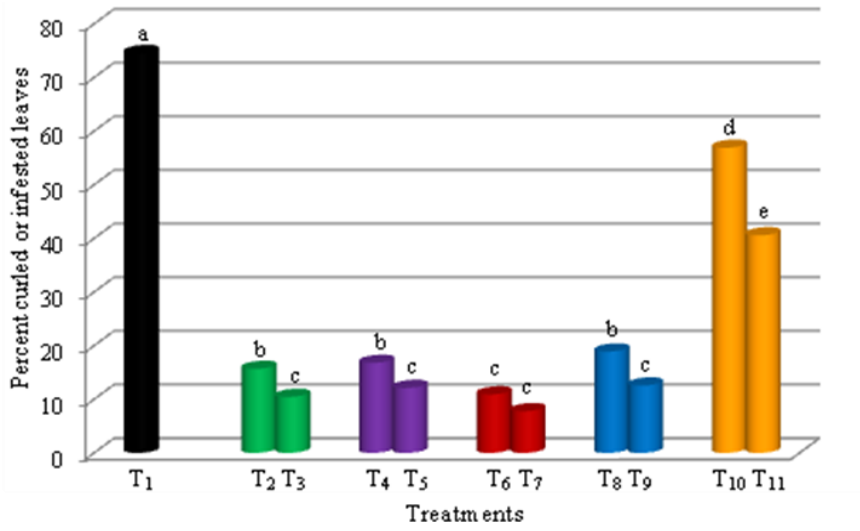

Fig 1: Percent infested or curled leaves of marigold in case of untreated (control) and treated condition after given 3rd spray. Different letters on each bar indicates significant difference among the treatments at 5% level of probability.

[T_1:Control, T_2: Oberon 240 SC @ 0.5 ml/L, T_3: Oberon 240 SC @ 1.0 ml/L, T_4: Mite Scavenger 10 EC @ 0.5 ml/L, T_5: Mite Scavenger 10 EC @ 1.0 ml/L, T_6: Omite 57 EC @ 1.0 ml/L, T_7: Omite 57EC @ 1.5 ml/L, T_8: Heron 5EC @ 1.0 ml/L, T_9:Heron 5EC @ 1.5 ml/L, T_{10}:Pyrifen 10.8 EC @ 1.0ml/L, T_{11}: Pyrifen 10.8 EC @ 1.5ml/L]

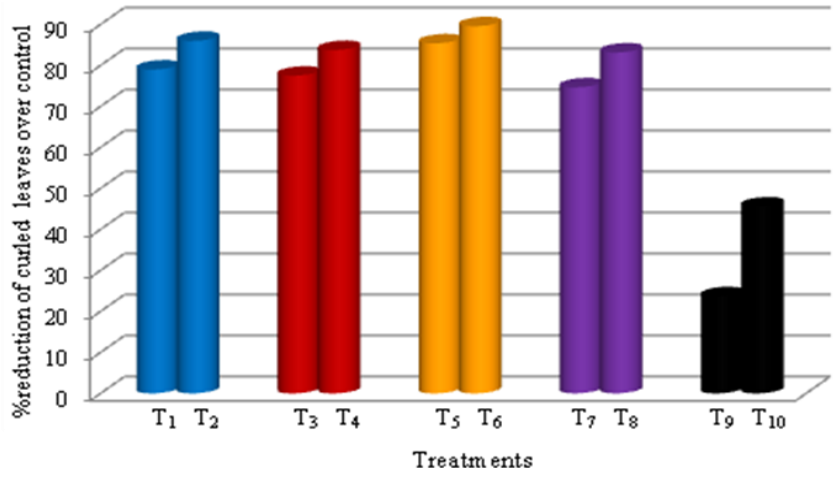

Fig 2: Percent reduction of curled leaf over control after given 3rd spary

[T_1: Oberon 240 SC @ 0.5 ml/L, T_2: Oberon 240 SC @ 1.0 ml/L, T_3: Mite Scavenger 10 EC @ 0.5 ml/L, T_4: Mite Scavenger 10 EC @ 1.0 ml/L, T_5: Omite 57 EC @ 1.0 ml/L, T_6: Omite 57EC @ 1.5 ml/L, T_7: Heron 5EC @ 1.0 ml/L, T_8:Heron 5EC @ 1.5 ml/L, T_9:Pyrifen 10.8 EC @ 1.0 ml/L, T_{10}: Pyrifen 10.8 EC @ 1.5ml/L]

Effect of selected treatments on the formations of webs or silk ball (cm^2)

T. urticae is a phytophagous mite that forms colonies of several thousand individuals. These mites construct a common web or silk ball to protect the colony. When plants become overcrowded and food resources become scarce, individuals gather at the plant apex to form a ball composed of mites and their silk threads. In the present study, silk webs or silk ball size was measured to know the sign of damage severity. It was found that a severe silk formation was found in untreated plants compared to treated plants which indicate that in absence of acaricides or control action mite populations gets all environments to form the silk balls (Fig. 5). Like as previous results, Omite 57 EC showed the best efficacy compared to other IGRs/acaricides. On the other hand, highest silk ball size was recorded when plants were kept untreated (about 20 cm^2) (Fig. 3). Pyrifen 10.8 EC was found less effective compared to other acaricides/IGRs.

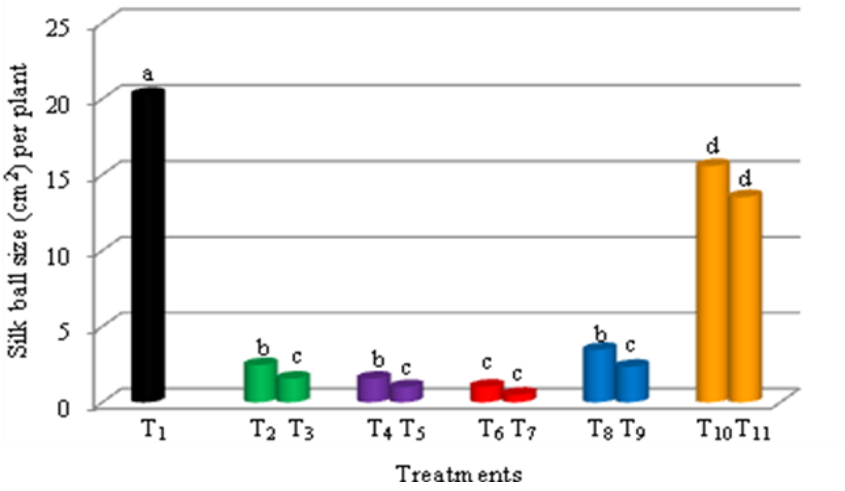

Fig 3: Effect of different treatments on the silk ball size (cm^2) per plant. Different letters on each bar indicates significant difference among the treatments at 5% level of probability

[T_1:Control, T_2: Oberon 240 SC @ 0.5 ml/L, T_3: Oberon 240 SC @ 1.0 ml/L, T_4: Mite Scavenger 10 EC @ 0.5 ml/L, T_5: Mite Scavenger 10 EC @ 1.0 ml/L, T_6: Omite 57 EC @ 1.0 ml/L, T_7: Omite 57EC @ 1.5 ml/L, T_8: Heron 5EC @ 1.0 ml/L, T_9:Heron 5EC @ 1.5 ml/L, T_{10}:Pyrifen 10.8 EC @ 1.0ml/L, T_{11}: Pyrifen 10.8 EC @ 1.5ml/L]

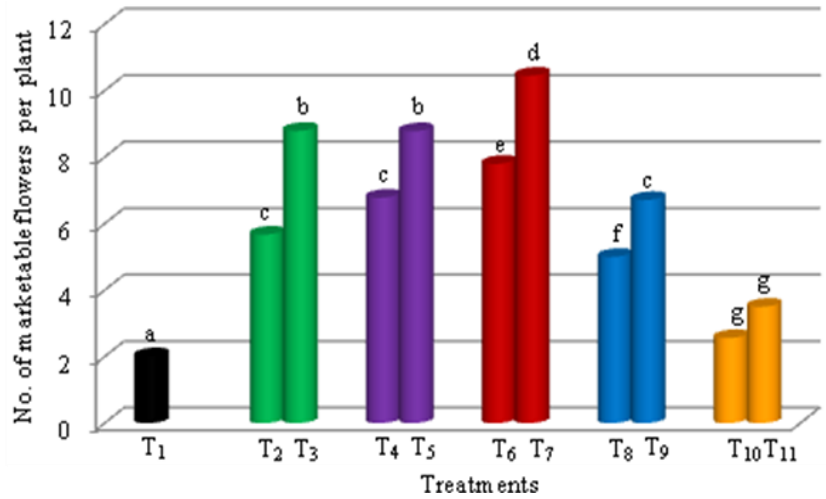

Fig 4: Effect of different treatments on the number of fresh or marketable flowers per plant. Different letters on each bar indicates significant difference among the treatments at 5% level of probability

[T_1:Control, T_2: Oberon 240 SC @ 0.5 ml/L, T_3: Oberon 240 SC @ 1.0 ml/L, T_4: Mite Scavenger 10 EC @ 0.5 ml/L, T_5: Mite Scavenger 10 EC @ 1.0 ml/L, T_6: Omite 57 EC @ 1.0 ml/L, T_7: Omite 57EC @ 1.5 ml/L, T_8: Heron 5EC @ 1.0 ml/L, T_9:Heron 5EC @ 1.5 ml/L, T_{10}:Pyrifen 10.8 EC @ 1.0ml/L, T_{11}: Pyrifen 10.8 EC @ 1.5ml/L]

Number of fresh or marketable marigold flowers per plant

Fresh or marketable flower formations were significantly affected by mite infestation as well as application of different IGRs or acaricides (Fig. 4). On average, 2 flowers/plant were recorded when plants were kept untreated (control). In contrast, number of flowers increased significantly per plant when plants were sprayed with different IGRs or acaricides (P<0.05). Similar to previous results, Omite 57 EC showed the best performance where 10-12 flowers/plant were counted @ 1.5 ml/L that was followed by 1.0 ml/L (7-9 flowers). This result was closely followed by Oberon 240 SC, Mite Scavenger 10 EC and Heron 5 EC, respectively. Pyrifen 10.8 EC was found comparatively less effective than Heron 5EC or other acaricides.

Discussion

The red spider mite, *T. Urticae* (Koch.) is one of the

devastating mite pest infesting several field crops like chilli, tomatoes, cucumbers, apples, grapes and citrus [9]. Marigold is one of the most important commercial cut flower in Bangladesh and thousands of small households in southern districts are directly or indirectly depend on this income [1, 3]. But recently *T. urticae* infestation on marigold has becoming the emerging and severe threat of marigold production. About 75% marigold farmers has opined that *T. urticae* is the presently major threat for marigold cultivation in southern districts of Bangladesh [4]. They are currently using different conventional insecticides against this culprits but does not getting satisfactory outcome. In fact, it is very difficult to control *T. urticae* using old or conventional insecticides/acaricides due to their ability to develop resistance after frequent and injudicious application for the long period. It is good news that many of new generation acaricides with novel mode of action are available in the market. Moreover, insect growth regulators (IGRs) are becoming the potential eco-friendly molecules for managing insects or mite pests. Therefore, it is urgently needed to evaluate the alternative agents like new generation acaricides as well as different IGRs like chitin synthesis inhibitors and juvenoids.

In the present study, some IGRs and new generation acaricides were evaluated in laboratory condition against red spider mite, *Tetranychus urticae* (Koch.) infesting marigold plants. Our study clearly showed that Heron 5 EC (Lufenuron), a chitin synthesis inhibitor worked potentially in controlling mites and significantly increased marketable flower production. In contrast, Pyrifen 10.8 EC (Pyriproxifen), a juvenoid analogue performed moderately compared to Heron 5 EC or other acaricides. It raises the possibility that there had different mode of action of two selected IGRs. Heron is basically a chitin synthesis inhibitor which has some potential properties includes translaminar action in plants, acts on the incorporation of N-acetyl glucosamine monomer into chitin of integument resulting no or abnormal cuticle formation, delayed and/or disrupted moulting and inhibited reproduction [10-11]. In contrast, pyriproxifen attributes slow and contact action, less translaminar activity in plants and less disruption of chitin synthesis resulting low mortality of target pests [10]. Our present findings are in close agreement with several studies [11-13]. Hence, IGRs are considered to be safe for bio-control agents as well as eco-friendly, Heron 5 EC can be used against *T. urticae* as sole application or with IPM components. On the other hand, the Juvenoid, Pyrifen 10.8 EC can apply in integration with IPM packages rather its sole application.

On the other hand, all three new generation acaricides were proved to be highly effective in reducing mite populations, leaf infestations and increasing fresh flowers compared to control. Numerous field studies demonstrated that adequate control can be achieved using bio-pesticides and acaricides [12, 14, 15]. An experiment was conducted using Propergite 57 EC against red spider mite and found that about 79% mite populations can be controlled using this acaricides [9]. In our study, about 89% mite populations were reduced when marigold plants were sprayed with Omite 57 EC @ 1.5 ml/L. It has been reported that Mite Scavenger 10 EC and Oberon 240 SC provided good efficacy against red spider infesting tea where 74 and 72% mortality were found respectively in laboratory condition and this result is almost consistent with our present findings [16].

Fig 5: Infested marigold plant that left untreated [A], IGRs or acaricides treated plant [B], severely mite-infested plants (C & D) developed silk ball.

Conclusion

It can be concluded from the present studies that all the three new generations' acaricides *viz.* Omite 57 EC, Oberon 240 SC and Mite Scavenger 10 EC could be considered for managing red spider mite on marigold successfully. Heron 5 EC (Lufenuron) @ 1.5 ml/L also provided good efficacy against red spider mite. On the other hand, the Juvenoid, Pyrifen 10.8 EC can apply in integration with IPM packages rather its sole application.

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Conflict of interest

The authors declares no conflict of interest.

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