J. Sher-e-Bangla Agric. Univ., 6(1): 1-7, January 2012 ISSN 1997-6038

EFFECT OF SOME CHEMICAL INSECTICIDES AND NONCHEMICAL MEASURES FOR THE MANAGEMENT OF RED PUMPKIN BEETLE ON WHITE GOURD

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ABSTRACT

The experiment was conducted to determine the comparative effectiveness of three chemnical insecticides such as cypermethrin 10EC, chlorpyriphos 20EC, cartap 50SP, and three nonchemical methods viz. mosquito net barrier at seedling stage, application of ash, hand collection and destruction of adult against red pumpkin beetle, *Aulacophora foveicollis* (Lucas) infesting white gourd in the experimental field of Sher-e-Bangla Agricultural University, Dhaka during March to August, 2008. Among the insecticides, cypermethrin was found as the most effective treatment and reduced 88.20% beetle population over control. The treatment had the lowest percent of leaf area damage (17.08%), increased vine length (94.16%), fruit length (23.62%), diameter of fruit (50.75%) and produced the highest amount of fruit yield (30.41 t ha^{-1}) . Chlorpyriphos and cartap reduced beetle population more than 80% over control, produced moderate yield as compared to cypermethrin. Application of ash and hand collection and destruction of adult showed better performance against the beetle among the nonchemical methods and gave higher fruit yield of white gourd. The performance of mosquito net barrier at seedling stage was not satisfactory. All chemical insecticides showed better performance than nonchemical methods against red pumpkin beetle & cypermethrin was the best.

Keywords: red pumpkin beetle, white gourd, insecticide, ash, mosquito net

INTRODUCTION

White gourd (*Benincasa hispida* Thunb) is an important cucurbit vegetable crop in Bangladesh, which can be grown easily in kharif season. Therefore, it plays an important role to supplement the shortage of vegetables during the lag period (Rashid, 1993). Sales of white gourd throughout the prolonged harvest season provide farmers with valuable cash income. The average yield of white gourd is only 20-23 t/ha in Bangladesh which is very low as compared to world average (Mangal *et al.,* 2004). Red pumpkin beetle, *Aulacophora (Raphidopalpa) foveicolis* (Lucas) is the most destructive pest of cucurbit crops particularly in early stage of the crop. It is widely distributed in Asia, Australia, Southern Europe and Africa. It is a serious pest of cucurbitaceous vegetables specially cucumber, white gourd, watermelon, muskmelon and sweet gourd (Rajak, 2001). Both of the adult and the grub of red pumpkin beetle cause considerable damage to cucurbit plants during all stages of plant development. The beetles are very destructive to cucurbitaceous vegetables, particularly during March to April when the creepers are very young. The adult also feed flowers and in some cases on young fruits while the grubs attack the root, underground stem and leaves closely in touch with soil thereby lowering the yield substantially. The adults feed on both surface of leaves. When the adult feed on the middle of the leaf, they produce a characteristic circular ring like injury. The adult while feeding on flowers feed mainly on petals. They also feed anthers, pollens, stigma and ovary rendering the flowers incapable of fruiting. The beetles also injure fruits producing characteristic circular bands on the fruits, which help in rotting and subsequent attack of disease of the fruits (Atwal and Dhaliwal, 2007). The pest, however, occurs throughout the year and cause severe damage to the crop especially at seedling stage (Reeta and Johri, 2003). Current pest control strategy of *A. foveicollis* is based largely on synthetic insecticides of different chemical groups in Bangladesh and elsewhere (Tariq *et al.,* 2006, Lakshmi *et al.,* 2005, Pandey *et al.,* 2003). However, sole reliance on insecticides for control of pests

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may lead to many well known and serious problem viz., resistance of chemicals in pest populations, resurgence of treated populations, outbreak of secondary pests, residues on food and forage products and legal complications, destruction of beneficial predators, parasites and pollinators, hazards to applicators, domestic animals, fish and wildlife and expense of pesticides, involving recurrent costs for equipment, labour and material. Farmers of Bangladesh and other countries also use some cultural and mechanical methods such as application of ash, hand collection and destruction of adult beetle, mosquito net barrier around seedlings. Several researchers also used these non-chemical methods for the control of *A. foveicollis* but their efficacy was not unsatisfactory (Rajak and Singh, 2002; Das *et al.,* 1999). Although the effectiveness of these non-chemical methods is less than chemical control they are environmentally safe. In Bangladesh, research reports on the chemical insecticides and nonchemical methods against *A. foveicollis* are limited. Therefore, this study was undertaken with the objectives to determine the comparative effectiveness of three chemical insecticides and commonly used nonchemical methods for the control of red pumpkin beetle.

MATERIALS AND METHODS

Field trial was conducted in summer during March - August 2008 against red pumpkin beetle, *Aulacophora foveicollis* (Lucas) at the experimental farm of Sher-e-Bangla Agricultural University, Dhaka, Bangladesh. The field trial was carried out in a randomized complete block design (RCBD) with three replications. Seeds of white gourd variety BARI chal kumra-1 were collected from the Horticultural Research Center (HRC) of Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh. White gourd seeds were sown on March 19, 2008 in 21 plots. The whole field was divided into three blocks of equal size having 1.0 m space between the blocks and 1.0 m between the plots. The unit plot size was 3.0 m× 2.0 m accommodating 2 pits plot^{-1} and the pit to pit distance was 2.0 m. Ten seeds were sown in each pit and light irrigation was given to each pit after seed sowing. Supplementary irrigation was applied at an interval of 2-3 days. Stagnant water was effectively drained out at the time of over irrigation and rainfall. Weeding was done as and when necessary. Excess seedlings of white gourd were removed from the pit after 15 days of seed germination. Only two times thinning were done. Manures and fertilizers were applied as per recommendation of Rashid (1993).

The treatments were as follows:

T_1 = Application of cypermethrin (ripcord 10 EC) @ 1.0 ml L^{-1} of water at 7 days interval.
T_2 = Application of chlorpyriphos (dursban 20 EC) @ 2.0 ml L^{-1} of water at 7 days interval.
T_3 = Application of cartap 50SP (suntap 50SP) @ 1.5 g L^{-1} of water at 7 days interval.
T_4 = Mosquito net barrier at seedling stage.
T_5 = Hand collection and destruction of adult beetle.
T_6 = Application of wood ash.
T_7 = Untreated control.

Treatments application

Insecticides were applied when it was necessary according to the treatments. The insecticides were applied with the help of a knapsack sprayer. The first application of insecticides was done after first week of the seedling emergence and subsequent applications were made at 7 days interval. Precautions were taken to avoid drift to the adjacent plots. In case of mosquito net barrier, seedlings were covered by mosquito net after emergence and kept upto 40 days. Hand collection and destruction of beetle was done in the morning every day. Ash was applied in the morning by hand at 7 days interval starting from one week of seedling emergence.

Data collection

Vine length of each plant was measured at 5, 10 and 12 weeks after emergence. The total number of leaves and infested leaves per plant was counted at two days after emergence and continued up to five weeks and then averaged to estimate the percent leaf infestation. Number of adult beetle per plant was counted after emergence of seedlings at 7 days interval and continued up to 40 days of after emergence. After application

of the treatments percent reduction of pests was estimated. The number of flowers and fruits per plant was counted separately from each plot. Harvesting was done when fruits were matured and length and diameter of fruits were measured after each harvest and continued until the end of the cropping season. The data were pooled over and then averaged to obtain the mean value of each parameter. Percent increase of length and diameter of fruits was estimated throughout the cropping season. After each harvest, the weight of the fruit from each treatment was recorded separately. After final harvest the total yield was calculated in tons per hectare and percent increase or decrease of yield over untreated control was estimated.

Statistical analysis

Data were analyzed by using MSTAT software for analysis of variance. Mean values were ranked by Duncan's Multiple Range Test (DMRT) at 5% level of significance which was used to compare the mean differences among the treatments (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

The number of leaves plant^{-1} at seedling stage was significantly varied in different treatments against *A. foveicollis* attack. The highest number of leaves (22.45 plant^{-1}) was found in cypermethrin treatment having no significant difference with chlorpyriphos (21.45 plant^{-1}) and cartap (21.22 plant^{-1}). However, significant difference was found with other non chemical treatments. The lowest number of leaves (16.17 plant^{-1}) was observed in untreated control, which was significantly lower than other treatments (Table 1). Number of infested leaves plant^{-1}, percent leaf infestation and percent leaf area damage was significantly influenced by spraying with cypermethrin insecticides. The number of infested leaves (1.40 plant^{-1}) was the lowest in cypermethrin. On the other hand the highest number of infested leaves (4.68plant^{-1}) was observed in untreated control, which was significantly different from other treatments. Although the number of infested leaves plant^{-1} was varied in chlorpyriphos (2.00 plant^{-1}) and ash (2.02 plant^{-1}), however, no significant difference was observed among these treatments regarding this parameter. The lowest percent leaf infestation (6.25%) and leaf area damage (17.08%) were observed in the treatment cypermethrin which were significantly different from other treatments, whereas the percent leaf infestation (28.97%) and percent leaf area damage (65.38%) were found highest in untreated control (Table 1). The results obtained from above findings under the present study were supported by Pandey *et al.* (2003) and illustrated that synthetic pyrethroid insecticide was more effective than chlorpyriphos insecticides as a result of decreased number of infested leaves and percent leaf infestation.

Table 1. Effect of treatments on number of total and infested leaves plant^{-1} at seedling stage, percent leaf infestation and percent leaf area damage against red pumpkin beetle infestation

Treatments	Number of leaves plant^{-1} at seedling stage	Number of infested leaves plant^{-1} at seedling stage	Percent leaf infestation at seedling stage	Percent leaf area damage
Cypermethrin	22.45 a	1.40 d	6.25 e	17.08 f
Chlorpyriphos	21.45 ab	2.00 d	9.34 d	22.38 e
Cartp	21.22 ab	2.64 c	12.46 c	26.65 c
Mosquito net	19.00 c	3.34 b	17.56 b	38.68 b
Hand collection of adult	20.47 bc	3.34 b	16.30 b	25.24 d
Ash	20.85 b	2.02 d	9.67 d	26.82 c
Control	16.17 d	4.68 a	28.97 a	65.38 a
CD (0.05)	1.06	0.59	1.90	0.97
CV (%)	7.39	9.03	7.64	6.73

In a column, means having same letter(s) are statistically similar at 5% level of significance by Duncan's Multiple Range Test (DMRT)

The data in Table 2 indicate that the lowest number of adult insect (0.57 plant^{-1}) was found in cypermethrin treated plots while it was maximum (4.83 plant^{-1}) in untreated control plots. Similarly cypermethrin showed the best efficacy against *A. foveicollis* by reducing 88.20% population over control. Chlorpyriphos and cartap also reduced more than 80% population over control. None of the non-chemical methods were effective as insecticides in reducing population of *A. foveicollis* in white gourd. However, application of ash and hand collection and destruction of adult beetles reduced more than 60% population (Table 2). The result of the present study agrees with the findings of Rajak and Singh (2002), who reported that insecticidal treatments were superior to non-chemical control and dung ash was effective up to 3 days of application. It also supports the findings of Borah (1997) who stated that synthetic pyrithroids namely deltamethrin, cypermethrin and fenvalerate gave acceptable levels of control against *A. foveicollis*.

Table 2. Effect of treatments on incidence of adult red pumpkin beetle on white gourd

Treatments	Number of adult insect plant^{-1}	Percent reduction of insect population over control
Cypermethrin	0.57 c	88.20 a
Chlorpyriphos	0.93 c	80.69 c
Cartp	0.79 c	83.59 b
Mosquito net	3.34 a	30.83 f
Hand collection of adult	1.64 b	66.13 d
Ash	1.83 b	62.07 e
Control	4.83 a	--
CD (0.05)	1.38	1.55
CV (%)	10.83	8.24

In a column, means having same letter(s) are statistically similar at 5% level of significance by Duncan's Multiple Range Test (DMRT)

The vine length of plant was significantly varied in different treatments against *A. foveicollis* attack. The highest vine length of plant (412.10 cm) was observed in the treatment cypermethrin, which was significantly different from other treatments (Table 3). Among the non-chemical methods, higher vine length (301.90 cm) was found in ash treated plots, which was significantly lower than chemical control. Besides this, the lowest vine length of plant (212.20 cm) was observed in untreated control. Figure 1 illustrated that application of cypermethrin showed the best efficacy against *A. foveicollis*

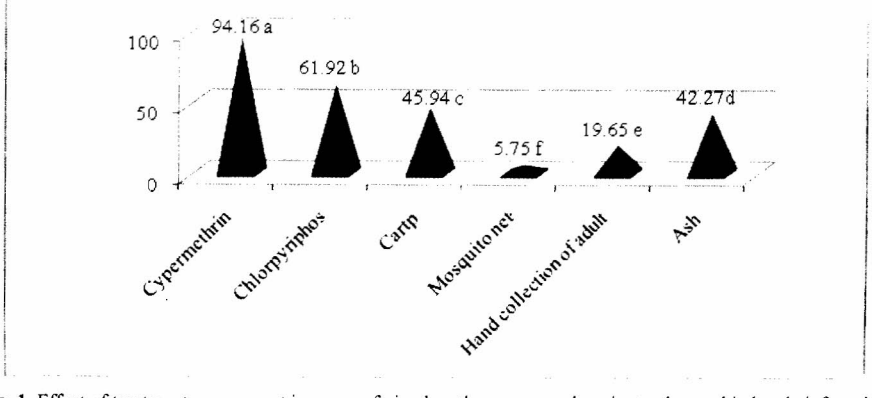

Fig. 1. Effect of treatments on percent increase of vine length over control against red pumpkin beetle infestation

attack and increased (94.16%) vine length plant^{-1} over control. Application of ash was more effective than other non-chemical methods, which increased 42.27% length of vine. On the other hand the lowest result (5.75%) was found in mosquito net barrier treated plots, which was significantly lower than other

treatment. The data in table 3 expressed that the number of flowers plant^{-1} was significantly varied in different treatments against *A. foveicollis* attack. The highest number of flowers (19.92 plant^{-1}) was recorded from cypermethrin, which was significantly different from other treatments. On the other hand the lowest number of flowers (5.33 plant^{-1}) was observed in untreated control, which was significantly higher than all other treatments. However, no significant difference was observed among mosquito net barrier (7.25 plant^{-1}), ash (7.25 plant^{-1}) and cartap (7.38 plant^{-1}), regarding number of flowers plant^{-1} (Table 3). It was also observed that the highest length of fruits (19.27 cm) was found in cypermethrin, which was statistically identical with chlorpyriphos (18.36 cm), ash (18.07 cm) and cartap (18.09 cm) but significantly different from other treatments (Table 3). In contrast, the lowest length of fruits (15.59 cm) was observed in untreated control, which was significantly different from others. Figure 2 showed that application of different treatments significantly increased the length of fruits. The best result was obtained by application of cypermethrin which increased 23.62% length of

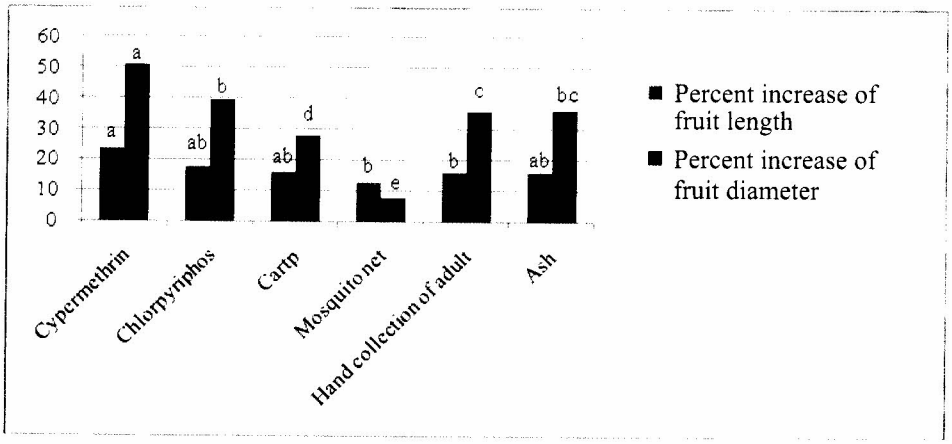

Fig. 2. Effect of treatments on percent increase of fruit length and diameter over control against red pumpkin beetle infestation

fruits over control. On the other hand the lowest result (12.64% increase of fruit length over control) was found in mosquito net barrier, which was significantly lower than other treatments. Similarly, fruit diameter also varied in different treatments used in this study. The highest diameter of fruits (39.68 cm) was found in the treatment cypermethrin, which was significantly different from other treatments while the lowest diameter of fruits (26.32 cm) was observed in untreated control (Table 3). Although

Table 3. Effect of chemical insecticides and nonchemical methods on white gourd vine length, number of flowers plant^{-1}, fruit length and diameter against red pumpkin beetle infestation

Treatments	Vine length (cm)	Number of flowers plant^{-1}	Fruit length (cm)	Fruit diameter (cm)
Cypermethrin	412.10 a	19.92 a	19.27 a	39.68 a
Chlorpyriphos	343.60 b	13.33 b	18.36 ab	36.67 b
Cartp	311.20 c	7.38 d	18.09 ab	33.59 d
Mosquito net	224.40 f	7.25 d	17.56 b	28.35 e
Hand collection of adult	254.00 e	8.25 c	17.66 b	35.69 b
Ash	301.90 d	7.25 d	18.07 ab	35.85 bc
Control	212.20 g	5.33 e	15.59 c	26.32 f
CD (0.05)	1.05	0.56	0.53	0.92
CV (%)	6.20	3.21	7.22	8.21

In a column, means having same letter(s) are statistically similar at 5% level of significance by Duncan's Multiple Range Test (DMRT)

the diameter of fruits was varied in hand collection and destruction of adult beetles (35.69 cm), chlorpyriphos (36.67 cm) and ash (35.85 cm) however, no significant difference was observed among these treatments regarding this parameter.The best result was found in cypermethrin, which increased (50.75%) diameter of fruits over control against *Aulacophora foveicollis* attack. On the other hand the lowest result (7.69%) was found in mosquito net barrier, which was significantly lower than other treatments.

The data (Table 4) revealed that the highest number of fruits (3.09 plant^{-1}) was found in the treatment cypermethrin which was significantly different from other treatments. On the other hand the lowest number of fruits (1.21 plant^{-1}) was observed in untreated control, which was statistically identical with mosquito net barrier (1.75 plant^{-1}) but significantly different from other treatments. Although the number of fruits was varied in cartap (2.42 plant^{-1}), ash (2.38 plant^{-1}), chlorpyriphos (2.34 plant^{-1}) and hand collection and destruction of adult beetle (2.17 plant^{-1}) however, no significant difference was observed among these treatments regarding this parameter. The highest weight of fruits plant^{-1} (1.82 kg) was in the treatment cypermethrin, which was significantly different from other treatments. On the other hand the lowest weight of fruits plant^{-1} (1.28 kg) was observed in untreated control, which was statistically identical with mosquito net barrier (1.29 kg) but significantly different from other treatments. It was also found that the highest yield (30.41 t ha^{-1}) was obtained in the treatment cypermethrin, which was significantly different from other treatments. On the other hand the lowest yield (21.23 t ha^{-1}) was observed in untreated control, which was statistically identical with mosquito net barrier (21.48 t ha^{-1}) but significantly different from other treatments. Application of different treatments significantly increased the yield. However, the best result was found in cypermethrin, which increased (43.20%) yield over control against *A. foveicollis* attack. On the other hand the lowest result (1.18%) was found in mosquito net barrier, which was significantly lower than other treatments (Table 4).

Table 4. Effect of chemical insecticides and nonchemical methods on number and weight of fruits plant^{-1} and yield of white gourd against red pumpkin beetle infestation

Treatments	Number of fruits plant^{-1}	Weight of fruit plant^{-1} (kg)	Yield (t ha^{-1})	Percent increase of yield over control
Cypermethrin	3.09 a	1.82 a	30.41 a	43.20 a
Chlorpyriphos	2.34 b	1.56 c	25.96 c	22.29 c
Cartp	2.42 b	1.50 d	25.02 d	17.82 d
Mosquito net	1.75 cd	1.29 f	21.48 f	1.18 f
Hand collection of adult	2.17 b	1.37 e	22.75 e	7.14 e
Ash	2.38 b	1.61 b	26.78 b	26.14 b
Control	1.21 d	1.28 f	21.23 f	--
CD (0.05)	0.51	0.15	21.48	0.61
CV (%)	7.97	8.38	6.16	7.17

In a column, means having same letter(s) are statistically similar at 5% level of significance by Duncan's Multiple Range Test (DMRT)

The results of the present study clearly demonstrated that application of different chemicals and non-chemical methods have significant effect on yield contributing characters and yield of white gourd. Among the different chemicals cypermethrin showed the best efficacy against A. foveicollis attack. It increased the highest number of fruits plant-1, length of individual fruit, weight of fruits, fruit diameter and yield of white gourd. Chlorpyriphos and cartap also have significant effect in reducing A. foveicollis infestation and yield of white gourd. The order of efficacy of three chemical insecticides was cypermethrin > chlorpyriphos > cartap. All the non-chemical methods also significantly increased the number of fruits plant-1, length of individual fruit, weight of fruits, fruit diameter and yield of white gourd but their efficacy was lower than chemical insecticides. However, application of ash and hand collection and destruction of adult beetle showed the better performance than mosquito net barrier. Comparatively chemical insecticides were more effective than non-chemical methods against A. foveicollis infesting white gourd. These results agree with the findings of Pandey et al. (2003), who

reported that synthetic pyrethroid was more effective than chlorpyriphos and gave higher yield. The findings also supported the reports of Tariq et al. (2006), who noted that chemical control was more effective than application of ash. However, these results may vary with reports of some researchers because of methods of treatment application, timing of spray and some other unknown factors. Cypermethrin is the most effective insecticide for the management of A. foveicollis however, considering the health hazards and environmental safety point of view application of ash or hand collection and destruction of adult beetles may be used.

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