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INTEGRATED APPROACHES FOR MANAGEMENT OF PEST COMPLEX IN POINTED GOURD (*TRICHOSANTHES DIOICA* ROXB)

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ABSTRACT
The experiment was done to evaluate the efficacy and economics of different combination of treatments at different dosage against major pests of pointed gourd. Results of three consecutive seasons showed that the treatments T_2 (carbosulfan 25EC + neem granule + NSKE 5%) and T_4 (carbofuran 3G + propergite 7.5%) contained consistently lowest level of fruit fly, leaf roller and epilachna infestation. While T_6 (carbosulfan 25EC + vermicompost + *Paecilomyces lilacinus* (PL) + dicofol 18.5 EC followed by propergite 7.5%) and T_7 (carbosulfan 25EC + PL + dicofol) took much better care for root knot nematodes and mites infestation in pointed gourd. Further yield component was highest in these treatments than T_4 or T_2, which was not at all potent enough to decimate yield alarmingly. Considering incremental cost benefit ratio (ICBR), adoption of carbosulfan 25EC + azadirachtin 1% (T_1) was found to be the most economical (ICBR ~ 6.67 in 2007-08, 8.23 in 2008-09 and 8.18 in 2009-10). However, T_6 would be an option where nematode egg parasitic fungus, *P. lilacinus* in combination with dicofol and propergite restrict both root knot nematode and red spider mite population development on the long duration crop like pointed gourd.

INTRODUCTION

Pointed gourd (*Trichosanthes dioica* Roxb.) is one of the most popular vegetable crops in north eastern part of India. The crop is grown during October-November and remains in field up to September. It has medicinal properties on circulatory system especially in lowering blood sugar and serum triglycerides (Chandrasekhar *et al.,* 1988; Sharma and Pant, 1988) and anti-ulcerous effects (Singh, 1989) of fruits upon consumption. The crop is commonly cultivated in Bihar, Uttar Pradesh, Assam and West Bengal (Nath and Subramanyam, 1972) and in West Bengal shares nearly 78.4 thousand hectares with an annual production of 809.1 thousand MT (Anon., 2005-06). There are number of insect-pests attacking pointed gourd during growing season of the crop and management of pest complex is difficult using synthetic chemicals alone. The information on holistic management of pests in pointed gourd is still scanty. Jha *et al*. (2007) reported infestation of fruit fly to the tune of 17% on the crop in the district of Malda, Murshidabad and Nadia. Among the other pests, spider mite (Chintha *et al*., 2002; Patel and Karmakar, 2004, 2005) and root knot nematodes (Verma and Anwar, 1995, 1998; Mahapatra *et al.,* 1999; Khan and Verma, 2004; Mukhopadhyay *et al.,* 2006) are also the major menace to profitable cultivation of the crop. The application of synthetic pesticide is common practice by the vegetable growers without bothering their harmful effects. This is quite frequent in long duration crop like pointed gourd where picking of fruits is done at regular intervals. The present investigation was undertaken with a view to manage the multiple pests infesting pointed gourd by integrating fungal, neem and chemical products under West Bengal conditions.

MATERIALS AND METHODS

The experiment was conducted at Central Research Farm, Bidhan Chandra Krishi Viswavidyalaya (BCKV), Gayeshpur (at 23°N latitude, 89°E longitude and 9.75m above sea level), West Bengal (India). The soil was a typical alluvial soil (Entisol) with a sandy clay loam texture with good drainage, slightly acidic pH and moderate fertility. The experiment consisted of seven treatments viz., carbosulfan 25EC + azadirachtin 1% (T_1), carbosulfan 25EC + neem granule + NSKE 5% (T_2), neem granule + NSKE 5% (T_3), carbofuran 3G + propergite 7.5% (T_4), carbosulfan 25EC + vermicompost + azadirachtin 1% (T_5), carbosulfan 25EC + vermicompost + *Paecilomyces lilacinus* (PL) + dicofol 18.5 EC followed by propergite 7.5% (T_6) and carbosulfan 25EC + PL + dicofol 18.5 EC (T_7). Each treatment was replicated three times on plots of 6 m^2 (3m x 2m) size maintaining 6 pits at spacing of 100x130 cm, laid out in a randomized block design. Mature root cuttings of pointed gourd cv. *Dhapa* were planted in three seasons during November to August in 2007-08, 2008-09 and 2009-10. A female: male ratio of 6:1 was maintained per plot. Agronomic practices were followed as per recommendations of the crop for the region. The harvesting of fruits was done at regular interval starting from March-April to August. Root cuttings of pointed gourd were treated with carbosulfan 25EC by dipping

in chemical suspension for six hours. The granular formulation of neem (EID Parry India Ltd) and carbofuran (FMC Rallis India Ltd) and talc based formulation of *Paecilomyces lilacinus* (NBAII, Bangalore) were applied each pit at the time of planting. The spraying of pesticides and EC formulation of azadirachtin (EID Parry India Ltd) was done with knapsack sprayer. Considering the relative economic injury and population density of the pest species, the efficacy of chemicals were evaluated against the different insect and non-insect pests at different intervals viz. 1 day before spray and 1, 3, 7 and 14 days after spraying to find out the levels of pesticidal efficiency in suppression of the pest population. Three spraying were done at 15 days intervals. The initial population of root knot nematode (RKN) in soil was determined by collecting composite samples. Each was consisting of eight sub-samples covering the entire field just before land preparation. Samples were processed by Cobb's decanting and sieving (Cobb, 1918) followed by modified Baermann's technique (Schindler, 1961). The soil nematode population from each plot was estimated through sampling of rhizosphere of the soil (200 cc) during final harvest of the crop. The level of nematode infestation in each plot was measured by determining the gall index in a 0-5 scale where 0 = No gall, 1 = 1-2 galls, 2 = 3-10 galls, 3 = 11-30 galls, 4 = 31-100, 5 = > 100 galls per plant root system (Taylor and Sasser, 1978). The data obtained in this experiment was statistically analyzed with the help of M-stat and subjected to Duncan's Multiple Range Test. Incremental cost benefit ratio (ICBR) was determined based cost of the seeds, labourers, fertilizers, insecticides, irrigation *etc.* and return was calculated from the market price of harvested fruits over the seasons.

RESULTS AND DISCUSSION

The experimental results based on three seasons from 2007-08 to 2009-10 revealed that the population of fruit fly maggots gradually increased through post-treatment period. In case of leaf roller and epilachna beetle, the treatments had more or less consistent effect on their populations. While mite population was found decreasing trend of excepting of 2008-09 (Fig.1). The result on effectiveness of different treatments revealed that the treatments T_2 (root dip with carbosulfan 25EC and pit application of neem granule at basal + NSKE 5% as foliar spray) and T_4 (application of carbofuran 3G at basal and foliar spray with propergite 7.5%) contained consistently lowest level of fruit fly, epilachna and leaf roller infestation (Fig. 2, 3, 4). Antifeedent effect of neem and long residual activity of carbofuran were probably found to be suppressing the pest population. Adoptions of these treatments also reduced the nematode infestation but were not good enough in terms of enhancement of the yield per hectare (Table 1). The treatments T_6 (root dip with carbosulfan 25EC + vermicompost + *Paecilomyces lilacinus* (PL) at basal + dicofol followed by propergite 7.5% as foliar), T_7 (root dip with carbosulfan 25EC + PL + dicofol) and T_4 (application of carbofuran 3G at basal and foliar spray with propergite 7.5%) were relatively more efficacious in decreasing order (Fig. 5) for managing mite infestation in pointed gourd.

The above findings support the efficacy of aqueous extract of neem seed kernel (NSKE) on the fecundity and post-embryonic development of *Bactrocera cucurbitae* (Shivendra, 2003), on

Table 1: Effect of treatments on root knot nematode (*Meloidogyne incognita*) infesting pointed gourd in West Bengal

Treatment	Gall index (0-5)			Second stage juvenile (J_2)/200 cc soil			Yield (q/ha)			ICBR		
	2007-08	2008-09	2009-10	2007-08	2008-09	2009-10	2007-08	2008-09	2009-10	2007-08	2008-09	2009-10
T_1	2.67bcd	2.00ab	0.89	364	265	99	127.29 (33.13)	192.78(18.79)	331.11(14.44)	6.67	8.23	8.18
T_2	3.23abc	1.77b	0.46	456	298	125	101.93 (6.61)	203.33(25.30)	340.00(17.51)	0.67	5.61	5.02
T_3	2.87abcd	2.22ab	1.00	383	334	97	122.62(28.25)	178.06(9.72)	293.06(1.29)	2.97	2.23	0.38
T_4	3.00abc	1.66b	0.58	496	525	145	112.22(17.37)	205.72(26.77)	328.96(13.69)	2.26	7.57	5.01
T_5	3.33ab	2.00ab	0.33	385	266	92	103.72(8.48)	186.06(14.65)	344.67(19.12)	1.56	5.87	9.91
T_6	2.00d	1.55b	0.22	239	190	65	149.11(55.96)	232.44(43.24)	391.18(35.20)	2.02	3.40	3.58
T_7	2.33cd	1.66b	0.28	287	250	85	133.56(39.69)	212.78(31.12)	371.94(28.55)	2.01	3.44	4.08
T_8	3.67a	2.66a	1.07	572	630	177	95.61	162.28	289.33			
C.D. $_{at\ 0.05}$	0.82	0.64	0.23	-	-	-	25.79	31.82	NS			
S.Em ±	0.27	0.21	0.08	-	-	-	8.50	10.49	26.74			

Figures marked by a common letter are not significantly different according to Duncan's Multiple Range Test at $P < 0.05$; Cost of labour @ Rs. 72/- (2007-08), Rs. 80/- (2008-09) and Rs. 90/- (2009-10) per man-day; Price of pointed gourd @ Rs. 898/- (2007-08), Rs. 1152/- (2008-09) and Rs. 836/- (2009-10) per quintal in local market; NS = Not significant; ICBR = Incremental cost benefit ratio; Figures in parentheses are per cent increase of yield over control.
T_1- Carbosulfan 25EC + Azadirachtin 1%; T_2- Carbosulfan 25EC + Neem granule + NSKE 5%; T_3- Neem granule + NSKE 5%; T_4- Carbofuran + Propergite 7.5%; T_5- Carbosulfan 25EC + Vermicompost + Azadirachtin 1%; T_6- Carbosulfan 25EC + Vermicompost + *Paecilomyces lilacinus* (PL) + Dicofol followed by Propergite 7.5%; T_7- Carbosulfan 25EC + PL + Dicofol; T_8- Untreated control

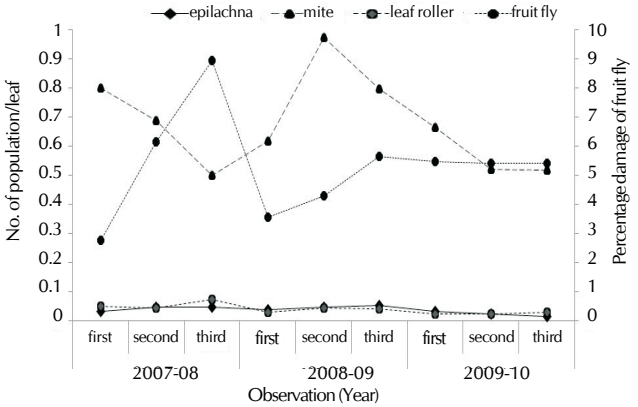

Figure 1: Effect of different treatments on fluctuation of insect pest and mite on pointed gourd

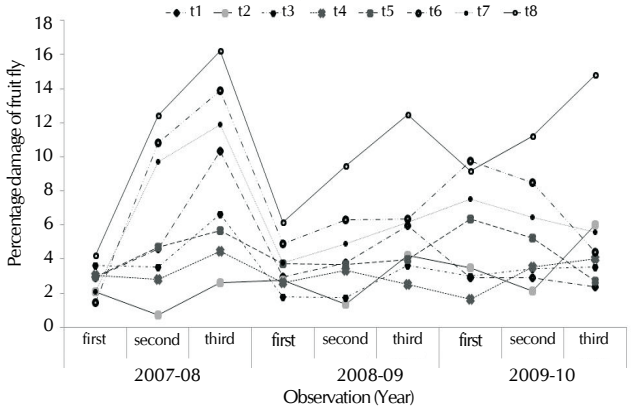

Figure 2: Effect of different treatments on infestation of fruit fly (*Bactrocera cucurbitae* Coq.) on pointed gourd

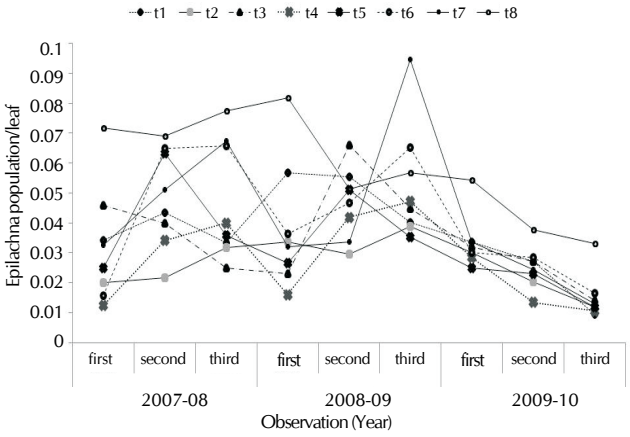

Figure 3: Effect of different treatments on epilachna (*Henosepilachna dodecastigma*) population on pointed gourd

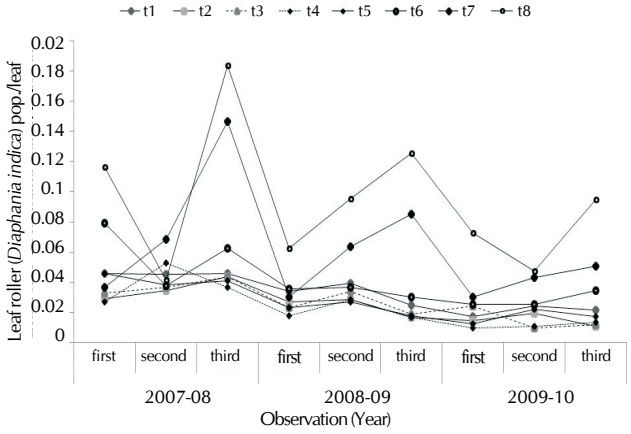

Figure 4: Effect of different treatments on leaf roller (*Diaphania indica*) on pointed gourd

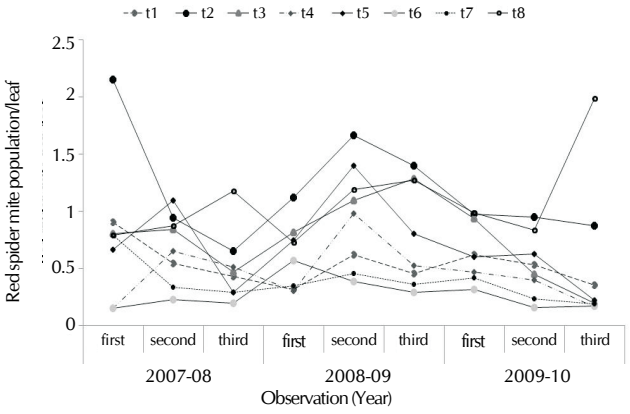

Figure 5: Effect of different treatments on red spider mite (*Tetranychus urticae* Koch.) on pointed gourd

the food consumption of leaf roller and epilachna beetle (Lixu *et al.*, 2002; Mala *et al.*, 2012). Application of carbofuran granules at 1.5 kg *a.i.*/ha at the time of sowing, vining and flowering gave good control against *B. cucurbitae* and *Henosepilachna vigintioctopunctata* on bitter gourd (Thomas and Jacob, 1990; Thomas and Jacob, 1991). Waites and Habeck (1968) also found good control of leaf roller with the application of carbofuran granules on summer squash. Kumar and Singh (2004) reported that the greatest mean level of two spotted spider mite mortality on pumpkin using dicofol and propargite and botanical pesticides. Azadirachtin in neem proved as natural biopesticides with the strongest nematicidal action and its bioefficacy test results on *M. incognita* showed 53.3% mortality at 100ppm after 24h and LC50 (ppm) 55 after 48h of exposure (Devkumar and Goswami, 1992). Neem seed kernel extract (NSKE) showed the greatest second stage juvenile (J_2) mortality to the extent of 77% (Khanna and Kumar, 2006).

The adoption of carbosulfan 25EC + vermicompost + *Paecilomyces lilacinus* (PL) as basal treatment and dicofol 18.5 EC followed by propergite 7.5% as foliar sprays at fifteen days interval (~T_6) provided relatively greater yield (~149.11 q/ha) as compared to untreated plots (~95.61 q/ha) (Table 1). This was obtained during 2007-08 when infestation of root knot nematode (*M. incognita*) was relatively high and the greater yield in the plot treated was primarily due to the efficacy of pre-planting application of carbosulfan, vermicompost and PL. The performance of this treatment was adjudged through reduction of gall index (~2.00) as well as estimation of root knot nematode population (J_2) in soil (~239 J_2/200 cc soil). However, bare root dipping with carbosulfan 25EC + PL +

dicofol 18.5 EC (~T_7), carbosulfan 25EC + azadirachtin 1% (~T_1) and neem granule + NSKE 5% (~T_3) showed no significant difference with T_6 treatment in respect of suppression of nematode infestation. During 2008-09, the nematode population and gall index varied from 190 to 630 per 200 cc soil and 1.55 to 2.66, respectively. Thus T_6 was found to be the most effective in terms of reduction of nematode population (~69.84%) and gall index (from 2.66 to 1.55). The yield obtained from this treatment was relatively good (232.44 q/ha). The results revealed that the plant treated with *Paecilomyces lilacinus* and dicofol 18.5 EC along with root dipping in carbosulfan 25EC (~T_7) and carbosulfan 25EC + neem granule + NSKE 5% (~T_2) gave considerable yield and their gall index was at par with each other. The nematode infestation in the experimental plot was low (Table 1) during 2009-10 and, therefore, impact of root knot nematode was on enhancing fruit yield of pointed gourd was not justified. Our results supported efficacy of bare root dipping with carbosulfan at 0.05% for six hour and soil application of *P. lilacinus* for management of root knot nematode in pointed gourd (Mahapatra *et al.*, 1999). Khan and Verma (2004) also found reduced nematode multiplication and greatest reduction in gall development (88.4%) in the pointed gourd field plots treated with *P. lilacinus*. Further, Mukhopadhyay *et al.* (2006) also found promising results of vines dipping with carbosulfan 25EC at 500ppm for 6h + carbofuran 3G at 2.5 g/pit 45 days after planting for improving yield (up to 36.81%) over untreated control.

Yield component during all the three years of experiment was consistently highest in T_6 (carbosulfan 25EC @ 750ppm + vermicompost @ 2ton/ha + *Paecilomyces lilacinus* @ 1ml/litre as basal treatment and foliar spray of dicofol 18.5 EC @ 3ml/litre followed by propergite 7.5% @ 1mL/litre) treated plots and followed closely by T_7 (carbosulfan 25EC + PL + dicofol 18.5 EC). Both the red spider mite and root knot nematode infestations were recorded lowest and thus contributed favourably to fruit yield. The adoption of T_6 treatment resulted yield increase to the extent of 55.96% in 2007-08, 43.24% in 2008-09 and 35.20% in 2009-10 over untreated control (Table 1). Further, application of T_7 also provided relatively higher yield and was considered to be the next best treatment in terms of enhancement of 39.69% in 2007-08, 31.12% in 2008-09 and 28.55% in 2009-10) of pointed gourd yield (Table 1). Incremental cost benefit ratio (ICBR) was, however, highest in T_1 (ICBR ~ 6.67 in 2007-08, 8.23 in 2008-09 and 8.18 in 2009-10) during first and second year but in T_5 (ICBR ~ 1.56 in 2007-08, 5.87 in 2008-09 and 9.91in 2009-10) in the last year with little difference from T_1 (Table 1). Therefore, adoption of carbosulfan 25EC + azadirachtin 1% (T_1) was found most economical for managing pest complex in pointed gourd. However, increased input cost of T_6 was probably made higher ICBR than T_1. Current approaches of pest management envisage less use of synthetic organic for increased environmental and food safety concerns. Therefore, managing pest by synthetic pesticide alone would not be a worthy proposition in multiple pest situations. Our results clearly indicated also that T_6 would take care for both nematodes and mites in pointed gourd. The nematode egg parasitic fungus, *P. lilacinus* in combination with dicofol and propergite restricted nematode and red spider mite population development on the long duration crop like pointed gourd. The juvenile (J_2) population in untreated control registered increase in the field during second year while their drastic decline was noted during the last year of the experiment. This was an indication of continued action of egg parasitic fungus (*P. lilacinus*). The root knot nematodes and mite problems are potential threat for the pointed gourd growers and, therefore, above pest management options would no doubt help growers for profitable cultivation of the crop in West Bengal.

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