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Management of causal agents of chilli leaf curl complex through bio-friendly approaches

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A B S T R A C T

Chilli leaf curl causes huge crop loss in Sundarban Islands that occurs primarily due to attack of thrips, yellow mites and white fly followed by invasion of chilli leaf curl virus. An attempt was made to find out the cost effective management schedule to minimize the crop loss. Seven treatments were taken up for study including two chemicals i.e. profenophos and diafenthiuron, three ecofriendly approaches i.e. garlic extract, spirit and alternate use of garlic with spirit, one predator insect *Chrysoperla carnea* and untreated control. The lowest population of thrips, mites and white fly was recorded with application of diafenthiuron at 15 days interval from seedling to early fruiting stage. Among the ecofriendly options, alternate use of garlic with spirit performed better than their single repeated use starting from seedling to early fruiting stage at every 15 days interval.

Keywords*:* Chilli leaf curl, mite, thrips, diafenthiuron, garlic extract

Introduction

Chilli is an important commercial crop covering 2.6% of total cultivable *rabi* crop area of Sundarban region of South 24-Parganas district of West Bengal (Anon 2011). It can tolerate salinity to an appreciable extent (Kaliappan and Rajagopal 1970). It can be stored as dry chilli when marketing of green chilli becomes a problem due to poor communication. The area under chilli cultivation is gradually reducing due to alarming incidence of leaf curl complex. Chilli leaf curl complex is usually caused by yellow mite, *Polyphagotarsonemus latus* (Banks) and chilli thrips, *Scirtothrips dorsalis* (Hood). Thrips is presently considered as the most important causal agent for chilli leaf curl complex (Anon 1994). Thrips feed by lacerating epidermal and mesophyll tissues of leaf (Biddle *et al.* 1992; Lewis 1973), thus it causes considerable yield loss to the chilli crop (Fernando & Peiris 1957; Peiris 1953). The farmers often use numbers of chemical pesticides indiscriminately to protect the crop without proper diagnosis of the causal organisms which results in resurgence of the pests, phytotoxicity, destruction of earthworm, killing of pollinator insects and presence of high amount of pesticide residue on harvested fruits. Indiscriminate use of chemical pesticides involves huge cost involvement without providing satisfactory control to this malady. In this context, a low-cost and eco-friendly management schedule is urgently needed. In the present experiment some botanicals, novel pesticides and other eco-friendly pest management practices were tested to develop a suitable eco-friendly management schedule of chilli leaf curl complex to grow a profitable chilli crop in the Sundarban agro-climatic situation.

Materials and Methods

The experiment was carried out at the Instructional Farm of Ramakrishna Ashram Krishi Vigyan Kendra, Nimpith, South 24-Parganas, West Bengal, India. The experiments were conducted for two consecutive years (2010 - 2011) during the rabi-summer season. The experimental plot was laid down in randomized block designs with three replications. Soil of the experimental plot was *(3m* x *4m)* sandy-loam with pH 6.12 and EC_2 0.73 dS/m. Fertility status of the soil was low to medium. The seedlings of 45 days old were transplanted in the main field during first week of January every year with a spacing of 45cm x 45cm. Essential intercultural operations (weeding, staking, time bound irrigation etc.) were carried out as and when required. There were six plant protection Modules tested against one untreated control. Module-1: Spraying of conventional chemical insecticide Profenophos 50EC @ 2 ml/litre of water at 15 days interval from seedling stage to early fruiting stage. Module-2: Application of Diafenthiuron 5WG @ 1g/litre at 15 days interval from seedling stage to early fruiting stage. Module-3: Spraying of Rectified spirit @ 20 ml/litre of water at 15 days interval from seedling stage to early fruiting stage. Module-4: Spraying of garlic extract (100 gm roasted garlic mixed with 50 ml kerosene for overnight and next day it is added with 500 ml water) @ 20 ml/litre of water at 15 days interval. Module-5: Alternate spraying of garlic extract (100 gm roasted garlic mixed with 50 ml kerosene for overnight and next day it was added with 500 ml water) @ 20 ml/litre of water and rectified spirit @ 20 ml/litre of water at 15 days interval. Module-6: Release of *Chrysoperla carnea* grubs @ 2/plant at 15 days interval from seedling stage to early fruiting stage. Control: No plant protection measure was taken.

To study the thrips population five plants were selected randomly from each plot and tagged by a colour tag. A kerosene-water mixture (1:2) was taken in plastic container and placed under the selected plants. Then the twigs were shaken gently upon the container. Thrips were fallen down on the kerosene-water, which were recorded subsequently and finally average was worked out. Mite population was studied taking another five plants, selected randomly from each plot and tagged. Six leaves from each plant taking two each from bottom, middle and top canopy were plucked and kept in properly labeled polyethylene bag. The selected leaves were examined immediately after collection under stereo-binocular microscope for counting the number of mites per leaf. The separate population of white fly, lady bird beetle and spider was recorded by calculating average data from 10 leaves each from five selected tagged plants. Five kinds of colour tags were used separately for five separate insects (thrips, mite, white fly, spider and lady bird beetle). Observations were recorded at seven days interval starting from 14 days after transplanting (DAT) and continued up to last marketable green fruit harvest. First plucking of fruits was made at 65 DAT and successive plucking was done at an interval of 10 days. Yield of each module was calculated by cumulating the successive plucking from respective plots. Thrips and mite infested plants were observed carefully and the symptoms were recorded in different stages of crop growth. Assessment of chilli leaf curl disease was done as per Banerjee and Kalloo (1987). Disease reaction data was recorded during the peak period of fruiting which was usually at 60 - 70 DAT. The percent disease severity and disease intensity grade was calculated by using the following formula:

$$\text{Percent Disease Intensity (PDI)} = \frac{\text{Number of diseased plant (s)}}{\text{Total number of plants observed}} \times 100$$

The coefficient of infection (CI) was calculated by multiplying the PDI with the Response value (RV) assigned to each severity grade. The overall disease reaction was assigned to the coefficient of infection (CI) range as given in the Table below.

Symptom	Symptom severity grade	Response value	Coefficient of infestation	Reaction
Symptom absent	0	0.00	0-4	HR
Very mild curling upto 25% leaves	1	0.25	5-9	R
Curling and puckering of 26-50% leaves	2	0.50	10-19	MR
Curling and puckering of 51-75% leaves	3	0.75	20-39	MS
Severe curling and puckering of >75% leaves	4	1.00	40-69	S
			70-100	HS

Results and Discussion

Nature of symptoms

It has been observed that leaf curl complex occurs primarily due to attack of thrips and yellow mite. Thrips was recorded on the both surface of leaves. It lacerates the epidermis and sucks sap. This small straw coloured insect creates streaky spots upon the infested leaves which curled upward, thickened and crinkled. In severe infestation, margin of the leaves showed burnt appearance and dried up (Fig. 1a). The mites suck sap from leaves, petioles and tender twigs. The margin of the young leaves curled downwards in an inverted boat shaped manner (Fig. 1b). The leaves look shiny, and silvery lining was recorded on the ventral surface. Aged leaves and petioles were found elongated. In severely infested plant, leaves and terminal twigs become hardened, twisted, thickened and in advance stages, get scorched. Infested plant produced very small sized leaves. In such a plant most of the young fruits look silvery and shiny, and in later stage the fruits become cracked and deformed. Besides, bud and flower dropping was also noted. No fruit shedding was observed. The findings are well corroborated with the earlier works of Gerson (1992) and Karmakar (1995).

Disease management

Attempts were made towards management of thrips, mite and white fly which are responsible for leaf curl complex. Overall seven treatments including one untreated control were taken up for the present study. The pooled average lowest population of thrips (0.3/leaf), yellow mite (1.8/leaf) and white fly (0.1/leaf) were recorded with application of diafenthiuron 5WG (Module 2) @ 1g/10litre of water at 15 days interval from seedling stage to early fruiting stage (Fig. 2). Amongst the bio/botanical approaches, Module-5 i.e. combination of garlic extract and rectified spirit performed better. Beneficial insect population (Fig. 3) was highest with a pooled average number of 1.3 and 1.4 per plant for lady bird beetle (LBB) and spider respectively in control treatment followed by Module-6 (per plant LBB- 1 and spider- 1.1) and Module-2 (diafenthiuron spray) (per plant LBB- 0.9 and spider- 0.9). Yield parameters (Fig. 4) like individual fruit weight and fruit diameter recorded least differences with respect to different modules, but fruit length observed significant differences among the modules. Highest yield (194.3 g/plant) and lowest disease incidence (CI- 18.4) was observed with Module-2 followed by Module-1 with yield per plant 168.6 g and CI- 23.6 (Fig. 5). Among non-chemical approaches, Module-3 and Module-5 both proved better with respect to yield per plant but Module-5 was slightly better as it recorded lower value (30.2) of coefficient of infection. Highest net return (0.42 lakh/ha) and highest BC ratio (2.13) was recorded in Module-2 followed by Module-1 with 0.37 lakh/ha and 1.89 respectively, both of which were chemical control measures (Fig. 6). Module-3 and Module-5 were the next successful treatments after the chemical control measures. So, it can be concluded that non-chemical approaches though better from environmental point of view, but were not effective enough to control thrips, yellow mite and in-turn chilli leaf curl complex. Use of diafenthiuron (Module-2) is a cost intensive option than Profenophos (Module-1) application. But the former one is much more environment friendly and IPM-oriented insecticide -acaricide. So, for commercial and profitable crop production, Module-2 is the best option. Module-3 and Module-5 are more eco-friendly and cost-effective pest management options. Among these two, Module-5 proved better. So, in small-scale or domestic crop production system, combination of rectified spirit and garlic extract may be a wise option. This plant protection measure against chilli leaf curl complex may be recommended for any house-hold chilli production system. The more or less similar finding was also reported earlier by other workers (Hosamani 2007; Mondal & Mondal 2012).

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Fig 1. Symptoms of chilli leaf curl : (a) chilli leaf curl by thrips, (b) chilli leaf curl by mites

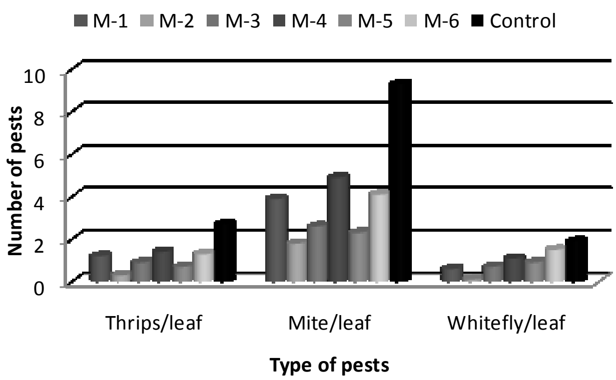

Fig 2. Effect of different modules on pest population

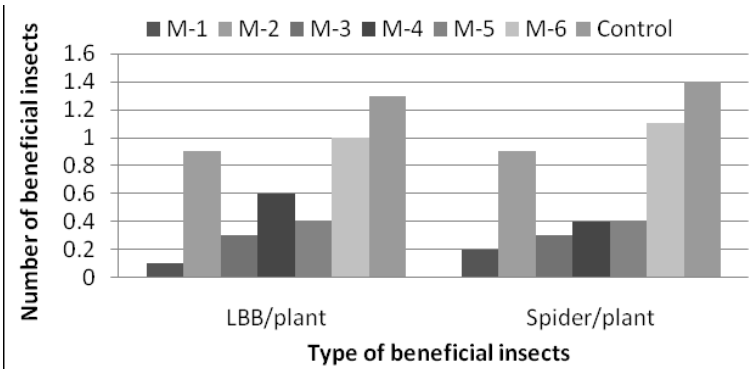

Fig 3. Effect of different modules on beneficial insect pest population

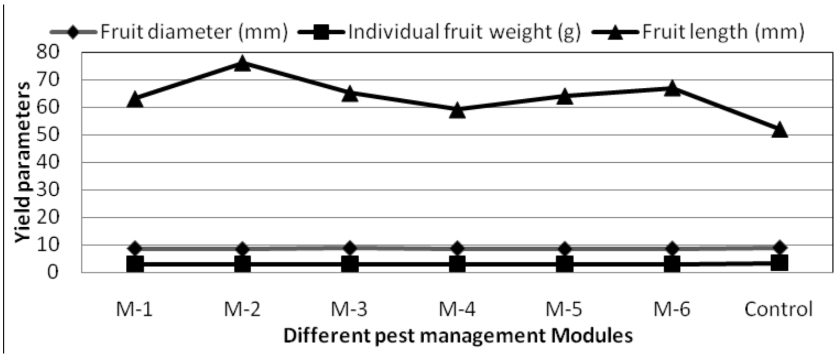

Fig 4. Effect of different modules on yield parameters of chilli

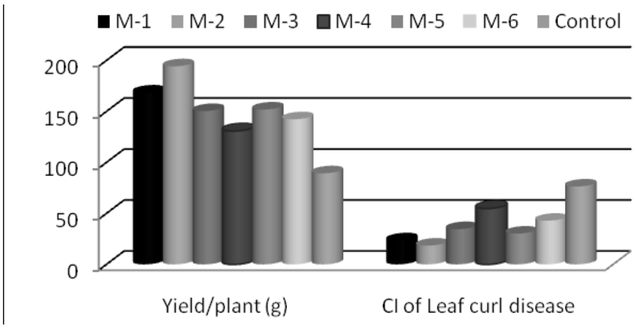

Fig 5. Effect of different modules on yield and disease reaction

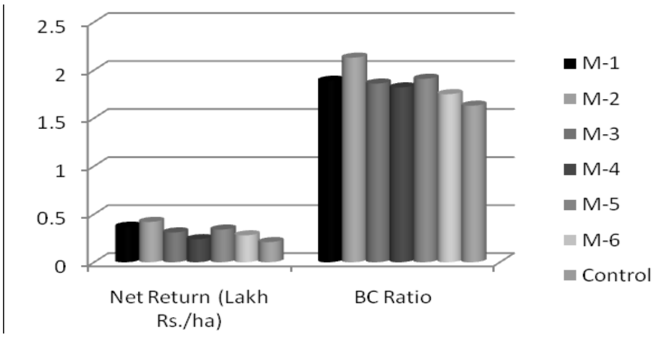

Fig 6. Effect of different modules on net return and BC ratio