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ASSESSMENT OF MANAGEMENT MODULES AGAINST LEAF CURL DISEASE IN CHILLI

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ABSTRACT
Field experiments were carried out during the year 2017 – 18 and 2018 – 19 to assess the different management modules against the leaf curl disease in chilli. The result on efficacy of modules revealed that during both the years of trial all the modules significantly reduced the disease incidence. Module having seed treatment with Imidacloprid 70 WS (10g/Kg seed), destruction of infested plants and spraying with Imidacloprid 17.8 SL (0.3 ml/litre water) exhibited the minimum leaf curl disease incidence (19.5% during the year 2017 – 18 and 18.0% during the year 2018 - 19) in chilli. Maximum yield (138.4 and 124.2 q/ha during the year 2017 – 18, 2018 – 19, respectively) was also observed in the same module.

INTRODUCTION

Chilli (*Capsicum annuum* L.) belongs to the family solanaceae and is one of the most widely cultivated crops grown for the value of its fruits in India. India is rich in maximum diversity of chilli varieties with different quality factors. Besides traditional use of chilli as vegetables, spices, condiments, sauces, and pickles it is used in pharmaceuticals, cosmetics and beverages (Tiwari *et al*., 2005). India is a major producer, exporter and consumer of chillies in the world. However, the average productivity is very low in comparison to other chilli growing countries. The crop is infested by more than 21 insects and non insect pests (Dey *et al*., 2001). Venkatesh *et al*. (1998) reported that chilli leaf curl was caused by leaf curl begomovirus (CLCV) transmitted by white fly (*Bemesia tabaci*) and is one of the major limiting factors in cultivation of crop. Meena *et al*. (2013) also reported white flies along with thrips and aphids as a major pest of chilli. The yield losses due to leaf curl ranged from 25 to 80 per cent (Ilyas and Khan, 1996) in chilli, however in epidemic conditions the yield loss may exceed up to 100 per cent (Senanayake *et al*., 2012). The farmers engaged in cultivation of chilli always give top priority to protect the crop from any type of damage caused by insect pests and others. Pesticides are used as most common tool to combat these insect pests. The farmers often use huge quantity of pesticides to protect the crop without proper diagnosis which has led phytotoxicity on fruits (Joia *et al*., 2001), insecticide resistance, pest resurgence and environmental pollution (Singh and Kumar, 1998). The basic idea of the research problem is to reduce the number of sprays and use of different cultural, botanical and chemical methods in an integrated approach. Similar works were carried out with integrated approach (Kumar and Kumar, 2017, Pandey *et al*., 2017 and Singh *et al*., 2018) in chilli and tomato (Ruth *et al*., 2016). There is need to reduce frequent sprayings to avoid the adverse side effects of chemical insecticides. In this context present study was planned to assess some management modules including chemical, botanical and cultural practices for the vector management of leaf curl disease in chilli.

MATERIALS AND METHODS

The field experiments were conducted during the year 2017 – 18 and 2018 – 19 at 10 farmers' field in the villages Bara and Nemotari of the Godda block by Gramin Vikas Trust – Krishi Vigyan Kendra, Godda (Jharkhand) to find out the efficacy of four management modules against leaf curl disease in chilli under on farm testing (OFT) activity of the KVK (Table 1). The trials were laid out in RBD with 04 management modules and 10 replications (farmers) during both the years. Thirty days old seedlings of chilli (improved variety of pvt. company) were transplanted in 3rd week of November with the spacing 45 x 45 cm in the plot size of 10 x 10 m. All other agronomical practices were followed to raise a good and healthy crop. The 1st spraying was done at 30 DAT (days after transplanting) when the symptoms of chilli leaf curl disease i.e curling of leaves, light and dark green mosaic, vein clearing, puckering of leaflets, stunting and bushy appearance was noticed in the field followed by 2nd and 3rd spraying at 15 days interval.

Data on the incidence of leaf curl disease was recorded by selecting 10 plants randomly from the net plot area in each module and were tagged to record disease incidence at 30 days interval up to harvest/last picking from the day of transplanting (Pandey *et al*., 2017). The per cent disease

incidence was recorded under natural infestation at random in different locations in the field by counting total number of plants and number of plants showing leaf curl disease symptoms using the formula given below (Nene, 1972):

Disease incidence (%) = Number of diseased plants/Total number of assessed plants x 100

Reduction in disease incidence (%) = Disease incidence in farmers' practice – Disease incidence in treated plot/Disease incidence in farmers' practice x 100

Fruit yield of green chilli of each plot were taken separately for each module and calculated by cumulating the successive plucking from respective plots and then converted to q/ha.

The cost incurred on different parameters of agronomic practices viz. nursery management, preparation of land for transplanting, fertilizer application, water management, plant protection, harvesting etc. were pooled to analyze the cost of cultivation. Based on the current price of inputs used and the produce obtained during both the years, the net return/ha and CB (Cost:Benefit) ratio were worked out.

The data collected from the experiments were statistically analyzed according to Gomez and Gomez (1984) to test the level of significance of modules.

RESULTS AND DISCUSSION

The results of the field experiments conducted by GVT – Krishi Vigyan Kendra, Godda revealed that incidence of leaf curl disease in chilli varied from 19.5 to 41.0% in the year 2017 – 18 and 18.0 to 39.4% during the year 2018 – 19 (Table 2). All the management modules caused significant reduction in disease incidence. The per cent leaf curl disease incidence was recorded minimum (19.5% during the year 2017 – 18 and 18.0% during the year 2018 – 19) in M4 (seed treatment with imidacloprid 70WS, 10g/Kg seed, destruction of infested plants and spraying with imidacloprid 17.8 SL, 0.3 ml/litre water) followed by M3 (20.5 and 22.7 % disease incidence during the year 2017 – 18 and 2018 – 19, respectively) in which 1st spraying was done with Boomtet, 1 ml/litre of water, 2nd spraying with Multineem (1500 ppm azadirachtin, 5 ml/ litre of water) and 3rd spraying with Thiomethoxam 25 WG (0.4 g/litre of water), M2 (32.5 and 33.2% in the year 2017 – 18 and 2018 – 19, respectively) having 1st spray with Boomtet (1 ml/litre of water), 2nd and 3rd spray with Diafenthiuron (1.0 g/litre of water) and M1 (41.0 and 39.4% during the year 2017 – 18 and 2018 – 19, respectively) *i.e.* Farmers' practice. The disease incidence recorded in the module M4 and M3 during the year 2017 -18 was found to be at par with each other. When the disease decreased in each module was computed it has been recorded that M4 decreased maximum disease incidence (52.4% during the year 2017 – 18 and 54.3% during the year 2018 – 19) followed by M3 (50.0 and 42.4% during the year 2017 – 18 and 2018 – 19, respectively) and M2 (20.7 and 15.7% during the year 2017 -18 and 2018 – 19, respectively) over farmers' practice (Table 2).

Economic effectiveness of various pest management modules were also evaluated as presented in Table 3. Maximum yield was recorded in the module M4 (138.4 and 124.2 q/ha during the year 2017 – 18 and 2018 – 19, respectively) followed by M3 (126.0 q/ha in the year 2017 – 18 and 120.4 q/ha in the year 2018 – 19), M2 (117.8 and 116.2 q/ha during the year 2017 – 18 and 2018 – 19, respectively) and M1 (110.5 and 101.8 q/ha during the year 2017 – 18 and 2018 – 19, respectively). The yield recorded in different modules differed significantly during both the years. It was also observed that M4 was highest with respect to CB ratio (1:5.12 in the year 2017 – 18 and 1:4.60 in the year 2018 – 19) due to comparatively low plant protection cost and highest fruit yield followed by M3 (1:4.48 and 1:4.28 during the year 2017 – 18 and 2018 – 19, respectively), M2 (1:4.17 and 1:4.11 during the year 2017 – 18 and 2018 – 19, respectively) and M1 (1:3.78 and 1:3.48 during the year 2017 – 18 and 2018 – 19,

Table 1: Details of the pest management modules

Pest Management Modules	Details
M1	Farmers' practice (Injudicious use of pesticides like Cypermethrin, Dimethoate, Dithane M – 45, etc.)
M2	1st spraying with Boomtet (1 ml/litre of water) + 2nd and 3rd spraying with Diafenthiuron (1.0 g/ litre of water)
M3	1st spraying with Boomtet (1 ml/litre of water) + 2nd spraying with Multineem (1500 ppm azadirachtin, 5 ml/litre of water) + 3rd spraying with Thiomethoxam 25 WG (0.4 g/litre of water)
M4	Seed treatment with Imidacloprid 70 WS (10g/Kg seed) + Destruction of infested plants + 3 spraying with Imidacloprid 17.8 SL (0.3 ml/litre of water)

1st spraying was done at 30 DAT followed by 2nd and 3rd at 15 days interval
Boomtet: Natural alkaloids and lactone (0.4%) + Terephenoids and isoflavones (1.6%)

Table 2: Effect of management modules on the leaf curl disease incidence in chilli

Pest Management Modules	Leaf curl disease incidence (%)		Disease decreased over farmers' practice (%)	
	2017 - 18	2018 - 19	2017 - 18	2018 - 19
M1	41	39.4	—-	—-
M2	32.5	33.2	20.7	15.7
M3	20.5	22.7	50	42.4
M4	19.5	18	52.4	54.3
CD (P = 0.05)	2.72	2.37		

Table 3: Economic analysis of leaf curl disease management modules

Pest Management Modules	Yield of green chilli (q/ha)		Total cost of production (Rs/ha) (Rs. 51000/ha without plant protection + Cost of plant protection) for both the years	Gross Return (Rs/ha) (Rs. 2000/q)		Net return (Rs/ha)		CB Ratio	
	2017 - 18	2018 - 19		2017 - 18	2018 - 19	2017 - 18	2018 - 19	2017 - 18	2018 - 19
M1	110.5	101.8	58500	221000	203600	162500	145100	01:03.8	01:03.5
M2	117.8	116.2	56500	235600	232400	179100	175900	01:04.2	01:04.1
M3	126	120.4	56250	252000	240800	195750	184550	01:04.5	01:04.3
M4	138.4	124.2	54030	276800	248400	222770	194370	01:05.1	01:04.6
CD (P = 0.05)	4.86	3.02							

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respectively).

In the present investigation seed treatment with imidacloprid 70 WS (10g/Kg seed), destruction of infested plants and spraying with imidacloprid 17.8 SL (0.3 ml/litre water) provided maximum protection to the chilli crop in terms of lowest leaf curl disease incidence, highest fruit yield and maximum CB ratio. Destruction of diseased plants may be helpful in reducing source of disease in the field because white flies carry the virus from one plant to another and application of imidacloprid checked the population level of vector causing leaf curl problem. Seed/seedling treatment with Imidacloprid, destruction of infested plants and application of Imidacloprid have also been reported effective against leaf curl disease in chilli by Pandey *et al*. (2017). Efficacy of modules having different components and chemicals like planting of maize as border crop + resistant variety + seed treatment with Thiomethoxam + seedling treatment with Imidacloprid + application of Carbofuran/Imidacloprid/Neem oil have also been reported in chilli against leaf curl disease by Kumar and Kumar, 2017 and Singh *et al*.,2018.

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