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Occurrence of fusarium wilt disease and pest population in IPM and Non-IPM fields of chilli *Capsicum annuum* L. in Andhra Pradesh

C Ruth, MN Bhat, HR Sardana, K Gopal and B Srinivasulu

Abstract
An investigation was carried out on evaluation of different integrated pest management (IPM) modules against Fusarium wilt disease and pest complex of chilli for promotion of adaptable IPM Technology under wide area approach at Regadaguduru village, Velugodu mandal, Kurnool district, Andhra Pradesh. The number of IPM interventions were 16 as against 21 numbers of interventions in Non-IPM plot for cultivar Devanur Deluxe, whereas in case of Super-10 cultivar, it was 16 in IPM plots as against 21 in Non-IPM plots. The incidence of Fusarium wilt ranged from 10.85 to 21.82 per cent in IPM plot as against 9.94 to 23.96 per cent in Non-IPM plot. The incidence of wilt started late in the season by October and reached its peak by January. The average seasonal Fusarium wilt incidence was 16.41% in the IPM plots and 17.36% in Non IPM plots. During the year 2014-15. thrips and mites population, aphids and whitefly**,** the fruit borer complex viz; *Helicoverpa armigera* (Hub.), and *Spodoptera litura* (Fab) and natural enemies *viz.*,coccinellids, chrysoperla, spiders and predatory mites were counted *in situ* and expressed in terms of population per plant randomly selected twenty plants in each IPM and non IPM plots of both Devanur Deluxe and Super-10 cultivars. The IPM practices were applied in IPM plots and the pest population was monitored and recorded the observations. In the present investigation, in Devanur Deluxe the peak activity of thrips was noticed during October month with a mean population of 1.27 thrips per leaf in IPM plot while non IPM plot recorded a maximum of 2.64thrips per leaf. In September month IPM plot recorded 1.33 thrips per leaf while non IPM plot recorded 2.70 thrips per leaf, respectively similarly, in Super-10, the peak activity of 2.61 thrips per leaf was noticed in IPM plot and in non IPM plot it was 4.14thrips per leaf. Maximum peak recorded of mite 4.00 per leaf was noticed IPM plot during January while in non IPM plot. It was 3.61 mites per leaf in Devanur Deluxe. However in non IPM plot maximum mite population of 4.30 per leaf was noticed during January month. Similar trend was noticed in Chilli variety Super-10.There was negligible population of aphids and white fly was noticed in IPM and non IPM plot both in Devanur Deluxe and Super-10. Spodoptera activity was less in IPM plot of Devanur Deluxe and Super-10. The activity of fruit borer, *H.armigera* was noticed during December month in both IPM and non IPM plot and maximum larval incidence was noticed during October month in both IPM and non IPM plot of Devanur Deluxe 3.86 and 1.55 larval per plant. Similarly in Super-10 the peak activity of larval noticed at January month 2.66 and 6.90 larval per Plant. In both IPM and non IPM plots of Devanur Deluxe and Super-10 the per cent defoliation was negligible Maximum fruit damage of 6.34 per cent was noticed in IPM Plot of Devanur Deluxe while it was 11.19 per cent in non IPM plot. Predatory population *viz.*, coccinellids and chrysoperla was more in IPM plot compared to Non-IPM plot.

Keywords: IPM, Non IPM, Chilli, Pest Population, Fusarium wilt

Introduction
India is a major producer, exporter and consumer of chillies in the world. It is primarily grown in Andhra Pradesh, Karnataka, Tamil Nadu, Maharashtra, Karnataka and to a small extent in West Bengal, Uttar Pradesh and North East. Chili farming, in particular, has been able to revitalize rural economy through increases in farmers' income, agricultural factor market and

employment (Bhattarai and Mariyono, 2016; Mariyono and Bhattarai, 2011) [3]. India is one of the major producers of chillies in the world with an annual production of 1.4 million tonnes from an area of about 7.75 lakh hectares constituting about 24.21% of Indian spice exports in value (Geetha *et al.*, 2017) [5]. The productivity is much low compared to many western countries owing to higher spectrum of insect pest and diseases prevailing in the growing regions of the country. Major insect pests include mites, thrips, aphids, borers (sucking pests) threatening right from nursery till end of the crop season. Among diseases, powdery mildew, die back and anthracnose, *Cercospora* leaf spot, wilts and rots are important. Under favourable conditions, sucking pests and diseases account for > 50 % yield reduction. Application of chemical insecticide in vegetable is very intensive which accounts for 13-14% of cropped area in India (Bhat, 1984) [2]. It is not uncommon to see farmers in irrigated chilli resorting to 25-40 rounds of chemical sprays in a single season (Anon, 2011) [1]. In many instances, dry chilli export from Guntur market was hit due pesticide residue problem. Repeated use of pesticides on a large scale also indeed led to pest resurgence, insecticide resistance, destruction of natural enemies, secondary pest outbreaks, high cost of production and occurrence of toxic residues in crops and products. Management strategies in vegetables in general and chillies in particular are at cross roads which require popper direction and reorientation. Integrated disease management attempts to use all the known suitable techniques of control to maintain the particular pest population at a level below that which causes economical losses to the crop. Integration of different treatments, including seedling root dip in carbendazim (0.1%), addition of vermicompost, drenching with fungicide (carbendazim+mancozeb 0.2%) and soil application of *Trichoderma viride* was highly effective against Fusarium wilt disease in chilli, which showed 89.8 per cent reduction in the wilt incidence. (Kamaran Khan *et al.*, 2018) [7]

Materials and Methods

A field experiment was conducted at Regadaguduru, Velegodu mandal, Kurnool, (A. P.) in Devanur deluxe & Super 10 cultivars in an area of 10 hactares of 10 farmers. In these fields, adopted the following IPM technology in farmer fields and compared with non-IPM fields. (Fig.1)

a. Application of neem cake @ 2kg, and vermin-compost @ 50 kg per 40 sq.m and treat the nursery beds with fipronil granules 80 g/cent. (Fig.2) b. At sowing time, seed treatment with imidachloprid (Gaucho) @ 0.5 %. Apply Neem cake powder in seed bed @ 1 kg / cent area. Seed treat with *Trichoderma viride* @ 5g /kg seed need – based application of COC @ 0.3 %. c. In nursery, apply imidacloprid @1 ml in 3-4 litres of water or fipronil @ 0.2 % against sucking pests nursery. d. Marigold and castor crops as trap and guard crops. e. Dip the seedling in Imidachloprid 0.03 % and Carbendazim 0.1 % for 5 minutes. f. Installation of pheromone traps and live bird perches 10 traps per acre, 5 for *Helicoverpa* sp. and 5 for *Spodoptera* sp. About 10 bird live perches / acre. g. Install 4 Yellow pan/sticky traps per acre to monitor and control whitefly and thrips. (Fig.4) h. Need based application of Imidachloprid @ 0.03 % or fipronil @ 0.2 % or Spinosad 0.025 % or Pegasus 0.125 % against thrips. i. Collection and destruction of egg masses and larvae of pod borer. J.Trizophous 0.015 % + NSKE 5% @ 0.5 % followed by chloropyriphos @ 0.025 % at flowering/fruiting against blossom Midge. K. *Trichoderma viride* enriched FYM @ 5kg/ha.

Wilt: The wilt disease incidence was assessed in chilli fields by using the formula.

$$\text{Disease incidence (\%)} = \frac{\text{No. of infected plants}}{\text{Total number of units assessed}} \times 100$$

Fig 1: Wilt symptoms in chilli crop at Regadaguduru village

Fig 2: Chemicals used in Chilli IPM plots

Thrips population

Both adults and nymphs were counted *in situ* from three half to fully opened young top leaves from twenty randomly selected plants with the help of 10 X hand lens on both upper and lower surface of leaf and later expressed in terms of number of thrips per leaf.

Mite population

In each plot twenty plants were selected randomly and tagged for observation. Three half to fully opened top leaves were collected in perforated polythene bag of size 16 x 18 cm and the samples were brought to laboratory and examined under 20 X magnification of stereo binocular microscope. Total number of mites from top three young leaves in each plant were counted and expressed in terms of number of mites per leaf.

Fruit borer

Fruit borer complex viz; *Helicoverpa armigera*(Hub.), and *Spodoptera litura* (Fab.) were recorded in field itself. In each plot twenty plants were randomly selected to record observations. In case of *H. armigera* number of larvae per plant were recorded and expressed as larvae per plant, while for *S. litura* at the base of plant a basin of 15 cm diameter was made and number of larvae per basin was recorded and expressed as number of larvae per plant in each plot.

Natural enemies
Natural enemies *viz.,* coccinellids, chrysoperla, spiders and predatory mites were counted *in situ* and expressed in terms of population per plant in randomly selected twenty plants in each IPM and non IPM plots of both Devanur Deluxe and Super-10. (Fig.3)

Fig 3: Natural enemies in chilli IPM plot

Fig 4: Yellow sticky traps in IPM plot

Results and Discussion
Fusarium Wilt incidence
The incidence of wilt root rot ranged from 10.85 to 21.82 per cent in IPM plot as against 9.94 to 23.96 per cent in Non-IPM plot. The incidence of wilt started late in the season by October and reached its peak by January (Table 1). The average seasonal wilt/root rot incidence was 16.41% in the IPM plots and 17.36%in Non IPM plots.

Thrips and Mites population
In Devanur Deluxe the peak activity of thrips was noticed during October month with a mean population of 1.63 thrips per leaf in IPM plot while non IPM plot recorded a maximum of 2.46 thrips per leaf. In November month IPM plot recorded 1.75 thrips per leaf while non IPM plot recorded 3.48 thrips per leaf, respectively (Table 2) similarly, in Super-10, the peak activity of 5.56 thrips per leaf was noticed in IPM plot and in non IPM plot it was 6.98 thips per leaf (Table 5). Maximum peak recorded of mite 4.10 per leaf was noticed IPM plot during January while in non IPM plot it was 5.10 mites per leaf in Devanur Deluxe. However in non IPM plot maximum mite population of 6.45 per leaf was noticed during January month (Table 2). Similar trend was noticed in Chilli variety Super-10 (Table 5).

Aphids and Whitefly
There was negligible population of aphids and white fly was noticed in IPM and non IPM plot both in Devanur Deluxe and Super-10 (Table 2 & 5).

Defoliator, *Spodoptera litura*
Spodoptera activity was less in IPM and more in Non IPM plot of Devanur Deluxe and Super-10 (Table 3 & 6).

Fruit borer, *Helicoverpa armigera*
The activity of fruit borer, *H.armigera* was noticed during December month in both IPM and non IPM plot and maximum larval incidence was noticed during October month in both IPM and non IPM plot of Devanur Deluxe 3.86 and 1.55 larval per plant (Table 3). Similarly in Super-10 the peak activity of larval noticed at January month 2.66 and 6.90 larval per Plant (Table 6).

Foliage and Fruit damage
In both IPM and non IPM plots of Devanur Deluxe and Super-10 the per cent defoliation was negligible (Table 3 & 6). Maximum fruit damage of 5.65 per cent was noticed in IPM Plot of Devanur Deluxe while it was 10.27 per cent in non IPM plot (Table 3).

Predatory population
Predatory population *viz.,* coccinellids and chrysoperla was more in IPM plot compared to Non-IPM plot of Devanur Deluxe and Super-10 (Table 4, 7).
Latha S and Hunumanthraya L studied on integrated management of chilli pest during March of 2015. The results revealed that chilli crop was bordered by double layered shade net with one sprays of all chemicals viz., imidacloprid 17.8 SL @ 0.3 ml/l @ two WAT, clorantraniliprole 18.5 SC @ 0.25 ml/l @ five WAT, flubendiamide 48 SC @ 0.2 ml/l @ seven WAT, spiromesifin 30 SC @ 2ml/l @ nine WAT, spinosad 45 SC @ 0.25 ml/l @ 11 WAT were found to be better and which were on par with seed treatment of imidachloprid 70 WS @ 7g/kg, neem cake @ 250 kg/ha. seedling dip with imidacloprid 17.8 SL @ 0.3 ml/l at the time of transplanting and one sprays of all chemicals viz., azadirachtin 10000 ppm @ 2ml/l @ two, cyantraniliprole 10% OD @1.2 ml/l @ five, L. leacanii @ 2g/l + spinosad 45 SC @ 0.25 ml/l @ seven, M. anisoplea @ 2g/l + spiromesifin 2 ml/l @ nine and flubendiamide 48 SC @ 0.2 ml/l @ 11 WAT. The results pertaining to populations of thrips, mites and fruit borers were significantly different among the treatments. The treatment chemical based module (CBM) recorded significantly lower populations of thrips and mites (0.04 thrips/leaf and 0.28 mites/leaf,
These results were in conformity with Joko Mariyono (2016) revealed that Chili disease control technologies that include crop barrier with corn and Crotalaria, and compost tea have been introduced to farmers in Magelang and Brebes. A qualitative approach was used to assess and estimate the socio-economic impact of agricultural research. According to Bindu madhavi and. Bhattiprolu (2011) [4] i*n vitro* evaluation of nine fungicides by poison food technique showed that tebuconazole and combination of carbendazim+mancozeb were effective in inhibiting the mycelial growth (94.1%). Waseem Ali Dar *et al.* (2018) [12] reported that minimum wilt/root rot incidence (7.0%) and maximum dry fruit yield

74.73 q/ha was recorded in treatment combination of carbendazim (seed treatment) + metalaxyl (seedling dip) + hexaconazole (foliar spray) as compared to other possible combinations and their individual treatments. Manasa *et al.* (2018) [9] narrated that the pesticides are playing a prominent role in the pest management aspect in both agriculture and horticulture crops. But usage of the pesticides is posing severe ecological consequences. Alternative approach consisting of ecofriendly components are safe and is most preferable. In this view, an investigation was carried out on evaluation of different IPM modules against pest complex of chilli and it revealed that, M-I comprised of seedling treatment with raw cow milk (15%) in combination with *Trichoderma* (4g), incorporation of Vermicompost at 2.5t/ha and Neem cake at 2.5q/ha during transplanting, two rows of marigold barrier crop and marigold trap crop (1:16),scheduled spray of Garlic Chilli Kerosene at 5 WAT, Azadirachtin 10000 ppm (1 ml/l) + *Lecanicillium lecanii* (2X108 cfu/ml) at 5 g/l at 9 WAT, Chlorfenapyr 10 EC @ 2 ml/l was most effective by maintaining minimum pest incidence and maximum yield i.e. 32 q/h. Tatagar *et al.* (2011) [16] opined that two rows of maize as a border crop with the combination of Neemazal (1%) @ 2 ml/l and Diafenthiuron 50 WP at 0.75 g/l at 7 and 9 WAT, respectively resulted a least population of thrips (0.30). The border crop blocks the adult thrips into the field and hence influences the pest population.

Margaret C. Gentz *et al.* (2010) [10] reported that selective chemical insecticides have become the dominant approach for management of recalcitrant and resistant insect pests, and the prospects for use of these chemicals in combination with biocontrol agents are on the rise. These chemical compounds, when used in combination with an effective natural enemy, may provide more comprehensive prophylactic and remedial treatments in the context of an integrated pest management program (IPM) than either approach alone. Many of these compounds have promise for a diversity of applications, including sustainable agriculture, control of urban pests, and invasive species eradication. Unfortunately, there are only a limited number of studies in which the effect of these insecticides on natural enemies has been examined. In this article, we examine the risk of several classes of insecticidal compounds to non-target animals, particularly natural enemies and pollinators, and review the most promising compounds for combined deployment with biological agents.

Table 1: Incidence of Wilt disease in IPM and non IPM plot during 2014-15 *kharif* at Regadaguduru Village, Velugodu Mandal, Kurnool District.

Month / week	Date	Per cent disease incidence	
		IPM	Non IPM
October	03.10.2014	03.50	04.05
	10.10.2014	08.80	11.85
	17.10.2014	10.65	11.65
	24.10.2014	14.65	16.95
	31.10.2014	15.65	05.15
Mean		10.85	09.94
November	07.11.2014	06.50	06.92
	14.11.2014	13.80	16.85
	21.11.2014	12.50	13.15
	28.11.2014	19.65	20.65
Mean		13.11	14.39
December	05.12.2014	12.50	12.90
	12.12.2014	19.80	22.85
	19.12.2014	20.50	21.15
	26.12.2014	26.65	27.65
Mean		19.86	21.14
January	02.01.2015	14.50	16.90
	09.01.2015	21.80	26.85
	16.01.2015	22.50	25.15
	23.01.2015	28.65	31.65
	30.01.2015	21.65	18.90
Mean		21.82	23.96
Seasonal Average		16.41	17.36

Table 2: Incidence of sucking insect pests in IPM and Non IPM plots Devanur Deluxe chilli under irrigated ecosystem during-2014-15

Months	Date	IPM Plot				Non-IPM Plot			
		Thrips/Plant	Mites/Plant	Aphids/plant	Whitefly /plant	Thrips/plant	Mites/plant	Aphids/plant	Whitefly /plant
October	03.10.2014	1.60	0.00	0.00	0.00	1.40	0.00	0.00	0.00
	10.10.2014	1.40	0.00	0.00	0.00	1.85	0.00	0.00	0.00
	17.10.2014	1.65	0.00	0.00	0.00	4.40	0.00	0.00	0.00
	24.10.2014	1.55	0.00	0.00	0.00	1.95	0.00	0.00	0.00
	31.10.2014	1.95	0.00	0.00	0.00	2.70	0.00	0.00	0.00
	Mean	1.63	0.00	0.00	0.00	2.46	0.00	0.00	0.00
November	07.11.2014	1.65	0.00	1.33	0.00	3.95	0.00	1.87	0.00
	14.11.2014	1.50	0.00	1.27	0.00	2.85	0.00	1.73	0.00
	21.11.2014	1.85	0.00	0.87	0.00	4.70	0.00	1.60	0.00
	28.11.2014	1.95	0.00	1.27	0.00	2.40	0.00	2.13	0.00
	Mean	1.74	0.00	1.19	0.00	3.48	0.00	1.83	0.00

December	05.12.2014	2.60	1.10	0.67	0.93	5.95	2.10	1.87	1.67
	12.12.2014	2.40	0.85	0.53	1.07	4.85	0.85	1.73	2.07
	19.12.2014	2.65	1.05	0.33	0.73	5.70	1.05	0.53	1.93
	26.12.2014	2.55	1.50	0.60	0.80	3.40	1.40	1.53	1.73
	Mean	2.55	1.13	0.53	0.88	4.98	1.35	1.42	1.85
January	02.01.2015	2.65	3.10	1.20	0.60	4.95	4.10	2.20	1.53
	09.01.2015	2.50	2.85	0.93	0.53	3.85	2.85	1.60	1.47
	16.01.2015	1.00	4.05	1.00	0.73	3.40	4.05	1.33	1.20
	23.01.2015	2.55	2.50	1.13	0.47	1.80	2.40	1.60	1.07
	30.01.2015	1.15	4.10	0.87	1.13	4.95	5.10	1.00	0.73
	Mean	1.97	3.32	1.03	0.69	3.79	3.70	1.55	1.20
February	06.02.2015	1.60	1.85	0.00	0.00	2.95	3.10	0.00	0.00
	13.02.2015	1.40	3.05	0.00	0.00	1.85	1.85	0.00	0.00
	20.02.2015	1.65	1.50	0.00	0.00	5.40	3.05	0.00	0.00
	27.02.2015	1.55	3.10	0.00	0.00	1.20	1.40	0.00	0.00
	Mean	1.55	2.38	0.00	0.00	2.85	2.35	0.00	0.00
March	06.03.2015	2.10	0.00	0.00	0.00	4.95	0.00	0.00	0.00
	13.03.2015	1.85	0.00	0.00	0.00	3.85	0.00	0.00	0.00
	20.03.2015	1.50	0.00	0.00	0.00	4.70	0.00	0.00	0.00
	27.03.2015	1.80	0.00	0.00	0.00	2.40	0.00	0.00	0.00
	Mean	1.81	0.00	0.00	0.00	3.98	0.00	0.00	0.00

* Average of 20 plants

Table 3: Incidence of defoliators and fruit borers in IPM and Non IPM plots with Devanur Deluxe chilli under irrigated ecosystem during-2014-15

Months	**Date**	***Spodopteralitura*/meter length**		***Helicoverpaarmigera*/plant**		**Foliage Damage**		**Fruit Damage**	
		IPM Plot	**Non -IPM Plot**	**IPM Plot**	**Non -IPM Plot**	**IPM Plot**	**Non -IPM Plot**	**IPM Plot**	**Non -IPM Plot**
October	03.10.2014	0.00	0.00	0.00	0.00	5.84	6.92	3.25	2.95
	10.10.2014	0.00	0.00	0.00	0.00	4.51	5.53	2.30	1.85
	17.10.2014	2.20	5.07	3.24	9.95	3.48	4.78	2.45	5.40
	24.10.2014	1.92	4.79	2.96	7.83	1.55	3.51	3.50	2.45
	31.10.2014	1.76	4.63	2.80	6.53	0.00	2.02	2.55	9.95
	Mean	1.18	2.90	1.80	4.86	3.08	4.55	2.81	4.52
November	07.11.2014	1.49	4.36	2.53	7.82	0.00	0.00	3.50	6.35
	14.11.2014	1.68	4.55	2.72	6.61	0.00	0.00	4.80	9.68
	21.11.2014	1.42	4.29	2.46	5.94	0.00	0.00	5.65	7.65
	28.11.2014	1.33	4.20	2.37	7.02	0.00	0.00	4.65	10.27
	Mean	1.48	4.35	2.52	6.85	0.00	0.00	4.65	8.48
December	05.12.2014	1.35	4.22	2.39	6.82	0.00	0.00	2.90	2.95
	12.12.2014	1.21	4.08	2.25	5.31	0.00	0.00	1.85	3.05
	19.12.2014	1.17	4.04	2.21	4.95	0.00	0.00	1.80	3.45
	26.12.2014	1.37	4.24	2.41	5.99	0.00	0.00	2.10	2.95
	Mean	1.28	4.15	2.32	5.77	0.00	0.00	2.16	3.10
January	02.01.2015	1.27	4.14	2.31	5.77	0.00	0.00	0.00	0.00
	09.01.2015	1.46	4.33	2.50	7.86	0.00	0.00	0.00	0.00
	16.01.2015	1.61	4.48	2.65	7.22	0.00	0.00	0.00	0.00
	23.01.2015	1.51	4.38	2.55	6.20	0.00	0.00	0.00	0.00
	30.01.2015	1.59	4.46	2.63	5.84	0.00	0.00	0.00	0.00
	Mean	1.49	4.36	2.53	6.58	0.00	0.00	0.00	0.00
February	06.02.2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	13.02.2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	20.02.2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	27.02.2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
March	06.03.2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	13.03.2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	20.03.2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	27.03.2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

* Average of 20 plants

Table 4: Predatory population in IPM and Non IPM plot with Devanur Deluxe chilli under irrigated ecosystem during-2014-15

Months	Date	IPM Plot				Non-IPM Plot			
		Coccinellids	Chrysoperla	Spiders	Predatory mites	Coccinellids	Chrysoperla	Spiders	Predatory mites
October	03.10.2014	0.19	0.00	0.65	0.00	0.14	0.00	2.25	0.00
	10.10.2014	0.24	0.24	0.50	0.00	0.19	0.19	0.80	0.00
	17.10.2014	0.24	0.19	0.80	0.00	0.19	0.14	0.95	0.00
	24.10.2014	0.19	0.19	0.90	0.00	0.14	0.14	1.30	0.00
	31.10.2014	0.14	0.24	1.50	0.00	0.19	0.19	1.20	0.00
	Mean	0.20	0.17	0.87	0.00	0.17	0.13	1.30	0.00
November	07.11.2014	0.19	0.14	0.40	0.24	0.14	0.00	1.75	0.19
	14.11.2014	0.24	0.29	0.50	0.39	0.19	0.24	0.55	0.34
	21.11.2014	0.19	0.19	0.60	0.54	0.14	0.14	0.65	0.49
	28.11.2014	0.24	0.24	0.55	0.39	0.29	0.19	1.45	0.34
	Mean	0.22	0.22	0.51	0.39	0.19	0.14	1.10	0.34
December	05.12.2014	0.14	0.29	0.20	0.64	0.00	0.24	0.70	0.59
	12.12.2014	0.24	0.24	0.25	0.34	0.19	0.19	0.45	0.29
	19.12.2014	0.19	0.19	0.15	0.24	0.14	0.14	0.60	0.19
	26.12.2014	0.19	0.19	0.15	0.29	0.14	0.14	1.05	0.24
	Mean	0.19	0.23	0.19	0.38	0.12	0.18	0.70	0.33
January	02.01.2015	0.19	0.20	0.00	0.37	0.15	0.16	0.00	0.32
	09.01.2015	0.24	0.19	0.00	0.00	0.19	0.14	0.00	0.00
	16.01.2015	0.19	0.24	0.00	0.00	0.14	0.19	0.00	0.00
	23.01.2015	0.19	0.24	0.00	0.00	0.24	0.19	0.00	0.00
	30.01.2015	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	0.19	0.17	0.00	0.07	0.14	0.14	0.00	0.06
February	06.02.2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	13.02.2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	20.02.2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	27.02.2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
March	06.03.2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	13.03.2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	20.03.2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	27.03.2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

* Average of 20 plants

Table 5: Incidence of sucking insect pests in IPM and Non IPM plots with Super-10 chilli hybrid under irrigated ecosystem during-2014-15

Months	Date	IPM Plot				Non-IPM Plot			
		Thrips/Plant	Mites/Plant	Aphids/plant	Whitefly /plant	Thrips/plant	Mites/plant	Aphids/plant	Whitefly /plant
October	03.10.2014	4.60	0.00	0.00	0.00	3.40	0.00	0.00	0.00
	10.10.2014	4.40	0.00	0.00	0.00	3.85	0.00	0.00	0.00
	17.10.2014	4.65	0.00	0.00	0.00	6.40	0.00	0.00	0.00
	24.10.2014	4.55	0.00	0.00	0.00	3.95	0.00	0.00	0.00
	31.10.2014	2.95	0.00	0.00	0.00	4.70	0.00	0.00	0.00
	Mean	4.23	0.00	0.00	0.00	4.46	0.00	0.00	0.00
November	07.11.2014	4.65	0.00	1.67	0.00	5.95	0.00	1.87	0.00
	14.11.2014	4.50	0.00	1.40	0.00	4.85	0.00	1.99	0.00
	21.11.2014	4.85	0.00	1.33	0.00	6.70	0.00	1.60	0.00
	28.11.2014	4.95	0.00	1.33	0.00	4.40	0.00	2.44	0.00
	Mean	4.74	0.00	1.43	0.00	5.48	0.00	1.97	0.00
December	05.12.2014	5.60	3.20	1.27	1.40	7.95	1.05	1.87	1.80
	12.12.2014	5.40	2.80	1.13	1.07	6.85	1.25	1.73	1.93
	19.12.2014	5.65	3.45	0.47	1.09	7.70	2.70	0.53	1.87
	26.12.2014	5.55	3.60	1.33	0.73	5.40	3.00	1.60	2.20
	Mean	5.56	3.26	1.05	1.08	6.98	2.00	1.43	1.95
January	02.01.2015	5.65	5.20	1.87	0.73	6.95	5.00	2.20	1.67
	09.01.2015	5.55	4.80	1.33	0.93	5.85	3.05	1.60	1.87
	16.01.2015	4.00	6.45	1.13	1.00	5.40	4.25	1.73	1.20
	23.01.2015	5.55	4.60	1.80	1.07	3.10	3.70	1.60	1.73
	30.01.2015	4.15	6.20	0.87	0.87	6.15	6.00	1.28	1.40
	Mean	4.97	5.45	1.40	0.92	5.49	4.40	1.68	1.57
February	06.02.2015	4.60	3.80	0.00	0.00	4.95	4.00	0.00	0.00
	13.02.2015	4.40	5.45	0.00	0.00	3.85	2.05	0.00	0.00
	20.02.2015	4.65	3.60	0.00	0.00	7.40	3.25	0.00	0.00
	27.02.2015	4.55	5.20	0.00	0.00	1.70	2.70	0.00	0.00
	Mean	4.57	4.51	0.00	0.00	4.48	3.00	0.00	0.00
March	06.03.2015	5.10	0.00	0.00	0.00	6.95	0.00	0.00	0.00
	13.03.2015	4.85	0.00	0.00	0.00	5.85	0.00	0.00	0.00
	20.03.2015	4.50	0.00	0.00	0.00	6.70	0.00	0.00	0.00
	27.03.2015	4.80	0.00	0.00	0.00	4.40	0.00	0.00	0.00
	Mean	4.81	0.00	0.00	0.00	5.98	0.00	0.00	0.00

* Average of 20 plants

Table 6: Incidence of defoliators and fruit borers in IPM and Non IPM plots with Super-10 chilli hybrid under irrigated ecosystem during-2014-15

Months	Date	*Spodopteralitura*/meter length		*Helicoverpaarmigera*/plant		Foliage Damage		Fruit Damage	
		IPM Plot	Non -IPM Plot	IPM Plot	Non -IPM Plot	IPM Plot	Non -IPM Plot	IPM Plot	Non -IPM Plot
October	03.10.2014	0.00	0.00	0.00	0.00	6.88	7.58	6.25	2.75
	10.10.2014	0.00	0.00	0.00	0.00	5.63	6.47	5.30	4.95
	17.10.2014	3.66	6.35	5.06	10.39	5.21	5.72	5.45	3.85
	24.10.2014	2.93	5.62	4.32	9.02	3.93	3.83	6.50	7.40
	31.10.2014	3.31	5.90	3.72	7.99	2.55	3.31	5.55	11.15
	Mean	1.98	3.57	2.62	5.48	4.84	5.38	5.81	6.02
November	07.11.2014	2.59	6.27	3.99	8.92	0.00	0.00	6.50	6.95
	14.11.2014	2.51	6.19	3.91	7.80	0.00	0.00	7.80	4.85
	21.11.2014	2.88	5.57	4.28	7.13	0.00	0.00	8.65	8.40
	28.11.2014	2.97	5.66	3.38	8.84	0.00	0.00	7.63	2.05
	Mean	2.74	5.92	3.89	8.17	0.00	0.00	7.66	2.56
December	05.12.2014	3.17	5.86	3.58	7.92	0.00	0.00	5.90	4.95
	12.12.2014	2.76	5.55	4.16	6.79	0.00	0.00	4.85	3.05
	19.12.2014	2.36	6.04	3.76	6.23	0.00	0.00	4.80	4.75
	26.12.2014	2.38	6.16	3.88	7.36	0.00	0.00	5.10	3.05
	Mean	2.67	5.90	3.85	7.08	0.00	0.00	5.16	3.95
January	02.01.2015	2.67	5.90	3.85	7.07	0.00	0.00	0.00	0.00
	09.01.2015	3.28	5.97	3.69	9.32	0.00	0.00	0.00	0.00
	16.01.2015	2.80	5.49	4.20	8.86	0.00	0.00	0.00	0.00
	23.01.2015	2.79	5.48	4.19	7.66	0.00	0.00	0.00	0.00
	30.01.2015	2.60	6.28	3.91	7.12	0.00	0.00	0.00	0.00
	Mean	2.83	5.82	3.97	8.01	0.00	0.00	0.00	0.00
February	06.02.2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	13.02.2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	20.02.2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	27.02.2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
March	06.03.2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	13.03.2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	20.03.2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	27.03.2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

* Average of 20 plants

Table 7: Predatory population in IPM and Non IPM plot with Super-10 chilli hybrid under irrigated ecosystem during-2014-15

Months	Date	IPM Plot				Non-IPM Plot			
		Coccinellids	Chrysoperla	Spiders	Predatory mites	Coccinellids	Chrysoperla	Spiders	Predatory mites
October	03.10.2014	0.23	0.00	2.75	0.00	0.18	0.00	0.80	0.00
	10.10.2014	0.28	0.28	2.15	0.00	0.23	0.23	0.95	0.00
	17.10.2014	0.28	0.23	2.75	0.00	0.23	0.18	1.20	0.00
	24.10.2014	0.23	0.23	3.30	0.00	0.18	0.18	2.90	0.00
	31.10.2014	0.18	0.28	1.50	0.00	0.23	0.23	3.25	0.00
	Mean	0.24	0.20	2.49	0.00	0.21	0.16	1.82	0.00
November	07.11.2014	0.23	0.18	1.40	0.28	0.18	0.00	2.65	0.23
	14.11.2014	0.28	0.33	1.50	0.43	0.23	0.28	0.55	0.38
	21.11.2014	0.23	0.23	1.60	0.58	0.18	0.18	0.65	0.53
	28.11.2014	0.28	0.28	1.55	0.43	0.33	0.23	2.05	0.38
	Mean	0.26	0.26	1.51	0.43	0.23	0.17	1.48	0.38
December	05.12.2014	0.18	0.33	1.20	0.68	0.00	0.28	1.10	0.63
	12.12.2014	0.28	0.28	1.25	0.38	0.23	0.23	0.45	0.33
	19.12.2014	0.23	0.23	1.15	0.28	0.18	0.18	0.60	0.23
	26.12.2014	0.23	0.23	1.15	0.33	0.18	0.18	1.25	0.28
	Mean	0.23	0.27	1.19	0.42	0.15	0.22	0.85	0.37
January	02.01.2015	0.23	0.24	0.00	0.41	0.19	0.20	0.00	0.36
	09.01.2015	0.28	0.23	0.00	0.00	0.23	0.18	0.00	0.00
	16.01.2015	0.23	0.28	0.00	0.00	0.18	0.23	0.00	0.00
	23.01.2015	0.23	0.28	0.00	0.00	0.28	0.23	0.00	0.00
	30.01.2015	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	0.23	0.21	0.00	0.08	0.18	0.17	0.00	0.07
February	06.02.2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	13.02.2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	20.02.2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	27.02.2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
March	06.03.2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	13.03.2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	20.03.2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	27.03.2015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

* Average of 20 plants

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