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Field performance of newer insecticide Chlorfenapyr 240 SC, cyantraniliprole 10.26% OD and Dimethoate 30% EC against Tomato Whitefly (*Bemisia tabaci*) in Madhya Pradesh

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Abstract
Investigations were conducted in College of Agriculture, Indore (Madhya Pradesh) to assess the performance of newer insecticide Chlorfenapyr 240 SC, Cyantraniliprole 10.26% OD and Dimethoate 30% EC against whitefly in tomato. The experiment consisted of eight treatments laid out in randomized block design replicated three times with spacing of 60 x 45 cm. All the alternate sprays of newer insecticides were found significantly superior over the untreated control. Among the various treatments the maximum reduction in insect number was calculated in T_5-Chlorfenapyr 240 SC @ 480 ml/ha (91.66%) followed by T_4- Chlorfenapyr 240 SC @ 288 g *a.i.* /ha(88.16%), T_6-Cynantraniliprole 10.26%OD 100 ml/ha (87.16%), T_7-Dimethoate 30% EC @ 150 gm/ha (84.81%) T_3-Chlorfenapyr 240 SC @ 240 g *a.i.*/ha (84.57%) and T_2-Chlorfenapyr 240 SC @ 192 g *a.i.*/ha (84.17%). The minimum reduction in population of whitefly was found in T1-Chlorfenapyr 240 SC @ 144 g a.i./ha (83.36%). The higher fruit yield also recorded in T5-Chlorfenapyr 240 SC @ 480ml/ha (32 t/ha) followed by T4-Chlorfenapyr 240 SC @ 288 ga.i./ha (27 t/ha).

Keywords: Whitefly, chlorfenapyr, Cyantraniliprole, dimethoate, tomato

Introduction
Tomato (*Lycopersicon esculentum* Miller) belongs to the Solanaceae family. Tomato is one of the most important "protective food" because of its special nutritive value. It is one of the most versatile vegetable with wide usage in Indian culinary tradition. Tomatoes are used for soup, salad, pickles, ketchup, puree, sauces and in many other ways. It is also used as a salad vegetable. It is a rich source of vitamin 'C' and many minerals like calcium, potassium, magnesium and phosphorus. It is also called as 'Poor Man's Orange'. Tomato has very few competitors in the value addition chain of processing.

Present world production of tomato is about 100 million tonnes. Fresh fruits produced on 3.7 M ha area. India ranks third in the area and second in production of tomato, after China. In India It is grown in 0.76 M ha area with 18.39 MT production and 16.1 MT/ha productivity. The major tomato producing states are Karnataka, Bihar, Uttar Pradesh, Maharashtra, Madhya Pradesh and West Bengal (Anonymous 2016) [1]. Madhya Pradesh is endowed with favorable climatic and soil conditions for cultivation of tomato with an area of 0.07 m ha, approximate production of 1.94 m MT and productivity of 29.5 MT/ha, Production of tomato is concentrated in Ratlam, Indore, Khargone, Indore, Jhabua, Ujjain, Sagar, Raisen, Bhopal, Shahjapur, Jabalpur, Chhindwara, Satna, Vidisha and Bhopal during 2016 (Anonymous, 2016) [2].

Tomato crop is mainly infested by insect pests like fruit borer, leaf miner, white fly and mites. The white fly, Bemisia tabaci Gennadius (Hemiptera: Aleurodidae) is a widely distributed polyphagous pest in tropical and subtropical regions of India. Both adult and nymph suck the cell sap from phloem by secreting honey dew. This causes weakening and dryness of plants. Indirect damage caused by B. tabaci to plant by transmitting leaf curl virus. (Khan and Ahmad 2005) [8].

Objectives
1. To assess the bio efficacy of Chlorfenapyr with different doses against tomato whitefly.
2. To obtain the fruit yield for economic assessment.

Material and Methods

The studies entitled "Assessment of impact of Chlorfenapyr 240 SC against Whitefly of Tomato" carried out in Rabi season of 2016-17 at experimental site of Horticulture field no 5, College of Agriculture, Indore (M.P.). The present experiments were carried out on medium black cotton soil of the College of Agriculture, Indore having a uniform topography. Tomato Hybrid Pahuja 508 was transplanted on 8th November, 2016 with 60 x 45 cm spacing. Insecticidal spray was started at the ETL of insects @ 500 liter water per hectare with knapsack sprayer fitted with a flood jet nozzle. The eight treatments consist of Five doses of chlorfenapyr 240 sc @ 144, 192, 240, 288 and 480 g.a.i.ha-1, Cyantraniliprole 10.26% OD @ 90 g.a.i. ha-1 and Dimethoate 30% EC @ 200g.a.i. ha-1 including untreated control were sprayed thrice at 10 days interval. Whitefly population was counted one day before and 1st, 3rd, 5th, 7th and 10th days after each spray from five randomly selected plants of each plot and population were counted on per plant. Per cent population reduction was calculated for each spray, averaged for three sprays and finally overall population reduction was calculated. Thus, data obtained from the observations for each character were tabulated and analysed statistically.

Result and Discussion

It was revealed that the data on count of whitefly showed non-significant difference among different plots before the application of treatments. The population of whitefly ranged from 11.06 to 13.55. After first spray the Overall maximum reduction in insect number was recorded in T5-Chlorfenapyr 240 SC @ 480ml/ha (68.85%), T4-Chlorfenapyr 240 SC @ 288 g a.i./ha (66.61%) followed by T6-Cynantraniliprole 10.26%OD 100 ml/ha (61.03%), T2-Chlorfenapyr 240 SC @ 192 g a.i./ha (53.70%), T3-Chlorfenapyr 240 SC @ 240 g a.i./ha (48.16%), T7-Dimethoate 30% EC @ 150 gm/ha (46.41%), T1-Chlorfenapyr 240 SC @ 144 g a.i./ha (40.05%). The similar findings was also recorded after second spray repeatedly in the highest dose OF T5-Chlorfenapyr 240 SC @ 480 ml/ha (62.79%) followed by T3-Chlorfenapyr 240 SC @ 240 g a.i./ha (58.13%), T6-Cynantraniliprole 10.26%OD 100ml/ha (55.29%), T4-Chlorfenapyr 240 SC @ 288 g a.i./ha (51.24%), T2-Chlorfenapyr 240 SC @ 192 g a.i./ha (45.28%), T7-Dimethoate 30% EC @ 150 gm/ha (42.68%) and T1-Chlorfenapyr 240 SC @ 144 g a.i./ha (42.66%). After third spray the maximum reduction in insect number was calculated in T5-Chlorfenapyr 240 SC @ 480 ml/ha (91.66%) followed by T4- Chlorfenapyr 240 SC @ 288 g a.i. /ha(88.16%), T6-Cynantraniliprole 10.26%OD 100 ml/ha (87.16%), T7-Dimethoate 30% EC @ 150 gm/ha (84.81%) T3-Chlorfenapyr 240 SC @ 240 g a.i./ha (84.57%), T2-Chlorfenapyr 240 SC @ 192 g a.i./ha (84.17%) and T1-Chlorfenapyr 240 SC @ 144 g a.i./ha (83.36%). Various workers reported the effectiveness of Chlorfenapyr 240 SC, Cyantraniliprole 10.26% OD and Dimethoate 30% EC against Whitefly of Tomato. Ditya *et al.* (2010) reported that chlorfenapyr belongs to pyrrole group of insecticides and used as a broad spectrum insecticide cum acaricide for the control of whiteflies, thrips, caterpillars, mites, leaf miners, aphids, etc. in chilli. Kumar and Singh (2014) [9] reported that chlorfenapyr gave nymphal mortality of greenhouse whitefly which ranged from 32 to 88 per cent. Xue (2012) tested this insecticide against M. persicae and recorded LC50 of 14.34 mg/l on vegetables. The efficacy of chlorfenapyr was reported by these workers on other crops than tomato hence these findings are in partial agreement with the present study.

Further, effectiveness of cyantraniliprole against tomato white fly Bemisia tabaci was reported by various workers. Mandal (2012) [12] reported that cyantraniliprole 10% OD @ 90 and 105 g a.i./ ha was highly effective in controlling the white fly, Bemisia tabaci on tomato crop. Govindappa *et al.* (2013) [6] resulted that cyantraniliprole 10 OD at 60 and 75 g a.i./ha was more effective in reducing the whitefly at first and final observation with the least whitefly population. Civolani *et al.* (2014) [4] reported that the cyantraniliprole was a useful new tool for producers to protect tomato plants from damage by B. tabaci. Kwon and Youn (2014) [11] investigated that cyantraniliprole showed effect of anti-feeding or avoidance to B. tabaci. Choi *et al.* (2016) [3] investigated that cyantraniliprole showed 51.0% mortality with recommended doses on tomato whitefly adults and observed average effective on tomato crop. Patel *et al.* (2014) [13] revealed that the two higher doses of cyantraniliprole 10% OD i.e. 90 and 105 g a.i.ha-1 was found highly effective in managing the population of whitefly in cotton. Karthik *et al.* (2017) [7] determined that cyantraniliprole 10% OD at 90 g a.iha-1 was effective when sprayed twice at 15 days interval, minimized the sucking pests population of cotton crop. The findings of these researchers are in closeness with the present investigation as they found the higher effectiveness of cynantraniliprole on mainly tomato and later on other crops.

The effectiveness of dimethoate was also reported by various workers against tomato white fly (Bemisia tabaci). Shivanna *et al.* (2011) [14] reported that dimethoate 30 EC was most effective on whitefly in cotton. Yadav *et al.* (2015) [15] revealed that dimethoate (0.03%) proved the most effective against sucking insect pests whitefly, Bemisia tabaci (Genn.) of cluster bean Cyamopsis tetragonoloba (Linn.). Kumar *et al.* (2017) [10] reported that dimethoate 30 EC @ 500 mlha-1 was recorded less effective to reduce the white fly population. These findings are in partial association with the present investigation as they found the higher effectiveness of dimethoate on other crops than tomato but due to its mode of action the efficacy might be justified.

Table 1: Effect of insecticidal treatments on *Bemisia tabaci*

Treatments	Dose g *a.i.* /ha	Pre-treatment count	Whitefly population/leaf					Population Reduction (%)	% overall reduction
			1 Das	3 Das	5 DAS	7 Das	10 Das		
T_1-Chlorfenapyr 240 SC	144	3.80 (2.07)	1.70 (1.48)	1.76 (1.50)	1.80 (1.52)	1.83 (1.53)	1.93 (1.56)	49.21	83.36
T_2-Chlorfenapyr 240 SC	192	3.25 (1.94)	1.13 (1.27)	1.17 (1.29)	1.23 (1.31)	1.53 (1.42)	2.03 (1.59)	37.53	84.17
T_3-Chlorfenapyr 240 SC	240	2.42 (1.70)	0.78 (1.13)	0.81 (1.14)	0.89 (1.17)	1.15 (1.28)	1.72 (1.49)	28.92	84.57
T_4-Chlorfenapyr 240 SC	288	2.16 (1.68)	0.56 (1.04)	0.58 (1.05)	0.70 (1.11)	1.02 (1.23)	1.57 (1.44)	27.31	88.16
T_5-Chlorfenapyr 240 SC	480	1.57 (1.44)	0.31 (0.90)	0.31 (0.90)	0.42 (0.96)	0.62 (1.06)	1.13 (1.28)	28.02	91.66

T_6-Cyantraniliprole 10.26% OD	99	2.28 (1.67)	0.76 (1.12)	0.71 (1.10)	0.93 (1.19)	1.12 (1.27)	1.68 (1.48)	26.31	87.16
T_{7-} Dimethoate 30% EC	200	3.64 (2.04)	1.45 (1.40)	1.51 (1.42)	1.56 (1.44)	1.59 (1.45)	1.80 (1.52)	50.54	84.81
T_8-Untreated control		14.42 (3.86)	14.45 (3.86)	14.45 (3.86)	14.47 (3.86)	14.55 (3.87)	14.61 (3.88)		
S Em±		-	0.07	0.07	0.07	0.06	0.06		
CD at 5% (p=0.05)		NS	0.20	0.21	0.21	0.18	0.17		
CV %		-	7.64	7.66	7.55	6.36	5.55		

Yield and Economics

Findings revealed that obtained marketable fruit yield was noted highest inT5- hlorfenapyr 240 SC @ 480 ml/ha (32.00 t/ha) followed by T4-Chlorfenapyr 240SC @ 288 g a.i/ha (27.00 t/ha), T3-Chlorfenapyr 240 SC @ 240 g a.i/ha (25.33 t/ha), T6-Cyantraniliprole 10.26% OD @ 99 g a.i/ha (24.67 t/ha), T2-Chlorfenapyr 240 SC @192 g a.i/ha (24.24 t/ha), T1-Chlorfenapyr 240 SC @144 g a.i/ha (23.84 t/ha) T7-Dimethoate 30% EC @ 200 g a.i/ha (20.00 t/ha) and T8-untreated check (14.10 t/ha).

Table 2: Effect of newer insecticides molecules on marketable Fruit yield of Tomato

Treatments	Dose g *a.i.*/ha	Dose gm or ml/ha	t/ha
T_1-Chlorfenapyr 240 SC	144	600	23.84
T_2-Chlorfenapyr 240 SC	192	800	24.24
T_3-Chlorfenapyr 240 SC	240	1000	25.33
T_4-Chlorfenapyr 240 SC	288	1200	27.00
T_5-Chlorfenapyr 240 SC	480	2000	32.00
T_6-Cyantraniliprole 10.26% OD	90	900	24.67
T_{7-} Dimethoate 30% EC	200	600	20.00
T_8-Untreated control			14.10
S Em±			0.09
CD at 5% (p=0.05)			0.27

Conclusion

The present study concluded that maximum reduction in population was observed in treatment Chlorfenapyr240 SC @ 480 ml/ha. Under untreated control minimum population reduction was found. The marketable Okra fruit yield was recorded higher in higher dose of Chlorfenapyr 240 SC @ 480 ml/ha followed byT4-Chlorfenapyr 240SC @ 288 g a.i/haandT3-Chlorfenapyr 240 SC @ 240 g a.i/ha as compared to untreated control.

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