Entomology

Evaluation of chilli germplasm against, yellow mite, *Polyphagotarsonemus latus* (Banks) (Acari: Tarsonemidae)

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Abstract

To record the incidence of *P. latus*, the seeds of fourteen chilli hybrids; 10/CHIhyb-2, 10/CHIhyb-6, 10/CHIhyb-11, 10/CHIhyb-5, 10/CHIhyb-7, 10/CHIhyb-9, 10/CHIhyb-3, 10/CHIhyb-12, 10/CHIhyb-10, 10/CHIhyb-16, Kashi Anmol, 9/CHIhyb-4, 9/CHIhyb-8 and 9/CHIhyb-10 were sown in nursery beds under natural conditions from June, 2013 to November, 2013 in the Research Farm Area, Department of Vegetable Sciences, CCS Haryana Agricultural University, Hisar (Haryana) following standard agronomical practices. The field was divided into plots of 3m × 2.7m with spacing 60 cm × 45 cm. Plots were made as per requirement of experiment design. Transplanting of plants was done in the month of August. The plants were continuously monitored in unprotected conditions and these were naturally attacked by *P. latus*. Screening of chilli hybrids were initiated with the appearance of the pest on the crop. In the present investigation, mites were encountered only on ventral surface of chilli leaves. During the study period, the fourteen chilli hybrids exhibited wide difference in population of *P. latus* (2.53 to 6.28 mites per leaf), however, none of them was found immune to this pest. Among the hybrids, maximum population developed on hybrid 10/CHIhyb-7 (6.28 mites/leaf) followed by 5.70 mites/leaf on 10/CHI Hyb-6; both were statistically comparable with each other but significantly higher than population recorded on other hybrids. Least number of mites, 2.97 and 2.53 mites/ leaf was observed in hybrid 9/CHI Hyb-10 and 9/CHI Hyb-8 hybrids, respectively as compared to other hybrids.

Keywords: chilli, germplasm, *Polyphagotarsonemus latus*, screening

1. Introduction

Chilli, *Capsicum annum* L. (Family: Solanaceae) is one of the most important condiment and vegetable crop having immense commercial dietary and therapeutic values, cultivated all over India. In India, chilli is cultivated in an area of 775 thousand hectares and the production was estimated at 1492 thousand metric tones in 2013-14 (IHD, 2014). A number of limiting factors could be attributed to the low productivity. The various factors are responsible for low yield of chilli, among which, insect and mite pests are of prime importance which significantly affects both the quality and production of chilli. Among various destructive sucking pests, yellow mite (*Polyphagotarsonemus latus* Banks) (Acarina: Tarsonemidae) and thrips (*Scirtothrips dorsalis* Hood) (Thripidae: Thysanoptera) are noted to be of much devastating causing yield loss to the tune of 12 to 90% at national level and also responsible for leaf curl malady (Rai *et al.*, 2014) [9]. They have got some bio-ecological advantages than the other pests, due to having very small size, high biotic potential, lack of effective natural enemies, capacity to adopt newer environment quickly and quick resistance development against toxicants (Venkateshalu, 2009) [15]. They cause a havoc economic loss each year and have become a threat to the chilli growers (Sarkar *et al*., 2013) [12]. The yield losses due to infestation of both these pests are estimated to the tune of 35 to 60% (Desai *et al*., 2007) [4]. Therefore, the present scenario reveals that use of insect tolerant crops is economically, ecologically and environmentally advantageous. Selection of tolerant germplasm can be alternative control measure against the yellow mite. Screening of chilli genotypes for sources of resistance against yellow mites was reported by several workers in India (Singh and Pandey, 2015; Bala *et al*., 2016) [13, 1]. In the present investigation, efforts were made to screen some germplasm lines of chilli against yellow mite based on visible leaf symptoms.

2. Materials and Methods

2.1 Study Area

Supervised and systematic field experiment was carried out in the Research Farm Area, Department of Vegetable Sciences, CCS Haryana Agricultural University, Hisar (Haryana) during *kharif* season from June 2013 to November 2013.

2.2 Experimental Layout

Field trials were laid out in Randomized Block Design (RBD) with three replications. Fourteen chilli hybrids (10/CHIhyb-2, 10/CHIhyb-6, 10/CHIhyb-11, 10/CHIhyb-5, 10/CHIhyb-7, 10/CHIhyb-9, 10/CHIhyb-3, 10/CHIhyb-12, 10/CHIhyb-10, 10/CHIhyb-16, Kashi Anmol, 9/CHIhyb-4, 9/CHIhyb-8 and 9/CHIhyb-10) were utilized for screening against yellow mite, *P. latus*. Seedlings were raised in nursery beds and 30 days old seedlings of different genotypes were transplanted in the plot of 3.0m x 2.7m with a spacing of 60 cm between rows and 45 cm between plants on manually dug small pits in each plot on raised beds. A light irrigation was applied immediate after transplanting to prevent “transplanting shock” or wilting of

transplanted seedlings. All recommended agronomic package of practices free from pesticide application were adopted for raising the crop.

2.3 Observations Taken

Mite population were counted from 6 leaves per plant of randomly selected 10 plants per plot. Two leaves from each stage (top, middle and bottom) per plant were collected in separate labelled poly bags, one bag for each plant in the morning of each sampling day. Samples were taken weekly during the nursery period up to harvesting (last week of November, 2013). All the collected leaves from the field brought to the Acarology laboratory for counting the number of mites. Examination of mite infested leaves was done with the help of Stereo Zoom Binocular Microscope. From both surface (dorsal and ventral) mite number was counted from per replicate. Observations on the eggs and mobile population of mites per leaf were recorded. The observations were continued till the crop was terminated. Screening of chilli hybrids were initiated with the appearance of the pest on the crop. On the basis of population, hybrids were categorized as least susceptible, slightly susceptible, moderately susceptible and highly susceptible.

2.4 Statistical Analysis

All statistical analyses were carried out by using software 'OPSTAT', developed at the Computer Centre, College of Basic Sciences and Humanities, CCS Haryana Agricultural University, Hisar was used for the analysis. To know the least/highly susceptible hybrid and peak period of mite incidence, Critical Differences (CD) were calculated at 5 percent level of significance between fourteen hybrids, observation period and *P. latus* population by using three factorial CRD.

3. Results & Discussion

The average data is presented in Tables 1 and 2 revealed that none of the chilli hybrids were found free from infestation by yellow mite. There exist significant differences between different chilli genotypes in terms of incidence of yellow mites per leaf in all the observation.

3.1 Susceptibility of chilli hybrids to *P. latus* Infestation

The data pertaining to three factorial experiments (hybrid × observation period × mite stage) is presented in Table 1. All the hybrids were susceptible to *P. latus* infestation but susceptibility was found to significantly vary with the observation period. Statistical analysis depicted a significant effect of hybrid on population build up of *P. latus* on chilli (CD= 0.74; p=0.05). In the present study, results revealed that maximum population developed on hybrid 10/CHIhyb-7 (6.28 mites/leaf) followed by 5.70 mites/leaf on 10/CHI Hyb-6; both were statistically comparable with each other but significantly higher than population recorded on other hybrids. To isolate yellow mite resistant sources, field investigations were also carried out on 77 chilli cultivars; out of them only nine chilli entries LlC 19, LCA 312, YAM, LlC 13, LCA 235, Cluster mutant, LCA 330, EC 128946 and LlC 45 were categorized as resistant cultivars against chilli yellow mite (Khalid, 2001). In other hybrids, *P. latus* population was 5.56, 5.44, 5.34, 5.30, 4.82, 4.75, 4.25, 4.11, 4.03, 3.44, 2.97 and 2.53 mites/ leaf on, 10/CHI Hyb-10, 10/CHI Hyb-11, 10/CHI Hyb-12, 10/CHI Hyb-2, 10/CHI Hyb-9, 10/CHI Hyb-16, 10/CHI Hyb-3, 10/CHI Hyb-5, Kashi Anmol, 9/CHI Hyb-4, 9/CHI Hyb-8 and 9/CHI Hyb-10 hybrids, respectively. The latter two hybrids recorded lowest mite incidence in the present study and were statistically at par with each other. In earlier studies, LEC 7, UC 8, UC 45 (Sanap *et al.,* 1985) [11] and LEC 1, Kalyanpur Red, X-068, X204, Golikalyanpur, 309-1-1-15, 300-1-15-1, 5-118, 635 and 565 (Tewari *et al.,* 1985) [14] were found tolerant chilli cultivars for yellow mite under field conditions. Similarly, 21-8, IHR-243-1-1-15, Musalvadi selection (Borah, 1987) [2] and HD 16, HD 12 (Depestre and Gomez, 1995) [3] were promising genotypes against mite incidence. In Brazil, the accessions BGH/UFV 1774 (*C. annuum*) and BGH/UFV 5086 (*C. frutescens*) were ranked as resistant and highly resistant to *P. latus,* respectively under severe testing conditions (Echer *et al*., 2002) [5]. Impala cultivar was found to be more resistant to *P. latus* population showing 0.64 adults and 7.57 immature stages/ leaf in a study conducted by Montasser *et al*. (2011) [8] in Egypt. Samanta *et al*. (2017) [10] recorded highest mean population of yellow mites on chilli hybrid 2011/CHYB-8 (6.79 mites/leaf) and lowest mean population of yellow mites was found on the genotype 2012/CHYB-11 (2.16 mites/leaf).

At 5.00 to 7.00 mites/leaf, most of the replicated plants showed downward curling within first fortnight of transplanting. When the results on population build up of *P. latus* over fortnightly observations were compared, a significant effect of observation period was recorded (CD= 0.48; p=0.05) (Table 1). Irrespective of the hybrid, the mite number was found to significantly increase with each observation period till the attainment of peak in population in second fortnight of October (9.54 mites/ leaf), which afterwards showed a gradual decline to the lowest count of 0.92 mites/leaf on second fortnight of November. On all the hybrids, *P. latus* laid significantly higher number of eggs (4.99eggs / leaf) which can be seen with pooled means of both stages, respectively (CD= 0.28; p= 0.05) (Table 1). Irrespective of hybrid and observation period, number of mobile stages was significantly less (4.23 mites/ leaf) than the number of eggs laid by *P. latus* on chilli hybrids. Fortnightly observations on the population build up of *P. latus* on chilli revealed a significant interaction between hybrids and mite stages (CD= 1.05; p= 0.05).

A significant interaction was recorded between observation period and mite stages (CD= 0.68; p= 0.05). Concurrent of the results above recorded from top, middle and bottom leaf, mite population was found to significantly increase till the attainment of peak in each hybrid. With increase in observation period, corresponding increase in *P. latus* population was witnessed in various chilli hybrids which showed significant difference with mite numbers at all observation periods (CD= 1.81; p= 0.05). Three factor interactions were also observed between hybrids, observation periods and mite stages which showed hybrid wise, increase/ decrease in mite numbers was statistically significant with each other in all the observation periods.

In the present investigation, the fourteen chilli hybrids exhibited wide difference in population of *P. latus* (2.53 to 6.28 mites per leaf), however, none of them was found immune to this pest (Table 1). Hybrids 9/CHI Hyb-10, 9/CHI Hyb-8 and 9/CHI Hyb-4 sheltering lowest mite populations (2.53, 2.97 and 3.44 mites/leaf, respectively) was marked the least

susceptible hybrid (Table 2). On the basis of symptoms also, these hybrids were considered as a least susceptible against *P. latus*. Likewise, Kashi Anmol, 10/CHIhyb -3, 10/CHIhyb -5 and 10/CHIhyb -16 (4.1 to 4.8 mites/leaf) were categorized as slightly susceptible whereas, 10/CHIhyb-2, 10/CHIhyb-9, 10/CHIhyb-10, 10/CHIhyb-11 and 10/CHIhyb-12 (4.9 to 5.6 mites/leaf) were identified as moderately susceptible chilli hybrids (Table 2) and 10/CHI Hyb-6 and 10/CHI Hyb-7 (5.7 to 6.4 mites per leaf) were categorized as highly susceptible hybrids. Montasser *et al*. (2011) [8] screened six pepper cultivars *viz.*, Godyon, Khyrate, Qaha, Impala, Mandy and Hora against *P. latus* adult and immature populations. It was observed that Mandy (1.55 adults, 9.79 immature stages/ leaf) and Khyrate (1.28 adults, 10.08 immature stages/ leaf) were more susceptible than other cultivars.

Table 1: Population build up of *Polyphagotarsonemus latus* on various chilli hybrids at different duration

Hybrid (H)	1st Fortnight September (OP)			2nd Fortnight September (F)			1st Fortnight October (OP)			2nd Fortnight October (OP)			1st Fortnight November (OP)			2nd Fortnight November (OP)			Mean (H × MS)		Pooled mean (H)
	Mite Stage (MS)		Mean OP ×H	Mite Stage (M S)		Mean F×H	Mite Stage (M S)		Mean OP ×H	Mite Stage (M S)		Mean OP ×H	Mite Stage (M S)		Mean OP ×H	Mite Stage (M S)		Mean OP ×H	E	M	
	E	M		E	M		E	M		E	M		E	M		E	M				
9/CHIhyb– 4	4.67	2.67	3.67	3.33	1.33	2.33	3.00	3.00	3.00	5.67	8.67	7.17	3.00	5.33	4.17	0.33	0.33	0.33	3.33	3.56	3.44[b,c]
9/CHIhyb– 8	2.33	4.00	3.17	2.00	2.33	2.17	3.00	1.00	2.00	4.33	6.67	5.50	2.33	6.00	4.17	0.00	1.67	0.84	2.33	3.61	2.97[a,b]
9/CHIhyb-10	3.00	3.00	3.00	2.33	2.33	2.33	2.67	2.67	2.67	3.33	3.34	3.34	3.00	3.00	3.00	1.00	0.67	0.84	2.56	2.50	2.53[a]
10/CHIhyb–2	5.00	5.33	5.17	4.33	5.00	4.67	4.00	3.00	3.50	17.3	9.00	13.17	1.67	7.00	4.34	0.67	1.33	1.00	5.50	5.11	5.30[e]
10/CHIhyb–3	5.00	4.00	4.50	6.00	4.33	5.17	3.67	3.67	3.67	5.67	6.33	6.00	5.00	4.33	4.67	1.00	2.00	1.50	4.39	4.11	4.25[d]
10/CHIhyb–5	3.33	4.00	3.67	4.33	3.67	4.00	3.67	1.33	2.50	10.7	8.67	9.67	3.00	5.67	4.34	1.00	0.00	0.50	4.34	3.89	4.11[c,d]
10/CHIhyb–6	5.00	3.67	4.34	5.33	7.00	6.17	6.33	3.33	4.83	12.7	11.7	12.17	7.00	4.67	5.84	1.33	0.33	0.83	6.28	5.12	5.70[f]
10/CHIhyb–7	7.00	4.67	5.84	8.67	3.67	6.17	6.00	2.00	4.00	13.7	17.0	15.34	4.66	7.00	5.83	0.67	0.33	0.50	6.78	5.78	6.28[f]
10/CHIhyb–9	5.00	5.00	5.00	6.33	4.67	5.50	5.33	3.00	4.17	8.67	8.66	8.67	5.83	3.67	4.75	1.00	0.67	0.84	5.36	4.28	4.82[d]
10/CHIhyb10	7.00	4.33	5.67	7.00	2.33	4.67	2.67	4.67	3.67	12.7	13.3	13.01	5.66	4.67	5.17	2.00	0.33	1.17	6.17	4.94	5.56[e]
10/CHIhyb-11	5.67	2.67	4.17	7.33	5.33	6.33	6.00	2.00	4.00	11.3	10.0	10.67	7.00	6.33	6.67	0.67	1.00	0.84	6.33	4.56	5.44[e]
10/CHIhyb–12	6.33	4.67	5.50	5.67	3.00	4.34	3.67	3.33	3.50	12.7	7.67	10.17	9.33	4.67	7.00	1.33	1.67	1.50	6.51	4.17	5.34[e]
10/CHIhyb–16	7.00	1.67	4.34	7.00	3.00	5.00	2.67	5.67	4.17	10.7	8.33	9.50	5.33	3.34	4.33	1.67	0.67	1.17	5.73	3.78	4.75[d]
Kashi Anmol	3.00	2.67	2.84	5.00	4.33	4.67	3.00	1.00	2.00	9.67	8.67	9.17	3.67	5.33	4.50	1.00	1.00	1.00	4.22	3.83	4.03[c]
Mean (F × MS)	4.95	3.74		5.33	3.74		3.98	2.83		9.93	9.14		4.75	5.07		0.98	0.86				
Pooled mean (OP)			4.35[a]			4.54[a]			3.41			9.54			4.92			0.92			
Pooled mean (MS)																			4.99	4.23	

MS= mite stage; E= egg stage; M= mobile stage; Values with the same superscript do not differ significantly; C.D. for Hybrid (H) =0.74, SE(m) = 0.27; C.D. for Observation Period (OP)=0.48, SE(m)= 0.17; C.D. for Mite Stage (MS)=0.28, SE(m)=0.10; C.D. for Interaction OP × H = 1.81, SE(m)=0.65; C.D. for Interaction H × MS = 1.05, SE(m)=0.38; C.D. for Interaction OP × MS = 0.68, SE(m)=0.25; C.D. for Interaction H × OP × MS =2.56, SE(m)=0.92

Table 2: Susceptibly reaction of some chilli hybrids to *Polyphagotarsonemus latus*

SI. No.	Reaction category	Population of mites/leaf	Hybrid(s) identified
1	Least susceptible	1.0 - 4.0	9/CHIhyb-4, 9/CHIhyb-8, 9/CHIhyb-10
2	Slightly susceptible	4.1 - 4.8	Kashi Anmol, 10/CHIhyb-3, 10/CHIhyb-5, 10/CHIhyb-16
3	Moderately susceptible	4.9 - 5.6	10/CHIhyb-2, 10/CHIhyb-9, 10/CHIhyb-10, 10/CHIhyb-11, 10/CHIhyb-12
4	Highly susceptible	5.7 - 6.4	10/CHIhyb-6, 10/CHIhyb-7

4. Conclusion

The outcomes of the present investigation suggested that chilli hybrid 9/CHIhyb-8 and 9/CHIhyb-10 can be taken as promising source of resistance or tolerant against yellow mite, *P. latus* (Banks) owing to less susceptibility against mite incidence and resultant leaf curl and could be exploited in the resistance breeding programme. While the extremely susceptible hybrids *viz*., 10/CHIhyb-7 and 10/CHIhyb-6 can be taken for management study or evaluating control strategies.

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