



E-ISSN: 2320-7078

P-ISSN: 2349-6800

JEZS 2019; 7(3): 1374-1380

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Received: 23-03-2019

Accepted: 25-04-2019

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Screening of chilli accessions against chilli thrips *Scirtothrips dorsalis* Hood (Thysanoptera: Thripidae)

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Abstract

Selection of an efficient, simple and accurate screening method is important in a varietal evaluation programme. The objective of this study was to evaluate reaction of chilli accessions to thrips infestation. Chilli thrips *Scirtothrips dorsalis* population number and per cent leaf curl were most suitable in separating the difference of chilli accessions. The accessions viz., EC-596952, EC-390033 and EC-391082 were least preferred by the insect pest and colonized few thrips (43.40 to 45.20 thrips / 10 terminal) and two accessions viz., EC-599976 and EC-599994 were highly susceptible to the pest incidence. The leaf curl index was taken on 50, 70 and 90 days after transplantation. The accessions such as EC-596952, EC-391082 and EC-390033 showed least per cent leaf curl index whereas, accessions EC-599976 and EC-599994 recorded highest per cent leaf curl index.

Keywords: Chilli thrips, leaf curl index, accessions, *Scirtothrips dorsalis*, leaf terminal

1. Introduction

Chilli is an important commercial crop of India, cultivated for vegetable, spice and industrial (oleoresin and capsaicin extraction) purposes [1]. Over 20 insect species in chillies from India of which thrips (*Scirtothrips dorsalis*), mites (*Polyphagotarsonemus latus*) and aphids (*Aphis gossypii* and *A. craccivora*) are among the most damaging pests [2]. Among the sucking insect pests, chilli thrips *S. dorsalis* Hood (Thripidae: Thysanoptera) is considered as the most serious and important pest as it attacks the crop from nursery till the harvest of the crop. Chilli thrips multiply appreciably at a faster rate during dry weather periods and causes yield loss of 30 to 50 per cent in South India [3] and sometimes may cause more than 90 per cent yield reduction [4]. Due to variation in the agro climatic conditions of different regions, the nature and extent of damage caused by thrips varies. Environmental factors play an important role in determining the seasonal abundance and damage caused by the insect pests. Hence it is necessary to study the influence of various abiotic factors effecting the population fluctuation of thrips species in chilli crop. These studies would give an idea about the peak period of their activity which in turn may be helpful in developing better pest management strategies. Due to mono culture of chilli over a period of time, the pest buildup of *S. dorsalis* has increased enormously and the farmers are resorting to a minimum of 5-6 chemical sprays. In addition to this the increased pesticidal sprays become a threat to chilli ecosystem causing resurgence of pests and menace to natural enemies. Pesticide residues in chilli are also of great concern for domestic consumption and exports as well. It is therefore imperative to resort to other alternative pest management strategies such as use of resistant varieties. It is important to screen the varieties for resistance/susceptibility to pest infestation. For developing resistant cultivars, the germplasm lines with known sources of resistance should be available so that they can be utilized in the breeding programme [5]. To control these pests, frequent application of excessive and indiscriminate use of several insecticides causes heavy environmental pollution and health hazards along with pest resurgence problems which ultimately increases the cost of cultivation without giving satisfactory production. To overcome this menace, host plant resistance can play a key role in formulating alternative pest management strategies. Therefore, an alternative method by introducing or determining the use of resistant varieties that may contain different chemical substances to detoxify these insect's attack will be one of main component to be added in IPM as an environmental friendly pest management approaches.

2. Materials and Methods

Screening of thirteen chilli accessions viz., EC-390033, EC-391082, EC-391087, EC-596952, EC-596958, EC-599957, EC-599959, EC-599967, EC-599976, IC-599994, IC-284474, IC-570343 and IC-572470 along with one resistant check (Pusa Jwala) and susceptible check (LCA-334) to chilli thrips *S.dorsalis* was taken up under field conditions at ICAR-National Bureau of Plant Genetic Resources (NBPGR), Regional station Hyderabad during *Kharif*, 2014-15.

The accessions were raised in pots and 35 days old healthy seedlings were transplanted in the main field with a plot size of 4 m × 5 m on 20th September 2014. The planting was done with a row to row and plant to plant spacing of 60 cm. Each accession was transplanted in two rows of 6 m length each row with 10 plants. Three replications were maintained for each treatment. The treatments were planted in a randomized block design. All recommended package of practices were followed except plant protection measures.

2.1. Collection of thrips species from chilli leaves

It is very difficult to take the population counts of the thrips species in the field as they are very minute, very active and inhabit the young terminal leaves. Hence for taking the thrips counts and identifying different species inhabiting the leaves, young terminals were collected from ten plants of each quadrat as described by Amin *et al.* (1981) [6]. The thrips species inhabiting the terminal leaves were collected in 250 ml plastic containers containing 70% ethyl alcohol filled to half of its capacity. Thus 10 samples from each quadrat were collected at weekly intervals. After collecting the samples, the labels containing the information about the date of observation and the quadrat from which the samples were collected were written and pasted on the container.

2.2. Separation of thrips from leaves

The chilli leaves collected in 70% ethyl alcohol solution were brought to the Laboratory. To collect the thrips present inside the leaves, they were transferred to 500 ml beaker separately and to the samples 30% ethyl alcohol was added till they immersed completely and washed 3 to 4 times in 30% ethyl alcohol solution and then the solution was poured in to a big petridish (13 cm) by retaining the sample in the beaker. The thrips were collected from the alcohol solution with the help of pointed tip of pauster pipette fitted with a rubber bulb on the other end to draw the thrips from the alcohol solution into the pipette. The thrips specimens collected in the pipette were transferred into a glass vial (5 cm × 1 cm) containing 70% ethyl alcohol. After collecting the samples, the labels containing the information about the date of observation and the quadrat from which the samples were collected were written and pasted on the container. The upward curling symptoms caused by thrips on leaves were recorded based on visual rating scale of 0-4 at 50, 70 and 90 days after transplantation [7]. During the crop growth period various morphological parameters like plant height, number of fruits per plant, fruit length and yield were recorded in all the test accessions.

Damage Score	Extent of damage
0	healthy foliage
1	<25% foliage showing thrips curling symptoms
2	26 to 50% foliage showing thrips curling symptoms
3	50 to 75% foliage showing thrips curling symptoms
4	>75% foliage showing thrips curling symptoms

Based on the leaf curl symptoms the percent leaf curl index (PLI) was calculated for each accession as per the formula given by Niles (1980) [8].

$$\text{Per cent Leaf curl Index (PLI)} = \frac{\text{Sum of scores of all plants}}{\text{Total no of plants} \times \text{No. of score category}} \times 100$$

Based on the PLI, the accessions were classified into 6 categories on 0-100 scale as described by Niles (1980) [8].

PLI	Category
0	Highly resistant
1-10	Resistant
11-20	Moderately resistant
21-30	Moderately susceptible
31-50	Susceptible
51-100	Highly susceptible

3. Results and Discussion

3.1. Screening of chilli accessions for resistance against *S. dorsalis* under field conditions

In the present studies an attempt was made to screen 13 chilli accessions along with one resistant and one susceptible check for their reaction to thrips under field conditions during *Kharif*, 2014. The performance of the accessions was assessed based on thrips population counts and leaf curl symptoms caused by them. The results obtained from the studies are presented in tables 1-3.

3.1.1. Screening of chilli accessions against *S. dorsalis* population under field conditions

The thrips population recorded on different chilli accessions ranged from 43.40 to 66.09 thrips / 10 terminals. Among the accessions significantly lowest population of thrips was observed on EC-596952 (43.40 thrips / 10 terminals), EC-390033 (43.65 thrips / 10 terminals) and EC-391082 (45.20) on par with resistant check Pusa Jwala (45.66 thrips / 10 terminals) and it is followed by IC-572470 (53.47 thrips / 10 terminals). Highest density of *S. dorsalis* population was recorded from EC-599976 (66.09 thrips / 10 terminals) but population significantly was less when compared to the susceptible check LCA 344 (84.30 thrips / 10 terminals). The thrips population observed in EC-599994 (61.5 thrips / 10 terminals), EC-599957 (63.31 thrips / 10 terminals), EC-596958 (62.29 thrips / 10 terminals), EC-599959 (60.68 thrips / 10 terminals) and EC-570343 (60.17 thrips / 10 terminals) were on par with each other. Thrips population observed in IC-284474 (58.24 thrips), EC-599967 (58.88 thrips) and EC-391087 (59.10 thrips) were on par with each other. The population counts recorded during different standard weeks indicated that the population was present throughout the crop growth period. Though the population was less during the initial stages i.e. during 45th (1.07 thrips) and 46th (3.43 thrips) std. weeks, it gradually increased thereafter and reached to peak population during 2nd std. week (121.94 thrips / 10 terminals) which continued with II week of January. The population did not decrease even at the end of the crop growth period and during 7th and 8th std. weeks also it recorded 98.99 and 84.28 thrips / 10 terminals, respectively Table -1.

The interaction effect of accessions and the standard weeks showed the highest population of thrips were recorded in IC-570343 (154.40 thrips), EC-596958 (153.20 thrips) and IC-284474 (150.27 thrips) during 2nd std. week to the susceptible check LCA 334 (176.40 thrips). During the same 2nd std. week lowest thrips population was recorded in EC-390033

(42.27) followed by EC-596952 with 56.93 thrips population. Then the accessions EC-390033, EC-391082 and EC-596952 continued to support low population almost throughout the crop growth period, whereas EC-599957, EC-596958 and EC-599976 supported high population from 45th std. week to 8th std. week. From the present results it was evident that the thrips population showed different preference to chilli accessions.

Where, EC-390033, EC-391082 and EC-596952 were less preferred by the pest on par with the resistant check Pusa Jwala while EC-599976, EC-599957 and EC-596958 continued to support high population throughout the crop growth period suggesting the preference of the accessions for colonization. Differentiation reaction of chilli accessions to *S. dorsalis* population was observed by many workers. Among the 1chilli accessions screened for *S. dorsalis* population significant low population was observed in G-4 (0.91 / leaf) and Chanchal (0.93 / leaf)^[9]. The screened chilli genotypes against *S. dorsalis* the results indicated that the lowest population was observed in resistant variety GPC-80 (5.31 / 5 leaves), while it was highest in Byadagi (13.72 / 5 leaves)^[10]. The lowest and highest thrips population reported on PDC-24 (0.2 / plant) and highest LCA-235 (6.6 / plant) on chilli crop^[11]. Lowest thrips in EC-391090 (4.2 / 25 buds) and the highest population recorded in IC-214991 (13.2 / 25 buds)^[5].

3.1.2. Screening of chilli accessions to *S. dorsalis* based on leaf curl index

The screening of chilli accessions against *S. dorsalis* was done based on per cent leaf curl index. The data were recorded at 50 DAT, 70 DAT and 90 DAT and the results are presented in tables 2 and 3.

At 50 days after transplanting (DAT), lowest per cent leaf curl index (PLI) was recorded in EC-596952 (4.00) followed by EC-391082 (5.33) and EC-390033 (6.67) while PLI highest was recorded in four accessions viz., EC-391087, EC-599967, EC-599976 and EC-599994 next to the susceptible check LCA 334 (57.33) and it ranged from 45.33 to 57.33. The PLI recorded in rest of the accessions varied from 20 to 40 (Table-2).

Similar trend continued at 70 DAT also where the three accessions EC-391082 (4.00), EC-596952 (5.33) and EC-390033 (6.67) recorded lowest PLI, while highest PLI was noticed in EC-599967 (50.67), EC-599976 (54.67) and EC-599994 (57.33) which was nearer to the PLI recorded in susceptible check LCA 334 (57.33). In other accessions, the PLI ranged from 18.67 to 46.67 (Table-2).

The data recorded at 90 DAT also revealed the similar trend where the three accessions which showed less PLI at 50 DAT, 70 DAT continued to show same performance by recording less PLI (5.33 to 8.00) whereas the four accessions viz., EC-391087 (48.44), EC-599967 (48.89), EC-599976 (54.67) and EC-599994 (57.33) showed susceptible reaction. The other accessions which recorded the PLI ranging from 19.56 to 40 showed intermediate reaction (Table-2).

Based on the mean PLI the accessions were classified in to 6 categories viz., highly resistant (0), resistant (1-10), moderately resistant (11-20), moderately susceptible (21-30), susceptible (30-50) and highly susceptible (51-100). The three accessions viz., EC-391082, EC-596952 and EC-390033 recorded the PLI of 4.89%, 4.89% and 7.11%, respectively were categorised as resistant varieties. The accessions IC-572470 which recorded PLI of 19.56 showed moderately resistant reaction and IC-570343 (29.33) was moderately

susceptible to thrips. The six accessions viz., IC-284474 (32.00), EC-599957 (37.33), EC-596958 (38.67), EC-599959 (40.00), EC-391087 (48.44) and EC-599967 (48.99) which recorded the PLI ranging from 32 to 48.89 were categorised as susceptible and the rest of the two accessions EC-599976 and EC-599994 recorded 54.67 and 57.33 PLI, respectively on par with the susceptible check LCA 334 (57.33) and they were classified as highly susceptible accessions (Table-3).

For classifying the chilli varieties against *S. dorsalis* different workers have used different scales. Chilli varieties categorised into 6 categories based on leaf curl symptoms^[12]. Varieties showing leaf curl symptoms of 0-5% were classified as highly resistant, 6-25% as resistant, 26-50% as moderately resistant, 51-75% as moderately susceptible and 100% curling as highly susceptible. Among the eleven genotypes screened. Chilli varieties classified based on visual injury grade (0-5 scale) as and reported that NEC had more tolerance index (2.50) than other cultivars^[13]. The reaction of chilli varieties to chilli thrips based on 0-4 scale where 0 grade (resistant) healthy foliage, 1 = 25% (moderately resistant) foliage showing leaf curling, 2 = 50% (moderately susceptible) showing leaf curling, 3 = 75% (susceptible) foliage showing leaf curling and 4 = 100% (highly susceptible) foliage showing leaf curling^[14]. Based on the results he classified DCC-524, EC-532386 and selection 40 as moderately resistant accessions. The reaction of chilli varieties to leaf curl complex based on 5 grades. I with 0.1% incidence was rated as immune and II with 0.1-25% leaf curl was categorised as resistant, III with 25.1-50% as moderately resistant, IV with 50.1-75% susceptible and V with 75.1-100% leaf curl was categorised as highly susceptible. Based on the studies Pant C-1, LIC-45 and N-66-A were found moderately resistant to the disease^[15].

Thus the results obtained from the field screening studies clearly showed the differential reaction of chilli accessions to thrips population as well as damage. Among the accessions EC-390033, EC-391082 and EC-596952 recorded significantly less population as well as less leaf curl symptoms (Plate 1) and showed resistant reaction while IC-572470 which recorded comparatively less thrips and < 20 PLI was moderately resistant to thrips. While the two highly susceptible accessions viz., EC-599976 and EC-599994 (Plate 2) and recorded significantly high population of thrips next to control and showed > 50% leaf curl symptoms (Fig 1).

3.1.3. Morphological traits and yield attributes of chilli accessions

The various morphological attributes observed in the chilli accessions were plant height, colour of fruits, number of fruits and fruit length table 4. Among the accessions, EC-391082 (82 cm), EC-390033 (72.33 cm) and LCA-334 (70.53 cm) were significantly taller and were on par with each other. The accessions EC-599957 was significantly shorter (49.87 cm) than the other accessions. In rest of the accessions the plant height ranged from 51.93 cm-68.60 cm. The number of fruits recorded from different accessions indicated that significantly lowest numbers of fruits were obtained from the EC-391082 (28.89/plant), IC-284474 (38.22/plant), IC-572470 (38.22/plant) and EC-599994 (41.78) and they were on par with each other. In rest of the accessions the number of fruits ranged from 49.56 to 74.44 and they were on par with each other. The fruit length was significantly highest (13.17 cm) in EC-391082 followed by EC-390033 (8.83 cm), EC-599959 (8.77 cm) and EC-596952 (8.6 cm) which were on par with

each other. Significantly lowest fruit length was recorded in both resistant (4.12 cm) and susceptible (3.48 cm) checks, respectively. In the rest of the accessions it ranged from 5.89 to 7.45 which were on par with each other. The green chilli yield obtained from different chilli accessions showed significant variation in the yield. Among the chilli accessions significantly highest yield recorded in EC-599994 (1217 kg ha⁻¹) was on par with the yield obtained from seven accessions viz., EC-599976 (1198 kg ha⁻¹) EC-599957 (1131 kg ha⁻¹), EC-390033 (1120kg ha⁻¹), IC-570343 (1076kg ha⁻¹), Pusa Jwala (1006) and EC-391082 (950 kg ha⁻¹).

From the results it was evident that the rest accessions EC-390033, EC-391087 and EC-596952 which colonised less thrips population and recorded low PLI also recorded higher yields (950-1132 kg ha⁻¹). EC-391082 in spite of yielding few fruits/plant (28.89) recorded good yield (950 kg ha⁻¹) on par with the other resistant accessions as the fruits was obtained from this accession was significantly longer (13.17 cm) than the other accessions. In present study one of the highly susceptible accession EC-599994 in spite of showing high PLI and thrips population recorded highest yield (1217 kg ha⁻¹) which indicate the tolerance mechanism of resistance in depth studies need to be done to conform the mechanism of resistance.

4. Conclusions

- The varietal screening studies conducted with 13 accessions showed the superior performance by 3 accessions viz., EC-390033, EC-391082 and EC-596952 which recorded low thrips population and low per cent leaf curl index (PLI) and they were categorized as resistant accessions.
- The two accessions EC-599994 and EC-599976 were highly susceptible to the pest infestation, while the remaining accessions showed moderately resistant, moderately susceptible and susceptible reaction.
- The morphological traits and yield attributes observed in the study showed that the three resistant accessions (EC-390033, EC-391082 and EC-596952) were not only least preferred by the pest but also possessed good morphological traits and gave good yield (950 to 1132 Kg ha⁻¹).
- Some of the highly susceptible (EC-599994, EC-599976) and susceptible (EC-599957) accessions in spite of colonizing high population and maximum PLI recorded higher yield (1131 to 1217kg ha⁻¹) showing the possible tolerance.

Table 1: Screening of chilli accessions against thrips under field conditions during *Kharif*, 2014-15

Accessions	<i>Scirtothrips dorsalis</i> population on 10 terminals																
	Standard weeks																Mean
	45	46	47	48	49	50	51	52	1	2	3	4	5	6	7	8	
EC-390033	0.80	3.73	11.15	27.07	13.47	51.20	71.20	60.40	61.20	76.80	42.27	52.13	91.73	34.53	55.33	45.33	43.65
EC-391082	1.33	2.40	7.94	13.47	16.67	46.40	66.67	53.87	56.67	117.07	66.27	54.93	70.80	35.33	61.47	52.00	45.20
EC-391087	0.80	3.07	4.97	10.40	11.33	35.33	55.33	95.73	92.27	127.33	64.60	68.00	124.00	32.53	116.27	103.60	59.10
EC-596952	0.27	4.80	6.05	14.53	13.33	38.80	58.80	54.53	59.33	78.80	56.93	50.13	69.60	32.40	76.66	79.47	43.40
EC-596958	0.27	3.46	8.43	12.93	17.07	55.46	75.73	84.00	81.86	153.20	104.53	84.66	64.53	43.07	115.87	91.60	62.29
EC-599957	1.32	2.66	6.18	20.93	12.13	72.53	97.86	81.33	82.27	117.33	95.46	92.00	59.60	62.26	114.40	94.66	63.31
EC-599959	2.00	3.06	10.82	12.53	19.73	64.40	84.40	73.07	73.33	145.20	105.73	52.93	85.20	46.40	100.40	91.73	60.68
EC-599967	0.66	3.86	5.78	17.73	17.60	92.66	112.53	86.26	83.60	120.66	62.00	51.20	81.33	39.07	87.20	80.00	58.88
EC-599976	1.60	2.80	8.25	26.00	27.33	76.66	98.13	78.66	78.53	94.00	92.80	71.33	78.00	78.13	129.60	115.60	66.09
EC-599994	1.06	2.26	8.19	17.73	13.07	81.73	95.60	79.73	82.13	130.40	48.80	69.73	78.40	52.66	117.86	104.80	61.51
IC-284474	2.00	2.93	6.72	16.00	20.53	59.73	82.93	46.80	47.60	150.27	58.80	78.53	90.13	72.66	114.40	81.73	58.24
IC-570343	1.87	4.93	4.39	13.20	16.53	58.13	78.13	50.00	46.80	154.40	75.07	109.87	63.73	74.93	129.20	81.60	60.17
IC-572470	1.20	3.46	8.40	11.60	20.80	51.60	71.47	52.00	50.27	100.93	57.87	102.27	102.27	65.33	83.73	72.40	53.47
Pusa Jwala	0.26	3.60	5.43	9.86	14.93	47.07	64.13	62.67	64.93	86.26	61.33	58.00	81.33	42.80	66.93	61.07	45.66
LCA-334	0.66	4.40	6.93	15.06	22.40	95.33	115.33	105.60	112.00	176.40	116.13	118.80	133.60	102.13	115.47	108.53	84.30
Mean	1.07	3.43	7.31	15.94	17.13	61.80	81.88	70.98	71.52	121.94	73.91	74.30	84.95	54.28	98.99	84.28	

CD (5%)

S. Em±

Accessions	:	2.30	0.82
Standard weeks	:	2.38	0.86
Accessions × Standard weeks	:	9.18	3.30

Table 2: Reactions of chilli accessions to screening for leafcurl caused by *S. dorsalis*

Accessions	Days After Transplantation			Mean	Grade
	50	70	90		
EC-390033	6.67	6.67	8.00	7.11	R
EC-391082	5.33	4.00	5.33	4.89	R
EC-391087	52.00	46.67	46.67	48.44	S
EC-596952	4.00	5.33	5.33	4.89	R
EC-596958	36.00	36.00	44.00	38.67	S
EC-599957	37.33	37.33	37.33	37.33	S
EC-599959	40.00	40.00	40.00	40.00	S
EC-599967	45.33	50.67	50.67	48.89	S
EC-599976	54.67	54.67	54.67	54.67	H.S
EC-599994	57.33	57.33	57.33	57.33	H.S
IC-284474	38.67	34.67	22.67	32.00	S
IC-570343	24.00	22.67	41.33	29.33	M.S
IC-572470	20.00	18.67	20.00	19.56	M.R

Pusa Jwala	5.33	5.33	5.33	5.33	R
LCA-334	57.33	57.33	57.33	57.33	H.S

Table 3: Grouping of chilli accessions based on per cent leaf curl index

Category	Per cent Leaf Curl Index	Accessions
Highly Resistant	0	
Resistant	1-10	EC-390033, EC-391082, EC-596952, Pusa Jwala
Moderately Resistant	11-20	IC-572470
Moderately Susceptible	21-30	IC-570343
Susceptible	30-50	IC-284474, EC-599957, EC-596958, EC-599959, EC-391087, EC-599967
Highly Susceptible	51-100	EC-599976, EC-599994, LCA-334

Table 4: Morphological traits and yield attributes of the chilli accessions

Accessions	Plant height	No of fruits	Fruit length	Yield (Kg ha ⁻¹)
EC-390033	72.33	53.45	8.83	1120.09
EC-391082	82.0	28.89	13.17	949.59
EC-391087	68.60	40.78	7.33	722.69
EC-596952	60.33	52.56	8.60	1132.26
EC-596958	65.27	64.00	7.28	915.67
EC-599957	49.87	49.56	7.86	1130.90
EC-599959	64.13	41.67	8.77	807.87
EC-599967	58.73	50.00	6.10	828.87
EC-599976	57.13	50.00	7.23	1197.65
EC-599994	54.20	41.78	7.45	1216.66
IC-284474	58.40	38.22	5.89	565.50
IC-570343	67.27	65.67	6.81	1076.32
IC-572470	61.80	38.22	7.43	597.02
Pusa Jwala (R.C)	51.93	59.00	3.48	1005.97
LCA-334 (S.C)	70.53	74.44	4.12	556.90
S. Em±	1.59	2.93	0.40	39.12
CD (0.05)	13.38	28.02	2.75	278.28

R.C: Resistant check

S.C: Susceptible check

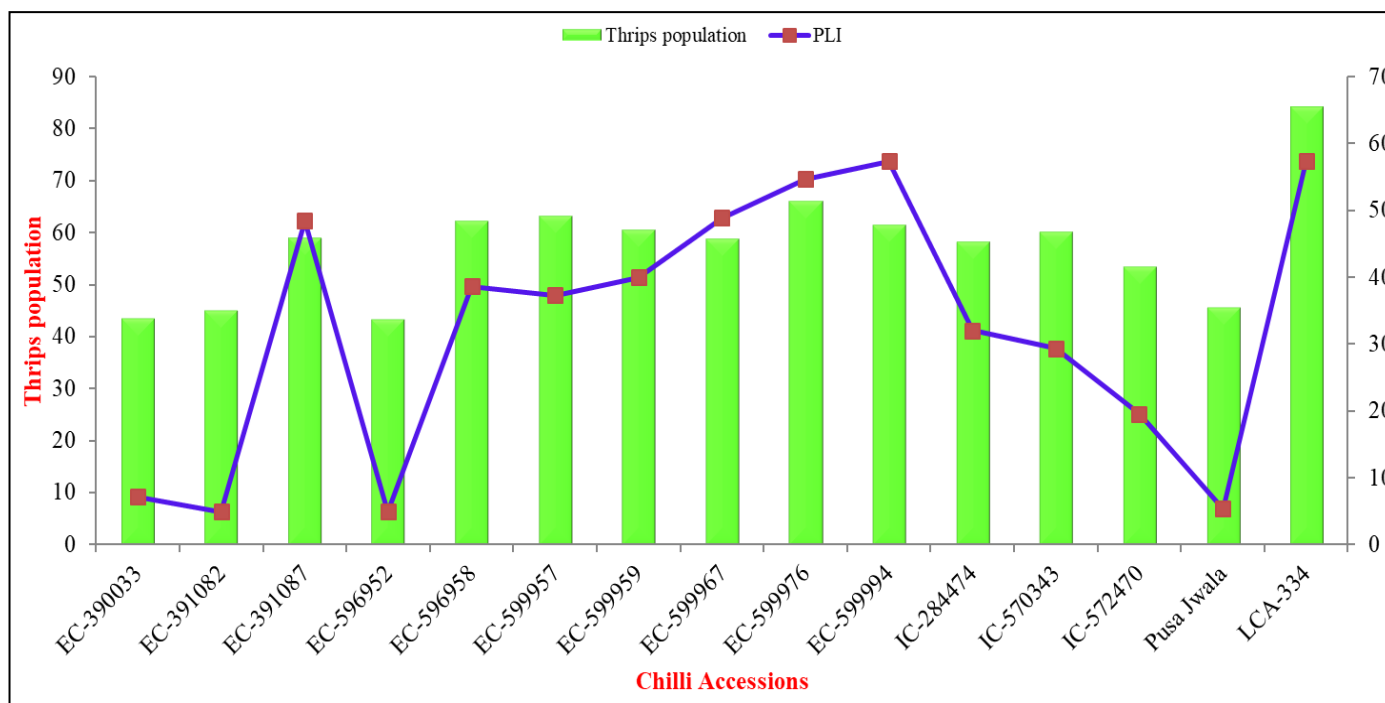


Fig 1: Chilli accessions along with thrips population and per cent leaf curl index

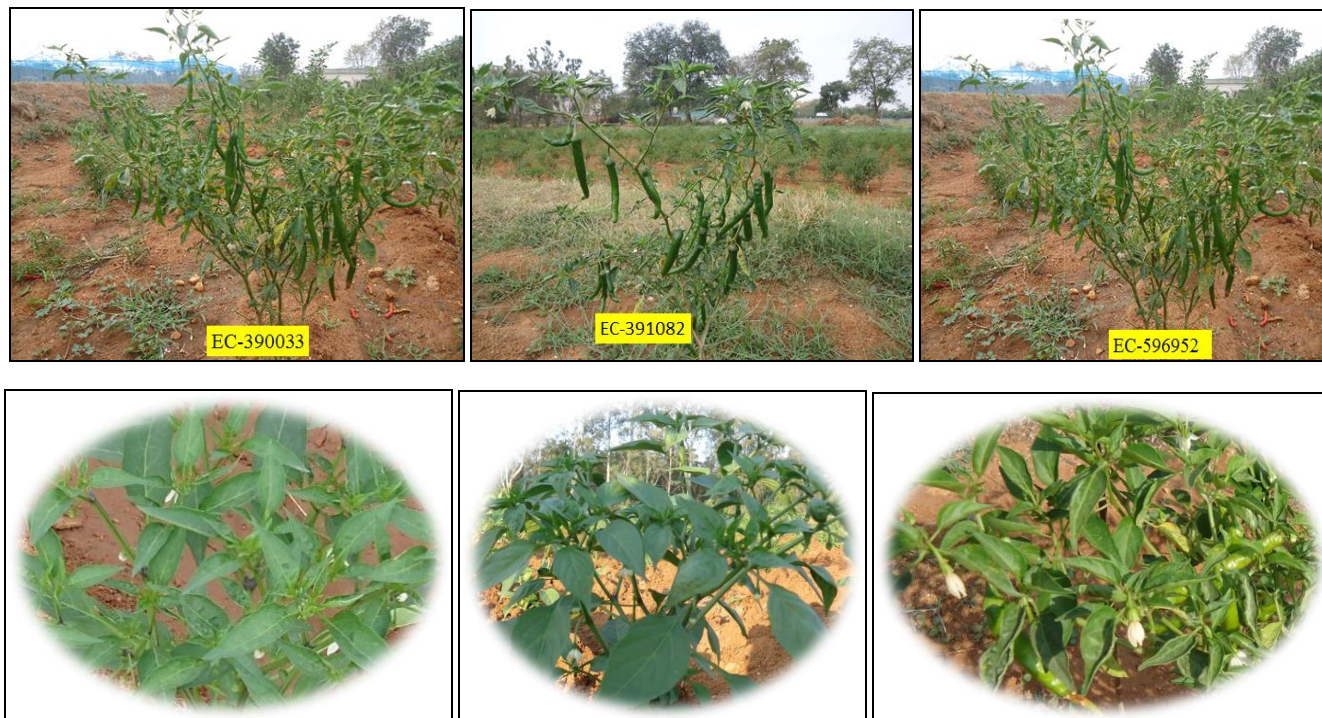


Plate 1: Resistant accessions showing very less leaf curl symptoms by *S. dorsalis*

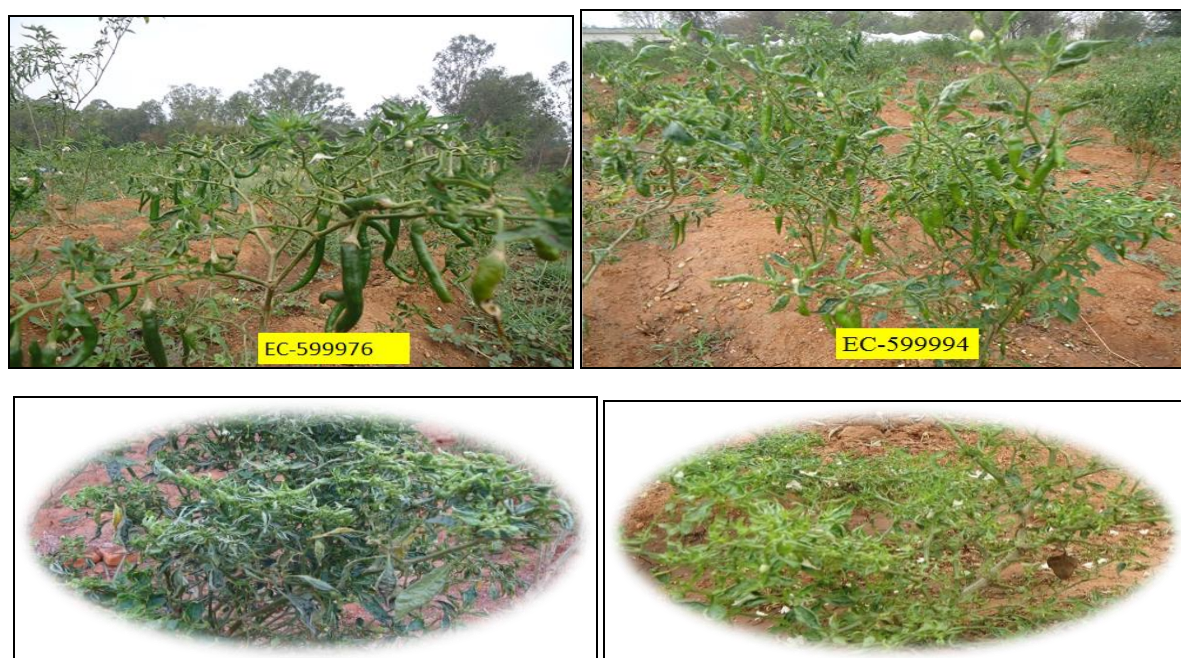


Plate 2: Severe leaf curl symptoms observed in highly susceptible accessions

5. Acknowledgement

The study is a part of M. Sc (Ag). dissertation of the first author and the facilities provided by Department of Entomology, College of Agriculture, Rajendranagar, Hyderabad, Professor Jayashankar Telangana State Agricultural University is greatly acknowledged.

6. References

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