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Field screening of chilli germplasm collections for resistance to chilli thrips, *Scirtothrips dorsalis* Hood

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ABSTRACT: Forty chilli germplasm collections were field screened against chilli thrips, *Scirthothrips dorsalis* Hood during consecutive summer seasons of 2017-18 and 2018-19 under natural infestation conditions at All India Co-ordinated Research Project on Vegetable Crops, Odisha University of Agriculture and Technology, Bhubaneswar. Observations on the population of *S.dorsalis* were recorded at weekly interval from the appearance of the pest to last picking of the chilli fruits during all the seasons. Further the germplasm were visually rated for infestation of *S.dorsalis* in 0-4 point scale based on the 'upward leaf curl' damage symptom at 45, 60, 75, 90 and 105 DAT (Days After Transplanting). Mean population of *S.dorsalis* and per cent leaf curl index were computed which were further pooled to get aggregate mean population and leaf curl index over two seasosns. On the basis of this aggregate mean population and per cent leaf curl index values, none of the germplasm was found in highly resistant category. The germplasm collections *viz.*, BC-7-2-1, BC-25 were identified as resistant whereas the genotypes *viz.,* BC-79-1, BC-27-2-2, Utkal Abha (RC), BC-21 and BC-406 were identified as moderately resistant categories. These may be further utilized as donor parents in developing the cultivars resistant to *S.dorsalis.*

Keywords: Chilli thrips, germplasm, screening, resistance, *Scirtothrips dorsalis*

INTRODUCTION

Chilli, *Capsicum annum* L. (Family: Solanaceae) is the most important vegetable cum spice and condiment crop in India. Moreover, it is also utilized in the industrial purpose for extraction of oleoresin and capsaicin. In India, it is intensively cultivated in Andhra Pradesh, Maharashtra, Karnataka, Tamil Nadu, Rajasthan and hilly areas of Uttar Pradesh (Ratnakumari *et al.,* 2001). In spite of concerted efforts at various levels, the productivity of chilli has not gained expected momentum in India. Various factors are accountable for the low productivity of chilli, out of which damage due to insect pest attack to the crop right from the nursery stage till harvesting is one of the major production constraints. More than 39 genera and 51 species of insect and mite pests have been recorded attacking chilli leaves and fruits. Among them, chilli thrips, *Scirthothrips dorsalis* Hood and tarsonemid mite, *Polyphagotarsonemus latus* Banks are the foremost destructive sucking pests causing yield losses upto 50 per cent in India (Ahmed *et al.,* 1987 and Berke and Sheih, 2000). Chilli thrips, *Scirthothrips dorsalis* Hood is a polyphagous pest with more than 100 reported hosts. Originating in the Indian subcontinent, it is now found throughout the chilli growing countries (Kumar *et al.,* 2013). This dreaded pest multiplies appreciably at a faster rate during dry weather periods and inflicts significant damage to chilli crop directly by feeding in both the larvae and adult stages on leaves, moreover, in severe conditions attacking flowers or fruits. Its feeding results in scarring, distortion of leaves, discoloration of buds, flowers, and young fruit. Upward curling of leaves (boat shape structure), elongation of petiole, stunted growth/ burnt appearance, silvery streaks on pods, deformed pods and reduction in pod size and length are the various symptoms of attack of this pest (Welter *et al*., 1990; Shipp *et al*., 1998). It is also an efficient vector of plant viruses *viz*., Ilarvirus, Tospovirus, Sobemovirus, Carmovirus, Machlomovirus genera and the dreaded tomato spotted wilt virus (TSWV) causing indirect damage to the crop (Ulman *et al*. 1992; Jones, 2005). Management of *S. dorsalis* through insecticides though effective, their excessive use resulted in development of resistance, pest resurgence, high residues in the fruits and human health hazards (Joia *et al*., 2001) and thus aggravating the problem of *S. dorsalis*. Various behaviour of this pest *viz.*, small size, polyphagous mode of feeding, higher reproductive capacity, facultative parthenogenic reproduction style, their ability to conceal themselves in bud during larval phase and in soil during pupating stage and development of resistance to different group of insecticides are inadvertently the major reasons for recent failures in management of *S. dorsalis* (Maharijaya *et al*., 2011; Bharpoda *et al*., 2014). To overcome such crisis, host plant resistance (HPR) is considered as an alternative pest management approach because it is environmentally sustainable, inexpensive and efficient where the resistant host plant can be used (Cuartero *et al*., 1999). Screening of chilli accessions is the first important step to obtain female parent to be used for breeding program of chilli resistant cultivars against *S. dorsalis* which also delay and reduce the transmission of viruses. Although no commercial chilli cultivars are available with high levels of resistance, several wild accessions have been identified that show resistance to *S. dorsalis* (Kumar *et al.,* 1996; Babu *et al*., 2002). Hence, the present investigation was undertaken to field screen forty chilli germplasm collections for their response to *S. dorsalis* under the coastal agroclimatic conditions of Odisha.

MATERIALS AND METHODS

Forty chilli germplasm including resistant and susceptible check (Utkal abha and Byadagi kaddi) received from different centers of India were field screened for their resistance/tolerance against *S. dorsalis* under natural infestation conditions at the research plot of All India Co-ordinated Research Project on Vegetable Crops, Odisha University of Agriculture and Technology, Bhubaneswar (latitude of 20^0 15' N and longitude of 85^0 52'E and 25.5 m above mean sea level), Odisha during summer 2017-18 and 2018-19. The field experiment was laid out in a randomized block design (RBD) with two replications. For the screening trials, chilli genotypes were sown in the raised bed and 45 days old healthy seedlings were transplanted in the main field. Each genotypes was raised in two rows of 2.5m length with inter and intra row spacing of 60 cm and 40cm respectively. All the recommended agronomic practices for the region were followed for raising the crop except plant protection measures in order to keep the insect population. For assessing the performance of chilli germplasm collections for resisitance/ tolerance against *S. dorsalis*, the population count and per cent leaf curl index (PLI) were recorded.

Population count: Observations on population of nymphs and adults of *S. dorsalis* were recorded on three leaves of chilli at top, middle and bottom canopy from five randomly selected and tagged plants in each plot at weekly interval from the appearance of the pest to last picking of the chilli fruits. The population was counted visually by using a magnifying lens in early morning hours (Bhede *et al*., 2008).

Per cent leaf curl index**:** The germplasm collections were visually rated for infestation of *S. dorsalis* based on the 'upward leaf curl' damage symptom. The observations on leaf curl symptoms were recorded from five randomly selected and tagged plants at 45, 60, 75, 90 and

105 DAT (Days After Transplanting) from each plot. The leaf curl symptoms were recorded on the basis of a 0-4 point scale *viz*., 0= No leaf curl incidence or healthy plant,1=1-25 per cent of the leaves in a plant showing curling with less silvery patches, 2=26-50 per cent of leaves in a plant showing curling with more silvery patches, 3=51-75 per cent leaf curl with small, needle shaped leaves, boat shaped symptoms and 4= More than 75 per cent of leaves showing curling with severe damage, less number of reproductive parts like flowers and fruits, complete stunted growth (Niles,1980). The data of leaf curl rating was converted into per cent leaf curl index using the given formula (Samota *et al*.,2018).

$$\text{PLI} = \frac{\text{Sum of scores of all plants}}{\text{Total no. of plants observed x No. of score categories}} \times 100$$

The resistance reaction of chilli germplasm collections were classified into four categories based on the PLI value, where, 0-10 = resistant; 11-25 = moderately resistant; 26-50 = susceptible and 51-100 = highly susceptible (Tewari *et al.,* 1989).

Mean population of *S.dorsalis* and mean per cent leaf curl index were computed for each germplasm in both the year of study. To judge the overall performance of germplasm collections these values on mean population of *S.dorsalis* and mean per cent leaf curl index were further pooled over the seasons to get aggregate mean population and leaf curl index. Thereafter, the chilli germplasm collections were categorized on the basis of aggregate mean leaf curl index values. Fruit yield in each germplasm was recorded and was converted to quintal per hectare. All these data on population of *S. dorsalis*, leaf curl index and fruit yield were statistically analyzed as per standard procedure after suitable data transformation.

RESULTS AND DISCUSSION

Forty chilli germplasm collectiomns that were tested for their reaction to the infestation of *S. dorsalis* showed a great degree of variations in respect of its population count and leaf curl index values. None of the chilli germplasm collections was completely free from the infestation of *S. dorsalis***.**

Table 1. Variable susceptibility of chilli germplasm collections to *S.dorsalis* (summer 2017-18 and 2018-19)

Sl.No	Germplasm	Mean population of *S. dorsalis* (Nos/ leaf)		
		Summer-2017-18	**Summer-2018-19**	**Pooled mean**
1	Utkal rashmi	2.88 (1.70)	2.92(1.71)	2.90(1.70)
2	LCA-620	2.01 (1.42)	2.10(1.45)	2.06(1.43)
3	LCA-625	2.88 (1.70)	2.91(1.71)	2.89(1.70)
4	LCA-358	2.41 (1.55)	2.37(1.54)	2.39(1.55)
5	LCA-305	2.32 (1.52)	2.26(1.50)	2.29(1.51)
6	LCA-235	2.28 (1.51)	2.33(1.53)	2.31(1.52)
7	G-3	2.88 (1.70)	2.94(1.71)	2.91(1.71)
8	CA-960	2.88 (1.70)	2.95(1.72)	2.92(1.71)
9	G-4	2.90 (1.70)	2.95(1.72)	2.92(1.71)
10	Manipur local(1)	2.00 (1.41)	2.11(1.45)	2.06(1.43)
11	Manipur local(2)	2.88 (1.70)	2.91(1.70)	2.90(1.70)
12	Arka abhir	2.80 (1.67)	2.92(1.71)	2.86(1.69)
13	Arka lohit	2.02 (1.42)	2.07(1.44)	2.04(1.43)
14	KAU-Anuragha	2.90 (1.70)	2.96(1.72)	2.93(1.71)
15	Kunchinda Local	2.98 (1.72)	2.97(1.72)	2.97(1.72)
16	Pusa sadabahar	2.92 (1.71)	2.96(1.72)	2.94(1.71)
17	KAU-Ujwala	2.83 (1.68)	2.92(1.71)	2.88(1.70)
18	Arka suphul	2.33 (1.53)	2.32(1.52)	2.33(1.52)
19	BC-24-1	2.81 (1.68)	2.88(1.70)	2.85(1.69)
20	BC-25	0.92 (0.96)	0.97(0.99)	0.95(0.97)
21	BC-20	2.91 (1.71)	2.96(1.72)	2.94(1.71)
22	BC-21	1.11(1.05)	1.21(1.10)	1.16(1.08)
23	BC-43	2.06 (1.44)	2.12(1.45)	2.09(1.44)
24	BC-28	2.02 (1.42)	2.16(1.47)	2.09(1.45)
25	BC-40-2	2.89 (1.70)	2.94(1.72)	2.92(1.71)
26	BC-78-1	2.81 (1.68)	2.88(1.70)	2.84(1.69)
27	BC-27-2-2	1.17 (1.08)	1.25(1.12)	1.21(1.10)
28	BC-79-1	1.15 (1.07)	1.22(1.10)	1.18(1.09)
29	BC-40-2-1-1	2.25 (1.50)	2.27(1.51)	2.26(1.50)
30	BC-78-1-2	2.02 (1.42)	2.08(1.44)	2.06(1.43)
31	BC-7-2-1	0.63 (0.80)	0.73(0.86)	0.68(0.83)
32	BC-30	2.82 (1.68)	2.88(1.70)	2.85(1.69)
33	BC-40-3-1-1	2.94 (1.71)	2.98(1.73)	2.96(1.72)
34	BC-70-2	2.24 (1.50)	2.25(1.50)	2.25(1.50)
35	BC-7-1-1	2.88 (1.70)	2.92(1.71)	2.90(1.70)
36	BC-5-1-7	1.99 (1.41)	2.08(1.44)	2.04(1.43)
37	BC-7-2-2	2.86 (1.69)	2.90(1.70)	2.89(1.70)
38	BC-406	1.20 (1.09)	1.20(1.10)	1.20(1.10)
39	Utkal Abha (RC)	1.13 (1.06)	1.20(1.10)	1.17(1.08)
40	Byadagi kaddi (sc)	2.85 (1.69)	2.91(1.71)	2.88(1.70)
	SE(m) ±	**0.033**	**0.036**	**0.034**
	CD (5%)	**0.094**	**0.103**	**0.099**

*Values in parantheses are square root transformed (√x + 0.5)

Table 2. Categorization of chilli germplasms for resistance against *S.dorsalis* based on leaf curl index during summer 2017-18 and 2018-19

Sl.No	Germplasm	Mean leaf curl index by *S.dorsalis* (%)			Resistant categories	Fruit yield(q/ha)
		2017-18	2018-19	Pooled mean		
1	Utkal rashmi	67.99(55.55)	65.93(54.29)	66.97(54.92)	HS	18.10
2	LCA-620	29.64(32.98)	30.53(33.54)	30.09(33.26)	S	23.72
3	LCA-625	67.27(55.10)	69.20(56.29)	68.23(55.69)	HS	12.65
4	LCA-358	46.43(42.96)	45.83(42.61)	46.14(42.78)	S	20.31
5	LCA-305	44.23(41.69)	43.33(41.17)	43.79(41.43)	S	20.93
6	LCA-235	42.60(40.74)	42.90(40.92)	42.75(40.83)	S	20.46
7	G-3	70.20(56.91)	71.20(57.54)	70.70(57.23)	HS	13.26
8	CA-960	67.20(55.06)	66.80(54.82)	67.00(54.94)	HS	16.95
9	G-4	69.40(56.42)	68.53(55.88)	68.97(56.15)	HS	15.99
10	Manipur local(1)	38.60(38.41)	38.00(38.06)	38.30(38.23)	S	22.33
11	Manipur local(2)	73.23(58.84)	73.67(59.13)	73.45(58.98)	HS	11.09
12	Arka abhir	67.40(55.18)	68.23(55.69)	67.82(55.44)	HS	12.12
13	Arka lohit	39.17(38.74)	40.00(39.23)	39.59(38.99)	S	22.55
14	KAU-Anuragha	72.30(58.24)	73.83(59.23)	73.07(58.74)	HS	10.51
15	Kunchinda Local	75.00(60.00)	75.53(60.35)	75.27(60.18)	HS	9.85
16	Pusa sadabahar	70.87(57.33)	71.80(57.92)	71.33(57.63)	HS	10.24
17	KAU-Ujwala	69.40(56.42)	69.53(56.50)	69.47(56.46)	HS	15.53
18	Arka suphul	43.60(41.32)	43.63(41.34)	43.62(41.33)	S	21.95
19	BC-24-1	66.63(54.72)	67.13(55.02)	66.89(54.87)	HS	19.78
20	BC-25	9.03(17.49)	8.87(17.32)	8.95(17.41)	R	26.50
21	BC-20	67.90(55.49)	67.57(55.28)	67.74(55.39)	HS	18.89
22	BC-21	19.47(26.18)	19.60(26.28)	19.53(26.23)	MR	24.74
23	BC-43	32.63(34.84)	33.10(35.12)	32.87(34.98)	S	23.06
24	BC-28	31.13(33.91)	31.80(34.33)	31.47(34.12)	S	24.06
25	BC-40-2	69.17(56.27)	70.03(56.81)	69.60(56.54)	HS	14.01
26	BC-78-1	64.93(53.69)	64.77(53.59)	64.85(53.64)	HS	18.55
27	BC-27-2-2	19.33(26.09)	19.57(26.25)	19.45(26.17)	MR	25.53
28	BC-79-1	19.77(26.40)	20.03(26.59)	19.90(26.49)	MR	25.88
29	BC-40-2-1-1	45.23(42.27)	45.07(42.17)	45.15(42.22)	S	21.74
30	BC-78-1-2	32.10(34.51)	33.40(35.30)	32.75(34.91)	S	23.37
31	BC-7-2-1	8.03(16.47)	8.33(16.78)	8.19(16.62)	R	27.30
32	BC-30	67.40(55.18)	66.10(54.39)	66.75(54.79)	HS	19.33
33	BC-40-3-1-1	71.87(57.97)	71.83(57.95)	71.50(57.73)	HS	14.87
34	BC-70-2	44.30(41.73)	44.83(42.03)	44.57(41.88)	S	21.53
35	BC-7-1-1	69.23(56.31)	68.00(55.55)	68.62(55.93)	HS	17.64
36	BC-5-1-7	36.93(37.42)	38.20(38.17)	37.57(37.80)	S	22.82
37	BC-7-2-2	67.87(55.47)	67.70(55.37)	67.78(55.42)	HS	19.10
38	BC-406	20.86(27.18)	21.73(27.78)	21.30(27.48)	MR	24.31
39	Utkal Abha (RC)	20.46(26.89)	20.56(26.96)	20.51(26.93)	MR	25.24
40	Byadagi kaddi (sc)	68.23(55.69)	68.67(55.96)	68.45(55.83)	HS	11.51
	SE(m) ±	**1.658**	**1.682**	**1.670**		**0.52**
	CD (5%)	**4.741**	**4.810**	**4.775**		**1.44**

*Arc-sin transformed parenthesis values

R - resistant **MR -** moderately resistant **S**-susceptible **HS**-highly susceptible

Table 3. Categorization of chilli genotypes based on their reaction to thrips, *S. dorsalis* and per cent leaf curl index

Category	Genotypes
Highly resistant	0
Resistant	BC-7-2-1, BC-25
Moderately resistant	BC-79-1, BC-27-2-2, Utkal Abha (RC), BC-21, BC-406
Susceptible	BC-28, LCA-620, BC-78-1-2, BC-43, BC-5-1-7, Arka lohit, Manipur local(1), Arka suphul, BC-40-2-1-1, BC-70-2, LCA-305, LCA-235, LCA-358,
Highly susceptable	BC-24-1, BC-30, BC-7-2-2, BC-20, BC-78-1, Utkal rashmi, BC-7-1-1, CA-960, G-4, KAU-Ujwala, BC-40-3-1-1, BC-40-2, G-3, LCA-625, Arka abhir, Byadagi kaddi (sc), Manipur local(2), KAU-Anuragha, Pusa sadabahar, Kunchinda Local

Incidence of *S. dorsalis* in chilli germplasm

The experimental results (Table 1) showed that among the forty germplasm collections the mean number of *S. dorsalis* per leaf over two seasons ranged between 0.68 to 2.97/ leaf. The germplasm BC-7-2-1 significantly harbored least population of 0.68 / leaf of *S. dorsalis* followed by BC-25 (0.95), BC-21 (1.16), Utkal Abha(resistant check) (1.17), BC-79-1 (1.18), BC-406 (1.20) and BC-27-2-2 (1.21). Maximum population of 2.97/leaf of *S. dorsalis* was recorded from Kunchinda Local followed by BC-40-3-1-1 (2.96), Pusa sadbahar (2.94), Bc-20 (2.94), KAU-Anuragh (2.93), CA- 960 (2.92), G-4 (2.92), G-3 (2.91), Utkal rashmi (2.90), BC-7-1-1 (2.90), Arka abhir (2.92), KAU- Ujwala (2.92), BC-7-2-2 (2.89) and next to the susceptible check Byadagi kaddi (2.88).

Leaf curl index due to *S. dorsalis* in chilli germplasm and fruit yield

The overall mean leaf curl index caused by *S. dorsalis* over two seasons recorded from different chilli germplasm collections ranged from 8.19 to 75.27 per cent (Table 2). Of all the germplasm evaluated, significantly least per cent leaf curl index was observed on BC-7-2-1(8.19) followed by BC-25 (8.95). The performance of chilli germplasm collections *viz.,* BC-27-2-2 (19.45), BC-21(19.53), BC-79-1 (19.90), BC-406 (21.30) and resistant check Utkal abha (20.51) were at par with each other with respect to per cent leaf curl index caused by *S. dorsalis*. Highest per cent leaf curl index was noticed in Kunchinda Local (75.27) followed by Manipur Local-2 (73.45), KAU-Anuragha (73.07), BC-40-3-1-1(71.50), Pusa sadabahar (71.33), G-3(70.70) and G-4 (68.97).

Based on the mean percent leaf curl index caused by *S. dorsalis* , two germplasm collections *viz*., BC-7-2-1 and BC-25 were categorized as resistant (0-10%), five germplasm collections *viz*., BC-79-1, BC-27-2-2, Utkal Abha (RC), BC-21, BC-406 as moderately resistant (11-25 %),thirteen germplasm collections as susceptible (26-50%) and twenty germplasm collections as highly susceptible (51-100%) (Table 3). The pest had better survival on susceptible then resistant /moderately resistant chilli germplasm collections due to antibiosis or antixenosis resistance mechanism. The earlier screening studies in chilli against *S. dorsalis* also resulted in identification of several resistant genotypes. Ramesh *et al.,* (2015) reported that among the 71 chilli genotypes screened for their resistance against *S. dorsalis* only two genotypes IC-3423390 and IC-572492 were found to be resistant; 11 were moderately resistant; 45 were susceptible and 13 were highly susceptible to the pest. In a screening trail on 46 chilli genotypes, found 7 genotypes of chilli showed moderately resistance to *S. dorsalis* while 37 genotypes showed susceptible and 2 genotypes resulted highly susceptible for thrips infestation (Megharaj *et al.* 2016). The present results are also supported by the findings of Samanta *et al.* (2017), Latha and Hanumantharaya (2018) and Samota *et al.* (2018) who had screened different chilli genotypes against thrips infestation.

The pooled analysis of the data indicated that considerable variation was observed among the chilli germplasm collections with respect to fruit yield which ranged from 9.85 to 27.30q/ha. (Table 2). Among the germplasm collections, the entries BC-7-2-1 recorded highest fruit yield of 27.30q/ha which was statistically at par with BC-25 (26.50q/ha) and BC-79-1 (25.88q/ha).The other germplasm collections in order of their performance were BC-27-2-2 (25.53q/ha), Utkal Abha (resistant check) (25.24q/ha), BC-21 (24.74q/ha) and BC-406 (24.31q/ha). The lowest fruit yield of 9.85q/ha was recorded in the genotype Kunchinda Local followed by Pusa sadabahar (10.24) and KAU-Anuragh (10.51). The marketable yield is a complex character, which depends on fruit parameters along with the insect pest incidence.

CONCLUSION

It is inferred from the present investigation that none of the tested chilli germplasm was found completely free from the attack of *S.dorsalis*. The germplasm collections *viz.*., BC-7-2-1 and BC-25 were found resistant while the germplasm collections *viz.*, BC-79-1, BC-27-2-2, Utkal Abha (RC), BC-21 and BC-406 were identified as moderately resistant. These resistant / moderately resistant germplasm collections may be used as donor parents in breeding programme for the development of *S.dorsalis* resistant varieties of chilli and need to be further evaluated for identification of resistance mechanism.

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