



Screening of Germplasm Accessions for their Resistance to Leaf Hopper, Whitefly and Thrips Infesting Castor, *Ricinus communis* L.

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Abstract

A field experiment was undertaken during September, 2023 to March, 2024 at Centre for Oilseeds Research, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat, India to screen the castor germplasm accessions against leafhoppers (22 no.), thrips (17 no.) and whiteflies (15 no) with checks. Out of 22 entries screened against leaf hoppers, 4 entries exhibited hopper burn grade 1 on 0–4 scale and were found resistant to leafhoppers. Leafhopper population among these accessions ranged from 11.0 to 419.2 leafhoppers 3 leaves⁻¹ plant⁻¹, whereas the susceptible check, DPC-9 recorded 369.2 leafhoppers 3 leaves⁻¹ plant⁻¹ with hopper burn grade of 4 on 0–4 scale. The highest leafhoppers were in RG-4097 (419.2 leafhoppers 3 leaves⁻¹ plant⁻¹) with a hopper burn grade of 4 (76 to 100% hopper burn). Four entries recorded a medium leafhopper population (30.4 to 170.7 leafhoppers 3 leaves⁻¹ plant⁻¹) with hopper burn grade II (upto 11–25% hopper burn). The moderate to high infestation of thrips on top tender leaves and spikes were noticed on test entries. Among the accessions BCS-2 (0.1 whitefly top⁻¹ leaf plant⁻¹), PLM-23-1 (0.4 whitefly top leaf⁻¹ plant⁻¹), DPC-9 (1.3 whiteflies top leaf⁻¹ plant⁻¹), DCH 177 (5.4 whiteflies top leaf⁻¹ plant⁻¹) and 48-1 (9.4 whiteflies top leaf⁻¹ plant⁻¹), recorded significantly low population of whiteflies (pupae and adults) with damage grade of 0 on 0–5 scale and they were found resistant to whiteflies. These germplasm accessions identified as resistant to leaf hoppers, thrips, and whiteflies can be employed in breeding programs to develop resistant castor cultivars.

Keywords: Castor, germplasms, thrips, leafhoppers, whiteflies, screening, resistance

1. Introduction

In India, castor is one of the industrially important non-edible oilseeds crops and major producing country in the world. The current castor production in the country is 19.75 lakh tonnes from 9.88 lakh hectares with productivity of 1999 kg ha⁻¹ in 2023–24 (Anonymous, 2023). The major castor growing states in India are Gujarat, Andhra Pradesh, Rajasthan, Karnataka, Orissa, Tamil Nadu and Maharashtra. Of these, Gujarat is the largest castor growing state where the estimated area under castor is 7.24 lakh ha with production of 15.95 lakh tones and productivity of 2201.36 kg ha⁻¹ (Anon, 2024). Castor oil is made up of over 80% ricinolic acid, which gives the unique industrial characteristics to the oil. It is primarily utilized in the production of paints, lubricants, soaps, hydraulic brake fluids, polymers, and fragrances. Additionally, as an oilseed crop, castor crop is primary host for rearing of eri silkworms in indoor conditions. In spite of its immense production potential, castor crop suffers severe damage of nearly 100

insect pests and among them defoliators and sucking pests are economically important (Basappa and Lingappa, 2001). Throughout its growth, from the emergence of seedlings to the harvesting of capsules, the crop faces threats from sap sucking insects, defoliators, mites to capsule borers. These pests target the plant at various growth stages, leading to a decline in the overall health of the plant (Gahukar, 2018). The seed yield losses in castor due to insect pests varied with the season, the severity of the pest and the hybrid variety of the plant (Rai, 1976). The losses ranged from 40 to 89% due to infestation of various species of insects and mites (Lakshminarayana and Duraimurugan, 2014 and Kotle, 1995). The sucking pests such as leafhoppers (*Empoasca flavescens* Fabricius), whitefly (*Trialeurodes ricini* Misra) and thrips (*Scirtothrips dorsalis* Hood) have been known to be the most important pests attacking castor resulting in excessive loss of seed yield (Ramanjaneyulu et al., 2017). The studies revealed that 14–15% of yield loss caused by sucking pests in

Gujarat (Khanpara and Patel, 2002). Leafhoppers (*Empoasca flavescens*), thrips and whiteflies are known to be the most important sucking pests attacking castor, resulting in excessive loss of grain yield (Patel et al., 2015). The leafhoppers can damage the crop by sucking the sap from leaves, resulting in a burnt appearance. Yellow patches appear on leaf margins followed by distortion of veins and leaf curling; these patches then turn brown and leaves become dry and brittle on the margins. Hopper burn, thus, lowers the vitality and plants become stunted with poor capsule formation. Nymphs and adults of thrips are feed on both upper and lower leaf surfaces, resulting in crinkling of the terminal leaves with a silvery appearance. Severe infestation causes stunted growth of plants, withering of emerging spikes and drying of the newly formed capsules while nymphs of whiteflies adhere to the leaves and suck the sap for a week and then pupate at the same site with a waxy margin around the pupal body. In case of severe infestation, the damaged leaves are covered with a sooty mould (Sujatha et al., 2011). The application of broad-spectrum insecticides presents a twofold risk, it poses threat to natural predators, which may result in a resurgence of pests, and adversely impacts the environment (Singh et al., 2020). Therefore, present research was conducted to identify genotypes that are resistant to leafhoppers, thrips, and whiteflies in castor accessions, as this represents the most economical strategy to reduce the frequency of insecticide applications while conserving natural enemies. Additionally, it promotes environmental safety by utilizing tolerant or resistant cultivars in integrated pest management programmes.

2. Materials and Methods

The experiment was conducted during September 2023 to March 2024 at Centre for Oilseeds Research, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar to screen the castor germplasm accessions against leafhoppers, thrips and whiteflies along with susceptible and resistant checks. A total of 22 castor germplasm accessions were screened against leafhoppers, 17 for thrips and 15 for whiteflies which were provided by ICAR-IIOR, Rajendranagar, Hyderabad, India under AICRP castor programme. Each germplasm was sown in a single row of 6 m length in augmented block design with two replications at spacing of 90×60 cm². The crop was raised as per the package of practices except the plant protection measures. Susceptible check DPC-9 was used as an infester row and sown after every two rows in promising castor genotypes for leafhoppers. Leafhopper populations with adult and nymphs were counted on three leaves in each plants electing one leaf from top (excluding 2 topmost leaves), middle (medium maturity) and bottom (leaving one or two bottommost leaves) on the main shoot. The observations on number of leafhoppers 3 leaves⁻¹ plant⁻¹ and percent leaf area burnt per plant taken on 5 plants plot⁻¹. Hopper burn injury was recorded as per the scale suggested (Duraimurugan et al., 2023a)

Hopper burns grade:

Score	Damage level
0	No injury
1	Hopper burn up to 10%
2	Hopper burn 11 to 25%
3	Hopper burn 26 to 50%
4	Hopper burn above 50%

Susceptible check DPC-9 was used as an infester row and sown after every two rows in promising castor genotypes for thrips. The observations on number of thrips top⁻¹ tender leaves plant⁻¹ and thrips spike⁻¹ plant⁻¹ were taken on 5 plants plot⁻¹. Further, the observation on number of whiteflies 3 leaves⁻¹ plant⁻¹ was taken on 5 plants plot⁻¹. The grade of whiteflies was recorded according to scale given (Duraimurugan et al., 2023a)

Score	Population scale (Nymphs and Pupae)
0	No nymphs and pupae
1	1–50 nymphs and pupae
2	51–100 nymphs and pupae
3	101–200 nymphs and pupae
4	201–500 nymphs and pupae
5	More than 500 nymphs and pupae and honey dew secretion with black sooty mould fungus

3. Results and Discussion

3.1. Leaf hoppers

Out of 22 castor genotypes were screened (Table 1) against leafhoppers, 4 germplasm accessions viz., K-18-98 (27.7 leaf hoppers 3 leaves⁻¹ plant⁻¹), BCS-5 (29.4 leaf hoppers 3 leaves⁻¹ plant⁻¹), PLM-23-6 (32.2 leaf hoppers 3 leaves⁻¹ plant⁻¹) and PLM-23-5 (52.8 leaf hoppers 3 leaves⁻¹ plant⁻¹) along with resistant checks DCH-519 (11 leaf hoppers 3 leaves⁻¹ plant⁻¹), ICH-66 (25.6 leaf hoppers 3 leaves⁻¹ plant⁻¹) and GCH-8 (21.4 leaf hoppers 3 leaves⁻¹ plant⁻¹), respectively recorded low leafhopper infestation and found resistant with hopper burn grade of 1 on 0–4 scale. while, entries RG-4107 (286.2 leaf hoppers 3 leaves⁻¹ plant⁻¹), RG-4097 (419.2 leaf hoppers 3 leaves⁻¹ plant⁻¹), RG-4088 (111.0 leaf hoppers 3 leaves⁻¹ plant⁻¹), RG-4104 (237.5 leaf hoppers 3 leaves⁻¹ plant⁻¹), RG-4081 (118.6 leaf hoppers 3 leaves⁻¹ plant⁻¹), RG-4058 (244 leaf hoppers 3 leaves⁻¹ plant⁻¹), RG-4091 (153 leaf hoppers 3 leaves⁻¹ plant⁻¹), RG-3041 (271.0 leaf hoppers 3 leaves⁻¹ plant⁻¹), PLM-23-4 (274.8 leaf hoppers 3 leaves⁻¹ plant⁻¹), respectively are found susceptible to leaf hoppers and susceptible check DPC-9 (369.2 leaf hoppers 3 leaves⁻¹ plant⁻¹) recorded significantly higher leaf hopper infestation with hopper burn grade of 4 on 0–4 scale. In line with this, 20 different germplasm



Table 1: Screening of castor genotypes against leaf hoppers during 2023–24

Sl. No.	Entries	Leafhoppers	
		Nos 3 leaves ⁻¹ plant ⁻¹	Hopper burn (0–4 grade)
1.	RG-3041	271.0	III
2.	RG-3090	53.0	II
3.	RG-4058	244.0	IV
4.	RG-4081	118.6	III
5.	RG-4088	111.0	III
6.	RG-4091	153.0	IV
7.	RG-4097	419.2	IV
8.	RG-4104	237.5	IV
9.	RG-4107	286.2	IV
10.	K-18-59	106.4	III
11.	K-18-98	27.7	I
12.	BCS-5	29.4	I
13.	BCS-6	170.7	II
14.	PLM-23-4	274.8	III
15.	PLM-23-5	52.8	I
16.	PLM-23-6	32.2	I
17.	DPC-9 (C)	369.2	IV
18.	DCH-177 (C)	281.4	IV
19.	DCS-107(C)	122.2	III
20.	DCH-519 (C)	11.0	I
21.	GCH-8 (C)	21.4	I
22.	ICH-66 (C)	25.6	I
	SEm±	14.7	-
	CD ($p=0.05$)	43.1	-
	C.V. (%)	13.2	-

accessions were found highly resistant with no injury by the leaf hopper while, check DPC-9 recorded maximum leaf hoppers (67.8 leaf hoppers 3 leaves⁻¹ plant⁻¹) with hopper burn grade of 4. Further, thirteen entries have recorded hopper burn grade of 1 with minimum leafhoppers ranged from 17.6 to 38.8 leaf hoppers 3 leaves⁻¹ plant⁻¹ as compared to the susceptible check, DCS-9 which has recorded a hopper burn grade of 3 with the population of 58.6 3 leaves⁻¹ plant⁻¹ (Madhuri et al., 2023). Similarly, 9 advanced lines were found highly resistant to leaf hoppers without hopper burn while DPC-9 with hopper burn grade of 4 (Duraimurugan et al., 2023a).

3.2. Thrips

Among the seventeen selected germplasm accessions were screened (Table 2) against thrips the infestation on tender

spikes in different test accessions and checks were recorded moderate to high infestation and ranged between 18.0 thrips tender spike⁻¹ plant⁻¹ (RG-4778) to 45.2 thrips tender spike⁻¹ plant⁻¹ (PLM-23-4). Further, thrips infestation on castor leaves in different test entries and checks were moderate which are ranged from 3.7 thrips 3 leaves⁻¹ plant⁻¹ (M-574) to 6.1 thrips 3 leaves⁻¹ plant⁻¹ (PLM-23-4). However, maximum aphid incidence was also recorded in susceptible check DPC-9 (44.8 thrips tender spike⁻¹ plant⁻¹). The studies (Duraimurugan et al., 2023b) also revealed that the check DPC-9 recorded maximum thrips on tender spike.

3.3. Whiteflies

Out of 15 promising genotypes were screened (Table 3) against whitefly along with susceptible check (DCH-519) low to heavy infestation of whiteflies (pupae and adults) were recorded on different genotypes and checks during May-June 2023-24. Among germplasm accessions viz., BCS-2 (0.1 whitefly top leaf⁻¹ plant⁻¹), PLM-23-1 (0.4 whitefly top leaf⁻¹ plant⁻¹) along with resistant checks DPC-9 (1.3 whitefly top leaf⁻¹ plant⁻¹), DCH 177 (5.4 whitefly top leaf⁻¹ plant⁻¹) and 48-1 (9.4 whitefly top leaf⁻¹ plant⁻¹), respectively recorded significantly low population of whiteflies (pupae and adults) with damage

Table 2: Screening of castor genotypes against thrips during 2023–24

Sl. No.	Entries	Leafhoppers	
		Nos 3 leaves ⁻¹ plant ⁻¹	Nos. spike ⁻¹ plant ⁻¹
1.	RG-4058	4.9	43.6
2.	RG-4061	5.1	42.9
3.	RG-4078	5.3	18.0
4.	RG-4089	5.3	41.5
5.	RG-4098	5.4	43.4
6.	K18-39-1	4.7	35.3
7.	K18-98	5.6	43.7
8.	PLM-23-4	6.1	45.2
9.	PLM-23-5	5.7	41.9
10.	PLM-23-6	4.7	37.2
11.	DCS-9 (C)	5.8	44.5
12.	DPC-9 (C)	4.7	44.8
13.	48-1 (C)	4.1	36.0
14.	M-574 (C)	3.7	33.8
15.	DCH-519 (C)	5.4	33.9
16.	GCH-8 (C)	5.0	36.4
17.	ICH-66 (C)	5.7	44.1
	SEm±	0.46	2.53
	CD ($p=0.05$)	NS	7.60
	C.V. (%)	12.62	9.42



Table 3: Screening of castor genotypes against whitefly during 2023–24

Sl. No.	Entries	No. of whiteflies or whitefly pupae top leaf ⁻¹ plant ⁻¹	Grade (0-5)
1.	RG-2976	138.6	III
2.	RG-3041	199.7	III
3.	RG-3087	147.3	III
4.	BCS-2	0.1	0
5.	BCS-6	114.7	III
6.	BCS-7	59.9	II
7.	PLM-23-1	0.4	0
8.	M-574 (C)	54.0	III
9.	DCH-519 (C)	179.0	III
10.	YRCH-2(C)	76.9	II
11.	DPC-9 (C)	1.3	I
12.	DCH 177 (C)	5.4	I
13.	48-1 (C)	9.4	I
14.	GCH-8(C)	198.2	III
15.	ICH-66 (C)	129.1	III
	SEm±	6.8	-
	CD ($p=0.05$)	20.7	-
	C.V. (%)	11.0	-

grade of 0 on 0–5 scale and they were found resistant to whiteflies. The genotypes BCS-7 (59.9 whitefly top leaf⁻¹ plant⁻¹) and YRCH-2 (76.9 whitefly top leaf⁻¹ plant⁻¹) observed moderate population with damage scale of 2 on 0–5 scale. The entries RG-2976 (138.6 whitefly top leaf⁻¹ plant⁻¹), RG-3041 (199.7 whitefly top leaf⁻¹ plant⁻¹), RG-3087 (147.3 whitefly top leaf⁻¹ plant⁻¹), BCS-6 (114.7 whitefly top leaf⁻¹ plant⁻¹) and checks DCH-519 (179.0 whitefly top leaf⁻¹ plant⁻¹) GCH-8 (198.2 whitefly top leaf⁻¹ plant⁻¹) and ICH-66 (129.1 whitefly top leaf⁻¹ plant⁻¹), respectively recorded significantly higher population of whiteflies with damage grade of 3 on 0–5 scale.

4. Conclusion

Screening of castor germplasm accessions revealed potential sources of resistance to leafhopper, whitefly, and thrips. Further genetic and molecular studies will enhance understanding of resistance mechanisms and facilitate breeding efforts for sustainable pest management in castor.

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