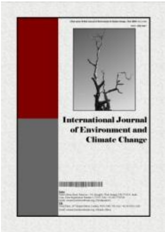

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Screening of Various Genotypes of Castor for Resistance against Castor Leafhopper, *Empoasca flavescens* Fabricius

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A screening trial with 10 castor genotypes to assess their relative reaction to leafhoppers (*Empoasca flavescens*) was conducted at CCSHAU, Regional Research Station, Bawal during the *Kharif* season, 2019-20. Among the 10 genotypes, leafhopper population varied from 2.3 to 8.3. Based on leafhopper population and hopper burn score, the triple bloom genotypes Maharaja-9 and GCH-7 were found tolerant to leafhopper whereas the single bloom genotype DCH-177 was highly susceptible. The phenols content in the castor leaves had a significant negative correlation with leafhopper population and hopper burn score while total carbohydrates present in the leaves had a significant positive correlation with leafhopper population and hopper burn score. The intensity of bloom and phenols and carbohydrates content were found to play a major role in the infestation of castor leafhopper.

Keywords: Castor; genotypes; leafhopper.

1. INTRODUCTION

Castor (*Ricinus communis* L.) belongs to the family Euphorbiaceae, is an important non-edible oilseed crop grown mainly in arid and semi-arid regions of India. With an average seed yield of 1761 kg/ha and annual seed production of 18.42 lakh tonnes, India is one of the world's top

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producers of castor, accounting for 73% of global production, followed by China (12%) and Brazil (6.4%) [1]. Castor oil contains more than 80 % ricinolic acid which confers distinctive industrial properties to the oil. Castor oil is mainly used in the manufacturing of paints, lubricants, soaps, hydraulic brake fluids, polymers and perfumery products. Besides, being an oilseed crop, castor has also been considered the most preferred and successful host for eri silkworm rearing.

The defoliators, such as the semilooper, *Achaea janata* L., tobacco caterpillar *Spodoptera litura* Fab., capsule borer *Conogethes punctiferalis* Guen and sucking pests such as leafhopper, *Empoasca flavescens* Fab., thrips, *Retithrips syriacus* Mayet and whitefly, *Trialeurodes ricini* Misra are the major insect pest problems in castor. Green leafhopper is one of the serious sucking pests at vegetative stage as the nymphs and adults suck sap from leaves and characteristic symptoms of hopper burn appear owing to the toxigenic nature of the insect. Among different management practices, host-plant resistance serves as the most reliable measure for the non-preference mechanism of feeding and oviposition by insects [2] and is eco-friendly and economical to control leafhoppers [3]. The use of resistant varieties in the IPM programmes is the most economic approach and would be inexpensive in long run [4]. Hence, the present study on screening of various genotypes of castor for resistance against castor leafhopper gives a better understanding of plant-insect relationships especially the mechanism of resistance in the plant and aid in the selection and breeding of resistant varieties.

2. MATERIALS AND METHODS

Ten castor genotypes *viz*., JSB-1018, SHB-974, SLCH-158, ICH-66, ICH-68, Maharaja-9, DCH-519, GCH-7, DCH-177 and DCH-1566 were selected and the field experiment was carried out at CCSHAU, Regional Research Station, Bawal during *Kharif* season of 2019-20. The genotypes were sown with the spacing of 120 cm between rows and 90 cm plant to plant in the row following a randomized block design and each treatment (genotype) was replicated thrice. The observation on leafhopper count including both nymphs and adults were recorded from three leaves per plant representing top (excluding two topmost leaves), middle (medium maturity) and bottom (leaving 1 or 2 bottom-most leaves) leaf on the main shoot. The population was recorded as the number of leafhoppers/3 leaves/plant from five randomly selected plants per treatment and the observations were recorded at weekly intervals starting from 30 days after sowing. The hopper burn injury on leaves was recorded visually as per cent damage and was scored as per standard grades followed by the All India Coordinated Research Project (AICRP) on Castor. Based on the leafhopper population and hopper burn score, the genotypes were categorized as highly susceptible, less susceptible and tolerant.

Grade (score)	Hopper burn on leaves (%injury)
0	No injury
1	Hopper burn 0-10%
2	Hopper burn 11-25%
3	Hopper burn 26-50%
4	Hopper burn above 50%

2.1 Estimation of Biochemical Constituents

The castor leaves from each genotype were collected and different biochemical constituents were evaluated in the laboratory. Total phenols were estimated by the method suggested by Swain and Hillis [5] and the total carbohydrates from leaves of castor genotypes were estimated as per the method suggested by Hedge and Hofreiter [6].

3. RESULTS AND DISCUSSION

The perusal of the data obtained from different treatments indicated that the incidence of leafhopper was highest during the 44th standard meteorological week. Based on leafhopper population and hopper burn score, the triple bloom genotypes Maharaja-9 and GCH-7 were categorized as tolerant to leafhopper with a mean leafhopper population of 2.3 and 2.4 leafhopper/three leaves/plant and recorded hopper burn score of 0.16 and 0.25, respectively whereas the genotype ICH-68, DCH-519 and ICH-66 were categorized as less susceptible to leafhopper with a mean leafhopper population of 3.9, 4.0 and 5.1 leafhopper/three leaves/plant and a hopper burn score of 0.50, 0.58 and 0.58, respectively. The genotypes DCH-177 and SHB-974 were found highly susceptible with a mean infestation of 8.3 and 7.8 leafhopper/three leaves/plant and mean hopper burn score of 2.25 and 1.92, respectively. Dorairaj et al. [7] and Lakshminarayana et al. [8] also reported similar findings where genotypes with waxy bloom showed resistance to leafhopper which is

Table 1. Population dynamics of leafhopper, *Empoasca flavescens* Fab. on different castor genotype during *Kharif*, 2019-20

Genotype	Mean number of leaf hopper/three leaves/plant during the different standard meteorological week																							Overall Mean	Yield (q/ha)
	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	1	2	3	4	5	6	7		
JSB-1018	2.7	1.9	4.5	3.7	5.5	4.7	17.2	16.2	15.2	13.4	12.0	10.0	6.0	5.0	4.0	4.7	4.3	4.2	3.7	3.6	2.2	2.3	0.0	6.2	33.3
SHB-974	3.7	3.1	5.7	5.3	6.9	6.1	23.1	20.2	20.5	17.1	13.0	12.0	7.0	5.0	4.2	5.7	5.1	5.1	4.1	4.1	3.1	3.2	1.0	7.8	30.7
SLCH-158	1.6	1.1	3.2	2.7	4.7	4.1	14.7	13.3	12.5	10.3	9.3	8.5	6.0	4.0	3.3	4.3	3.8	3.2	3.2	3.2	2.5	2.1	1.0	5.1	28.8
ICH-66	1.4	1.1	3.3	2.3	4.3	4.2	14.3	13.6	12.3	10.4	9.7	8.8	6.0	4.0	4.0	4.1	3.6	3.2	3.1	3.5	2.2	2.1	0.0	5.1	40.0
ICH-68	1.1	0.5	1.7	1.1	5.2	4.1	12.4	10.6	9.3	7.3	6.5	6.1	5.0	4.0	3.2	3.6	3.2	2.7	2.3	2.1	1.3	1.1	0.0	3.9	38.8
Maharaja-9	0.5	0.1	1.2	1.1	3.1	2.3	6.1	7.3	5.1	4.1	4.2	3.7	2.1	2.0	1.3	3.1	2.3	2.3	1.3	1.2	1.0	0.1	0.0	2.3	41.1
DCH-519	1.3	0.6	1.3	1	4.1	5.1	12.7	10.3	9.6	7.2	6.7	6.2	5.0	4.0	4.5	4.1	3.3	2.7	2.3	2.1	1.4	1.2	0.0	4.0	37.8
GCH-7	0.6	0.3	1.1	0.9	3.3	2.4	6.3	7.5	5.7	4.2	4.5	3.2	3.0	3.0	2.3	3.2	2.6	2.1	1.3	1.5	0.7	0.3	0.0	2.4	40.4
DCH-177	4.1	3.2	6.2	5.9	7.2	6.3	25.3	23.3	21.1	17.5	14.0	13.0	7.0	5.0	4.3	6.6	5.7	5.2	4.6	4.3	3.1	3.3	1.0	8.3	40.0
DCH-1566	2.6	1.7	4.3	3.2	5.3	4.3	17.7	16.5	15.2	13.7	12.0	10.0	6.0	5.0	4.2	4.5	4.1	3.9	3.7	3.2	2.4	2.3	0.0	6.1	32.1

SMW- Standard Meteorological Week

Table 2. Biochemical parameters and morphological characters of leaf on different castor genotypes during *Kharif*, 2019-20

Genotype	Phenol (mg/g)	TSS (mg/g)	Type of waxy bloom
JSB 1018	1.66	42.08	Triple
SHB 974	1.33	49.83	Triple
SLCH 158	1.43	38.33	Triple
ICH 66	1.41	38.67	Triple
ICH 68	1.86	36.50	Triple
Maharaja-9	2.04	30.08	Triple
DCH 519	1.76	30.16	Triple
GCH 7	2.10	30.52	Triple
DCH 177	1.31	65.70	Single
DCH 1566	1.69	42.17	Triple

Table 3. Correlation studies of biochemical parameters with leafhopper population

Sr. no.	Variable	Correlation coefficient
1	Phenol content	-0.814**
2	Total carbohydrates	0.910**

***Significance at p= 0.01 level*

Table 4. Hopper burn score of different castor genotypes at different days after sowing during *Kharif*, 2019-20

Genotype	30 DAS	60 DAS	90 DAS	120 DAS	150 DAS	180 DAS	Mean
JSB-1018	0	0.0	1.0	1.0	2.5	2.0	1.08
SHB-974	0	1.5	1.5	2.0	4.0	2.5	1.92
SLCH-158	0	0.0	0.5	1.0	2.5	1.5	0.91
ICH-66	0	0.0	0.0	0.5	1.5	1.5	0.58
ICH-68	0	0.0	0.0	1.0	1.0	1.0	0.50
Maharaja-9	0	0.0	0.0	0.0	0.5	0.5	0.16
DCH-519	0	0.0	0.0	0.5	1.5	1.5	0.58
GCH-7	0	0.0	0.0	0.0	1.0	0.5	0.25
DCH-177	0	1.5	2.0	2.5	4.0	3.5	2.25
DCH-1566	0	0.0	0.5	1.5	2.5	2.5	1.16

DAS- Days after sowing

Table 5. Correlation studies of biochemical parameters with hopper burn scores

S. no.	Variable	Correlation coefficient
1	Phenol content	-0.744*
2	Total carbohydrate	0.946**

**Significance at p= 0.05 level, **Significance at p= 0.01 level*

evidenced in the current study. Lakshmi et al. [9] also classified DCH-177 as highly susceptible based on the population of *E. flavescens* and hopper burn incidence. The pest population decreased with the increase in the intensity of waxy coating; this trait had a greater effect on pest incidence than the other morphological characters (growth habit, stem colour, number of nodes to primary raceme, leaf shape, nature of spike, nature of capsules, seed size, seed colour and seed weight). All genotypes (except DCH-177) had a waxy coating in all parts of the plant (triple bloom), whereas DCH-177 had a waxy coating only on the stem (single bloom). Lakshminarayana [10] and Shilpakala and Murali Krishn [11] also reported that triple bloom genotypes were less preferred by leafhoppers and exhibited a lower degree of hopper burn while single bloom genotypes were more preferred with more hopper burn.

3.1 Biochemical Components

The highest content of carbohydrates was recorded from the leaves of DCH-177 (65.70 mg/g) followed by SHB-974 (49.83 mg/g), while the lowest carbohydrate content of 30.08, 30.16, and 30.52 mg/g were recorded in leaves of Maharaja-9, DCH-519 and GCH-7 respectively. Total carbohydrates showed a significant positive correlation with the leafhopper population and hopper burn score. Masood [12] reported the association of low sucrose content and high phenol content in cotton aphids which are in close confirmation in castor also.

The highest amount of phenol content was recorded in the leaves of GCH-7 (2.10 mg/g) and Maharaja-9 (2.04 mg/g) while the lowest amount of phenol content was recorded in the leaves of DCH-177 (1.31 mg/g) and SHB-974 (1.33 mg/g). Phenols showed a negative correlation with the leafhopper population and with the hopper burn score. Rohini et al. [13] reported that maximum phenol content was found in leafhopper resistant varieties while minimum phenol content was reported in varieties which are susceptible to leafhoppers in cotton.

4. CONCLUSION

Among 10 castor genotypes screened against leafhopper Maharaja-9 and GCH-7 were least preferred whereas DCH-177 was found most preferred genotype having the highest leafhopper population and hopper burn score due to single bloom nature. The genotype with the highest phenol content showed the least population of leafhoppers while total carbohydrates content had a significant positive correlation with the leafhopper population. This could be supported by the fact that the phenol content of leaves has an adverse effect on the leafhopper population while carbohydrate content favours the incidence of leafhopper.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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