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Screening of castor genotypes against major insect-pests in South-West Haryana

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Abstract
Twelve castor genotypes were screened against major insect-pests of castor *viz.*, leafhopper, *Empoasca flavescens*; castor shoot and capsule borer, *Conogethes punctiferalis*; castor semilooper, *Achaea janata* and tobacco caterpillar, *Spodoptera litura*. The screening was done under field conditions during 2018-19 at CCS HAU, Regional Research Station, Bawal (Haryana). The levels of infestation of the four major insect-pests varied from genotype to genotype. The genotype Maharaja 9 exhibited minimum incidence of all the four major insect-pests as well as maximum yield (30.62 q/ha). The maximum incidence of *E. flavescens* was recorded in genotype DCH 177 (9.04 nymphs/3 leaves/ plant). The genotype SHB 974 suffered maximum mean damage by *C. punctiferalis* (14.23 % infested capsules), *A. janata* (4.01 larvae/plant) and *S. litura* (3.45 larvae/plant) during the crop period. The minimum yield was noticed in the genotype SLCH 158.

Keywords: Castor, genotype screening, *Empoasca flavescens*, *Conogethes punctiferalis*, *Achaea janata*, *Spodoptera litura*

Introduction
Castor (*Ricinus communis* L.) is an oilseed crop of industrial importance which is well suited for the arid as well as semi-arid areas of the world [1]. Castor is grown in about 30 countries on industrial scale and India holds first rank both in acreage and production of castor among the castor growing countries. In India, castor was cultivated in an area of 0.82 million ha producing 1.56 million tonnes during 2017-18 with a productivity of 1902 kg/ha [2]. The major use of castor crop is to extract non-edible oil from its seeds. Castor oil is used in a wide range of industrial processes for the manufacturing of products such as lubricants, paints, polymers, hydraulic brake fluids, perfumery products and soaps. Besides them, many bye-products of castor oil are also used by manufacturing industries [3]. Castor leaves are also used to rear non-mulberry Eri silkworm, *Philosamia ricini* (Saturniidae: Lepidoptera) [4]. During 2017-18, India fetched Rs. 6170 crores in terms of valuable foreign exchange by exporting 0.62 million tonnes of castor oil [5]. There are many factors responsible for losses in castor crop but insect-pests are the major ones. As many as 107 species of insect-pests and six species of mites are reported to cause serious damage to the castor crop. The major insect-pests of castor are castor semilooper (*Achaea janata* Linnaeus), castor shoot and capsule borer (*Conogethes punctiferalis* Guenée), leafhopper (*Empoasca flavescens* Fabricius), tobacco caterpillar (*Spodoptera litura* Fabricius) and whitefly (*Trialeurodes ricini* Misra). *E. flavescens*, *A. janata* and *D. punctiferalis* cause 4.69, 13.17 and 19.0-85.0 per cent yield losses in castor, respectively [6]. Losses in castor due to insect-pests are estimated to be in the tune of 35-50 per cent [7]. The insect-pests that cause serious damage to castor crop in the south-west zone of Haryana are castor semilooper (*A. janata*), castor shoot and capsule borer (*C. punctiferalis*), leafhopper (*E. flavescens*) and castor hairy caterpillar (*E. lunata*) [8]. Screening of genotypes were never conducted from the entomological point of view in the south-west zone of Haryana, so the present investigations were undertaken to evaluate the best suited genotypes from the entomologist's point of view.

Materials and methods
The experiment was conducted during 2018-19 at CCS HAU, Regional Research Station, Bawal located at latitude 28°10' N, longitude 76° 50' E and 266 m above mean sea level in South-Western area of Haryana in the Rewari district.

Experiment details: The experiment was laid out in Randomized Block Design (RBD) with three replications. The plots of size 4.8 × 4.8 m^2 were formed. The spacing of 120 cm (row-row) × 60 cm (plant-plant) was followed. Sowing was done on 20^{th} July, 2018. The recommended package of practices was followed except the insecticide treatments [9].

Genotypes screened: Twelve genotypes were screened against major insect-pests of castor. The genotypes are listed in Table 1.

Observations recorded: The incidence of major insect pests *viz*., castor semilooper (*A. janata*), castor shoot and capsule borer (*C. punctiferalis*), leafhopper (*E. flavescens*) and tobacco caterpillar (*S. litura*) was recorded. Five plants were selected from each plot and tagged randomly to observe the incidence and population of major insect-pests of castor starting from 30 days after sowing (DAS) at 15 days interval during entire crop growth period.

The nymphal population of *E. flavescens* was recorded from three leaves from the main shoot - top (excluding two top most leaves), middle and bottom leaf. The nymphal population was observed as the adult leafhoppers fly away even on causing slight disturbance to leaves for taking observations. Incidence of *A. janata* and *S. litura* was recorded by counting the number of larvae per plant. The incidence of *C. punctiferalis* was recorded by calculating the number of infested capsules as compared to the total number of capsules from 3 branches per plant at 15 days intervals. Per cent capsule infestation was expressed using the formula:

$$Capsule\ infestation\ (\%) = \frac{Number\ of\ infested\ capules}{Total\ number\ of\ capsules} \times 100$$

Statistical analysis: All the observations recorded in the due course of investigations were subjected to statistical analysis by proper methods using online statistical package OPSTAT [10].

Results and Discussion

The results revealed that the genotypes showed variable response to different insect-pests.

Screening of castor genotypes against leafhopper, *Empoasca flavescens*

Significant differences in mean leafhopper population of *Empoasca flavescens* was observed among the different genotypes. The mean nymphal population of leafhopper, *E. flavescens* on different genotypes varied from 2.59 to 9.04 nymphs/ 3 leaves/ plant (Figure 1). The maximum mean nymphal population was noticed in the genotype DCH 177 (9.04 nymphs/ 3 leaves/ plant) and SHB 974 (8.98 nymphs/ 3 leaves/ plant) both statistically non-significant. The genotype Maharaja 9 exhibited least mean nymphal population of 2.59 nymphs/ 3 leaves/ plant which was non-significantly different from the genotypes SHB 1033 and GCH 7 with mean population of 3.72 and 3.74 nymphs/ 3 leaves/ plant, respectively (Table 2). This differential reaction of genotypes to *E. flavescens* is mainly attributed to their waxy bloom character. The triple bloom genotypes Maharaja 9, SHB 1033 and GCH 7 exhibited less nymphal incidence of *E. flavescens* as compared to single bloom genotype DCH 177 which is in confirmation with the findings of previous authors [11-14].

Screening of castor genotypes against castor shoot and capsule borer, *Conogethes punctiferalis*

Significant differences in capsule infestation by *C. punctiferalis* was observed among the different genotypes. The highest per cent capsule infestation was noticed in the genotype SHB 974 (14.43 %) followed by DCH 1566 (14.02%), JSB 2018 (13.38 %) and SLCH 158 (11.59 %), all four genotypes showing non-significant statistical difference among them. The minimum capsule infestation among the genotypes screened was found in Maharaja 9 (5.23 %) which was at par with the genotypes ICH 68 and DCH 177 with per cent capsule infestation of 7.24 and 7.22 per cent, respectively (Table 2). The minimum capsule infestation observed in genotypes Maharaja 9 and ICH 68 was due to loose arrangement of capsules on their spikes as shown in Figure 3. Earlier studies also revealed similar results as the compact arrangement of capsules on spike make the genotype more favourable for *C. punctiferalis* and vice-versa [11].

Screening of castor genotypes against castor semilooper, *Achaea janata*

Significant differences in mean larval population of *A. janata* was observed among the different genotypes. The genotype SHB 974 exhibited higher mean larval population of 4.01 larvae per plant as compared to SLCH 158 (3.95 larvae per plant), DCH 1566 (3.59 larvae per plant), all three differing non-significantly (Figure 1). The minimum larval population of 1.81 larvae per plant was observed in the genotype Maharaja 9 and DCH 177 (1.86 larvae per plant), both differing non-significantly (Table 2). The larva of *A. janata* favours lush green foliage as compared to dull green foliage, this resulted in more larval incidence in the genotypes SHB 974, SLCH 158 and DCH 1566 which was also reported earlier, hence providing confirmation to our results also [15].

Screening of castor genotypes against tobacco caterpillar, *Spodoptera litura*

Significant differences in infestation caused by *S. litura* was observed among the different genotypes. The maximum *S. litura* larval incidence was observed in the genotype SHB 974 (3.45 larvae/ plant) followed by the genotypes JSB 2018 (3.24 larvae/ plant) and DCH 1566 (3.15 larvae/ plant) as depicted in Figure 1. The minimum mean larval population was observed in the genotype Maharaja 9 (2.16 larvae/ plant) which was at par with DCH 177 (2.32 larvae/ plant), DCH 519 (2.44 larvae/ plant) and ICH 68 (2.47 larvae/ plant) (Table 2). The present findings are in confirmation with the earlier findings which concluded that the castor genotypes with large size leaves were preferred by *S. litura* as compared with the genotypes having small sized leaves [11].

Comparison of seed yield of castor genotypes

It is clearly evident from Table 2 that the maximum seed yield was noticed in the genotype Maharaja 9 (30.62 q/ ha) followed by the genotypes DCH 177 (30.48 q/ ha), ICH 68 (30.34 q/ ha), GCH 7 (30.16 q/ ha), ICH 66 (29.68q/ ha) and DCH 519 (29.15 q/ ha). All of these genotypes showed no significant difference in yield statistically. The minimum yield was obtained in genotype SLCH 158 (23.36 q/ ha) which in turn was found non-significantly different with the genotype SHB 974 (25.36 q/ ha).

Table 1: Castor genotypes screened against major insect-pests of castor

S. No.	Genotype	S. No.	Genotype
1.	DCH 177	7.	ICH 68
2.	JSB 2018	8.	ICH 66
3.	DCH 1566	9.	SLCH 158
4.	Maharaja 9	10.	ICH 278
5.	SHB 1033	11.	SHB 974
6.	DCH 519	12.	GCH 7

Table 2: Screening of castor genotypes against major insect pests of castor

Genotypes	Leafhopper (nymphs/ 3 leaves/ plant)	Capsule borer infestation (%)	Semilooper (larvae/ plant)	Tobacco caterpillar (larvae/ plant)	Yield (q/ ha)
DCH 177	9.04 (3.16)	7.22 (15.56)*	1.86 (1.69)	2.32 (1.82)	30.48
JSB 2018	6.49 (2.73)	13.38 (21.38)	3.45 (2.11)	3.24 (2.06)	27.55
DCH 1566	6.84 (2.80)	14.02 (21.98)	3.59 (2.14)	3.15 (2.04)	25.76
Maharaja 9	2.59 (1.89)	5.23 (13.20)	1.81 (1.68)	2.16 (1.78)	30.62
SHB 1033	3.72 (2.17)	7.89 (16.30)	3.17 (2.04)	2.96 (1.99)	27.31
DCH 519	4.83 (2.40)	9.78 (18.15)	2.37 (1.84)	2.44 (1.86)	29.15
ICH 68	4.55 (2.34)	7.24 (15.57)	2.24 (1.80)	2.47 (1.86)	30.34
ICH 66	5.64 (2.57)	9.94 (18.32)	2.26 (1.81)	2.84 (1.96)	29.68
SLCH 158	5.80 (2.61)	11.59 (19.86)	3.95 (2.23)	3.03 (2.01)	23.36
ICH 278	4.58 (2.36)	8.78 (17.22)	2.72 (1.93)	2.83 (1.96)	26.53
SHB 974	8.98 (3.16)	14.43 (22.26)	4.01 (2.24)	3.45 (2.11)	25.36
GCH 7	3.74 (2.17)	8.41 (16.84)	2.29 (1.81)	2.49 (1.87)	30.16
C.D. (p=0.05)	0.33	2.42	0.07	0.08	2.29
SE(m)	0.02	0.03	0.11	0.79	0.78
C.V.	1.97	2.50	7.69	8.01	4.79

Figures in parentheses are $\sqrt{x+1}$ transformation values
* Figures in parentheses are Arc sine transformation values

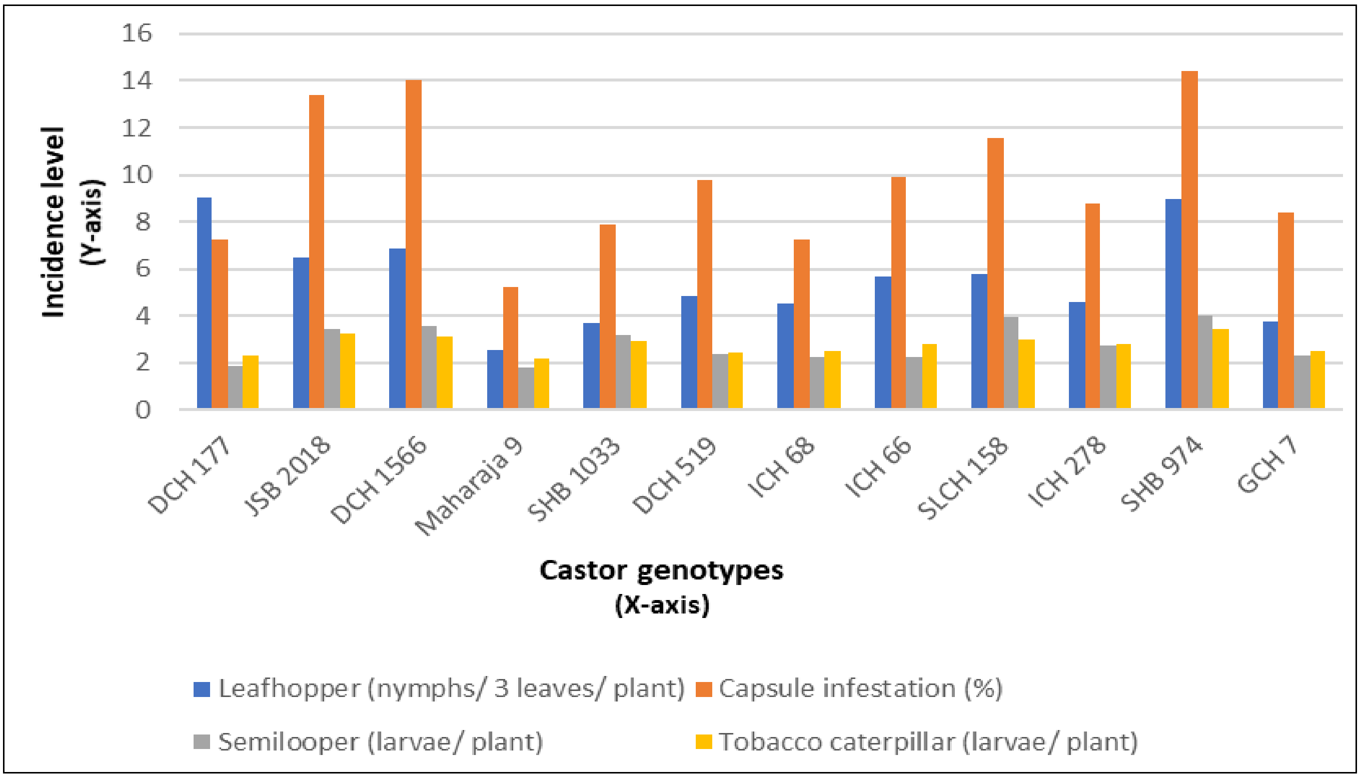

Fig 1: Relative incidence of major insect pests on castor genotypes during 2018-19

a. b. c. d

Fig 2: Major insect-pests of castor in south-west Haryana (a) Adult of leafhopper, *Empoasca flavescens* (b) Caterpillar of castor shoot and capsule borer, *Conogethes punctiferalis* inside the capsule (c) Caterpillar of castor semilooper, *Achaea janata* (d) *Spodoptera litura* causing defoliation

(a) (b)

Fig 3: Loose arrangement of capsules on spike on genotypes (a) Maharaja 9 (b) ICH 68

Conclusion

The genotypes showed differential response to different insect-pests. But the genotype Maharaja 9 was found superior over all other genotypes screened due to maximum yield as well as less incidence of all the four major insect-pests considered. Morphological characters play a major role in determining the level of resistance against insects. In castor, waxy bloom, compactness of capsules on spike, stem colour etc. are such characters. Furthermore, biochemical studies need to be conducted to decipher the biochemical factors that determine the variable response of insects to the genotypes grown.

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