

## Interaction Between Pest Incidence of Leaf Hoppers, *Empoasca flavescens* Fab and Epicuticular Wax Content in the Leaves of Castor Genotypes

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**Abstract** Epicuticular wax content in the leaves of different castor genotypes which varied from minimum of 281.80µg in Kranthi to a maximum of 583.72µg in the genotype Haritha. More than 350µg of wax was recorded in the genotypes i.e. 368.61µg in RG-2928, 381.15µg in PCH-111, 387.90µg in RG-2835, 389.83µg in DCS-9, 390.80µg in PCH-288 and 394.65µg in PCH-282. The epicuticular wax content ranging from 400 to 500µg was observed in the castor genotypes i.e. PCH-294 (423.59µg), PCH-106 (423.59), DPC-9 with 426.49µg, RG-776 (429.38), 48-1 and PCH-248 with 458.32µg and PCH-262 with 462.18µg though highest range of wax more than 500µg was recorded in genotypes i.e. M-574 with 532.59µg and RG-1180 with 508.76µg per 273.33µg of leaf discs. Epicuticular wax content of higher range i.e. approximately from 400µg

and above in the leaf could result in offering moderate to high resistance against leafhopper damage in the form of hopper burn recording significantly negative relation against hopper incidence in castor.

**Keywords** Interaction, Epicuticular wax, Castor, Genotypes, *Empoasca flavescens*.

### Introduction

Castor (*Ricinus communis* Lin.) is an important non edible oilseed crop which is grown in arid and semi arid regions. In India, Castor is sown during July or August and harvested around December or January. More than 20 species of insect pests were found associated with castor, but many of them were highly irregular in occurrence over years, distributed in patches with low population causing no remarkable damage to the crop. Only 10 species belonging to Lepidoptera, Hemiptera, Orthoptera and Thysanoptera showed variable economic importance and of them, five species were found regular with high degree of severity as major pests. Most of the insect pests were either defoliators or sucking pests [1]. The magnitude of insect pest problem is quite high in Southern India where castor is grown mainly as rainfed crop, resulting in lower seed yield. The major pest problems in castor include the defoliators,

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semilooper, *Achaea janata* L., tobacco caterpillar, *Spodoptera litura* Fab. capsule borer, *Conogethes punctiferalis* Guen. and the sucking pests, leafhopper, *Empoasca flavescens* Fab. thrips, *Retithrips syniacus* Mayet and whitefly, *Trialeurodes ricini* Misra [2]. Morphological characters of host plant serve as a non preference mechanism for feeding and oviposition by insects [3]. In castor, morphological characters of the plant like plant height, intensity of waxy bloom coating, age of plant at flowering, number of nodes on the stem, intermodal length, stem color, number of branches, number of leaf lobes, shape of the leaf, leaf area, petiole length, leaf sinus depth, spike compactness (loose/compact) and spiny characters are permissive factors for insect activity. Bloom character of castor crop played a major role in determining the resistance or susceptibility to sucking pest. Studies on incidence of insect pests in relation to morphological characters of castor genotypes give better understanding of plant insect relationship, especially in recognizing the mechanism of resistance in plants that aid in selection and breeding of insect resistant varieties. Use of resistant varieties is the most economical approach and would become in expensive in the long run. Incorporation of resistant plant genotypes into integrated pest control system minimizes the number of insecticide applications and conserves the natural enemies besides preserving the environmental safety.

### Materials and Methods

The field experiment was carried out at student farm and wax estimation of castor genotypes was carried out in the Department of Entomology, College of Agriculture, Rajendranagar, Hyderabad. The seed material of various cultivars/genotypes/hybrids was obtained from Regional Agricultural Research Station, Palem, Mahaboobnagar district, AP and Directorate of Oilseeds Research (DOR), Rajendranagar, Hyderabad. The genotypes and their morphological characters were described as per castor germplasm catalogue of the Directorate of Oilseed Research, Hyderabad and RARS, Palem (Table 1). The genotypes were sown in two rows. The field was ploughed thoroughly thrice to obtain fine tilth and properly levelled after removing stubbles, weeds and trash. Sowing was taken up on 30.08.2013 by dibbling the seed

**Table 1.** Morphological character of castor genotypes. Bloom =waxiness, Zero – No bloom, Single –bloom on stem, Double – bloom on stem, branches, lower side of leaves, Triple - bloom on whole plant.

Sl. No.	Genotypes	Bloom	Stem color	Leaf shape	Nature of capsule
1	DPC-9	Zero	Green	Flat	Spiny
2	DCS-9	Double	Red	Flat	Spiny
3	48-1	Double	Red	Flat	Non-spiny
4	Haritha	Double	Green	Flat	Spiny
5	PCH-288	Double	Green	Flat	Spiny
6	PCH-111	Double	Green	Flat	Spiny
7	Kiran	Double	Red	Flat	Non-spiny
8	PCH-106	Double	Green	Flat	Spiny
9	PCH-222	Double	Red	Flat	Semi spiny
10	PCH-262	Double	Green	Flat	Spiny
11	Kranthi	Double	Red	Flat	Spiny
12	M-574	Triple	Green	Cup shaped	Spiny
13	RG-1180	Triple	Green	Cup shaped	Non-spiny
14	PCH-254	Triple	Green	Flat	Spiny
15	GCH-4	Triple	Red	Flat	Semi spiny
16	PCH-282	Triple	Green	Flat	Spiny
17	PCH-248	Triple	Red	Flat	Spiny
18	PCH-294	Triple	Green	Flat	Spiny
19	RG-2835	Double	Red	Flat	Spiny
20	RG-2928	Double	Red	Flat	Spiny
21	RG-776	Triple	Red	Flat	Spiny

with a spacing of 90 × 60 cms at the rate of two seeds per hill.

### Estimation of epicuticular wax content of castor genotypes

Wax content in the castor leaves was estimated by following colorimetric method based on the color change produced due to the reaction of wax with acidic  $K_2Cr_2O_7$ . The reagent was prepared by mixing 40 ml deionized water with 20 g powdered potassium dichromate. The resulting slurry was mixed vigorously with 1 liter of concentrated sulfuric acid and heated (below boiling) until clear solution was obtained. The individual sample consisted of two castor leaf discs, having an area of 3 cm<sup>2</sup> (273.33 mg) and three samples for every entry. Each sample was immersed in 15 ml redistilled chloroform for 15 sec. The extract was filtered and evaporated on a boiling water bath, until the smell of chloroform could not be detected. After adding 5 ml of reagent, samples were placed in boiling water for 30 min. After cooling, 12 ml of deionized water was added. Later samples were allowed for color

**Table 2.** Epicuticular wax content in castor genotypes. Figures in parenthesis are square root transformed values. nm = Nanometer,  $\mu\text{g}$  = Microgram, mg = Milligram.

Genotypes	Mean optical density at 590 nm	Wax content ( $\mu\text{g}/273.33$ mg leaf discs)
DPC-9	0.420 (20.52)	426.49 (20.68)
DCS-9	0.382 (19.77)	389.83 (19.77)
48-1	0.453 (21.41)	458.32 (21.43)
Haritha	0.583 (24.05)	583.72 (24.18)
PCH-288	0.383 (19.82)	390.80 (19.79)
PCH-111	0.373 (19.39)	381.15 (19.55)
PCH-254	0.392 (19.96)	399.48 (20.01)
M-574	0.530 (23.26)	532.59 (23.10)
Kiran	0.313 (17.78)	323.27 (18.01)
PCH-248	0.453 (21.48)	458.32 (21.43)
PCH-294	0.417 (20.54)	423.59 (20.61)
PCH-262	0.457 (21.59)	462.18 (21.52)
GCH-4	0.305 (17.56)	315.56 (17.79)
PCH-282	0.397 (20.17)	394.65 (19.89)
RG-2835	0.380 (19.77)	387.90 (19.72)
PCH-106	0.417 (20.52)	423.59 (20.61)
PCH-222	0.323 (18.19)	332.92 (18.27)
RG-2928	0.360 (19.20)	368.61 (19.23)
RG-1180	0.497 (22.44)	508.76 (22.58)
RG-776	0.423 (20.56)	429.38 (20.75)
Kranthi	0.270 (17.13)	281.80 (16.82)
SE (m)	0.123	0.013
CD ( $p=0.05$ )	0.043	0.037

development and after cooling, the optical density of the sample was read at 590 nm [4].

#### Observations on leaf hoppers

Leaf hoppers counts including both nymph and adults were recorded on three leaves in each plant selecting one leaf from top (excluding two top most leaves), middle (medium maturity) and bottom (leaving 1 or 2 bottom most leaves) on the main shoot. Population was recorded as no of leaf hoppers/3 leaves/plant and percent leaf area burnt per plant (average of three plants). Observations were taken in the early morning (6.00-8.00 am) and percent of leaf burnt (hopper burn) at peak infestation was reported. Hopper burn injury was recorded by following the score index given by Directorate of Oilseeds Research, Rajendranagar, Hyderabad.

Score index (0-4 score) : 0-No injury, 1- Hopper burnt upto 10%, 2- Hopper burnt 11-25%, 3- Hopper burnt 26-50%, 4- Hopper burnt above 50%.

**Table 3.** Incidence of leafhoppers, *Empoasca flavescens* in relation to epicuticular wax content in leaves of castor genotypes. Figures in parentheses are logarithmic transformed values.  $\mu\text{g}$  = Microgram, mg = Milligram.

Genotypes	Wax content ( $\mu\text{g}/273.33$ mg leaf discs)	Leafhoppers/ 3 leaves/3 plants	Hopper burn injury
DPC-9	426.49 (20.68)	170.00 (5.124)	4
DCS-9	389.83 (19.77)	167.67 (5.127)	3
48-1	458.32 (21.43)	17.00 (2.845)	0
Haritha	583.72 (24.18)	75.33 (4.332)	2
PCH-288	390.80 (19.79)	265.00 (5.550)	4
PCH-111	381.15 (19.55)	258.33 (5.548)	4
PCH-254	399.48 (20.01)	21.67 (3.118)	0
M-574	532.59 (23.10)	17.67 (2.911)	0
Kiran	323.27 (18.01)	212.33 (5.362)	3
PCH-248	458.32 (21.43)	27.33 (3.327)	1
PCH-294	423.59 (20.61)	78.33 (4.371)	2
PCH-262	462.18 (21.52)	29.00 (3.369)	0
GCH-4	315.56 (17.79)	306.67 (5.729)	3
PCH-282	394.65 (19.89)	48.00 (3.890)	1
RG-2835	387.90 (19.72)	209.00 (5.335)	4
PCH-106	423.59 (20.61)	219.33 (5.391)	4
PCH-222	332.92 (18.27)	263.33 (5.577)	4
RG-2928	368.61 (19.23)	179.67 (5.163)	4
RG-1180	508.76 (22.58)	80.00 (4.392)	2
RG-776	429.38 (20.75)	122.00 (4.809)	3
Kranthi	281.80 (16.82)	200.00 (5.278)	3

## Results and Discussion

#### Estimation of epicuticular wax on the leaves of castor genotypes

Data presented in the Table 2 reveals that the amount of wax present in the leaves of different castor genotypes which varied from minimum of 281.80mg in Kranthi to a maximum of 583.72 $\mu\text{g}$  in the genotype Haritha. Lower range of wax content i.e. from 315.56, 323.27 and 332.92 $\mu\text{g}$  was observed in GCH-4, Kiran and PCH-222 genotypes respectively. However, more than 350 $\mu\text{g}$  of wax was recorded in the genotypes i.e. 368.61 $\mu\text{g}$  in RG-2928, 381.15 $\mu\text{g}$  in PCH-111, 387.90 $\mu\text{g}$  in RG-2835, 389.83 $\mu\text{g}$  in DCS-9, 390.80 $\mu\text{g}$  in PCH-288 and 394.65 $\mu\text{g}$  in PCH-282. The epicuticular wax content ranging from 400 to 500 $\mu\text{g}$  was observed in the castor genotypes i.e. PCH-294 (423.59 $\mu\text{g}$ ), PCH-106 (423.59), DPC-9 with 426.49 $\mu\text{g}$ , RG-776 (429.38), 48-1 and PCH-248 with 458.32 $\mu\text{g}$  and PCH-262 with 462.18 $\mu\text{g}$  though highest range of wax more than 500 $\mu\text{g}$  was recorded in genotypes i.e.M-574 with

**Table 4.** Correlation between epicuticular wax content defoliators and leafhopper incidence. NS=Non-significant.

Pest population	Correlation coefficient	
Leafhopper	Wax content	-0.678**

532.59µg RG-1180 with 508.76µg per 273.33mg of leaf discs.

Interaction between pest incidence and epicuticular wax content in the leaves of castor genotypes

Studies on correlation between the wax content of castor leaves and the two major lepidopteran defoliators i.e. *Spodoptera litura* and *Achaea janata* was found to be non-significant where the wax content couldn't influence pest infestation, hence the larval population varied among the genotypes without reference to the wax content. However, incidence of leafhoppers, *Empoasca flavescens* had showed significantly negative reaction with the wax content of castor genotypes. Similar results reported against sucking pest in cabbage by Trdan et al. [5] and Znidarcic et al. [6]. In the present study, wax content of higher range i.e. approximately from 400 µg and above in the leaf could result in offering resistance against leafhopper. This was clearly evidenced in the case of genotypes, 48-1 with 458.3µg, 399.48µg in PCH-254, 423.59µg in PCH-294, 458.32µg in PCH-248 and 462.18µg in PCH-262, 508.76µg in RG-1180 and maxi-

mum of 583.72µg in Haritha, which have recorded resistance either moderately or high against the leafhopper damage in the form of hopper burn. Though there are exceptions with regard to high content of wax in leaves recording susceptibility to leafhopper infestation which was clearly observed in the genotypes PCH-106 with 426.59µg, DPC-9 with 427.49µg and RG-776 with 429.38µg with hopper population of 219.33, 170.00 and 122.00 respectively but recorded a score of 2 showing 25 to 50% hopper burn which might be due to the variations in the shape of leaves or nature of the plant that harbored hoppers favoring their build up and further damage (Tables 3 and 4).

#### References

1. Sarma AK, Singh MP, Singh KI (2005) Studies on insect-pests of castor in the agro-ecosystem of Manipur. *J Appl Zool Res* 16 : 164—165.
2. Lakshminarayana M, Raoof MA (2005) Insect pests and diseases of castor and their management. Directorate of Oilseeds Res, pp 78.
3. Painter RH (1951) Insect resistance in crop plants. Macmillan & Co., New York, pp 520.
4. Ebercon A, Blum A, Jordan WR (1977) Rapid calorimetric method for epicuticular wax content of sorghum leaves. *Crop Sci* 17 : 179—180.
5. Trdan S, Valic N, Vovk I, Martelanc M, Simonovska B, Vidrih R, Vidrih M, Znidarcic D (2009) Natural resistance of cabbage against three insect pests. *IOBC/WPRS Bull* 51 : 93—106.
6. Znidarcic D, Markovic D, Vidrih R, Bohinc T, Trdan S (2011) Which biophysical and biochemical factors may contribute to higher resistance of cabbage (*Brassica oleraceae* L. var *capitata*) to attack of the most important pests. *Acta Agriculturae Slovenica* 97 : 151—158.