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Preferred stage of the crop for cotton stem weevil infestation and scanning electron microscopic view of healthy and infested cotton stem

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ABSTRACT

Cotton stem weevil, Pempherulus affinis Faust is the most destructive pest of the seedling stage of cotton in South India. Its habitat, inside the stem protects the pest from control measures and hence management of this pest is challenging. The pest occurred in the early stage of the crop, multiplied later, and continue the damage in grown-up crop until dislodging of galled plant and carry over to next season's crop. Hence, the present study was carried out to identify and to generate information about the preferred stage of the crop for cotton stem weevil infestation to recommend timely management tactics as heavy yield loss occurs due to early infestation. Four staggered pot culture sowings at weekly intervals were done to attain four phonological stages of the crop viz.,15 Days After Sowing (DAS), 22 DAS, 29 DAS, and 36 DAS. Five pairs of weevils were released at each stage of the crop and the observation was made on the infestation level on different days after the release of the weevil. The mean percent infestation at different growth stages of the crop revealed that the highest percent infestation was found in fifteen days old crop (63.57). The present study revealed that the early stage (15 days old crop) are more prone to stem weevil infestation than compared to later stage.The contribution of this study is that the management tactics are advised to practice in early stage of the crop to reduce stem weevil infestation and to prevent yield loss.

Keywords: *Stage of the crop, cotton stem weevil, pot culture experiment, Days After Release, healthy stem, galled (infested) stem.*

Introduction

In India, cotton (*Gossypium hirsutum*) is one of the most economically important agricultural crops and India is the only country in the world that commercially grows all four cultivated cotton species, ranking first in area and second in production [1].Area under cotton and raw cotton production is high in India at the global level [8]. Insect pests are one of the limiting factors of cotton yield and cotton stem weevil *Pempherulus affinis* Faust is considered as a major pest next to bollworms which is distributed throughout the cotton growing tracts of the country [3].The success of the pest not only depends on the physical ecology but also depends on the plant phenology; both are interrelated. Studies on plant phenology preference of the pest also help to record the Economic Thresh Hold level, suitable biological control agents, and accurate management practices, hence the present study was carried out to record the preferred stage of the crop for cotton stem weevil infestation.

Materials And Method

Mass culturing of cotton stem weevil, *Pempherulus affinis*

Mass culturing of *P. affinis* was done by using infested cotton stalks [6]. Gall portion of infested stalks was placed inside the glass chamber of 1' x 1' x 1' containing sand and humidity was maintained by sprinkling water once in 5 days. The emerged adult weevils were separated by sex and five pairs were released in potted cotton plants of 15- 20 days old. The adult weevils could also be maintained on sugarcane bits for 10 days by providing sugarcane bits once in 3 days.

Studies on the preferred stage of the crop for *Pempherulus affinis*

Staggered pot culture sowings of cotton variety Co 17 was done on four different dates at weekly intervals. Four phenological stages of plants *i.e.* 15 days after sowing (DAS), 22 DAS, 29 DAS and 36 DAS were subjected for this experiment. The experiment consisted of four crop phenological growth stages as treatments and was replicated five times. Five pairs of male and female weevil were released at each stage of the crop and covered with mylar film cage. Observations were taken on a number of infested plants at 15, 30, 45, 60, 75, 90, and 105 days after release (DAR) of adult weevil. Then the percent infestation was calculated by using the following formula:

$$\text{Infestation (\%)} = \frac{\text{Number of infested plants}}{\text{Total number of plants}} \times 100$$

Statistical analysis

The data on percent stem weevil infestation were transformed into arc sine transformation [9].The Duncan's Multiple Range Test (DMRT) was used to compare the treatment means. In the table presented, the means which were significantly different at

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5 percent level were designated with different letters in each column [4].

Results

The results pertaining to the preferred stage of the crop for cotton stem weevil infestation is presented in Table 1. The fifteen days old crop infested with stem weevil shown 45 percent damage at early stage which increased up to 70% at 60 DAR of the weevil. As the age of the crop increases the initial infestation level decreased and it was found to be true with twenty days old crop which attained the stem weevil infestation of 35% initially and 60 % in 105 DAR of the weevil. Twenty-five percent damage was recorded initially and reached the maximum (45%) in twenty-nine and thirty-six days old crop. In general, after 60 DAR of weevil, there was no further increase of infestation noticed in all stages of crop. The overall mean revealed that the highest percent infestation (63.57%) was found in fifteen days old crops followed by twenty two days old crops (53.57%). The other two stages *viz.,* twenty nine days old and thirty six days old crop had 43.57% and 38.57% stem weevil damage respectively.

The young succulent stem of the crop at an early stage might be the reason for higher infestation and also it might favour the egg laying by an adult weevil which can easily insert its ovipositor into the stem. The preferred stage of the crop of 12-15 days for *P. affinis* was described by Ayyar [2].The management of *P. affinis* at 8-10 DAS was examined in the histopathological studies of cotton stem tissues at different age of the crop [5]. The time of sowing may also play the role in pest occurrence and other attributes of the crop [8]. Initiation of management of the pest at the economic level needed to identify the correct stage of the crop infestation which was reported by [7] in pink bollworm management.

The present study concluded that fifteen days old cotton seedlings are preferred by *P. affinis*. It shows that any prophylactic measures in terms of bio-intensive management methods may be applied before a fortnight of the crop stage from sowing.

Scanning electron microscopic view of healthy and infested cotton stem

Healthy cotton stem

The epidermal region of the healthy stem was broad and remained intact. Chlorenchyma and collenchyma cells were clearly visible. The cortex area was narrow with 4-5 layers of diverging cell clusters. The primary phloem was clearly visible. The secondary phloem was comprised of funnel-shaped expanded rays with cone-shaped phloem tissues.

The expanded rays consisting of rectangular cells were arranged in diverging blocks. The primary and secondary xylem cells were narrow, thin-walled and radially arranged. The pith region consisting of parenchyma cells was wide and remained intact (Fig. 1).

Cotton stem weevil-infested stem

The epidermal layer of the galled bark was totally collapsed with chlorenchyma and collenchyma cells. Vascular bundles consisting of xylem and phloem cells had undergone some modifications. The outer layer of primary phloem cells was found to be crushed, resulting in a distorted mass of phloem fibres. The secondary phloem cells were modified and reduced. The primary xylem had undergone structural modification. The outer part of the secondary xylem underwent narrow cleavage leaving several small clusters. The parenchyma cells of the pith region were fissured due to the feeding of cells by grub providing a dark powdery mass (Fig. 1).

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Conflict of interest

The authors declare that they have no conflict of interest

Table 1. Stage-wise Infestation of cotton stem weevil, Pempherulus affinis Faust

Days after release of weevil.

Mean of five replications. Each replication is a mean of four observations.

Figures in parentheses are arc sine transformed values.

In columns, means followed by different letters are significantly different at 5 % level (Duncan's Multiple Range Test)

Age of the crop	Per cent stem weevil infestation							Mean
	15 DAR	30 DAR	45 DAR	60 DAR	75 DAR	90 DAR	105 DAR	
15 days old	45.00 (41.98)^{a}	60.00 (50.98)^{a}	60.00 (50.98)^{a}	70.00 (56.98)^{a}	70.00 (56.98)^{a}	70.00 (56.98)^{a}	70.00 (56.98)^{a}	63.57
22 days old	35.00 (35.98)^{ab}	50.00 (44.98)^{a}	50.00 (44.98)^{ab}	60.00 (50.98)^{ab}	60.00 (50.98)^{ab}	60.00 (50.98)^{ab}	60.00 (50.98)^{ab}	53.57
29 days old	25.00 (29.98)^{b}	35.00 (35.99)^{b}	45.00 (41.98)^{bc}	50.00 (44.98)^{bc}	50.00 (44.98)^{bc}	50.00 (44.98)^{bc}	50.00 (44.98)^{bc}	43.57
36 days old	25.00 (29.98)^{b}	30.00 (32.98)^{b}	35.00 (35.99)^{c}	45.00 (41.98) ^{c}	45.00 (41.98) ^{c}	45.00 (41.98) ^{c}	45.00 (41.98) ^{c}	38.57
SE.d	3.354	4.242	4.242	3.968	3.968	3.968	3.968	-
CD (*P*= 0.05)	7.110	8.994	8.994	8.413	8.413	8.413	8.413	-

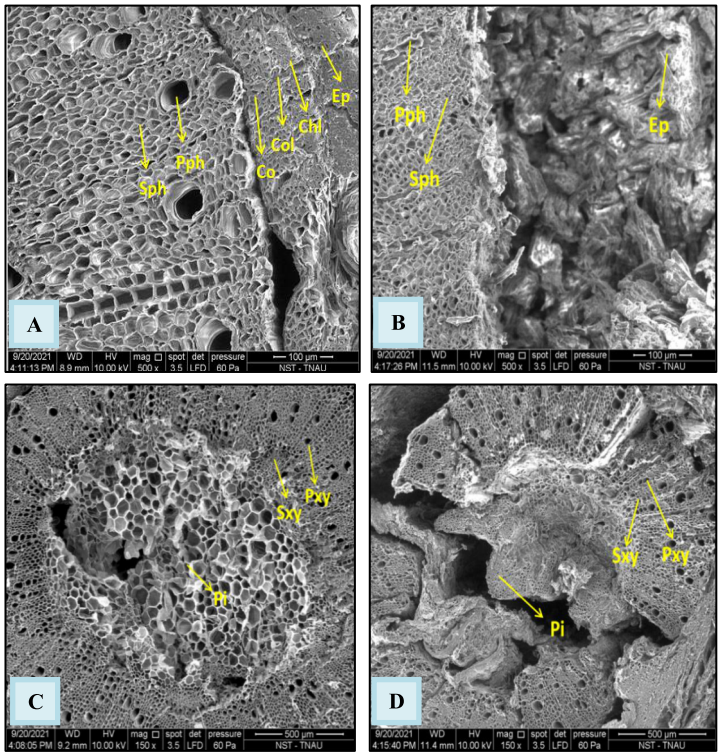

Fig 1. Cross section of cotton stem; A. Co 17- Healthy stem; B. Galled stem; C. Healthy inner stem; D. Galled inner stem.

Note: Ep - Epidermis; Chl - Chlorenchyma; Col - Collenchyma; Co - Cortex; Pi - Pith; Pxy - Primary xylem; Sxy - Secondary xylem; Pph - Primary phloem; Sph- Secondary phloem

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