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SEASONAL POPULATION DYNAMICS AND MANAGEMENT OF DUSKY COTTON BUG (DCB), *OXYCARENUS HYALINIPENNIS* COSTA IN COTTON

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ABSTRACT

Studies were conducted to see the seasonal population incidence of Dusky Cotton Bug (DCB), *Oxycarenus hyalinipennis* Costa at the Nuclear Institute for Agriculture & Biology (NIAB), Faisalabad during June, 2015. Data revealed that the incidence of DCB started in the second week of September and reached to the peak level in the first week of October. The population started to decline till first week of November at the termination of the crop. The DCB population recorded low on non-*Bt* compared to *Bt* cotton genotypes. The optimum temperature and humidity for DCB was recorded at 35.5 and 41 %, respectively. Moreover, a field bioassay study showed that the mean DCB population remained at 1.8 per boll on imidacloprid, whereas no DCB was recorded on chlorpyriphos after 96 hrs post treatment.

Key words: Dusky Cotton Bug, *Bt* and non-*Bt* cotton, Field bioassay, Imidacloprid and Chlorpyriphos.

INTRODUCTION

Cotton technically known as *Gossypium hirsutum* L., commercially grown for making cotton thread and fabric, is a vital source of foreign exchange earning of Pakistan. It serves both as a source of vegetable oil and fiber (Mallah *et al*., 1997). The average per acre yield of cotton in Pakistan is lower in comparison with other cotton growing countries, despite numerous efforts (Bakhsh *et al*., 2005). The yield loss of around 30-40% is attributed to Insect pests alone which are considered the most important limiting factor (Haque, 1994; Kannan *et al*., 2004).

Dusky cotton bug is a severe pest of cotton crop and plants of the family Malvaceae, distributed and well documented round the globe with few exceptions. This pest has already established on islands near U.S mainland and it has been noticed several times at U.S ports. High population density of this pest has been reported in Florida (Smith and Brambila, 2008) It has also been reported from Turks and Caicos, Bahamas, Cayman Islands, and Hispaniola (Baranowski & Slater, 2005). Besides cotton crop it has been reported to cause damage to persimmon, fig, dates and avocado in Isreal and sunflower seeds in India (Goyal, 1974); Nakache and Klein 1992).

Dusky cotton bug, *O. hyalinipennis* Costa is a member of family Oxycarenidae and superfamily Lygaeoidea (Henry, 1997). In many countries round the globe, it has the ability to become a major pest of cotton owing to potential losses it can inflict to cotton crop. It has the ability to decrease cotton seed germination, weight and reduction in oil quality besides DCB being crushed during the ginning process and stained the lint of cotton to pinkish color (Henry, 1983).

Severe infestation of DCB damages the seed cotton embryo resultantly seed viability is reduced (Kirkpatrick, 1923; Pearson, 1958; Srinivas and Patil, 2004). The prevalence of DCB is on the rise in *Bt* compared to non-*Bt* Cotton genotypes owing to the lower number of insecticide applications for the control of bollworms (Patil and Rajanikanth, 2005). Due to its damages it has turned into a potential threat to cotton crop (PERAL, 2006) which present a serious economic risk to cotton (Smith and Brambila, 2008).

With the increasing level of awareness about the damages caused by DCB, the need for its management is gaining momentum. At present the only option available to the farmers is the application of chemical insecticides (Prayogo *et al.*, 2005).Other options including biocontrol are limited. Therefore, it is necessary to screen most effective insecticides against DCB.

The present studies were conducted to see the seasonal population abundance of the DCB in relation with temperature and relative humidity as well as to screen an effective insecticide for its control under the field conditions.

MATERIALS AND METHODS

The cotton varieties *Bt* and non-*Bt* with 90 cm plant to plant and 60 cm row to row distance, respectively were sown on June 14, 2015. The field experiment was laid out in a Randomized Complete Block 'Design (RCBD) at the Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad. Data on DCB seasonal incidence at weekly intervals was recorded from the five

selected cotton plants; at the bottom, middle and top bolls of unsprayed *Bt* and non-*Bt* varieties.

Data recorded from the *Bt* and non-*Bt* cotton varieties was pooled for the population abundance. Environmental data, maximum and minimum daily temperatures and relative humidity were recorded round the year by the environmental station established by the Soil Science Division (SSD), NIAB. DCB seasonal incidence data was graphed in MS-excel against maximum and minimum temperatures and relative humidity.

To assess the effect of insecticides on DCB, two insecticides, imidacloprid and chlorpyriphos of neonicotinoid and the organophosphate (OP) group were selected. A 500 ppm concentration of both the insecticides was prepared for field application. Insecticides were applied to five plants per treatment and the experiment was replicated thrice. Data was recorded as a reduction in DCB population by a particular insecticide.

RESULTS

The incidence of DCB on *Bt* and non-*Bt* cotton was noticed in the second week of September with a mean population of 7 and 4 DCB per boll on *Bt* and non-*Bt* cotton varieties, respectively. The population of DCB gradually increased to its maximum level in the first week of October, remained at 46 and 20 DCB per boll on *Bt* and non-*Bt*, respectively. Afterwards, the population of DCB starts declining from the peak level in the second week of October with the mean population of 26 and 14 DCB on *Bt* and non-*Bt*, respectively to the last week of November (Table 1).

Maximum and minimum temperatures also showed their influence on the population of DCB. The optimum minimum and maximum temperatures for DCB was 22 and 35, respectively, as the population remained at the peak level on both *Bt* and non-*Bt* cotton varieties in the first week of October. With the decline in temperature the population of DCB started to decline (Fig. 1, 2). The corresponding relative humidity favoring the DCB population was recorded at 40 % (Table 3,4).

Field bioassay studies data taken before treatment did not show significant variations. However, significant variations among both the treatments were seen after the treatment of imidacloprid and chlorpyriphos. The data revealed that the mean DCB population on imidacloprid remained at 14.6 per boll and 5.2 per boll on chlorpyriphos 24 hrs post application, showing significant difference. Afterwards, the mean population of DCB declined to 8.2, 4.4 and 1.8 after 48, 72 and 96 hrs post treatment on imidacloprid, whereas the mean DCB population declined to 1.8, 0.2 and 0 after 48, 72 and 96 hrs post treatment on chlorpyriphos showing significant differences at $P=0.5$ level (Fig. 5).

Table 1. Seasonal population abundance of DCB on *Bt* and non-*Bt* cotton.

Date	Mean DCB per boll on Bt	Mean DCB per boll on non-*Bt*	Temperature Minimum °C	Temperature Maximum °C	Relative humidity (%)
14-Sep-15	7	4	**26**	**37.5**	**50**
22-Sep-15	17	9	**21**	**32**	**64**
29-Sep-15	40	17	**21**	**34**	**44**
07-Oct-15	46	20	**22.1**	**35.5**	**41**
14-Oct-15	26	14	**22**	**30.9**	**56**
21-Oct-15	16	10	**16.9**	**31.5**	**39**
28-Oct-15	8	12	**13.2**	**29.3**	**52**
04-Nov-15	7	6	**17.5**	**28**	**64**

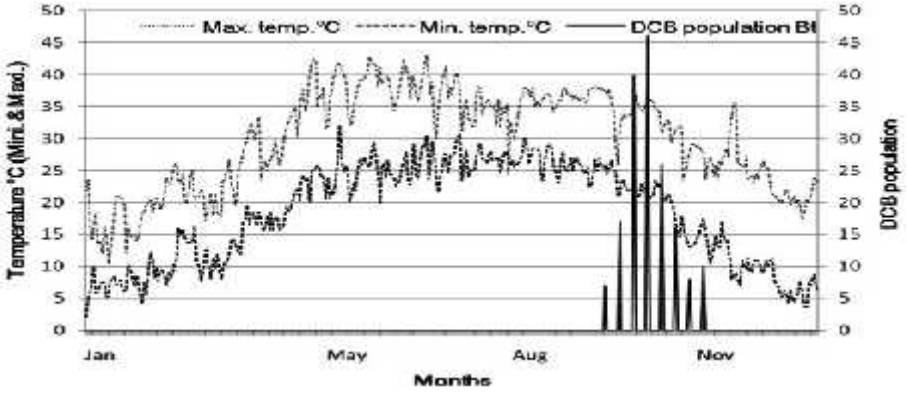

Fig.1. Seasonal population incidence of DCB with temperature in *Bt* cotton.

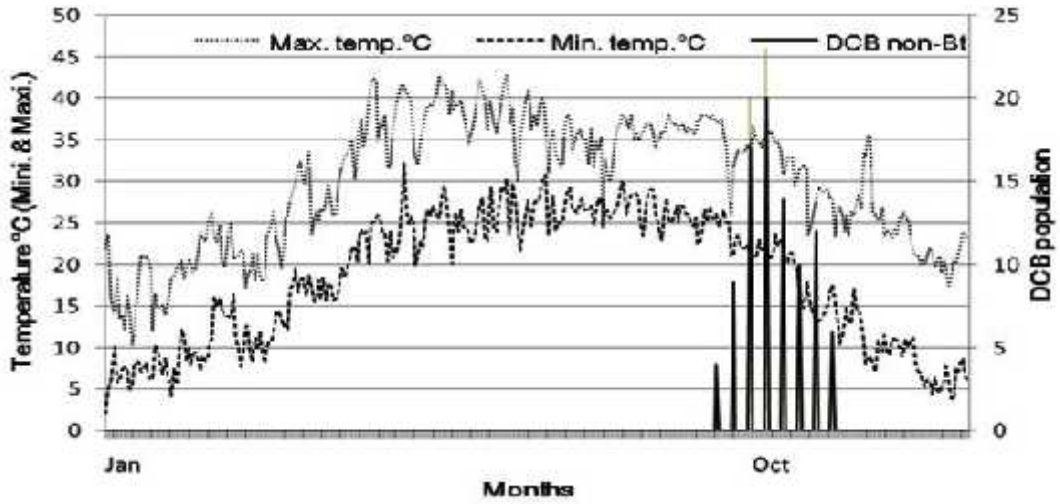

Fig. 2. Seasonal population incidence of DCB with temperature in non-*Bt* cotton.

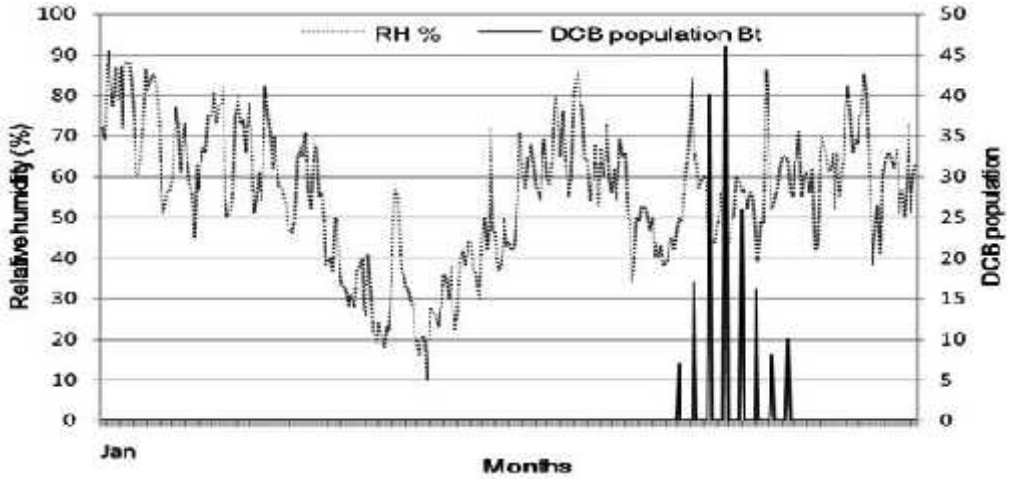

Fig. 3. Seasonal population incidence of DCB with relative humidity (%) in *Bt* cotton.

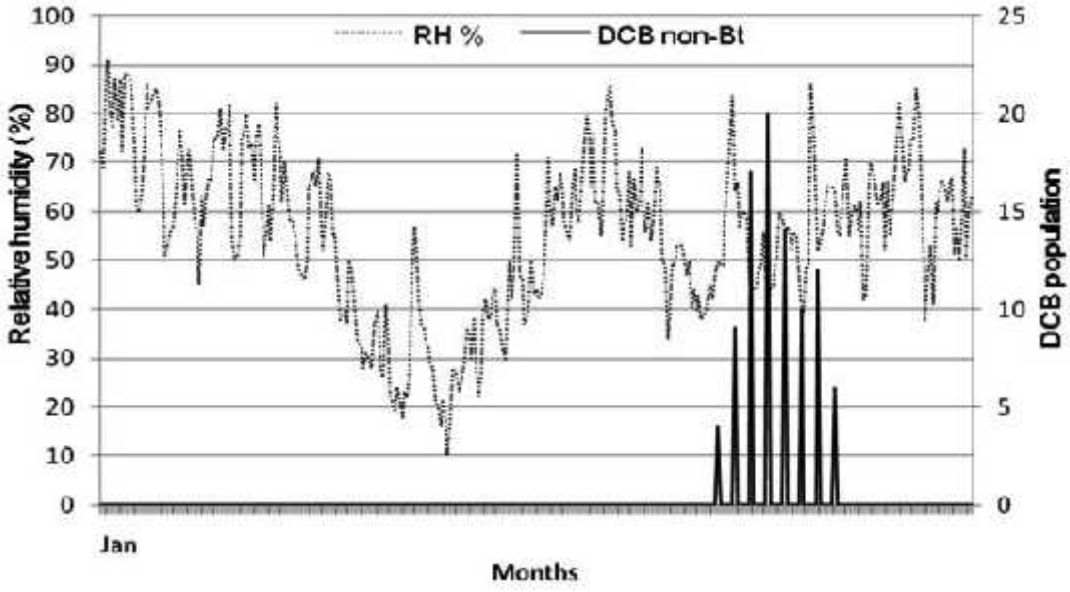

Fig. 4. Seasonal population incidence of DCB with relative humidity (%) in non-*Bt* cotton.

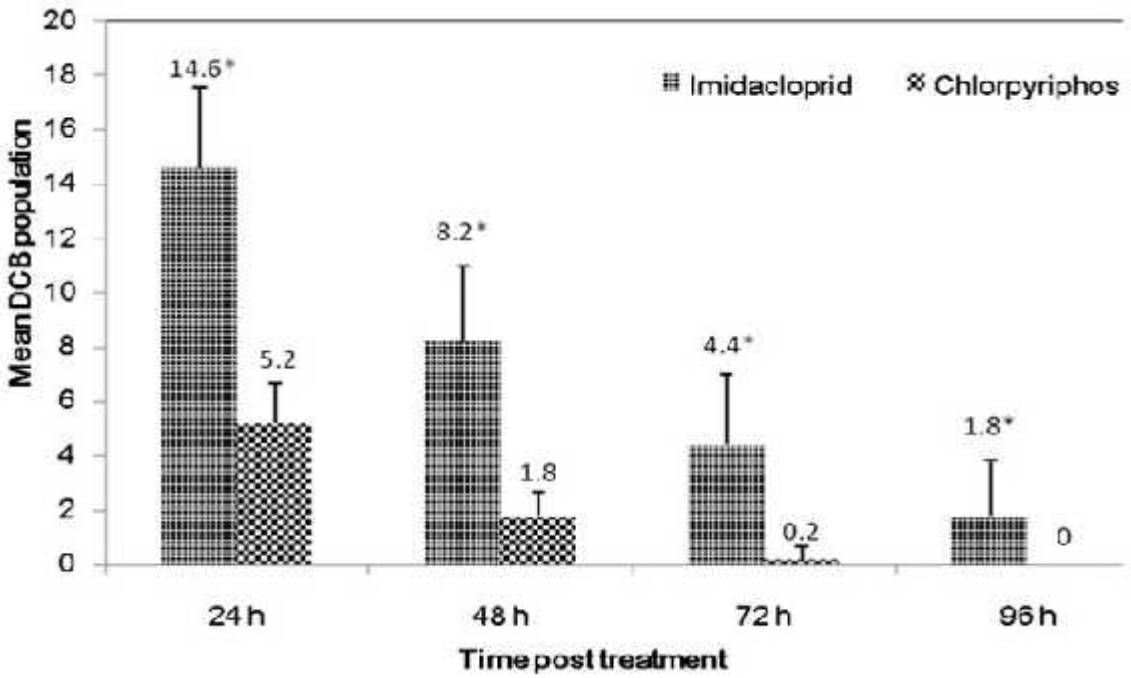

Fig. 5. Field efficacy of insecticides, imidacloprid and chlorpyriphos against DCB.

DISCUSSION

In light of the present investigations, it is clear that DCB incidence was more prevalent on *Bt* cotton compared to non *Bt* cotton. It might be due to the low level of competition from other insects on *Bt* cotton. In one previous investigation the author maintained higher incidence of DCB might be due to the availability of more favorable cotton host and migration from the alternate hosts to the main cotton crop (Srinivas and Patil, 2004).Various research investigations on commercial *Bt* cotton varieties have shown that the *Bt* toxin expressed in the cotton plants are toxic to the target insects, whereas it has no direct impact on non-target insects (O'Callaghan *et al.*, 2005).

Pest incidence and population density depends upon abiotic factors. Among abiotic factors, temperature is considered the most limiting factor which govern growth and development of insects and therefore play an important role in population buildup of the pest (Weisser *et al*., 1997). Likewise, relative humidity within certain upper and lower range may affect the population growth (Beirne, 1970). Similarly, in present investigation we determine certain range of temperature and relative humidity helped pest population to reach its peak level. The main purpose of the pest forecasting in relation to temperature and humidity will help cotton growers to predict the attack of DCB in advance and consequently appropriate management measure may be taken to counter the pest attack. For the development of the effective strategies pest forecasting model plays a vital role (Atlamaz *et al*., 2007).

Our results of a field bioassay are in line with Srinivas and Patil, 2003. Their results also showed steady decline in DCB population after the use of imidacloprid and chlorpyriphos with the latter being more effective in a field experiment. In another field experiment (Abbas *et al.*, 2014) chlorpyriphos was ranked the highest compared to other insecticides such as lamdacyhalothrin, nitenpiram and spintoram, respectively. The previous studies reports the DCB population decline from 24 to 4 per boll after first spray and 1.11 per boll after the second spray with chlorpyriphos (Abbas *et al*., 2015). The effectiveness of chlorpyriphos was also confirmed when used in a mixture with cypermethrin (Akram *et al*., 2013)

Conclusion: Based on our investigations into the population dynamics of DCB, it was found that it preferred *Bt* cotton compared to non *Bt* cotton under unsprayed field conditions and the peak population was recorded during the month of October. Moreover, chlorpyriphos provided better and quick control of DCB compared to imidacloprid in field bioassay.

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