

SEASONAL INCIDENCE OF NATURAL ENEMIES OF KEY INSECT PESTS OF COTTON AND THEIR RELATIONSHIP WITH WEATHER PARAMETERS

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Abstract: The population of spider feeding on insect pests of cotton was observed throughout the growth period of the crop, being maximum in the month of July. Chrysoperla was observed from second fortnight of June to harvesting of the crop being maximum in November. The incidence of coccinellids was recorded from the middle of August to middle of September and remained till harvesting of the crop being maximum in the first fortnight of November. A positive significant effect of maximum and minimum temperature on spider and negative significant effect on population of chrysoperla and coccinellids was recorded. Evening RH exerted positive significant effect on spider and negative significant effect on coccinellids.

Key words: seasonal incidence, natural enemies, key insect pests, cotton

INTRODUCTION

Most cotton agro-ecosystems have a rich complex of naturally occurring entomophagous arthropods and entomopathogenic micro-organisms. The conservation of native natural enemies has been pointed by many researchers a promising factor in combating cotton insect pests problem. The key insect pests of cotton in the region as detailed hereunder.

| Sr. No. | Common name | Scientific name |
|------------------|-------------|-----------------------------------|
| 1 | 2 | 3 |
| A. Sucking Pests | | |
| 1 | termite | <i>Microtermes obesi</i> Holmgren |
| 2 | cutworm | <i>Agrotis ipsilon</i> Hufnagel |

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| 1 | 2 | 3 |
|--------------|-------------------|---|
| 3 | thrip | <i>Thrips tabaci</i> Lindeman |
| 4 | jassid | <i>Amrasca biguttula biguttula</i> Ishida |
| 5 | whitefly | <i>Bemisia tabaci</i> Gennadius |
| 6 | aphid | <i>Aphis gossypii</i> Glover |
| 7 | leaf-roller | <i>Sylepta derogate</i> Fabricius |
| 8 | red cotton bug | <i>Dyesdercus koenigii</i> Fabricius |
| 9 | dusky cotton bug | <i>Oxycarenus laetus</i> Kirby |
| 10 | mite | <i>Tetranychus macfarlanei</i> Baker & Prichard |
| 11 | grey weevil | <i>Myllocerus undecimpustuletus maculosus</i> Desbrocher |
| B. Bollworms | | |
| 1 | spotted bollworm | <i>Earias insulana</i> Boisduval <i>E. vitella</i> Fabricius |
| 2 | pink bollworm | <i>Pectinophora gossypiella</i> Saunders |
| 3 | american bollworm | <i>Helicoverpa armigera</i> Hubner |

Chelonus blackburni Cameron, *Trichogramma achaeae* Nagraja, *T. brasiliensis* (Ashmead), *Bracon*, *Chrysopepla carnea* Stephens, *Coccinella septempunctata* Linnaeus, *Menochilus sexmaculatus* Fabricius and spiders have been observed as potential natural enemies of key pests of cotton and play an important role in the cotton ecosystem. The major predators and parasites of insect pests of cotton in the region are as detailed hereunder.

| Sr. No. | Common name | Scientific name |
|------------|----------------|--|
| A. Insects | | |
| 1 | chrysopepla | <i>Chrysopepla carnea</i> Stephens |
| 2 | coccinellids | <i>Coccinella septempunctata</i> Linnaeus <i>Menochilus sexmaculatus</i> Fabricius <i>Brumoides suturalis</i> Fabricius <i>Hippodamia variegata</i> Goeze |
| 3 | syrphid fly | <i>Syrphus serarius</i> Wiedmann |
| 4 | wasp | <i>Vespa orientalis</i> Linnaeus |
| 5 | preying mantid | <i>Mantis religiosa</i> |
| B. Spider | | |
| 1 | spider | <i>Distina albida</i> Linnaeus |
| C. Birds | | |
| 1 | house sparrow | <i>Passer domesticus</i> Linnaeus |
| 2 | house crow | <i>Corvus splendens</i> Vieillot |
| 3 | king crow | <i>Dicrurus adsimilis</i> Bech. |
| 4 | indian mynah | <i>Acridotheres tristis</i> Linnaeus |
| 5 | partridges | <i>Francolinus pondicerianus</i> Gmelin |

A thorough knowledge of seasonal incidence of natural enemies of key insect of cotton and the climatic factors affecting their population dynamics helps in developing efficient pest management strategies. The present study is expected to generate know how about seasonal incidence of natural enemies of key insect pests of cotton and their relationship with weather parameters.

MATERIALS AND METHODS

The experiments were conducted at the farm of Agricultural Research Sub Station, Diggi, Tonk, in two consecutive years. Field trials were laidout in Randomized Block Design with four replications, sowing upland cotton variety RST-9 (*Gossypium hirsutum* L.). The crop was sown on May 16 in the plots measuring 4.8×6.0m having row to row and plant to plant distances of 0.6m and 0.45m, respectively, in both the years. All recommended agronomical practices were followed from time to time to raise the crop successfully as per Package of Practices prescribed for the region. The nymph and adult stages of predators and parasites of insect pests of cotton were included in counting. The population recorded visually on 10 randomly selected and tagged plants from the interior rows of a plot at weekly interval after one week of germination to harvesting of the crop in early hours (before 8 AM) when insect had minimum activity. For counting the population of predators and parasites of insect pests of cotton, the leaf was held at the petiole by thumb and forefinger and turned until the entire underside of leaf was clearly visible. The weather parameters viz., maximum and minimum temperature (°C), morning and evening relative humidity (%) and total rainfall (mm) in different standard weeks during the crop seasons were recorded and their relationship with incidence of predators and parasites of insect pests of cotton was worked out by using simple correlation.

RESULTS AND DISCUSSION

Seasonal incidence of natural enemies

Spider

In present investigation the incidence of spider was recorded from 21st standard week (sw) ending 27th May on cotton plants in both the years (Table 1, 2). The population increased with the increase in insect population and reached to its maximum (9.50 spiders/10 plants in 1st year and 19.75 spiders/10 plants in 2nd year) in the month of July. Thereafter, the population of spider declined and persisted on the crop till harvest. The population of spider ranged between 1.75 to 9.50/10 plants in 1st year and 2.5 to 19.75/10 plants in 2nd year. The present observations are in accordance with that of Sharma *et al.* (2004) who reported more population of spider in June–July being 0.2 to 0.3 spider/plant.

Meagre work is available on the incidence of spider on cotton crop, therefore, it could not be compared and discussed in detail.

Chrysoperla

The incidence of chrysoperla nymphs and adults started from 3rd week of June in both the years and persisted in low number (Table 1, 2). The population increased in

Table 1. Seasonal incidence of natural enemies of insect pests of cotton in relation to weather parameters during 1st year

| Month | Std. week | Std. week ending | Temperature | | Relative humidity | | Rainfall [mm] | Population/10 plants* | | |
|-------|-----------|------------------|-------------|-------|-------------------|---------|---------------|-----------------------|-------------|--------------|
| | | | max. | min. | morning | evening | | spider | chrysoperla | coccinellids |
| May | 21 | May 27 | 38.86 | 27.43 | 63.86 | 42.43 | 0.00 | 6.50 | 0.00 | 0.00 |
| June | 22 | June 3 | 39.21 | 27.43 | 66.43 | 48.14 | 0.00 | 7.75 | 0.00 | 0.00 |
| | 23 | June 10 | 39.36 | 26.57 | 70.71 | 57.29 | 0.00 | 8.25 | 0.00 | 0.00 |
| | 24 | June 17 | 37.57 | 26.07 | 79.57 | 55.79 | 0.00 | 7.75 | 1.25 | 0.00 |
| | 25 | June 24 | 36.79 | 26.29 | 75.14 | 53.86 | 0.00 | 6.25 | 3.50 | 0.00 |
| July | 26 | July 1 | 36.50 | 23.79 | 72.57 | 70.14 | 0.00 | 8.25 | 3.75 | 0.00 |
| | 27 | July 8 | 32.57 | 24.57 | 84.14 | 70.57 | 0.00 | 9.50 | 3.75 | 0.00 |
| | 28 | July 15 | 31.00 | 24.79 | 86.14 | 82.71 | 0.00 | 7.25 | 3.50 | 0.00 |
| | 29 | July 22 | 30.43 | 24.14 | 86.71 | 74.43 | 0.20 | 6.50 | 4.25 | 0.00 |
| | 30 | July 29 | 31.43 | 25.14 | 89.00 | 84.14 | 0.00 | 6.50 | 3.75 | 0.00 |
| Aug. | 31 | Aug. 5 | 33.79 | 24.21 | 86.14 | 69.43 | 0.00 | 5.75 | 3.50 | 0.00 |
| | 32 | Aug. 12 | 33.79 | 24.50 | 82.86 | 77.00 | 0.62 | 5.50 | 3.75 | 0.00 |
| | 33 | Aug. 19 | 32.00 | 24.36 | 90.00 | 71.57 | 0.00 | 4.75 | 3.25 | 2.25 |
| | 34 | Aug. 26 | 33.07 | 23.64 | 86.86 | 71.29 | 0.00 | 4.50 | 3.75 | 3.25 |
| Sept. | 35 | Sept. 2 | 33.43 | 22.43 | 91.29 | 60.29 | 1.70 | 5.25 | 2.75 | 3.50 |
| | 36 | Sept. 9 | 34.71 | 22.36 | 90.71 | 63.57 | 0.00 | 6.25 | 3.50 | 3.25 |
| | 37 | Sept. 16 | 35.07 | 22.07 | 85.00 | 57.86 | 2.35 | 6.00 | 4.25 | 3.50 |
| | 38 | Sept. 23 | 38.29 | 22.07 | 72.29 | 53.29 | 0.00 | 5.75 | 3.50 | 3.50 |
| | 39 | Sept. 30 | 39.50 | 20.43 | 64.14 | 40.00 | 0.00 | 4.50 | 2.25 | 4.50 |
| Oct. | 40 | Oct. 7 | 35.00 | 22.29 | 80.14 | 57.00 | 0.00 | 4.25 | 3.50 | 6.25 |
| | 41 | Oct. 14 | 36.86 | 20.43 | 80.43 | 57.29 | 0.00 | 3.50 | 2.25 | 7.50 |
| | 42 | Oct. 21 | 36.36 | 15.43 | 66.14 | 48.14 | 0.00 | 3.25 | 2.75 | 9.25 |
| | 43 | Oct. 28 | 37.29 | 16.36 | 67.29 | 46.43 | 0.00 | 3.50 | 6.50 | 9.75 |
| Nov. | 44 | Nov. 4 | 36.93 | 19.14 | 65.29 | 49.43 | 0.00 | 3.50 | 8.50 | 12.50 |
| | 45 | Nov. 11 | 31.29 | 11.93 | 69.86 | 51.71 | 0.00 | 2.75 | 9.75 | 21.00 |
| | 46 | Nov. 18 | 32.36 | 9.86 | 80.14 | 53.57 | 0.00 | 2.50 | 13.50 | 19.00 |
| | 47 | Nov. 25 | 31.43 | 8.93 | 76.00 | 56.71 | 0.00 | 1.75 | 12.25 | 12.00 |

* mean of four replications; Std. – standard

Table 2. Seasonal incidence of natural enemies of insect pests of cotton in relation to weather parameters during 2nd year

| Month | Std. week | Std. week ending | Temperature | | Relative humidity | | Rainfall [mm] | Population/10 plants* | | |
|-------|-----------|------------------|-------------|-------|-------------------|---------|---------------|-----------------------|-------------|--------------|
| | | | max. | min. | morning | evening | | spider | chrysoperla | coccinellids |
| May | 21 | May 27 | 44.21 | 28.57 | 67.14 | 48.29 | 0.00 | 7.50 | 0.00 | 0.00 |
| June | 22 | June 3 | 38.43 | 23.79 | 74.29 | 69.43 | 2.80 | 9.25 | 0.00 | 0.00 |
| | 23 | June 10 | 42.50 | 28.21 | 76.86 | 73.57 | 0.00 | 9.25 | 0.00 | 0.00 |
| | 24 | June 17 | 44.29 | 30.00 | 77.14 | 75.71 | 0.00 | 9.00 | 0.00 | 0.00 |
| | 25 | June 24 | 40.43 | 27.43 | 83.86 | 79.43 | 1.71 | 7.75 | 2.50 | 0.00 |
| July | 26 | July 1 | 36.79 | 27.07 | 82.29 | 82.29 | 3.03 | 9.50 | 3.75 | 0.00 |
| | 27 | July 8 | 37.79 | 27.79 | 84.14 | 79.29 | 0.00 | 8.25 | 5.5 | 0.00 |
| | 28 | July 15 | 39.21 | 28.07 | 79.71 | 79.43 | 0.00 | 16.25 | 6.50 | 0.00 |
| | 29 | July 22 | 39.36 | 27.14 | 84.57 | 79.00 | 0.93 | 19.75 | 7.25 | 0.00 |
| | 30 | July 29 | 37.64 | 27.10 | 87.00 | 84.71 | 0.00 | 18.25 | 5.75 | 0.00 |
| Aug. | 31 | Aug. 5 | 39.21 | 26.86 | 90.29 | 82.86 | 1.50 | 13.50 | 4.00 | 0.00 |
| | 32 | Aug. 12 | 36.50 | 25.14 | 90.00 | 87.43 | 4.43 | 10.25 | 5.25 | 0.00 |
| | 33 | Aug. 19 | 34.64 | 25.00 | 90.29 | 89.00 | 2.00 | 7.25 | 6.75 | 0.00 |
| | 34 | Aug. 26 | 35.57 | 25.86 | 90.00 | 79.57 | 2.29 | 7.75 | 7.25 | 0.00 |
| Sept. | 35 | Sept. 2 | 33.43 | 25.21 | 84.86 | 82.29 | 3.23 | 4.50 | 7.50 | 0.00 |
| | 36 | Sept. 9 | 33.71 | 23.50 | 86.71 | 80.86 | 5.86 | 4.75 | 7.50 | 5.50 |
| | 37 | Sept. 16 | 35.79 | 22.00 | 89.43 | 84.43 | 0.00 | 5.50 | 8.25 | 4.75 |
| | 38 | Sept. 23 | 36.93 | 21.57 | 78.14 | 86.00 | 0.00 | 6.50 | 9.25 | 5.50 |
| | 39 | Sept. 30 | 38.21 | 21.93 | 83.71 | 81.43 | 0.00 | 7.00 | 10.50 | 5.25 |
| Oct. | 40 | Oct. 7 | 39.64 | 21.14 | 72.43 | 63.29 | 0.00 | 7.50 | 12.5 | 7.75 |
| | 41 | Oct. 14 | 38.00 | 21.86 | 72.29 | 68.43 | 0.00 | 7.25 | 13.25 | 13.50 |
| | 42 | Oct. 21 | 36.36 | 19.64 | 75.43 | 65.00 | 0.00 | 5.75 | 9.25 | 18.50 |
| | 43 | Oct. 28 | 35.14 | 13.71 | 82.14 | 78.00 | 0.00 | 4.50 | 6.25 | 18.75 |
| Nov. | 44 | Nov. 4 | 36.14 | 17.57 | 85.29 | 80.29 | 0.00 | 5.25 | 8.50 | 19.75 |
| | 45 | Nov. 11 | 30.50 | 15.50 | 79.43 | 69.57 | 0.00 | 3.50 | 16.75 | 13.50 |
| | 46 | Nov. 18 | 30.50 | 12.00 | 82.29 | 80.14 | 0.00 | 2.75 | 12.25 | 14.25 |
| | 47 | Nov. 25 | 31.20 | 12.00 | 81.14 | 76.71 | 0.00 | 2.50 | 11.25 | 9.75 |
| Dec. | 48 | Dec. 2 | 29.71 | 9.43 | 82.71 | 78.17 | 0.00 | 3.25 | 6.25 | 7.50 |

* mean of four replications; Std. – standard

last week of October, 2nd week of November and population persisted till the harvest of the crop. The population ranged between 1.25 to 13.50/10 plants in 1st year and 2.5 to 16.75/10 plants in 2nd year. The present observation corroborates with that of Sharma *et al.* (2004) who noticed chrysoperla eggs more during August to October.

Coccinellids

Four species of coccinellids (*Coccinella septempunctata* Linnaeus, *Menochilus sex-maculatus* Fabricius, *Brumoides suturalis* Fabricius and *Hippodamia variegata* Goeze) were recorded on cotton crop from 3rd week of August and 2nd week of September in 1st year and 2nd year, respectively (Table 1, 2). The population of coccinellids increased gradually and reached to its maximum in first fortnight of November in both the years and lasted upto the harvest of the crop. The population of coccinellids ranged between 2.25–21.00/10 plants in 1st year and 4.75–19.75/10 plants in the 2nd year. The present result partially corroborates with those of Kapadia and Puri (1989) and Sharma *et al.* (2004) who reported that the predators of cotton pests were more active during September–October.

Correlation between seasonal incidence of natural enemies and weather parameters

Spider

It is obvious from Table 3 that the maximum temperature ($r = 0.560$ in 2nd year and $r = 0.361$ in pooled data), minimum temperature ($r = 0.824$ in 1st year, $r = 0.630$ in 2nd year and $r = 0.755$ in pooled data) and evening RH ($r = 0.370$ in 1st year and $r = 0.461$ in pooled data) had positive significant effect on the spider population feeding on insect pests of cotton. No work is available on the effects of weather parameter on the incidence of spider on cotton or any other crop, therefore, it could not be compared and discussed.

Table 3. Correlation coefficient of population of natural enemies of insect pests of cotton with abiotic factors

| Weather parameters | Spider | | | Chrysoperla | | | Coccinellids | | |
|-----------------------|----------|----------|--------|-------------|----------|---------|--------------|----------|---------|
| | 1st year | 2nd year | pooled | 1st year | 2nd year | pooled | 1st year | 2nd year | pooled |
| Temperature [°C] | | | | | | | | | |
| Maximum | 0.193 | 0.560* | 0.361* | -0.510* | -0.610* | -0.760* | -0.400* | -0.460* | -0.601* |
| Minimum | 0.824* | 0.630* | 0.755* | -0.859* | -0.620* | -0.858* | -0.840* | -0.750* | -0.930* |
| Relative humidity [%] | | | | | | | | | |
| Morning | 0.170 | 0.080 | 0.194 | -0.010 | -0.010 | 0.077 | -0.074 | -0.186 | -0.184 |
| Evening | 0.370* | 0.130 | 0.461* | -0.060 | -0.013 | 0.017 | -0.243 | -0.217 | -0.320* |
| Rainfall | 0.035 | 0.017 | 0.027 | -0.310 | -0.248 | -0.297 | -0.124 | -0.390* | -0.275 |

* significant at 5 per cent level

Chrysoperla

It is evident exhibited in Table 3 that the negative significant effect of maximum temperature ($r = -0.510$ in 1st year, $r = -0.610$ in 2nd year and $r = -0.760$ in pooled data) and minimum temperature ($r = -0.859$ in 1st year, $r = -0.620$ in 2nd year and $r = -0.858$ in pooled data) was computed with chrysoperla population. Relative humidity and rainfall had no effect on the incidence of chrysoperla. No work is available on the effects of abiotic factors on the incidence of chrysoperla on cotton, therefore, these results could not be compared and discussed.

Coccinellids

Data presented in Table 3 revealed that a negative significant effect of maximum temperature ($r = -0.400$ in 1st year, $r = -0.460$ in 2nd year and $r = -0.601$ in pooled data), minimum temperature ($r = -0.840$ in 1st year, $r = -0.750$ in 2nd year and $r = -0.930$ in pooled data) and evening RH ($r = -0.320$ in pooled data only) on coccinellids population was computed. Rainfall exerted negative significant effect ($r = -0.390$ in 1st year only). Morning RH had no effect on the population. No work is available on the effects of abiotic factors on the incidence of coccinellids on cotton, therefore, these results could not be compared and discussed.

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POLISH SUMMARY

SEZONOWE WYSTĘPOWANIE NATURALNYCH WROGÓW NAJWAŻNIEJSZYCH SZKODNIKÓW BAWĘŁNY I ICH ZWIĄZEK Z PARAMETRAMI POGODY

Prowadząc w okresie wegetacji bawełny obserwacje populacji pajęczaków pasożytujących na szkodnikach owadach tej rośliny stwierdzono maksymalne nasilenie występowania tych nadpasożytów w miesiącu lipcu. Nadpasożyty zaliczane do *Chrysoperla* obserwowano od trzeciego tygodnia czerwca do zbioru bawełny, przy czym maksymalne ich nasilenie odnotowano w listopadzie. Pojaw nadpasożytów zaliczanych do *Coccinellidae* stwierdzono od połowy sierpnia do połowy września, ich populacja była obecna do zbioru, a maksymalne nasilenie odnotowywano w pierwszych dwóch tygodniach listopada. Stwierdzono pozytywny istotny wpływ maksymalnej i minimalnej temperatury na populację pajęczaków i negatywny istotny wpływ na nadpasożyty zaliczane do *Chrysoperla* i *Coccinellidae*. Wieczorna wilgotność względna powietrza wywierała istotny pozytywny wpływ na pajęczaki i negatywny istotny wpływ na nadpasożyty zaliczane do *Coccinellidae*.