Bulletin of Pure and Applied Sciences
Zoology (Animal Science), Vol.43B, No.2S,
July-December 2024: P. 474-482

Print version ISSN 0970-0765
Online version ISSN 2320-3188

Original Research Article
Content Available online at: www.bpasjournals.com

SEASONAL ABUNDANCE OF SUCKING INSECT PESTS IN BT COTTON AGRO-ECOSYSTEM OF YADAGIRI DISTRICT, KARNATAKA, INDIA.

Ambrisha Venkateshwar[1*], K. Vijaykumar[1], Vishwajit B D[2]

[1*,1] Department of Studies and Research in Zoology Gulbarga University, Kalaburagi-585106, Karnataka, India. Email: amrishyakapur@gmail.com, Email: katepaga63@gmail.com
[2] Department of P.G. Studies & Research in Zoology, Sharnbasva University, Kalaburagi, Karnataka, India. Email: vishwajeetdarekar@gmail.com

***Corresponding Autur**: amrishyakapur@gmail.com.*

Abstract:
In the present study the field investigations were undertaken at Bt cotton fields in selected study area of Yadagiri to study the seasonal abundance of sucking pests. Ajit-BG II is most commonly practiced Bt cotton hybrid in the selected area and sowing process will be carried out from June. Sucking arthropod pests recorded during study includes Aphids (*Aphis gossypii*), Leafhopper (*Amarasca biguttula biguttula*), Whitefly (*Bemisia tabaci*), Thrips (*Thrips tabaci*) and Melaybug (*Phenacoccus solenopsis*). Among these sucking arthropod pests, the incidence of leafhopper and whitefly prevailed more active throughout the cropping season and cause damage crop at different stages of growth. Peak abundance of whitefly and aphids was observed at end of October 2021 up to early November 2021. Leafhoppers are invaded from July and peak abundance was noticed in the month of early October 2021 whereas, thrips were most abundant in the month of October 2021. Melay bugs were noticed at the end of September and infestation of this pest continues up to completion of cotton harvesting.

Keywords: Bt cotton, Arthropods, Pests, Sowing, Peak abundance, Harvesting, Ecosystem.

Introduction:

Cotton (*Gossypium sp.*) commonly known as 'White gold' of India is the most important commercial crop in India and plays a vital role in agricultural, industrial and monetary affairs of the country. It provides employment about 6 million and contributed 1/3rd of total foreign exchange earning of India (Mayee and Rao, 2002). In India cotton cultivated on 12.2 million ha area with production of 347.05 lakh bales (170 kg) and productivity of 484 kg lint/ha. In Karnataka, cotton occupies an area of 4.64 lakh hectare with a production of 21.00 lakh bales and with a productivity of 769 kg/ha (2016-17). The Predominant Bt cotton growing areas are Yadgir, Kalaburgi, Bidar, Raichur, Bellary, Koppal and Bagalkot (Mahendrakar M *et al.,* 2018). After 2002 Bt cotton was introduced in India which is most effective against main pest of cotton i.e., lepidopteron pest (Bollworms), but not against sucking pest complex and resulted higher yield of cotton.

The practice of Bt cotton ultimately reduced usage of insecticides in Bt cotton has led to increased population of sucking insect pests (Krishna and Qaim, 2012). Practicing of cotton under diversified climatic conditions makes the crop to suffer a lot by various pests and diseases. Major cotton growing areas which are under rainfed conditions where the extensive replacement of conventional varieties is taking place with superior hybrids will make the cotton crop easily exposed to many insect pests. Cotton ecosystem harbours In India, as many as 162

species of insect-pests are known to attack cotton from sowing to maturity which cause up to 50-60 per cent loss (Agarwal *et al.,* 1984). Cotton pests are mainly divided into sucking pests, foliage feeders and bollworms. Bt cotton seems to be more vulnerable to the attack of sucking insect pest complex as compared to desi cotton (*Gossypium arborium*) (Nath *et al.,* 2000).

Among sucking pests; Aphid, *Aphis gossypii* (Glover), leafhoppers, *Amrasca biguttula biguttula*(Ishida), Thrips, *Thrips tabaci* (Lind.), Whitefly, *Bemisia tabaci* (Genn.) and Mealybug, *Phenococcus solenopsis* (Tinsley) are of major importance and cause the major damage in Bt cotton which results in the loss of yields and quality cotton lint. Among these sucking pests Leaf hopper will cause damage to the leaves by sap sucking from leaves and cause typical damage called hopper burn where the edges of leaves curl downwards and become yellowish and then reddish before drying-out and shedding (Atakan, 2009) whereas whitefly vector of CLCuV (Malik *et al.,* 1995) injure to cotton by secreting honeydew and transmitting cotton leaf curl viral disease. Bt cotton shows resistance against Helicoverpa armigera (Hub.) *Pectinophora gossypiella* (Saund.), *Earias vittella* (Fab.) and *E. insulana* (Biosd.) both under field and laboratory conditions (Kranthi and Kranthi, 2004). The Bt cotton is designed to control specifically the lepidopteran pests by releasing Cry 1 Ab proteins but having lack of resistance towards the sucking pests (Hofs *et al*., 2004; Sharma and Pampapthy, 2006).

The Bt cotton may provide significant economic and environmental advantages but these benefits can be eliminated by the evolution of resistance in insect pests (Carpenter 2010; Tabashnik *et al*., 2010). The cultivation of Bt cotton may help in the reduction of insecticides but results in the increase of sucking pests population (Men *et al.,* 2005). Practice of only chemical control is not only creating health hazards and ecological contamination but also growing the resistance in the insects and negatively effect on the beneficial arthropods in cotton agro-ecosystem including predators, parasitoids and pathogens (Sorejani,1998). These sucking pests are becoming more serious now adays by inviting indiscriminate use of pesticides. The knowledge about incidence of sucking pest during the cropping season and its possible dynamics help in designing pest management strategies (Santhosh *et al*, 2009). As there is very less information available about the sucking pest complex in cotton fields of selected study area the present study was undertaken to assess the seasonal abundance of sucking pests in Bt cotton fields of Yadagiri District

Material and Methods:

Study Area:

Yadagiri district is one of the 30 districts of Karnataka state in southern India. The district is one among the major cotton growing areas in Karnataka. The district is located in the northern part of the state. It lies between 16°-20' to 17°-45' N Latitude and 76°-04' to 77°-42' E Longitude and occupies an area of 523500 Ha. Yadagiri has been blessed by incessant flowing of two major rivers Kirishna and Bhima in addition to this, few tributaries flow in this region. The present study was undertaken at selected Bt cotton fields of Doranahalli village, Shahapur taluka, Yadagiri District. The hybrid of Bt cotton namely Ajit-BG II is practiced in selected study area. The present study was undertaken during June 2021 to December 2021.
During the study period 500 m2 study plots were selected avoiding the border of cotton fields of study area. On each plot, the observation was carried out on weekly basis. The study we also involved discussion with farmers on the type of pesticides and insecticides used for control of cotton pest such as Imidacloprid[1-(6-chloro-3-pyridylmethyl)-N-nitroimidazolidin-2-ylideneamine)], Cypermethrin(2- dimethyl cyclopropane carboxylate), Ampligo [Clorantraniliprole (10%) + Lambdacyhalothrin (5%)] and Super killer (Cypermethrin 10%) etc.

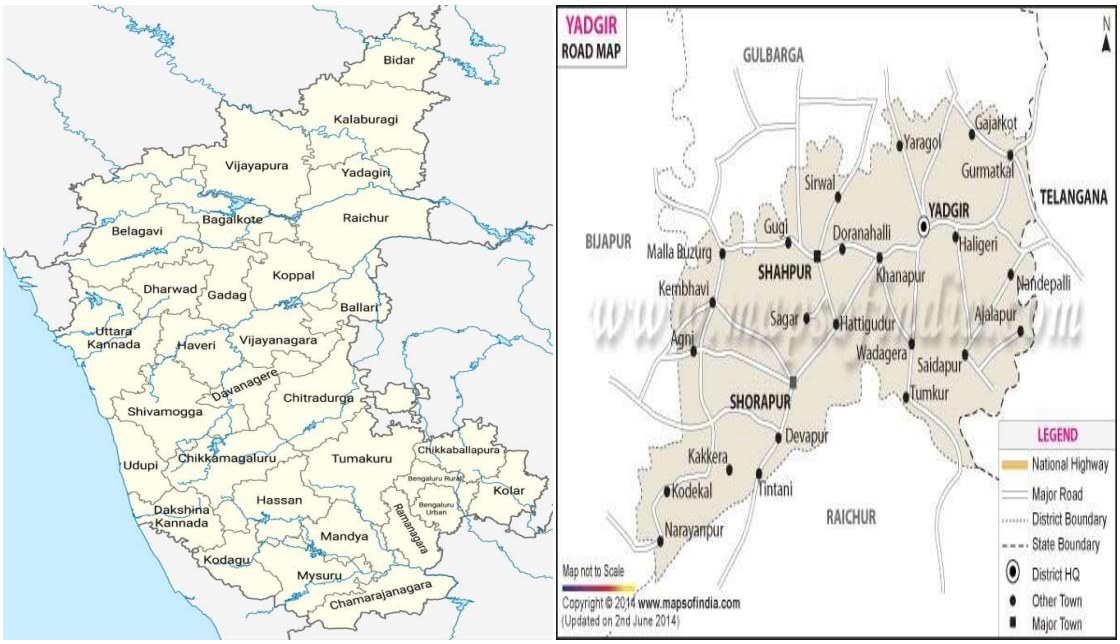

Plate No. 1: Showing the map of the study area Ydagiri

METHODOLOGY:

Insects are usually less active in early morning and early evening hours. Hence most of the collection was undertaken during morning hours and evening hours after sunset. Various sampling techniques were used to collect arthropod samples namely, sweep net technique and light-trap technique.

1) **Sweep net technique:** This method is mostly used for flying arthropod species by using two types of sweep nets. The sweeps were done during morning hours and also early evening. This method suits much for ground layer vegetation and helps to collect flying arthropods.

2) **Light-trap technique:** Sometimes in the late evening after sunset we used light trap to attract flying arthropods and they were collected.

Observations on sucking pests viz., leafhoppers, aphids (adult population), whitefly (adult population), and thrips (adult population) were recorded from 20 randomly selected plants on 3 leaves per selected plant representing the top, middle and bottom canopy of the crop in the selected plot at centre of cotton fields of the field. For mealy bug, 3 twigs per plant (10cm length) were selected and adult population was counted. Insect counts were taken at weekly intervals (based on standard mean week) from early stage to maturity of crop during morning hours (8.00 am to 10.00 am). The data collected about seasonal abundance of sucking pests were converted to mean population by using window MS excel functions including the following formulae

$$\text{Mean}(X) = \frac{\sum X}{N}$$

Where,
Mean (X) = Average/mean population
N= No. of plants
$\sum X$ = Sum of sucking pests population on selected plant,

Environmental (weather) Factors in the Study Area of Yadagiri:

The temperature and rainfall during the study period of 2021 is recorded (Table No.1). Maximum temperature of 43°C was recorded in the month of May 2021 and minimum temperature of 15°C recorded was recorded in the month of November during study period. The highest rainfall was recorded in the month of October (54.6 mm) and lowest rainfall recorded 10.3 mm in the month of May 2021.The same is represented in Fig. 1 and Fig2.

Months	Temperature Maximum (°C)	Temperature Minimum (°C)	Rainfall Maximum	Rainfall Minimum
January	34°C	15°C	0 mm	0 mm
February	36°C	17°C	0 mm	0 mm
March	40°C	20°C	5.8 mm	1 mm
April	42°C	23°C	5.6 mm	10.3mm
May	43°C	25°C	13.6 mm	1.9 mm
June	38°C	23°C	39.4 mm	1.5 mm
July	35°C	22°C	18.7 mm	1.1 mm
August	37°C	22°C	18 mm	1.4 mm
September	39°C	21°C	34.2 mm	1.2 mm
October	36°C	21°C	54.6 mm	1 mm
November	33°C	17°C	6.56 mm	0 mm
December	31°C	16°C	4.9 mm	0 mm

Table No.1 Temperature and Rainfall during the study year 2021

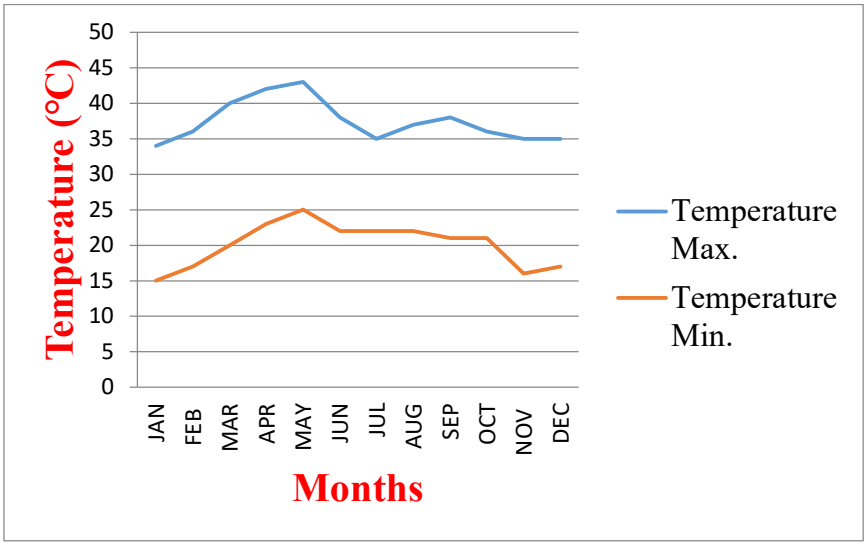

Fig No.1 Temperature during the study year 2021

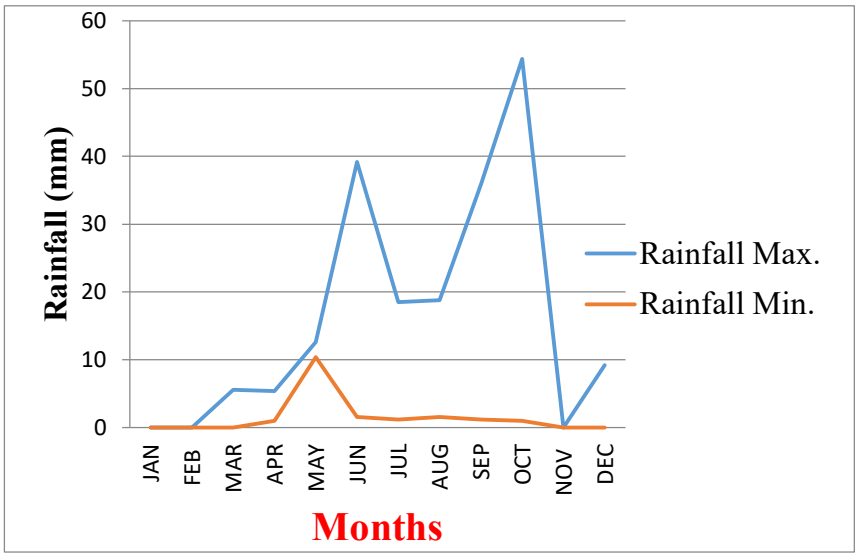

Fig No.2 Rainfall data during the study year 2021

Results and Discussion:

Among sucking insect pests, the *Amarasca biguttula* and *Bemisia tabaci* were key pests and remained active through the cropping season. *Thrips tabaci* population was only observed in early stages of the crop growth.

Month	SMW	No. /3 leaves/plant				
		Leafhopper	Whitefly	Thrips	Aphids	Melaybug
July	29	1.73	0.82	0.98	15	1
July	30	1.64	0.95	1.01	7	2
Aug	31	1.52	1.05	1.3	18	3
Aug	32	1.68	3.35	1.38	26	7
Aug	33	2.88	1.8	12.19	37	1
Aug	34	3.3	3.56	26.04	41	3
Sept	35	3.92	6.31	36.81	52	1
Sept	36	4.45	14.44	28.03	58	7
Sept	37	4.18	16.74	16.67	54	1
Sept	38	3.64	22.4	18.4	56	1
Sept	39	3.13	13.54	13.9	52	10
Oct	40	3.21	13.59	4.65	48	9
Oct	41	2.87	14.09	3.49	45	8
Oct	42	12.28	34.59	3.87	45	7
Oct	43	8.94	13.59	3.06	40	8
Nov	44	1.60	6.17	2.28	36	6
Nov	45	1.88	2.65	1.98	32	9
Nov	46	1.83	2.2	1.62	31	5
Nov	47	1.91	1.65	1.67	34	5
Nov	48	1.19	1.65	1.13	37	7
Dec	49	1.22	1.45	0.94	33	2

Dec	**50**	**1.04**	**1.45**	**0.92**	**28**	**2**
Dec	**51**	**0.98**	**1.33**	**0.81**	**28**	**2**
Dec	**52**	**2.85**	**1.26**	**0.94**	**27**	**2**
Mean		**2.94**	**7.03**	**7.15**	**35.81**	**4.35**

(SMW: Standard Meteorological Week)

Table No. 2. Seasonal abundance of sucking insect pests in Yadagiri District during the cropping season of 2021.

A. Seasonal abundance of Leafhoppers:

The present studies reveals that incidence of Jassids commenced on Bt cotton from third week of July 2021 and persisted active from 2nd week of August up to the first week of November 2021. Leafhopper population observed in range of 0.98 to 12.28/ 3 leaves with mean 2.94/3 leaves during the period of study (Table 2). Peak abundance of leafhoppers was observed (12.28/3 leaves) during 3rd week (42nd SMW) of October 2021 (Fig No. 3). The results of present study are in line with the findings of Bhute *et al.* (2012) who reported highest population of Jassid (13.80/3 leaves) was observed during 40th MW in kharif 2007–2008. Shahid *et al,* also (2012) reported that peak population (3.33/leaf) of Jassid was recorded on October 30.

Leafhoppers shows positive correlation with maximum temperature (r = 0.25,), minimum temperature (r = 0.40) and maximum relative humidity (r = 0.12) in both the season while it shows non-significant negative correlation with Minimum relative humidity (r = -0.01) and average rainfall (r =-0.26) during 2010-11 (Table No. 3). Kalkal et al,. (2015) reported leafhopper population was significantly and positively correlated with temperature (r = 0.49), relative humidity (r = 0.42) while significantly negatively correlated with rainfall (r = -0.47).

B. Seasonal abundance of Whitefly:

During the study period the incidence of whitefly was observed in range of 1.05 to 34/ 3 leaves with mean of 7.039/3 leaves during 2021 (Table No. 2). Maximum incidence of whitefly recorded from 2nd week of August to 2nd week of November with two peaks in both the season (Fig 3). Whitefly incidence increased gradually in September with slight reduction in second fortnight of September and again it achieved highest peak during October month in both the season. Peak abundance of whitefly observed (34.59 / 3 leaves) during 3rd week (42nd SMW) of October 2021. Bhute *et al.,*(2012) also reported incidence of whitefly (52.75-63.00/3 leaves) during 45th standard week. Weather parameters *viz.*, rainfall, morning RH and evening RH showed significant and negative correlation whitefly population while maximum temperature showed significant positive correlation with whitefly populations. Boda and Ilyas (2017) reported the peak activity of whitefly was observed from 41st MW to 44th MW, while highest incidence (22.60 whiteflies/3 leaves) of whiteflies population observed in 42ndMW.

Correlation study of current study reveals that incidence of whitefly shows significant positive correlation with maximum temperature (r = 0.30), minimum temperature (r = 0.55) in both the season and non-significant with maximum relative humidity (r=0.39) during study period. It shows negatively non significant correlation with minimum relative humidity (r = -0.18) and average rainfall (r = -0.05) (Table No. 3). The results of the present studies are in confirmatory with findings of Kalkal *et al.,* 2015 who reported that whitefly population was significantly positively correlated with maximum temperature (r = 0.35) and relative humidity (r = 0.08) while significantly negatively correlated with rainfall (r = -0.38).

C. Seasonal abundance of Thrips:

Population of thrips in cotton recorded with range of 0.81-36.81/3 leaves with mean of 7.66/ 3 leaves during the study period (Table No.2). Maximum incidence of thrips observed from second fortnight of August to second fortnight of October in both the season. Peak abundance of thrips was observed (36.81/ 3 three leaves) during first week (35th SMW) of September 2021(Fig. 3). Bhute *et al.* (2012) reported highest incidence of 110.10 thrips/ 3 leaves in 40th standard week in Bt cotton. Phulse and Udikeri (2014) reported the incidence of thrips ranged from 0.8 to 29.4 / 3 leaves and population was high in September across Bt cotton genotypes.

According to the correlation studies the incidence of thrips was positively correlated with maximum temperature (r = 0.20), maximum relative humidity (r = 0.39) and average rainfall (r = 0.74). Thrips incidence shows no correlation with minimum relative humidity and average rainfall. Bhute *et al.,* (2012) reported maximum temperature showed significant positive correlation with thrips populations. Phulse and Udikeri (2017) have also reported that peak thrips incidence was recorded in September 2nd fortnight to October first fortnight due to low rainfall and low humidity.

D. Seasonal abundance of Aphids:

During the present investigation incidence of aphid incidence was observed throughout the year in both the cotton season and ranged from 10-67% with mean of 28.68% Highest abundance of aphid 58/ 3 three leaves recorded during 2nd week (36th SMW) of September 2021(Fig. 3). Incidence of aphid population decreases gradually after September at the end of season. Boda and Ilyas (2017) reported the peak incidence of aphid population was recorded to be 73.40 / three leaves during 35th meteorological week of October 2013. Tomar S P S *et al.,* (2010) have also reported the population reached peak in 35th standard week with 22.0/leaf during 2004-05.

Correlation study reveals that aphids shows positive correlation with maximum temperature (r=0.17) and maximum relative humidity (r=0.24) and shows strong positively significant correlation with minimum temperature r=0.43). Aphids showed non-significant negative correlation with minimum relative humidity (r= - 0.18) and average rainfall (r = -0.07). The present results are confirmatory with findings of Bhute *et al.* (2012) who reported the rainfall, morning RH and evening RH showed significant and negative correlation with aphids. Aphid population did not show any association with rainfall.

E. Seasonal abundance of Melaybugs:

Incidence of mealy bug on Bt cotton observed throughout the year, it appeared on cotton one month after cotton sowing. The range of mealy bug observed from 1-10% with mean of 4.65%. The highest incidence of mealy bug in cotton observed about 10% during 5th week of September 2021 after this period it decreased gradually at the end of season (Fig. 3).

Mealybug shows significant positive correlation with maximum temperature (r = 0.33), minimum temperature (r = 0.25). It shows negative non significant correlation with maximum relative humidity (r = -0.09). Melaybugs showed negative correlation with minimum relative humidity (r = -0.19) and average rainfall (r = -0.24) (Table No. 3).

Max Temperature (°C)	0.25	0.30	0.20	0.17	0.33
Min Temperature (°C)	0.40	0.55	0.05	0.57	0.25
Max R Humidity	0.12	0.10	0.39	0.38	-0.09
Min R Temperature	0.00	0.18	0.36	0.32	-0.19
Average Rainfall (mm)	0.05	-0.05	0.74	0.66	-0.24

Table No.3 Represents correlation of sucking pests with weather parameters

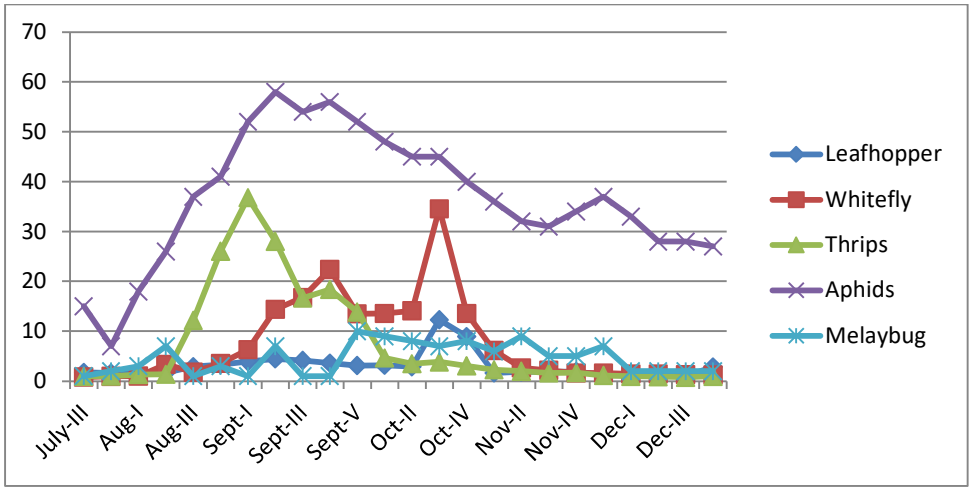

Fig No.3. Graph showing Seasonal incidence of sucking pests of cotton in Yadagiri District during cropping season of year 2021.

CONCLUSION

The results of the present research study shows that in the Bt-cotton agro ecosystem of selected study area of Yadagiri the weather factors will determine the seasonal activity and population build-up of insect pest in Bt cotton crop. The correlation studies clearly shows the importance of weather parameters in predicting the sucking pest incidence and this studies will be definitely helpful to farmers and extension workers for developing efficient pest management strategies for increased cotton production. In the Bt-cotton fields selected study area the abundance of natural enemies is less compared to pests due to the heavy application of pesticides. Role of predatory spiders, Ladybird beetle, Ants, and lace wings are noteworthy but, their population is declined due to heavy pesticide application. Hence, the conservation of natural enemies has to be done by practicing integrated pest management with reduction in the use of harmful chemical pesticides and instead of them we should promote use of organic pesticides so that to achieve biological pest control and save the agro-ecosystem.

REFERENCES:

1. Mayee, C.D and Rao M.R.K (2002). Current cottonproduction and protection scenarios including G.M. Cotton. Agrolook, April-June, 14-20.
2. Krishna, Vijesh V and Qaim M (2012). Bt cotton and sustainability of pesticide reductions in India. Agril.Systems.107:47-55.
3. Mahesh Mahendrakar, Jahanara and Syed H M (2018). Knowledge Level of Respondents about Bt CottonProduction Practices in Shahapur Taluk of Yadgir District (Karnataka). International Journal of Innovative Science and Research Technology.
4. Agarwal, R. A. Gupta G. P. and Garge D.O (1984). Cotton pest management in India. Res. Publn., Azadnagar, Delhi, pp. 1-19.
5. Nath P, Chaudhary O.P, Sharma P, Kaushik H.D (2000). The studies on the incidence of important insect pests of cotton with special reference to Gossypium arborium (Desi) cotton. Indian Journal of Entomology 62:391–395.
6. Atkan E. (2009) Damage assessment of the leafhopper complex [Asymmetrasca decedens (Paoli) and Empoasca decipiens Paoli] (Homoptera: Cicadellidae) in cotton. Journal of Pest Science.; 82:227-234.

7. Hofs J. L, Schoeman A and Vaissayre M (2004). Effect of Bt cotton on arthropod biodiversity in South African cotton fields. Common Agri. Appl. Biol. Sci., 69: 191-194.
8. Sharma, H. C and Pampapathy G (2006). Influence of transgenic cotton on the relative abundance and damage by target and non-target insect pests under different protection regimes in India. Crop Prot. 25: 800-813.
9. Kranthi, K. R and Kranthi, N.R (2004). Modelling adaptability of the cotton bollworm, Helicoverpa armigera (Hubner) to Bt cotton in India. Curr. Sci., 87: 1096-1107.
10. Tabashnik B.E, Sisterson M.S, Ellsworth P.C (2010). Suppressing resistance to Bt cotton with sterile insect releases. Nat Biotechnol. 2010;28(12):1304.
11. Men X, Ge F, Edwards C.A and Yardim E.N (2005). The influenceof pesticide applications on Helicoverpa armigera and sucking pests in transgenic Bt cotton and non transgenic cotton in China. Crop Prot., 24: 319-324.
12. Santhosh, B.M, Patil S.B, Udikeri S.S, Awaknavar J.S and Katageri I.S. (2009). Impact of Bt cotton on pink bollworm, Pectinophora gossypiella (Saunders) infestation. Karnataka J. Agric. Sci. 22(2): 322-326.
13. Carpenter J.E (2010). Peer-reviewed surveys indicate positive impact of commercialized GM crops. Nat Biotechnol.28 (4):319–21.