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Diversity of soil arthropod community in Bt and Non-Bt cotton fields of Karimnagar District Telangana.

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Abstract: *Biodiversity study in cotton ecosystem is very important to understand species composition of agriculturally important arthropods which mediate or regulate a variety of functions essential for plant growth and productivity, soil resource structure and ecosystem health. In order to study biodiversity of soil surface arthropods in Bt and non-Bt cotton ecosystems an attempt was made from July 2016 to February 2017 in three seasons in farmers Bt and non-Bt cotton fields. The results indicated that arthropods were recorded from 8 insect orders besides spiders and millepods. A total of 138 individuals in Bt cotton, 309 individuals in non-Bt cotton field were recorded by using pitfall traps. Arthropods collected from twenty one species in Bt and twenty five species in non-Bt cotton fields were recorded. Our results overall suggested that no significant differences between the Bt and non–Bt cotton fields in these arthropod community. But abundance of arthropods were high in non-Bt cotton compare to Bt cotton fields. Based on our findings, we conclude that Bt cotton generally exerts marked negative effective on the abundance of arthropods community in Bt cotton fields, various diversity indices were measured.*

Key words*: Biodiversity, Bt Cotton, non-Bt cotton, abundance of soil arthropods, diversity indices.*

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I. Introduction

Cotton (*Gosspium hirsutum*) plays a vital role in India, agro based economy and is a major source of Foreign exchange earnings. It is cultivated on area of 11.8 million hectares with 2.210 million tones production. India ranked 2nd in world production after China and USA. Cotton crop is susceptible to attack of 96 insect and mite pests (Wilson et.,al 1972). Bt cotton, expressing the endotoxin gene from the Bacterium *Bacillus thrungiensis* to manage cotton bollworm (Forrester et.,al 1993). It also offers the potential to reduce the total use of broad, spectrum insecticides to control Lepidopterous pests (Gary P. Fitt 1994). This crop have been readily adopted by farmers have resulted in increased yield and reductions in insecticide applications. However, the risks and benefits of this technology have limited its benefits in many parts of the world (Conner et.,al 2003, Carriere et.,al 2004).

The toxins produced by Bt cotton plants kill a narrow range of insect species. Many Bt cotton varieties have been transformed with genes encoding various Bt Crystal (Cry) proteins and are resistant to Lepidoptera pests of cotton. Many herbivore insects may consume the Bt toxin. Predators that consume such herbivores may be adversely affected, such interactions are likely to be complex, because neither all herbivores that feed on Bt cotton plants update the toxin nor are natural enemies always affected by consuming prey that have taken up the toxin (Dutton et.,al, 2002). The growing Worldwide transgenic crops may impose risks on communities of ground dwelling arthropods. Predator arthropods and ground dwelling arthropods are considered to be important not only for insect pest management but also for managing weeds and other organisms competing with cultivated crops.

Many studies related to the impact at Bt cotton on non target organisms have examined. Most field studies assessing potential impacts of Bt crops have focused on a limited numbers of species (Liu et.,al 2003). Long term field studies conducted to compare arthropod populations in Bt-cotton and Non-Bt cotton in South Carolina Georgia, Southern and Alabama revealed that there were no significant differences in the population of arthropod taxa, but little information is available on the effects of transgenic cottons on arthropod biodiversity. In the tropics, one of the major concerns of transgenic crops in their effects on the non-target organisms and may other predators and decomposers are sensitive to the change in the Environment. Little information is available on the effect of transgenic cotton on arthropod biodiversity in the tropics. Therefore, the present studies were undertaken to compare the abundance and diversity of arthropods in Bt and non-Bt cotton fields of farmers. The Bt cotton ecosystem is the main agricultural Transgenic cotton can have a number of direct and indirect effects on arthropoda communities in agro ecosystems. Transgenic Bt cotton can affect natural enimies

indirectly through the removal of eggs, Larvae, and pupae of lepidoptern insects that serve us food sources for parasitic and predatory arthropods (Huang 1999). The number of insecticide applications are another important factors that can effect arthropod communities in Bt cotton fields.

II. Materials And Methods

The study was carried out at experimental fields of Bt cotton Pinaka BG II (MH5343BG II) during rainy season in semi-arid tropical region of Ranipur village, Karimnagar District, Telangana State. It is located between ($18^{o}\,26^{1}\,18.8^{"}$ N $79^{o}7^{1}\,43.83^{"}$ E). Pitfall traps were used to estimate population abundance and diversity of soil surface-dwelling arthropods. Sampling was done every month from July, 2016 to February, 2017. Each trap was 250 ml plastic cups buried, so that the mouth was level of with the soil surface. The inner cup containing 250 ml of Isopropyl alcohol, the trap was covered with 20 cm diameter plastic plant to exclude rain and debris. The trap were collected monthly and brought to the laboratory, where the content removed and stored in 70% ethnol. Later the trap contents was identified and recorded the species, family and order level, using the data available species richness index, Shannon Weinner diversity Index and evenness of soil arthropods analysed.

Measurement of Diversity Index:

To assess the abundance patterns and the species richness in insecticide treated fields. The Shannon weaver diversity index H' was used.

Shannon diversity $H' = -\sum \log_e Pi$

III. Results

A total of 138 individuals in Bt cotton, 309 individuals in non-Bt cotton fields were obtained by using pitfall trapping during July, 2016 to February, 2017. Twenty one species in Bt cotton and twenty five species non-Bt cotton were recorded during the cropping season from July, 2016 to February, 2017 and which belonged to 14 different insect families and one millipede and two spiders. Four species of insects from order Orthroptera three Coleoptera, one species Termitidae, four species Hemiptera five species in Hymnoptera, one species in Lepidoptera, three species in Diptera two species in Dermoptera and one species Millipeds, two species aranea were obtained (Table-1).

Analysis of community structure were completed for all arthropods collected in pitfall traps over the entire cropping seasons for both July, 2016 to February, 2017. Three characteristics were examined i.e., species richness, which we calculated simply as the (1) number of species observed (2) evenness, which measure, the equitability of abundance across species, (3) diversity index, which attempts to integrate both richness and evenness.

TABLE – 1 - Diversity of Arthropods community in Bt and Non-Bt cotton fields of Karimnagar District, Telangana State during 2016-17

Order	Family	Species	
		Bt	Non-Bt
Orthoptera	Gryllidae	*Gryllus pennsylvanius*	*Gryllus pennsylvanius*
	Gryllidae	*Gryllus sagilatus*	*Gryllus sagilatus*
	Gryllidae	*Achata domostica*	*Achata domostica*
	Acrididae	*Melanopius*	*Melanopius*
Coleoptera	Scarabeedae	*Geotrupes strcorarusdor*	*Geotrupes strcorarusdor*
	Carabidae	*pterastichus*	*pterastichus*
Isoptera	Termitidae	--	*Odontotermes Species*
Hemiptera	Pyrrocorecidae	*Dysdercus cingulatus*	*Dysdercus cingulatus*
	Aphidae	*Aphis gossypii*	*Aphis gossypii*
	Aleycodoidae	*Bimisia tobaci*	*Bimisia tobaci*
	Pentamoidae	*Nezara*	*Nezara*
Hymnoptera	Formicidae	componotus	componotus
	Formicidae	*Crematogaster*	*Crematogaster*
	Formicidae	*Solonopsis invicta*	*Solonopsis invicta*
	Formicidae	*Lacius niger*	*Lacius niger*
	Formicidae	*Wasmania auropunctata*	*Wasmania auropunctata*
Lepedoptera	Neptulidae	--	*Helicoverpa armigera*
Diptera	Sarcophagidae	*Sarcophaga carnaria*	*Sarcophaga carnaria*
		Sarcophaga bercae	*Sarcophaga bercae*
		--	*Anthomyia pulvallis*
Dermaptera	Anisolabidae	*Anisolabis martima*	*Anisolabis martima*
	Forficulidae	*forficula auriculata*	*forficula auriculata*
Millepeds	Spirosteptidae	--	*Cryptoterms domesticatus*
Aranea	Lycosidae	*Rabidosa punctata*	*Rabidosa punctata*
		Schicosa saltarix	*Schicosa saltarix*

Table-2 - Percentage of arthropods in Bt and non Bt cotton fields during July, 2016 to February, 2017.

Name of the species	Bt No. of individuals	Percentage (%)	Non-Bt No. of individuals	Percentage (%)
Orthoptera	14	10.14	44	14.23 *
Coleoptera	27	19.56 *	22	7.119
Isoptera	--	--	03	0.97
Hemiptera	50	36.23 *	102	33.009 *
Hymenoptera	18	13.04	75	24.27 *
Lepedoptera	--	--	2	0.64
Diptera	4	2.89	7	2.26
Dermaptera	4	2.89	6	1.94
Melliped	--	--	1	0.32
Aranea	21	15.24 *	47	15.21 *
	138		309	

Abundance of Arthropods in Bt &non-Bt cotton fields.

Over all 447 individuals insects and mellipads and spiders were recorded in one cropping season in both Bt and non-Bt cotton fields. A total of 138 individuals in Bt cotton and 309 in non-Bt cotton fields were recorded.(Table-2).

Order Hemiptera is dominated with 36.23% in Bt, 33.009% in non-Bt cotton and Coleoptera, 19.56% in Bt and 7.119% non-Bt and Hymenoptera 13.04% in Bt and 24.27% in non-Bt cotton fields (Table-2).

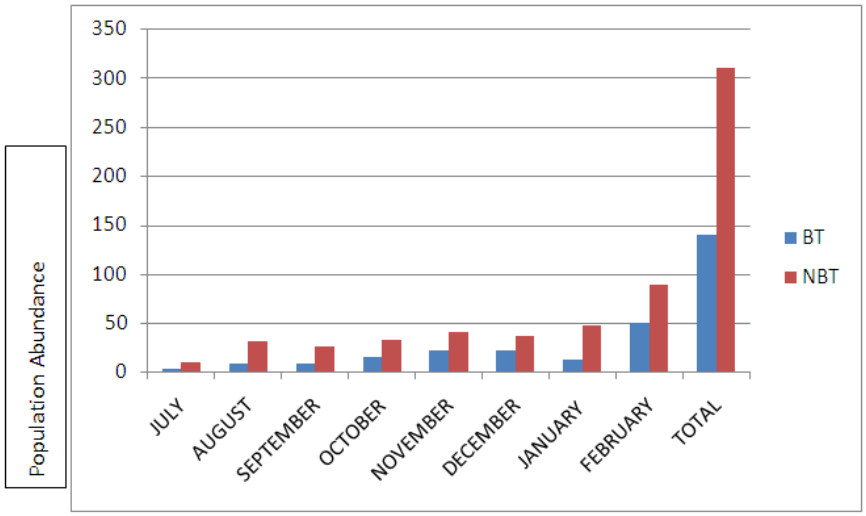

Fig.-1. Seasonal Abundance of soil arthropods in Bt and Non-Bt Cotton fields.

The seasonal abundance of soil arthropods were recorded in Bt & non-Bt cotton fields. Seasonal abundance was lower in both crops in the month of July, gradually increased from July, 2016 to February, 2017. We also found differences in abundances of arthropods between Bt and non- Bt cotton fields.(Fig-1)

Ecological indexes of diversity and community structure of soil macrofauna showed different tendencies among Bt and non-Bt cotton fields. Non-Bt cotton field had high richness (Table-3) with low diversity and evenness. It shows a highly non-homogeneous distribution of individuals among species. Low evenness indicate non-homogeneous distribution of individuals among species.

IV. Discussion

The number of arthropods species found in this study was obviously lower in Bt cotton in comparison to non-Bt cotton fields. (Sisterson et.,al 2004) showed minor differences in the arthropod community between Bt and non-Bt cotton. The abundance of ground dwelling predators in cotton fields were not negatively impacted by Bt cotton (Torres and Ruberson 2005). A slight difference was shown in the arthropod community between the spayed Bt and non-Bt cotton fields (White house et.,al 2005,Chintha Sammaiah et.,al 2014). In China, the diversity of arthropod communities in Bt cotton field was similar to that in Non-Bt cotton fields with spraying (Li et.,al 2004) indices differ slightly between Bt and Non-Bt cotton.

V. Conclusion

As a result of this study we recorded 22 species of soil arthropods in Bt cotton and 26 species in non-Bt cotton. In conclusion, our findings suggest that the Bt cotton has no marked negative effects on the arthropod community in cotton fields. However, abundance of arthropods showed significant differences comparisons between Bt and non-Bt cotton fields. The diversity indices evenness and richness were close and highly reasonable to each other.

The ecological indexes showed that species composition and soil fauna community structure in each agro ecosystems show contrasting patterns between Bt and Non-Bt cotton fields (the lowest species richness and a homogenous taxonomical distribution of individuals). The structure of arthropods was similar to that of the Non-Bt Cotton. The effects are consistent with the low macro soil fauna richness in both crops.

Table – 3 - Ecological indexes for soil arthropods in Bt and Non-Bt cotton agroeco-systems

	SHANNON VALUES OF					
	H-VALUES		EVENNESS		RICHNESS	
	Bt	non-Bt	Bt	non-Bt	Bt	non-Bt
Orthoptera	1.4	1.79	0.67	0.86	3.76	6.72
Choleoptera	1.08	1.00	0	0	6.515	3.45
Isoptera	0	0	0	0	0	0.5
Hemiptera	0.37	1.42	0.17	0.68	7.428	12.3
Hymenaptera	1.73	2.37	0.83	1.0	3.975	13.65
Lepedoptera	0	0.1	0	0	0	0.3
Diptera	0	0.2	0	0	0.993	1
Dermoptera	1.02	0.28	0.49	0.13	0.99	0.93
Millipeds	0	0.1	0	0	0	0.18
Aranea	1.64	2.2	0.78	0.09	0.169	8.435

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