

IMPACT OF WEATHER FACTORS ON SOIL INVERTEBRATE FAUNA IN Bt AND NON Bt COTTON FIELDS OF WARANGAL, TELANGANA, INDIA

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ABSTRACT

Soil invertebrates were collected by pitfall traps in Bt and non Bt cotton fields of Warangal, Telangana from June 2012 to March 2013. Four insect orders such as Collembola Hymenoptera, Coleoptera, Orthoptera, and Araneida (spiders) and Acari (mites) were collected and correlation coefficient was calculated between soil fauna and weather factors, such as maximum and minimum temperature, relative humidity and rainfall. Soil fauna showed positive correlation with minimum temperature, relative humidity (morning and evening) and rainfall and negative correlation with maximum temperature in Bt and non Bt cotton.

KEY WORDS: Bt, cotton, non Bt, soil invertebrates

INTRODUCTION

Soil biota mediates or regulates a variety of functions essential for plant growth and productivity, soil resource structure and ecosystem health. Soil faunal (micro, meso, and macro fauna) play a critical role in a variety of biological functions both in the rhizosphere and the soil near decomposing plant residues (Coleman and Crossley Jr., 1995; Gupta and Yeates, 1997) and without these organisms nature would have no way of recycling organic material on its own (Trombetti and Williams, 1999). They perform a number of key functions essential to plants, such as nutrient cycling, disease regulation, agrochemical degradation, and development and maintenance of physico-chemical properties of soil. Soil invertebrates are an important group in agro ecosystem which greater

affected by weather factors like temperature, relative humidity and rainfall. Temperature was reported as critical factor in determining the survival and development of immature stages and the reproductive performance of the arthropods (Chandrika Mohan *et al.*, 2004).

A significant proportion of the world biodiversity is recorded in agro-ecosystems (Pimentel *et al.*, 1992). Soil invertebrates are ubiquitous in natural and agricultural habitats. They are useful indicators of overall species richness and health of terrestrial communities (Noss, 1990). There is no information on soil invertebrates diversity and ecology in Bt and non Bt cotton fields. The present study was undertaken to study the population of soil invertebrates' community in Bt and non Bt cotton fields of Warangal District, Telangana, India.

MATERIAL AND METHODS

Soil invertebrates were collected monthly by pitfall trap method (Coddington and Levi 1991) in Bt and non Bt cotton fields of Warangal (17°.51' NL and 79°.22'EI at 380m MSL) during June 2012 to March 2013. The collected soil invertebrates were preserved in 80 per cent ethyl alcohol with a few drops of glycerin and identified under stereoscopic binocular microscope with help of keys. The soil invertebrates belonging to different taxa were enumerated and their mean number per trap was calculated. Weather parameters of temperature, relative humidity (morning, evening) and rainfall was measured during the study period and calculated its impact on soil invertebrates abundance.

RESULTS AND DISCUSSION

A total of 46 species belonging to four insect orders, Collembola, Hymenoptera Coleoptera and Orthoptera, and Araneae (spiders) and Acari (mites) were recorded during cropping seasons of Bt cotton and non Bt cotton fields during 2012-2013 (Table 1).

Bt cotton

The species composition of Collembola represented by *Sminthurus viridis*, *Arrhopalites principalis*, *Isostomidae* sp, *Isostoma viridis*, *Desoria olivaea*, *Folsomia quadrioculata*, *Entomobryid* sp, *Pseudosinella*- sp, *Entomobrya atrocineta*, *Lepidocyrtus lignorum*, *Cyphoderus*, and *Podura aquatic*. Hymenoptera represented by *Monomorium* sp, *Crematogaster* sp., *Componatus* *Pochycondyla tesserinoda*, *Occophylla maragdina*, *Wasmannia aleropunctata* and *Diacamma ecylonense*. Coleoptera was represented by *Anthia sexgutta*, *Neolema sexpunctata*, *Hybosorus scarob*, *Geotrupes strcorariusdor*,

Pterostichus melanarius, and *Harpalus*. Orthoptera represented by *Achetadomesticus*, *Gryllispennsylvanicus*, *Nemobiussylvesters*, and *Gryllusassimillis*. Araneae (Spiders) represented by *Pholcus Phalangioides*, *Thanatus*, *Gonngylidium rufipes*, *Zodarion* Sp, *Schizocosa Saltarix*, and *Rabidosa Punctulata*. The order Acarina was represented by *Eustigmaeus*, *Gamasidmite*, *Oribatida-mite*, *Thinoseius spinosus*, and *Mycobates sarakensis*.

Non Bt-cotton

The order Collembola represented by *Sminthurus viridis*, *Arrhopalites principalis*, *Isostomidae* sp, *Isostoma viridis*, *Desoria olivaea*, *Folsomia quadrioculata*, *Entomobryid* sp, *Pseudosinella*- sp, *Entomobrya atrocineta*, *Lepidocyrtus lignorum*, *Mega* *phoruraarchia* *Cyphoderus*, *Podura aquatic*, and *Hypogostrura harveyi*. Hymenoptera represented in *Monomorium* sp, *Crematogaster* sp., *Componatus* *Pochycondyla tesserinoda*, *Occophylla maragdina*, *Wasmannia aleropunctata* and *Diacamma* cf *ecylonense*. Coleoptera was represented by *Anthia sexgutta*, *Neolema sexpunctata*, *Oryzaephilus surinamensis*, *Hybosorus scarob*, *Geotrupes strcorariusdor*, *Pterostichus melanarius*, *Harpalus*, and *Selenophorus* sp. Orthoptera was represented by *Achetadomesticus*, *Gryllispennsylvanicus*, *Nemobiussylvesters*, and *Gryllusassimillis*.. Araneae (Spiders) was represented by *Pholcus phalangioides*, *Thanatus*, and *Gonngylidium rufipes*, *Zodarion* Sp, *Schizocosa Saltarix*, *Rabidosa Punctulata* and *Thomisus spectabilis*. The order Acarina was represented by *Trombidium* sp, *Eustigmaeus*, *Gamasidmite*, *Oribatida-mite*, *Thinoseius spinosus*, and *Mycobates sarakensis*. Mean abundance of the different orders presented in (Table 2)

revealed that all abundance of insect orders such as collembolan, hymenoptera orthoptera and coleopteran little higher in non Bt cotton fields than the Bt cotton fields. Spiders and mites also recorded little more abundance in non Bt-cotton. Several studies reviewed through meta-analysis (Naranjo, 2009) have suggested that effects of Bt crops on soil arthropods are little. The results also supported by the (Naranjo, 2009) and Dillon and Sharma (2013).

Soil arthropod fauna showed positive (significant at $p=0.05$) correlation with minimum temperature, relative humidity (morning and evening) and rainfall and negative correlation with maximum temperature (Table 3).

CONCLUSION

From the above results it can be seen that a total of 46 species belonging to four insect orders, Collembola, Hymenoptera Coleoptera and Orthoptera, and Araneae (spiders) and Acari (mites) were recorded during cropping seasons of Bt cotton and non Bt cotton fields. Soil fauna showed positive correlation with minimum temperature, relative humidity (morning and evening) and rainfall and negative correlation with maximum temperature in Bt and non Bt cotton.

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Table 1: Diversity of soil fauna in Bt and non Bt cotton fields at Warangal

Order	Family	Bt Cotton	Non Bt Cotton
		Species	
Collembola	Sminthridae	<i>sminthurus viridis</i>	<i>sminthurus viridis</i>
	Sminthridae	<i>arrhopalites pricipalis</i>	<i>arrhopalites pricipalis</i>
	Isostomidae	<i>Isostomidae sp</i>	<i>Isostomidae sp</i>
	Isostomidae	<i>Isostoma viridis</i>	<i>Isostoma viridis</i>
	Isostomidae	<i>Desoria olivaea</i>	<i>Desoria olivaea</i>
	Isostomidae	<i>Folsomia quadrioculata</i>	<i>Folsomia quadrioculata</i>
	Entomobrydae	<i>Entomobryid sp(slender sp)</i>	<i>Entomobryid sp(slender sp)</i>
	Entomobrydae	<i>Pseudosinella- sp</i>	<i>Pseudosinella- sp</i>
	Entomobrydae	<i>Entomobrya atrocinet</i>	<i>Entomobrya atrocinet</i>
	Onychiridae	<i>Lepidocyrtus lignorum</i>	<i>Lepidocyrtus lignorum</i>
		-----	<i>Megaphorura archia</i>
	Cyphoderidae	<i>Cyphoderus</i>	<i>Cyphoderus</i>
	Produridae	<i>Podura aquatic</i>	<i>Podura aquatic</i>
		-----	<i>Hypogostrura harveyi</i>
Hymenoptera	Formicidae	<i>Monomoriumsp</i>	<i>Monomoriumsp</i>
	“”	<i>Crematogaster</i>	<i>Crematogaster</i>
	“	<i>Componotus</i>	<i>Componotus</i>
	“	<i>Pochycondyla tesserinda</i>	<i>Pochycondyla tesserinda</i>
	“	<i>Occophyllas maragdina (red ants)</i>	<i>Occophyllas maragdina (red ants)</i>
	“	<i>Wasmannia aleropunctata</i>	<i>Wasmannia aleropunctata</i>
	Ponerinae	<i>Diacamma ceylonense</i>	<i>Diacamma ceylonense</i>
Coleoptera	Chrysomelidae	<i>Anthia sexgutta</i>	<i>Anthia sexgutta</i>
		<i>Neolema sexpunctata</i>	<i>Neolema sexpunctata</i>
		-----	<i>Oryzaephilus surinamensis</i>
	Hybosoridae	<i>Hybosorus scarob</i>	<i>Hybosorus scarob</i>
	Scarabaeidae	<i>Geotrupes strcorariusdor</i>	<i>Geotrupes strcorariusdor</i>
	Carabidae	<i>Pterostichus melanarius</i>	<i>Pterostichus melanarius</i>
	Carabidae	<i>Harpalus</i>	<i>Harpalus</i>
	Carabidae	-----	<i>Selenophorus sp</i>
Orthoptera	Gryllidae	<i>Achetadomesticus</i>	<i>Achetadomesticus</i>
	Gryllidae	<i>Gryllispennsylvanicus</i>	<i>Gryllispennsylvanicus</i>
	Gryllidae	<i>Nemobiussylvestrs</i>	<i>Nemobiussylvestrs</i>
	Gryllidae	<i>Gryllusassimillis</i>	<i>Gryllusassimillis</i>
Araneae	Pholcidae	<i>Pholcus Phalangioideis</i>	<i>Pholcus Phalangioideis</i>
	Philodromidae	<i>Thanatus SP</i>	<i>Thanatus SP</i>
	Linyphiidae	<i>Gonngylidium Rufipes</i>	<i>Gonngylidium Rufipes</i>
	Zodariidae	<i>Zodarion Sp</i>	<i>Zodarion Sp</i>
	Lycosidae	<i>Schizocosa Saltarix</i>	<i>Schizocosa Saltarix</i>
	Lycosidae	<i>Rabidosa Punctulata</i>	<i>Rabidosa Punctulata</i>
	Thomisidae	----	<i>Thomisus spectabilis</i>
Acarina	Trombidiidae	-----	<i>Trombidium sp</i>
	Stigmaeidae	<i>Eustigmaeus</i>	<i>Eustigmaeus</i>
	gamasiidae	<i>Gamasidmite</i>	<i>Gamasidmite</i>
	Oribatidae	<i>Oribatida-mite</i>	<i>Oribatida-mite</i>
	Oribatidae	<i>Thinoseius spinosus</i>	<i>Thinoseius spinosus</i>
	Tectocephidae	<i>Mycobates sarakensis</i>	<i>Mycobates sarakensis</i>

Table 2: Abundance of soil invertebrates (Mean $\pm$ SE) in Bt and non Bt-cotton fields of Warangal

Months	Bt	Non Bt	Bt	Non Bt	Bt	Non Bt	Bt	Non Bt	Bt	Non Bt	Bt	Non Bt
	Cotton	Cotton	Cotton	Cotton	Cotton	Cotton	Cotton	Cotton	Cotton	Cotton	Cotton	Cotton
	collem	Collem	ants	ants	beetles	beetles	crickets	crickets	spiders	spiders	mites	mites
June	15 $\pm$ 2.72	31 $\pm$ 2.44	17.6 $\pm$ 2.65	18.6 $\pm$ 2.31	2 $\pm$ 0.77	4.4 $\pm$ 1.56	2 $\pm$ 0.70	2.4 $\pm$ 0.24	2 $\pm$ 1.04	2.2 $\pm$ 0.96	3 $\pm$ 0.88	4.6 $\pm$ 0.81
July	16.8 $\pm$ 1.31	32.2 $\pm$ 5.95	13.2 $\pm$ 2.05	19.8 $\pm$ 2.90	3 $\pm$ 0.54	5 $\pm$ 1.44	2 $\pm$ 0.77	3 $\pm$ 1.34	2.4 $\pm$ 0.67	2.6 $\pm$ 0.50	3.6 $\pm$ 0.6	4.8 $\pm$ 0.66
Aug.	21.8 $\pm$ 1.28	30 $\pm$ 7.58	11 $\pm$ 2.40	14 $\pm$ 3.88	4.2 $\pm$ 0.66	5.8 $\pm$ 1.01	3 $\pm$ 0.54	4.2 $\pm$ 0.66	3.4 $\pm$ 1.07	3.2 $\pm$ 0.37	3 $\pm$ 0.54	5.2 $\pm$ 1.39
Sep.	20.6 $\pm$ 0.92	27 $\pm$ 5.14	9.2 $\pm$ 2.13	12.4 $\pm$ 1.46	4.6 $\pm$ 0.81	9 $\pm$ 2.21	4 $\pm$ 1.48	8.4 $\pm$ 1.20	4.4 $\pm$ 1.53	7.4 $\pm$ 0.67	3.4 $\pm$ 0.92	8 $\pm$ 1.84
Oct.	16 $\pm$ 1.37	22 $\pm$ 3.57	8 $\pm$ 1.81	9.6 $\pm$ 1.60	3 $\pm$ 0.31	8.4 $\pm$ 1.43	3.6 $\pm$ 0.87	8 $\pm$ 1.26	3.8 $\pm$ 0.86	7.4 $\pm$ 1.28	2.6 $\pm$ 0.74	7 $\pm$ 1.51
Nov.	13.4 $\pm$ 2.11	19.6 $\pm$ 2.24	5.8 $\pm$ 0.58	7.6 $\pm$ 0.67	2 $\pm$ 0.44	4 $\pm$ 1.18	2.6 $\pm$ 0.74	3.8 $\pm$ 0.48	1.6 $\pm$ 0.81	2.8 $\pm$ 0.37	1.4 $\pm$ 0.87	2.6 $\pm$ 0.50
Dec.	9.4 $\pm$ 1.61	17 $\pm$ 2.09	4.4 $\pm$ 1.09	6.8 $\pm$ 1.31	1.6 $\pm$ 0.81	4 $\pm$ 0.70	1.6 $\pm$ 0.50	3 $\pm$ 0.31	1.4 $\pm$ 0.50	2.4 $\pm$ 0.50	1 $\pm$ 0.77	1.6 $\pm$ 0.24
Jan.	4 $\pm$ 0.70	11 $\pm$ 1.87	3 $\pm$ 0.63	5.4 $\pm$ 0.67	1 $\pm$ 0.77	3 $\pm$ 1.26	0.8 $\pm$ 0.58	2.6 $\pm$ 0.92	0.8 $\pm$ 0.58	2 $\pm$ 0.54	0.8 $\pm$ 0.37	2 $\pm$ 0.44
Feb.	4.6 $\pm$ 0.74	8 $\pm$ 1.70	2 $\pm$ 0.31	4 $\pm$ 1.04	0.6 $\pm$ 0.4	2.6 $\pm$ 0.67	0.8 $\pm$ 0.2	2 $\pm$ 0.44	0	1.6 $\pm$ 0.24	0.6 $\pm$ 0.4	2.6 $\pm$ 1.02
Mar	3 $\pm$ 0.70	6.2 $\pm$ 0.96	1.6 $\pm$ 0.81	3.4 $\pm$ 0.74	0	2 $\pm$ 0.54	0	1.44 $\pm$ 0.24	0	1.6 $\pm$ 0.24	0	2 $\pm$ 0.44

Table 3: correlation of soil arthropods fauna with weather factors in Bt and non Bt Cotton crops

Correlation with Weather factors	Collembolan		Ants		Beetles		Crickets		Spiders		Mites	
	Bt	Non Bt	Bt	Non Bt	Bt	Non Bt	Bt	Non Bt	Bt	Non Bt	Bt	Non Bt
Max. Tem(°c)	-0.139	-0.035	0.179	0.144	-0.265	-0.082	-0.239	-0.131	-0.153	0.030	0.003	0.124
Min Tem(°c)	0.541*	0.521*	0.590*	0.567*	0.428*	0.417*	0.355*	0.279	0.449*	0.387*	0.570*	0.636*
R. H.M%	0.530*	0.574*	0.436*	0.479*	0.594*	0.471*	0.586*	0.418*	0.523*	0.346*	0.595*	0387*
R.H.E%	0.525*	0.496*	0.470*	0.468*	0.511*	0.202	0.367*	0.104	0.326	0.455*	0.510*	0.370*
Rainfall(mm)	0.676*	0.727*	0.594*	0.760*	0.705*	0.474*	0.438*	0.390*	0.744*	0.372*	0.792*	0.584*

**Significant at P=0.05*

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