International Journal of Agriculture Innovations and Research
Volume 2, Issue 5, ISSN (Online) 2319-1473
Manuscript Processing Details (dd/mm/yyyy) :
Received : 26/02/2014 | Accepted on : 29/03/2014 | Published : 02/04/2014

# Diversity of Soil Arthropod Community in Bt-Cotton and Non Bt-Cotton Fields of Warangal, Andhra Pradesh, India

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*Abstract* – **Soil arthropod community was investigated by using pitfall and compared the abundance and diversity of arthropods in Bt-cotton and non Bt-cotton fields from June 2011 to March 2012. A total of 46 specimens in non Bt-cotton and 40 in Bt-cotton (Collembola, Ants, Beetles, Crickets, Spiders and Mites) were captured and identified. The largest number of individuals was collected in both crops. The monthly diversity was calculated by using the Shannon –wiener diversity index and highest diversity of Collembola was found in October (H=1.47), Ants (H=1.49) in June, Beetles (H=1.41) in September, Crickets (H=1.18) in December, Spiders (H=1.48) in October and Mites (H=1.48) August in Bt-cotton fields. Highest diversity of Collembola (H=2.09) in November, Ants (H=1.89) in July, Beetles (H=1.92) in July, Crickets (H=1.31) in August and October, Spiders (H=1.76) in August 2011, and Mites (H=1.62) in August and October in non Bt-cotton. Total species and number of individuals and groups were determined there were no significant difference were observed in their abundance of arthropod species in Bt-cotton and non Bt-cotton fields. Suggesting that there were no adverse effects of Bt-cotton on the arthropod diversity under field conditions.**

*Keywords* – **Bt-Cotton and Nonbt-Cotton, Soil Arthropods, Species Diversity, Warangal, Andhra Pradesh.**

## I. INTRODUCTION

Cotton is the major crop in India, covering a large area of cultivable land in India and other countries and plays a vital role in economy sustains the cotton textile industry provide employment to millions of people. India ranks first in cotton acreage (12m ha) occupying about 34% of the global cotton area 135m ha (James, 2010). However India contributed about 12% of the total cotton production. The growing worldwide transgenic crops may impose risks on communities of ground dwelling arthropods; predatory arthropods on the ground may have direct contact with activated Bt toxins released into the rhizosphere through plant roots (Saxena et al 1999, Zwahlen et al 2003, Baumgartes and Tebbe, c.c 2005). They may be exposed to toxin through prey that is able to acquire and convey toxin to predators (Saxena & Stozkey 2001) and may be indirectly impacted through the changes in food chains (herbivore community) that serves as the prey base. 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 (Tooley and Brust 2002).Studies from different countries indicate that Bt-cotton has no detrimental impact on biodiversity (Cattaneo et al.,.2006)especially when compared with non Bt-crops (Marvier et al., 2007). 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 changes in the environment, therefore the present studies were undertaken to compare the abundance and diversity of arthropods in Bt-cotton and non Bt- cotton field conditions.

In the present paper a comparative analysis of soil arthropods was carried out in the Bt-cotton and non Bt-cotton fields in K.U campus to understand the impact of Bt-cotton fields on soil fauna.

## II. MATERIALS AND METHODS

The study was carried out at experimental fields, of Bt-cotton (Bt- mech 12) and non Bt-cotton (mech 12) during rainy season semi-Arid tropics, Warangal, A.P, at the Kakatiya University campus; it is located between (17°.51' NL and 79°.22′EI at 380m MSL). Fit fall traps were used to estimate population abundance and density of soil surface-dwelling arthropods Sampling was done every month from June 2011 to March 2012. Each trap was 250ml plastic cups buried, so that the mouth was level with the soil surface. The inner cup, containing 250ml of isopropyl alcohol, the traps was covered with 20cm diameter plastic plat to exclude rain and debris. The traps were collected monthly and brought to the laboratory where the contents removed and stored in 70% ethanol. Later the trap content was identified and recorded the species, family and order level, using the data available species richness index, shanon-diversity index and species evenness of soil arthropods were analyzed.

## III. RESULTS

A total of 3750 ground dwelling individuals comprising 40 and 46 taxa were collected from Bt and non Bt-cotton fields during the study period respectively. All the specimens were identified as Collembola, Hymenoptera,

Coleoptera, Orthoptera, Araneae and Acari were collected in both fields, the species of Collembolans are viz *Sminthurus viridis, arrhopalites pricipalis, Isostomidae* sp, *Isostoma viridis, Desoria olivaea, Folsomia quadrioculata, Entomobryid sp, Pseudosinella-* sp, *Entomobrya atrocineta, Lepidocyrtus lignorum, Cyphoderus,*and *Podura aquatic.* In Hymenoptera *Monomorium* sp, *Crematogaster* sp., *Componatus* sp, *Pochycondyla tesserinoda*, *Occophylla maragdina*, *Wasmannia aleropunctata* and *Diacamma cf ecylonense.* In Coleoptera such as *Anthia sexgutta, Neolema sexpunctata, Hybosorus scarob, Geotrupes strcorariusdor, Pterostichus melanarius, and Harpalus.* In Orthoptera *Achetadomesticus,Grylllispennsylvanicus,Nemobiussylvestrs,* and *Gryllusassimillis.* In Araneae (Spiders) represented by *Pholcus Phalangioideis, Thanatus* sp *Gonngylidium Rufipes, Zodarion* sp, *Schizocosa Saltarix, and Rabidosa Punctulata.* In Acari represented by *Eustigmaeus, Gamasidmite, Oribatida-mite Thinoseius spinosus,* and *Mycobates sarakensis* were found in both (Table-1 and 2) Bt-cotton and non Bt-cotton fields. However, species *Mega phoruraarchia, Hypogostrura harveyi* in collembola, *Oryzaephilus surinamensis, Selenophorus* sp in Coleoptera, *Thomisus spectabilis* in Arachnida and *Trombidium* sp in Acari were recorded only in non Bt-cotton fields.

Species diversity of the Collembola, Hymenoptera, Coleoptera, Orthoptera Arachnida and Acari in Bt –cotton lower than non Bt-cotton, this may be due to more numbers of soil arthropods in non Bt-cotton than Bt-cotton. However, no significant influence of Bt-cotton was observed on the diversity index of soil dwelling arthropods. The richness and the diversity index of the soil dwelling arthropods species was similar in Bt- and non Bt-cotton except in a few cases, therefore, there is a continuing need to monitor the population of arthropods for a longer period of time to understand the long term impact of Bt- crops on soil biodiversity and population dynamics. In this study, abundance and diversity of soil dwelling arthropods in Bt -cotton field not affected significantly during one year of study.

The Species diversity, index ($H^{-}$) of the collembolan ranged between 1.26 to1.47, in Bt-cotton, and 1.54 to 2.09 in non Bt-cotton , Hymenoptera ants 1.02 to 1.49 in Bt-cotton , and 1.09 to 1.89 in non Bt-cotton , Coleoptera beetles 0.71 to 1.49 in Bt-cotton , and 1.04 to 1.92 in non Bt- cotton , Orthoptera , crickets 0.55 to 1.18 in Bt-cotton , and 0.68 to 1.31 in non Bt-cotton Spiders ranged between 1.02 to 1.48 in Bt-cotton and 1.01 to 1.76 and mites 1.02 to 1.48 in Bt-cotton , and 1.04 to 1.62 in non Bt-cotton(Table-2). The Evenness(J)values of collembolans ranged between 0.38 to 1.29 in Bt-cotton ,and 0.79 to 1.24 in non Bt-cotton , ants 0.41 to 1.22 in Bt-cotton , and 0.67 to 1.01 in non Bt-cotton , beetles 0.11 to 1.18 in Bt-cotton , and 0.79 to 1.73 in non Bt-cotton ,crickets 0.19 to 1.00 in Bt-cotton and 0.54 to 0.98 in non Bt-cotton , spiders0.23 to 1.22 in Bt-cotton ,and 0.18 to 1.50 in non Bt-cotton and mites 0.49 to 1.37 in Bt-cotton , 0.78 to 1.58 in non Bt-cotton(Table-3). Species richness of collembolans 1.11 to 2.61 in Bt- cotton , and 1.45 to 3.25 in non Bt-cotton, ants 0.74 to 1.63 in Bt-cotton, and 1.06 to 1.65 in non Bt-cotton, beetles 0.62 to 1.64 in Bt-cotton, and 0.86 to 2.34 in non Bt-cotton, crickets 0.72 to 1.44 in Bt-cotton, and 0.51 to 1.20 in non Bt-cotton, spiders 1.30 to 1.93 in Bt-cotton, and 1.30 to 2.34 in non Bt-cotton and mites 1.03 to 1.83 in Bt-cotton, and 0.96 to 1.59 in non Bt-cotton(Table-4).

Table: 1(a) Diversity of soil fauna in Bt-cotton fields during 2011- 2012

| **Order** | **Family** | **Species** |
|---|---|---|
| Collembola | Sminthridae | *Sminthurus viridis* |
| | Sminthridae | *Arrhopalites pricipalis* |
| | Isostomidae | *Isostomidae* sp. |
| | Isostomidae | *Isostoma viridis* |
| | Isostomidae | *Desoria olivaea* |
| | Isostomidae | *Folsomia quadrioculata* |
| | Entomobrydae | *Entomobryid* sp (slender sp) |
| | Entomobrydae | *Pseudosinella-* sp. |
| | Entomobrydae | *Entomobrya atrocineta* |
| | Onychiridae | *Lepidocyrtus lignorum* |
| | Cyphoderidae | *Cyphoderus sp.* |
| | Produridae | *Podura aquatica* |
| Hymenoptera | Formicidae | *Monomorium* sp. |
| | Formicidae | *Crematogaster* sp. |
| | Formicidae | *Componotus* sp. |
| | Formicidae | *Pochycondyla tesserinda* |
| | Formicidae | *Occophyllas maragdina* (red ants) |
| | Formicidae | *Wasmannia aleropunctata* |
| | Ponerinae | Diacamma cf ceylonense |
| Coleoptera | Carabidae | *Anthia sexgutta* |
| | Chrysomelidae | *Neolema sexpunctata* |
| | Hybosoridae | *Hybosorus scarob* |
| | Scarabaeidae | *Geotrupes strcorariusdor* |
| | Carabidae | *Pterostichus melanarius* |
| | Carabidae | *Harpalus* |
| Orthoptera | Gryllidae | *Achetadomesticus* |
| | Gryllidae | *Grylllispennsylvanicus* |
| | Gryllidae | *Nemobiussylvestrs* |
| | Gryllidae | *Gryllusassimillis.* |
| Araneae | Pholcidae | *Pholcus phalangioideis* |
| | Philodromidae | *Thanatus* sp. |
| | Linyphiidae | *Gonngylidium Rufipes* |
| | Zodariidae | *Zodarion* sp |
| | Lycosidae | *Schizocosa Saltarix* |
| | Lycosidae | *Rabidosa Punctulata* |
| Acari | Stigmaeidae | *Eustigmaeus* |
| | gamasiidae | *Gamasidmite* |
| | Oribatidae | *Oribatida-mite* |
| | Oribatidae | *Thinoseius spinosus* |
| | Tectocepheidae | *Mycobates sarakensis* |

Table: 1 (b) Diversity of soil fauna in non Bt-cotton fields during 2011- 2012

| **Order** | **Family** | **Species** |
|---|---|---|
| Collembola | Sminthridae | *Sminthurus viridis* |
| | Sminthridae | *Arrhopalites pricipalis* |
| | Isostomidae | *Isostomidae* sp |
| | Isostomidae | *Isostoma viridis* |
| | Isostomidae | *Desoria olivaea* |
| | Isostomidae | *Folsomia quadrioculata* |
| | Entomobrydae | *Entomobryid* sp(slender sp) |
| | Entomobrydae | *Pseudosinella-* sp |
| | Entomobrydae | *Entomobrya atrocineta* |
| | Onychiridae | *Lepidocyrtus lignorum* |
| | | *Megaphorura archia* |
| | Cyphoderidae | *Cyphoderus* sp. |
| | Produridae | *Podura aquatica* |
| | | *Hypogostrura harveyi* |

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Volume 2, Issue 5, ISSN (Online) 2319-1473

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|---|---|---|
| Hymenoptera | Formicidae | *Monomorium* sp. |
| | Formicidae | *Crematogaster* sp. |
| | Formicidae | *Componotus* sp. |
| | Formicidae | *Pochycondyla tesserinda* |
| | Formicidae | *Occophyllas maragdina* (red ants) |
| | Formicidae | *Wasmannia aleropunctata* |
| | Ponerinae | *Diacamma cf ceylonense* |
| Coleoptera | Carabidae | *Anthia sexgutta* |
| | Chrysomelidae | *Neolema sexpunctata* |
| | Silvanidae | *Oryzaephilus surinamensis* |
| | Hybosoridae | *Hybosorus scarob* |
| | Geotrupidae | *Geotrupes strcorariusdor* |
| | Carabidae | *Pterostichus melanarius* |
| | Carabidae | *Harpalus* |
| | Carabidae | *Selenophorus* sp |
| Orthoptera | Gryllidae | *Achetadomesticus* |
| | Gryllidae | *Grylllispennsylvanicus* |
| | Gryllidae | *Nemobiussylvestrs* |
| | Gryllidae | *Gryllusassimillis* |
| Araneae | Pholcidae | *Pholcus Phalangioideis* |
| | Philodromidae | *Thanatus* sp |
| | Linyphiidae | *Gonngylidium Rufipes* |
| | Zodariidae | *Zodarion* sp. |
| | Lycosidae | *Schizocosa Saltarix* |
| | Lycosidae | *Rabidosa Punctulata* |
| | Thomisidae | *Thomisus spectabilis* |
| Acari | Trombidiidae | *Trombidium* sp |
| | Stigmaeidae | *Eustigmaeus* |
| | gamasiidae | *Gamasidmite* |
| | Oribatidae | *Oribatida-mite* |
| | Oribatidae | *Thinoseius spinosus* |
| | Tectocepheidae | *Mycobates sarakensis* |

Table 2: Shannon-Weiner index Diversity of soil fauna in Bt-cotton and non Bt-cotton fields of Warangal during-2011-2012(H-Values)

| S. NO | Bt-cotton | Non Bt-cotton | Bt-cotton | Non Bt-cotton | Bt-cotton | Non Bt-cotton | Bt-cotton | Non Bt-cotton | Bt-cotton | Non Bt-cotton | Bt-cotton | Non Bt-cotton |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Months | **collembola** | **Collembola** | **ants** | **ants** | **beetles** | **beetles** | **crickets** | **crickets** | **spiders** | **spiders** | **mites** | **Mites** |
| Jun-11 | 1.29 | 1.86 | 1.49 | 1.82 | 1.27 | 1.44 | 1.02 | 1.19 | 1.16 | 1.59 | 1.27 | 1.57 |
| Jul-11 | 1.45 | 1.96 | 1.45 | 1.89 | 1.4 | 1.92 | 0.59 | 1.22 | 1.2 | 1.74 | 1.42 | 1.56 |
| Aug-11 | 1.46 | 1.93 | 1.36 | 1.79 | 1.4 | 1.89 | 1.03 | 1.31 | 1.21 | 1.76 | 1.48 | 1.62 |
| Sep-11 | 1.46 | 2.08 | 1.33 | 1.77 | 1.41 | 1.74 | 0.98 | 1.31 | 1.46 | 1.75 | 1.4 | 1.6 |
| Oct-11 | 1.47 | 2.04 | 1.3 | 1.82 | 1.3 | 1.76 | 0.97 | 1.31 | 1.48 | 1.67 | 1.23 | 1.62 |
| Nov-11 | 1.44 | 2.09 | 1.36 | 1.7 | 1.21 | 1.75 | 1.01 | 1.26 | 1.34 | 1.7 | 1.06 | 1.32 |
| Dec-11 | 1.43 | 2.07 | 1.27 | 1.56 | 0.71 | 1.74 | 1.18 | 1.2 | 1.13 | 1.65 | 1.04 | 1.06 |
| Jan-12 | 1.42 | 1.92 | 1.03 | 1.5 | 1.49 | 1.3 | 0.68 | 1.21 | 1.02 | 1.21 | 1.02 | 1.36 |
| Feb-12 | 1.39 | 1.85 | 1.02 | 1.32 | 0 | 1.3 | 0.55 | 1.04 | 0 | 1.18 | 1.08 | 1.23 |
| Mar-12 | 1.26 | 1.54 | 1.02 | 1.09 | 0 | 1.04 | 0 | 0.68 | 0 | 1.01 | 0 | 1.04 |

The values of (H) above 1.6 and below 3.00 indicate that the structure of habitat in stable and balanced

Table 3: Evenness Diversity of soil fauna in Bt-cotton and non Bt-cotton fields of Warangal during-2011-2012(J-Values)

| S.NO | Bt-cotton | Non Bt-cotton | Bt-cotton | Non Bt-cotton | Bt-cotton | Non Bt-cotton | Bt-cotton | Non Bt-cotton | Bt-cotton | Non Bt-cotton | Bt-cotton | Non Bt-cotton |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Months | **collembola** | **Collembola** | **ants** | **ants** | **beetles** | **beetles** | **crickets** | **crickets** | **spiders** | **spiders** | **mites** | **Mites** |
| Jun-11 | 0.53 | 0.79 | 0.65 | 0.67 | 1.05 | 0.79 | 1 | 0.88 | 0.54 | 1.12 | 1.26 | 1.43 |
| Jul-11 | 0.71 | 0.89 | 0.56 | 0.69 | 1.18 | 1.65 | 0.49 | 0.68 | 0.57 | 1.46 | 1.37 | 1.07 |
| Aug-11 | 0.76 | 0.8 | 0.79 | 0.75 | 0.57 | 1.53 | 0.38 | 0.81 | 0.81 | 1.5 | 1.06 | 1.27 |
| Sep-11 | 0.77 | 0.85 | 0.55 | 0.81 | 1.15 | 1.19 | 0.31 | 0.55 | 0.91 | 1.15 | 0.98 | 0.95 |
| Oct-11 | 0.66 | 1 | 0.41 | 0.94 | 0.79 | 0.87 | 0.31 | 0.56 | 1.22 | 1.19 | 0.97 | 1 |
| Nov-11 | 0.63 | 0.83 | 0.48 | 0.94 | 1 | 1.41 | 0.4 | 0.86 | 0.24 | 0.57 | 1.33 | 0.89 |
| Dec-11 | 0.38 | 1.24 | 0.55 | 1.01 | 0.11 | 1.73 | 0.73 | 0.71 | 0.23 | 0.64 | 1.04 | 1.15 |
| Jan-12 | 1.23 | 1.17 | 0.69 | 0.99 | 0.12 | 1.1 | 0.98 | 0.77 | 0.49 | 1.13 | 0.49 | 1.58 |
| Feb-12 | 1.09 | 0.96 | 1 | 1.01 | 0 | 1.22 | 0.19 | 0.98 | 0 | 0.73 | 0 | 0.78 |
| Mar-12 | 1.29 | 1.09 | 1.22 | 0.7 | 0 | 0.98 | 0 | 0.54 | 0 | 0.18 | 0 | 0.98 |

Evenness index values are closer to 1, and more than one it means that the individual are distributed equally in fields

Table 4: Species richness of soil fauna in Bt-cotton and non Bt-cotton fields of Warangal during-2011-2012 (D=Species Richness)

| S.NO | Bt-cotton | Non Bt-cotton | Bt-cotton | Non Bt-cotton | Bt-cotton | Non Bt-cotton | Bt-cotton | Non Bt-cotton | Bt-cotton | Non Bt-cotton | Bt-cotton | Non Bt-cotton |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Months | **collembola** | **Collembola** | **ants** | **ants** | **beetles** | **beetles** | **crickets** | **crickets** | **spiders** | **spiders** | **mites** | **mites** |
| Jun-11 | 1.39 | 2.24 | 1.34 | 1.32 | 1.3 | 1.29 | 0.86 | 1.2 | 1.3 | 2.09 | 1.48 | 1.59 |
| Jul-11 | 1.8 | 2.59 | 1.43 | 1.3 | 1.48 | 2.18 | 0.86 | 1.11 | 1.61 | 2.34 | 1.38 | 1.57 |
| Aug-11 | 2.34 | 2.57 | 1.5 | 1.41 | 1.64 | 2.08 | 1.11 | 0.98 | 1.76 | 2.16 | 1.48 | 1.55 |
| Sep-11 | 2.37 | 2.55 | 1.57 | 1.45 | 1.59 | 1.84 | 1 | 0.8 | 1.61 | 1.66 | 1.41 | 1.35 |
| Oct-11 | 2.51 | 2.76 | 1.63 | 1.55 | 1.48 | 1.87 | 1.03 | 0.81 | 1.64 | 1.66 | 1.56 | 1.4 |
| Nov-11 | 2.61 | 2.83 | 1.48 | 1.65 | 1.3 | 2.34 | 0.78 | 1.02 | 1.93 | 2.41 | 1.03 | 1.56 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dec-11 | 2.07 | 2.92 | 1.29 | 1.42 | 0.96 | 2.34 | 1.44 | 1.11 | 1.54 | 2.41 | 1.25 | 0.96 |
| Jan-12 | 1.33 | 3.25 | 0.74 | 1.51 | 0.62 | 1.11 | 0.72 | 1.17 | 1.44 | 1.3 | 1.44 | 1.3 |
| Feb-12 | 1.27 | 2.44 | 0.86 | 1.33 | 0.91 | 1.17 | 0.72 | 0.86 | 0 | 1.44 | 1.83 | 1.17 |
| Mar-12 | 1.11 | 1.45 | 0.96 | 1.06 | 0 | 0.86 | 0 | 0.51 | 0 | 1.44 | 0 | 0.86 |

Species richness in the number of different species in a given area, which to assess the homogeneity of an environment

## IV. Discussion

Total numbers of arthropods recorded in Bt-cotton (40) species and non Bt-cotton (46) species several studies reviewed through meta- analysis (Naranjo, 2009) have suggested that effects of Bt- crops on soil arthropods are minimal. The results also supported by the (Naranjo,2009)Dillon and Sharma (2013), the breadth of coverage of biodiversity within agro ecosystem in general and arthropods in particular for bio safety studies is not sufficient in the tropics and therefore , there is a continued need to monitor the effects of the Bt-cotton crops on the abundance and diversity of arthropods.

## V. Conclusion

As a results of this study we recorded 40 species of soil arthropods in Bt-cotton and 46 species non Bt-cotton fields indicate that effect of Bt crops on soil arthropods are minimal. The diversity indices, evenness and richness were close and highly reasonable to each other. The values under 1.0 indicate not supporting survival of the arthropods.

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## Author's Profile

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is born in Godishal, Karimnagar Dist, Andhra Pradesh, India. Date of Birth 15th July, 1955, he is BSc in Botany, Zoology and Chemistry and MSc in Zoology specialized in Entomology from Kakatita University, PG Dip. in Env. Sciences, Andhra University and Ph.D. (Urban Termite Ecology), Kakatiya University.

He has teaching experience 33 years (UG-09 Years & PG-24Years), he has started his professional career as Jr. lecturer from, Nov. 1981-1983 in Govt. Degree college Adilabad, Andhra Pradesh, Lecturer, Aug.1983-1992, Reader, Dec. 1992-2000 and Professor from Dec. 2001 onwards, in the Kakatiya University, Warangal, Andhra Pradesh. He also served as Principal, HOD, Chairman, Board of studies, for Zoology, Environmental studies and Sericulture, Director Hostels, Vice-Principal and Addl. Controller Examination. His Research specialization Environmental Entomology. He has 28 Years research experience and Ph.D.12, M.Phil.06, awarded under his guidance and 08 Ph.D., 6 M.Phil Scholars working under his supervision. He has published 50 papers, 03 Books. He has completed 03 (UGC) Minor Research Projects and one (UGC) Major Research Projects. He likes most his 3 publications:

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