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A Study on Pesticide Toxicity on Surface Soil Microarthropod (Insecta) Population in Warangal District

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Abstract: Insect class of soil microarthropods were most dominated in all type of environments. In the present study we observed the pesticide toxicity on Insects soil microarthropod population in different cotton and normal fields in Narsampet mandal of Warangal rural District, Telangana, during June 2015 to May 2016. In this study cotton field is treated as pesticide treated site and nearby area where the pesticides not used is taken as normal site. The common pesticides used in this area are Imidacloprid, Monochrotophos,Chloropyrifos, Pegasus and Fame etc. During the research period interesting findings were observed that the insects population relatively high in normal fields. Distinguished variation observed in Insects soil microarthropod population in normal and pesticide treated fields. In normal field Insecta soil microarthropod population is high in north east monsoon season and low in summer. Whereas pesticide treated field highest population were observed in south west monsoon and lowest density observed in north east monsoon season.

Keywords: Insect, Soil microarthropod, Pesticides, Normal.

INTRODUCTION

A late recent and latest technology utilizing maximum management of several pesticides as tool for different pest control has become a truth to increase crop yield and agricultural production quality. Most of the soil microarthropods are Saphrophagous, and Herbivorous also act as natural predators. Among all these are influence the soil organic matter and leaf litter decomposition, plays crucial role in nutrient recycling and sustained soil microarthropod biodiversity in soil eco-system. The main aim of this present study is screening of pesticide toxicity within top and upper soil layer (5-15 c. m) on soil microarthropods individual population density per sample. Soil microarthropods acts as a connective links in food chain and plays significant role in food web also. Decreasing the density of microarthropods will lead to disturb the ecological balance.However in India eco-toxicological experimental and applied studies are rare on soil microarthropods. Knowingly or unknowingly, now the farmers are addicted to using agrochemicals indiscriminately and excessively to make the situation from bad to worse not only in India but also in other parts of world as well [1]. Potential adverse effects of microbial pesticides include the displacement of non-target micro-organisms and allergenic, toxic or pathogenic effects on humans or other non-target organisms [2]. Even though there is no standard and accurate biomarkers was established and many differences were exist in life cycle, life history, reproduction rate and gestation period of soil microarthropods in between the tropical soils and temaprate soils. For example one surface application of insecticides was found to reduce predator populations by 60% for as long as six weeks [3].

The collembolans are most vulnerable to pollution of soil. Once applied agrochemicals perstist in the soil for long periods and have negative impacts on soil microbial flora such as the killing certain specific groups of microorganisms [4]. Decrease in number of spiders and diversity and species richness of collembolan after application of insecticide chloropyrifos has been reported on grassland pasture in UK [5]. The current study findings supports the observations of [6,7] that effects of herbicides on non-target organisms are often short lived or overshadowed by other factors.

MATERIAL AND METHODOLOGY

Iron core sampler from 5 cm diameter and depth of 15 cm is used for the collection of soil samples in the present study. This iron core sampler was similar to used by [8]. Soil samples were collected first week of every month throughout the year. These samples brought to laboratory and transfer to Tullgren funnel extractor within three hours of collection. The Berlese Tullgren funnel [9] extractor is best for extracting soil microarthropods with effieciency of about 90% [10]. The insect microarthropods which passed through 2x2 mm sieve of the sample holder were collected separately, the phials

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containing 70% alcohol fixed to the lower edge of funnel, regularly the phials were checked for the desired level of alcohol. By using sucking pipette extracted insect microarthropods collected and observed under stereo binocular dissecting microscope for quantitative analysis. The number in each group was identified and conformed by [11, 12].

RESULTS AND DISCUSSION

Apterigota: leaf litter and soil organic matter plays a significant role on the population concentration of Mites, Apterigota and Pterigota in agricultural lands. The Diplurans are found in soil, under leaf litter and under stones like damp habitats. During the study period the Diplura species value recorded in between 16 to 36 individuals in normal field and 12 to 22 individuals in pesticide treated field. The highest individuals were recorded in September month of south west monsoon season and lowest were recorded in the month of May in summer season. Whereas pesticide treated field highest values recorded in August of south west monsoon season and lowest individuals were recorded in December month in north east monsoon season. The mean and S.D. values are 25.50±4.79 in south west monsoon, 28.75±2.63 in north east monsoon season and 19.75±3.50 in summer season in normal field. In pesticide treated field the mean and S.D. values are 20.50±1.29 in south west monsoon, 15.75±3.86 in north east monsoon season and 15.75±1.50 in summer season. In the worldwide more than 660 types of Protura species were described and these are also found in damp and moist habitats. In the study period the Proturans value recorded in between 15 to 39 individuals in normal field and 11 to 32 individuals in pesticide treated field. The highest individuals were recorded in August month in south west monsoon season and lowest were recorded in the month of May in summer season. Whereas pesticide treated field highest values recorded in July of south west monsoon season and lowest individuals were recorded in January month in north east monsoon season. The mean and S.D. values are 35.25±4.04 in south west monsoon, 34±3.36 in north east monsoon season and 19.75±4.85 in summer season in normal field. In pesticide treated field the mean and S.D. values are 28±3.65 in south west monsoon, 18.75±5.67 in north east monsoon season and 15±2.16 in summer season.

COLLEMBOLA

The Collembolans are positively correlated with the moisture content and health of soil. [13] Reported a reduction in the number of major taxonomic and trophic groups of collembolan as well as decreased rates of reproduction by application of heptachlor and endosulfan pesticides. In Collembola the most primitive and advanced families are Isotomidae, Sminthuridae and Entomobryidae. In the present investigation the Entomobryidae species value recorded in between 78 to 152 individuals in normal field and 92 to 132 individuals in pesticide treated field. The highest individuals were recorded in October month of north east monsoon season and lowest were recorded in the month of May in summer season. Whereas pesticide treated field highest values recorded in September of south west monsoon season and lowest individuals were recorded in December month in north east monsoon season. The mean and S.D. values are 110.30±26.23 in south west monsoon, 141.30±14.68 in north east monsoon season and 94.75±14.03 in summer season in normal field. In pesticide treated field the mean and S.D. values are 123±10.13 in south west monsoon, 103.25±12.52 in north east monsoon season and 100±4.96 in summer season. During the study period the Isotomidae species value recorded in between 31 to 82 individuals in normal field and 30 to 54 individuals in pesticide treated field. The highest individuals were recorded in October month in north east monsoon season and lowest were recorded in the month of May in summer season. Whereas pesticide treated field highest values recorded in September of south west monsoon season and lowest individuals were recorded in November month in north east monsoon season. The mean and S.D. values are 52.25±18.66 in south west monsoon, 75.50±7.18 in north east monsoon season and 43.25±11.67 in summer season in normal field. In pesticide treated field the mean and S.D. values are 41±11.91 in south west monsoon season, 36±10.03 in north east monsoon season and 37.25±2.87 in summer season.

In the study period the Sminthuridae species value recorded in between 104 to 152 individuals in normal field and 64 to 126 individuals in pesticide treated field. The highest individuals were recorded in November month in north east monsoon season and lowest were recorded in the month of May in summer season. Whereas pesticide treated field highest values recorded in September of south west monsoon season and lowest individuals were recorded in January month in north east monsoon season. The mean and S.D. values are 127.50±11.68 in south west monsoon, 146±5.88 in north east monsoon season and 119.50±12.01 in summer season in normal field. In pesticide treated field the mean and S.D. values are 103.25±17.46 in south west monsoon, 98±29.83 in north east monsoon season and 68.50±5.19 in summer season. Mites, Springtails and ants are some important microarthropods used to assess environmental impacts [14]. During the study period the Onychiuridae species value recorded in between 19 to 39 individuals in normal field and 10 to 22 individuals in pesticide treated field. The highest individuals were recorded in the month of August in north east monsoon season and lowest were recorded in the month of May in summer season. Whereas pesticide treated field highest values recorded in August of south west monsoon season and lowest individuals were recorded in the month of January in north east monsoon season. The mean and S.D. values are 35.25±3.30 in south west monsoon, 32.50±1.73 in north east monsoon season and 23.75±3.59 in summer season in normal field. In pesticide treated field

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the mean and S.D. values are 21.5±2.08 in south west monsoon, 13.25±2.98 in north east monsoon season and 14.25±1.50 in summer season.

PTERIGOTA: (ENDOPTERIGOTA)

Diptera species are very interesting group due to their size and shape of body, predaceous and parasitic living nature in both dead animals and plants material. During the study period the Diptera species value ranged in between 10 to 23 individuals in normal field and 1 to 16 individuals in pesticide treated field. The highest individuals were recorded in December month in north east monsoon season and lowest were recorded in the month of May in summer season. Whereas pesticide treated field highest values recorded in September of south west monsoon season and lowest individuals were recorded in December month in north east monsoon season. The mean and S.D. values are 13.75±2.06 in south west monsoon, 20±2.58 in north east monsoon season and 15.50±4.20 in summer season in normal field. In pesticide treated field the mean and S.D. values are 11±3.91 in south west monsoon, 3.50±3.10 in north east monsoon season and 3.75±1.25 in summer season. The Hymenoptera species exhibit a great Diversity of habits, social behavior and complexity. During the study period the Hymenoptera species value recorded in between 16 to 32 individuals in normal field and 5 to 18 individuals in pesticide treated field. The highest individuals were recorded in January month in north east monsoon season and lowest were recorded in the month of May in summer season. Whereas pesticide treated field highest values recorded in September of south west monsoon season and lowest individuals were recorded in December month in north east monsoon season. The mean and S.D. values are 13.75±3.10 in south west monsoon, 26±4.96 in north east monsoon season and 25.25±6.80 in summer season in normal field. In pesticide treated field the mean and S.D. values are 13±3.46 in south west monsoon, 8.50±4.50 in north east monsoon season and 9±0.81 in summer season.In the order of Insecta, Coleopterans consisting more than 2, 80,000 variety of species in worldwide and placed as a major group. Carabids are important soil predators, easy to trap due to their mobility on the soil surface. Carabids are being widely distributed they are considered sensitive indicators of environmental conditions [15, 16, 17]. During the study period the Carabidae (Coleoptera) species value recorded in between 10 to 26 individuals in normal field and 5 to 17 individuals in pesticide treated field. The highest individuals were recorded in September month in north east monsoon season and lowest were recorded in the month of May in summer season. Whereas pesticide treated field highest values recorded in June of south west monsoon season and lowest individuals were recorded in November month in north east monsoon season. The mean and S.D. values are 22.50±3.10 in south west monsoon, 21.50±3.87 in north east monsoon season and 12±1.63 in summer season in normal field. In pesticide treated field the mean and S.D. values are 14.25±2.50 in south west monsoon, 6.25±1.25 in north east monsoon season and 8.25±1.50 in summer season. During the study period the Staphylinidae species value recorded in between 15 to 49 individuals in normal field and 4 to 27 individuals in pesticide treated field. The highest individuals were recorded in October month in north east monsoon season and lowest were recorded in the month of May in summer season. Whereas pesticide treated field highest values recorded in September of south west monsoon season and lowest individuals were recorded in November month in north east monsoon season. The mean and S.D. values are 32.50±11.62 in south west monsoon, 42.50±7.18 in north east monsoon season and 21.50±6.24 in summer season in normal field. In pesticide treated field the mean and S.D. values are 24.75±3.20 in south west monsoon, 5.75±1.70 in north east monsoon season and 8.50±2.64 in summer season.

EXOPTERIGOTA

During the present study period the Isoptera species value recorded in between 21 to 38 individuals in normal field and 9 to 30 individuals in pesticide treated field. The highest individuals were recorded in September month in south west monsoon season and lowest were recorded in the month of May in summer season. Whereas pesticide treated field highest values recorded in September of south west monsoon season and lowest individuals were recorded in January month in north east monsoon season. The mean and S.D. values are 30.50±5.97 in south west monsoon, 34±2.44 in north east monsoon season and 25.50±3.87 in summer season in normal field. In pesticide treated field the mean and S.D. values are 26.25±3.50 in south west monsoon, 13.75±6.89 in north east monsoon season and 15.50±2.64 in summer season. During the study period the Psocoptera species value recorded in between 11 to 31 individuals in normal field and 2 to 22 individuals in pesticide treated field. The highest individuals were recorded in October month in north east monsoon season and lowest were recorded in the month of May in summer season. Whereas pesticide treated field highest values recorded in September of south west monsoon season and lowest individuals were recorded in November and December months in north east monsoon season. The mean and S.D. values are 20.75±6.07 in south west monsoon, 27.50±3.41 in north east monsoon season and 14.75±4.11 in summer season in normal field. In pesticide treated field the mean and S.D. values are 17.25±4.64 in south west monsoon, 5.25±5.25 in north east monsoon season and 6.25±1.50 in summer season. During the study period the Thysanoptera species value recorded in between 12 to 27 individuals in normal field and 3 to 20 individuals in pesticide treated field. The highest individuals were recorded in January month in north east monsoon season and lowest were recorded in the month of May in summer season. Whereas pesticide treated field highest values recorded in September of south west monsoon season and lowest individuals were recorded in November month in north east monsoon season. The mean and S.D. values are 16±2.16 in

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south west monsoon, 23.75±2.75 in north east monsoon season and 18±4.24 in summer season in normal field. In pesticide treated field the mean and S.D. values are 15.25±4.64 in south west monsoon, 6.75±4.92 in north east monsoon season and 8.25±1.25 in summer season. [18]suggest that herbicides can affect arthropod community dynamics separate from their impact on the plant community and may influence biological control in agroecosystems. Similar results were made by [19].

CONCLUSION

The present study revealed that Collembolan group of species like Entomobridae, Isotomidae, Sminthuridae and Onychiuridae population densities were decreased due to over use of pesticide application. When compare to both normal and pesticide used fields, the pesticide used fields Insecta microarthropod population is low to normal pesticide unused fields. These results clearly stated that the pesticide toxicity is effecting on Insect soil microarthropod fauna.

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Table 1. Showing the normal field soil microarthropod density during the year 2015-16

		South West monsoon					North East monsoon					Summer				
III.INSECTA		June	July	Aug	Sep	Mean±S.D	Oct	Nov	Dec	Jan	Mean±S.D	Feb	Mar	April	May	Mean±S.D
A.APTERIGOTA																
	1.Diplura	21	23	26	32	25.5±4.79	31	30	29	25	28.75±2.63	24	21	18	16	19.75±3.50
	2.Protura	30	35	39	38	35.5±4.04	38	35	33	30	34±3.36	26	21	17	15	19.75±4.85
	3.Collembola															
	a.Entomobryidae	83	98	116	144	110.3±26.23	152	150	143	120	141.3±14.68	112	97	92	78	94.75±14.03
	b.Isotomidae	38	39	54	78	52.25±18.66	82	80	74	66	75.5±7.18	59	43	40	31	43.25±11.67
	c.Sminthuridae	113	124	133	140	127.5±11.68	148	152	146	138	146±5.88	132	125	117	104	119.5±12.01
	d.Onychiuridae	31	36	39	35	32.25±3.30	34	33	33	30	32.5±1.73	27	26	23	19	23.75±3.59
B.PTERIGOTA																
1.Endopterigota																
	a.Diptera	11	14	14	16	13.75±2.06	17	19	23	21	20±2.58	20	17	15	10	15.50±4.20
	b.Hymenoptera	10	12	15	17	13.50±3.10	20	25	27	32	26±4.96	32	28	25	16	25.25±6.80
	C.Coleoptera															
	i.Carabidae	19	21	24	26	22.50±3.10	25	23	22	16	21.50±3.87	14	12	12	10	12±1.63
	ii.Staphylinidae	19	28	37	46	32.50±11.62	49	47	41	33	42.50±7.18	29	24	18	15	21.50±6.24
2.Exopterigota																
	a.Isoptera	24	28	32	38	30.50±5.97	37	34	34	31	34±2.44	30	27	24	21	25.50±3.87
	b.Psocoptera	14	18	23	28	20.75±6.07	31	29	27	23	27.50±3.41	20	16	12	11	14.75±4.11
	c.Thysanoptera	14	15	16	19	16±2.16	21	22	25	27	23.75±2.75	21	21	18	12	18±4.24

Table 2. Showing the pesticide treated field soil microarthropod density during the year 2015-16

		South West monsoon					North East monsoon					Summer				
II.INSECTA		June	July	Aug	Sep	Mean±S.D	Oct	Nov	Dec	Jan	Mean±S.D	Feb	Mar	April	May	Mean±S.D
A.APTERIGOTA																
	1.Diplura	19	21	22	20	20.50±1.29	20	18	12	13	15.75±3.86	14	15	17	17	15.75±1.50
	2.Protura	26	32	30	24	28±3.65	23	23	18	11	18.75±5.67	13	14	15	18	15±2.16
	3.Collembola															
	a.Entomobryidae	110	130	132	120	123±10.13	116	112	92	93	103.25±12.52	95	97	102	106	100±4.96
	b.Isotomidae	27	36	47	54	41±11.91	51	30	32	31	36±10.03	35	35	38	41	37.25±2.87
	c.Sminthuridae	86	94	107	126	103.25±17.46	125	121	82	64	98±29.83	62	67	71	74	68.50±5.19
	d.Onychiuridae	19	24	22	21	98±29.83	17	14	12	10	13.25±2.98	13	13	15	16	14.25±1.50
B.PTERIGOTA																
1.Endopterigota																
	a.Diptera	7	9	12	16	11±3.91	8	3	1	2	3.50±3.10	2	4	4	5	3.75±1.25
	b.Hymenoptera	10	12	12	18	13±3.46	15	6	5	8	8.50±4.50	8	9	9	10	9±0.81
	C.Coleoptera															
	i.Carabidae	17	15	14	11	14.25±2.50	8	5	6	6	6.25±1.25	7	7	9	10	8.25±1.50
	ii.Staphylinidae	20	26	26	27	24.75±3.20	8	4	5	6	5.75±1.70	6	7	9	12	8.50±2.64
2.Exopterigota																
	a.Isoptera	22	25	28	30	26.25±3.50	24	11	11	9	13.75±6.89	12	15	17	18	15.50±2.64
	b.Psocoptera	11	17	19	22	17.25±4.64	13	2	2	4	5.25±5.25	5	5	7	8	6.25±1.50
	c.Thysanoptera	12	13	16	20	15.25±3.59	14	3	5	5	6.75±4.92	7	8	8	10	8.25±1.25

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Fig 1. Showing the normal field soil microarthropod density during the year 2015-16

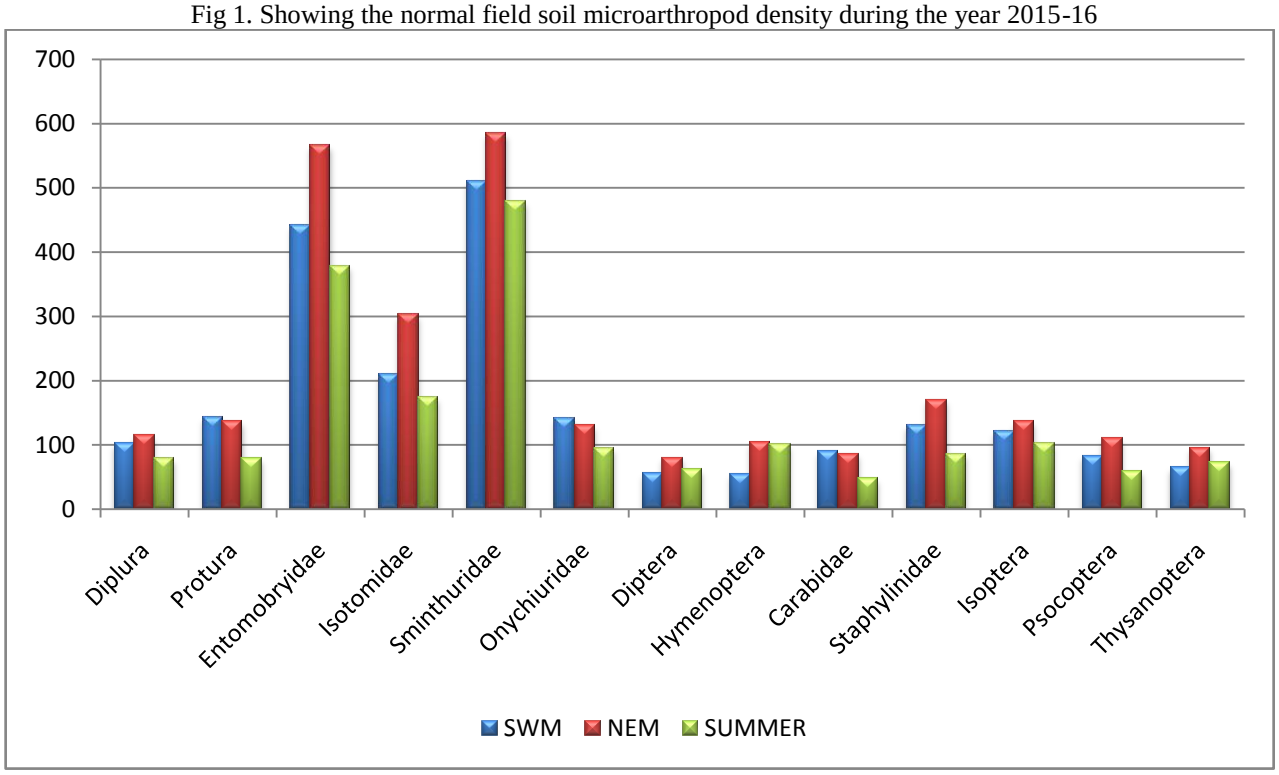
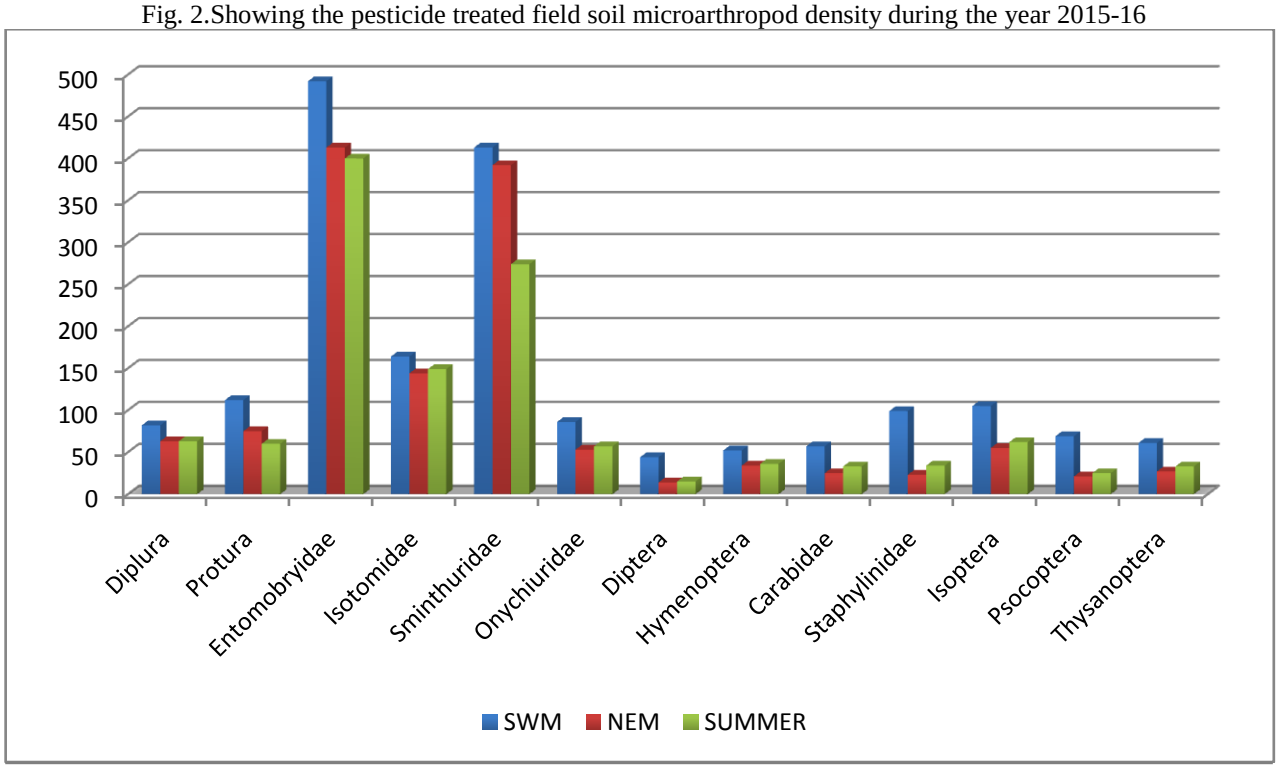


Fig. 2.Showing the pesticide treated field soil microarthropod density during the year 2015-16



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