Effects of Sewage Irrigation Water on Soil Salinity and Related Soil Macro-Fauna among Cauliflower (Brassica Oleracea Var. Botrytis) Fields

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Abstract

During the present research work, total of 901 specimens were collected and maximum population 67.92 % (N = 612) was recorded from tomato-control fields and least population 32.08% (N = 289) was recorded from tomato-treated fields. Collected soil samples were analyzed for salinity effects. The analysis showed that among cauliflower control fields occurrence level of soil macro-fauna spawn their life in accordance with natural manner; because along the season their occurring level was recorded in normal frequencies. At the beginning, their population was recorded least, it accelerates up to fourth sampling wise and then trends toward reduction. While in cauliflower treated fields, salinity level was not recorded in disciplinary manner. It holds up or down as per overall nature of irrigation water. Consequently, frequency of soil macro-fauna was also disturb and tends toward reduction. Diversity was recorded maximum among cauliflower control fields (0.1530) and least was recorded among cauliflower treated fields (0.0723). Evenness ratio was also recorded in same context (0.0549 and 0.0294, respectively). Dominance was recorded maximum from cauliflower control fields (1.0549) and least from cauliflower treated fields (1.0294). However, richness was a little bit recorded high among cauliflower treated fields (11.6633) and least among cauliflower control fields (10.0333). Results of ANOVA were non-significant between both fields (F =1.31; P = 0.2648). Kruskal-Wallis test was again should non-significant result (F = 0.43; P =0.5167). Wilcoxon Rank Sum test was showed that macro fauna were not differ significantly between both fields but habitat preference was level of significance (P-value = 0.5205).

Keywords: Soil salinity, Sewage irrigation, Soil macro-fauna, Vegetable crops.

Introduction

Vegetables are the essential part of human diet yet they have proteins, carbohydrates, as well as different kinds of vitamins and minerals. Due to the increased awareness on the nutritional value of vegetables, their consumption is increasing gradually. Now days, due to the shortage of water, sewage water is under use as potential source of irrigation for raising vegetables crops. Sewage irrigation is quite common practice all over the world. World Health Organization (WHO) has reported that worldwide about twenty-million-hectare area is irrigated by using untreated wastewater and by this, 80% vegetables are consumed locally in many areas [1-2]. In rural areas of Pakistan, due to small landholdings and labor force availability vegetable cultivation is the main approach to reduce poverty as well as to overwhelmed food security problems. In Punjab, total 2% of the area is used for cultivation of vegetable crops [3]. Cauliflower is closely related to cabbage, mustard and broccoli, is the most popular winter season cultivated vegetable in Punjab. It grows best in a relatively cool temperature with a wet atmosphere. India occupies first position in the production of cauliflower and Pakistan ranked 22nd in area and 19th in production over the world. Its share in vegetables production of the world is 1.09 percent [4]. Soil diversity is a key parameter for maintaining the productivity, fertility and food production of...
The soil hosts (macro-organisms) determine fertility, chemical and physical properties of soil on which our present day agriculture is dependent [5-6]. Order Diptera is very sensitive toward moisture change, in related environment; hence its population decrease as a result of drainage [7] e.g. Tipulidae, Limoniidae, Chironomidae, Ceratopogonidae and Tabanidae [8]. They are soil dwelling insects and sensitive toward inputs of pollutants [9]. Their decline owing to industrial dust emission is extensive as compared to control localities e.g. agricultural landscapes.

Richards [10] reported that EC saturated soils are called as “Saline soils” with soil extract more than 4 dS/m at 25°C. The saline soil EC usually recorded is more than 4 dS/m. Soil salinity is a common handicap in semi-arid and arid areas, and in Pakistan, about 6.30 million hectares soil is pertaining to this nature (1.89 hectare), out of which 0.45 million hectares are present in Punjab production [11].

Hence, major portion of soil is under threat of salinization and need rapid screening to overcome salinity. Wherein poor drainage and irrigation managements are major causes in this regard [12]. Salinity affects crop performance, beneficial for soil invertebrates and resultantly cause economic losses. It also has impacts on soil organisms, growth and survival of macro-organisms [13-14]. Mostly unusual land management practices affect soil quality by minimizing the abundance and variety of organisms in soil [15].

Although! It is impossible for earthworms to remain alive in such conditions and their eggs remain viable under such conditions over 40 years. When the salt level becomes low, these dormant eggs begin to hatch. However, this macro-fauna can play an important role in recycling of nutrients in soil. Hence, keeping in view the handicaps of sewage irrigation water toward soil salinity and related soil macro fauna, the present study was conducted to record its impacts on soil macro-fauna among cauliflower fields.

### Materials and Methods

#### Study Design

To accomplish the objectives of the present study, a preliminary survey was made to select the fields those were being irrigated with polluted water and tube-well/clean water for cauliflower fields from Central Punjab (Pakistan). Cauliflower fields having similar topography were selected randomly from each locality. Tube-well water irrigation system was taken as control, whereas, fields irrigated with sewage waste water was taken as treated.

#### Soil Sampling

Soil sampling was made from the selected cauliflower field’s right from the pre-harvesting stage to post-harvesting stage for the whole seasons. Sampling was made on fortnight basis from treated fields (irrigated with polluted sewerage water) and control fields (irrigated with polluted tube-well water). Total five quadrates samples were collected from each site in a sample for the collection of macro-fauna [16-17-18]. Sorting of macro-fauna among these sample was made.

#### Identification

Soil samples were brought to the Biodiversity Laboratory, Department of Zoology, Wildlife and Fisheries, University of Agriculture, Faisalabad to sort soil macro-fauna. Sorting was done through (a) hand (b) Burlee Funnel and (c) sieving (sieve 0.20, 2.00 and 4.75 mm sieves) to separate macro-fauna from soil particles and the sorted organisms were preserved in glass vials containing 70:30% alcohol and glycerin solution with few drops of glycerin. Each glass vial was labeled accordingly containing the date of collection, locality name, Microhabitat (boundary, middle and center), crop name (tomato) and technical name. Identification of the specimens was made with the help of reference material [19-20-].

#### Soil Analysis

Soil sample was being analyzed to record the salinity level during each sampling in Hi-Tech Lab., University of Agriculture, Faisalabad as per laydown procedure [17].

#### Statistical Analysis

Diversity related various issues was calculated according to Shanon’s Diversity Index [21] and hazardous impacts of soil salinity caused by...
sewage irrigation was underlined by using ANOVA. The data were analyzed using Microsoft Office 2007 and GWBASIC programmed (www.daniweb.com-online) according to Ludwig and James [22]. Thereafter, all the observed specimens were arranged in table form according to their morphological characters e.g. order, family, genus and species. All statistical tests were conducted at the level of significance \( \alpha = 0.05 \).

## Results and Discussion

Population means per sampling along with standard deviation (SD) was calculated (Table 01). In case of cauliflower control fields, maximum population was recorded during 2\(^{nd}\) sampling (215±90.21), followed by 145±40.71 (3\(^{rd}\) sampling), 86±1.01 (4\(^{th}\) sampling) and so on. While, least values were recorded during 1\(^{st}\), 6\(^{th}\) and 7\(^{th}\) sampling (48±27.88), (32±39.19) and (24±44.85), respectively. Whereas, species abundance was recorded utmost during 2\(^{nd}\) and 3\(^{rd}\) sampling (19 and 16 species, respectively) at temperature and humidity of 43ºC, 18% and 37ºC, 27.5%, respectively. However, least species relative abundance was recorded during 7\(^{th}\) sampling i.e. 04 species at 38ºC (temperature) and 43% (humidity). In case of cauliflower treated fields, maximum population was recorded during 3\(^{rd}\) sampling (86±3.23), followed by 64±28.59 (2\(^{nd}\) sampling), 58±2.43 (5\(^{th}\) sampling), 53±10.30 (4\(^{th}\) sampling) and so on. While, least value was recorded during 1\(^{st}\) sampling (0±40.00); whereas species abundance was recorded utmost in 4\(^{th}\) sampling (12 species) and was recorded equal in 2\(^{nd}\) and 3\(^{rd}\) sampling (11species) at temperature and humidity 30ºC, 34.5%, 43ºC, 18% and 37ºC, 27.5%, respectively. However, none of the species was recorded in 1\(^{st}\) sampling i.e. 0 species at 31ºC temperature and 34.5% humidity. evaluated that insects pest have negative correlation with humidity and temperature as maximum population of *Spodopteralitura* was recorded 3.75 larvae/ 10 plant at humidity 68.8% and temperature 5.0-23.6 ºC while maximum larvae of *Plutellaxylostella* recorded at temperature 11.0-25.9ºC; 7.3-24.0ºC and humidity 64.4-68.9% for the year 2010 and 2011, respectively among cauliflower fields.

### Table 1: Population Means ± SD and species abundance of recorded Taxa from Cauliflower Control and Treated Fields

<table>
<thead>
<tr>
<th>Sampling No.</th>
<th>Control Fields</th>
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<th></th>
<th>Treated Fields</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean±SD Species</td>
<td>Temperature (ºC)</td>
<td>Humidity</td>
<td>Mean±SD Species</td>
<td>Temperature (ºC)</td>
<td>Humidity</td>
</tr>
<tr>
<td>1</td>
<td>48±27.88 7</td>
<td>31</td>
<td>34.5</td>
<td>0±40.00 0</td>
<td>31</td>
<td>34.5</td>
</tr>
<tr>
<td>2</td>
<td>215±90.21 19</td>
<td>43</td>
<td>18</td>
<td>64±28.59 11</td>
<td>43</td>
<td>18</td>
</tr>
<tr>
<td>3</td>
<td>145±40.71 16</td>
<td>37</td>
<td>27.5</td>
<td>86±3.23 11</td>
<td>37</td>
<td>27.5</td>
</tr>
<tr>
<td>4</td>
<td>86±1.01 10</td>
<td>30</td>
<td>34.5</td>
<td>53±10.30 12</td>
<td>30</td>
<td>34.5</td>
</tr>
<tr>
<td>5</td>
<td>62±17.98 9</td>
<td>36</td>
<td>40</td>
<td>58±2.43 9</td>
<td>36</td>
<td>40</td>
</tr>
<tr>
<td>6</td>
<td>32±39.19 8</td>
<td>39</td>
<td>41.5</td>
<td>22±53.34 9</td>
<td>39</td>
<td>41.5</td>
</tr>
<tr>
<td>7</td>
<td>24±44.85 4</td>
<td>38</td>
<td>43</td>
<td>06±30.81 3</td>
<td>38</td>
<td>43</td>
</tr>
</tbody>
</table>

Whereas, comparative relative abundance of each species from each fields was recorded heterogeneously (Table 2), because overall relative abundance of each species was vary from each other and between each fields; some species were recorded more abundantly in one field while other fields, were devoid off by them or exist with very lest abundance. Wherein a lot of species representing one field instead of overall representation.

Among cauliflower control fields, *Allenemobiusfasciatus* (Gryllidae) was recorded as an extraordinary contributing species with relative abundance of 40.20% (N= 246).

Thereafter, *Succinea* spp. (*Succineidae*) was recorded with utmost relative abundance 10.62% (N= 65), followed by *Formica* spp. (*Formicidae*) 5.39% (N = 33), *Formica componatus* (*Formicidae*) 5.23% (N= 32). Afterward, gradual decrease was recorded for *Cylisticusconvexus* (*Cylisticidae*) 4.41 % (N = 27), *Coccinellaseptempunctata* (*Coccinellidae*) 3.76% (N= 23), *Pheretimaelongata* (*Megascholoidae*) 3.43 % (N= 21),
Lumbicusterestreris (Lumbicidae),
Mastusbundans (Enidae) 2.61% (N = 16),
Psammodesulicollis (Tenebrionidae),
Gonocephalumcostatum (Tenebrionidae) 2.29% 
(N = 14), Pheretimamorritsi (Megascholoidae),
Succineanique (Succineidae),
Oniscusassellus (Oniscidae) 1.96% (N = 12), Zebrinadetrita 
(Enidae) 1.80% (N = 11), Xerosectacespitum 
(Hygromiidae) 1.63% (N = 10),
Arocatuslongiceps (Lygaeidae) 1.31% (N = 08),
Pheretimaposthuma (Megascholoidae),
Phaenicasericata (Calliphoridae) 1.14% (N = 07). However, least relative abundance (N ≤ 05) was 
recorded for Agonumfuliginosum (Carabidae),
Metafruteticoliniosina (Hygromiidae),
Chorhippusbiguttulatus (Acrididae), Trochosaspinipalpis (Lycosidae),
Muscardomestica (Musidae), Tapinomaesessilis,
Dolichonderusspp., Allopecosachamberlini, Rabidosarabida 
(Lycosidae). Wherein following taxa: Labianominor(Labiidae),
Forficulaauricularia (Forficulidae), Euboreliannahupipes 
(Anisolabididae), Tritomegassexmaculatus (Cydnidae),
Cicindelascutellaris, Agonumcupripenne, Bembidionvariurn 
(Carabidae),
Gonocephalumdepresso, Gonocephalus simplex 
(Tenebrionidae), Cyclocephalasp., Cyclocephalaborealis,
Aphodiusrufus (Scarabaeidae), Paeduruslittoralis, Ocypusulens 
(Staphylinidae), Syrphustorvus, Episyprhusbalteatus (Sphingidae),
Cynomycauderina (Calliphoridae), Hybomitrabimaculata 
(Tabanidae), Camponotusspp., Solenopsisinvicta,
Pheidolehyatti, (Formicidae), Podiainterpunctella, Pierisbrrassicae 
(Pyrailidae), Darapsachoerilus (Sphingidae), Porcellioscaber 
(Chorpingidae), Armadillidiumvulgare (Armadillidiidae),
Lithobiufurcatus (Lithobiidae) and 
Trachelastranquillus (Corinnaidae) were not 
recorded from cauliflower control fields. Ruiz 
and Lavelle [23] reported that presence of soil 
invertebrates is essential for the maintenance of 
healthy productive soils and loss of species 
with unique functions, have disastrous effects,
leading to the irreparable degradation of soil 
and the loss of agricultural productive capacity 
and it was an acknowledgement about our 
present findings. From cauliflower treated 
fields, Darapsachoerilus (Sphingidae) was 
recorded abundantly with relative abundance 
of 42.91% (N = 124). Thereafter, Oniscusassellus 
(Oniscidae) was recorded with maximum 
relative abundance 9.34% (N = 27), followed by 
Episyprhusbalteatus (Sphingidae) 6.93% (N = 20), 
Cylisticusconvexus (Cylisticidae) 6.23% (N = 18), 
Porcellioscaber (Porcellionidae) 5.19% (N = 15), 
Pheretimaposthuma (Megascholoidae) 
4.15% (N = 12) and then gradual decrease was 
recorded for Ocypusulens (Staphylinidae) 3.11% 
(N = 09), Paeduruslittoralis (Staphylinidae) 
2.77% (N = 08), Armadillidiumvulgare 
(Armmadiiiidae) 2.08% (N = 06). However, least 
relative abundance (N ≤ 05) was recorded for 
Trachelastranquillu (Corinnaidae), 
Syrphustorvus, Coceophalasp., Cyclocephalaborealis,
Aphodiusrufus (Scarabaeidae), Gonocephalumdepresso, 
Gonocephalus simplex (Tenebrionidae), 
Pierisbrrassicae (Pieridae), Coccinellaseptomptcata 
(Coccinellidae), Cicindelascutellaris, Agonumcupripenne,
Taridiuscpeus, Bembidionvariurn (Carabidae),
Euboreliannahupipes (Anisolabididae), 
Tritomegassexmaculatus (Cydnidae), 
Labianominor (Labiidae), Forficulaauricularia 
(Forficulidae), Euboreliannahupipes 
(Anisolabididae), Tritomegassexmaculatus 
(Cydnidae), Labianominor (Labiidae), Forficulaauricularia 
(Forficulidae), Pheretimaelongata 
(Megascholoidae), Mabusbundans (Enidae), 
Wherein Pheretimamorritsi (Megascholoidae), 
Arocatuslongiceps (Lygaeidae), Agonumfuliginosum 
(Perabidae), Gonocephalumcostatum 
(Tenebrionidae), Xerosectacespitum, Metafruteticoliniosina 
(Hygromiidae), Mabusbundans,
Zebrinadetrita (Enidae), Succineasp., 
Succineanique (Succineidae), 
Phaenicasericata (Calliphoridae), 
Muscardomestica (Musidae), 
Formicaomponatus, Tapinomasessile, Componatusrecticulatus, Dolichonderusspp. 
(Formacidae), Rabidosarabida (Lycosidae), 
Chorhippusbiguttulatus (Acrididae), Allenemobiusfuscatus 
(Gryllidae) were not recorded from cauliflower treated fields. 
reported that soil biodiversity is a key 
parameter that determine fertility, chemical,
physical properties, maintaining the productivity and food production of a soil on which our present day agriculture is dependent. Hence, deterioration of soil macro-

Upholding efficiency and integrity of any ecosystem depends upon the contributors (living organisms and related plantations)—allthese are participants divided into different taxonomic compositions and each composition consists of organisms having identical role. Among any taxonomic composition, a lot of species contribute with analogous or disparate distinctiveness. So, to hold up and scrutinize this supposition, their happening regularity (relative abundance) was accessed further up to order level. From total of 12 recorded orders, 09 orders were recorded from cauliflower control fields and among them higher relative abundance (40.69%; N =249) was recorded for order Orthoptera, followed by Pulmonata (19.28%; N = 118), Hymenoptera (11.44%; N = 70), Haplotaxida, Coleoptera (9.15%, N = 56) and Isopoda (6.37% N=39). However, least relative abundance (N ≤ 10) was recorded for order Diptera, Hemiptera and Araneae. Whereas, order Dermaptera, Lepidoptera were not recorded from cauliflower control fields. Wherein total of 12 recorded orders, 10 orders

Table 2: Overall Relative Abundance of recorded Taxa from Cauliflower Control and Treated Fields

<table>
<thead>
<tr>
<th>Phylum</th>
<th>Class</th>
<th>Order</th>
<th>Family</th>
<th>Species</th>
<th>Relative Abundance (%)</th>
<th>Significance</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annelida</td>
<td>Oligochaeta</td>
<td>Haplotaxida</td>
<td>Megascolidae</td>
<td>Pheretimaelongata</td>
<td>0.69(2)</td>
<td>***</td>
<td>≤0.001</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Pheretimamorissi</td>
<td>0.00(0)</td>
<td>***</td>
<td>≤0.001</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Pheretimaposthuma</td>
<td>4.15(12)</td>
<td>**</td>
<td>≤0.005</td>
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<td></td>
<td></td>
<td></td>
<td>Lumbricidae</td>
<td>Lambricusterrestris</td>
<td>1.04(3)</td>
<td>***</td>
<td>≤0.001</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td>2.61(16)</td>
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<tr>
<td>Insecta</td>
<td></td>
<td>Hemiptera</td>
<td>Lygaeida</td>
<td>Arocatuslongiceps</td>
<td>0.00(0)</td>
<td>***</td>
<td>≤0.001</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Agonamfuliginosum</td>
<td>0.00(0)</td>
<td>***</td>
<td>≤0.001</td>
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<td></td>
<td></td>
<td></td>
<td>Coccinellidae</td>
<td>Coccinellaespempunctata</td>
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<td>***</td>
<td>≤0.001</td>
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<td></td>
<td>3.76(23)</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>Tenebrionidae</td>
<td>Psammodesessulcicollis</td>
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<td>***</td>
<td>≤0.001</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Paedursuslittoralis</td>
<td>2.77(8)</td>
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<td>≤0.001</td>
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<td></td>
<td>Ocyopusolens</td>
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<td>***</td>
<td>≤0.001</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Hygromiidae</td>
<td>Xerosectacespitum</td>
<td>0.00(0)</td>
<td>***</td>
<td>≤0.001</td>
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<td></td>
<td>1.63(10)</td>
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<td></td>
<td></td>
<td>Coleoptera</td>
<td>Carabidae</td>
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<td>3.76(23)</td>
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<td>Staphylinidae</td>
<td>Coccinellaseptempunctata</td>
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<td>3.76(23)</td>
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<td>Xerosectacespitum</td>
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<td>1.63(10)</td>
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<td></td>
<td></td>
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<td>Enidae</td>
<td>Mastusabundans</td>
<td>0.00(0)</td>
<td>***</td>
<td>≤0.001</td>
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<td>2.61(16)</td>
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<td>***</td>
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<td></td>
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<td>Syrphides</td>
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<td>***</td>
<td>≤0.001</td>
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<td></td>
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<td></td>
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<td>1.96(12)</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Diptera</td>
<td>Calliphoridae</td>
<td>0.00(0)</td>
<td>***</td>
<td>≤0.001</td>
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<td></td>
<td></td>
<td></td>
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<td>Formicidae</td>
<td>1.38(4)</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Formica spp.</td>
<td>5.39(33)</td>
<td>***</td>
<td>≤0.001</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Formica componatus</td>
<td>0.00(0)</td>
<td>***</td>
<td>≤0.001</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5.23(32)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lepidoptera</td>
<td>Sphingidae</td>
<td>42.91(124)</td>
<td>***</td>
<td>≤0.001</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Darapsachoerilus</td>
<td>0.00(0)</td>
<td>***</td>
<td>≤0.001</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Oniscidae</td>
<td>Oniscusasellus</td>
<td>9.34(27)</td>
<td>***</td>
<td>≤0.001</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.96(12)</td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cylisticidae</td>
<td>Cylisticusconexus</td>
<td>6.23(18)</td>
<td>**</td>
<td>≤0.005</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.41(27)</td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Porcellionidae</td>
<td>Porcellioscaber</td>
<td>5.19(15)</td>
<td>***</td>
<td>≤0.001</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td>0.00(0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Malacostraca</td>
<td>Isopoda</td>
<td>2.08(6)</td>
<td>***</td>
<td>≤0.001</td>
</tr>
<tr>
<td></td>
<td>Arthropoda</td>
<td></td>
<td></td>
<td>Armadillidium vulgare</td>
<td>2.08(6)</td>
<td>***</td>
<td>≤0.001</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.00(0)</td>
<td></td>
<td></td>
</tr>
<tr>
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<td></td>
<td>Arachnida</td>
<td>Orthoptera</td>
<td>Gryllidae</td>
<td>0.00(0)</td>
<td>***</td>
<td>≤0.001</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Allenemobiusfasciatus</td>
<td>40.20(246)</td>
<td>***</td>
<td>≤0.001</td>
</tr>
</tbody>
</table>
Table 03 were recorded from cauliflower treated fields and among them, higher relative abundance (44.29%; N = 128) was recorded for order Lepidoptera, followed by Isopoda (22.84%; N = 66), Coleoptera (10.03%; N = 29), Diptera (7.61%; N = 22), Haplotaxida (5.88%, N=17) and Araneae (4.50%, N = 13). However, least relative abundance (N ≤ 10) was recorded for order Hymenoptera, Dermaptera, Lithobiomorpha and Hemiptera. Whereas, order Orthoptera, Pulmonata were not recorded from cauliflower treated fields. These findings were in-line with Kajak et al. [7] Frouz and Syrovatka [8].

Diversity indices are key components to draw the natural lines regarding taxa composition pertaining to any managed or unmanaged landscaping. They consist of diversity, evenness, dominance and richness of inhabiting taxa in that particular area. So, keeping in view the importance of these aspects, calculations were made as per Shannon diversity index [21]. Diversity was recorded maximum among cauliflower control fields (0.1530) and least was recorded among cauliflower treated fields (0.0723). Evenness ratio was also recorded in same context (0.0549 and 0.0294, respectively). Dominance was recorded maximum from cauliflower control fields (1.0549) and least from cauliflower treated fields (1.0294). However, richness was a little bit recorded high among cauliflower treated fields (11.6633) and least among cauliflower control fields (10.0333) (Table 4).

Conclusions

It was concluded that soil salinity affected the occurrence level of soil macro-fauna rather than natural manner; because along the season their occurring level was recorded in normal frequencies. At the beginning, their population was recorded least, it accelerates up to fourth sampling wise and then trends toward reduction. While in cauliflower treated fields, salinity level was not recorded in disciplinary manner. It holds up or down as per overall nature of irrigation water. Consequently, frequency of soil macro-fauna was also disturb and tends toward reduction. [23-26]
References


