ROOT FEEDING BEHAVIOUR
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INTRODUCTION

The economic importance of symphylans was established and recorded even in the beginning of the 20th century. In North America Woodsworth (1905) reported that symphylans are serious root pests on Asparagus in Boldin Island. Davis (1924, 1928) and Searls (1928) reported that symphylans as a root pests of Asparagus. Essig (1915) reported that symphylans attack the root system of all kind of plants – especially sprouting seeds particularly peas and beans. It was also stated that growing plants also suffered injury.

Some of the important papers published which show this animal to be economically important are Brade-Birks (1929), Almeida (1930), Compton (1930), Davis (1912, 1924, 1928, 1931), Dusten (1940), Feytaud (1925), Fillinger 1928-31, Flint (1932), Hauser (1932), Herrick (1927), Herms (1926), Howitt and Bullock (1955), Illingsworth (1927), Ingram (1931), Knowlton (1932), Mendenhall (1931), Michelbacher (1932, 1938), Waterhouse, (1967), Scheller (1971 b, 1993), Straalen (1998), Kozul'-ko (1998).

These early papers draw attention to symphylans as potential plant pest and a large number of reports about the wide range of damage had come out. A large number of workers claimed that they had found symphylans feeding on the root system, stems and even on the leaves of the seedlings of a large variety of cultivation crops. Walton (1930), Stanliland (1932), Keams (1932), Miles and Cohen (1935). Edwards, (1957), Waterhouse (1967), Scheller (1986, 1988, 1989, 1990) all have studied the heavy infestation of green houses by these organisms. But over all from Europe, the studies by Feyland (1926) and Lairieu (1934) from France and Almeda (1930) from Portugal have almost concluded that the low soil temperature prevalent in N. Europe seemed to be unfavourable for symphylans.
The important species as pest

Initially it was believed that Scutigerella immaculata was the only species that caused damage to cultivated plants. Though this seemed to be the most widely distributed species a large number of species especially belonging to the family Scutigerellidae seemed to be pest on a variety of plantation crops. The major species of economic importance and the crops they have found to be destroying are given in the table.

Table I: Species of symphylids of economic importance

<table>
<thead>
<tr>
<th>Species</th>
<th>Crop damaged</th>
<th>Type of damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scutigerella immaculata</td>
<td>Cabbage, Tomatoes</td>
<td>Entire root</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Young roots and root hairs</td>
</tr>
<tr>
<td>Scutigerella immaculata</td>
<td>Carnation, Lettuce, Straw berries, Tomatoes, Straw berries</td>
<td>Young roots</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Young roots and base of stem</td>
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<tr>
<td></td>
<td></td>
<td>Young roots</td>
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<tr>
<td></td>
<td></td>
<td>Young roots</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Entire roots</td>
</tr>
<tr>
<td>Scutigerella lineatus</td>
<td>Tomatoes, Lettuce</td>
<td>Young roots</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Young roots &amp; base of stem</td>
</tr>
<tr>
<td>Hanseniella caldaria</td>
<td>Tropical palms</td>
<td>Young roots</td>
</tr>
<tr>
<td>Hanseniella unguiculata</td>
<td>Sugar cane</td>
<td>Cavities in roots</td>
</tr>
<tr>
<td>Hanseniella agiiis</td>
<td>Beet</td>
<td>Eat roots</td>
</tr>
<tr>
<td>Hanseniella unichaetosa</td>
<td>Sugar cane, Bamboo, Sugar cane</td>
<td>Cavities in roots</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cavities in roots &amp; tips of shoots</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Attacks roots</td>
</tr>
<tr>
<td>Symphylella vulgaris</td>
<td>Anemones, Mushrooms</td>
<td>Small abrasions on stem &amp; leaves Holes in stiples.</td>
</tr>
<tr>
<td>Symphylella asciatica</td>
<td>Sugar cane</td>
<td>Abrasion of cortex</td>
</tr>
<tr>
<td>Symphylella tentabunda</td>
<td>Sugar cane</td>
<td>Pitting of roots</td>
</tr>
</tbody>
</table>
The members of the family Scolopendrellidae are generally innocuous and are confined to finding on dead organic matter, fungi and bacteria while those of family Scutigerillidae are active feeders of living plant tissue.

The population and type of damage.

The most important factor to be considered in symphylan attack is the total population. In some areas in USA and Europe about 80 million symphylans/acre have been reported. If the infestation is so heavy not only the seedlings but the adult plants which are comparatively resistant to its attack also may be partially damaged. In heavily infested soil what was usually met with was the stunted growth of plants. In some areas the crops were reported destroyed in patches. Symphylans depend upon the variety of environmental factors and have uneven distribution though found almost everywhere.

The damage.

It was reported that the symphylan attack and feed voraciously on the root system of plants. In some cases they feed on the young tender stem. They are also capable of feeding on leaves of creepers and shrubs. These organisms are said to be voracious feeders and was calculated to feed 15 times their own body weight of living weight of plants. When found in small numbers their damage may become inconspicuous because of their small size.

The stage of crop and susceptibility

The germinating seedlings, young tender stages of plants are rapidly attacked by symphylans. They have high preference for soft succulent tissue seeds with tender cotyledons etc. In heavily infested soil the number of symphylans around roots of plants have found to be very high. Perennial crops such as Strawberries are usually attacked when they are producing young roots.
Physiological state of symphylans

It has already been described in earlier chapters that symphylans have well defined feeding cycles. A period of approximately one-week prior to moultng they stop feeding. The intervals between moultng shall be considered the most voraciously feeding phase. The initial instars also are non-feeders. Those, which are casting spermatophores and laying eggs are also found in inactive (non feeding) states. So approximately about 50% of symphylans of the actual field population we come across with are not in feeding phase.
METHODOLOGY

One field experiment was conducted to study the feeding of different species of symphyla, on sugarcane. The important facts, which were considered during the conduct of the experiment, were the following:

1. To destroy a plant there should be a high density of symphylan population
2. The symphylans attack the young tender seedlings more than the adult plant
3. The actively feeding stage of symphylans starts with the fifth instar.
4. Out of the total population only 50% will be physiologically in a feeding state
   (The premoult – moulting stages are non-feeding stages.)
5. They have definite host range and preferences in feeding
6. They feed more on roots than other part of plants.
7. Wounds caused by symphylans during feeding may lead to further infections.

For the experiment 30-day-old healthy seedlings of sugar cane were collected from the nursery of Kerala Agricultural University, Thiruvalla. About 60 seedlings were kept in 20 clay pots (3 each in a pot) filled with well-prepared soil beds consisting of a mixture of clay-loam soil, fine sand and potash. Ten pots were steam sterilized and ten were with unsterilized soils. When the seedlings showed signs of growth, taking new shoots, by about 20 days 16 pots were selected for the experiment, 8 sterilized and 8 without sterilization i.e., about 48 seedlings were used for the experiment.

About 300 active feeding phased symphylans were collected both among Hanseniella unichaetosa and Symphylella vulgaris. The 16 experimental pots were grouped into 4 groups A, B, C & D each consisting of 4 pots. In all 4 groups A, B, C & D two pots were sterilized and 2 were unsterilized. Out of the first set of 4 pots (Group A) 2 pots were sterilized and 2 were unsterilized. To one pot each of both sterilized and unsterilized groups, organic manure (a mixture of cow dung and bone meal), which was steam sterilized, was added. Thus the first group of 4 consisted of 2 sterilized, 1 with manure and the other without manure and 2 unsterilized, 1 with and 1 without manure. This was taken as control for the experiment.
Out of the second set of 4 pots (Group B) 2 pots were sterilized and 2 unsterilized. One in each group was with manure and without manure. About 50 *S. vulgaris* adults of active feeding phase were released into the each of the pots in group B and the pots were covered with fine cotton mesh to avoid symphylans from getting out of the pot.
OBSERVATION AND DISCUSSION

Group A

Control pots
1. Unsterilized with manure – plants healthy
2. Unsterilized without manure – plants weak
3. Sterilized with manure – plants healthy
4. Sterilized without manure – plants weak

Group B

Pots with S. vulgaris
1. Unsterilized with manure – plants healthy
2. Unsterilized without manure – plants wilt fast
3. Sterilized with manure – plants healthy
4. Sterilized without manure – plants wilt

Group C

Pots with H. unichaetosa
1. Unsterilized with manure – plants wilt
2. Unsterilized without manure – plants wilt fast
3. Sterilized with manure – plants wilt
4. Sterilized without manure – plants wilt fast

Group D

Pots with both H. unichaetosa and S. vulgaris
1. Unsterilized with manure – plants wilt
2. Unsterilized without manure – plants wilt fast
3. Sterilized with manure – plants wilt
4. Sterilized without manure – plants wilt fast

The result helps to draw a few logical conclusions. What ever be the condition, H. unichaetosa feeds on the roots of sugarcane. The wounds caused
by the symphyllans seems to lead to secondary infections. S. vulgaris also feeds on roots but only when they run short of organic debris.

The result almost confirms the general idea that family Scutigerellidae are pests on roots where as the members of the family Scolopendrellidae are less harmful to roots in the soil. But S. vulgaris also can feed on roots when organic food is scarce. Since the soil in the natural sugarcane and pineapple field are rich in organic content they are doing very little noticeable harm to the plants. If H. unichaetosa were the dominating species in the fields they would have done great damage to the plantations. Why S. vulgaris is outnumbering H. unichaetosa in the natural fields is yet to be found out since no competition exclusion was found in common cultures of S. vulgaris and H. unichaetosa during this study. The findings of this experiment were almost reconfirmed by the study of the feeding habits of both these species later on the agar medium in the laboratory. It was found out that S. vulgaris preferred organic debrie while H. unichaetosa was showing preferences to feed on fresh roots of Sugarcane.