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REGENERATION IN RELATION TO ROOT SIZE IN TARAXACUM OFFICINALE*

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Segments of the storage root of *Taraxacum officinale* W. provide a useful material for investigation of the factors which control the regeneration of shoots and roots. When root material is collected from the field it becomes necessary to reduce variability by using segments cut from a single root for each experiment. It was necessary to know the minimum size of root segment which would regenerate successfully in order to decide whether a sufficient number of segments could be obtained from a single root.

In the past Warmke and Warmke[1] found that a minimum of 1.25 mm diameter and 6–10 mm length was required for the regeneration. Satchuthananthavale,[2] using roots of the same species, found a correlation between root diameter and regeneration for 2cm long root pieces, the thicker roots regenerated more rapidly than thinner ones. None of these workers made any attempt to observe the minimum length of the root required for regeneration at a fixed diameter of the root cutting. This paper describes work designed to give information on the potential for regeneration of segments of fixed diameter and varying thickness.

Material and Methods

Taraxacum officinale W. roots of 5 mm and 10 mm diameter were collected from the open ground in the vicinity of Sheffield University (U.K) and cut into 1, 1.5, 2.0, 3.0 and 4.0 mm long segments using a bench microtome. Plastic trays were filled with a mixture of five parts of washed sand to one part of vermiculite. Fifty root segments from each group were placed in the above mixture at a depth of one cm (approx). The experiment was performed at 25°C in darkness and the trays watered every day.

The percentage of regenerated shoots and roots were recorded after 9, 14 and 21 days.

Results and Discussion

The results are presented in Table 1. It was found that more shoots and roots regenerated in the longer segments than in the shorter ones. The minimum length for shoot regeneration was 1.5 mm and for root regeneration 2 mm. Callus formed at both cut surfaces within 3–4 days. Shoots emerged through the callus at the proximal end (shoot-end of the plant) of the segment at about day 9, roots were found at the distal end (root-end of the plant) at about 21 day. Less than half the segments regenerating shoots developed roots and roots were initiated only on segments in which shoots had developed.

Nemec[3,4] found that short segments of *Taraxacum* roots produced callus on both the proximal (root-end of the plant) and distal (shoot-end of the plant) ends while leaf primordia differentiated from the distal end callus. Using the same material, Czaja,[5] showed that with repeated removal of shoot primordia at the proximal end, leaves were produced at the distal end.

The present study could not confirm these findings. Shoots always regenerated from the

TABLE 1.—REGENERATION OF *Taraxacum* ROOT SEGMENTS IN RELATION TO LENGTH AND DIAMETER.

Root diameter in mm	Root length in mm	per cent of segments regenerating leaves at 3 different intervals in days			per cent of segments regenerating roots at 3 different intervals in days		
		9	14	21	9	14	21
5	1.0	0	0	0	0	0	0
5	1.5	44	78	80	0	0	0
5	2.0	74	90	98	0	0	22
5	3.0	82	100	100	0	0	28
5	4.0	80	100	100	0	0	38
10	1.0	0	0	0	0	0	0
10	1.5	52	90	98	0	0	0
10	2.0	78	98	100	0	0	26
10	3.0	80	100	100	0	0	34
10	4.0	78	100	100	0	0	40

*This work was carried out at the Department of Botany, University of Sheffield and is based on part of a thesis accepted for the Ph.D. degree. The author wishes to thank Dr. A. Booth for taking keen interest in this work.

proximal end (shoot-end of the plant) and root from the distal end (root-end of the plant) irrespective of the length and diameter of the root pieces. Similar conclusions were also made by Warmke and Warmke.[1]

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OBSERVATION ON THE SEASONAL INFESTATION OF THE SUGARCANE TOP SHOOT BORERS IN EAST PAKISTAN

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At least two species of top shoot borers, *Scirpophaga monostigma* Zeller and *S. auriflua* Zeller (Pyralidae:Lepidoptera) attack sugarcane in East Pakistan. They are most serious pests and are rather common in all the districts of the province where sugarcane is grown. The young sugarcane plants are most easily affected.

In East Pakistan early planting of sugarcane begins from October and continues up to December before the fall of temperature below 52°F. Late planting begins as soon as the temperature springs up during the month of February and continues through March.

The seasonal infestation of the top shoot borer was estimated by counting the infested plants from the month of May to December in the E.P. Agricultural University Farm. For infestation counts 1500 plants were checked twice in each month at random from different portions of the sugarcane field. No insecticidal treatment was made in the test plots. The infested plants could easily be detected from characteristic "dead heart" symptoms. The level of infestation is shown in the histogram (Fig. 1). During monsoon (May–July) the average percentage of infestation was 3.50. Field infestation increased to its peak during the month of August when an average of 14.13% infestation was recorded. In the months of September and October the infestation was also significantly high showing an average of 9.27%. However, with the fall of temperature in November and December the incidence of infestation became reduced.

The increased infestation in August is probably due to the draught and high temperature which favour the growth and activities of the top shoot borer. Continuous raining as well as fairly low temperature during May through July favoured the growth of the plant but hampered the activities of the pests. Literature shows that the seasonal activities and abundance of the pest are correlated with various environmental factors, such as cold, high temperature, draught, rainfall, etc. [1–3] Ghos[1] observed that the incidence of infestation of sugarcane borers is related with the climatic conditions. It is specially during the periods of draught that great damage is done by insects. Wolcott[2] stated that borer infestation varies inversely with the rainfall, the less the rainfall, the greater the number of infested canes.

During the study four hymenopterous parasites were found to parasitize the top shoot borers.

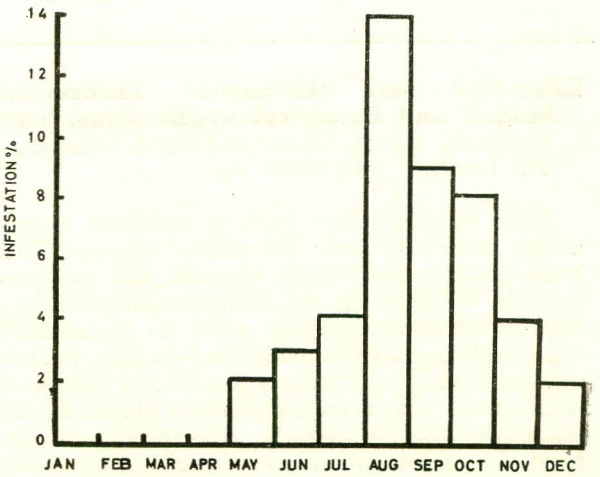

Fig. 1.—The relative level of infestation of the sugarcane top shoot borers.

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Of the four parasites, one (*Tricogramma* sp.) infests the egg, two (*Shirakia jokohamensis* (Cam.) and *Elasmus zehntneri* Ferr.) attack the larvae and the fourth one (*Melcha* sp.) is a pupal parasite. In contrast to the borers, the parasites were more active during the months of October to December. Apparently, they played important role in reducing the population level of the top shoot borers.

The authors extend sincere appreciation to Mr. M.Z. Alam, Entomologist to the Government of East Pakistan, for valuable suggestion and helping to identify the parasites from the Commonwealth Institute of Entomology, London, through his Division.

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ACHERONTIA STYX WESTV. LEPIDOPETRA: SPHINGIDAE

A Pest of Medicinal Plants— Two New Records

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Acherontia styx is the prominant species in most parts of the Indo-Pakistan subcontinent and is reported to attack some 18 host plants. Its occurence on *til*, *Sesamum indicum*, in Tandojam is more regular and seasonal, whereas its appearance on brinjal is occasional.

Two of the recent additions recorded in Tandojam are the medicinal plants used in the treatment of a variety of diseases.

Caterpillars in small numbers have been found feeding on kaner, *Nerium indicum* Mill. (Apocynaceae), a perinnial shrub with dark green leaves, the decoction of which is used in the treatment of ringworm, leprosy. Roots are reported to be used to cause abortion.

Asgandh, *Withania somnifera* (L.) Dunal. (solanaceae) is another preferred host plant of this insect. The herb is used in curing tumors, tubercular glands, rheumatism, dyspepsia, asthma, lumbago and arthritis.[1]

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BOOK NOTICES

Education and Manpower: Theoretical Models and Empirical Applications. Tore Thonstad. 162 pp. Oliver and Boyd, Edinburgh and London, 1969. Price 63s.

Some countries have tried to construct econometric models of their educational systems. This book presents Norwegian research and development in this field but the theoretical implications and practical applications have an importance transcending national confines. In the mathematical models, education is treated as a process of production. Particular emphasis is placed on the manpower aspects and the consequences of the need for given quantities of manpower with different kinds of training. The models presented are of two main types; human flow models, simulating the flow of pupils through the entire school system of a country, and manpower requirement models, used to derive educational requirements in order to satisfy given manpower targets. Empirical applications of both are given. Using these models, the interdependencies between the different parts of the school system and between its structure and the supply of educated manpower are studied. The information thus provides useful tools for educational planners and manpower analysts.

The book is in four parts. Part I gives a survey of the literature and includes a brief discussion of the present status of the theory of manpower requirements. Part II gives a detailed empirical model of the human flow type, from which a large