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Studies on the Development of Tubers in Nutgrass and Their Starch Content at Different Depths of Soil

by

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Introduction: Nutgrass (*(Cyperus rotundus* L.) is one of the most troublesome weeds, and this is primarily due to the efficient propagation methods by the hardy subterranean tubers. The degree of tuber development and density of population are however, conditioned by the soil, environment and climatic situations. The present investigation was undertaken to study the tuber development, density of tubers and their starch contents at different depths in cultivated and fallow areas.

Review of Literature: Andrews (1940 a) found the depth of penetration of tubers, to be largely dependant on the moisture relationships of soil as well as the tubers. The above author has investigated the viability of tubers in undisturbed and cultivated areas. Andrews (1940 b) in another study, invesvigated the maintenance of life in nutgrass tubers at different depths, in fallow and flooded soils. In Mauritius, Rochecouste (1956) investigated the distribution and competition of the species in sugarcane

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fields. Similar investigations were carried out by Rochecouste (1962) in *Cynodon dactylon* Pers. Rao and Nagarajan (1963) brought out the relationship between the moisture levels and viability potential of nutgrass tubers.

Materials and Methods: The study presented here has been divided into three aspects *viz.*, (i) tuber development of the species (ii) distribution and population of tubers at different depths of soil and (iii) the estimation of starch content of tubers located at different depths.

In respect of tuber development study, a single tuber was planted in large sized pots and for each pot (10 kg) of red loam (pH 8·7) was used. Watering was done uniformly, to keep the soil moisture adequate. The pots were examined after 15, 30, 45, 60, 75 and 90 days subsequent to planting. The soil was removed intact, washed thoroughly and examined for the number of tubers developed, size of tubers, weight of tubers and number of shoots developed, at intervals indicated above, in two replications.

The distribution and population were studied in two types of soils *viz.*, in a cultivated red loam (pH 8·7) and uncultivated red loam (pH. 8·1). The tuber formation and development were studied in four zones of the soil *viz.*, 1 – 3" (Zone A), 4 – 6" (Zone B), 7 – 9" (Zone C) and 10 – 12" Zone D) in three replications. The tubers found in each of the above zones were analysed for starch contents by the Prit and Whelan method.

Results: (i) *Tuber development:* A single tuber was capable of producing 99 tubers of different sizes, within a period of 90 days. The details of tubers formed after 15, 30, 45, 60, 75 and 90 days, their fresh weights and number of shoots recorded are given in Table 1. A single tuber produced two, five, nine and 18 tubers of different sizes at the end of 15, 30, 45 and 60 days. But, thereafter, at the end of 75 and 90 days, there was a sudden increase in the number of tubers to 35 and 99, respectively.

TABLE 1. *Tuber Development from Single Tuber*

No. of days	No. of tubers			Total no. of tubers	Fresh weight of tubers in gm	No. of shoots	
	Large above 1 gm	Medium 0·5 to 1·0 gm	Small 0·00 to 0·5 gm			Aerial	Underground
15	1	0	1	2	1·35	1	—
30	2	0	3	5	2·94	2	—
45	3	2	4	9	6·93	4	—
60	11	4	3	18	17·92	2	2
75	13	12	10	35	19·56	10	10
90	53	25	21	99	56·48	20	25

The tubers which were mature enough at the end of first four fortnights, also took part in reproduction. The fresh weight of tubers also increased corresponding to the number of tubers.

(ii) *Tuber distribution and density at different depths:* The most interesting observation was that in the cultivated soil there was nearly double the population of tubers per unit area, as compared to the undisturbed soil. On calculation basis, there was a total of 33,17,040 tubers per acre in the cultivated plot. The second layer between 4" – 6" (Zone B) had a maximum number of 11, 51, 920 tubers, which constituted 34·8 per cent of the total number of tubers. However, the upper six inches had 60 per cent of the tuber population. The details of observations made are shown in Table 2.

TABLE 2. *Tuber Density in Cultivated Soil*

Zone	Depth	Average no. per quadrat of 3'x3'	Tubers/ acre (calculated)	% of tubers in each zone	% Starch
A	1–3"	189	8,14,760	24·5	28·4
B	4–6"	238	11,51,920	34·8	41·5
C	7–9"	152	7,35,680	22·2	35·0
D	10–12"	127	6,14,680	18·5	43·1
		Total	33,17,040		

The undisturbed area exhibited different density of tuber distribution, the lowermost zone (10–12") having maximum distribution of 6,02,580 tubers per acre. The total population of tubers calculated to an acre was only 18,46,400 as compared to 33,17,040 recorded in the cultivated plot. The details of observations are given in Table 3.

TABLE 3. *Tuber Density — Undisturbed Soil*

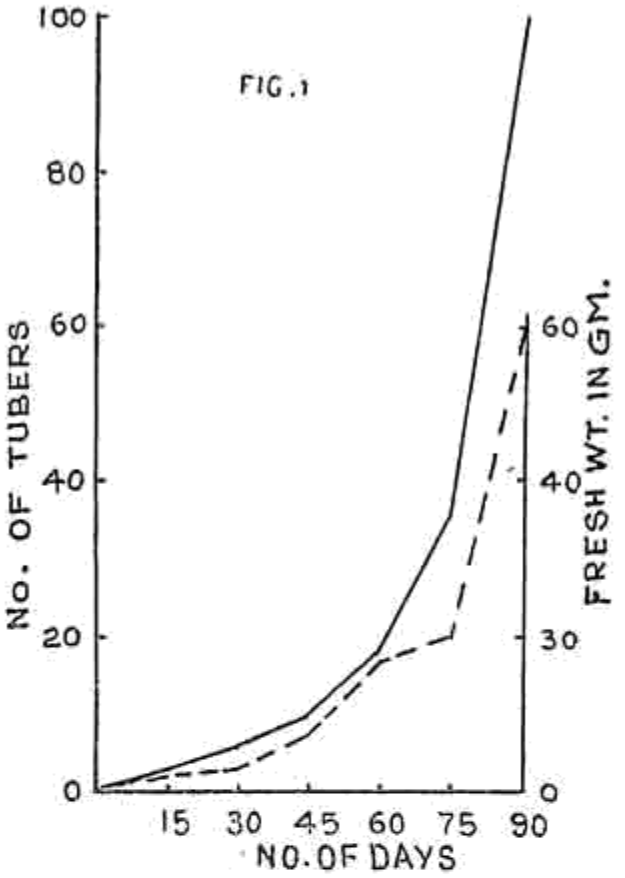
Zone	Depth	Average tubers/ quadrat of 3'x3'	Tubers/ acre (calculated)	% tubers at each depth	% Starch
A	1–3"	54½	2,63,780	14·4	53·5
B	4–6"	90	4,35,600	23·6	41·9
C	7–9"	112½	5,44,500	29·5	46·2
D	10–12"	124½	6,02,580	32·5	44·8
		Total	18,46,460		

(iii) *The starch content of tubers situated at different depths:* The starch content of tubers located at different depths of the two sample plots varied considerably and the details of starch content are presented above in Tables 2 and 3.

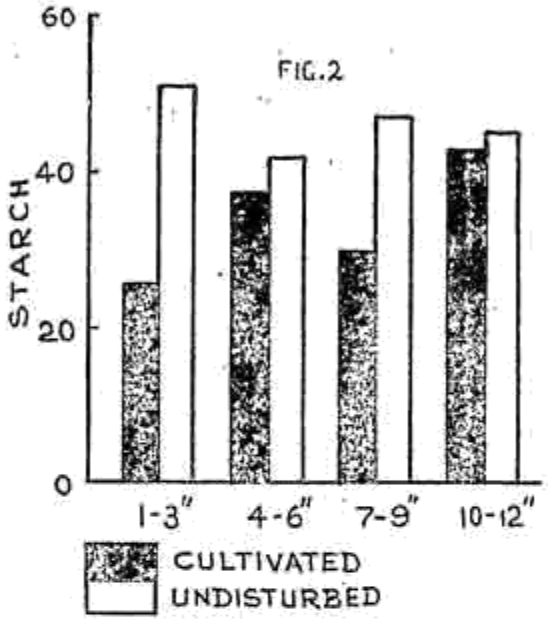
In cultivated plot, the lowermost layer (Zone D) had the maximum starch content followed by Zone B. The uppermost layer had only 28·4 per cent starch, which suggested that tubers at deeper depths were largely storage tubers. As a contrast to the above pattern of starch distribution at different levels, in undisturbed soil, Zone A had the maximum starch content of 53·5 per cent and the other three layers had very close figures relating to starch content. In all the four zones the starch content in uncultivated area was more, corresponding to the zone in cultivated plot.

Discussion: The study indicated the potentialities of the nutgrass tubers in reproduction capacities. The tubers exhibited low initial rate of development and at the end of 60 days, only 18 tubers were produced, out of which eight produced shoots. But within subsequent 30 days, 81 tubers were added making the total to 99 tubers. This increase is due to the participation of the mature tubers in multiplication at the end of 60 days. The observations bring out the seriousness of the weed, particularly when tubers start multiplying at the rates indicated above. This justifies the the presence of 33,17,040 tubers in an acre of cultivated land. The fresh weight of the tubers of different sizes increases gradually which had naturally a close relationship with the number of tubers (Fig. 1).

The tuber development and density at different depths present interesting study. The opinion of Andrews (1940 a and 1940 b) and Rochecouste (1956) that the top layer of 1–6" in general has the maximum density of tubers irrespective of soil type, has not been found to be true. The present study confirms the view of Andrews (1940 a) that cultivated land has a larger population of tubers than undisturbed area. But the above author's observation that the 4–6" zone has the maximum percentage of tubers, though true in cultivated field, has not been the case in undisturbed plot, where the lowermost zone (10–12" D) had the maximum population of tubers (Fig. 2). The distribution and population of tubers in the two samples gave some important informations. The cultivated plots had nearly double the number of tubers, which appears to be due to frequent disturbance of the soil, facilitating adequate aeration and proper tilth for rapid development of tubers. The location of maximum tubers at the lowermost depth (10—12") in uncultivated sample area also suggests that the tubers chose a zone where moisture content was more.



Rate of development of tubers from a single tuber and their fresh weight after 15, 30, 45, 60, 75 and 90 days



Starch contents of tubers of cultivated and uncultivated soils at different depths *viz.*, 1-3", 4-6", 7-9" and 10-12"

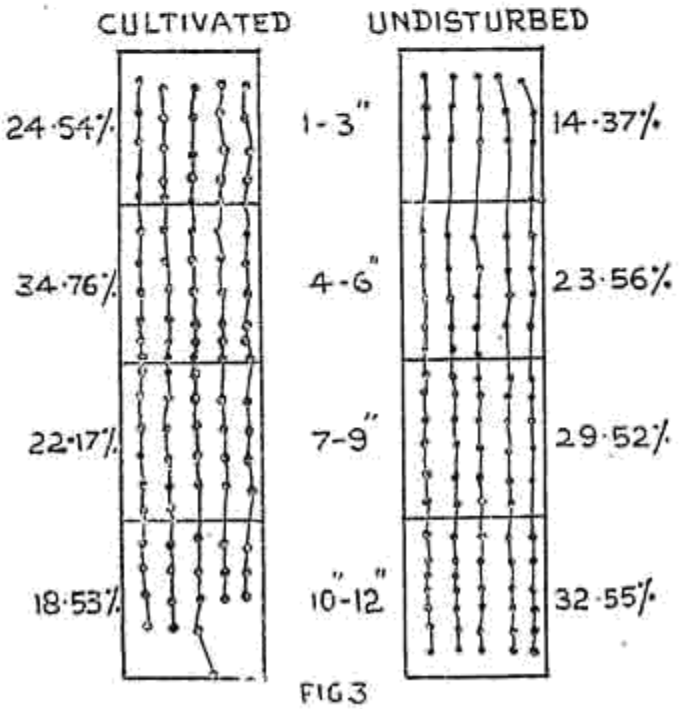


FIG 3

Tuber density at different depths of soil in cultivated and undisturbed soils

Regarding the starch content of tubers (Fig. 3) the percentage was more in undisturbed area at all the four depths of soil. The foliage formation in uncultivated area was less when compared to the growth exhibited in cultivated plot. Since photosynthetic activity is less here, the utilisation of stored food was also less. Another interesting feature was that in cultivated plot the lower most zone (10–12") had the maximum percentage of starch content of 43·14 per cent while in undisturbed area the top zone (1–3") had the maximum content of 53·5 per cent starch.

Summary: The tuber development study on nutgrass indicated that a single mature tuber of nutgrass has the potentiality to produce 99 tubers in a period of 90 days, which speaks well about the seriousness of the weed species. With regard to the distribution and population density of the tubers the cultivated area had 33,17,040 tubers per acre while undisturbed plot had only 18,46,460 per acre. The upper layer (1–3") had maximum starch content in the uncultivated area while in a cultivated field the lower depth (10–12") had the maximum percentage of starch. The tubers in cultivated plot had comparatively lower starch content at all depths.

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