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Tenuous Plants in Sorghum Roxburghii

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Introduction: The occurrence of thin, wiry plants is one of the many seedling abnormalities in Sorghum. Sieglinger (1929) found such plants in a single head-row population of F.5 generation from a cross between two varieties of Kafir. He termed these plants as 'tenuous' and described them as slender grass-like plants which produced practically no secondary or coronal roots and made all their development from single seminal roots. He also considered that a single factor explanation seemed 'plausible' to account for their occurrence and that in the recessive condition the factor prevents the development of the coronal roots and the thickening of the stems to such an extent that the plants do not fruit. This is the only previous record of tenuous plants in cereals, as far as the author is aware.

An experience similar to that of Sieglinger's (loc. cit.) was obtained at the Millet Breeding Station, Coimbatore, in the monsoon crop-season of 1953, with a variety of Sorghum locally known as *Thalaivirichan cholam* and taxonomically described by Snowden (1936) as *Sorghum Roxburghii var. hians*, Stapf. The present study was undertaken to gather more details and confirmatory data on the occurrence and behaviour of such tenuous plants in Sorghum.

Materials and Methods: A single head-row population among several of selfed seed of strain Co. 19, which threw up conspicuously frail and lanky seedlings along with the normal ones, contributed the material for this study. The seedlings were noted when the crop was about four weeks old and had been thinned and hoed once. Though this had disturbed the proportion in which the segregating types originally occurred in the line, counts were taken in the existing population which indicated 376 normal seedlings as against 77 of the tenuous. The abnormal seedlings had their internodes thin and drawn-out, in sharp contrast to the normals in which the stem was thicker, much compressed and totally ensheathed at that age. Most of the tenuous plants were withering out fast and the few available healthy ones were carefully transferred to pots and nursed with a standard nutrient solution (Knop's). Only one from a dozen such plants established well and survived for about eleven weeks.

The normal phenotypes in the particular head-row plots were selfed at flowering time and finally 26 earheads were available from that stock for further study. Among the lot, 16 heads exhibited heterozygosity for seedling character in preliminary tests, and subsequently 500 seeds from each of these heads were sown in small plots to determine the segregation by actual counts.

Experimental Data : The counts obtained are :

Total number of heterozygous heads tested.		Total number of normal seedlings.	Total number of tenuous seedlings.	Total.
16	Observed	5,755	1,821	7,576
	Expected (3 : 1)	5,682	1,894	7,576

$X^2 = 3{\cdot}752$ $P > 0{\cdot}05$

The data furnished above would sustain the assumption that the segregation is a simple monogenic one. Plate 1 shows, comparatively, the growth of both normal and tenuous seedlings about four weeks old. At that age, no coronal roots have appeared in the tenuous seedlings and their leaves are also longer and narrower than those of the normal seedlings. The measurements of two representative seedlings, both normal and tenuous, at the age of four weeks are furnished in the following table.

Particulars	Normal seedings		Tenuous seedings	
	1	2	1	2
Length of seminal root	5·4 cm.	3·7 cm.	7·4 c m.	5·2 cm.
Length of coleoptile	2·4 ,,	1·0 ,,	3·2 ,,	3·6 ,,
Height of plant (from the lowest node to the tip of longest leaf)	22·1 ,,	23·1 ,,	34·0 ,,	39·4 ,,
Length of first internode	Much compressed and oneheated.		5·6 ,,	4·5 ,,
Length of second internode	do.		5·0 ,,	3·9 ,,
Number of visible leaves	7	7	6	6
Dimensions of third leaf (L/B)	13·1 cm. 5·0 mm.	10·5 cm. 8·0 mm.	23·3 cm. 2 5 mm.	25·5 cm. 2·5 mm.
Dimensions of fourth leaf (L/B)	22·1 cm. 2 0 cm.	23 0 cm. 1·5 cm.	24·0 cm. 3·0 mm.	30·3 cm. 3·0 mm.

Plate 3 shows a well grown tenuous seedling at the age of 11 weeks and plate 2 shows a normal plant of comparable age from the same parent stock, in marked contrast with regard to relative growth under identical conditions. The heights of the normal and tenuous plants at this age were almost the same (about 150 cm. measured from the lowest node to the tip of longest leaf) but the length of the stem was nearly double in the case of the tenuous plant (110 cm.) against that of the normal plant (61 cm. measured from the lowest node to the apical meristem in the desheathed stem).

The tenuous seedlings are easily spotted right from germination. They appear to grow faster than the normal seedlings in the initial stages due to rapid elongation of the internodes, which are wiry and well exposed from the leaf sheath. The depth of green in the leaves is also lighter. Under favourable field conditions the tenuous seedlings tenaciously survive even up to 11 weeks ond under pot conditions, for, about three weeks more, after which they gradually dry cut. In most of the plants the growing tip dries up after the fifth or the sixth node and axillary buds are activated. Indeterminate growths of adventitious roots are also noticeable even up to the sixth node. The duration of the normal plant in this particular variety of Sorghum is about 140 days and flowering commences about 40 days earlier to seed maturity. In the case of the tenuous type, no plant could be made to live long enough to come to flowering age even with all possible care. Examination of the shoot terminals at the maximum growth of the tenuous plants failed to reveal any floral primordia, as against their clear presence in the normal plants of the same age. While in a great majority of the tenuous plants there was only the seminal root, an additional, though very short, coronal root was also discovered in a few older plants. Under pot conditions, the maximum penetration of the meagrely branched and the only main root of the tenuous plant is about five inches. The normal plant under similar conditions produces a fan of well branched and ramified coronal roots from the basal nodes. On account of the weakness of the root system and the thinness of the stem, the tenuous plants do not stand erect unless propped, after three weeks of age.

Discussion: The present record runs more or less parallel to that made by Sieglinger (loc. cit) in the same genus, Sorghum. But while this record relates to *Sorghum Roxburghii var. hians* Stapf. Sieglinger's relates to Kafirs which belong to a different species, *Sorghum caffrorum*, And also, Sieglinger's experience of the tenuous plants was obtained in a crossed progeny while in the present instance

such plants were obtained by spontaneous mutation in a selfed population. Sieglinger also observed that the tenuous plants do not produce earheads but at best show only rudimentary glumes and ovaries and no anthers or stigmas at all. In the present case of record the tenuous plants, even at their maximum growth, showed no clear evidence of any floral parts, either rudimentary or normal, in the apical meristem. The tenuous plants mentioned by Sieglinger appears to have had the same period of growth as that of the normal from the same parent stock. A different experience was obtained here, with the tenuous plants not living beyond 11 weeks while the normal plants of the same descent had a growth duration of 20 weeks. The difference may have been due to the variety or seasonal factors or both. Sieglinger has not mentioned about the rapid elongation of the internodes and leaves in the seedling stage of the tenuous plants, which mark them out very conspicuously from other normal seedlings. Working on the balance of the original crossed seed which threw out the tenuous plants, Sieglinger obtained segregation counts of normal and tenuous seedlings, and considered that a single factor explanation was plausible, to account for the inheritance of this abnormality, even though the number of normal plants was over-proportionate. In the present case a clear monohybrid segregation was obtained between normal and tenuous seedlings, through selfed seed of heterozygous plants that occurred in a mutant selfed progeny.

The gene responsible for the occurrence of tenuous plants in Sorghum is designated *tn* and it gives rise to thin, attenuated and grossly under-developed plants with poor survival value.

Summary and Conclusions: Observations following a mutational occurrence of tenuous plants in a selfed population of *Sorghum Roxburghii var. hians* Stapf., (an indigenous variety locally known as *Thalaivirichaṁ cholam*) made it possible to indicate that a single gene in its recessive condition, produced this abnormality, which is also lethal in ultimate effect.

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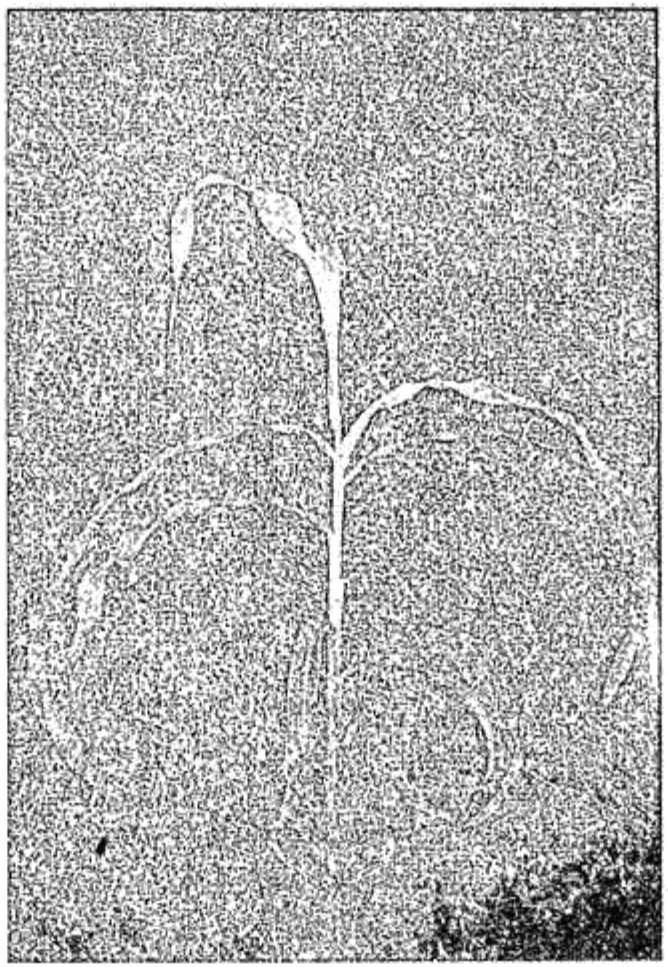
PLATE 1

FOUR WEEK OLD SEEDLINGS

1. Normal 2. Tenuous

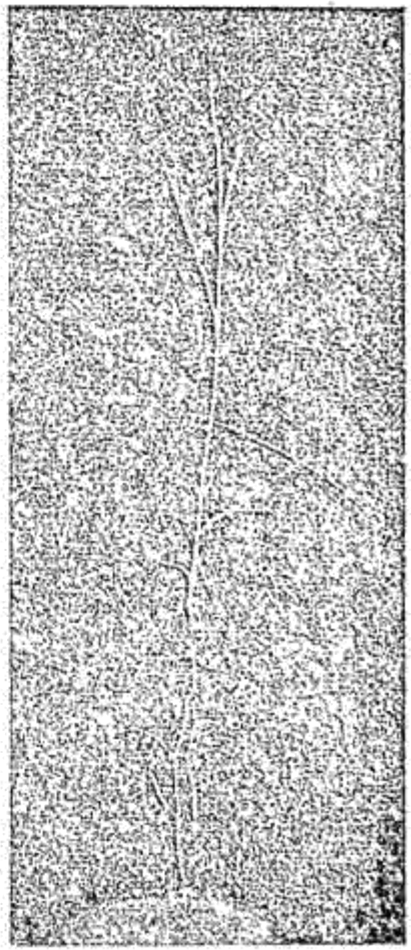
[Note Coronal roots, indicated by arrow, in the normal seedlings and their absence in the tenuous seedlings.]

PLATE 2



NORMAL SORGHUM PLANT—II WEEKS

PLATE 3



TENUOUS SORGHUM PLANT—II WEEKS

[Note tiny adventitious root, indicated by arrow, from the fifth node.]