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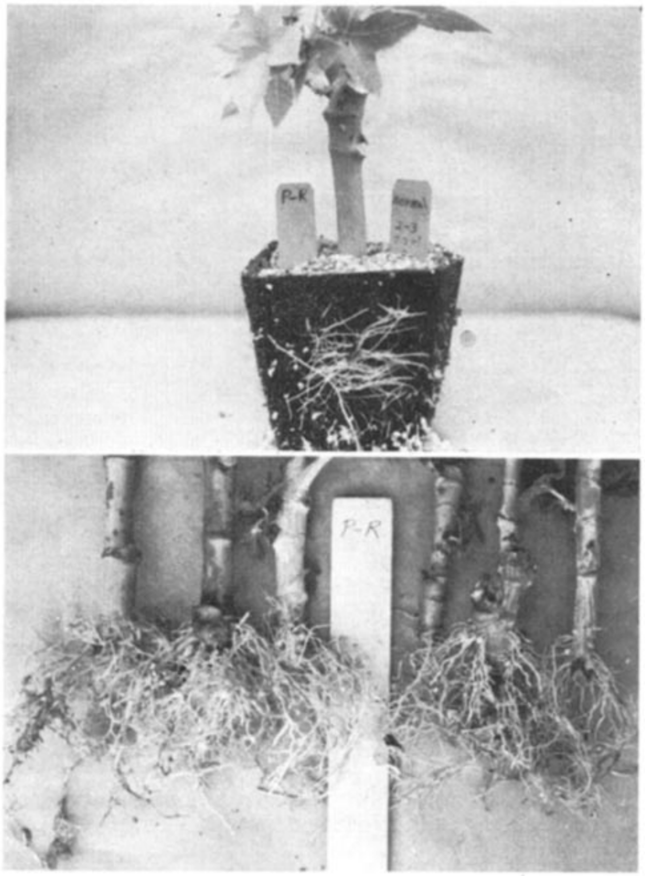

Fig. 1. (Top) A 50-day-old Rootone-treated castor stem cutting in perlite. (Bottom) Several Rootone-treated cuttings showing roots emerging through the epidermis at points along the internode and at the basal portion of the cuttings.

cuttings set in sand required an average of 15 and 22 days to root, respectively.

Significantly more treated cuttings rooted in perlite than in sand (Table 1). Significantly more treated than untreated cuttings rooted in perlite. Only six treated and four untreated cuttings rooted in sand. Fifty-three percent of the treated cuttings rooted in perlite, compared with 19% in sand. Twelve percent of the untreated cuttings rooted in sand and perlite.

Prolific root systems were obtained on treated cuttings set in sand and perlite. Roots generally emerged from the stem epidermis at points along the internode and at the cut end of the stem (Fig. 1).

We obtained the best rooting of cuttings set with one or two nodes below the media surface and three or four nodes above the surface. Cuttings with leaves on the stem rooted better than those having only buds. This is in agreement with data reported for several horticultural plants (1). No rooting was obtained using petioles with their leaves and/or short lengths of internode.

Literature Cited

1. Cooper, W. C. 1935. Hormones in relation to root formation on stem cuttings. Plant Physiol. 10:789-794.

2. Hartman, H. T., and D. E. Kester. 1968. Plant propagation, principles and practices. Prentice-Hall, Inc., Englewood Cliffs, N. J. 702 p.

ABORTIVE TERMINAL, A CYTOPLASMICALLY INHERITED CHARACTER IN COTTON, *Gossypium hirsutum* L.[1]

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ABSTRACT

A mutant character was observed in a segregating population of *Gossypium hirsutum* L. The mutant seedlings failed to show apical growth, so the character was named "abortive terminal." The abortive terminal condition was transmitted only through the maternal parent, and was not under the control of nuclear genes. Progeny tests using seeds from each boll of several individual plants demonstrated that the condition was transmitted only through certain bolls. Tests showed that it was probably not caused by viruses, bacteria, fungi, or visible cytological irregularities. We concluded that the abortive terminal was controlled by a mutant organelle in the cytoplasm.

Additional index words: Apical growth.

CYTOPLASMIC inheritance is found widely distributed in the plant kingdom (1, 7, 8, 9). In most instances, investigators concluded that inheritance patterns were under cytoplasmic control after extensive tests for nuclear control and had given negative results.

Cytoplasmically inherited characters often can be classified according to their association with certain cytoplasmic particulates. "Kappa" (the killer factor in *Paramecium*) and chlorophyll variegation in higher plants were found associated with definite cytoplasmic particulates, i.e., the kappa factor and chloroplasts. Other cytoplasmic characters, such as pollen sterility and serotypes in *Paramecium*, either are not associated with definite cytoplasmic particulates or have not yet been identified with such factors. Gibor and Granick (2) reviewed the evidence showing that DNA is present in mitochondria and plastids. The existence of DNA in these organelles provides a basis for cytoplasmic inheritance.

Several characters in cotton (*Gossypium hirsutum* L.) are known to be inherited cytoplasmically. Among them are the external ovule character (5), a form of reduced pollen fertility (6), reduced androecium (10), and a chlorophyll variegation (3).

Materials and Methods

Accidental damage to or destruction of the apical bud sometimes occurs in the cotton genetics nursery at College Station when cotton seedlings are transplanted into the field. In 1964 a population was observed in which an unusually large number of the seedlings failed to initiate any apical growth beyond the cotyledons. Because of the large number of these plants, a study was initiated to determine if the observed condition was under genetic control. Seedlings that failed to initiate any apical growth were given the name "abortive terminal."

The normal plants from this population flowered and were self-pollinated. They were transplanted into the greenhouse at the end of the growing season. These plants were F_2 progeny from the cross T-86 $\times$ TM-1. The female parent of the cross,

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T-86, is one of the so-called primitive or dooryard stocks of Upland cotton collected by Richmond and Manning in Southern Mexico. This stock flowers only under short-day regimes. The pollen parent, TM-1, is a standard American Upland inbred tester stock (4). The original T-86 and TM-1 plants which were used to make the cross were destroyed before this study began. New crosses were made between T-86 and TM-1 lines, and these were progeny-tested.

The normal-appearing plants from the original segregating population were progeny-tested to determine if the observed condition was heritable. Reciprocal crosses were made with normal cotton plants to study the mode of inheritance. The lethal condition of abortive terminal required maintenance of the mutant in the heterozygous condition. Heterozygous plants were identified by progeny tests.

Approach grafts between normal and abortive terminal seedlings were made to test for a virus as the causal agent. These grafts were allowed to develop a secure union, and then the roots from the normal seedlings were cut below the graft union to allow the virus, if present, to move from the tissue of the mutant plant directly into that of the normal plant. The grafted plants were allowed to reproduce and then progeny-tested. Abortive terminal progeny would be indicative of a virus.

The possibility of bacteria or fungi as the causative agents was tested by plating out, on both water and nutrient agar, seeds from heterozygous abortive terminal plants. These agar plates were placed in a bacterial incubator for 2 weeks and then examined under a microscope for the growth of bacterial or fungal colonies.

Results and Discussion

All the normal plants from the original population segregated for the mutant condition, thus demonstrating that the abortive terminal mutant was heritable. The segregation ratios obtained from the different progeny tests varied from 1:1 to 39:1, normal to mutant seedlings.

Abortive terminal mutants were not found among the F_2 progeny of the crosses made between T-86 and TM-1. We concluded that the mutant condition was not the result of genetic breakdown caused by the interaction of diverse genotypes or by the action of duplicate genes.

Reciprocal crosses between known heterozygous and normal plants were progeny-tested in the F_2 generation. The data from these tests showed that the abortive terminal condition was inherited only through the female parent, and in a non-Mendelian fashion. Further evidence for non-Mendelian inheritance was obtained when F_1 progenies segregated for the mutant condition. Cytological analysis of heterozygous plants revealed a normal complement of chromosomes at metaphase I. Maternal transmission and non-Mendelian ratios from segregating populations led us to conclude that the abortive terminal character is cytoplasmically inherited.

Abortive terminal was evaluated for somatic segregation. Plants heterozygous for the condition did not produce either all normal or all abortive terminal progeny. Individual bolls were harvested from plants carrying the abortive terminal condition. The location of each boll was recorded as it was harvested. Seeds from these bolls were planted, and the resulting progeny were scored for abortive terminal segregation. The results revealed that the factor controlling the mutant phenotype appeared to be transmitted through definite cell lineages. If one boll on a branch segregated for abortive terminal progeny, then all bolls on that branch segregated for the mutant condition.

The abortive terminal condition was not caused by a virus, bacterium, or fungus. Progeny tests of normal plants grafted onto abortive terminal rootstocks did not result in mutant progeny. The lack of abortive terminal progeny showed that a virus was not the causative agent. Examination of the agar plates revealed an absence of bacterial or fungal growth.

Literature Cited

1. Anderson, E. G. 1923. Material inheritance of chlorophyll in maize. Botan. Gaz. 76:411-418.
2. Gibor, A., and S. Granick. 1964. Plastids and mitochondria: inheritable systems. Science 145:890-897.
3. Kohel, R. J. 1967. Variegated mutants in cotton, *Gossypium hirsutum* L. Crop Sci. 7:490-492.
4. ———, T. R. Richmond, and C. F. Lewis. 1970. Texas Marker-1. A description of a genetic standard for *Gossypium hirsutum* L. Crop Sci. 10:670-672.
5. Meyer, Vesta G., and M. Buffet. 1962. Cytoplasmic effects on external-ovule production in cotton. J. Hered. 53:251-253.
6. ———, and James R. Meyer. 1965. Cytoplasmically controlled male sterility in cotton. Crop Sci. 5:444-448.
7. Michaelis, P. 1951. Interactions between genes and cytoplasm in *Epilobium*. Cold Spring Harbor Symp. Quant. Biol. 16:121-129.
8. Mitchell, M. B., and H. K. Mitchell. 1952. A case of "maternal" inheritance in *Neurospora crassa*. Proc. Nat. Acad. Sci. U. S. 38:442-449.
9. Rhoades, M. M. 1933. The cytoplasmic inheritance of male sterility in *Zea maize*. J. Genet. 27:77-93.
10. Rhyne, C. L., Jr. 1965. Cytoplasmic inheritance of reduced androecium in cotton. J. Hered. 56:67-70.

COMPARISONS OF THREE SCALES OF MEASUREMENT OF CREEPING IN ALFALFA[1]

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ABSTRACT

Percentages of plants creeping, visual estimates of spread of individual creeping plants, and measurements of spread of both creeping and noncreeping plants were compared as scales of measurement of creeping-root development in alfalfa. In Experiment I, the scales did not differ significantly in power to detect differences in creeping among the lines. In Experiment II, percentages of plants creeping and measurements of spread were equally sensitive, and both scales were more sensitive than visual estimates of spread.

Additional index words: **Root-spreading, Root-proliferation.**

LITERATURE concerning creeping alfalfa was reviewed by Heinrichs (1963). The creeping or root-spreading character offers promise for improving alfalfa for both pasture and hay purposes. In 1963, breeding work aimed toward developing creeping alfalfas for specific environments was being conducted in seven countries.

Expression of the creeping character has been measured by different scales, such as, percentages of plants exhibiting the character and extent of spread. Degree or extent of spread has been estimated either by visual

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