1. Plant F_2 kernels from an opaque-2, floury-2 cross.
2. Self each plant and cross to an opaque-2 tester.
3. Using double pollination techniques, pollinate plants in 2 above with pollen from an R^{nj} tester.

Those plants homozygous for the double mutant will give positive results from the opaque-2 testcross. In addition, if the plant is homozygous for floury-2 all R^{nj} kernels will have a floury phenotype because of the dosage effect of floury-2. This will be true regardless of whether the double mutant gives a normal, seminormal or opaque phenotype.

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METHODS OF ASEXUAL PROPAGATION AND MINIMUM MAINTENANCE OF LIVE COTTON PLANTS[1]

J. B. Weaver, Jr. and R. P. Athanas[2]

ABSTRACT

The effects of different rooting media, hormone treatments, and rooting techniques in cotton (*Gossypium hirsutum* L.) were investigated. Cuttings from cotton plants rooted readily in several different rooting media under intermittent mist with or without rooting hormones.

A plastic bag technique is described which permits rooted cuttings to remain alive for at least one year without any care except to avoid excessive heat or cold.

Additional index words: **Hybrid cotton, Male-sterile cotton.**

A RAPID and easy method of propagating a single plant is often desirable in many types of investigations. This is especially true in cotton (*Gossypium hirsutum* L.) breeding when a large number of seeds are needed to determine doubtful segregation ratios, to study environmental effects on male-sterility, or in testing for insect or disease resistance.

The discovery of a double recessive genetic male-sterile cotton (2) raised the question of the feasibility of utilizing rooted cuttings to establish a large acreage of male-sterile plants. F_1 hybrid seeds produced on these male-sterile plants could be advanced to the F_2 generation for commercial production. The double recessive male-sterile genes produce only 1 out of 16 male-sterile plants in the F_2 generation. Observations made by several cotton breeders across the cotton belt in 1969 indicated that male-sterile plants are adequately cross pollinated by insects except in a few areas.

The fact that cotton could be propagated from cuttings has been known for many years but has not been generally recognized. In 1927 Harland (1) stated "Experiments carried on in England in the greenhouse at the Shirley Institute in 1923-26 showed that in lower temperatures, *circa* 70° to 78° F (21-26 C), softwood cuttings would root without the slightest difficulty in a few days." Recently Wilhelm (3) reported that cotton cuttings rooted readily in 7 to 14 days under intermittent mist.

Preliminary work by the senior author in 1962 showed that cotton could be rooted easily from cuttings under intermittent mist. Another method tested in 1962 that proved promising involved the use of polyethylene bags. About 500 g of wet rooting medium (25% peat moss, 25% sand, 50% soil) was placed in home freezer type polyethylene bags. Softwood cuttings of cotton with 2 to 3 leaves taken from healthy plants were placed in the bag and sealed with a rubber band. The cuttings rooted readily and increased in height a few centimeters and then essentially ceased growth; however, the plants remained alive for several months with little evidence of additional growth. Several rooted cuttings were maintained in a fiberglass greenhouse for a year in plastic bags without being opened.

During the early part of 1968 additional studies were initiated on techniques of rooting cotton. During February and March, 45 cuttings were successfully rooted using the polyethylene bag system described above.

On April 13th a study was begun to test various rooting media, three commercial hormone preparations, and the effect of sunlight intensity on cuttings placed in plastic bags. The rooting media were 100% sand, 50% sand-50% perlite, chip pine bark, 50% peat-50% perlite, and 50% sand-50% peat. The rooting compounds were Rootone (0.067% 1-naphthaleneacetamide, 0.033% 2 - methyl - 1 - naphthaleneacetic acid, 0.013% 2-methyl-1-naphthaleneacetamide, and 0.057% indole butyric acid), Hormodin #2 (0.3% indole butyric acid), and chloromone (a chlorophyll extract). The type of rooting medium or hormone treatment produced no significant differences. However, the sunlight variable was important. At the end of 2 months, 14 out of 25 cuttings exposed to direct sunlight in a glass greenhouse had died, 5 out of 25 cuttings in partial shade (50% sunlight under plastic shade screen) had died, and only 1 out of 25 in full shade (under greenhouse bench) had died. This difference was attributed to the high temperature inside the plastic bags in full sun. Average temperature for a 14-day period taken at 1 p.m. was 41C on the inside of the plastic bags exposed to full sunlight. The average temperature immediately outside the bags was 30C. There was essentially no difference in temperature inside and outside the bags under 50% shade and full shade.

Sand plus peat and perlite plus peat as rooting media along with the hormones listed above were used in conventional greenhouse flats; with the cuttings placed under intermittent mist in a glass greenhouse. Three hundred cuttings were rooted and the degree of root formation was graded on a scale 0 to 5 with grade 0 as very poor root formation and grade 5 as excellent. Sand plus peat produced an overall average grade of 2.83. Peat and perlite produced an average grade of 2.29. Grades for hormone treatments were as follws: Rootone, 2.0; Check, 2.2; Chlormone,

[1] Contribution from the Agronomy Department, College Experiment Station, University of Georgia, Athens, Georgia 30601. Received May 15, 1970.

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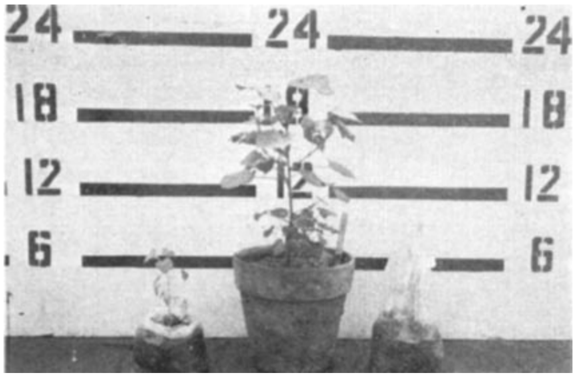

Fig. 1. Rooted cotton plants using a polyethylene bag technique.

3.2; and Hormodin #2, 3.6. The results indicate that Hormodin #2, with sand and peat media, will produce the best root system. The major difference observed was that the hormone treated cuttings tended to produce a large number of short roots, whereas the untreated check cuttings produced fewer but longer roots.

In the spring of 1969 over 500 cuttings from male-sterile cotton plants were rooted with intermittent mist (20 seconds mist/5 minutes) and successfully transplanted to the field. Some of these roots transplants produced over 250 g of F_1 hybrid seed.

Figure 1 shows a rooted cutting on the left that had been exposed for the first time just prior to taking the photograph. The plastic bag on the right has a rooted cutting still unopened. The potted plant in the middle is a rooted cutting that had been removed from a plastic bag 6 weeks before the photograph was taken. All three cuttings were placed originally in plastic bags on the same date (90 days prior to date photograph was made).

A procedure for storage of field grown cotton plants was investigated during the fall and winter of 1969-70. Mature plants were bare rooted from the soil and the roots were pruned. All limbs were removed and the main stem cut back to 15 cm in length. A total of 12 "stubbed" plants were placed in single large polyethylene plastic bags (35 by 65 cm) and the roots were covered with moist rotten sawdust. Each bag was then sealed at the top. One group of 10 bags was placed on the top of a greenhouse bench. The greenhouse was made with Denverlight 6-20-C3 fiberglass. After 4 months storage these plants were alive and made normal growth when removed from the bags and placed in open pots. Another group of ten bags was placed under greenhouse benches where they received very little light. This group of plants tended to mold and die. Ten bags were placed in a dark cold storage room at 5.5C. After 3 months of storage these plants were dead.

The plastic bag technique of rooting and storage may be a useful tool for other crops. Cotton plants have been rooted and maintained in the laboratory, which indicates that a greenhouse is not essential. This study shows that rooted plants can be maintained for a year without any care except to avoid excess heat or cold. There is the possibility that these plants would live for even longer periods under these conditions.

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ROOTING FROM SOD BY *Poa pratensis* L. AND *Agrostis tenuis* Sibth.[1]

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ABSTRACT

The source was examined of roots which "knit" blue and bentgrass sods by emergence from the sod into the soil below. Sod was knit by new adventitious roots which emerged from the sod into the new soil in greater numbers as sod was more thinly cut. Regrowth of old roots was not a factor in knitting of sod. All bluegrass shoots initiated new roots. Only some bentgrass shoots initiated roots the first week, but the percent rooting increased with time.

Additional index word: **Turfgrass.**

IN 1925 the staff of the U. S. Golf Association Green Section Bulletin reported that sod cut 12 mm thick had a firm hold in 1 week and was firmly attached 2 weeks after planting, while sod cut 50 mm thick was still unattached 7 weeks after laying.[3] Superior rooting of thinly cut sod is well known in the trade and has been noted in the literature.[4] The question studied and reported here is of the effect of sod thickness and of the source of new roots which emerge from the sod into the "seedbed" soil. Are they new adventitious roots, branches from cut roots, or is there a difference depending on sod thickness?

On 1 Dec., 1969, sods (ca. 1 dm^2) were cut from turf of Kentucky bluegrass (*Poa pratensis* L.) and of colonial bentgrass (*Agrostis tenuis* Sibth.). Sods were selected to provide pure samples free of other plant species. Sods were trimmed to a soil thickness of 12, 25, or 50 mm, and three sods of each variety and each thickness were planted in medium to fine quartz sand in flats. Flats were placed in a 20 C greenhouse with daylight supplemented with floodlighting 16 hours a day. Bluegrass sods were harvested after 8, 15, and 22 days, and bentgrass sods after 8, 18, and 29 days. During this time ca 4 cm of new leaf growth was made. Both roots emerging from the sod and total shoots were counted; and rooting patterns were examined by picking or washing the soil from subsamples.

Quantitative results are presented in Table 1. When analyzed as roots per 100 shoots; sod thickness, sampling dates, varieties, and all interactions were significant. The thinner the sod the more emergent

[1] A contribution of the Department of Environmental Horticulture, University of California, Davis. Assistance of the Dept. of Botany, University of Edinburgh, Scotland, is acknowledged with pleasure. Work was done there as a postdoctoral fellow while on leave. Received Feb. 4, 1970.

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