TABLE 1. A SUMMARY OF PHYTOTOXICITY TO ALMOND TREES FROM 1963–66 FROM 10 UNIFORM TRIALS FOR ANNUAL WEED CONTROL WITH SIMAZINE AND DIURON

County location of orchards*	Tree age†	No. years treated	Soil characteristics				Type irrig.	Phytotoxicity‡	
			Org. matter	Sand	Silt	Clay		Simazine	Diuron
			%	%	%	%			
Butte	4	1	6.1	42.0	40.0	18.0	Sprinkler	–	–
Contra Costa	20+	2	5.6	21.6	54.0	24.4	Sprinkler	–	–
Contra Costa	20+	2	3.2	25.4	51.0	23.6	Furrow	–	–
Contra Costa	20+	2	2.7	81.8	14.0	3.6	Sprinkler	–	–
San Joaquin	7	3	2.1	81.2	14.0	4.8	Sprinkler	–	–
Sutter	4	3	2.1	47.2	30.0	22.8	Flood	+	+
Stanislaus	4	3	1.6	65.4	27.8	6.8	Flood	+	+
Fresno§	5	1	1.4	54.4	37.6	8.0	Furrow	+	+
Fresno	10	2	1.4	54.4	37.6	8.0	Furrow	–	–
Stanislaus	2	2	1.2	80.0	14.0	6.0	Flood	+	+

* Special Note: Varieties tested included Mission, Nonpareil, and Ne Plus in Butte County; mixed varieties in Contra Costa; Nonpareil and Merced in San Joaquin; Nonpareil, Ne Plus, and Mission in Sutter; Nonpareil, Mission, and Merced in Stanislaus; and Nonpareil, Davey, and Mission in Fresno County.

† Approximite tree age at time of first application.

‡ + = phytotoxicity at herbicidal rates, i.e., ratings of 3 or above on a scale of 0–10 where 0 = no observable effect, 5 = severe chlorosis and marginal burn of foliage, 10 = all leaves dead. – = 0 to 3 rating.

§ Some irrigation broke over the treated beds between trees.

sandy soils with low organic matter. In the University of California trials on heavier soils, there was no injury even at the high rate of 8 lbs per acre. Commercial applications have shown injury on heavy as well as on light soils at herbicidal rates. In about one out of eight observations, toxicity was observed on almonds at the 4-lb-per-acre rate, and some symptoms occurred from simazine even at 2 lbs per acre. Since at least 2 lbs per acre are usually necessary for weed control in most soils, simazine and diuron offer a very narrow safety margin. A year of heavy rainfall, overirrigation of the treated area, a slight overdosage, or the build-up of other factors detrimental to tree health could (and did) reduce the margin of safety. These levels are too hazardous.

This orchard work, and research with herbicides in general, has shown that a number of factors in the soil can influence weed control and crop sensitivity. Sandy soils, low in organic matter and clay content, are often associated with tree injury from soil-persistent herbicides. Unfortunately, a recent survey (table 2) showed that 50% of our almond orchard soils come under this classification. (Pears, however, are predominantly on heavier soils which could explain their relative resistance to simazine and diuron injury. See CALIFORNIA AGRICULTURE March 1967.)

Young almond trees that have been uninjured even by high rates of simazine and diuron have been in soils that are deep. More injury has occurred on shallow than on deep soils because roots growing close to the surface in a shallow soil are more apt to be damaged. Half of our almond orchards are on shallow soils, further reducing the margin of safety.

Work with rootstocks showed that almonds growing on peach roots are considerably more resistant to herbicides than those on plum roots. Fortunately, the greatest percentage of almond trees in the state are on peach stock.

TABLE 2. SUMMARY OF 1964–1965 CALIFORNIA ORCHARD SURVEY BY FARM ADVISORS, CALIFORNIA AGRICULTURAL EXTENSION SERVICE

PERCENTAGE OF CALIFORNIA ORCHARD CROPS GROWN ON SANDY AND CLAY SOILS

Orchard crop	Sandy	Clay
	%	%
Almonds	60	41
Pears	27	73
Walnuts	52	48

PERCENTAGE OF CALIFORNIA ORCHARD CROPS GROWN ON SHALLOW AND DEEP SOILS

Orchard crop	Shallow	Deep
	%	%
Almonds	50	50
Pears	12	88
Walnuts	29	71

While this summary may represent a somewhat conservative picture in light of many experimental orchard trials over the years where there was no indication of toxicity from the use of simazine in almonds, it clearly points out the hazards involved as well as the difficulties of making general recommendations for simazine and diuron for almond orchards.

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Vegetative

COTTONS DERIVED FROM the species *Gossypium hirsutum* such as the Acala varieties, and from *G. barbadense* such as Sea Island and Tanguis varieties —or hybrids between the two species—have been found easy to propagate vegetatively by cuttings. There are obvious advantages in certain disease studies to conducting experiments with genetically uniform or clonal lines of cotton. There may also be advantages to the seed industry. For example, a plant selected as a basic seed parent for superior yield and quality could be increased many fold by cuttings and an abundant seed crop realized—sufficient to reduce the time between initial selection, and release of the seed to growers by perhaps one seed generation.

Maintain plants

Also, when tests determine the value of specific cotton plants to the industry as seed or breeding parents, these could be maintained by cuttings year after year—or until replaced by superior lines. With vegetatively propagated cottons, field performance of basic lines could be evaluated in several different geographical areas. Cottons rooted by cuttings do not have the tap root system characteristic of those grown conventionally from seed, and thus may perform atypically in the field, but there is a tendency in rooted cottons for one or more roots to grow considerably faster than others, as if the plant might reconstruct the tap root. Atypical performance in the field, if it occurred, would not affect the genetic composition of the seed.

The incorporation of Verticillium wilt resistance into Acala cottons from the species *G. barbadense*, with clonal cottons for instance, would allow back-crossing to the same individuals year after year, in

PROPAGATION OF COTTON PLANTS BY CUTTINGS

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contrast to back-crossing to a new generation grown from seed each year. Variations in levels of resistance to Verticillium wilt are inevitable in seedlings grown even from highly resistant cottons. Clonally propagated cottons could counter this variation, and no doubt provide a basis for obtaining precise genetic information on the inheritance of the resistance.

In recent experiments, lateral branches 3 to 8 inches or more long, cut at a node, made excellent cuttings. Branching was induced by cutting off the terminal shoot of a plant. Neither mature leaves, squares nor flowers had to be removed from a cutting. They may have, in fact, contributed to rooting. A mixture of approximately equal parts by volume of peat moss and sponge rock, such as commercial perlite, made an ideal rooting medium—and did not require sterilization when used for the first time. When needed, sterilization can be done by steam. Under intermittent mist operating approximately one second of every two minutes, and using a rooting-medium temperature of 65° to 70°F, roots form in 7 to 14 days. Slight variation has been noted in the time of rooting of various cottons, but none studied to date required longer than two weeks to root. Rooting is possible any time of the year. In addition to the species already named (and plants of 15 different F-1 hybrids between them), *G. tomentosum* Nutt. x Seem., *G. anomalum* Waw., and Peyr., *G. raimondii* Ulbr. and *G. arboreum* L. have been rooted.

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Rooted cutting of a cotton hybrid, G. barbadense (Berkeley 106–16) x G. hirsutum (Acala 4–42). Enlarged inset shows tendency of certain roots to become dominant. These may reconstruct the tap root.