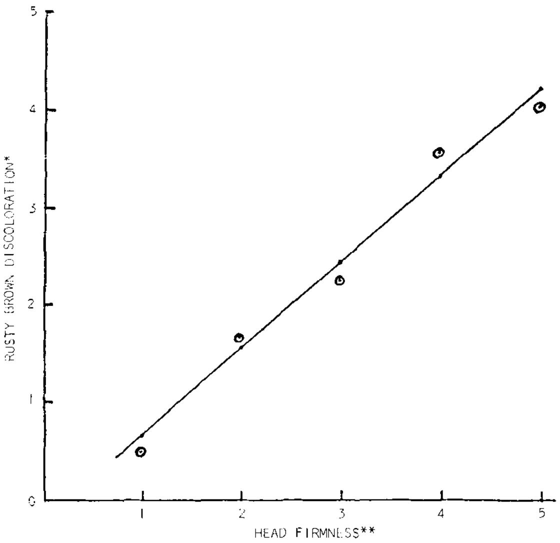
REGRESSION CORRELATION OF HEAD FIRMNESS AND RUSTY BROWN DISCOLORATION IN CLIMAX PLANTS INOCULATED WITH LETTUCE MOSAIC VIRUS (37 plants from each of 3 inoculation dates were analyzed) r = 0.989



* 0 = no leaf discoloration
5 = severe discoloration
† 1 = immature, soft head
3 = optimum market maturity
5 = hard, overmature head

When the heads were stored for two weeks for RBD to develop, additional tests were done. In one test half of the LMV-inoculated heads were placed in pairs in a large plastic bag and an additional virus-free Climax head collected from a commercial field was also placed in the bag to determine if a volatile compound produced in the LMV-infected heads could cause RBD on the virus-free head. Although RBD developed on all 60 LMV-infected heads, none of the 30 healthy heads developed RBD. In addition, there was a direct correlation between head firmness (i.e. maturity) and RBD severity with the more mature heads developing more severe RBD (see graph).

Climax lettuce heads collected from a commercial field were assayed and found to be free of LMV. When these heads were stored for three weeks or more, they often developed a mild discoloration that was similar to RBD. This mild discoloration also was more severe on the firmer heads but it never became as severe as RBD caused by LMV; it would rate less than 1 on a 0–5 scale of increasing RBD severity. The similarity of this discoloration and RBD suggests that LMV infection accelerates physiological processes that normally do not produce effects on Climax lettuce until the lettuce is overmature. This work was done only with Climax so the reaction of other varieties is unknown, but judging from their resistance to RBD in other tests it seems likely that susceptibility to the mild discoloration represents an undesirable characteristic of the variety Climax, which is accentuated by LMV infection.

A double-wall plastic shelter covering two lettuce beds, 12 ft long, was constructed to evaluate the effect of minimum temperature on the incidence of IRN. Large vents on each end served to keep the inside temperature near ambient during daytime and also allowed free access to all insects. A thermostatically controlled electric heater was installed to keep the minimum temperature above 40° F, during the night when the vents were closed. The shelter was installed over young plants on November 30, 1971, and at the same time several plants were inoculated with lettuce mosaic virus. At maturity, on January 25, 1972, the plants from the shelter were evaluated for IRN. Of the 41 plants within the shelter all but two exhibited typical symptoms of IRN. This experiment confirms that temperatures below 40° F are not required for the development of IRN symptom in Climax.

This work demonstrates that IRN and RBD are limited to the variety Climax among the varieties which are commonly grown in the Imperial Valley, California. It also confirms the results of carefully controlled experiments which have shown that lettuce mosaic virus is the cause of IRN and RBD, and it emphasizes the necessity for the control of lettuce mosaic virus through a clean-seed program. A clean seed program in which the only lettuce seed lots certified for planting are those with zero mosaic in 30,000 seeds was instituted in Imperial County in 1971. This has given excellent control of LMV in subsequent seasons. A similar program has effectively controlled LMV for 10 years in the summer lettuce crops of the Salinas Valley.

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NEW

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Water placement is very important to strawberry production. Under the conditions of this experiment, plants on a conventional 40-inch bed with standard furrow irrigation required the greatest amount of water and yielded the least fruit, whether figured on a per-plant or per-acre basis. In contrast, the experimental 60-inch midbed furrow-irrigated plants yielded significantly more fruit on a per-plant or per-acre basis, even though there was a 35% increase in plant population. Apparently surface application, with the water constantly moving downward, improves plant performance. Of the new application systems investigated here, only the use of porous pipe placed under the soil surface was of questionable value from the point of view of plant performance.

THE MILD CLIMATE of coastal California contributes to high strawberry yields, although urbanization is reducing the available land in the best areas. These experiments were designed to study the production efficiency of novel irrigation methods, but also involved bed shape and plant placement.

Drip system

Promising results were obtained in 1967–68 at San Diego in preliminary experiments with the "drip" irrigation system utilizing plastic pipe positioned between the plant rows on top of the conventional 40-inch, double-row bed with orifices every two feet. Water con-

Strawberry Irrigation Systems

WATER USE AND CROP YIELD COMPARISON FOR STRAWBERRIES UNDER EIGHT IRRIGATION SYSTEMS AND TWO BED SIZES

Plot no.	Bed size	Irrigation system	Water used Acre-ft	%	Yield Grams/plant	Tons/acre
1	40"	standard furrow	2.6	100	238 a*	16.5 a*
5	60"	single poly pipe	2.4	96	249 ab	23.0 bc
2	40"	single poly pipe	1.0	38	260 bc	18.0 a
6	60"	double poly pipe	1.3	50	267 bc	24.6 bc
7	60"	single poly tube	2.2	85	282 c	26.0 c
3	40"	single poly tube	1.3	50	283 c	19.6 ab
8	60"	double poly tube	1.6	62	308 c	28.4 c
4	60"	midbed furrow	2.0	77	309 c	28.5 c

* Those with a letter in common are not significantly different at the 5% level.

sumption and salt accumulation were reduced and yield and fruit size were increased, although a relatively poor quality water containing about 1000 ppm total salts was used. Because furrows on either side were dry, and the fruit normally hanging on the sides was not wetted by irrigation, pickers could enter the field immediately after or even during irrigation. In addition to the high installation and maintenance costs of the system, the main problem was clogging of the small orifices in the pipes. A highly efficient filtration system must be employed to minimize this difficulty.

The favorable results with the experimental "drip" system led to exploration of bed modification as a method of increasing plant density (without reducing yield per plant), reducing fruit rot, and making the harvest more convenient for pickers. An experimental bed shaper was designed and built which formed a smaller, relatively shallow center-of-bed (hereafter referred to as "midbed") furrow for irrigation. After additional experimentation, a 60-inch center-to-center four-row bed width was developed with two rows of plants on either side of the midbed furrow and the midbed furrow was bridged over with the polyethylene mulch. Thus, only the midbed furrow received water and the much deeper between-the-row furrows remained dry throughout the season, making the water relationships similar to those previously studied under the "drip" system. In addition, two new commercial systems were investigated: (1) semi-rigid *porous polyethylene pipe that must be* buried from two to four inches under the soil surface; and (2) a flexible, black polyethylene twin-wall tube perforated every 12 inches to be placed on the bed surface.

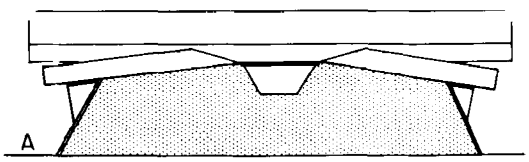
In 1970–71, the following eight experiments were compared at the South Coast Field Station, Santa Ana, comparing methods of water placement, bed shapes, widths and plant densities:

1. Conventional 40-inch, double-row bed with standard furrow irrigation—62,725 plants per acre.
2. Conventional 40-inch, double-row bed irrigated by one porous polyethylene pipe buried four inches deep between double rows—62,725 plants per acre.

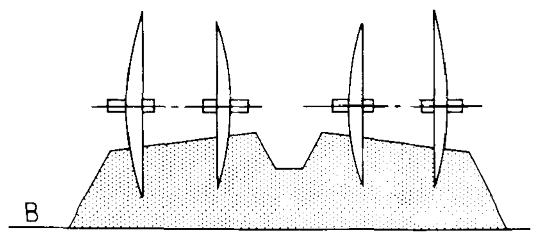
4. Experimental 60-inch, four-row bed irrigated by a shallow, midbed furrow with two rows of plants on either side—83,630 plants per acre.
5. Experimental 60-inch, four-row bed irrigated by one line of porous polyethylene pipe buried four inches deep at bed center with two rows of plants on either side—83,630 plants per acre.
6. Experimental 60-inch, four-row bed irrigated by two lines of porous polyethylene pipe buried four inches deep between each set of double rows.

8. Experimental 60-inch, four-row bed irrigated by two lines of perforated, flexible polyethylene tubing between each set of double rows—83,630 plants per acre.

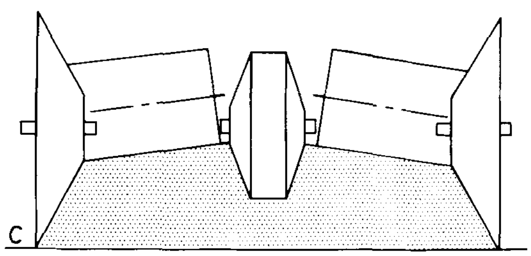
High elevation plants of the Tufts variety were planted November 10, 1970 under the standard winter system. Sprinkler irrigation was used to facilitate land preparation, fumigation, bed shaping, and plant establishment. Irrigation differentials began with installation of the clear polethylene bed mulch, December 1, 1970. Tensiometers were placed 6 inches deep on the outside row of each bed and the plots were irrigated each week sufficiently to bring the tens-



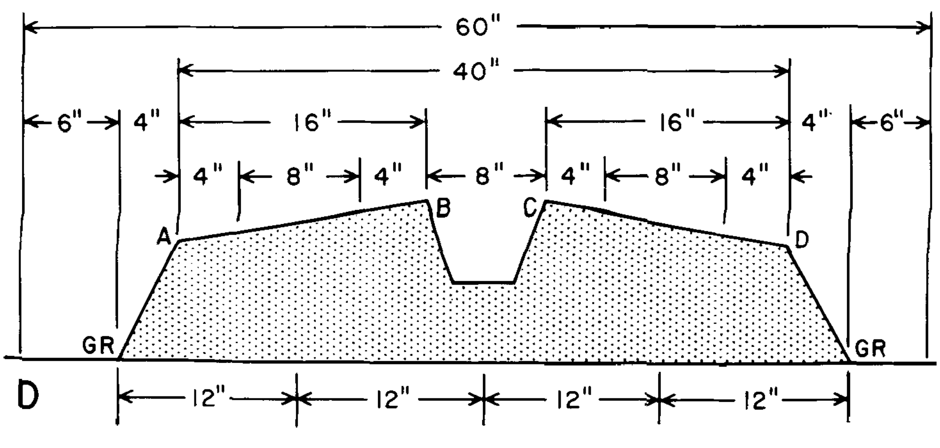
Bud shaper for the experimental 60-inch bed with midbe furrow.



Four-row planting groover for experimental 60-inch be



Rolling cone press with top press cylinder for closing a reshaping experimental 60-inch bed with midbed furr(after planting.



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iometers to the wet level. The amount of water used was metered. Rows were 130 ft long; each treatment was replicated four times and each plot was 30 ft long. Plants were harvested weekly from February through June, and yield and fruit size were measured.

Irrigation time required to bring the tensiometers to the wet reading was very different among irrigation treatments. Wetting of conventional furrow-irrigated 40-inch beds could be done rapidly since it only required that the furrow be filled each irrigation. The midbed irrigated furrow on the experimental bed required from three to five hours depending upon the ambient temperatures during the preceding week. Irrigation with the two tubes or pipes on the experimental 60-inch bed, or one tube or pipe on the conventional 40-inch bed, required from five to seven hours, again depending upon the previous weeks' temperatures. The experimental 60-inch bed irrigated with the single tube or pipe required more than twice the time necessary for the double-tube or double-pipe irrigation. In fact, the difficulties encountered in wetting the 60-inch bed completely with the single lines were so great that only the double line should be considered further. The single line on the conventional 40-inch double-row bed was completely adequate. The perforated tubing on top of the bed gave more rapid and greater lateral movement than the porous pipe buried four inches. The table shows a comparison of water usage and yield over the two beds, and several irrigation systems.

Salt accumulation was not measured in these experiments because measurements during 1969 and 1970 at the same location showed no significant difference among similar treatments, and no plant injury was observed. However, salt accumulation differences were not ruled out, especially in comparing the conventional 40-inch beds under standard furrow irrigation with the perforated polyethylene tubing on the same bed. The plastic tubing required only half the water, as compared with standard furrow irrigation, and the plants yielded about 20% more.

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JOJOBA

. . . a brief survey of

JOJOBA, (*Simmondsia chinensis*) has been considered by many as a species which has the potential of becoming a commercial crop. Its economic value is based on the liquid wax produced in its seed which could have several industrial uses. Its special appeal lies in the fact that it is a desert species adapted to the semi-arid regions of southern California, southern Arizona, and northern Mexico —i.e., the areas in which new sources of revenue must be developed if they are going to develop economically. Furthermore, jojoba wax can be a substitute for sperm whale oil and thus it could replace a commodity obtained from an endangered species.

The hopeful attitude adopted by most jojoba enthusiasts up to now regarding its agricultural potential was based on optimistic intuition, rather than on data available regarding the possibility of producing and marketing jojoba wax at competitive prices. Because of the lack of such convincing experimental data no one ventured to invest capital in a jojoba production enterprise. It seemed clear that this climate of optimism, but also of inactivity, was destined to continue indefinitely until someone launched a research project which would prove or disprove claims made by friends or by enemies of jojoba about the possibility of producing it commercially.

OEO funds

About a year ago with funds granted by the Office of Economic Opportunity, a research project was initiated, jointly, by the Universities of California and Arizona to develop jojoba production into a source of revenue for American Indian Reservations. It will take a few years before a thorough evaluation of the potential of jojoba can be made. This report summarizes research experiences in California with jojoba during the past twelve months.

Two approaches appear possible for the commercial production of jojoba. First, harvesting the existing natural populations. Second, establishing new commercial plantations of jojoba much like almond or walnut groves. Following the first approach, in the summer of 1972 about 80,000 lbs of seed were harvested in Arizona and California from natural populations. Harvesting was done by hand and to some extent with the use of simple hand tools or pickers. Any seed that matures early and drops on the ground cannot be picked. Of the mature seed that still clings to the plant a portion drops to the ground as the fingers of the worker touch or shake these seeds during the harvest. The immature seed which is larger, easier to harvest, and heavier than the dry mature seed due to its high moisture content, presents a great temptation to the workers for harvesting, especially if they are paid by the weight of the seed they harvest, rather than by the day.

Harvest costs

It was calculated that, on the average, each worker picked 4 to 6 lbs of seed per hour. Thus, if payment was based on a minimum wage of $2.00 per hour the cost of merely harvesting the seed would be 35 to 50 cents per pound. The workers employed last summer did not have previous experience in harvesting jojoba. Thus, along with the mature seed, they often harvested immature seed with moisture content as high as 40%—also tending to include considerable quantities of leaves and stems with the seed.

After drying and cleaning it, the seed harvested last summer would have to be sold for over $1.00 per lb just to cover the harvest, drying and cleaning costs. Development of the simple picking tools shown in photos, helped raise the efficiency of harvesting. At the same time, however, they increased the percentage of leaves and stems in the seed harvested and so the net gain from their use was not significant. It should be pointed out that last year was one of the driest years on record in California and Arizona—