

Tests continued . . .

MECHANICAL HAR

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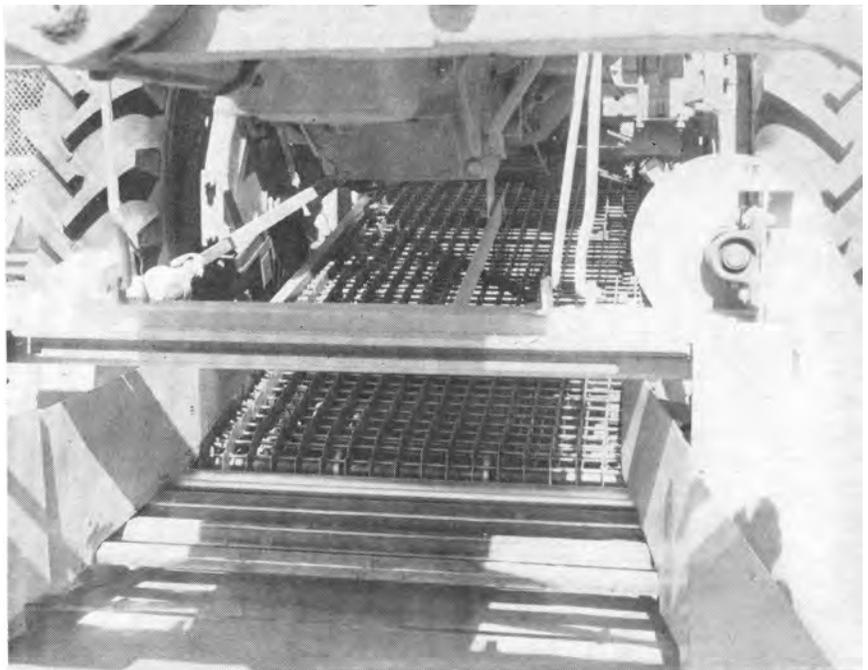
Front view of 1965 harvester with blade and front of conveyor at operating depth in sandy loam soil at Davis.

TESTS were conducted at the request of California asparagus growers and canners in 1964 to determine the effect of nonselective mechanical harvesting on white asparagus yields. The harvester used in those tests was similar to one built by Magnuson Engineers in 1951. This machine cuts all spears at a depth of 8 to 9 inches, separates them from most of the dirt and trash, and discharges them onto the top of the asparagus bed. Results from the 1964 tests have been reported. In the 1965 tests reported here, additional comparative-yield tests were undertaken along with the construction and further development of a second harvester, a preliminary study of methods of handling and sorting mechanically harvested asparagus, and investigation of the effects of sprinkler irrigation on peat soil structure, wind erosion, and dust.

Test plots

Comparative yields for hand cutting and nonselective mechanical harvesting were determined in three test plots, all on peat soils in the Delta area. One plot was at the same location as in the 1964 tests at Staten Island and the other two were south and north sites on Bouldin Island. The south Bouldin plot was on a lighter peat soil than that of the peaty muck soil of the Staten Island plot and the north Bouldin plot was on a fairly light peaty sediment soil.

Labor problems caused most growers to delay cutting white asparagus until several weeks later than usual. Consequently, the yield tests were not started until May 5 in one plot and May 8 in the other two.



Close-up front view of 1965 harvester showing blade, the four pickup rolls, and the channel-type separating conveyor.

The tests were continued until July 3, thus approximating the usual length of harvest season for white asparagus.

Procedures were essentially the same as in the 1964 tests, with the 1964 harvester being used for most of the yield test machine cuttings. In each plot, four 400-ft rows were hand cut daily by University personnel and four other rows were machine cut when a few spears were taller than 1½ inches above the level of the top of the bed ("on time" schedule). A second machine treatment in the Staten Island plot was always cut one day later, to determine how critical the timing might be for a white cutting.

Machine-cut beds in the south Bouldin plot (and in the north Bouldin plot during the first part of the season) were shaped to a height of about 13 inches

after each cutting. A 12-inch height was adequate in the Staten Island plot. Because of the narrow (6-ft) row spacing, the middles in the Bouldin Island plots had to be cut down deeper than the 7-ft rows in the Staten Island plot to obtain enough soil, and the beds had to be made increasingly narrow as the season progressed. A harvester blade height of 4 to 4½ inches above the middles was necessary in the Bouldin Island plots to avoid hitting crowns, whereas a 3-inch height was satisfactory in the Staten Island plot.

Erosion of machine-cut beds by crosswinds was a serious problem in the light peat soil of the south Bouldin plot, which had a north-south row orientation. The peaty sediment soil in the north Bouldin plot became so powdery and fluidlike above the cutting level that it was impos-

ESTING OF WHITE ASPARAGUS

sible to maintain the desired 13-inch bed height during the last half of the season and the harvester pickup system was not effective during the last two cuttings (which were omitted from the analysis).

Although the Staten Island machine-cut beds dried out almost to the cutting level and became rather dusty, there was never a problem in obtaining the desired bed shape.

An application of about 0.2 inch of water immediately after each machine cutting of practice rows in the south Bouldin field, although not enough to form a crust, greatly reduced wind erosion. The same treatment on practice rows in the Staten Island field produced a weak crust and practically eliminated wind erosion. The beds in both fields remained moist to within an inch or so of the surface and there was very little dust from the harvester cutting operation. This amount of water had no adverse effects on harvester performance.

When 1 to 2 inches of water were applied to previously unsprinkled rows, the beds became much firmer than from the light application and there was very little wind erosion, even in the south Bouldin plot. However, when these rows were cut

with the 1965 harvester, an excessive amount of soil was carried over the rear of the conveyor. The effectiveness of a single, heavy application of water on wind erosion control diminished rapidly after the first cutting following the sprinkling.

Because of the late season, a warm May, and a cool June, there was not much variation in time intervals between cuttings. The interval for the Staten Island on-time schedule was consistently six days. The south Bouldin plot was cut a little more frequently (average interval of $5\frac{1}{3}$ days) because the tops of the beds were not as high above the crowns and eroded more. The north Bouldin machine rows were cut mostly at 6-day intervals but, because of the inadequate bed height, there was a higher percentage of part-green spears than there should have been.

As in the 1964 tests, there appeared to be a tendency for the plants to cycle, with the greatest concentration of spears between lengths of 6 and 9 inches. There was no difference in average weight per $4\frac{1}{2}$ -inch trimmed spear between machine-cut and hand-cut asparagus.

To determine machine-cut yields, all

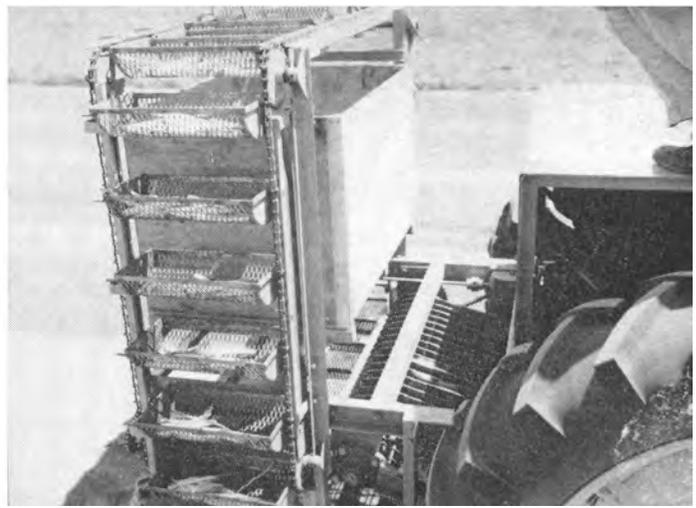
spears longer than $4\frac{1}{2}$ inches were trimmed to $4\frac{1}{2}$ inches and spears initially $3\frac{1}{2}$ to $4\frac{1}{2}$ inches were trimmed to $3\frac{1}{2}$ inches. For comparative purposes, hand-cut yields were based on $4\frac{1}{2}$ -inch trimmed weights. Spears with butt diameters less than $\frac{3}{8}$ inch were excluded in all cases. Average yield ratios (machine ÷ hand) for each of the three plots are included in the table.

In the Staten Island plot the on-time machine-cut rows and the hand-cut rows were the same as those used for these treatments in 1964. Machine-versus-hand yield ratios for good white or green-tipped spears plus the allowable 10% part-green spears (over $1\frac{1}{2}$ inches green) were essentially the same in both years—0.72 in 1964 and 0.73 in 1965. The corresponding ratio for the day-late schedule was 0.75, indicating that the time of cutting can be varied a day or so without any appreciable effect on the yield of marketable product. The day-late schedule produced more part-green spears than did the on-time schedule, but the total yield was also greater.

Yield ratios for good white or green-tipped spears plus the 10% allowable part-green spears were only 0.56 for the

Experimental fruit washer, right photo, and hand sorting belt, left photo, being used for mechanically harvested asparagus. Elevating section of conveyor is a continuation of horizontal conveyor in wash tank.





Cross conveyor and collection bin. For hand sorting, basket dumping guides at top center, left photo, are replaced with straight guides that keep baskets upright all the way across top leg. Side view, right photo, showing relation of cross conveyor to discharge end of separating conveyor. Plywood deck that usually rests on frame in front of bin was removed for photograph.

south Bouldin plot and 0.53 for the north Bouldin plot. The ratio would have been substantially higher for the north Bouldin plot and somewhat higher for the south Bouldin plot (see next to last line in table) if the beds could have been maintained at the desired height and width and kept centered on the rows, thus reducing the percentage of part-green spears.

In the Staten Island machine schedules, the numbers of spears recovered during the season (omitting the period of the first machine cutting) were 90 to 95% as great as from hand cutting, as compared with ratios of only 66 and 72% for the Bouldin Island plots. Although machine harvesting may have reduced the number of spears produced in the Bouldin Island plots, there was evidence to indicate that the low yield ratios were at least partly due to the fact that spears growing on the sides of narrow beds were not recovered by the machine. A modification made in the 1965 machine late in the season appeared to have overcome this problem.

The 1965 harvester had a cross conveyor with 8- x 14-inch baskets that collected the spears discharged from the separating conveyor, elevated them, and dumped them into a bin on the harvester. When operating in second gear at the usual forward speed of 2½ miles per hour, the linear speed of the baskets was 21 ft per minute and each basket collected material from about 7 ft of row.

The separating conveyor was an experimental unit consisting of 5/16-inch-diameter cross rods connected by vertical plates 0.05 inch thick to form longitudinal channels 2 inches wide and about 1¼ inches deep. When operating in second gear the conveyor speed was about 60% greater than the forward speed.

The band saw unit was the same design used on the 1964 machine. As indicated in the 1964 report, this type of unit does an excellent job in peat soils but the wear-rate is prohibitively high in sedimentary soils. No development work on a new cutting unit for sedimentary soils was undertaken in 1965.

It was observed that unless there is

soil passing over all pickup rolls along the full width between the crowders, lateral flow of soil may carry some spears to the side so they do not feed onto the conveyor and are lost. The loss is appreciable where beds are narrow and the cutting level is high, as in the Bouldin Island plots.

Late in the season the crowders on the 1965 machine were modified by extension downward of the front portions 2 or 3 inches below the blade level so they would gather in more soil, and by reduction of the distance between crowders at the location of the front roll. This modification appeared to solve the loss problem with narrow beds and had no adverse effects with wide beds.

The channel-type conveyor was effective in orienting spears so most of them were discharged butt first. This orientation is desirable to be sure butt ends will hit first in the cross-conveyor baskets or other collection device, thus minimizing tip damage.

The new conveyor did an excellent job of separating out practically all the fine soil except when it was moist enough to be sticky, as in the first cutting after a heavy rain or a heavy sprinkler irrigation. Trash and clods larger than 1 to 1¼ inches were discharged onto the cross conveyor with the asparagus.

The quantity of trash and clods obtained in the first cutting in most fields would be much too great to put into the bin with the asparagus. In a commercial operation this material should be pulverized or removed each season at the time the beds are first shaped for white asparagus. In the 1965 tests there was very little trash or dirt in the bin after the second cutting.

The limited experience gained in 1965

ASPARAGUS SEASON YIELDS, GRADE DISTRIBUTION, AND YIELD RATIOS

	Staten Island		Bouldin Island	
	on time	1 day late	south	north
Test period, days	53	54	59	46*
Distribution of machine-cut spears, percent of total 3½" + 4½" weight				
3½" good (all-white)	7.8	5.4	9.3	6.9
4½" good, white or green-tipped	59.5	55.3	55.5	49.0
4½" good, all-green	0.9	4.7	1.6	3.2
4½" good, part-green (over 1½" green)	15.0	19.7	13.7	18.7
Culls (total, 3½" + 4½")	16.8	14.9	19.9	22.2
Hand-cut culls, % of total 4½" weight	9.9	10.0	13.3	14.5
Hand-cut yields				
Good (4½"), lb per acre	845	860	1,950	1,075
Ratio, 7" wt. ÷ 4½" wt.	1.62	1.62	1.60	1.72
Yield ratios, machine ÷ hand				
Good, incl. allowable part-green†	0.73	0.75	0.56	0.53
Good, incl. all part-green spears	0.80	0.89	0.61	0.63
Total harvested, including culls	0.87	0.94	0.66	0.69

* Beds actually were cut for 56 days, but results from machine-cut beds were unreliable during the last 10 days.

† Includes good, all-green spears and enough part-green spears (part white but over 1½" green) to represent 10% of the total white or green-tipped plus part-green (the present hand-cut tolerance allowed by canneries).

indicated that collecting and handling mechanically harvested asparagus in bins is feasible. Damage in the 2- × 3- × 2-ft bin used on the 1965 machine did not appear to be significant unless clods were being discharged into the bin with the spears. A standard 4- × 4- × 2-ft bin usually would be sufficient for 1 to 2 miles of row.

Several lots of asparagus harvested from practice rows with the 1965 machine were put through an experimental fruit washer and onto a sorting belt that was set up in a grower's wash shed. Hand sorters removed the good spears, oriented them with the tips all in one direction, and separated them into two or three groups by length.

In these tests, the material from the bins was transferred into the wash tank by hand, but in a system designed for asparagus, the bin would be dumped while submerged in water. The asparagus was allowed to soak for a few minutes before being elevated out of the tank by the conveyor. After being sorted, the asparagus was put through the grower's regular washing and trimming unit for hand-cut asparagus, where the longer spears were trimmed to 7 inches. Several lots that had been put through the experimental washing and sorting unit were taken to canneries for quality evaluation and for consideration of handling procedures and other problems.

Although the washer and sorter used in these tests were not intended for asparagus, the results were encouraging. Hand sorting of mechanically harvested asparagus in growers' wash sheds is envisioned as an interim system that might eventually be mechanized—and probably would be centralized.

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Yield tests were conducted in fields owned by the M & T Company (Clair Davis, field manager) and Western California Cannery, Inc. (Buzz Walker, field manager). The experimental fruit washer and sorter were provided by the Department of Food Science and Technology, University of California, Davis, and were set up at K. R. Nutting Co., Holt.

Eradication of **ANGULAR LEAF SPOT** *of Cotton*

W. C. SCHNATHORST

ANGULAR LEAF SPOT of cotton (*Gossypium hirsutum* L.) was first reported in California in 1912 and again in 1929. It had become an established disease of cotton by 1951 and was finally eradicated 10 years later. Its spread was attributed to (1) the introduction of sprinkler irrigation; (2) a 100% carry-over of the bacterial pathogen, *Xanthomonas Malvacearum*, each year in affected fields; (3) the use of contaminated seed; and (4) use of a highly susceptible variety (Acala 4-42). This report analyzes measures leading to final eradication of the pathogen from California cotton fields and points out procedures to control the disease should it reappear in the future.



Symptoms of angular leaf spot on Acala 4-42 cotton in California.

The number of known occurrences from 1951-65 are plotted on the graph. The first extensive survey of disease distribution in the San Joaquin Valley was made in 1952, and others in 1957, 1958, and 1959. Some involved 100,000 acres. By 1958 at least 66 fields were reported to be affected. From 1951-1961 there were 70 known different occurrences. In some fields the disease recurred for 8 years. After 1958 the number of occurrences dropped sharply. In 1959 there were only 12; in 1960, 3; in 1961, 2; and from 1962-1965 no angular leaf spot was reported.

The disease occurred primarily on the west side of the San Joaquin Valley where sprinkler irrigation was widely used. The use of sprinklers has steadily increased since the early 1940's. The disease has been known to occur only twice in furrow-irrigated cotton. Only Race 1 of the pathogen is known in California.

Control factors

Some of the factors considered favorable and unfavorable for control of the disease in California are listed in the table. California's low rainfall during the growing season is unfavorable for the development of angular leaf spot, but the use of sprinklers provides the moisture necessary for the spread of the pathogen. Organizational control of planting seed and the restriction on planting varieties other than Acala 4-42 is, in many respects, beneficial. It prevents the production of seed from infected plants and makes it illegal to import from other states seed that may be contaminated with the pathogen. However, the seed can become contaminated in the ginning process. This has occurred when clean planting