

Cutting Dates Affect **COOKING QUALITY** *of Dark Red* **Kidney Beans**

Neither yield nor seed size increases when Dark Red Kidney beans are cut after the average moisture content has reached 50%, according to this report of Davis tests. Susceptibility to mechanical damage and to splitting in the canned product continues to increase in beans cut after they have reached 50% moisture. Other advantages to earlier cutting include earlier marketing possibilities, more leaves to buffer seed damage during threshing, and higher quality beans.

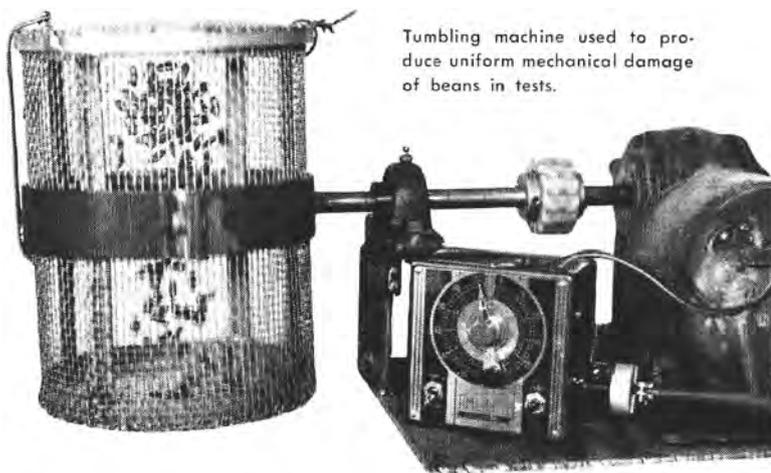
CUTTING GUIDES

To retain maximum quality, beans should be cut at 50% moisture and not later than 40% moisture. Beans lose moisture at an average rate of about 2.5% per day so the difference between 50% and 40% moisture is accomplished in four days. Since moisture content is not easy to determine in the field, the following visible signs of maturity can be used as a guide:

1. At 50% moisture, the beans have been planted about 85 days, as shown on graph 3. (This may vary some with cultural practices and weather conditions, but it is a useful guide.)

2. At 50% moisture about $\frac{1}{5}$ of the pods are green, $\frac{1}{3}$ are yellow and only about half appear as ripe. When $\frac{2}{3}$ of the pods are ripe, the beans have around 40% moisture (see graph 2).

3. At 50% moisture, about $\frac{1}{10}$ of the beans are still green, $\frac{3}{4}$ are colored but still soft; and only $\frac{1}{5}$ have the appearance of dry beans. When the proportion of dry beans reaches $\frac{2}{3}$, there will be no green beans and the moisture content will be around 40%.



Tumbling machine used to produce uniform mechanical damage of beans in tests.

SEVERAL YEARS ago Dark Red Kidney beans were introduced into California in relatively small amounts to produce disease-free seed for Michigan and New York planters. Production of this market class increased when a higher yielding type, bred at Davis, was released to growers as "California Dark Red Kidney." With improved yields and increasing demands of canners for Dark Red Kidney beans, the production of this market class has increased to 38 per cent of the Red Kidney beans grown in 1961 and 1962.

The entry of canners into the market inevitably led to higher standards of quality than were necessary for dry beans of the Red Kidney market class. The ideal canned product is one in which all the beans are cooked but the seed coats re-

main intact. Even a small percentage of cracked or broken seed coats reduces the quality of beans for canning. California growers who want to continue supplying beans for this more demanding market must pay greater attention to quality.

In recent years, the variety has been improved genetically by reducing the tendency to split, and studies have been made of the factors which affect splitting of the canned beans. The work reported here is part of the general study and points out some of the things growers can do to prevent loss of quality. The effect of age of plants at the time of cutting on canning quality is emphasized in the study. Rough handling in threshing, cleaning and transportation of beans causes considerable damage by cracking the seed coats and often breaking the

Undamaged Dark Red Kidney beans to left, as compared with mechanically damaged beans to right, after 1½ hours of soaking.

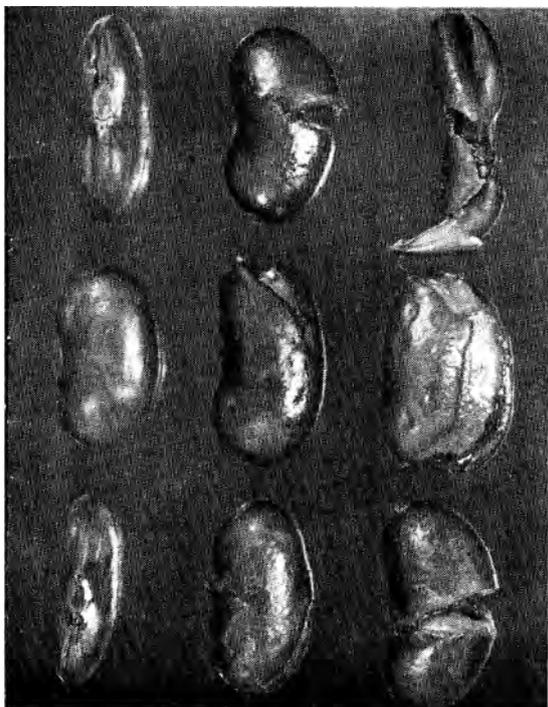


cotyledons. Resistance of the seed coat to damage is an important feature for good canning quality.

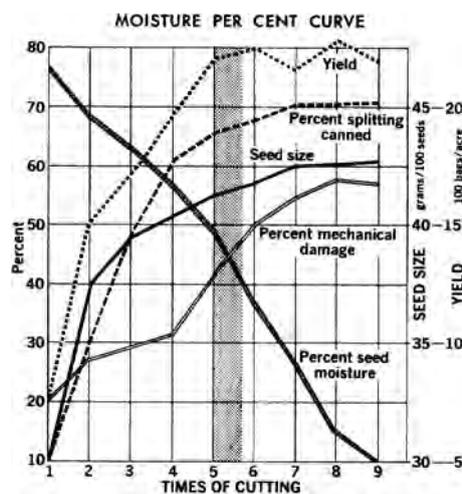
Experiments were conducted in 1961 and 1962 on the effect of time of cutting on quality. Two varieties, California Dark Red Kidney and Michigan Dark Red Kidney, were cut at three-day intervals over a period of several weeks. In the second year, data were obtained from two planting dates. At each harvest date, a 30-plant sample was pulled from each of four replications. A smaller sample taken at the same time was used to determine moisture content of the seed and obtain notes on the appearance of the pods and beans. The plants were left in piles until all were dry enough to thresh. All the plots were threshed the same day. The threshed beans were used for the canning tests and the mechanical damage tests.

In the canning tests, two samples of 100 beans were taken from each plot. The samples were pre-soaked 24 hours and canned at a commercial cannery in the regular manner. After three months, the cans were opened and the number of split beans were counted. A break in the seed coat exceeding about $\frac{1}{8}$ inch was classed as a split bean. The most common split was across the eye of the bean or hilum, although splits in the dorsal edge were also often found (see photos). The "percent split" was the average of the duplicate samples.

Sample of canned Dark Red Kidney beans with left row undamaged and right rows showing splitting.



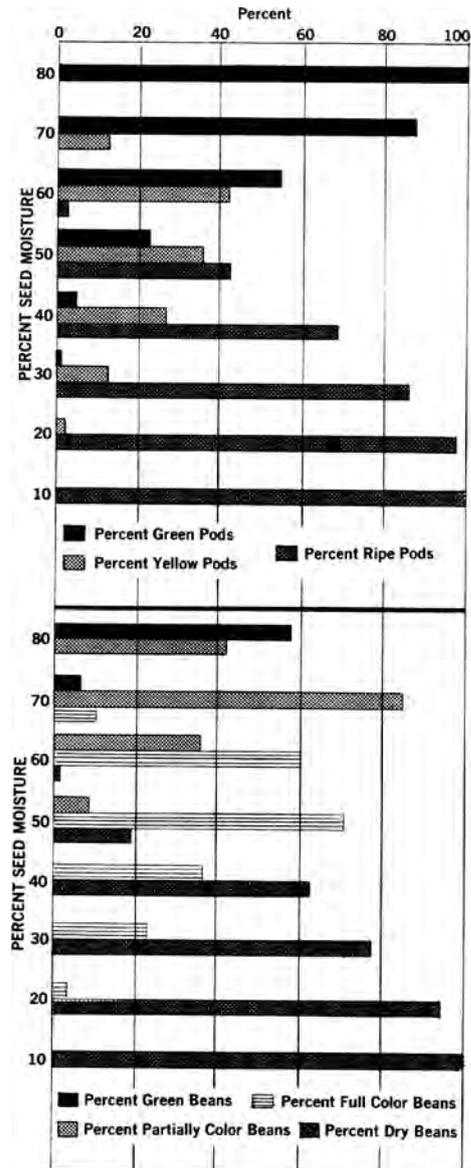
The device used to measure the susceptibility of the seed coats to mechanical damage was a tumbling machine (see photos) borrowed from the same cannery. The wire cage is about 12 inches long and rotates at 50 rpm. Two 100-seed samples were taken from each treatment; one was rotated for exactly one minute in the tumbling machine and the other was not treated. Damage was measured by soaking the seed for $1\frac{1}{2}$ hours in distilled water. Breaks in the seed coat would show up by swelling of the bean in the areas of the breaks as shown in photos. The "per cent mechanical damage" was calculated from the difference in the per cent of seed coat breaks in the treated and the nontreated beans. The correla-



GRAPH 1—Effects of moisture content at time of cutting of California Dark Red Kidney beans on: yield, seed size, splitting in canning, and susceptibility to mechanical damage. Vertical band indicates the optimum time of cutting.

tions of mechanical damage and the splitting of beans when canned were positive and highly significant.

Data from the three experiments conducted over two years are summarized for California Dark Red Kidney beans in graph 1. Similar results were obtained from Michigan Dark Red Kidney beans. The main varietal difference observed was that the Michigan variety was earlier and had a lower moisture content when samples were cut the same day. The moisture content of the most immature samples was 77% and for the driest 11% (see moisture per cent curve on graph 1). Yields increased from seven bags per acre at 77% moisture to 22 bags at 50% moisture. The yields did not significantly increase in samples cut with less than 50% moisture. The seed size increased from 30 grams per 100 seeds at 77% moisture to 41 grams at 50% moisture. The maximum of 43 grams at 11% moisture was



GRAPH 2—Appearance of pods of California Dark Red Kidney beans at different seed moisture content levels, top graph. GRAPH 3—Appearance of seeds of California Dark Red Kidney beans at different seed moisture content levels, bottom graph. Optimum time of cutting falls between 40 and 50% moisture.

not statistically different from beans cut at 50% moisture.

It can be concluded that beans cut at the 50% moisture level do not suffer in either yield or seed size when compared with those cut later. This critical time between 50 and 40% moisture is emphasized on graph 1 as a narrow vertical band. Splitting damage in the canned beans was 12% at 77% moisture, 66% at 50% and reached a maximum of 71% at 11% moisture. Mechanical damage at the high moisture level was 20%, at the 50% moisture level 41%, and in the driest samples, 58%. This last increase was significantly different. It should be

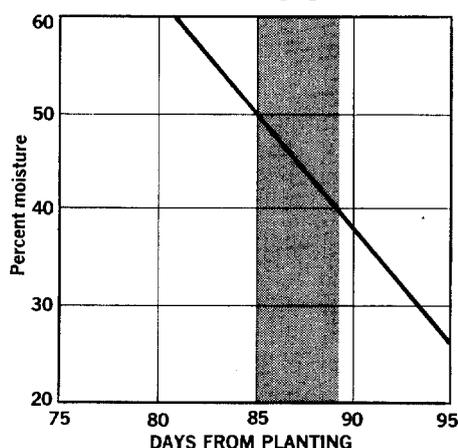
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GRAPH 4—Relation of seed moisture content and age of California Dark Red Kidney bean plants. Vertical lines indicate optimum age of cutting.

emphasized that the differences were due to time of cutting and not to threshing.

When the beans were at the same moisture, there was no varietal difference in appearance of pods and seed at each harvest date, so the data were combined from the two varieties. The moisture content at the time of cutting was classed in 10% intervals.

The condition of pods (green, yellow or dry) at different moisture levels is shown in graph 2. This chart indicates that when the average of 50% moisture is reached, 23% of the pods are green, 34% are yellow and 43% are dry.

The beans were classed as green, some color, fully colored and dry. As in the pod study, moisture percentages at harvest were grouped at 10 percent intervals, as shown in graph 2. By the time the beans had reached 50% moisture, there were no green beans, only 8% had some color, 73% were fully colored, and 19% had the appearance of mature dry beans. As graph 2 indicates, changes in the appearance of the beans progressed rapidly. California Dark Red Kidney lost an average 2.45% moisture per day and the Michigan Dark Red Kidney lost 2.63%. The 50% moisture content was attained at 85 days after planting and the 40% moisture at 89 days. Thus, in a short period of four days, beans in the field lost 10% in moisture content (graph 3).

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S and W Foods, Redwood City, cooperated in the cannery testing.

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