

# A Year's Experience Using an Electric Eye Thinner

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Before discussing the latest development in mechanical thinning, I believe that a short review of the sugar beet culture as I first became acquainted with it in 1921 might be advisable. Being a comparatively new industry in our territory, complete reliance on the fieldman for all procedure was necessary. Seed and labor were relatively cheap, and horses an important factor for motive power, especially for planting and cultivating. Seed bed preparation was relatively unimportant as a heavy seeding rate, 20-25 lbs. per acre, was used in order to obtain a thick and continuous stand. Next, this thick stand must be thinned to single beets twelve inches apart, with great emphasis placed on singles, as well as 100 beets per 100' of row. After the men proceeded to thin to singles the field appeared to be destroyed; however, the next day all remaining beets were standing up again.

During this period of approximately thirty years, it was being brought more and more forcibly to the industry that this was wasteful, not only in seed, but also in manpower, and determined efforts were made by sugar processors, manufacturers, agricultural colleges and progressive farmers to mechanize the production of sugar beets.

We are all familiar with the progress made in planters, cultivators, harvesters, as well as many devices to reduce the beet populations, including also the development and use of sheared and decorticated seed.

Spring mechanization progressed slowly as the main difficulty was the elimination of the single plant idea, as well as absolute uniform spacing. Great progress has been made in this field of study and today a few doubles are not considered detrimental to yield, consequently many types of blockers and thinners are available. However, blockers and thinners, whether of the pendulum or rotating type, have no plant selection ability, therefore skips are widened, and healthy plants destroyed with the weak.

In attempting to overcome this weakness, Mr. Leo Marihart of Salinas, California, hit upon the idea of electronics, using the so-called electric eye. In connection with Hewlett Packard Company, outstanding electronic engineers of Palo Alto, California, they developed such a machine which has been successfully operated over several years. Like all new developments this machine started as a clumsy, crude affair, but has now developed into a compact, clean unit, capable of being mounted on practically any wheel tractor.

The machine is composed of three units, namely the control box, the electric eye, and the knives. They are mounted on a tractor, and can work, day or night, any desired number of rows, or row spacing, as the machine works down the row. Four rows thinned at one time has proved to be the most efficient operation of this equipment.

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I am indebted to Mr. Marihart for the following description of the thinner:

"Basically, the machine consists of a photo-tube, or, as it is more commonly known, an electric eye, with its own light source and of a definite color range. The eye and light source are so mounted that they are carried at any desired setting along the row of plants. Due to the wiping action of the unit, whereby the foliage of the plant is literally pushed forward, the eye actually sees the foliage, or leaves, near the roots, and by this means determines the root location."

The impulse picked up or received by the electric eye is amplified greatly and made to operate the timer. The timer is controlled both mechanically and electrically, which means any variation of tractor speed does not affect the timing of the machine. Several adjustable switches are so placed that any desired thinning distance may be obtained at any fractional setting, and this range, for all practical purposes, is from six inches to sixteen inches. Other adjustments are possible with minor changes.

The timer in turn controls the action of the knives. At present, there is mounted a one-hundred-twenty degree clutch action with two sets of knives for each one-third revolution. These knives are spring-mounted so as to simulate hand hoeing. To explain, rather than having knives which are rigidly mounted on a rotatable shaft, whereby this action is one of radially cutting through the ground, limited by the radii of the cutting edges and the shaft, the spring-mounted knives are offset, allowing a six- or seven-inch cut through the ground at a predetermined depth set by the grower. Furthermore, the loosened earth is left, providing a mulch around the plant. The knives are so mounted to allow one knife to cut in front of the plant and the other knife in back of the plant. Necessarily, the knives are laterally adjustable to allow any desired plant clearance; in other words, this clearance would not be the same for plants in the cotyledon stage and a plant having nine or ten leaves. It should be understood only one setting, ordinarily, is necessary for any field in any desired condition of growth to the limits already mentioned, viz., plants so large so that the down the row growth is solid. Minimum tearing of the leaves of the larger plants is avoided by the undercutting action and design of the knives.

Although there may be skips in stands throughout the fields, due to the overlapping of the knives in their cutting action, the area is usually cleaned. For example, if a crop is being thinned and the spacing is twelve inches, ten-inch knives may be used, then when the next cut is made the other plant could be twenty inches away and the knives would clean the whole area.

As previously stated, the photo-tube and light source are so mounted that they travel down the plant row guided by the tractor driver. The tractor driver can control the sensitivity of the photo-tube by a dial similar to one on a radio. This sensitivity can be set to respond to a small or a large plant. Once this setting is made it can be left alone and the photo-tube will respond

accordingly. However, if the plants at the end of a long row are smaller the sensitivity can be changed to accommodate them. This can be done at any time, even while the machine is operating. It is similar to tuning a radio. Wherever the best response the dial is set, and any change in reception can be adjusted accordingly.

Assuming the driver has made his setting and starts his tractor down the row of plants, the machine functions as follows: The photo-tube receives an impulse from a desired plant; immediately this is amplified and the photo-tube is made inoperative. The setting the operator or driver had made for

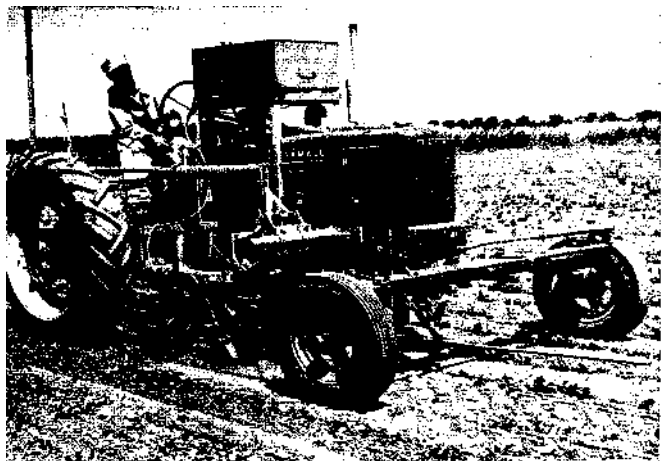


Figure 1. The Marihart electric eye thinning machine in use near Clarksburg, Calif.

his thinning distance determines when it will again be operative, as previously explained, as the impulse is carried on through to the time the photo-tube as stated is again made operative, and the clutch actuated allowing the knives to cut out all but the desired plant, located by the photo-tube, and at the desired distance.

This machine will thin plants any desired spacing. This variation in spacing is controlled electrically, and when a desired setting is made by turning a dial, let us say at 8,  $8\frac{1}{2}$ , 9,  $9\frac{1}{2}$ , etc., this spacing is kept accurately

for the entire field, so much so that it can be checked by measuring any of the various plants with a tape. By this means uniform desired distances between plants can be obtained, or, to state it another way, due to various growing conditions, i.e., conditions of the soil, moisture factors, fertility, etc., it is possible simply by setting a marked dial to secure the desired population of plants which the grower deems suitable so that his field can produce the maximum tonnage or yield.

Another advantage is the ability of the selection of plant size. Very often, due to field conditions and weather, plants do not germinate uniformly, causing many variations in plant size about thinning time. By means of two settings on the machine, a grower is able to select the larger plants and thus insure himself of more uniform growth.

Following thinning and before the plants grow into a solid row, a grower may weed as often as he thinks necessary.

While we had heard indirectly about the machine no particular attention was paid to it until the third experimental machine was made. This machine worked in the Salinas valley thinning and hoeing about 1,000 acres of broccoli, lettuce and sugar beets and also was taken to Imperial valley.

As our sons have taken over active farming operations, several trips were made in the company of other growers to observe the machine in action. We became convinced that the machine would do a satisfactory job, if properly operated.

Having decided that the machine was practical, although slightly premature, as it was ahead of development of planter, seed emergence, etc., a four-row unit was purchased to be mounted on an International Model H by Mr. Marihart. As all previous work had been done with John Deere tractors this required more time than anticipated, so the machine arrived in midseason. There were the usual disappointments and delays that follow any new ideas, but with wholehearted cooperation from all parties concerned the faults were gradually eliminated.

This required considerable patience and perseverance, not only with the boys, but also with the manufacturers. One boy took over the operation of the entire ranch, while the other spent his entire time with the machine during the day, then in company with engineers worked on it at night, until it was finally redeveloped to suit our soil and planting conditions. Fig. 1 shows the machine in the field, and Fig. 2 is a close-up of the mechanism.

During the course of operations 160 acres of beets were thinned satisfactorily. After thinning, a crew was sent there with instructions to clean out bunches left, and do no hand work at all. As the average single count was about 55% no attention was paid to doubles or triples. The cost of this work was very little and really consisted of a light hoeing job.

On account of the late start and the rapid growth, they were unable to go over very much of the acreage the second time, but did enough to convince all concerned that it was not only possible but practical.

In both fields check plots were left, and thinned and hoed in the usual manner. Differences in tonnage and sugar content were not significant.

In the first field the machine-thinned field was slightly better in tonnage, with no difference in sugar content. In the second field the hand-topped seemed to be slightly better in tonnage, with no difference in sugar content.



Figure 2. The Marihart thinner in detail. The light source and photo cell (right foreground) record on the tinier (not shown) the electrical impulse which rotates the thinning knives by engaging a clutch (left foreground).

All beets were harvested mechanically and the results were observed by the distance traveled to obtain a load. Both fields yielded approximately 18.5 tons to the acre with 18.99 and 19.59 sugar.

As the machine will cover from an acre to an acre and a half per hour, you can see that there is a great saving over the conventional hand method of thinning.

Our observations of the machine are as follows:

**First**, the machine is practical. This perhaps could be qualified by saying that you must have an operator who will take some interest in the performance of the machine.

**Second**, you must farm with the mechanical thinner in mind. This is important. Due to weather conditions the seed bed was not prepared

properly, yet the machine did an acceptable job under cloddy conditions. The stand of beets should be fair, but need not be as heavy as desired for cross cultivation or hand thinning.

Third, you can start thinning a little earlier than otherwise, and by working both day and night eliminate all the stoop work from the sugar beet crop.

We also believe that one of the important points is that the beets are not disturbed, and will continue their growth, which certainly is not possible under hand thinning methods, at least in our territory. The present machine is so designed that replacement parts can be installed by the tractor driver. Spare units are available and can be substituted immediately.

The boys, like myself, have a special aversion to handling a hoe, but what modern youth, boy or girl, will not sit on a tractor in the shade of an umbrella, and blithely watch the weeds and extra beets disappear beneath him. Certainly, electronic machines of this type will become commonplace in a very short time on our progressive farms, and the man with the hoe will play only a minor part in the sugar beet industry in the U.S.A.