Beater Type Topper Use 1947–in Nampa Nyssa District of the Amalgamated Sugar Company

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DURING THE 1947 harvest season the growers in the Nampa-Nyssa area harvested 28 percent of their crop with 293 beater toppers. While not all of these acres were 100 percent beater topped, beaters were used in some stage of the harvesting operation. This shows an increase in the percentage of total harvested acres beater topped, from 2.7 percent in 1946 to 28.7 percent in 1947, or approximately 360,000 tons beater topped during the past harvest season.

Beater Harvest Costs

Costs of topping with beaters naturally varies with the type machine and acreage covered. Averaged individual growers figures indicate topping and loading costs with a two-shaft four-row beater topper and two-row lifter-loader to be 52 cents per ton not including depreciation nor trucking.

Costs of topping and loading with single shaft four-row type beaters used in conjunction with lifter-loaders indicate an average cost of nearly 65 cents per ton on the same basis, with the additional cost due to the necessity of additional trips with the beater to insure complete top removal.

Lifting and windrowing with single-row, standard-type harvesters, following beating, then loading with conventional loaders, was found to add nearly 15 cents per ton to either of the above operations. With no charge or credit assigned to crowners or clipping because this was usually done with the standard topping device already on the harvester, or a simple clipper was added to the equipment on some tractor already charged against the total operation.

Beater Paddles

During the 1946 season, paddles and paddle attachments were a major problem. However, as a result of much experimentation satisfactory solid rubber paddles are now available which last considerably more than one season. Paddles can now be quickly replaced in case of failure due to a general swing on the part of manufacturers to "gang" attachments on rods instead of individual bolt attachment as was used in earlier models.

Two weights of paddles are standard, the heavier having a cross-section measuring $1\frac{1}{2}$ inches by $\frac{3}{4}$ inches, the other being $\frac{7}{8}$ inches

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square. Neither weight has enjoyed universal acceptance because of varying shaft speeds and field conditions. Practically all combinations have been tried. Observations indicate that alternate rows of each weight provide nearly ideal striking force for average field conditions. Lengths vary from 1 foot to 18 inches, depending on the make of machine.

Paddle quality research is continuing largely through the Gates Rubber Company in Denver, Colorado, who pioneered the field and developed the formula now used in the majority of our beater paddles.

Beater Types

Single-shaft four-row beaters are available in two major designs, front mount or trailer type. Two-shaft machines are available in four-row, three-row, and two-row sizes and are all trailer types.

Power demand for satisfactory operation under all conditions has centered at approximately one-half horsepower per inch of shaft, with a definite trend toward auxiliary motors on all types of machines, primarily because of difficulties encountered in maintaining the proper shaft R.P.M. and ground speed relation where power-take-off drives were used.

No studies have been made to date of draw-bar horsepower demands, but where 100 percent auxiliary power is used the lighter types of ordinary farm tractors have no difficulty handling even the heavier types of beaters.

Trash Comparisons

Shredding of tops beaten off presents somewhat of a problem where single-shaft type beaters are used in that though top removal is complete, some leaves remain nearly intact despite repeated trips with the beater. The two-shaft type machines seem to have extra shredding ability resulting in very little trash longer than 2½ to 3 inches, which is readily eliminated in the loader or lifter-loader.

Where topping and top salvage preceed beating, the problem of trash shredding is vastly simplified because of the great reduction in volume of bulk to be handled.

Clipping or Scalping

Complete removal of the center bud requires slow ground speeds and uses approximately one-third of the total horsepower used. This so limited the daily capacity of beaters in general that soon various clipping devices appeared to supplement the standard topping devices. These clippers were the very essence of simplicity and often home-made. They featured a fixed depth of cut with a paring knife type blade attached to, and pulled by, an up-sloping boiler plate finder. Spring pressure or added weights were employed where an unusual number of low beets required special adjustments. These clippers allowed beaters to leave beets with "pineapple" like

tops still attached, which were clipped or scalped just prior to lifting, thereby allowing much faster beating as well as insuring a minimum of possible trouble from top growth in storage piles.

The various combinations of toppers and beaters were so numerous that it was decided to assemble all types of machines in one field where true comparative performance could be tested.

An acre and one-half of beets were selected for the trial. Due to the uncertainty of weather condition, at the advanced time of harvest this test was performed, an extremely sandy piece of ground was selected. Therefore, these results can not be interpreted as being comparable to what would be expected from the average beet field found within the Nampa-Nyssa districts. It can only be taken as comparative operation data for the units used in the experiment.

The purpose of this trial is two fold, first, to compare the different variations of beet-topping machines using the centrifugal beating principle, and second, to determine the relationship, by comparative test, of variable factors such as: 1. Angle of beater to row, 2. Ground speed, 3. Direction of rotation of beater, 4. Peripheral speed, and 5. Diameter of peripherary when incorporated within a combination knife and beater beet-topping machine.

Mechanical topping machines used were as follows: 1. A four-row two-shaft machine, 2. A single-row four vertical shaft machine, 3. A single row combination of a rotary disk knife and two-shaft beater with a small peripheral diameter parallel to row, 4. A single row stationary knife, single-shaft, small peripheral diameter beater unit, 5. A stationary knife, variable angle, variable rotation, large peripheral diameter beater unit, and 6. A stationary knife vertical brush unit upon which either wire or fibre brushes could be mounted.

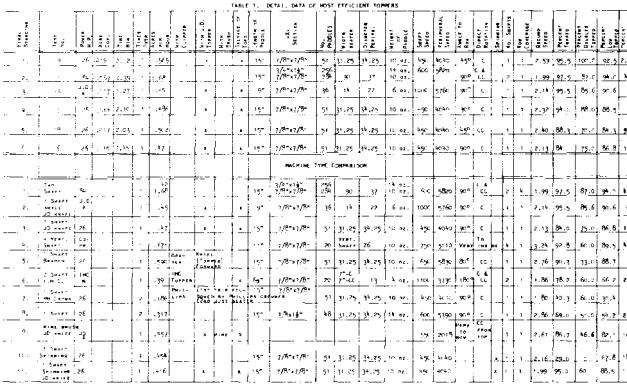
Detailed information upon the above units is given on the enclosed data sheet.

The stationary knife units were equipped with leaf pickup and salvage units. However, a clipper unit was incorporated, which did not salvage the tops, for several tests to determine the effect of undisposed tops upon the efficiency of the beater toppers.

Different combinations of the above mentioned variables were tried and results tabulated. Each trial covered one row on which length was measured and acreage determined. The time required for the run was also taken and ground speed determined. Results of the run were measured by obtaining, through actual count, the percentage of total beets topped, the percentage of low beets topped, the percentage of doubles topped, and the percentage of beets knocked out.

From this data the enclosed curves were drawn and conclusions formulated.

Seventy different test runs were made from which the most efficient combinations or machines performing satisfactory work were selected and listed in table 1.

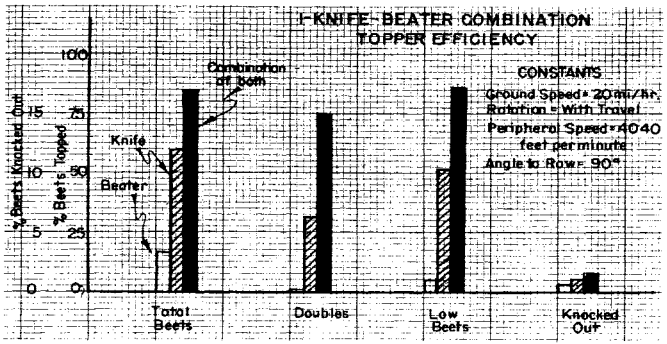


The selection was made as follows: Of the 70 runs, those were chosen which topped from 80 to 100 percent of all beets. From this 38, those were retained which topped from 80 to 100 percent of the low beets. Of these 23, those were selected which topped from 70 to 100 of the doubles. In each selection the runs were listed according to the percentage topped, number one being the highest percentage and the last one being the lowest percentage topped, the rank of each being noted. These remaining six were ranked according to the percentage of beets knocked out by them and their average ranking made. A listing according to rank is made in table 1 with pertinent detailed data.

In table 1 is also found a list of the different machines, or combinations used, so that a comparison of the efficiency between them may be made.

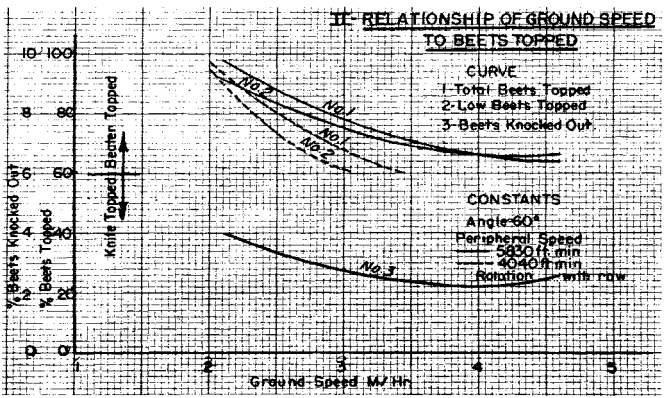
Explanation and Interpretation of Curves and Charts

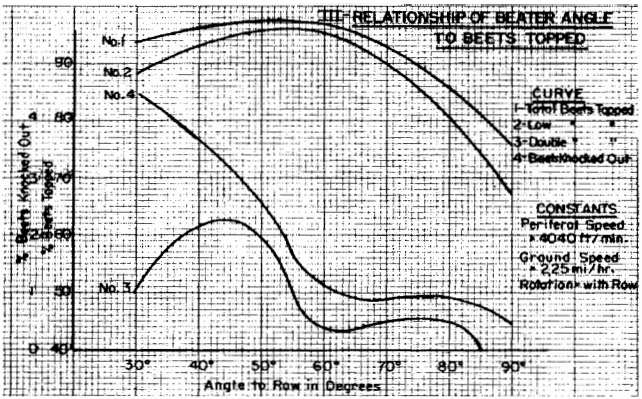
Chart No. I.—This chart is given to provide a balance in the interpretation of the following curves which give the results of tests with the combination system of topping. It will be noted here that neither the beater nor the knife alone top satisfactorily but the combination of both top an acceptable percentage. It should be noted also that the knife unit alone tops about 60 percent of the beets satisfactorily, 30 percent of the doubles, and 52 percent of the low beets.



Curve No. II.—Shown here is the reduced efficiency of the combination through increased ground speed. It will be noted that the curves level out at about 62 percent which shows that the beater becomes ineffective at that point and the remaining beets topped are those topped by the knife unit.

The dotted curve shows the effect of reduced peripheral speed upon efficiency of machine becoming inaffective at lower ground speeds.

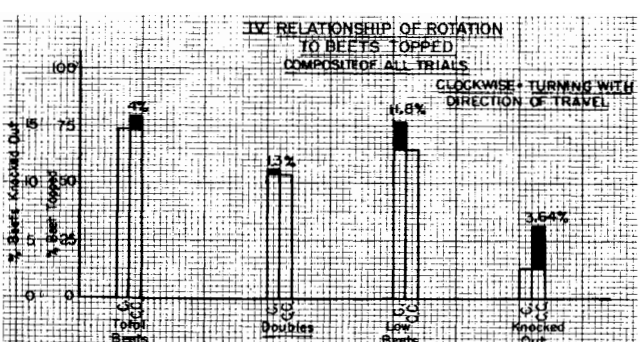


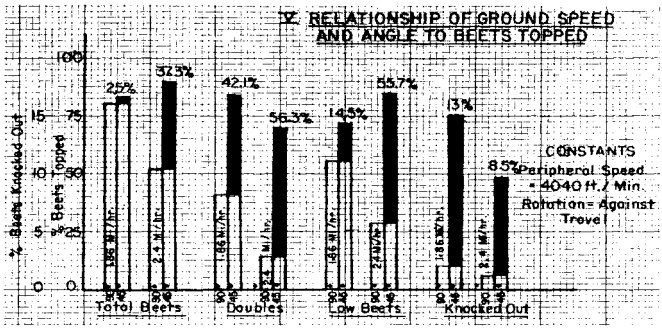


Curve No. III. —Efficiency of a beater increases as it is turned at an angle with the row up to about 52 degrees. More doubles are topped at 45 degrees but the rapid increase of beets knocked out from 60 degrees down to 30 degrees would cause hesitancy as to the selection of such an angle.

It will be noted that the only variable having any appreciable effect upon doubles topped is that of angle variation.

Chart No. IV.—The dark portion of the bars give the percentage of decrease in beets topped through the change in direction of rotation of

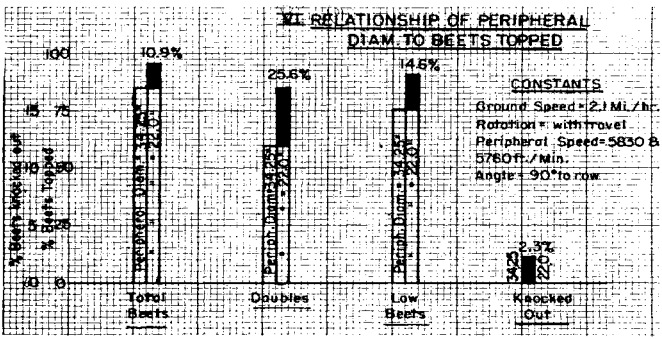




the beater. A slight increase in total beets topped is noted but this is offset by the larger percentage knocked over. Very little effect upon the doubles topped results from change in rotation.

Chart No. V.—The purpose of this chart is to show the increased efficiency of an angle beater at higher ground speeds. Very little difference in percentage of doubles topped is evident, however, a marked decrease in beets knocked out at higher speeds with angle beaters is manifest.

Chart No. VI.—An interesting contrast between beaters with larger and smaller peripheral diameters but the same peripheral speed may be noted on this chart. The absence of beets knocked out by smaller diameter beaters brings to the fore a point for consideration.



Conclusions

The following are general conclusions which may or may not be applicable in the majority of cases but are based upon data and observations of the preceding series of test runs as were here-in described.

1. A single-shaft beater topper is more efficient, covers more acreage in less time with less operating costs when in combination with a knife.

2. When using a beater topper behind a knife a smaller diameter peripherary with high peripheral speed is just as efficient as the larger diameters with slower speeds and it uses less power, reduces over-all weight of machine and permits, therefore, a greater ground speed.

3. The efficiency of a single-shaft combination unit is increased if the knife is set to cut a sloping cut through the crown of the beet. The direction of dip depending upon the rotation of the beater, towards the approaching side if the beater is rotating with the direction of travel and towards the far side of the beet if the direction of rotation is against travel.

4. A beater becomes more efficient when placed at an angle of from 60 degrees to 80 degrees to the row, as it tops more low beets and doubles at this angle and clears more trash from the row.

5. The most difficult portion of the foliage of a beet to beat off is that connected to the top of the crown. Side stringers are removed with much less power. Therefore, removal of the top portion of the beet foliage can best be accomplished with less power by a knife.

6. A beater topper placed at an angle to the row other than 90 degrees requires more power, a larger number of paddles, beet is hit more times at same ground speeds by paddles than when at 90 degrees to row.

7. Counter-clockwise rotation of beater provides a small increase in efficiency, however, such is offset by the increase in the percentage of beets knocked out.

8. An increase in ground speed must be accompanied with an increase in peripheral speed to provide comparable efficiencies. However, higher ground speeds are permissable with the same peripheral speeds, if the beater topper is placed at an angle of 45 degrees to 60 degrees to the row. More power is required in the latter case.

9. Results indicate that when a beater is at 90 degrees to row peripheral speed of 4.040 feet per minute will continue to top beets up to 2¼ miles per hour. A peripheral speed of 5,830 will top up to 3 miles per hour. When the beater is at an angle of 60 degrees to the row a peripheral speed of 4,040 feet per minute will top up to 2¾ miles per hour, and a speed of 5,830 will top up to 4 miles per hour. Efficiency decreasing to zero as the higher mileage is reached.

10. Increased peripheral speed at low ground speed 90 degrees to row appears to affect only a small change in efficiency, however, this increase greatly increases efficiency at higher ground speeds. If beater is at an angle to row, the reverse appears to be true.

11. Only factor effecting percentage of doubles topped is that of angle of beater to row.

12. Beets knocked out increases with slower ground speeds, a decrease in angle of beater to row from 90 degrees to zero degrees, higher peripheral speeds, greater peripheral diameters, rotation against direction of travel, and use of heavier paddles.

13. Efficiency of beater is increased when tops are salvaged and windrowed away from area covered by beater.

14. The use of wire brushes vertical to the row are not satisfactory due to the fact they knock too high a percentage of beets out and do not eliminate trash. Fibre brushes have little or no topping power but continue to knock out a high percentage of beets.

We are not convinced that the large beaters now in use are the final and perfect way to top beets. We also realize that beater topping does not have universal appeal in spite of the low harvest costs possible. However, we do believe in high topping as such, and feel that adaptation of some mutation or variation of beating into the future mechanical beet harvestors will better insure "streamer" free, trash free, delivered beets which are ideal for storage. Introduction of the additional crown borne impurities into the mill processing has been somewhat of a problem, but the ease of harvesting with beaters as well as the financial savings to growers has over shadowed the processing problem.