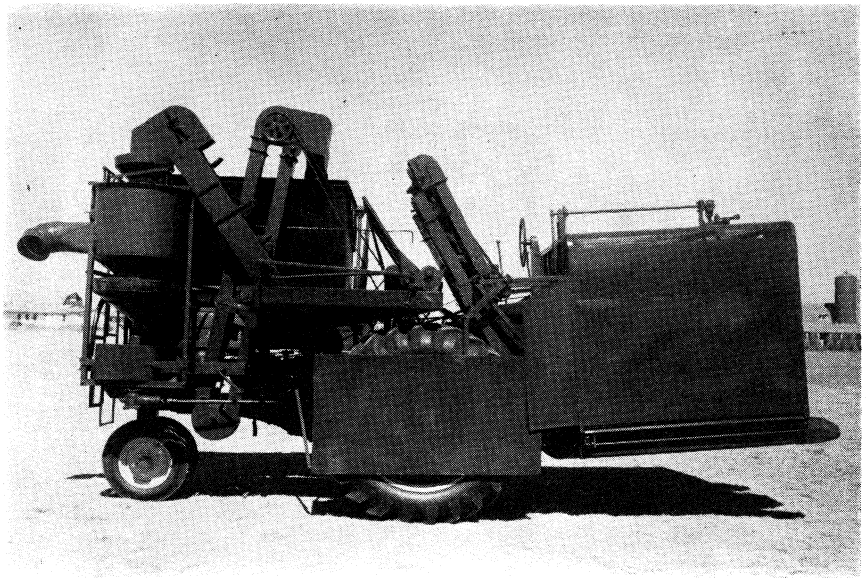
A Two-row, Tractor-mounted

Castor Bean Harvester



Agricultural Experiment Station
DIVISION OF AGRICULTURE
Oklahoma A. & M. College
and
Agricultural Engineering
Research Division
AGRICULTURAL RESEARCH SERVICE
United States Department of Agriculture

OKLAHOMA A&M COLLEGE DIVISION OF AGRICULTURE
SCIENCE SERVING AGRICULTURE

Bulletin No. B-489
March 1957

ACKNOWLEDGMENT

Acknowledgment for assistance in construction of the equipment described herein is made to Norvil R. Cole, mechanic, joint employee of the Oklahoma Agricultural Experiment Station and the U. S. Department of Agriculture.

A Two-row, Tractor-mounted Castor Bean Harvester

By L. G. Schoenleber, Fred Bouse, and G. E. Coppock
*Department of Agricultural Engineering**

This country imports over 95 percent of the castor beans (in form of oil or beans) used in this country. The total amount used is approximately 300 million pounds of castor beans annually. Recent discovery of new uses for the oil will greatly increase future requirements. It is estimated that 350,000 acres or more of high yielding beans will be required in the near future to grow our own needs. In many areas, acreage now adding to existing crop surpluses could be used to grow castor beans.

Lack of suitable harvesters is the major factor in keeping the castor bean acreage in this country from increasing rapidly. Mechanical harvesting of this crop is necessary for growers, to cut down the cost of labor and to save beans through early, efficient harvesting. Several varieties of castor beans have been developed which lend themselves to harvesting better than varieties available only a few years ago.

The cultural practices required for growing the crop fit into most existing farm operations.

Castor beans will grow in almost any area of this country but should be grown in locations that permit harvesting under dry weather conditions, as existing harvesters require the castor bean capsules to be completely dry. Castor bean hulls are highly hygroscopic and take up moisture readily when weather conditions of high humidity, heavy dews, and rains prevail. Areas of infrequent or no rains during harvest are essential to an orderly, quick and satisfactory harvest.

Description of the Harvester

The hervester described in this bulletin was developed over a two-year period by a cooperative project between the Oklahoma Agricultural Experiment Station and the Agricultural Research Service of the United States Department of Agriculture. It was developed to perform the total harvest in one operation requiring only one operator (Fig. 1).

*L. G. Schoenleber, Fred Bouse, Agricultural Engineers, Oklahoma Agricultural Experiment Station and USDA.
G. E. Coppock, USDA, and formerly Oklahoma Agricultural Experiment Station.

Fig. 1.—Harvesting dwarf castor beans yielding 2700 pounds per acre with USDA—Oklahoma harvester.

The main features of the USDA-Oklahoma harvester are as follows:

1. Requires only one man to operate machine.
2. Harvests by removing the seed capsules from standing plants, hulls the seed, blows the hulls onto the ground, and deposits the clean seed ready for mill processing into a bin on the machine.
3. Opens a field when harvesting without making down-rows of unharvested beans.
4. Includes a high lift on the header to provide a short turning radius at ends of the field which may have short head lands or irrigation ditches.
5. Has bin capacity of one ton clean seed which may be dumped quickly into a 9-foot height truck box.
6. Operates efficiently in high yielding beans up to 3½ miles per hour forward speed.
7. Harvests two 40-inch-spaced rows at a time in plants up to 6 feet tall.
8. Has service and adjustment features which are accessible and easily made.

9. Operates huller and clean-bean elevator from the tractor live power-take-off and is independent of the forward motion of the machine. Huller includes a quick release mechanism which controls spacing between discs to allow rocks and large foreign material to pass out of the machine without damaging the surface of the hulling discs.
10. Provides good visibility from the operator's platform for guiding the machine on the row and observing operation of the cleaner, elevators, huller, fill of beans in bin and operation of mechanism in header that removes bean capsules from plants.
11. Has operator's controls which are readily accessible and designed for ease in operation.
12. Has front-mounted augers and covered conveyor sprocket shafts to eliminate or reduce to a minimum wrapping of stalks.

The machine harvests by removing the seed capsules from the standing plants. As the machine moves forward on the row, the plants pass between two horizontal oscillating brushes which are positioned below the lowest cluster of castor seed (Fig. 2). The plants pass beside knockers which are positioned a few inches above the brushes. The

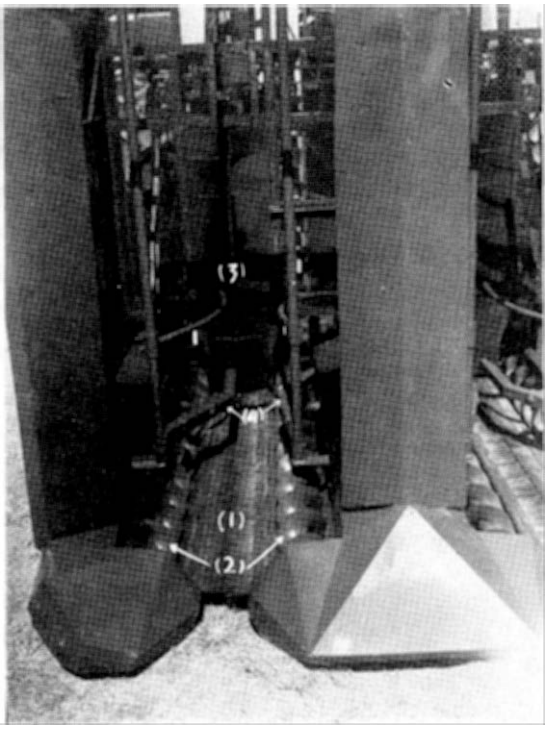


Fig. 2—Entrance view of header showing
(1) brushes,
(2) augers
(3) vertical curtains, and
(4) knockers.

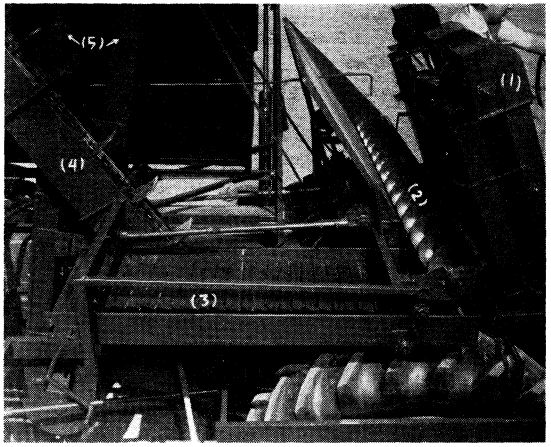


Fig. 3.—Top view of harvester showing
(1) inclined flight elevators,
(2) cross auger,
(3) scalper,
(4) flight elevator to huller, and
(5) cup elevator for clean beans.

knockers hit the plant with sufficient intensity and rapidity to cause all the bean capsules to fall off the plant onto the brushes and auger conveyors. The plants then move back between vertical curtains and out of the machine.

The brushes are designed to prevent the seed from passing between or through them but throw the beans into auger conveyors which are to the side and parallel. The augers move the beans along with sticks and leaves which may have been knocked off the plants back into drag flight elevators. These elevate the beans to a cross auger positioned above a scalper (Fig. 3). The sticks, leaves and trash pass over the scalper while the capsules fall through the screen into a drag flight elevator and move into a huller (Fig. 4). The huller removes the hulls

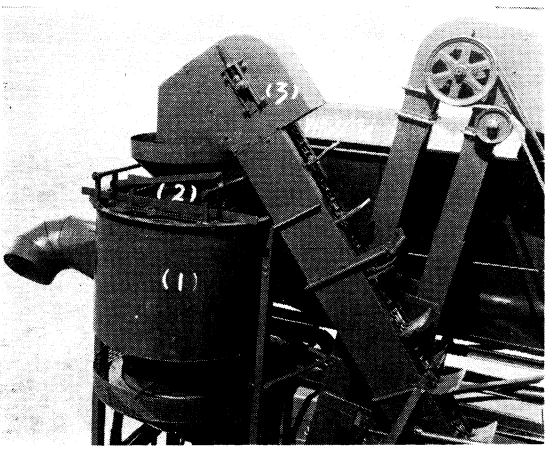


Fig. 4.—View of
(1) huller,
(2) disc release, and
(3) flight elevator.

Fig. 5.—Dumping clean seed from harvester into truck.

from the seed and by use of air separates the hulls and trash from the clean seed, blowing the foreign material out of the huller onto the ground.

The cleaned seed falls by gravity out the bottom of the huller into a cup elevator which moves it to a bin located above the tractor. The clean beans can then be dumped into trucks or trailers to complete the harvest operation (Fig. 5 and 6).

The path which castor beans follow through the harvester is illustrated in the schematic diagram, Fig. 7.

Fig. 6.—Truckload of clean seed ready for processing.

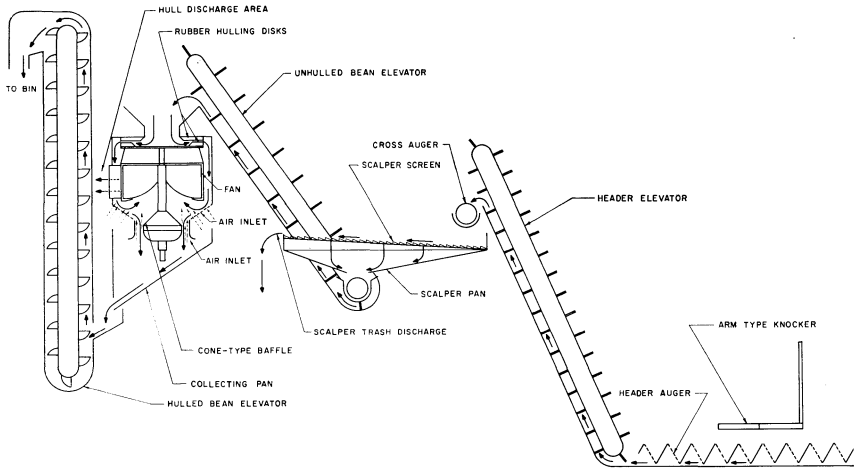


Fig. 7.—The path castor beans follow through the harvester may be traced by following the arrows from right to left.

The machine is particularly adapted for use in harvesting dwarf-type plants. These plants range in height from 30 to 48 inches depending on variety, season and growing conditions. Dwarf plants were found to stay in harvesting condition longer and had fewer wide spreading branches which would break off, as compared to varieties of normal height.

The machine is adapted for use in harvesting after the plant leaves have dropped or dried and the castor bean capsules are completely dry.

Where castor beans depend on frost and subsequent weather to dry the beans, harvesting should be accomplished as quickly as possible to prevent pre-harvest and harvest losses from winds and brittle plants. In some areas favorable harvesting conditions may last for no longer than two weeks. Beans may be ready for harvest in as little as one week after a killing frost or defoliation.

The harvesting period is more easily controlled where defoliation is used to dry the seed capsules and leaves. The amount of defoliation applied should be regulated to dry completely only the seed capsules and leaves. Harvesting should take place as soon as the beans and leaves are dry and before the plants revive and put forth new leaves. Excessive applications of defoliants will cause the leaves to "freeze" to the plants and act as a desiccant on the entire plant. In such cases the cleaner capacity requirements are increased greatly as the plants become brittle.

This harvester was built to fit onto a John Deere 70 tractor. However, such a machine could be adapted to mount on other tractors. A

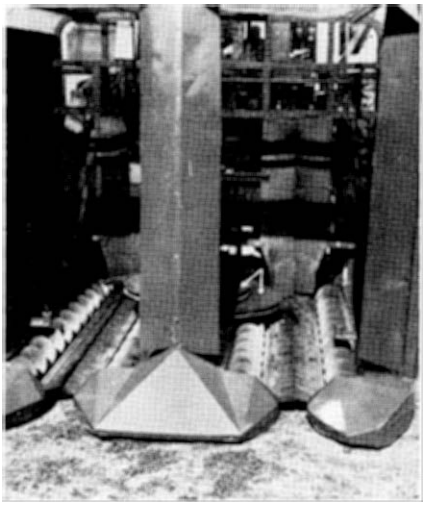


Fig. 8.—Header of harvester showing rotating beaters.

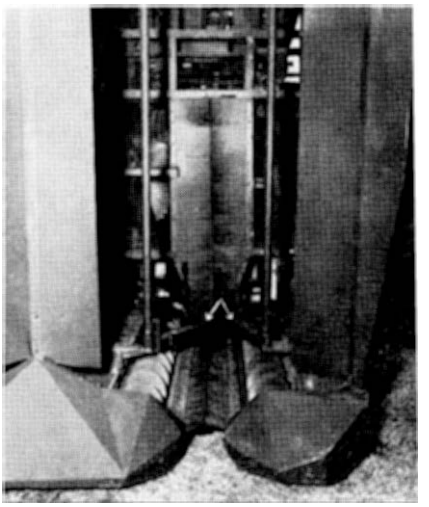


Fig. 9. — Header of harvester showing horizontal oscillating knockers.

large tractor of the size used with this machine is needed in order to provide sufficient power when high yields are encountered.

Two types of mechanisms were developed for removing the seed from the plants—the disc type beater and the horizontal oscillating knockers either of which may be used.

The disc type beater consists of a large diameter disc with four bars pivoted at equal intervals near the outside diameter of the disc. As the disc rotates, the bars swing outward at a controlled distance, striking the plants near the base and causing vibration in the plant of sufficient intensity to remove the bean capsules. A disc is provided for each row and rotates so that the bars hit the plants to knock the beans back into the harvester header (Fig. 8).

The horizontal oscillating knockers were developed with a knocker placed on each side of the row approximately 6 inches above the brush seals (Fig. 9). The knockers oscillate together across the row, first in one direction and then in the opposite direction. The frequency of oscillations and adjustment between knockers can be controlled to obtain the desired action to knock off all the capsules. Use of only one pair of knockers has been found sufficient to remove all the capsules from the plants.

Figure 10 shows the rear section of the harvester mounted on a John Deere tractor. Two lift arms extend out behind the large tractor wheels for lifting the header. The lower connecting arms help position

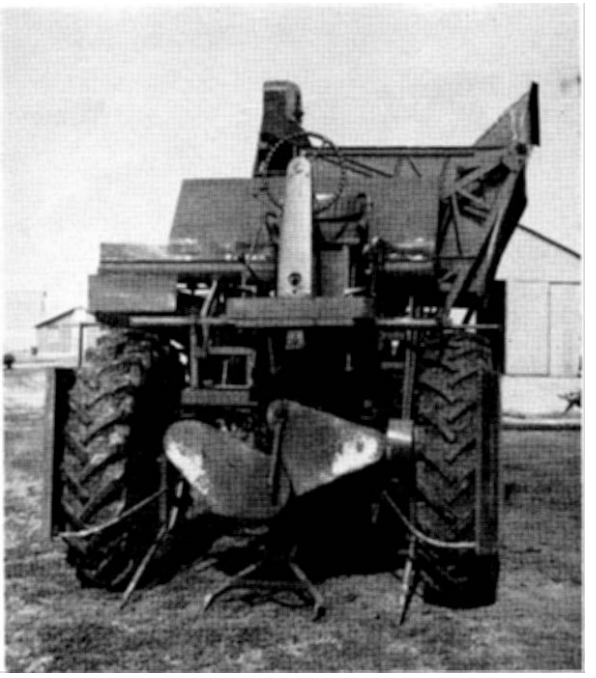


Fig. 10.—Rear section of harvester with header removed shows main power drive and mounting brackets for header.

the header and hold the bottom steady. Figure 11 shows the header removed from the tractor.

Performance of the Harvester

Field tests were made in the fall of 1956 in Texas on dwarf castor beans which were frost killed. The beans yielded as much as 2700 pounds per acre and ranged in height from about 30 to 48 inches. The field tests were made over the period November 9 through December 4. Only minor mechanical difficulties were encountered.

Harvesting losses on several test areas when traveling 2½ miles per hour were as follows:

Yield of Beans	Harvesting Loss
1240#/A	4.2%
1570#/A	2.8%
2700#/A	3.6 to 4.8%

Harvested beans from the machine had as low as 2/10 of one percent unhulled and no foreign material when operated under optimum harvesting conditions.

Foreign material and unhulled beans of the harvested seed were unusually low for the entire season, even on varieties considered hard to hull. Much of this is contributed to the dry condition of the capsules and minimum branches and leaves being knocked from the plants.

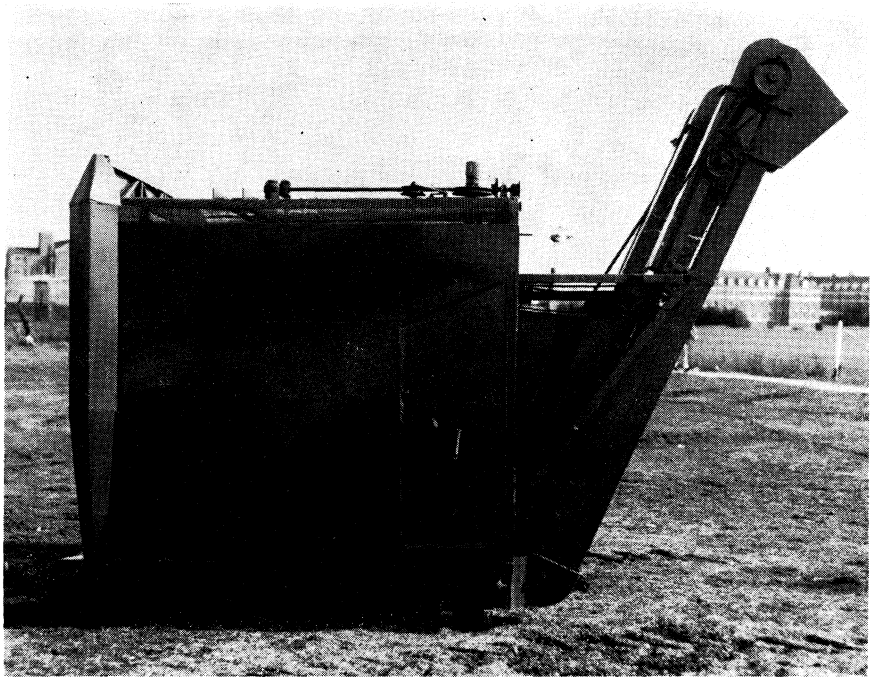


Fig. 11.—Header of harvester removed from tractor.

Practices Recommended for Mechanical Harvesting

1. Use varieties of castor beans with spike not less than 8 inches from the ground, which do not drop beans readily before harvest, and which have limited heavy side branching below first spike.
2. Plant seed to obtain a uniform spacing of plants about every 12 inches in the row.
3. Use 40-inch row spacing.
4. Keep fields clean of weeds and grass.
5. Make a suitable level space centered between the rows during the last cultivation to provide easy and accurate steering for the tractor-mounted harvester.
6. Harvest only when the castor beans are dry so that the beans will be in condition for good hulling.
7. Harvest as soon after frost as possible to prevent undue field losses from winds or wet weather. The practice of defoliating for a planned harvest date can be used if frost occurs later in the season than desired.
8. Keep harvester in adjustment.
9. Operate harvester at speeds to permit the operator to stay on rows easily without throwing beans in front of header.