EXPERIENCE WITH THE JOHN DEERE BEET HARVESTER AT THE COLORADO AGRICULTURAL EXPERIMENT STATION IN 1943

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Experimental work on mechanical harvesting of sugar beets in the vicinity of Fort Collins, Colorado, in the fall of 1943 was not a test of equipment working under conditions for which it was designed but was a test of mechanical harvesting under very cloddy soil conditions. The John Deere Company knew the limitations of their machine before the 1943 harvesting season and sold them with the definite stipulation that they be used on friable soils. It should be borne in mind that the John Deere harvester tested at the Colorado Agricultural Experiment Station was used under the most difficult conditions in the interests of research.

Soil conditions at harvest time in 1943 were probably the most adverse, for mechanical harvesting, in many years. Even where fields had been irrigated 10 days before harvest, the groun had dried out so that it was almost impossible to break the clods. Clods came up in all sizes. The small ones, while just as hard, did not cause much damage to the machine and were not as difficul to handle as those 6 to 12 or more inches in diameter.

In one field where the John Deere harvester and experimental John Deere loader were used, the harvester was able to reduce the clods to comparatively small sizes. Even with these small clod sizes the load of beets which was picked up directly from the windrow with the loader using a 2-inch pitch potato chain was found to contain 47 percent dirt by weight, and far too many small beets and tails were lost through the chain. A narrow er pitch chain would have saved many beets but would have materially increased the dirt tare.

In another field where the soil was extremely hard and dry the clods were large and a great many more clods than beets were put in the windrow. Here it was necessary to make a hand separation before any loading was done. Two methods were used:

1. The "A" frame on the harvester was lowered to make a track every four rows. Then with eight rows of beets and clods in one of these tracks the beets were hand sorted and thrown over into the empty "A" frame track from which they were picked up with the John Deere loader. This made a sati factory separation giving a 2 percent dirt tare and requirin 6.49 man-hours per acre for the hand operation on a 12.5-ton crop.

2. The beets were picked by hand out of the clods in the windrows and thrown directly into a truck instead of int a new windrow. This method gave about the same dirt tare of 2 percent but required 8.05 man-hours per acre on a 12.5-ton yield.

Scientific Series Paper No. 178, Colo.Agr.Exp.Sta.

Either method shows a considerable saving in labor over the conventional hand method of piling and topping, which required 28.95 man-hours per acre with the same crew. But this crew said that to pick the beets out of a windrow on the ground was harder work and more tiring for the same length of time than it was to hand top and pile in the conventional hand method, especially when they were throwing the beets directly into the truck.

The harvester saved 22.5 man-hours per acre in the extreme conditions under which it was used at the Colorado Agricultural Experiment Station this year. These adverse conditions, however, served to bring out and even magnify many of its limitations. Some of the most outstanding sources of trouble were:

1. The coulter frame was not strong enough to hold the coulters in place without bending. This is only a structural weakness and can be readily corrected.

2. The topping knife did an excellent job while it was sharp, but the keen edge was ground off almost immediately by the hard soil in topping the low-crown beets. When the knife was raised up to top a high crown, the half-dry leaf stems folded over the dull knife edge preventing it from re-entering the hard soil for the next low crown. Sometimes the knife would clear itself soon enough so that little damage was done, but more often it would continue to slide over the tops, and the tops thus missed would cause trouble by balling up in the puller, kicker wheels, and conveyors.

3. The finder wheels, top pick-up, and top conveyor functioned satisfactorily after a minor change was made in the top pick-up. Some machines reported excessive wear of the acme thread shaft drive sprocket after a few acres were harvested.

4. The beet puller and closely related parts were probably the source of more trouble than any of the rest of the machine under these unfavorable harvesting conditions. Heavy draft in the hard, dry soil caused the main vertical angle iron support to bend back at the lower end. Much trouble was experienced in getting the puller to go into the ground and stay there. It was necessary to run the points as low as possible in front, and even then the puller would sometimes come out of the ground. Since the puller points were tilted down so far, the rods at the back of the puller were too steep and this had a tendency to push the soil mass and beets forward instead of just lifting the beets. It was also necessary to reduce the floating movement of the puller to a minimum since the clods and not the beets in the row would guide the puller, throwing it to one side or the other. The angl iron across the top of the puller shanks was not strong enough and several welded joints in the puller frame were stressed too highly which resulted in cracking.

In November the John Deere Company sent their chief engineer and three other engineers and designers to do some late season experimenting with puller designs on the Experiment Station machine. This work was carried out on the Great Western

Sugar Company farm at Windsor, Colorado, in very hard, cloddy soil. These men in cooperation with the Experiment Station staff spent 3 days trying different puller designs and combinations in an attempt to break up the clods and pick up the beets without getting the clods. When a combination of puller devices was found that broke the clods up pretty well the Model AN John Deere tractor did not have power enough to pull it. Although nothing very definite came out of the experiments some of the principles studied may be helpful in the future.

5. Many clods were too large to go through the slat arrangement in the beet conveyor and too hard to be broken by either the kicker wheels or the slats. It was necessary, therefore, to remove the slats and reduce the spring tension on the kicker wheels as much as possible so the driving mechanism on each would function. Even with the load reduced on these two driving mechanisms the slip clutches broke frequently until heavier clutches were made.

6. Large clods coming through the kicker wheels caused the wheels to be thrown from side to side and the beets to be scattered about. The beet loss from this source was serious, running as much as 4 tons per acre in a 14-ton yield, or 28.5 percent.

7. The No. 55 steel drive chain for the gear box shaft was overloaded causing frequent breakage and delay. In addition to the slip clutches already mentioned, the one on the top pick-up seemed to be too weak since it broke without undue stress being applied.

We would be indulging in wishful thinking to expect equipment designed for friable soil to work well under the conditions of the Fort Collins test. However, the test did indicate certain advantages and limitations of the principles involved and the equipment tried. Not all Colorado conditions were as severe as those in the Fort Collins factory district. In the lighter more friable soils the machine did creditable work and lots of it Several machines are reported to have harvested 40 acres or more with only minor difficulties where soil conditions were more favorable. In all fairness to the machine and its manufacturer it must be said that great progress has been made in building a commercial beet harvester, and it is felt that changes and improvements may be made until this machine will be able satisfactorily to meet virtually every condition.