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Harvesting Cucumbers Mechanically  
Michigan State University  
Cooperative Extension Service  
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DURING THE EARLY 60's, pickle acreage declined due to increasing labor costs and declining availability of labor. Pickle growers were forced to pay up to three-fourths of their crop's value for hand harvesting, and they could not afford to continue to grow pickles.

Thus, in 1964 commercial pickle-harvesting mechanization was born. In 1974 over 90% of Michigan's acreage was harvested by machines in a once-over operation (Fig. 1).

## MECHANICAL HARVESTING CAN BE SIMPLE

The concept of once-over mechanical harvesting is the answer to the pickle industry's problem. The entire crop is picked when the largest number of usable pickles on the vines is ready for harvesting. Selection of the optimum harvesting date is very important. Pickles reach maturity and go to oversize very fast—at maturity, pickles can have a 40% weight change in 24 hours.

Mechanical harvesting is simple, if you understand the concept. If you follow the suggestions here, the operation should be profitable.

**FIGURE 1. Michigan mechanically harvested nearly 25,000 acres of pickling cucumbers in 1974, compared to only 9,500 acres machine harvested in the rest of the United States.**

## DELIVER CLEAN AND UNDAMAGED PICKLES

Processed pickles should be clean and undamaged. To provide a quality product for the consumer, the processor must start with a quality-grown, disease-free product, which means the grower must harvest and deliver a quality product to the processor. The name of the game is "harvest and deliver clean, undamaged pickles."

## CULTURAL PRACTICES\*

**Uniform high yields.** Different practices are needed to grow pickling cucumbers for mechanical harvesting than for hand harvesting. For mechanical harvesting all operations must promote *uniformity* in cucumber plant and fruit development. The grower's operations influence crop uniformity—from selection of the field through scheduling of harvesting dates.

Important considerations that affect yield are: soil preparation and fertilization; variety selection; chemical seed treatments; seeding techniques;

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established plant population; uniform soil moisture; weed, insect, and disease control; and adequate bees for pollination. Yield is reduced when any of these operations is conducted in a manner that induces variability in cucumber seed germination, seedling emergence, or plant and fruit development.

Environment also influences cucumber yield. Some of the adverse environmental effects on cucumber yield can be reduced by selecting the best possible time for planting and by irrigation.

*\*Also refer to: Chemical Weed Control for Horticultural Crops, Michigan State University Extension Bulletin 433.*

*Control of Insects, Diseases, and Nematodes on Commercial Vegetables, Michigan State University Extension Bulletin 312.*

*Pickling Cucumbers, Production & Harvesting, Michigan State University Extension Bulletin E-837.*



**Uniform stands** are essential for mechanical harvesting. Irregular stands may cause the harvester to operate inefficiently. It may make readjustment necessary or result in poor field recovery which reduces yields. Application of the proper cultural practices in seedbed preparation, planting techniques, and cultivation is essential for uniform stands.

**Good field selection** is also important. Select a well-drained field with a light soil texture. Although a field with light soil texture may be more droughty, field operations are usually possible the day following significant rainfall. Thus, seeding and harvesting schedules will not be slowed by wet fields and contamination of fruit by dirt, and debris will be minimized. Waiting for a wet field to dry can drastically reduce crop value because the cucumbers become oversize quickly.

**Weed, insect, and disease control** contribute to high pickling cucumber yields. Weeds interfere with harvesting and can reduce field recovery. Fields must be free of troublesome weed infestations before cucumbers are planted. Plant disease-resistant varieties to reduce the incidence of diseases. Control insect infestations to produce uniform stands and reduce the spread of certain diseases. Rotate cucumber crops with non-cucumber family crops to reduce the incidence of such pests.

Up-to-date weed, insect, and disease control information, as well as other cultural information, is available in the latest Michigan State University Cooperative Extension Service bulletins. These publications can be obtained from your local County Agricultural Agent's office.

#### HARVEST AT THE RIGHT TIME\*

**Optimum harvest time.** At harvest time, pickles can have a 40% weight increase in 24 hours—pickle sizes change from size 3A to 3B to oversize very rapidly. Thus, once-over mechanical harvesting must be a timely operation. The value of a field of cucumbers changes as the size changes; typically, depreciation in value of 5 to 10%, and sometimes 20%, occurs in a 24-hour period. Each field actually exhibits a unique cash value-time curve. The major negative contributing factor is uneven crop growth, which causes a variable fruit set over time; thus uniform stands are **important**.

\*Also refer to: *Scheduling Once-Over Cucumber Harvest*, J. B. Holtman, Agricultural Engineering Department, Michigan State University, AEIS #322.

To determine the best harvest time, walk diagonally across the field and collect 10 samples at random (ten, 51 1/2-in. row-length samples = 100 ft<sup>2</sup> = 1/435 acre in 28-in. row spacings). Size grade these pickles. Your pickle processor's fieldman will have a formula designed for your recommended size distribution and optimum harvest time.

The typical fruit size distribution over a period of time is shown in Table 1, and typical fruit development patterns are shown in Table 2.

Planting schedules, growing conditions, acres to be harvested, and weather can influence harvest time. Ten-acre plots are recommended because one machine can harvest a plot of this size in one day.

#### OPERATE HARVESTER PROPERLY

Cucumber harvesters and pickle fields ready for harvest represent considerable investment and therefore harvesters should be operated properly.

Follow the manufacturer's instructions for recommended speeds for the har-

vester—the relationship of ground speed, pickup reel speed, pinch roll speeds, and pinch roll pressure is very critical.

**Ground speed and pickup reel speed** should be coordinated so that the vines feed freely onto the apron (Condition 2) and do not lag (Conditions 3 and 4) as shown in Fig. 2.

Walk beside the harvester while it is in operation and observe the vine flow onto the pickup reel—strive for Condition 2 and avoid Conditions 1, 3 and 4. Condition 1 causes the pickup-reel fingers to strip the cucumbers from the vines. Conditions 3 and 4 cause the stems to bend and the cucumbers to detach from the vines. The pickup reel **cannot** pick up fruit that are not attached to a vine.

**Pinch rolls** that detach the cucumbers from the vines operate slightly differently on various manufacturers' harvesters. Pinch-roll pressure adjustment is very important, and the adjustment necessary is determined by each field situation. Recovery of small cucumbers is influenced by roll pressure. Use as high a roll pressure as practical, and that will still permit a

TABLE 1. Typical size distribution patterns. Values are ranked in order by highest Size Grade No. 2.

Percentage by Weight				Total Weight	Ratio
Size Grade				Pounds	Total No./Total Wt.
No. 2 (1-1/16" to 1-1/2")	No. 1 (under 1-1/16")	No. 3 (1-1/2" to 2")	No. 4 (over 2")		
55.69	18.54	24.46	.31	13.91	10.51
44.89	17.58	36.32	1.21	15.32	9.44
38.83	14.47	43.59	3.11	16.88	8.60
34.92	12.13	47.70	5.25	16.65	7.85
31.32	12.79	50.03	5.86	17.82	8.21
28.00	9.50	53.18	9.32	20.60	6.75
24.20	7.93	59.18	8.68	21.00	6.25
20.59	8.78	58.07	12.56	20.92	6.18
17.48	5.33	60.27	16.91	23.07	5.07
12.39	5.95	61.24	20.42	22.93	5.22

TABLE 2. Breakdown of pickles per size category at 24-hour intervals in a typical pickle field.\*

Date	Size Grade by Number					Value/Acre**
	1	2	3A	3B	4	
7/17/71	70	50	16	3	2	\$179
7/18/71	51	54	31	5	3	\$220
7/19/71	41	31	37	25	4	\$320
7/20/71	32	39	32	23	13	\$285

J. B. Holtman et al. 1974. *A Mathematical Model to Schedule Cucumber Harvest*. Trans ASAE 17(5): 861-863. Department of Agricultural Engineering, Michigan State University, East Lansing, Michigan 48824.

\*\*Value per acre varies with contract prices for the different grade sizes. Values shown are arbitrarily presented to illustrate the importance of selecting the proper time for harvest to obtain maximum value.

## OPTIMUM: ADJUST FOR NO. 2

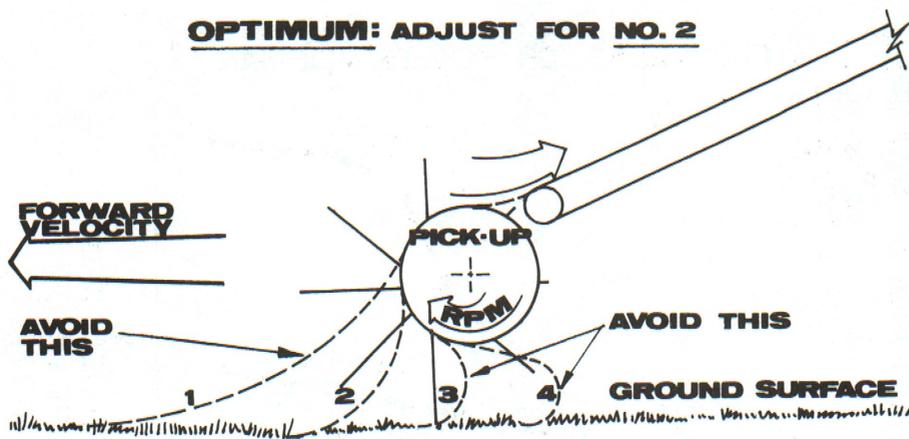


FIGURE 2. Cross-sectional view of cucumber harvester pickup reel showing four possible conditions of vine flow. Condition 2 is optimum. Avoid Conditions 1, 3 and 4.

desirable throughput of vines. Be aware that there are "rough" pinch rolls and "smooth" pinch rolls. All rolls may be smooth or used in rough/smooth combination. Rough rolls are more aggressive than smooth rolls and have a tendency to damage small (gherkin) pickles. Rough rolls may be necessary in fields that contain weeds or heavy vine foliage.

Many variables influence pinch-roll selection and adjustment. Here are a few to observe:

- ▶ Time of day (vines wet from morning dew, or dry)
- ▶ Density of the vine growth
- ▶ Nature of the roll surface (smooth or rough)
- ▶ Weed population

Consult your operator's manual or your harvester representative when selecting pinch-roll surfaces for your harvesting conditions and harvester model.

**Improper adjustments of the harvester** will result in lower recovery and greater damage to the cucumbers. Adjust components of the harvester as often as necessary. The collection of dirt and mud is influenced by the depth of the cut-off blade below the soil surface. For conservation of power requirements and reduction of dirt, operate the cut-off blade as near the surface as practical.

**Minimize or eliminate dropping** of cucumbers whenever possible. The breaking, damaging, and bruising of cucumbers are influenced by the height of the harvester's discharge conveyor above the collection source (e.g., bin, wagon, high-lift, truck). Preliminary findings indicate that a 2 1/2-foot drop causes visible internal fractures. Every effort

should be made to reduce the number and height of drops throughout the harvesting and handling system. Use of foam rubber (3 inches minimum) on the floor drastically reduces damage to the first few layers of fruit. Carpel separation and bloating in the brine tank are directly related to impacts.

### PROPER HANDLING AFTER

#### HARVEST

Harvesting is not the only operation where pickles are broken, damaged, and bruised. Impacts and pressure during handling can cause serious internal damage to pickles. This internal damage increases bloating during brining and drastically lowers the value of the pickles—all of which reduces what the processor can pay you. All of the key operations such as dropping, loading, hauling, unloading, and grading influence the quality of pickles that go into the processing plant.

Pickles are not baseballs—they should not be thrown, dropped, and bounced. Reduce drop heights to a minimum on the harvester conveyors and transfer points. Piling cucumbers over three feet deep in transport increases chance of damage. Use three-inch, foam-rubber padded bottoms in all high-lift and transport vehicles. Cover side-rack chains of the transport box with rubber or burlap bags. Do not unload pickles from a harvester directly over the retaining chains. Such unloading causes multiple damage.

Do not "grind" the pickles from harvester hoppers. If practical, harvest directly into a conveying vehicle that goes to the processing plant. When the harvester discharge conveyor delivers into the transport vehicle, there is a tendency for an excessive drop. Use a lowering, de-

accelerating device to reduce this drop. Reduce the number of times that pickles are dropped or rehandled to a practical minimum.

Abrasion on the pickle's surface shows up on fruit packed in glass. Keep harvester aprons, baffles, and conveyors free of mud accumulation. Truck floors should be clean of mud buildup. Keep the conveyor's side rails smooth and free of any protrusions such as bolt heads or welds that can severely damage and abrade cucumbers. Reduce abrasion by unloading with or into water, or both, and by reducing the accumulation of dirt with the harvested product. It may be feasible to set up field washing stations during seasons of excess dirt and mud accumulation.

Remember, impacts (drops) cause bruising and damage that are directly related to bloating.

Stand back and observe your operation. Whenever you see pickles drop, initiate action to reduce or eliminate this source of pickle abuse.

### ONCE-OVER IS ECONOMICAL

Whether you own your own harvester, have your crop custom harvested, or lease a processor-owned harvester—once-over harvesting works. The economics of once-over harvesting depend upon the extent of the harvester's use. A reasonable goal is 10 acres/day. If you schedule your planting so that you can harvest 10 acres per day, 6 days a week, for 5 weeks, your seasonal harvesting acreage will be 300 acres per machine—a reasonable range is 75 to 200 acres/machine/season.

For the per-acre cost of ownership and harvesting, it is important to base the size of operation on harvester ownership. In some cases, it will be more profitable to custom harvest or lease than to own your own machine.

### MECHANICAL HARVESTING

#### INCREASING

Once-over mechanical harvesting of cucumbers has introduced commercially in 1964 and has steadily increased (Fig. 3). Average cucumber yields in Michigan declined from 1966 to 1971; however, improved technology in varieties, cultural practices, mechanization, and time of harvest has resulted in an upward swing in yield (Fig. 3). Early mechanical harvesting yields were 80 to 90 bushels per acre. In 1974, yields were as high as 300 to 400 bushels. The Michigan average yield in 1974 was 169 bushels.

Michigan leads the nation in mechanical harvesting of cucumbers. In

1974, Michigan harvested nearly 27,500 acres of cucumbers of which nearly 25,000 were mechanically harvested. Only 9,500 acres were mechanically harvested in the rest of the United States.

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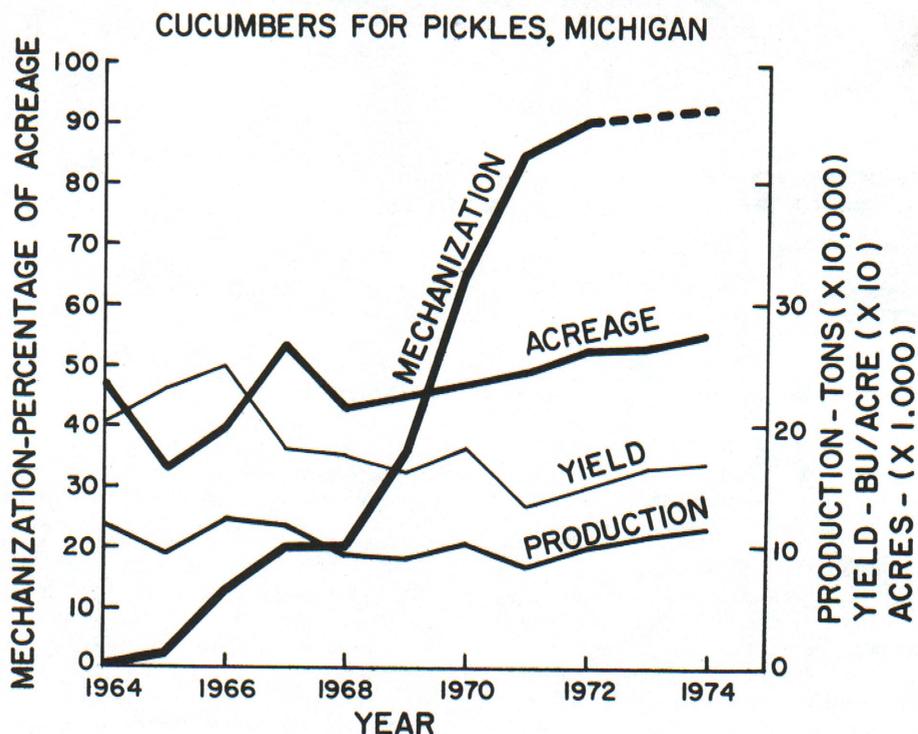


FIGURE 3. Production, yield, mechanization, and acres of cucumbers in Michigan.

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