The Impact of Mechanization of Horticultural Crop Production in Louisiana on Teaching

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INTRODUCTION

The necessity of mechanizing fruit and vegetable production as well as harvesting operations has greatly increased in Louisiana during the past five years and the need will become more acute during the next five if the state is to stay competitive. As the cost of labor increases and the availability of good labor decreases, farmers raising horticultural crops must mechanize or else turn to other crops that have already become mechanized and thus require a minimum of labor for their production.

Mechanization has been a favorite item of discussion among all agriculturalists for many years. We are now at a point where it must be more than a topic of conversation. WE MUST MECHANIZE IN ORDER TO SURVIVE. The accomplishment of this task is not solely the responsibility of the designers and builders of farm machinery; it is the obligation of everyone working with agricultural products.

IMPLICATIONS

Mechanization creates the need for new approaches to cultural practices, necessitates the development of new varieties adapted to once-over machine harvesting and demands a product with different handling and processing qualities.

"Total" and "early" yields may become obsolete terms for most crops under such conditions. The first point of consideration relative to growing a particular crop may well be, "When and how can maximum yields of acceptable produce be obtained in a single harvesting operation?" Land preparation, planting, fertilization, herbicide application, cultivation and irrigation must be accomplished in such a manner as to maximize the profits from this once-over or "destructive" type of harvest.

LOUISIANA HORTICULTURE

Louisiana grows considerable quantities of the following crops: sweet potatoes, pecans, strawberries, snap beans, tomatoes, peaches, cabbage, green peppers, cucumbers, watermelons, shallots, Irish potatoes, and a number of nursery and floricultural species.

While the production of each crop mentioned needs to be mechanized in all phases, the harvesting phase is doubtless farther behind than any other. Ironically it requires the most labor and is the most difficult to mechanize. The latter is perhaps the reason it has been so slow in development.

CHARACTERISTICS OF PLANTS

The varied forms of fruit and vegetable crops plus their general tenderness presents unique problems in regard to the development of mechanical harvesters. In some cases, leaves and stems are the edible portions; in others, fruits or portions that grow under ground are the parts to be harvested. Rough handling of any harvested portion may result in decreased market quality, even to the extent of total loss. So, we can rightly say that each fruit or vegetable has certain peculiar characteristics that require a specific design of harvester for that crop.

INTERIM SOLUTION

Engineers have attempted to bridge the gap between harvesting by hand labor and total mechanization by introducing machinery known as harvesting aids. This has resulted in making better use of labor in field harvesting, but, in most cases, it has not appreciably reduced the amount of labor required. This is an interim solution and cannot be a basis for continued production.

Meanwhile, State and Federal Experiment Stations, farm equipment manufacturers, trade associations and related industries have been working at developing machinery and techniques to meet these problems relating to harvesting. Many farmers in other states are now using machinery for harvesting crops which we in Louisiana are still harvesting by hand. In many cases these machines can be adapted to operate in Louisiana with only minor changes.

PRESENT STATUS

The following is a brief discussion of what machinery is available or being developed for each of our major horticulture crops as well as some of the problems that these crops present for mechanization.

Sweet Potatoes: L.S.U. Agricultural Engineering Department has been working on the development of a harvester for several years. Old methods of field handling prevented acceptance of a totally mechanized harvester until very recently. All potatoes that are to be processed should be handled in bulk pallet boxes, and fresh market potatoes in half-size pallet boxes. This allows the farmer to harvest and separate the fresh market potatoes from the ones to be processed in one operation with a minimum of labor. Planting still requires a large amount of labor, but the use of multi-row transplanters reduces appreciably this labor requirement and insures a better stand.

Pecans: Harvesters have been developed and are proving very satisfactory. Proper preparation of the ground around the trees is a must for satisfactory operation. Early models consisted of hydraulic tree shakers with canvas aprons spread under the tree. The more recent harvesters consist of a steel brush sweeper and pneumatic separation of the trash from the nuts. One type of harvester is pulled behind a tractor while a larger type is mounted on a tractor.

Strawberries: The acreage of this crop in Louisiana has dropped each year recently due to a scarcity of labor for harvesting. To help offset the labor shortage, for the past two seasons engineers at the L.S.U. Experiment Station have been testing a harvest aid machine. Results of these tests indicate that the harvesting aid did not increase the ability of the laborers to harvest strawberries, though it did add to their comfort.

The effort continues by engineers at several experiment stations to develop a fully mechanical harvester. The design being considered by L.S.U. engineers is to combine air suction with stripping fingers. The stripping principle is aided considerably by the existence of a strawberry variety which usually has only one berry on a peduncle. A variety is needed that shows a high degree of correlation between size and color.

Snap Beans: Harvesters for picking green beans for both fresh market and for canning purposes are now being used in most southern states. The machine strips the beans and foliage from the plant and a cleaning fan blows out the foliage and

trash. The beans are loaded directly into bulk bin boxes on the harvester. In stripping some bean pods are bruised, therefore some grading is required. Sizing is usually done in a cylinder type rotating sizer. A two row harvester can cover about 5 acres per day at a cost of about $50 per acre. A farmer should have approximately 50 acres of beans to justify buying a harvester costing about $14,000. Studies made in Tennessee in 1966 on hand-picked and machine-picked snap beans showed that the cost to hand pick beans varied from $90 to $117 per acre and from $20 to $25 an acre for machine-picked beans. Custom harvesting cost was $42.50 per acre. This was for a yield of 2 tons of beans per acre.

Tomatoes: The tomato may have the highest potential profit of any vegetable crop in Louisiana, however, at present there are no tomatoes harvested mechanically in this state. The mechanical harvesters available use the once-over principle; this area lacks varieties suitable for harvesting under eastern soil conditions. The horticulture staff at L.S.U. has varieties which appear to be suitable for mechanical harvesting. These will be tested in the near future.

Approximately 150,000 acres of tomatoes valued at 260 million dollars were mechanically harvested in California in 1966.

The tomato harvester consists of twin rotating disks and guiding shields which gather the fruit and vines to the center of the machine. The disks cut the vines at ground level and the vine mass is carried by an elevator to a "shaking" area. A reciprocating conveyor loosens the fruit from the vines. The fruit drops onto a cross conveyor and passes under a suction fan that removes loose leaves and trash. The vines are deposited back on the ground at the rear of the machine. Sorters inspect and remove unsound fruit and the sound fruit is conveyed to the machine's tomato loading system. These harvesters, costing approximately $18,000, can pick about 150 tons of tomatoes per day. A harvester will have from 8 to 20 sorters on a machine. It would require approximately 60 men to do this same job under the old methods of hand-picking. The use of mechanical harvesters will save the farmer about $185 per acre in harvesting labor.

Fruits (Peaches, Oranges, Etc.): Since most of our fruit varieties show abscession qualities, some type of a tree or limb shaking machine can be used for harvesting. These harvesters will vary from hand held shakers to those mounted on trucks and tractors. Aprons made of light metal frames covered with tarpaulin are placed around the tree before the shaking process. Some frames are sloped so that the fruit will roll to a central collecting pan. Some of the more mechanized harvesters have the catch aprons mounted on the tractor, and two machines work together in pairs, one on each side of the tree, as a continuous process. Results of tests conducted on mechanical harvesting of peaches show that one can expect about a 5% fruit loss due to damage as compared to hand picking. Tests also show that mechanical harvesting of peaches is practical and economically feasible.

Cabbage: Cabbage ranks seventh in money value as a cash crop for Louisiana farmers. At present all of the cabbage is harvested by hand. Cabbage raised in Louisiana is for the fresh market while that raised on the east coast is used primarily for processing into sauerkraut. Like most vegetable crops, labor requirements for producing cabbage is relatively high; however, almost 50% of the labor required is for harvesting. Experiments are now being conducted on pilot model cabbage harvesters at several universities and the results look promising. It appears that the harvester will be designed on a once-over basis. Harvesting aids, when used in cutting cabbage, have appreciably reduced the labor required.

The mechanical cabbage harvester consists of a cutting head composed of a pair of disks, a head supporting device and a band-saw blade. The heads are cut at ground level, passed on to a conveyor and elevator. The cabbage heads pass from the top of the inclined elevator on to a separator unit which rolls the full heads to the side and off to a final conveyor and on to the bulk bins. Small immature heads and loose leaves pass under the separator and are discarded. For fresh market sales these harvesting machines are still causing too much damage compared to hand-picked cabbage, but additional tests are being conducted and it is felt that a fresh market cabbage harvester will be available in the very near future.

Cucumbers & Cantaloupes: Machines are now under development that will allow multiple harvest of both cucumbers and cantaloupes. These harvesters work on the principle of size and weight in selecting the ripe fruit. Both approaches are based on the characteristic of the fruit having a high degree of abscession when ripe. There are many problems associated with totally mechanized harvesting of cucumbers and melons, such as the viney growth habit of the plant and the necessity of picking several times during the season; the difficulty of harvesting the fruit set within 6 inches of the base of the plant is another problem. Any attempt to train the vines would be very expensive. Cucumbers and melons are presently being gathered using a harvesting aid type of machine on which the pickers ride either sitting or in a prone position and pick by hand.

Leafy Vegetables: Harvesters are now on the market for mechanically harvesting leafy vegetables such as spinach, mustard, turnip tops, beet tops, and parsley that are to be processed. Additional work needs to be done to reduce damage while harvesting. Many areas are presently using some type of harvesting aid machine for leafy vegetables that are sold on the fresh market. While these machines are not totally mechanized, they can appreciably reduce the time and labor required, as compared to total hand harvesting.

Irish Potato: While the Irish potato cannot be listed in the top ten as a money crop in Louisiana, many agriculturists feel that it could become one of the leading money crops. Approximately 600 acres were harvested in Louisiana during this past season and more are expected to be planted in the future. Machinery and methods of handling potatoes have improved tremendously in the past ten years and the process can be totally mechanized.

The basic principle employed in most mechanical potato harvesters is a shovel attachment which travels through the soil below the potatoes. As the machine moves forward, the potatoes along with a considerable amount of soil are picked up by conveyor chains. As the potatoes move toward the rear of the machine, most of the soil is shaken through the chain to the ground. The potatoes may be either dropped on the soil surface or carried into a container. Machinery for harvesting potatoes with bagging attachments has been used since 1940. These machines have more recently been converted to load directly into trucks or bulk bodies.

Hot Peppers: This is one crop that has not been given much publicity as a Louisiana crop. It is, however, a very high cash value crop, but requires much hand labor for harvesting; therefore, farmers have been reluctant to increase the acreage of pepper. There are about 2500 acres grown in Louisiana each year. The L.S.U. Agricultural Engineering Department is conducting tests on a vibrating type of harvester for Tabasco peppers. Tests for mechanically harvesting the Cayenne pepper are planned for this coming season. If machinery for harvesting hot peppers can be developed, acreage in this crop will increase appreciably.

NATURE OF RESEARCH IN THE FUTURE

Along with the forced use of harvesting machines is the necessity for changes in cultural practices such as type of row, row spacing, and cultivation techniques. In most instances these cultural practices can be adapted to meet the requirements of harvesting machinery. For example, spinach or radishes can be produced on beds of a width that will match the width of harvesters; fertility practices can be modified according to changes in plant populations; cultivation procedures can be altered to conform to the conditions

required by harvesting equipment. Many such adaptations will have to be worked out experimentally, but these should evolve rather rapidly. The use of plastic mulch should increase and suitable plastic-laying machines are now available that can lay the plastic on the rows even under adverse weather conditions.

There is a real need for a transplanter that will set the plants through the plastic, since it is necessary to lay the plastic before planting. Such a transplanter is now being tested at a number of experiment stations, but I understand that it is not yet completely satisfactory. The development of this type of machine should be given a high priority.

One agricultural commodity that has received from little to no attention as to mechanization is floriculture. Estimates show the total sales of Louisiana nurserymen for 1966 to be approximately $2.5 million. One of the immediate needs of these nurserymen is a machine that will mechanically dig and wrap the plant roots of the nursery plants.

Many plant breeding programs have already been initiated as a result of increased emphasis on mechanical harvesting. Undoubtedly, many others will be started in the future. Some of the varieties of certain species now available are suitable for machine harvesting; but with other crops, few, if any, varieties are ideally suited to mechanized harvesting. The importance of developing varieties for this purpose is emphasized by the public statements of many workers in the field of vegetable production and processing to the effect that within the next ten years, vegetables and fruits that cannot be harvested by machinery will probably disappear from agriculture, or at least become specialized crops. Plant breeders in the future must put as much emphasis on the physical features of the plant that enables mechanical harvesting and handling as they have put on quality, yield, and other characteristics in the past. Such items as dwarf vine growth, concentrated fruit set, uniformity of color and maturity, resistance to mechanical injury, and others will also have to be criteria for selecting varieties.

SUMMARY

Mechanical harvesting of vegetable crops will receive more attention in the future as harvest labor becomes less available. At present, the use of mechanical harvesters shows promise of reducing the amount of labor, but the total harvest cost may not be decreased. Most mechanical harvesters have not been developed to the point of entirely preventing bruising and breakage of the vegetables which renders them unsuitable for the fresh market.

The uncertainty of the availability of harvest labor, coupled with a tightening of state and federal regulations governing housing and facilities for such laborers, are the prime motivating factors behind the pressure to develop mechanical harvesters. Harvesting vegetables and fruits mechanically may not be cheaper to begin with, but at least the farmer would be assured that he can harvest his crop after he goes to the expense of growing it. Farmers are so concerned about having labor available to harvest crops, they are hesitant about planting those that cannot be harvested mechanically, or with their regular labor force.

Mechanization brings about marketing problems which are created by the large amount of bruising and breakage of vegetables that often occurs during mechanical harvesting. This may not seriously impair processing quality, provided the delay between harvest and processing is kept to a minimum. On the other hand, bruised and broken produce does not appeal to the fresh market consumer.

Another problem brought about by once-over harvesting of vegetables is that all stages of maturity are harvested at one time. This is particularly serious in a crop such as tomatoes where the fruit may vary from a state less than mature-green to that of dead-ripe. Some of the fruit would be suitable for processing, some for fresh market, but a portion of it would be unsuitable for any of the established markets. Of course, this problem could be minimized by working out indices for predicting the stage of development most desirable from an economic standpoint and seeking uses of the immature fruits.

Another factor that must be considered is that the farmer will have to have additional investments in machinery and equipment. Tractor-mounted bean pickers may cost $12,000 to $17,000 each; potato harvesters may cost from $9,000 to $12,000 and the mechanical tomato harvester will probably be in the $15,000 to $18,000 range.

Processors in some areas maintain and operate harvesting equipment on a custom basis. Advantages of this system include better scheduling of deliveries to the processor and a reduced initial per acre investment. In most instances, however, processors would prefer to stay out of the farm operation, if possible.

In order to perfect mechanical harvesting or any phase of mechanization, the plant breeder, horticulturist, agricultural engineer, and farm machinery manufacturers must work together as a consolidated team.

EFFECT ON TEACHING

It is imperative that the college teacher be informed on the status of the development of farm machinery and that he know the impact of these changes on his teaching approach. Adequate laboratory facilities or close cooperation with producers in internship programs will be necessary to prepare the undergraduate for on-the-farm production or for professional services with agricultural industries and agencies.

A new look at production courses in horticulture is definitely in order.

New Publication Sought

Dr. Benton K. Bristol, Associate Professor of Agriculture, Illinois State University, Normal, Illinois, is leading an effort to establish an Agricultural Mechanization publication. The following have been published:

Agricultural Mechanics Newsletter – Ideas – Information – Suggestions, November 1967; Agricultural Mechanization – Ideas – Information – Suggestions, March 1968; Feasibility Study of Agricultural Mechanization Publication, February 1968; Instructions for completing survey form and a survey form for the purpose of Collecting Information to be Published in a Directory for Agricultural Mechanics Personnel in Colleges and Universities.

If you are interested in the above, please contact Dr. Bristol.