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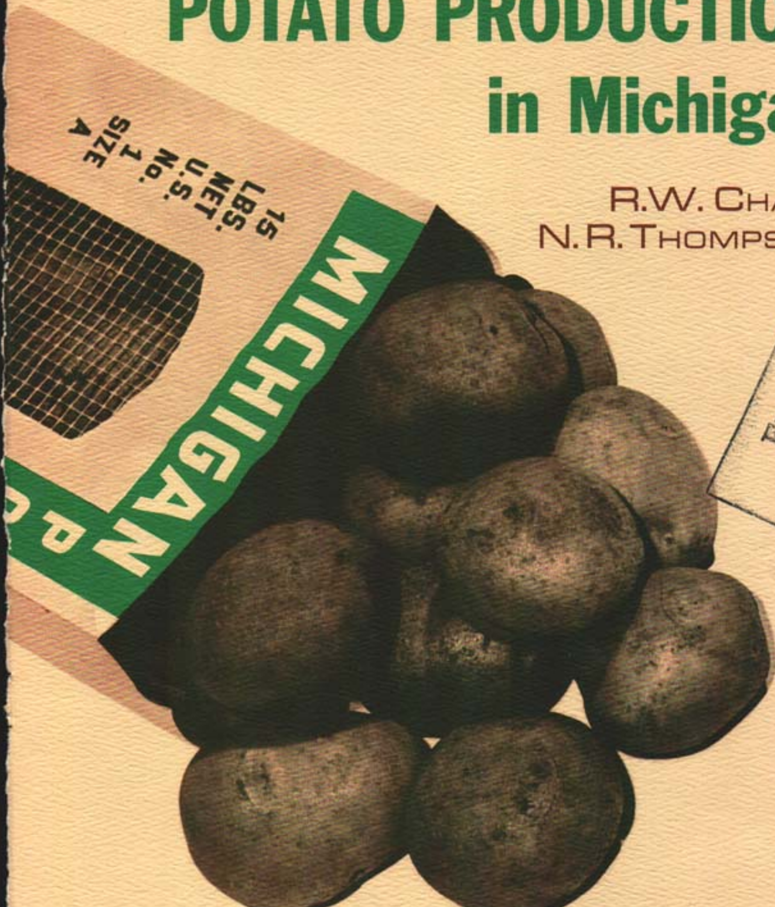
POTATO PRODUCTION in Michigan

R.W. CHASE
N.R. THOMPSON



Cooperative Extension Service
Michigan State University

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POTATO PRODUCTION IN MICHIGAN

By R. W. Chase and N. R. Thompson
Dept. of Crop Science
Michigan State University

Potato production in Michigan has progressed from a few acres on many farms to a highly specialized business on fewer and larger farms. This increase in specialization has brought about a decrease in the total potato acreage but the yield per acre has more than doubled. Michigan, once an exporter of potatoes, has become a deficit state, partially dependent upon other areas for supplies. Michigan has the production capacity, nearby markets and transportation facilities with which to become the leading potato processing and marketing outlet East of the Mississippi.

Since World War II the per capita consumption of processed potato products has risen sharply. This change in consumer requirements has created new problems for the grower and Michigan potato producers are adapting to meet their new challenge.

UTILIZATION

Fresh Market

Michigan "round whites" have traditionally been offered on the fresh produce market as a general purpose potato. Eye appeal is one of the most important factors influencing consumer preference. In the more discriminating market, which reflects a higher per capita income, more emphasis must be placed on a quality package. Dry brushing, to remove most of the soil, once produced an attractive package. Today, washing is required to compete in the market. In addition to a clean product, uniformity of size adds to eye appeal. As packages have decreased in weight, uniformity of tuber size becomes more important. To successfully compete for the consumers' dollar, potatoes should be washed, carefully graded and sized, attractively packaged and labeled as to use. The fresh market has always been and will continue to be an important outlet for the Michigan potato industry.

Processing

Processed products account for the increased per capita consumption in potatoes. Uniformity is essential in packaged products, and, processors have specific requirements for the raw products. Selection of a variety and proper cultural practices will meet these requirements.

The potato chip industry in the North Central region uses one million hundred weight of potatoes annually. Michigan could supply a larger volume of this trade. Potatoes for chipping should be high in total solids and low in reducing sugars. The raw product requirements for frozen French fries, dehydrated, and the many "convenience" packages, except for reducing sugar content, are similar. This is a new and expanding market in Michigan.

GROWTH REQUIREMENTS

Weather and soil type influence the yield and quality of potatoes. Not only total rainfall and mean temperature are important but a complex of rainfall distribution, extremes in temperature, length of growing season, and day length.

Soil

The most desirable soils for the highest yield and best quality potatoes are sandy, gravelly, and shale loams; they should be well drained, well aerated, and well supplied with organic matter and available plant food. Such soils are easily tilled, warm quickly in the spring to permit early planting, allow tubers to develop good shape, and simplify harvest operations. Potato roots, stolons, and tubers occupy a considerable volume of soil space. Peat and muck soils are particularly adapted to potato production if well drained, adequately fertilized and frost free during the growing season.

Temperature

The potato is a cool weather crop. The ideal average day temperature should seldom exceed 70°F. Cool night temperatures are more essential than cool day temperatures for accumulation of total solids in the tubers. The ideal temperature for photosynthesis is 68°F., and for tuber formation, 60° to 65°F.

Moisture

The potato plant is highly succulent, the tubers containing approximately 80% water. The crop needs adequate soil moisture throughout the growth cycle.

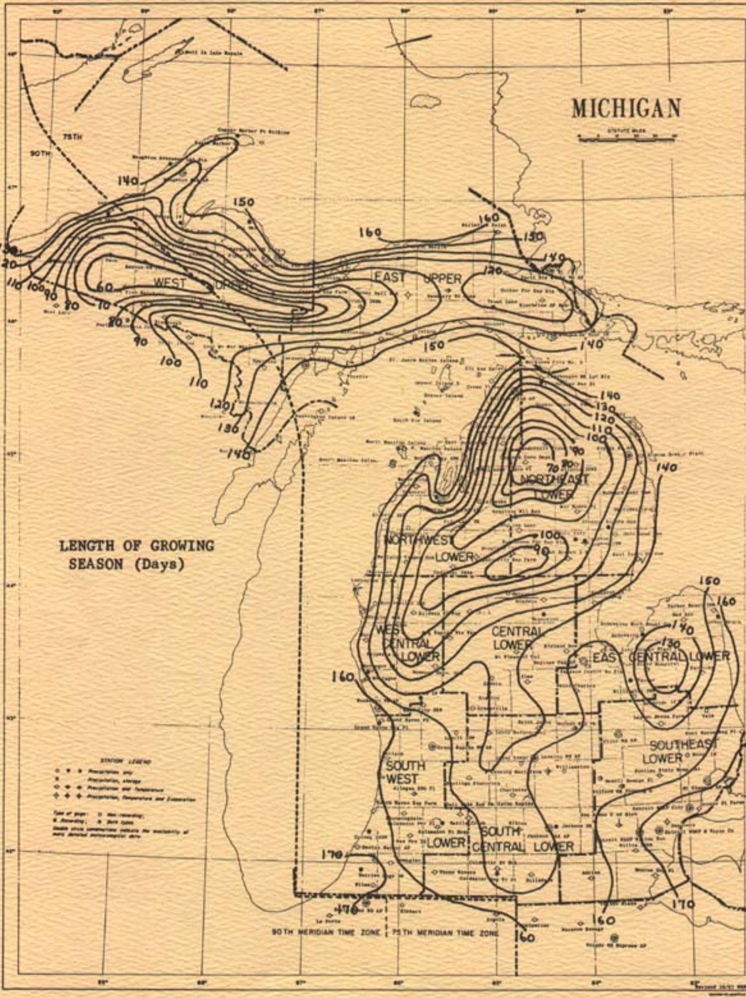


Fig. 1. — Length of growing season. The number of days between the average date of the last freezing temperature (32° F or colder) in the spring to the average date of the first freezing temperature in the fall. (Data furnished by A. H. Eichmeier, U. S. Weather Bureau, East Lansing.)

Rainy weather following periods of drought cause second growth, growth cracks, and hollow or knobby tubers in many varieties.

Day Length

Long days increase vegetative top growth whereas short days hasten maturity. Under short days, leaves tend to be soft and more susceptible to late blight. For example, the Sebago variety grown in winter in Florida is susceptible to late blight, yet in Michigan in summer it is moderately resistant.

Length of Growing Season

Yield of total solids per acre is usually a direct function of length of growing season, hence, early planting should be encouraged. Michigan, because of its position with respect to the Great Lakes and its geographic extent, has a great deal of variation in dates of the last freeze in the spring and the first freeze in the fall (Fig. 1).

VARIETIES

Variety selection is essential to the production of a top quality potato crop. The variety must be adapted to the soil and cultural conditions under which it is to be grown, and must meet the market requirements, whether it be all purpose tablestock, processing, chip production, seed, or combinations thereof.

Varieties have differing requirements for planting, growing, harvesting and storage. In Michigan trials, varieties have exhibited the following characteristics:

Arenac. — white skin, shallow eyes, immune to virus X, resistant to scab and late blight. Yield is medium; high specific gravity. Excellent processing and baking potato, but not recommended as an all-purpose potato. Shatter bruise has been observed.

Cherokee. — white skin; resistent to scab, late blight, and mild mosaic. Yield is medium; high specific gravity and good cooking quality. Susceptible to storage breakdown if severely bruised and injured during pre-storage handling.

Chippewa. — white skin, shallow eyes; resistent to mild mosaic and net necrosis. Very susceptible to leaf roll, rugose mosaic, scab and chilling injuries. Low specific gravity and good cooking quality.

Emmet. — white skin, shallow eyes; immune to virus X, resistent to scab and late blight. Susceptibility to Verticillium wilt and shatter bruise has been observed. Yield is high; medium to high specific gravity. Excellent cooking qualities and will chip at harvest time; but usually does not recondition. Produces best with uniform moisture.

Katahdin. — white skin and shallow eyes. Yield is high; medium specific gravity and fair culinary quality. Wide range of adaptability to soil, climate, and cultural conditions. Tendency to after-cooking-darkening increases with length of storage.

Kennebec. — white skin, shallow eyes; resistent to late blight, mild mocaic and net necrosis. Very susceptible to Verticillium wilt and should not be grown where this disease is known to be a problem. Also susceptible to scab, leaf roll, spindle tuber, and shatter bruise. High yielding, high specific gravity, and very desirable for chip manufacture.

Merrimack. — white skin, shallow eyes; resistent to ring rot, late blight, and net necrosis. Yield is medium; high specific gravity. Excellent processing potato.

Norland. — red skin, shallow eyes; moderate resistance to scab. Low specific gravity and good cooking qualities. Produces a high percentage of U.S. No. 1 tubers.

Onaway. — white skin, medium deep eyes; resistant to scab and late blight. High yielding; low specific gravity with good cooking quality early in season. Poor processing variety. Does not store well, as tubers are very susceptible to early blight rot in storage. Recommended for late summer and early fall market.

Russet Burbank. — skin netted and russeted, tubers long; some scab resistance. Susceptible to late blight, leaf roll, net necrosis, and Verticillium wilt. Excellent cooking and processing qualities. Best results on a highly productive soil with irrigation.

Russet Rural. — skin netted and russeted, shallow eyes; scab resistant. High specific gravity and variable culinary qualities. Tendency to after-cooking-darkening increases with length of storage.

Sebago. — white skin, shallow eyes; resistant to mild mosaic, net necrosis, scab, and late blight. Medium specific gravity and a good all-purpose potato.

The following variety characteristics are based on limited Michigan trials:

Norgold Russet. — released by North Dakota in 1964. Skin netted and russeted, shallow eyes; scab resistant. Tuber shape is similar to Russet Burbank, but much smoother and less susceptible to knobs and off-shaped growth. Medium specific gravity. A good boiler and baker, but a poor chipping variety. Hollow heart has been observed.

LaChipper. — released by Louisiana in 1962. White skin, medium deep eyes; some resistance to late blight. Medium specific gravity and good chipping quality.

Snowflake. — released by North Dakota in 1961. White skin, shallow eyes; resistant to virus Y but susceptible to other viruses, scab, and blight. Medium-high specific gravity and very good cooking and processing quality.

Superior. — released by Wisconsin in 1961. White skin, shallow eyes, resistant to scab. Medium yield, medium specific gravity and good cooking quality. Very acceptable in tuber shape and appearance.

Harvest Dates

Assuming a planting date of May 10-15, an average Michigan growing season should produce an acceptable yield of marketable tubers at the time indicated below:

Early August
Irish Cobbler
Norland
Cherokee
Onaway

Late August
Chippewa
Snowflake
Superior
Norgold Russet

Early September
Arenac
LaChipper

Late September
Emmet
Katahdin
Kennebec
Russet Burbank

Early October
Merrimack
Russet Rural
Sebago

Specific Variety Features:

Recommended on muck soils. — Arenac, Cherokee, Katahdin, Chippewa, Norland, Sebago, Superior.

Resistant to scab. — Arenac, Cherokee, Emmet, Norgold Russet, Norland, Onaway, Russet Burbank, Russet Rural, Sebago, Superior.

Resistant to late blight. — Arenac, Cherokee, Emmet, Kennebec, Merrimack, Onaway, Sebago.

Excellent chip quality. — Arenac, Kennebec, Merrimack.

Excellent boiling quality. — Cherokee, Chippewa, Emmet, Norland, Sebago.

Excellent baking quality. — Russet Burbank, Arenac.

LAND PREPARATION

Minimum Tillage

Minimum tillage principles have been advantageously adopted by many potato growers.

Frequently, land intended for potatoes is seeded to winter rye or oats. The land should be worked with a heavy disk and/or a field cultivator before plowing to eliminate vegetation and conserve moisture.

After the initial disking and field cultivator operation, the plowing and firming are done in one operation. A spike tooth harrow, clod buster, open faced roller or packer, or rotary hoe pulled in reverse are all acceptable to use in tandem with the plow. The tandem operation reduces the number of field operations thereby saving time and expense. For maximum benefits, plow 6 to 8 inches deep and plant the same day.

Rotations

Potatoes should be planted in a planned rotation to maintain soil fertility, build up organic matter, and reduce losses from weeds, insects, and diseases. Long rotations are best for reducing losses caused by such soil borne organisms as Verticillium wilt, Fusarium wilt, and scab. Three- and four-year rotations are commonplace when potato production is one facet of a mixed farming enterprise. When potatoes provide the main source of income, it may be necessary to grow potatoes more often on the best adapted soil.

One of the most important contributions of a rotation is that of supplying and maintaining organic matter. An ample supply of decaying organic matter helps keep the soil loose and mellow, permits easier root penetration, retains moisture, and is a continuing supply of plant nutrients. Tubers develop more nearly normal shape where there is an ample supply of organic matter.

Selection of crops to grow in the rotation is governed by each particular enterprise. Leguminous crops, which "fix" nitrogen from the air and return large crop residues, are valuable. Non-leguminous crops, fertilized with nitrogen, are equally as good.

Crops such as corn, alfalfa, lupines, oats, clover, wheat, rye, buckwheat, sundangrass, Japanese millet, and sorghum-sudan hybrids have been used in a crop rotation program with potatoes. In recent years many seed growers in Northern Michigan have successfully grown Foundation field beans, which provides an additional income crop in the rotation. Sudangrass and similar annual grasses are better adapted to Lower Michigan where growing temperatures are higher. Japanese millet grows well in most Michigan areas and performs better than sudangrass on the wetter and colder soils.

Rye is used as a winter cover crop in most rotations because it can be seeded late, and will germinate and produce a crop at low temperatures with little winter killing.

Fertilization

Analysis data have shown that a 360 cwt. or 600 bushel yield per acre potato crop will require the following nutrients:

	N Lbs.	P_2O_5 Lbs.	K_2O Lbs.	Mg. Lbs.
Tops	70	15	175	25
Tubers	90	30	200	15
Total	160	45	375	40

The best fertilization program starts with a soil test from samples taken in the late fall. Information on pH and available phosphorus, potassium, calcium, and magnesium enables your county extension agent to make the most profitable recommendation for the use of lime and both major and micro-nutrients. Consult MSU Extension Bulletin 498 "Sampling Soils for Fertilizer and Lime Recommendations," for the proper method of taking accurate soil samples.

Fertilizer recommendations should be based on the soil management group, previous crops, soil test and the yield goal. MSU Extension Bulletin 550, "Fertilizer Recommendations" and MSU Research Report 31 give complete information on fertilizing potatoes on mineral and organic soils.

Weed Control

The main reason for cultivating crops is to control weeds. Herbicides often control weeds at a considerable saving, and may be effective on weeds which normal tillage does not control.

Quackgrass

Quackgrass is one of the most troublesome weeds in potato fields. Quackgrass is a perennial which spreads by underground stems (rhizomes) and by seed. Late in the growing season, quackgrass rhizomes may actually penetrate the growing tubers and leave unattractive holes. A severe infestation can affect tuber quality and cause excessive gradeout. The gradeout due to this problem is determined on the basis of the length of holes. Quackgrass sod also causes harvest problems because the large grass clumps interfere with efficient digging and harvesting.

Cultural Control

Summer fallowing may be effective; however, it is time-consuming and expensive. A field cultivator is the most effective implement in a summer-fallow tillage operation. It is not necessary to plow prior to using the field cultivator. The first 2 or 3 operations should be made without waiting periods in between, with the first cultivation shallow and the succeeding cultivations deeper. Thereafter, the field should be worked at 10 to 14 day intervals.

Chemical Control

Dalapon will control quackgrass when applied in the fall at the rate of 12 pounds per acre. Generally, the application should be made between September 15 and October 15 when quackgrass is actively growing and 4 to 8 inches tall. When possible, plow 10 to 14 days after spraying, unless a good freeze occurs during the 10- to 14-day period. Rye cannot be planted after a fall dalapon application.

Potatoes are tolerant to soil residues of dalapon (except red skin varieties, where dalapon residues may cause a bleaching of the red color) so spring applications of dalapon on quackgrass are possible. For spring applications, use dalapon at 10 pounds per acre when quackgrass is 4 to 8 inches tall, and plow 10 to 14 days after spraying. If the area has been seeded to winter rye, it will be necessary to use a field cultivator to destroy the rye cover. Apply dalapon when quackgrass regrowth is 4 to 6 inches tall. When spring applications are to be used, oats should be grown as the winter cover. Oats will winterkill and dalapon can be applied directly to the quackgrass foliage when it is 4 to 6 inches tall.

When using dalapon for quackgrass control, use 30 to 40 gallons of water per acre, so that adequate foliage cover is obtained. To stimulate foliage growth and obtain more complete control, apply 40 pounds of nitrogen per acre to the quackgrass sod 4 to 6 weeks before treatment.

For more details on both quackgrass control, and for annual weed control, see Extension Bulletin E-434 for the specific herbicide recommendations.

SEED PREPARATION

The most important item in the success of a potato crop is the seed and "it should be handled as though the crop depended on it." It is essential that growers obtain the best seed available and handle it to preserve its vigor and quality. Commercial growers should always use certified seed. Many growers find it advantageous to use Foundation seed to develop a seed-tablestock program.

Seed Storage

Many Michigan growers, particularly those who grow the Onaway variety, purchase their seed in the fall to assure a supply and permit control of storage and preparation for planting. Seed so purchased should be removed from the bag and placed in a clean, disinfected, controlled temperature storage. If seed must be stored in bags, do not make piles over six sacks high, and leave adequate space between piles for ventilation. Pallets, thoroughly cleaned and disinfected, are ideal for storing seed.

Storage temperature and humidity can affect seed quality. Seed should be stored in a well ventilated place at 38 to 40°F. and 80 to 90 percent relative humidity until the pre-plant warming period. High temperatures and free water on the potatoes encourages early sprouting which if excessive, will reduce vigor. If sprouts are too long and will interfere with efficient planter operation, de-sprouting may be necessary. Proper storage environment should control sprouting until planting; however, if necessary, de-sprouting should be done 7 to 10 days before planting to allow adequate time for new sprouts to develop. Reduced yields may result if seed is de-sprouted more than once.

Preparing seed for planting

The ideal tuber for planting should be firm and beginning to sprout. The sprout should not be over ¼ inch in length to prevent injury during planting. Expose the seed to temperatures of 55° to 65°F. for 10 days to 2 weeks before planting to initiate sprout activity and to encourage more rapid emergence after planting.

Cut seed vs. whole seed

Many growers prefer to plant whole B-size seed. Uncut seed offers several advantages: (1) no disease spread by cutting knives; (2) elimination of the expense and time of cutting; and (3) frequently a better stand is obtained. Under adverse weather conditions, particularly cold, wet soils, whole seed will produce a better stand than freshly cut seed.

For cut seed, blocky seed pieces are most desirable and should weight from 1½ to 2 ounces. Growers who plant freshly cut seed should adjust their cutting schedule to the planting operation and plant as soon as possible after cutting. Do not leave cut seed in hot drying sun and wind.

Seed may be cut well ahead of planting, provided storage conditions are satisfactory for suberization. The cut seed should be held for a week to 10 days at 60° to 70°F. and 85% relative humidity with adequate ventilation. Slatted crates are desirable for storing cut seed. Wet burlap placed over the crates provides the necessary relative humidity and proper ventilation without excess water. Large, blocky seed pieces properly suberized are equal to whole seed in producing a desired stand.

Seed Treatment

Seed disinfection affects only disease organisms carried on the surface of the tuber and has no effect on disease organisms within the seed piece or in the soil. Materials such as Semesan Bel, which is a mercury dip, or captan plus streptomycin, which may be applied as a dust or dip are used by many growers. Seed treatment with captan plus streptomycin may reduce blackleg, particularly in the Sebago variety.

Researchers have reported that in some instances Semesan Bel will reduce Verticillium wilt infection in fields planted to a wilt susceptible variety such as Kennebec. Such treatment will not guarantee a wilt-free crop, but may be a deterrent to contamination of non-infected soil.

If seed is to be treated, it is essential that the manufacturers directions be followed. Improper seed treatment will be detrimental. Seed treatment should not be used to replace sanitary practices and the use of tagged seed.

Plant Stand

The correct plant population for a variety is essential for a maximum yield of marketable tubers. Factors which can reduce seed vigor and result in poor stands are: storing in poorly aerated storages which may be too cold or too wet; planting in a cold, wet soil (soil temperature below 45°F.); planting in a hot, dry soil; and planting poor quality non-certified seed. The planter must be properly adjusted to pick and place a seed piece at the desired interval. Missing plants reduce potential yield.

PLANTING THE CROP

Time of Planting

The soil temperature at the seed piece level should reach at least 45° and preferably 48° to 50°F. before planting. In Lower Michigan, April 25 to May 15 is the time for potato planting and in Northern Michigan and in the Upper Peninsula, May 15 to 25. Certain regions in Michigan have unique weather patterns and potatoes for early harvest can frequently be planted in mid to late April. The important consideration in time of planting is soil temperature.

Depth of Planting

The major consideration in the overall planting operation is to provide the best possible environment for rapid emergence. The sooner the plant emerges and begins to manufacture its own food, the stronger the young plant will be, and consequently more resistant to attacks by blackleg, rhizoctonia, and seed piece decay.

Greater care in the practice of planting deep and covering shallow should result in improved stands. Seed pieces should be placed 3 to 4 inches below the soil surface and covered with 2 to 3 inches of soil. This procedure encourages rapid emergence, yet the seed piece is deep enough to allow tuber set to occur well below the soil surface. Once the plant is established, subsequent cultivations can be timed to hill the potatoes as desired.

Plant Populations

Row widths vary from 32 to 36 inches depending upon the planting equipment. Seed pieces of round white varieties such as Sebago, Katahdin, Arenac, Emmet, Onaway, and Kennebec are planted 9 to 10 inches apart in the row. Many growers space the Onaway at 7 to 8 inches. This closer spacing helps prevent the development of oversize tubers. Russet

Correct plant populations are essential for maximum yields.

Rurals should be planted at 10 to 12 inches, Norgold Russet at 10 inches, and Russet Burbanks at 13 to 15 inches. The Russet Burbank sets a large number of tubers and closer spacings may produce too many undersized tubers, unless the soil fertility level is high and moisture is not limiting.

Amount of Seed

The amount of seed required per acre will depend on the variety, the size of the seed pieces, and the row and plant spacings (Table 1.)

Fertilizer Placement

Planting equipment should apply the fertilizer in a band about 2 inches to each side and slightly below the seed piece. Fertilizer which comes in contact with the seed piece will retard germination and produce weakened plants. When the fertilizer application exceeds 800 pounds per acre, the additional fertilizer should be broadcast before tillage operations and incorporated into the soil. If needed, additional nitrogen can be sidedressed or applied in the irrigation water. Where high rates of fertilizers are being applied, the use of high analyses should be considered. This will reduce the bulk and weight of material to be handled and stored, and will save time and labor at planting.

Table 1. Seed Potatoes Required to Plant One Acre at Different Spacings with Seed Pieces of Various Weights.

Row spacing and spacings within the row	Seed required per acre when seed pieces weigh an average of			plants per acre
	1 ounce Cwt.	1½ ounces Cwt.	2 ounces Cwt.	
32 inch rows				
6 inch	20.5	30.7	40.9	32,670
8 inch	15.3	22.9	30.6	24,502
10 inch	12.2	18.4	24.5	19,602
14 inch	8.7	13.1	17.5	14,001
34 inch rows				
8 inch	19.2	28.8	38.4	23,061
10 inch	11.5	17.3	23.0	18,448
14 inch	8.2	12.4	16.5	13,177
36 inch rows				
8 inch	18.1	27.1	36.1	21,780
10 inch	10.9	16.3	21.8	17,424
14 inch	7.7	11.6	15.5	12,445

GROWING THE CROP

Disease and Insect Control

Spraying for the control of diseases is a preventive measure therefore, it is essential that a definite spray schedule be established and conscientiously followed. After a disease affects the plant, little can be done to cure it, but much can be done to prevent its spread to other plants in the field or in adjoining fields. The spray schedule should start when the plants are 4 to 6 inches tall. During the early growing season, a 7- to 10-day schedule is usually adequate. As plants become larger with more vines and leaves, the interval should be shortened to 5 to 7 days to keep the new growth protected.

The use of systemic insecticides has become very popular in recent years. The materials phorate (Thimet) and DiSyston are applied as a granule at the time of planting. A special attachment consisting of a hopper and tubes leading to the front of the open row is attached to the planter. The material is placed in the band with the fertilezer. These materials are effective for the control of aphids, flea beetles, Colorado potato beetles, and leafhoppers. Dry soil conditions will reduce the effectiveness of these systemics. As plants emerge, check for flea beetle damage. Additional spray insecticides may be necessary until adequate moisture activates the systemic. Late in the season the systemic may not be sufficient to control insects, particularly aphids. Additional insecticides may be necessary, particularly for lots being grown for seed.

The success of a disease and insect spray program depends on the thoroughness of plant coverage. Two types of sprayers are commonly used in Michigan, the boom nozzle sprayer and the air blast sprayer. The use of air applications is also becoming popular in some areas. The boom-nozzle sprayer should be equipped with two, three, or four nozzles per row. If drop nozzles are used, they should be positioned so that one nozzle is on each side of the row. These nozzles should be directed slightly forward for adequate coverage of the lower plant portions. If there are two upper nozzles, they should be adjusted to give complete coverage of the upper half of the plant. To get good coverage, use 80 to 150 gallons of water per acre, the lower range for initial spraying when plants are small, and the higher for late-season sprays.

Successful disease and insect spray control depends on timeliness and thorough plant coverage.

Air blast sprayers will deliver pesticides in concentrated forms. The spray material is injected into an air blast across the rows. Checks should be made to insure adequate spray coverage to determine the effective spray area.

Follow the manufacturer's recommendations regarding proper lubrication and any special care required. Clean the sprayer after each use. Drain and flush with clean water. Always be sure nozzles are cleaned and are free of dirt, grit, and particles which disrupt a normal spray pattern.

For specific details on insect and disease control materials, consult MSU Extension Bulletin 312, "Chemical Control of Insects and Diseases on Commercial Vegetables."

Irrigation

The economic value of irrigation in Michigan is dependent upon the availability of suitable water, the soil type, and the unit size. Results in Michigan have shown yield increases of 70 to 110 cwt. per acre when supplemental irrigation was combined with a superior level of management. Research has indicated that highest yields of potatoes were obtained when available soil moisture was not permitted to fall below 50 percent.

In addition to yield response, the effect of irrigation on alleviating tuber defects is important. This has been demonstrated on Russet Burbanks and other varieties such as Emmet. Tuber defects such as growth cracks, knobs, hollowheart, and off-shapes are kept to a minimum if the tuber growth and development is kept uniform during the growing season. Defects may occur when there is an abrupt change in the growth pattern; therefore, irrigation management should be geared to produce a uniform and steady rate of growth.

CROP HARVEST

Topkilling

The need of an artificial method of topkilling has resulted from improved fertilization, insecticides, and fungicides. Artificial topkilling will: (1) facilitate

POTATO PRODUCTION IN MICHIGAN

(Extension Bulletin 546)

IMPORTANT NOTICE

Since this bulletin was written, the Federal government has cancelled registration of sodium arsenite as a potato vine killer. Sodium arsenite can no longer be used for this purpose.

-November, 1970.

earlier harvest; (2) promote a firmer skin-set and thereby reduce skinning and bruising during the harvest operation; (3) control tuber size; (4) control the spread of certain virus diseases and (5) prevent the spread of late blight from the foliage to the tubers.

Weather and market conditions are probably the most important factors to be considered when deciding the harvesttime. The harvest period in Michigan begins in late July in Bay County and continues through October in the northern areas.

Potatoes harvested when the plants are immature are very susceptible to skinning, bruising, and breakdown during the marketing process.

Tubers will continue to grow some after topkilling, which should be done 10 days to two weeks before harvest. A desired vine kill takes 4 to 6 days. More rapid kills may reduce yields and specific gravity, and cause stem-end discoloration. Sodium arsenite is recommended and growers are advised to follow the manufacturer's recommendations. Sodium arsenite should be applied at least 7 days before harvest and should not be applied to exposed tubers.

If a late blight infection exists in the foliage, apply copper sulfate at 15 pounds per 100 gallons of water per acre before harvest.

Beaters with rubber flails or chains can be used to destroy vines. The beaters must be run high enough to avoid disturbing the soil on top of the row and injuring tubers near the surface. Where conventional potato diggers are used, the combined methods of chemical and mechanical topkill will facilitate the harvest operation. Where harvestors are used, vines should be killed but not mechanically beaten. The dead vines will help provide a cushion for the potatoes and thereby reduce mechanical damage. They also make the devining attachment work more efficiently.

Harvesting to Maintain Quality

Do not dig potatoes for storage until after the vines are dead. This reduces the incidence of skinning and bruising. Plan to harvest before the soil temperature drops below 45°F. Potatoes to be used for processing should be harvested at soil temperatures above 50°F.

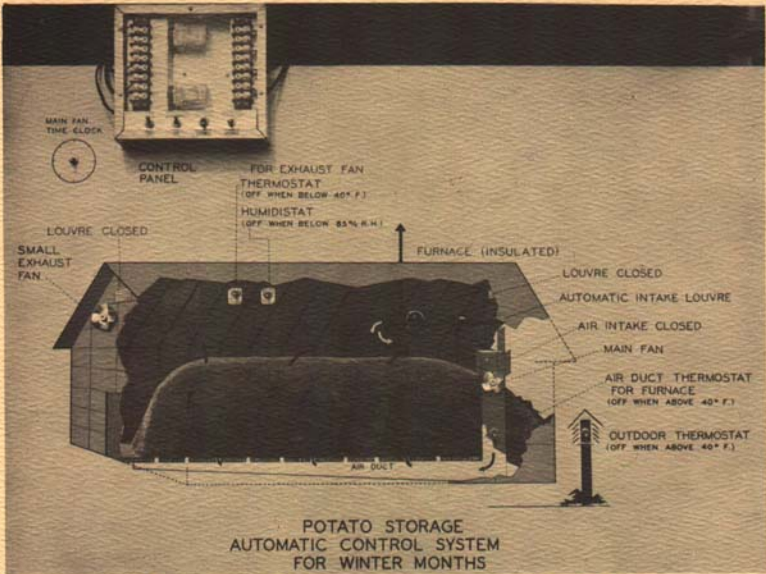
Slow speed harvester operations mean less injury to the tubers. Adjust digger or harvester deep enough to prevent cut tubers and to carry soil three-quarters of the length of the digger chain to provide a good soil cushion for the potatoes. A share operating only a half-inch too deep can mean handling an extra ton or more of soil per minute if at the speed of only 2 mph. If possible, do not operate the digger at more than 1½ miles per hour or the digger chain at more than 125 to 150 feet per minute. Eliminate all drops of more than 5 to 6 inches, pad truck beds and sacking platforms with a rubber or polyfoam material, and pad elevator and piler chains with rubber tubing. Avoid sharp edges and pad all areas on which potatoes will be dropped. Protect freshly dug potatoes from hot sun and drying winds.

Handling into Storage

Potatoes should be rough-graded as they go into storage to remove rotted and severely bruised tubers. Some growers remove "B" size potatoes to plant whole the following year.

Pre-storage washing is not practiced to any great extent but research is currently underway to determine the feasibility of this practice. Some of the advantages of pre-storage washing are: the soil is more easily removed; tuber defects are more readily seen and can be discarded before potatoes go into storage; and, if combined with a disinfecting material, it may prolong keeping quality.

Mechanized harvest includes stone removal and air separation.



Controlled environment of potato storages is essential to maintain potato quality after harvest.

STORAGE AND STORAGE MANAGEMENT

Maintaining the quality of the potato crop does not end with the harvest, but carries over into storage management. The storage should be of sound construction so that temperature, humidity, and air movement can be properly controlled. Growers should contact their county extension office for assistance in planning, designing, and construction of storages.

Prior to harvest, the storages should be thoroughly cleaned and disinfected with copper sulfate or quaternary ammonium compounds.

The first two weeks after harvest is referred to as the curing period. A temperature during this period of 55°F. and a relative humidity of 90 percent accelerates suberization and healing of bruised and damaged areas. Following this period, the temperatures may be lowered as soon as possible to the desired storage temperature. For short storage periods and, particularly for potatoes held for processing, temperatures of 50° to 55°F. are desirable. For longer storage periods where sprouting may be a problem, the temperature should be 40°F. A relative humidity of 85 to 90 percent will prevent excessive shrinkage and weight loss.

Ventilation in the storage bin is essential: (1) to circulate air through the pile to carry off the field heat; (2) to carry off excessive moisture; and (3) to regulate temperatures and humidity. A good system allows the mixing of warm inside air and cold outside air to bring the circulated air to the proper temperature. With the increased use of harvesters, potatoes are going into storage with considerably more moisture than when hand picked. Adequate ventilation will carry off the excess heat and moisture. A main fan capable of delivering air at one cubic foot per minute for each 150 pounds of potatoes is necessary. Delivery ducts should be spaced no more than 10 feet on centers.

An exhaust fan should be provided to deliver approximately 3.0 cubic feet per minute of air for each ton of potatoes in the storage.

A good circulation system will include a source of heat to warm the storage air or cold air brought into the storage. The purpose of supplemental heat is to permit the introduction of outside air during cold weather. For example, to maintain storage at 40°F. in Michigan, a furnace capacity of 120,000 BTU per hour per 40,000 bushels is necessary. The walls must have a good vapor barrier at the inside surface.

When the potatoes are first brought into storage from the field, the fans should be operated to remove excess moisture and heat. After the desired temperature and humidity are reached, the air movement should be only adequate to control temperature and humidity, yet not dry or shrivel the tubers. Some ventilation is needed in winter to remove water vapor and heat produced by the potatoes, and to prevent moisture condensation on the ceiling.

Storing "Frost Bitten" Potatoes

If field frost is a problem, steps to remove excessive moisture from frosted tubers must be taken to minimize breakdown in the storage. Maintain the temperature of the tubers at 40°F. (plus or minus 2°F.) and force air through the pile with the main fan system. Spread and level the bulk pile to be as shallow as possible, and be on the alert for unusual odors such as ammonia. Try to keep warm, moist grading room air from entering the storage. Allow the relative humidity of the storage to drop to 80 to 85% for greater moisture absorption from the pile.

Exhaust air from the storage steadily, when the outside replacement air is 44°F. or lower. The colder the outside air, the more moisture it will absorb from the potatoes, provided it is heated upon entering the storage. Blend the heated fresh air with the recirculated air at the intake to the main duct. The more cold air which can be taken into the storage and heated, the faster the pile will dry. If the outside temperature is above 44°F. do not introduce air into the storage, because moisture in the warm air will condense on the colder potatoes. Don't close the storage tightly during cold weather, but exhaust at a rate up to the capacity of the furnace to heat the entering air until the pile is "dried out."

Sprout Inhibitors

In certain situations, it may be advisable to use a chemical to control sprouting. Potatoes being held for processing at 50°F. or over may have serious sprout problems, as well as lots being held at 40°F. for tablestock late in the market season. This will be particularly important with varieties such as Sebago or Chippewa, which have a short rest period. Sprout inhibitors should be used with caution if seedstocks are involved. Techniques are now available to detect whether or not a lot has been chemically treated with a sprout inhibitor.

Applied in field

Maleic Hydrazide (MH). — Of the chemical inhibitors in use today, this is the only material applied in the field on the foliage. The material is applied 7 to 12 days after bloom and approximately 6 weeks before harvest. If applied too early, it may reduce yields and tuber sizing, and if applied too late, insufficient material may be translocated to the tubers and the sprout inhibition will be less than desired.

Disadvantages of a foliage-applied material such as MH, are that the entire crop is treated (which eliminates the possible use of the crop for seed), the crop may be sold soon after harvest, and the material is applied before the average grower really knows what his storage market program will be.

Applied directly to tubers

Tetrachloronitrobenzene (TCNB) (Fusarex). — A weak inhibitor with a holding period of only a few weeks. TCNB is available as a dust and may be applied to the tubers as they pass over an elevator or conveyer, or through ventilating ducts where floor ducts and air velocities are adequate. The dust occasionally discolors the surface of potatoes even though its color has been made to blend with that of the skin.

Isopropyl -N- Chlorophenylcarbamate (CIPC) (Sprout Nip). — The strongest chemical inhibitor available. Available as an emulsifiable concentrate applied on the potatoes as they travel over the sponge drier rolls following washing. The material is available also on a contract basis, applied by a custom applicator through the ventilating system. The storage must be kept closed and the air recirculated for 48 hours, after which normal storage practice is resumed. CIPC inhibits wound healing; therefore, it must be applied after the curing process.

Washing

Washing potatoes before packing for the fresh market is a widely accepted practice. Washing improves the appearance and makes grading easier. It is recommended that chlorine (sodium hypochlorite) be added to the wash water to help destroy surface organisms which can cause breakdown during marketing. The wash water should contain 150 to 200 parts of chlorine per million parts of water. Test kits can be obtained from chemical suppliers to peridically check the wash solution.

After washing, the potatoes should pass over absorbing rolls to remove all surface moisture. High rates of chlorine have been observed to cause excessive wear to foam rubber absorbing rolls. However, this can be minimized if the rolls are washed thoroughly with fresh water after use. Forcing warm air over the potatoes before they are bagged may be advisable to insure adequate drying. Potatoes packed with free surface moisture provide ideal conditions for breakdown. This moisture can be misleading in determining the correct overage in consumer packs.

POTATO OUTLOOK

The transition from an acre of potatoes on every farm to large-scale specialized production is returning Michigan to a position of importance in the potato market. Yields of potatoes in Michigan from 1960 to 1964 have averaged 180 cwt. per acre on 45,000 acres. *Project '80*, which is a prediction of agriculture in Michigan in 1980, estimates that the potato acreage will increase to at least 80,000 acres with an average yield of 300 cwt. per acre. Many progressive growers now attain this yield. An increase in specialization and utilization of modern technology by all growers could easily exceed the predictions.

The number of varieties being offered for sale has diminished. Four varieties account for over 80 percent of Michigan production. At the present time Russet Burbank, Onaway, Sebago, and Katahdin satisfy the diverse market and production areas of the state. Today's consumers who purchase "Michigan Round Whites" can expect to get the Onaway variety early in the season, followed by either Sebago or Katahdin. In a deficit potato area such as Michigan, it is possible to expand the fresh market production to take advantage of Michigan's strategic location, climate, and soils. More potatoes will promote better packaging and an extension of the market period.

The Michigan potato industry as a whole should give special attention to the selection of varieties. The most successful marketing enterprises have been built upon one or two identifiable varieties; thus the consumer can select potatoes for a desired purpose. Concentration on a limited number of varieties for the fresh market, chipping, and processing will develop confidence in Michigan potatoes.

On the other hand, seedsmen of the state, to compete in out-state sales, must produce varieties popular in other areas. Advance sales of seed or contracts for seed will help seedsmen to plan production to satisfy all markets.

Michigan has a history of being a deficit state in terms of seed produced and seed required. Michigan seed growers produce only 20 percent of the total seed requirements; therefore, each year commercial growers must look to other areas for their seed supplies. The premium for good seed offers considerable opportunity for many growers, particularly in Northern Michigan, to supply the need, not only within the state, but the many markets throughout the country.

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