Commercial Vegetable Recommendations
Michigan State University
Cooperative Extension Service
Farm Science Series

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COMMERCIAL VEGETABLE RECOMMENDATIONS FOR MICHIGAN

CONTENTS

EXTENSION BULLETIN E-675—A
Farm Science Series

COMMERCIAL VEGETABLE RECOMMENDATIONS FOR MICHIGAN April 1970
Cooperative Extension Service, Michigan State University

Growing Transplants

Broccoli, cabbage and cauliflower plants for a fall harvest are commonly seeded between June 1 and July 15 and transplanted four to six weeks later. For summer harvest, these crops are transplanted between April 15 and May 15. Early tomatoes, peppers and eggplants are transplanted from mid May to early June. Plants for early transplanting are grown in hotbeds or greenhouses locally or Southern-grown plants are used. Melon transplants must be grown locally in coldframes, hotbeds, or greenhouses.

As a guide to calculating the number of plants and seed required for one acre and growing time, refer to Table 1. Refer to Table 2 for germination and growing temperature requirements for transplants.

Soil for Seed Beds

Sandy or clay loams are preferred which contain 3 to 5% organic matter and test above 100 pounds of phosphorus and 200 to 400 pounds of potassium per acre. The pH should range from 6.0 to 6.8.

If fertilizer is added to bring the nutrients to the desired levels, it should be low in salts and should be thoroughly mixed with the soil. Soil mix is best prepared long in advance of use and steam-sterilized or fumigated to eliminate weeds, parasitic fungi, surface molds and insects (consult the most recent revision of Extension Bulletin 312). The mix should then be covered with a plastic tarp to prevent contamination with windblown seeds and undesirable microorganisms. It is equally important to sterilize or fumigate flats or other seedling containers (excepting peat pots or wood bands) and to prevent recontamination of these or the soil mix.

Lightweight artificial mixes (see below for one formula), though perhaps slightly more expensive in terms of materials, produce very satisfactory vegetable transplants. Such artificial mixes should be free of weeds, parasitic fungi and molds, excess soluble salts and other problems, without steaming or fumigation. Commonly, growth is more uniform, rapid and easily controlled than in soil mixes.

Dissolve the iron and borax in water (see formula) and sprinkle evenly over the spread-out mixture of peat and vermiculite. Spread the fertilizer, phosphate, and limestone uniformly over the mix; then thoroughly incorporate, preferably using a concrete mixer with revolving inclined screen shredder or by turning a number of times with a shovel. Plants grow rapidly in this mixture at favorable temperatures. The mix must be wet several times before seeding.

For seedlings, no further fertilization is needed, but usually about three weeks after transplanting to final flats,

Table 1. Amount of Seed and Time Required in Growing Vegetable Transplants

Crop	Field spacing	Approximate Amount 1 year old seed for 1 acre plants	Weeks required to grow plants: Seed to Transplanting — 1st transplanting	Weeks required to grow plants: Seed to Transplanting — to setting in field
Cabbage	3′ x 12″ to 24″	3 to 4 oz.	2 to 3	3 to 4
Cauliflower	3′ x 12″ to 20″	3 to 4 oz.	2 to 3	3 to 4[1]
Celery	3′ x 7″	2 oz.	4 to 5	4 to 6
Cucumbers	5′ x 3′	1 lb.	Seed in pots or bands 3 to 5 weeks before field transplanting[2]	
Eggplant	3′ x 3′	2 to 3 oz.	3 to 4	4 to 6
Lettuce	1½′ x 1′	2 to 3 oz.	2 to 3	3 to 4
Muskmelon	5½′ to 7′ x 3′ to 4′	1 to 2 lbs.	Seed in pots or bands 4 to 5 weeks before field transplanting[2]	
Onion	1½′ x 3′	¾ to 1 lb.	Seed in flats 8 to 10 weeks prior to field setting	
Pepper	3′ x 1½′ to 2′	3 to 4 oz.	3 to 4	4 to 6
Summer squash	5′ x 3′	3 lbs.	Seed in pots or bands 4 to 5 weeks before field setting[2]	
Watermelon	7′ x 5′ to 7′	2 lbs.	Seed in pots or bands 4 to 5 weeks before field setting	
Tomato:				
Early market	4′ to 5′ x 1½′ to 3′	1 to 2 oz.	2 to 3	4 to 6[3]
Main crop	4′ to 5′ x 2′ to 4′	1 to 2 oz.	2 to 3	3 to 5

[1] Avoid setting large transplants because they head prematurely (button).
[2] Transplant to field when two or three true leaves have developed.
[3] Allowing 12 to 16 square inches space per plant results in a higher earlier yield. Do not overharden transplants. Higher yields are generally obtained if transplants are not in flower when set in the field.

Formula for Lightweight Artificial Soil Mix for Growing Vegetable Transplants, Bedding Plants and Ornamentals[1]

Materials	*Quantity per cu. yd. of mix*
Shredded acid peat moss (sphagnum)	11 bushels
Horticultural vermiculite, size 2, 3 or 4	11 bushels
Ground limestone, dolomitic preferred	5 pounds
20% superphosphate (powdered)	3 pounds
5-10-5 or 5-10-10 fertilizer (low salt premium grade)	6 pounds[2]
Borax (11% boron)	1 level teaspoon
Chelated iron (such as NaFe)	2 level tablespoons

[1] *The Cornell mix.*

[2] *8 to 10 ounces of potassium nitrate or ammonium nitrate can be substituted.*

a weekly or biweekly feeding using a solution of ½ pound of a soluble fertilizer completely dissolved in 50 gallons of water (1 ounce to 5 to 6 gallons) is needed.

Transplants should never be overwatered except to flush excess salts from the growing medium. Slight wilting of plants periodically is not harmful. Use water and temperature sparingly to control growth when plants are growing too fast, diseases appear in the planting, and to toughen them for the shift to the field where wind, cold, and heat test their ability to survive and grow.

For maximum season's yield, transplants should never have fruits, flowers, or flower buds before setting in the field. An ideal transplant is young, growing fairly rapidly, but slightly hardened at transplanting time. It should never be overhardened nor too soft when placed in the field. Rapid growth following transplanting assures a well established plant before fruit develops. Cabbage, cauliflower, broccoli, and celery may seed prematurely if subjected to cool temperatures during the growing period.

Table 2. Temperature Requirements for Growing Vegetable Transplants

Crop	Temperature (°F)		
	Germination	Growing	
		Day	Night
Cabbage	65 - 75	55 - 75	45 - 55[1]
Cauliflower	65 - 75	55 - 75	45 - 55
Celery	60 - 70	60 - 75	60 - 65[2]
Cucumber	75 - 85	70 - 85	65 - 70
Eggplant	75 - 85	70 - 85	65 - 70
Lettuce	60 - 70	50 - 70	45 - 55
Muskmelon	75 - 85	70 - 85	65 - 70
Onion	60 - 70	60 - 75	60 - 65
Pepper	75 - 85	70 - 85	65 - 70
Summer squash	75 - 85	70 - 85	60 - 70
Watermelon	75 - 85	70 - 85	65 - 70
Tomato	70 - 75	65 - 80	60 - 65[3]

[1] Can withstand temperatures down to 35°F for short periods without ill effects.

[2] If exposed to 40 to 50°F for two weeks or longer, seedstalks will develop.

[3] For early market plants, exposing to temperatures of 52 to 54°F for 2 or 3 weeks following leaf expansion will increase the number of early flowers.

Wider spacings produce stockier, early-producing transplants while closer-spaced transplants are more wiry and produce later but usually as well or better for processing or other late production. Seedlings are normally grown in thickly seeded rows and transplanted to a wider spacing before the first true leaves appear. Flats or peat or other types of pots or containers are commonly used for the first transplanting.

Melons, cucumbers, and squash are usually seeded directly in the containers because they do not transplant well in the seedling stage. Occasionally small lots of sweet corn or lima beans are also produced in this manner. Consult the latest revision of Extension Bulletin 312 for insect and disease control measures.

NOTE TO THE GROWER

EXTENSION BULLETIN E-675 (A—S) presents guidelines for *commercial production* of vegetables in Michigan, including harvesting, post-harvest handling, and storage. For weed, insect and disease controls, consult the other MSU publications listed under appropriate headings.

The recommended varieties listed are adapted to Michigan conditions. Growers are urged also to try *new* varieties and cultural practices developed for the Midwest and Northeast, but on a small scale at first so as to involve only limited acreage in case the trials are not successful.

Most varieties developed for the Southeast or Southwest are not normally adapted to Michigan, primarily because of different day lengths and/or disease problems.

OTHER MSU VEGETABLE PUBLICATIONS

Extension Bulletin 312, (latest edition), Chemical control of insects and diseases on commercial vegetables.

Extension Bulletin 433, (latest edition), Chemical weed control for horticultural crops.

Extension Bulletin 598, Commercial production of asparagus in Michigan.

Extension Bulletin E 486, Micronutrients for vegetable and field crops.

Additional bulletins of interest to vegetable growers:

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U.S.D.A. Agr. Handbook 66, The Commercial storage of fruits, vegetables, and florist and nursery stocks.

The following abbreviations are used in this bulletin:

cwt — hundred weight
F — Fusarium wilt-resistant
F_1 — hybrid
K — potassium
K_2O — available potash
MR — mosaic-resistant
N — nitrogen
P — phosphorus
P_2O_5 — available phosphoric acid
V — Verticillium wilt-resistant
YR — Yellows-resistant

Authors of *Commercial Vegetable Recommendations for Michigan* are CLARK W. NICKLOW, extension specialist in horticulture; ROBERT C. HERNER, assistant professor of horticulture; JOHN D. DOWNES, professor of horticulture, and ROBERT E. LUCAS, extension specialist in crop and soil sciences.

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1P—7.5M—5:70—MB

Asparagus

Major Production Areas — Berrien, Van Buren and Oceana counties.

Acreage — 4,200 in 1945, 11,000 in 1955, 13,200 in 1968. Michigan is the only state with significant increases in recent years.

Utilization — The Michigan crop is snapped rather than cut, with 95 percent or more grown for processing.

Production Requirements

Although asparagus is still hand-harvested, decreasing labor supplies will force extensive industry efforts to mechanize.

Under present cultural practices, yields average around 1,500 pounds per acre. Drastic changes in cultural practices, including field-seeding, are anticipated in order to increase acre yields and to make mechanized harvest competitive with other production areas of the world.

Planting site — Elevated sites relatively free from spring and fall freezes are preferred. In anticipation of machine harvest, new fields should be relatively level or gently sloping. Asparagus, in general, should not be planted in a field where it has been grown before because of the danger of excessive stand loss due to Fusarium wilt. The site should also be somewhat protected from prevailing winds, as crooked and toughened spears result from wind damage and cooling. It should be kept free of perennial weeds such as quack grass, morning glory, bind weed, horse nettle, ground cherry, thistle and especially perennial smartweed. Fields should be prepared at least a year in advance to eliminate these weeds.

Soils

Deep, fertile loam or sandy loam soils with good water and air drainage are best, but good production is also possible on loamy sands and mucks. Droughty, sandy soils having highly porous subsoils will seldom produce good yields. Tight or compacted soils can result in low yields and a large proportion of misshaped spears.

Varieties

The term variety as understood for other vegetables does not apply to asparagus. All asparagus varieties are somewhat heterogeneous with respect to spear color, size, resistance to diseases, earliness, etc.

No available asparagus variety is immune to rust or Fusarium wilt. However, Mary Washington, Martha Washington, and some related strains show resistance or are rust tolerant. The following varieties are suggested:

Mary Washington 500	*Waltham Washington*
Mary Washington 500W	*California 309*
Mary Washington	*California 711*

For trial: *California 66, California 72, New Jersey Improved.*

Lime and Fertilizer

Lime — Apply dolomitic limestone to bring soil pH to 6.5, preferably the year before planting crowns or seed. Test the soil pH every 4 to 5 years and lime as required.

Fertilizer — Based on soil test results, the following quantities of P_2O_5 and K_2O are recommended:

	Available soil phosphorus (Bray P_1)—lbs. P/A					
	0–19	20–39	40–69	70–99	100–149	150+
	lbs. of P_2O_5 per acre recommended					
Crowns and new beds (including field seeding)	250	200	150	100	50	0
Established beds	150	100	50	25	0	0

Apply 200 pounds per acre of 20 percent phosphate fertilizer to the above recommended phosphate down the furrow before setting the crowns. This is very important because phosphate applied to the surface, unless worked into crown depth, becomes fixed in the surface 2 to 3 inches of soil. A heavy preplant incorporation through plow depth will carry the field for years.

	Available soil potassium—lbs. K/A						
	<60	60–99	100–149	150–199	200–249	250–300	300+
	lbs. of K_2O per acre recommended						
Crowns and new beds (including field seeding)	250	200	150	100	50	25	0
Established beds							
Sandy soil	200	150	100	50	25	0	0
Clay loams	150	100	50	25	0	0	0

Nitrogen — Apply 40 pounds of nitrogen per acre with the phosphate and potash fertilizer for crown production, establishing a new bed, and for field seeding. Apply 40 to 60 pounds of nitrogen per year on established beds.

Fertilizer application — All the fertilizer should be worked into the soil after plowing for seedling production and field seeding but plowed down for planting crowns.

Sidedress — For seedlings, field seeding and for planted crowns, sidedress with 30 to 50 pounds of nitrogen per acre in late June or early July. Sidedress with this same rate on established beds each year, either in early spring or after the cutting season.

*For more details on commercial production, consult Extension Bulletin 598.

Test soil every one or two years to determine potassium needs and apply fertilizer as recommended for established beds. Phosphate applied to established beds will be almost completely fixed in the surface 2 to 3 inches of the soil and will benefit only weed growth.

Spacing and Planting

Growing seedlings — Sow seeds about May 15 in rows 1½ to 2 feet apart and at a depth of 1 to 1½ inches on sandy loam soil. Seeds spaced 10 to 12 per foot of row should utilize 3 to 5 pounds of seed per acre.

Crowns — Space rows 4 to 5 feet apart, and set crowns 8 to 12 inches apart in the row. Depth of crowns: 6 to 8 inches for coarse textured soils, 5 to 6 inches for loam-clay loam soils. Crowns needed: 10,000 to 13,000 per acre depending on spacing.

Field seeding — Seed 2 to 3 rows in a 5-foot bed. This will take 2 to 3 pounds of seed per acre depending on germination. Precisely space seeds 4 to 6 inches in rows and seed at a depth of 2 to 3 inches. Field seed around May 15.

Weed Control

Consult the most recent revision of Extension Bulletin 433.

Insect and Disease Control

Asparagus miner has been a serious pest in at least one area in Michigan; hence, closely follow the recommendations given in Extension Bulletin 312.

Irrigation

Moisture is important for seed germination, and irrigation may be needed at this time. Give close attention to moisture needs of field seeding to assure a good stand. Once a field is well established, irrigation will rarely be economical. Occasionally in a very dry summer, applying water may give some improvement in yield the following year. Irrigation may become a requirement for field seeding at higher plant populations.

Harvesting

The first two years of a new asparagus bed are needed to develop the root system; therefore, do not harvest until the third year, and then harvest only 3 to 4 weeks. This is also true for field-seeded acreage. In later years, do not harvest later than the end of June to allow for fern growth to build up root food reserves for the next harvest season.

Tender and succulent asparagus is obtained when moderate temperatures (50 to 60°F at night; 60 to 75°F during the day) have prevailed for four to five days prior to harvest. Temperatures of 35 to 40°F slow growth of the spears, increase fibre content, and cause excessive purple pigmentation. For asparagus grown for processing, spears should be snapped when they are 7 to 10 inches high and before the tips have begun to separate.

Post-harvest Handling

Freshly harvested asparagus loses quality rapidly if held at warm temperatures. Move the spears as rapidly as possible to cold storage, the processor, or the market. If storage is required, store under high humidity (95% R.H.) and at a temperature of 32°F but no longer than ten days, or chilling injury can result at this temperature. Hydrocooling prior to storage is recommended to cool the asparagus as fast as possible. Lacking cold storage, a grower can definitely improve quality retention by keeping the harvested asparagus in the shade and sprinkling or misting lightly with cold water.

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F_1 — hybrid
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K_2O — available potash
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1P—7.5M—5:70—MB

Green Beans

Major Production Areas — Mason, Mecosta, Sanilac, and Van Buren counties, with scattered acreage throughout the west-central Lower Peninsula.

Acreage — Total 1968 harvested acreage was 10,600 for processing and 2,200 for the fresh market.

Production Requirements

A closely supervised system of production, including irrigation when needed, can result in yields of 4 tons per acre or better. This is expected to be the typical yield goal for green bean production in the future. However, using present cultural practices, the yields have been less than 2 tons per acre in Michigan. High temperatures and drying winds when the plants are flowering may reduce yields by failure of flower fertilization and subsequent blossom drop.

Soils

Deep, fertile, well-drained soils of coarse to medium texture are preferred. Grow green beans on the sandier soil types if earliness is important. Avoid stony fields for mechanical harvest and soils that crust badly after a rain.

Varieties

White seeded varieties are preferred for canning. Seed color is of less importance for freezing and fresh market. There are many good varieties. These include:

Tendercrop — high quality, colored seed for fresh market and freezing

Earliwax — yellow wax type

Midas — yellow wax type

Kinghorn wax — yellow wax type

Slenderwhite — white-seeded, tender pod

Harvester — the leading fresh market variety because of shipping quality

Contender — pods set well in hot weather and used for market and shipping

Tenderette — high quality, white seeded

Tenderwhite — a popular processing variety

Spartan Arrow — fresh, frozen, canned, picks very easy

For trial: Bush Blue Lake types

Processors usually suggest varieties to be used by growers.

Lime and Fertilizer

Lime — Apply lime to maintain a soil pH between 6.0 and 6.5.

Fertilizer — Based on soil test results the following quantities of P_2O_5 and K_2O are recommended:

	Available soil phosphorus (Bray P_1) (lbs. P/A)				
	0–19	20–39	40–69	70–99	100–149
	lbs. of P_2O_5 per acre recommended				
All soils	200	150	100	50	25

	Available soil potassium (lbs. K/A)						
	< 60	60–99	100–149	150–199	200–249	250–299	300+
	lbs. K_2O per acre recommended						
Sandy	250	200	150	100	50	25	0
Clay loams	200	150	100	50	25	0	0

Nitrogen — Add 20 pounds of nitrogen per acre with the above fertilizer.

Micronutrients — Manganese is often needed if soil pH is above 6.5. When needed, add 5 to 8 pounds of manganese to the fertilizer. Consult Extension Bulletin E 486 for more details on micronutrients.

Fertilizer Application — Apply up to 300 pounds in a band 2 inches to the side and 2 inches below the seed at planting. Plow down the balance of the fertilizer if more is required.

Sidedress — If foliage is light green, apply 20 to 30 pounds of nitrogen per acre from the time two to three true leaves have appeared up to flowering.

Spacing and Planting

Planting — Plant when temperature is above 60°F for best results unless planting for a very early crop.

ROWS: 24 to 32 inches

PLANTS: 6 to 10 per foot of row

SEED: 60 to 120 pounds per acre depending on seed size, percentage germination and row spacing.

Weed Control

Consult the most recent revision of Extension Bulletin 433.

Insect and Disease Control

Consult the most recent revision of Extension Bulletin 312.

Irrigation

Moisture is most needed for effective herbicidal activity and for the early stages of germination and plant emergence. Moisture is also needed during flowering and pod development. Provide supplemental irrigation to meet plant requirements during these two critical periods, emergence and pod development.

Harvesting

Different processors and markets require beans at different stages of maturity. Your processor will determine the best time to harvest or find out what the market demands and harvest accordingly.

Post-harvest Handling

Green beans lose their quality rapidly. Move the beans to market as soon as possible (within 24 hours) and avoid exposure to sun and drying winds at all times. If green beans must be held, put them under refrigeration at 40 to 50°F and at a high humidity (90 to 95% R.H.) to prevent excess water loss from the pods.

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1P—5M—5:70—MB

EXTENSION BULLETIN E-675—D
Farm Science Series

April 1970
Cooperative Extension Service, Michigan State University

Lima Beans

Major Production Areas — Ionia, Clinton, Saginaw, and Tuscola counties.

Acreage — 2,000 in 1968.

Production Requirements

Present yields are around 1.6 tons per acre but recent research results have shown that when rows are planted 9 to 12 inches apart and plants are spaced 3 to 5 inches apart in the rows, significant yield increases can result. With this spacing, irrigation may be needed to achieve high yields. Lima beans will be ready for harvest in 70 to 75 days from planting.

High temperatures and drying winds when the plants are flowering may reduce yields by failure of flower fertilization and subsequent blossom drop.

Soils

Deep, fertile, well-drained soils which are coarse to medium texture are preferred. Grow lima beans on the coarse textured (sandy) soil types if earliness is important. Soils that crust badly after a rain should be avoided.

Varieties

Early Thorogreen — green seeded, baby limas

Fordhook 242 — large, whitish seed in large pods, heavy yields

Spartan Freezer (trial) — new green seeded, baby lima

Processors usually suggest varieties to be used by growers.

Lime and Fertilizer

Lime — Apply lime to maintain a soil pH between 6.0 to 6.5.

Fertilizer — Based on soil test results the following quantities of P_2O_5 and K_2O are recommended:

	Available soil phosphorus (Bray P_1) (lbs. P/A)				
	0–19	20–39	40–69	70–99	100–149
	lbs. of P_2O_5 per acre recommended				
All soils	200	150	100	50	25

	Available soil potassium—lbs K/A						
	< 60	60–99	100–149	150–199	200–249	250–299	300+
	lbs. of K_2O per acre recommended						
Sandy soils	250	200	150	100	50	25	0
Clay loam	200	150	100	50	25	0	0

Nitrogen — Add 20 pounds per acre with the above fertilizer.

Micronutrients — Manganese is often needed if soil pH is above 6.5. When needed, have 5 to 8 pounds of manganese per acre mixed with the fertilizer. Consult Extension Bulletin E 486 on micronutrients.

Fertilizer Application — Apply up to 300 pounds in a band 2 inches to the side and 2 inches below the seed at planting. Plow down the balance of the fertilizer if more is required.

Sidedress — If the foliage becomes light green apply 30 to 40 pounds of nitrogen per acre from the time two to three true leaves have appeared up to flowering.

Spacing and Planting

Planting — Plant when soil temperature is above 60°F for best results unless planting for a very early crop.

Spacing — Plant in 24- to 30-inch rows and 3 to 4 plants per foot of row.

Seed — 40 to 60 pounds per acre depending on seed size, percentage germination and row spacing.

Depth — Plant as shallow as soil moisture permits, usually 1 to 1½ inches deep.

Weed Control

Consult the most recent revision of Extension Bulletin 433.

Insect and Disease Control

Consult the most recent revision of Extension Bulletin 312.

Irrigation

Moisture is most needed for effective herbicidal activity and for the early stages of germination and plant emergence. Moisture is also needed during flowering and pod development. Supplemental irrigation should be provided to meet plant requirements during at least these two critical periods. Evaporative cooling by irrigation may be beneficial when heat is excessive during flowering.

Harvesting

Different processors require lima beans at different stages of maturity. Your processor will determine the best time to harvest.

Post-harvest Handling

Shelled lima beans lose their quality rapidly. Move them to the processor as soon as possible. If they must be stored for any time, keep them as close to 32°F and 90% R.H. as possible. If stored too long at this temperature the lima beans become spotted and sticky, which are symptoms of chilling injury.

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YR — Yellows-resistant

Authors of *Commercial Vegetable Recommendations for Michigan* are CLARK W. NICKLOW, extension specialist in horticulture; ROBERT C. HERNER, assistant professor of horticulture; JOHN D. DOWNES, professor of horticulture, and ROBERT E. LUCAS, extension specialist in crop and soil sciences.

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EXTENSION BULLETIN E-675—E
Farm Science Series

April 1970
Cooperative Extension Service, Michigan State University

Beets

Major Production Areas — Newaygo, Tuscola, and Antrim counties.

Acreage — Total 1968 acreage of 800 was processed.

Production Requirements

The beet, a cool season crop tolerant of mild freezes, will mature in 90 to 110 days after planting. Seeds germinate at 40°F but optimum temperatures are 65 to 75°F. Best quality and color is developed under cool temperatures (50 to 65°F) and good sunlight. A biennial, the beet will often initiate a seed stalk if the plants are exposed to 2 to 3 weeks of temperatures below 50°F after the plants have several true leaves. Beet yields in Michigan are below the national average, but should increase with improved production practices.

Soils

A deep friable soil — mucks, sandy loams and clay loams — is preferred to soils that crust after a rain. Where earliness is important, grow beets on sandy loam soils.

Varieties

Detroit Dark Red
Ruby Queen
Red Pack (trial)
Garnet (trial)
Mono King Explorer (trial)
Fire Chief (trial)
Crosby Green Top (Green Top Bunching)
Early Wonder (for bunching or top for greens)
Pacemaker (trial)

Lime and Fertilizer

Lime — Apply lime to maintain a soil pH above 5.5 on muck and 6.5 on mineral soils.

Fertilizer — Based on soil test results the following quantities of P_2O_5 and K_2O are recommended:

	Available soil phosphorus (Bray P_1) lbs. P/A					
	0–19	20–39	40–69	70–99	100–199	200+
	lbs. of P_2O_5 per acre recommended					
Mineral or organic soils	250	200	150	100	50	0

	Available soil potassium—lbs. K/A					
	<60	60–99	100–149	150–199	200–249	250–349
	lbs. of K_2O per acre recommended					
Sandy loam soil	300	250	200	150	100	50
	<125	125–199	200–274	275–349	350–450	450+
Organic soil	400	350	300	250	200	150

Nitrogen — Apply 50 pounds of nitrogen per acre with the above fertilizer.

Micronutrients — Apply one pound of boron per acre on sandy loam soils with the above fertilizers and 3 pounds of boron on organic soils. If the pH of organic soils is above 6.0 or above 6.5 for mineral soils, apply 5 to 10 pounds of manganese in the band placed fertilizer. If fertilizer is all applied broadcast, apply the manganese as a foliar spray using a soluble form of manganese sulfate.

Fertilizer application — Band up to 300 pounds of fertilizer high in phosphorus 2 to 3 inches below the seed at planting, and drill in the remaining fertilizer before planting.

Sidedress — Four to six weeks after planting sidedress or topdress with 30 to 50 pounds of nitrogen. The treatment may not be needed if beets are grown on highly organic soils.

Spacing and Planting

The planting season for processing is from late April to early July.

Spacing — Rows, about 16 inches apart, are planted to achieve 12 to 15 plants per foot of row. Better results can be achieved if the seed can be dropped uniformly in a 3- to 4-inch band. Plant to a depth of ¾ to 1 inch.

Weed Control

Consult the most recent revision of Extension Bulletin 433.

Insect and Disease Control

Consult the most recent revision of Extension Bulletin 312.

Harvesting

Use standard harvesting procedures. Reducing the distance of drop and/or cushioning the fall of the beets from the harvester to the loading truck will reduce damage if beets are to be stored.

Post-harvest Handling

Topped beets stored at 32°F and a relatively high humidity (85% R.H.) can be expected to keep 3 to 5 months. Cellar storages often have a higher temperature range than is recommended and thus the period of successful storage will be comparatively shorter. Before beets are stored,

they should be sorted to remove all diseased roots and those showing mechanical injury. Providing good air circulation is important.

Bunched beets, more perishable than topped beets, can be stored at about 32°F for 10 to 14 days with humidity adequate to keep the tops in good condition.

NOTE TO THE GROWER

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The recommended varieties listed are adapted to Michigan conditions. Growers are urged also to try *new* varieties and cultural practices developed for the Midwest and Northeast, but on a small scale at first so as to involve only limited acreage in case the trials are not successful.

Most varieties developed for the Southeast or Southwest are not normally adapted to Michigan, primarily because of different day lengths and/or disease problems.

OTHER MSU VEGETABLE PUBLICATIONS

Extension Bulletin 312, (latest edition), Chemical control of insects and diseases on commercial vegetables.

Extension Bulletin 433, (latest edition), Chemical weed control for horticultural crops.

Extension Bulletin 598, Commercial production of asparagus in Michigan.

Extension Bulletin E 486, Micronutrients for vegetable and field crops.

Additional bulletins of interest to vegetable growers:

Extension Bulletin E 550 (latest edition), Fertilizer recommendations for Michigan vegetables and field crops.

U.S.D.A. Agr. Handbook 66, The Commercial storage of fruits, vegetables, and florist and nursery stocks.

The following abbreviations are used in this bulletin:

cwt — hundred weight	N — nitrogen
F — Fusarium wilt-resistant	P — phosphorus
F_1 — hybrid	P_2O_5 — available phosphoric acid
K — potassium	V — Verticillium wilt-resistant
K_2O — available potash	YR — Yellows-resistant
MR — mosaic-resistant	

Authors of *Commercial Vegetable Recommendations for Michigan* are CLARK W. NICKLOW, extension specialist in horticulture; ROBERT C. HERNER, assistant professor of horticulture; JOHN D. DOWNES, professor of horticulture, and ROBERT E. LUCAS, extension specialist in crop and soil sciences.

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EXTENSION BULLETIN E-675—F
Farm Science Series

COMMERCIAL VEGETABLE RECOMMENDATIONS FOR MICHIGAN

April 1970
Cooperative Extension Service, Michigan State University

Cabbage

Major Production Areas — Macomb, St. Clair, Monroe, and Wayne counties, with scattered acreage in Allegan, Saginaw, Bay, Ottawa, Kent, and Van Buren counties.

Acreage and Utilization — Eighty percent is grown for fresh market. In 1968, 3,600 acres harvested for both fresh market and processing. Yield per acre was 185 cwt.

Production Requirements

Cabbage, a frost-hardy crop, can be grown in all areas of Michigan. It requires from 60 to 105 days of growth from transplanting and 75 to 120 days from field seeding. For equal maturity, seed around 15 days ahead of transplanting. Premature seeding can result if cabbage transplants have long exposure to temperatures below 45°F.

Cabbage is susceptible to the soil-born fungus causing club root. Infected roots become much enlarged and malformed. Preventive measures include eradication of weeds of the mustard family, elimination of seed beds that show club root, and planting cabbage only one year out of four or five on the same land. Be certain to follow the suggestions for club root control in the latest revision of Extension Bulletin 312, using materials in the transplant water. Club root damage can often be significantly reduced in a given field by adjusting the soil pH to 6.8 with lime.

To control seed-borne black rot, black leg, and alternaria, be certain seed has been hot-water treated at the time of purchase.

Soils

Cabbage can be grown on a wide range of soils but well drained mineral of muck soils are preferred.

Varieties

The following varieties are suggested:

Early

YR Golden Acre
Stonehead (F_1) (YR)* (Trial)
Emerald Cross (F_1)
C - C Cross (F_1)
Market Dawn (F_1) (YR) (Trial)

Mid-season

Market Prize (F_1) (YR)
Badger Market (YR)
Greenback (YR)

Late

Danish Ballhead strains
Resistant Danish (YR)
Savoy King (F_1) (Trial)

Kraut

Glory 61 (YR)
Sanibel (F_1) (YR) (Trial)
King Cole (F_1) (YR)
Market Topper (F_1) (YR)
Superette (F_1) (Trial)

Many new hybrids are worthy of trial.

* YR — *yellow resistant.*

Lime and Fertilizer

Lime — Apply lime to maintain a pH between 5.5 to 6.5 for mineral soils and 5.0 to 6.5 for muck soils.

Fertilizer — Based on soil test results the following quantities of P_2O_5 and K_2O are recommended:

	Available soil phosphorus (Bray P_1) lbs. P/A					
	0–19	20–39	40–69	70–99	100–199	200+
	lbs. of P_2O_5 per acre recommended					
All soils	250	200	150	100	50	0

	Available soil potassium—lbs. K/A					
	< 60	60–99	100–149	150–199	200–249	250–300
	lbs. of K_2O per acre recommended					
Sandy soils	300	250	200	150	100	50
Clay loams	250	200	150	100	50	0
Organic soils*	400	350	300	250	200	150

* For organic soils testing 350 lbs. K apply 100 lbs. of K_2O per acre. Do not apply any potassium if soil test shows in excess of 500 lbs per acre.

Nitrogen — Plow down 30 to 50 pounds of nitrogen with stubble or grain cover crop. Apply 50 pounds of nitrogen with the fertilizer suggested above.

Micronutrients — For sandy soils, add 1 to 2 pounds of boron per acre, preferably with the banded fertilizer.

Fertilizer application — Band, if possible, up to 300 pounds of a fertilizer high in phosphorus near the transplants or seeds. Plow down or drill after plowing the remainder of the fertilizer suggested.

Starter solution — For transplants use a starter solution made by dissolving 3 to 5 pounds of an all soluble dry material such as 15-30-15 or 10-50-10, following manufacturers suggestion to 50 gallons of water.

Sidedress — Apply 30 to 50 pounds of nitrogen 2 to 3 weeks after transplanting or at time of thinning in case of field seeded acreage.

Spacing and Planting

(See Bulletin E-675—A, "Growing Transplants.")

Spacing — For fresh market, plant in rows 24 to 36 inches apart depending on the variety and 12 inches between plants in the row.

For processing, plants should be spaced 18 inches between plants for rows 36 inches apart, and spaced 24 inches for rows 24 inches apart.

Planting — Cabbage for early harvest may be transplanted into the field in late March. Seed outdoor field beds 4 to 6 weeks before expected transplanting date. Late fall harvested cabbage should be transplanted by mid July.

Direct seeding — Direct seeding in the field permits higher plant population without additional cost. Precision seed at a depth of ½ to 1 inch and drop a seed every 6 inches and thin to the desired stand. Seeding can be done in May and June. The control of good weed, flea beetle and maggot is essential.

Weed Control

Consult the most recent revision of Extension Bulletin 433.

Insect and Disease Control

Consult the most recent revision of Extension Bulletin 312.

Irrigation

Being equipped to apply water at crucial times can be beneficial for successful cabbage production. The most critical time is immediately after transplanting or field seeding. It is important to provide adequate water during the early plant growth period prior to head initiation since the greater the amount of vegetative growth prior to initiation of the head the larger will be the final head size. Excessive water when heads have reached full size may seriously reduce marketable yields by greatly increasing splitting.

Harvesting

Some varieties are very susceptible to splitting. It is important to harvest these varieties while the head is firm but before splitting begins. Machine harvest of cabbage is creating much interest and growers are urged to observe the machine operating prior to purchase of a harvester.

Post-harvest Handling

A large percentage of the late crop of cabbage can be stored and sold during the winter and early spring. If stored under proper conditions, late cabbage should keep for 3 to 4 months. The longest keeping varieties belong to the Danish class. Only disease-free heads should be placed in storage. The optimum temperature for storage is 32°F with a R.H. of 90 to 95%. Adequate fans should be provided for uniform temperature throughout the cabbage bins.

Modified atmosphere storage of cabbage has been shown to be very beneficial. The cabbage remains green longer and is more succulent and firm. The best results are obtained with mixtures of 2½ to 5% O_2 and CO_2.

NOTE TO THE GROWER

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The recommended varieties listed are adapted to Michigan conditions. Growers are urged also to try *new* varieties and cultural practices developed for the Midwest and Northeast, but on a small scale at first so as to involve only limited acreage in case the trials are not successful.

Most varieties developed for the Southeast or Southwest are not normally adapted to Michigan, primarily because of different day lengths and/or disease problems.

OTHER MSU VEGETABLE PUBLICATIONS

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Extension Bulletin 598, Commercial production of asparagus in Michigan.

Extension Bulletin E 486, Micronutrients for vegetable and field crops.

Additional bulletins of interest to vegetable growers:

Extension Bulletin E 550 (latest edition), Fertilizer recommendations for Michigan vegetables and field crops.

U.S.D.A. Agr. Handbook 66, The Commercial storage of fruits, vegetables, and florist and nursery stocks.

The following abbreviations are used in this bulletin:

cwt — hundred weight
F — Fusarium wilt-resistant
F_1 — hybrid
K — potassium
K_2O — available potash
MR — mosaic-resistant
N — nitrogen
P — phosphorus
P_2O_5 — available phosphoric acid
V — Verticillium wilt-resistant
YR — Yellows-resistant

Authors of *Commercial Vegetable Recommendations for Michigan* are Clark W. Nicklow, extension specialist in horticulture; Robert C. Herner, assistant professor of horticulture; John D. Downes, professor of horticulture, and Robert E. Lucas, extension specialist in crop and soil sciences.

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EXTENSION BULLETIN E-675—G
Farm Science Series

COMMERCIAL VEGETABLE RECOMMENDATIONS FOR MICHIGAN
Cooperative Extension Service, Michigan State University

April 1970

Carrots

Major Production Areas — Newaygo, Lapeer and Kent counties.

Acreage and Utilization — 6,000 acres in 1968 with 4,000 acres for the fresh market.

Production Requirements

Carrots are a cool season crop. They generally mature in 85 to 120 days from planting.

In rotation, carrots should not follow carrots, celery, lettuce, potatoes or cabbage. If carrots do follow these crops, check the nematode count in the soil. Fumigation may be necessary. Carrots should follow cereal crops, spinach, onions, corn or hay crops. Pack-out yields of 10 tons per acre are common for fresh market and 20 or more tons per acre for processing.

Soils

Carrots are grown best on deep, well-drained, friable sandy loams, marl or organic soils, such as muck. Carrots are easily damaged by excessive soil moisture. Minimum tillage practices are suggested so that the roots can penetrate the soil without hindrance. Use a tiller to break up any large clods or coarse material, such as fibrous subsoil peat that has been turned up with the plow.

Varieties

Fresh market	Processing
Spartansweet	*Danvers 126*
Gold Pak	*Royal Chantenay*
Imperator 58 (late planting)	*Chantenay Red Cored*
	Spartan Bonus

Lime and Fertilizer

Lime — Mineral soils should be limed to pH above 6.0 and muck soils above 5.5. The subsoil test should be above these pH values also.

Fertilizer — Based on soil test results the following quantities of P_2O_5 and K_2O are recommended:

	Available soil phosphorus (Bray P_1) lbs. P/A					
	0–19	20–39	40–69	70–99	100–199	200+
	lbs. of P_2O_5 per acre recommended					
Mineral and organic soil	250	200	150	100	50	0

	Available soil potassium—lbs K/A					
	< 60	60–99	100–149	150–199	200–249	250–299
	lbs. of K_2O per acre recommended					
Sandy loams	250	200	150	100	50	25
	< 125	125–199	200–274	275–349	350–424	425–499
Organic soils	300	250	200	150	100	50

Nitrogen — Apply 100 pounds of nitrogen per acre with the above fertilizer on marly and sandy loam soils and 40 to 60 pounds on organic soils.

Micronutrients — On organic soils, apply fertilizer containing ½ pound of boron and 2 pounds of copper per acre. Copper can be deleted if at least 20 pounds per acre of copper has been applied in the last few years. If the soil pH of organic mineral soil is above 6.5, apply 5 pounds of manganese in the band-placed fertilizer. If all the fertilizer applied is to be broadcast, apply the manganese as a foliar spray. Manganese sulfate (soluble form) can be applied in most fungicide and insecticide sprays.

Fertilizer application — Up to 200 pounds per acre of fertilizer high in phosphorus can be placed in a band 1 to 2 inches to the side of the seed. However, this is not advisable when 3- to 4-inch wide drill shoes are used. When soils are low in phosphorus, some of the fertilizer — particularly the phosphorus — should be mixed with the top soil near the seedlings to promote early growth. The remainder can be a plow down application.

Sidedress — If supplemental nitrogen is needed at an early stage, as indicated by pale color of foliage or following adverse wet weather conditions, sidedress with 50 to 60 pounds of nitrogen per acre. Use ammonium nitrate rather than urea on marly soils. Do not apply nitrogen later than 40 days before harvest.

Spacing and Planting

Carrots can be planted as early in the spring as the soil can be worked. Space the rows 16 inches apart and plant to achieve around 15 plants per foot of row. Better results can be achieved if the seed can be dropped uniformly in a 3- to 4-inch band. Seed to depth of ½ to ¾ inch.

One and a half to three pounds of seed per acre are needed depending upon size of seed, spacing, amount of chaff, and germination.

Weed Control

Consult the most recent revision of Extension Bulletin 433.

Insect and Disease Control

Consult the most recent revision of Extension Bulletin 312.

Irrigation

Irrigation, if used effectively, can help in seedling emergence, weed control, prevention of "burn off," control of wind erosion, and providing the necessary moisture to obtain high yields.

Burn off of small plants is likely on dark-colored soils when air humidity is low and the temperature and barometric pressure are high. Natural clods between rows help prevent burn off of seedlings. Use a good press wheel over the seed at planting to help bring soil moisture to the surface. The use of irrigation is very effective. High temperatures may continue for several days; therefore, if irrigation is used for evaporative cooling, use a low volume (1/10 inch per hour), and vary the duration with temperature and soil moisture. Excessive soil moisture can reduce the oxygen concentration in the soil and result in seriously misshapened roots.

Harvesting

Handle carrots as gently as possible. Some of the newer hybrids which are more tender and higher in sugar content may be more susceptible to cracking or breaking. If harvesting is delayed until late morning, cracking will normally be less of a problem. Reducing the distance of drop and/or cushioning the fall of the carrots from harvester to the loading truck will reduce cracking. Careful handling is also important for any carrot going into storage for any length of time.

Post-harvest Handling

Mature carrots may be stored 4 to 5 months at 32°F if promptly cooled to this temperature after harvest. Carrots freeze at about 29.5°F. Frozen carrots are especially subject to decay. Since carrots lose moisture rapidly, humidity should be kept high (90 to 95% R.H.) but condensation and dripping should be avoided as this is conducive to decay. Air circulation is desirable to maintain uniform temperature to aid in preventing condensation. Do not store carrots in a building with apples, pears, and some other fruits and vegetables that give off ethylene, or bitterness will result.

Most carrots for the fresh market are not fully mature, and therefore, can only be held up to 4 to 6 weeks at 32°F.

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EXTENSION BULLETIN E-675—H COMMERCIAL VEGETABLE RECOMMENDATIONS FOR MICHIGAN April 1970
Farm Science Series Cooperative Extension Service, Michigan State University

Cauliflower, Broccoli, Brussels Sprouts

Major Production Areas — Allegan, St. Clair, Macomb, Van Buren and Manistee counties.

Acreage — 850 acres of cauliflower in 1968 with average yield near 70 cwt. per acre. Very few acres of broccoli and Brussels sprouts.

Production Requirements

Cauliflower, broccoli, and Brussels sprouts are all frost-hardy crops and can be grown in all areas in Michigan. Cauliflower requires 58 to 95 days from transplanting to harvest; broccoli, 55 to 75 days; and Brussels sprouts about 90 days.

These crops can be field-seeded; however, if field-seeding, add 15 to 20 days to the above days to harvest.

Large transplants should not be used because premature heading or buttoning occurs in broccoli and cauliflower much more frequently than in medium or small-sized plants. Buttoning can also result if cauliflower or broccoli transplants are exposed to long periods of temperatures below 45°F.

All three of these crops are susceptible to a soil-borne fungus causing club root. Roots become much enlarged and malformed. Preventive measures include the eradication of weeds of the mustard family, elimination of seed beds that show club root, and a crop rotation, whereby these and other crops in the cabbage family, are planted only one out of 4 or 5 years on the same land. Club-root damage can be significantly reduced by adjusting the pH to 6.8. Be sure to follow the suggestions for club root control in the latest revision of Extension Bulletin 312 using material in the transplant water. To control seed-borne black rot, black leg and *Alternaria,* be certain seed has been hot water treated. Broccoli and cauliflower should be treated 20 minutes with 122°F water and Brussels sprouts for 25 minutes.

Soils

These crops grow on a wide range of mineral and muck soils, but good drainage is essential. Best quality and high yields are obtained from the more fertile soils.

Varieties

The following varieties are suggested:

Cauliflower

Super Snowball
Extra Early Snowball
Snowball A
Snowball E
Snowball Imperial
Snowball M
Many new varieties are worthy of trial

Broccoli

Spartan Early
Waltham 29
Primo (F_1)
Green Comet (F_1)

Brussels Sprouts

Jade Cross
Long Island Improved

Lime and Fertilizer

Lime — Apply to maintain a pH from 5.5 to 6.5 for mineral soils and 5.0 to 6.5 for muck soils.

Fertilizer — Based on soil test results the following quantities of P_2O_5 and K_2O are recommended:

	Available soil phosphorus (Bray P_1) lbs. P/A					
	0–19	20–39	40–69	70–99	100–149	150–199
	lbs. of P_2O_5 per acre recommended					
Mineral soils	250	200	150	100	50	25
Organic soils	300	250	200	150	100	50

	Available soil potassium—lbs. K/A					
	< 100	100–149	150–199	200–249	250–299	300–399
	lbs. of K_2O per acre recommended					
Sandy soils	300	250	200	150	100	50
Clay soils	250	200	150	100	50	0
Organic soils*	400	350	350	300	250	200

* For organic soils testing 350 pounds K apply 100 pounds of K_2O per acre. Do not apply any potassium if soil test shows in excess of 500 pounds per acre.

Nitrogen — Plow down 30 to 50 pounds of nitrogen with stubble or grain cover crop. Apply 50 pounds of nitrogen with the fertilizer suggested above.

Micronutrients — For sandy soils, add 1 to 2 pounds of boron per acre preferably with the banded fertilizer.

Fertilizer application — Apply up to 300 pounds of a fertilizer high in phosphorus in a band 2 inches below and 2 inches to the side of transplants or seeds. Plow down or disk in remainder of the fertilizer before planting.

Starter solution — For transplants, use a starter solution made by dissolving 3 to 5 pounds of an all-soluble dry material such as 15-30-15 or 10-50-10, following manufacturers suggestion, to 50 gallons of water.

Sidedress — Apply an additional 30 to 50 pounds of nitrogen 2 to 3 weeks after transplanting or at time of thinning in the case of field seeding. Additional sidedress nitrogen may be required later for sandy soils if there is excessive rainfall.

Spacing and Planting

(See Bulletin E-675—A, "Growing Transplants.")

Planting — The fall crop should be transplanted in June or July. Seed outdoor field beds 2 to 4 weeks before the expected transplanting date. For an early crop, transplant usually between April 15 and May 15, however, early crops are risky because of the likelihood of high temperatures at harvest, resulting in rapid decline in quality and low yields.

Broccoli is usually transplanted in 36-inch rows. If both center buds and side sprouts are to be harvested, broccoli plants should be spaced 18 to 25 inches apart in the row. For harvesting center buds only, a spacing of 8 to 10 inches in the row suggested.

Cauliflower is normally transplanted in 36-inch rows with plants 14 to 24 inches apart in the row.

Brussels sprouts are spaced 36 to 48 inches between rows and 18 to 24 inches between plants in the row.

Large transplants (taller than 6 inches) should not be used because of the tendency to head prematurely.

Direct seeding — Broccoli, cauliflower and brussels sprouts may be direct-seeded, permitting higher plant populations with little additional cost. The use of precision seeding followed by thinning to the desired spacing is recommended. Direct seeding requires an additional 15 to 20 days before harvesting compared to the time required from transplanting.

Weed Control

Consult the most recent revision of Extension Bulletin 433.

Insect and Disease Control

Consult the most recent revision of Extension Bulletin 312.

Irrigation

Irrigation as needed will result in an increased stand, a steady growth rate, optimum crop quality, and maximum yield. Special attention should be given to irrigation during the first week after transplanting, particularly if the soil is dry or temperatures are high. It is also important to provide adequate water during the early plant-growth period since the amount of vegetative growth during this period greatly influences the potential yield. During very hot periods, when evapotranspiration is high, especially during the harvest period, frequent light or moderate sprinklings (misting) of ¼ to ½ inch may have a beneficial cooling effect.

Harvesting

When heads are 2 to 3 inches in diameter, cauliflower usually needs to be tied to blanch the developing head, as exposure to sunlight discolors the curd. To tie the head, gather the larger outer leaves together and tie with twine or rubber bands. Using different-colored rubber bands or twine identifies those heads to be harvested the same day. Tie every 2 to 3 days. Time from tying to harvest varies from 4 to 5 days to 2 weeks, depending on temperature and available moisture.

Harvest cauliflower when mature heads are compact, clear white, and about 6 inches in diameter. Heads are cut by hand and usually carried to a shed for packing, or packing is done in the field. If packed as unwrapped heads in a crate, a few leaves should remain attached and cut off just above the head. The attached leaves will protect the head. If wrapped in film, trim closely. The film should be perforated to prevent off-colors and off-flavors.

Cut broccoli when heads are 3 to 6 inches in diameter and before the flowers open to show any yellow. Cut 8 to 10 inches of stem.

Brussels sprouts are usually harvested by hand. Several harvests are made starting with the more mature sprouts near the base of the stem. The first picking usually occurs 3 to 3½ months after transplanting and should not be delayed after the lower leaves begin to turn yellow. Delaying will result in tough sprouts and off-flavors. In picking, the leaf below the sprout is removed and sprouts broken off. Some growers have attempted once over harvesting to lower labor costs but this practice has resulted in lower yields. If once over harvesting is planned, removal of the growing point at about the time the basal sprouts are ½ to ¾ inch in diameter results in greater concentration of maturity.

Post-harvest Handling

The best holding conditions for these crops are 32°F and 90 to 95% R.H. All should be cooled immediately after harvest to 32°F. Broccoli can be held for 10 to 14 days and is usually iced. Cauliflower will hold in good condition for two to four weeks and Brussels sprouts three to five weeks.

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Most varieties developed for the Southeast or Southwest are not normally adapted to Michigan, primarily because of different day lengths and/or disease problems.

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Extension Bulletin E 486, Micronutrients for vegetable and field crops.

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U.S.D.A. Agr. Handbook 66, The Commercial storage of fruits, vegetables, and florist and nursery stocks.

The following abbreviations are used in this bulletin:

cwt — hundred weight	N — nitrogen
F — Fusarium wilt-resistant	P — phosphorus
F_1 — hybrid	P_2O_5 — available phosphoric acid
K — potassium	V — Verticillium wilt-resistant
K_2O — available potash	YR — Yellows-resistant
MR — mosaic-resistant	

Authors of *Commercial Vegetable Recommendations for Michigan* are Clark W. Nicklow, extension specialist in horticulture; Robert C. Herner, assistant professor of horticulture; John D. Downes, professor of horticulture, and Robert E. Lucas, extension specialist in crop and soil sciences.

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1P—5M—5:70—MB

EXTENSION BULLETIN E-675—I
Farm Science Series

April 1970
Cooperative Extension Service, Michigan State University

Celery

Major Production Areas — Ottawa, Muskegon, Kent, and Allegan counties.

Acreage — From 7,000 in 1940-41 to about 2,500 in 1956 and 1,900 in 1968, virtually all on muck soil. Acre yields average about 420 cwt.

Production Requirements

Celery is normally a biennial, although grown as an annual. It flowers as an annual when small plants are subjected to temperatures of 40 to 50°F for several days, causing premature seeding (bolting). The percent of plants seeding prematurely will depend on the length of exposure to cool temperatures. Celery thrives best under moderate temperatures (55 to 75°F) and with a moderate, well distributed rain-fall during the growing season.

The usual planting season is April 15 through June 30. Celery will be saleable in 85 to 100 days from transplanting. All celery in Michigan is transplanted. Some could be field-seeded, which would result in a saving of some labor costs, but risk of bolting may be increased.

Soils

The best soil for celery is a fertile muck. However, celery can be grown on fertile, medium-textured mineral soils under irrigation.

Varieties

Slow Bolting

Spartan 162

For Summer and Fall Harvest

Utah 52-70
Tall Green Light
Utah 15
Florida 2-13 (Strain of 52-70)
Florida 683

Lime and Fertilizer

Lime — Apply lime to maintain a soil pH of 6.0 to 6.5 on mineral soils. Consider applying lime to muck soil if the pH is below 5.5.

Fertilizer — Based on soil test results the following quantities of P_2O_5 and K_2O are recommended:

	Available soil phosphorus (Bray P_1) lbs. P/A					
	0–19	20–39	40–69	70–99	100–149	150–199
	lbs. of P_2O_5 per acre recommended					
All soils	300	250	200	150	100	50

	Available soil potassium—lbs. K/A					
	<100	100–149	150–199	200–249	250–299	300–400
	lbs. of K_2O per acre recommended					
Sandy loam soils	300	250	200	150	100	50
	<150	150–249	250–349	350–424	425–499	500–574	575+
Muck Soils	600	500	400	350	300	250	200

Nitrogen — Add 75 pounds of nitrogen per acre with the above fertilizer.

Micronutrients — Apply boron with the above fertilizer at the rate of 1 pound per acre if the soil pH is 5.0 to 6.4 and 2 pounds per acre if the soil pH is 6.5 to 8.0. Apply ½ to 1 pound of actual manganese as a foliar spray for mucks and dark colored sandy loams if the pH is above 6.5. Manganese sulfate (soluble form) can be applied in most fungicide and insecticide sprays.

Copper at the rate of 2 to 4 pounds per acre is recommended on acid mucks recently brought under cultivation. Copper can be mixed in with the fertilizer recommended above.

Fertilizer application — A starter fertilizer such as 100 pounds of 0-45-0 per acre is helpful at transplanting time. Broadcast and disk in before planting. Do not plow fertilizer down if field is kept wet and is deep plowed.

Sidedress — Sidedress one to three times during the growing season at the rate of 50 pounds of nitrogen per acre per application. The color of the foliage and plant tissue tests will help determine the nitrogen needs. Avoid excessive rates of ammonia forms of nitrogen in the spring if the soil has been fumigated. Ammonia fertilizers can be used after June 15.

Magnesium or calcium sprays — Use Epsom salts (magnesium sulfate) at the rate of 10 pounds per acre per week to correct magnesium yellowing in certain celery varieties. If this rate does not correct the situation, then increase the rate to 20 pounds. Calcium is needed to prevent blackheart disorder and is applied as calcium chloride at the rate of 5 to 10 pounds per acre weekly. Blackheart disorder is an indication of excessive salts and high potassium levels.

Spacing and Planting

Space rows 24 to 30 inches apart and 4 to 6 inches between the plants in the rows. Celery should be transplanted between April 15 and June 30.

Weed Control

Consult the most recent revision of Extension Bulletin 433.

Insect and Disease Control

Consult the most recent revision of Extension Bulletin 312.

Irrigation

Irrigation may be especially needed after transplanting. Celery making good growth on well-drained soils can use

1½ inches of water per week. Wetting the soil surface with irrigation helps to reduce wind damage and the danger of frost.

Harvesting

The celery industry has long utilized harvest aids, but in recent years the trend is toward complete mechanization. Growers should carefully evaluate the various harvesters and select the one that will be the most labor-saving and provide a high quality product.

Post-harvest Handling

Celery can be precooled by refrigerated forced air cooling, by hydrocooling, or by vacuum cooling. Hydrocooling is the most common method and temperatures should be brought to as near 32°F as soon as possible. In practice, temperature reduction is often only to 40 to 45°F. Vacuum cooling is used in Western states for celery packed in corrugated containers for long distance shipping.

If storage is necessary, maintain a relative humidity high enough to prevent wilting (90 to 95%) and with sufficient air circulation to keep the temperatures at the top and at the bottom of stacked containers as nearly equal as possible. Celery should not be stacked more than four crates high in storage without forced air circulation; otherwise, there is danger of overheating due to the heat of respiration. Celery should keep in good condition for 2 to 3 months at 32°F.

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P_2O_5 — available phosphoric acid
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YR — Yellows-resistant

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1P—5M—5:70—MB

EXTENSION BULLETIN E-675—J
Farm Science Series

COMMERCIAL VEGETABLE RECOMMENDATIONS FOR MICHIGAN April 1970
Cooperative Extension Service, Michigan State University

Cucumbers

Major Production Areas — Production for pickling is scattered east and west throughout central Lower Peninsula; slicing acreage is scattered throughout the state.

Acreage — More than 21,000 acres harvested for pickling in 1968, 8,000 by machine; 2,100 acres for slicing. Michigan leads all states in pickling cucumbers.

Production Requirements

The advent of gynoecious varieties — those producing all female flowers — has drastically changed the culture of cucumber production. Gynoecious varieties, in addition to producing more concentrated and earlier fruit, have vines with less leaf area per unit of fruit. To be successful in raising this variety, growers must pay closer attention to irrigation and other cultural practices. In many instances, growers have criticized gynoecious varieties but only because they were not meeting cultural needs of these type varieties. Yields in excess of 400 bushels per acre in one harvest are possible if close attention is paid to cultural practices and if varieties are utilized which are adapted to high plant population.

Soils

To maintain an orderly, scheduled planting and harvesing sequence, cucumbers should be grown on well-drained, sandy loam or loamy sand soils. Emphasis should be given to soils which can handle planting and harvesting equipment the day after a 2-inch rain. Soils that crust badly after a rain should be avoided.

Varieties

Pickling cucumbers — Only gynoecious hybrids are recognized as satisfactory for an economical return for once-over harvest. Gynoecious hybrids should contain 10 to 15 percent of the plants of the monoecious type mixed in the seed for adequate pollen supply. Gynoecious hybrids which have an excessive percentage of monoecious type plants should be avoided. Improved varieties are being developed each year. The gynoecious hybrids that are suggested for planting at plant populations up to 80,000 plants per acre are: Spartan Progress, Spartan Advance, Pickmore, Crusader, Pioneer and Ranger. For trial planting of plant populations in excess of 80,000 plants per acre Spartan Progress or Spartan Advance are suggested.

Slicing cucumbers — Gemini (gynoecious), Spartan Valor (gynoecious), Marketmore. *For trial:* Gemini 7 (gynoecious) and Meridian T (gynoecious)

Lime and Fertilizer

Lime — Apply lime to maintain a soil pH of between 6.0 and 6.5.

Fertilizer — Based on soil test results the following quantities of P_2O_5 and K_2O are recommended:

	Available soil phosphorus (Bray P_1) lbs. P/A					
	0–19	20–39	40–69	70–99	100–199	200+
	lbs. of P_2O_5 per acre recommended					
Slicers and low plant population pickles	200	150	100	50	25	0
Plant population of 40,000 or more	250	200	150	100	50	0

	Available soil potassium—lbs. K/A					
	< 60	60–99	100–149	150–199	200–299	300+
	lbs. of K_2O per acre recommended					
Slicers and low plant population pickles						
Sandy loams	250	200	150	100	50	0
Clay loams	200	150	100	50	25	0
Plant population of 40,000 or more						
Sandy loams	300	250	200	150	100	50
Clay loams	250	200	150	100	50	0

Nitrogen — Before planting, apply 50 to 75 pounds of nitrogen per acre for slicers and low plant population pickles and 70 to 90 pounds per acre for high plant populations of 40,000 or more.

Micronutrients — Manganese may be needed if soil pH is above 7.0. When needed, 3 to 5 pounds of manganese per acre should be mixed with the above fertilizer.

Fertilizer application — Apply up to 300 pounds of fertilizer high in phosphorus in a band, placing 2 inches to the side and 2 inches below the seed at planting if possible. Drill in or broadcast and disk in the balance of the fertilizer if more is required. If close row spacing does not permit band application, apply all fertilizer by the latter method.

Sidedress — When excessive leaching occurs, especially on sandy soils, up to 30 to 60 additional pounds of nitrogen may be needed after the vines start to run. Applying nitrogen through the irrigation system is very effective, but no more than 20 pounds per application per acre is suggested. A uniform light green leaf color indicates need of additional nitrogen.

Spacing and Planting

(See Bulletin E-675—A, "Growing Transplants.")

Cucumbers are direct seeded or transplanted when the soil temperature is above 60°F and usually not before June 1. For early market or machine harvest, earlier planting, especially in southern lower Michigan, may be advantageous. Rye strip windbreaks planted in the fall are often beneficial to early planted vine crops by reducing

wind damage to transplants and seedlings and elevating temperatures. Rye strips should be separated by no more than 36 to 40 feet.

Rows — Pickles: 14 to 16 inches between rows and 4 to 5 inches in the rows. (For trial, 5 inches between rows and 5 inches in the row). Slicers: gynoecious varieties have rows 4 feet apart and plants 8 to 10 inches in the rows; monoecious varieties have rows 5 to 6 feet between rows and 10 to 15 inches between plants in rows.

Seed — Pickles: 5 pounds per acre. (For the 5 x 5 inch spacing use 12 to 15 pounds of seed for trial). Slicers: ½ to 1 pound for transplants, 1½ pounds for field seeding.

Weed Control

Consult the most recent revision of Extension Bulletin 433.

Insect and Disease Control

Consult the most recent revision of Extension Bulletin 312.

Irrigation

No consistent planting and harvesting schedule for machine harvest can be maintained in Michigan if it depends on natural rainfall. Irrigation equipment should be available that can supply 1 inch of water in a 3- to 4-hour period once or twice a week, depending on the soil type and its ability to hold water. A faster irrigation rate can cause damage to the foliage as a result of the large water droplet size. Coarse-textured soils will need to be irrigated more frequently than fine-textured soils. At no time during the growth of the plant should the foliage be allowed to wilt. When possible, irrigating at night, when the foliage would be wet, should be a desirable practice to reduce the incidence of angular leaf spot. When temperatures are high (above 80°F), beneficial results are often obtained by frequent light sprinklings.

Pollination[1]

With the use of gynoecious varieties and high plant populations, more bees are needed. One colony per 50,000 plants per acre during the flowering period is suggested. No more than three colonies per acre appear to be necessary even for as high as 200,000 plants per acre. Growers should place the colonies in the field about 5 days after the first bloom is evident.

[1] *This section was prepared by Bert Martin, Department of Entomology, MSU.*

Harvesting

Maximum return for once over harvest of pickles should occur when there is a small percentage of pickles showing yellowing. Pickle fruits grow very rapidly in warm weather when water and fertilizer are not limiting, and in a few days an excess number of oversize pickles may result in reduced yields of the higher priced grade sizes.

The best method to determine maximum dollar value per acre is to sample harvest fruit daily from known square footage of representative areas throughout the given field, grade the fruit, and compute the dollar value. By observing the percentage of yield in the smaller size grades, it can be estimated if waiting another day will be beneficial. Processors, however, may suggest the most desirable stage of fruit development in order to meet their raw product needs.

Slicing cucumbers should be picked frequently, every 2 to 3 days in hot weather. Mature cucumbers left on the vine depress further set and enlargement of younger fruit and therefore should be removed even if not marketable.

Post-harvest Handling

Slicing cucumbers can be held 10 to 14 days at 45 to 50°F with high humidity (90 to 95% R.H.). The fruits are very susceptible to shriveling; hence, the humidity in storage should be kept high. Slicers are usually waxed to prevent moisture loss. At lower temperatures the cucumbers are subject to chilling injury and at higher temperatures they turn yellow. Do not store with fruits such as ripe apples and pears that produce ethylene.

If pickling cucumbers are to be held for any length of time, the field heat should be removed as rapidly as possible. Pickles have been successfully hydrocooled under experimental conditions and then kept for 4 days at 40°F.

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EXTENSION BULLETIN E-675—K
Farm Science Series

COMMERCIAL VEGETABLE RECOMMENDATIONS FOR MICHIGAN
Cooperative Extension Service, Michigan State University

April 1970

Lettuce

Major Production Areas — Ingham, Jackson, and Lapeer counties.

Acreage — About 1,400 acres in 1968, with average yields around 430 cartons (24's) per acre.

Production Requirements

Lettuce thrives best with a relatively cool growing season, a monthly mean temperature of 55 to 60°F. With proper management, Michigan is ideally suited to the production of lettuce. It is a short-season crop that is ready for harvest 55 to 60 days after seeding. Lettuce seeded in April will require about 75 days from seeding to harvest.

Recently harvested seed may exhibit seed dormancy, particularly if the soil temperature is above 80°F. To break the dormancy, expose the moist seed to chilling at 40°F for 3 to 5 days. If the sprout has not emerged from the seed coat, the chilled seed is preferred for planting.

Soils

Lettuce can be grown on a wide variety of soils but it is ideally suited to muck soils. Obtaining good emergence can be a serious problem for some mineral soils but is seldom a problem for an organic soil.

Varieties

Fulton (all summer)
Great Lakes (fall harvest)
Minetto (all summer)
Spartan Lakes (trial)

Plant Minetto only on best muck soils since it normally has a smaller head size. Use only mosaic tested lettuce seed for fall crops.

Lime and Fertilizer

Lime — On mineral soils, apply lime to maintain a soil pH of 6.0 to 6.5. Apply lime to muck soils if soil pH is below pH 5.5.

Fertilizer — Based on soil test results, the following quantities of P_2O_5 and K_2O are recommended:

	Available soil phosphorus (Bray P_1) lbs. P/A					
	0–19	20–39	40–69	70–99	100–149	150+
	lbs. of P_2O_5 per acre recommended					
Mineral soils	200	150	100	50	25	0
Muck soils	250	200	150	100	50	0

	Available soil potassium—lbs. K/A					
	< 60	60–99	100–149	150–199	200–249	250+
	lbs. of K_2O per acre recommended					
Sandy loam soils	250	200	150	100	50	25
	< 125	125–199	200–274	275–349	350–399	400–500
Muck soils	300	250	200	150	100	50

Nitrogen — Apply 75 pounds of nitrogen with the above fertilizer.

Micronutrients — Apply ½ pound of boron and for muck soils 2 pounds of copper per acre with the fertilizer. In addition, if the muck soil pH is between 5.8 to 6.4, use 5 pounds of manganese in the band application fertilizer; if the soil pH is above 6.4, then use 10 pounds of manganese per acre. If the soil is an acid fibrous peat, treat the seed with molybdenum by dissolving ½ ounce of sodium molydbate in 3 tablespoons of water and mix with seed required for 1 acre.

Fertilizer application — Apply 300 pounds of a fertilizer high in phosphorus in a band 2 to 3 inches below the seed and 1 inch to the side. Disk in or plow down the remaining fertilizer required.

Sidedress — Sidedress with 30 to 50 pounds of nitrogen per acre shortly after thinning. In years of excessive rainfall, apply one extra sidedressing.

Spacing and Planting

Plant as early as soil can be worked.

Space rows 12 to 16 inches apart and plants 10 to 14 inches apart in the rows.

Seed ½ to 1 pound per acre depending on percentage germination of seed and field spacing.

Weed Control

Consult the most recent revision of Extension Bulletin 433.

Insect and Disease Control

Consult the most recent revision of Extension Bulletin 312.

Irrigation

Consistently high yields of lettuce in Michigan are not possible without irrigation. Irrigation used effectively can help in the emergence of seedings, in more effective weed control, in preventing "burn-off", in keeping organic soils from blowing away, and in providing the necessary moisture to produce high yields. Because of possible diseases, it is unwise to irrigate after heads start to form if ditches are the source of water. If the water source is from wells, a low volume of water (1/10 inch/hour) applied during periods of the day when temperature on muck is above 85°F has been shown to greatly reduce or eliminate tip burn of lettuce. As with other crops on muck soils, water for the root system is supplied by regulating the water table once the crop is well established.

Harvesting

Harvest only firm heads and leave the loose heads in the field.

Post-harvest Handling

Chain store buyers have difficulty in handling Michigan lettuce unless it has been vacuum cooled. Hence, lettuce should be packed in cartons and vacuum cooled immediately after harvest. If some storage is required, after cooling, store at 32°F and at a 95% R.H. Lettuce intended for long storage should be packed in perforated plastic film, used as individual head wraps or as carton or crate liners, to maintain high humidity around lettuce. Do not store with products such as ripe apples and pears that give off ethylene. Since lettuce will keep twice as long at 32°F as at 38°F, the importance of holding lettuce at 32°F cannot be over emphasized.

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1P—5M—5:70—MB

EXTENSION BULLETIN E-675—L COMMERCIAL VEGETABLE RECOMMENDATIONS FOR MICHIGAN April 1970
Farm Science Series Cooperative Extension Service, Michigan State University

Muskmelon and Watermelon

Major Production Areas — Berrien, Bay, Monroe, Van Buren, Washtenaw, Wayne, Macomb and Ottawa counties.

Acreage — 2,100 harvested in 1968 with average acre yield around 85 cwt. Michigan ranks 4th in production and 6th in acreage.

Production Requirements

Commercial production requires a long, warm season. Southern exposures with at least partial wind protection are best. Windbreaks of fall-planted rye, black or clear polyethylene mulch and hot caps or hot tents aid in early production.

Bees are required for pollination. One or two hives per acre moved into blooming fields located at some distance from the former bee pasture may greatly increase the number and quantity of fruits produced, particularly from the crown set.

Soils

Well-drained sands, sandy loam or loamy sand soils are preferred.

Varieties

Muskmelon (often called cantaloupes) and watermelons are the two main kinds of melons grown in the state, but casaba, crenshaw and honey dew are also grown on a very limited scale for special markets. These latter three types usually require a fairly long growing season.

Fusarium wilt, a serious soil-borne disease, is controlled principally by the use of resistant varieties. Fumigation may also be used. Varieties vary in their susceptibility to cucumber mosaic, another serious disease of the crop, but no varieties are immune. All varieties are probably equally susceptible to bacterial wilt. F_1 hybrids are most commonly grown and are usually more uniform in size, shape, netting, color and maturity than most of the open pollinated varieties. Varieties with exceptional vigor appear to be less depressed by foliage diseases and powdery mildew.

Muskmelons[1]

Burpee Hybrid
Gold Star (F_1)
Supermarket (F_1)
Iroquois
Saticoy Hybrid
Harvest Queen (late)

Watermelons

Sugar Baby (early)
Sweet Princes[2]
Crimson Sweet
Summer Festival (F_1)
Seedless Hybrids — Trial

[1] *Fusarium-resistant. Varieties listed in seed catalogs as Fusarium-resistant may not be resistant to an apparently new race of Fusarium prevalent in the muskmelon production areas of Michigan.*

[2] *Possesses multiple disease-resistance.*

Lime and Fertilizer

Lime — Apply dolomitic lime to maintain a soil pH between 6.0 and 6.8. A deficiency of lime results in acid yellowing of the leaves, characterized by a rough, sandpapery feel and a light yellow color.

Fertilizer — Animal manures have been widely used and are of recognized value in muskmelon production. The average composition of manure is 12 to 22 pounds of N, 1 to 10 pounds of P and 7 to 9 pounds K per ton. Based on soil test results, the following quantities of P_2O_5 and K_2O are recommended:

	Available soil phosphorus (Bray P_1) lbs. P/A					
	0–19	20–39	40–69	70–99	100–199	200
	lbs. of P_2O_5 per acre recommended					
All soils	250	200	150	100	50	25

	Available soil potassium—lbs. K/A					
	< 60	60–99	100–149	150–199	200–299	300
	lbs. of K_2O per acre recommended					
Sandy soils	300	250	200	150	100	50
Clay loams	250	200	150	100	50	0

Nitrogen — Plow down 40 pounds of nitrogen with the rye cover crop. Apply 60 to 100 pounds of nitrogen with the fertilizer recommended above. The nitrogen level may be reduced 2 to 4 pounds per ton of manure applied.

Other Nutrients — When soil tests show low levels of magnesium, 10 to 15 pounds of Epsom salts in 100 gallons of water may be applied as a foliar spray after vines begin to run and repeated one week later. A more permanent program is to apply at least 1,000 pounds of finely ground dolomitic limestone per acre.

Fertilizer application — Apply up to 300 pounds per acre of a fertilizer high in phosphorus in a band several inches to the side and below the transplant or seed. Drill in 3 to 4 inches deep the remainder of the fertilizer recomended.

Sidedress — Sidedress using 30 to 60 pounds of nitrogen when the vines begin to run. Where the crop is plastic-mulched, broadcast this nitrogen over the top and irrigate immediately. It may be easier to put this nitrogen on through the irrigation system.

Spacing and Planting

(See Bulletin E-675—A, "Growing Transplants.")

Spacing — Muskmelons are commonly spaced 4 to 6 feet between rows and 2 to 4 feet in rows.

Seed required — ¼ to ½ pounds per acre for transplants; 1½ to 2 pounds per acre for field seeding.

Planting — Muskmelons are either field-seeded or transplanted. Watermelons, however, may not mature in Michigan when field-seeded. Field-seeding can commence in southern Michigan about May 25 to June 1. Transplants

are set in the field when danger of frost is past, usually after May 15 to 25 in southern Michigan. Plants in peat pots should probably be fertilized with an all-soluble high phosphate starter solution either at planting time or long enough beforehand for the pots to dry enough for easy handling without breakage.

Polyethylene film mulches applied by machine usually result in earlier and increased season's yields. Clear poly mulch requires chemical weed control application to the soil before laying, and even black poly mulch which shades out weeds underneath the plastic is now chemically weeded at the edges of the plastic. Consult the latest revision of Extension Bulletin 433.

Usually 2 to 4 seeds are planted in each pot and later thinned to 2 plants. Yields are usually slightly later but higher yields results from two plants per pot compared with one.

Weed Control

Consult the most recent revision of Extension Bulletin 433.

Insect and Disease Control

Consult the most recent revision of Extension Bulletin 312.

Irrigation

Equipment should be available to supply 1 inch of water during critical stages of the plant in a 3- to 4-hour period once or twice a week. Irrigation using too large a droplet size can injure the foliage. Coarse-textured soils will need to be irrigated more frequently than fine textured soils. Irrigation may be particularly important at time of transplanting or seeding and during fruit set and fruit development.

Harvesting

Muskmelons for local market are picked at or near full slip, preferably in the morning while they are still relatively cool. They are often brushed to remove sand and dirt, sized, and packed. Muskmelons that require some distant transport and shelf life should be harvested at less than ¼ slip; however, full quality may not have developed. The melons should release from the stem with some difficulty.

Experience is required to consistently pick mature watermelons. Withering or drying of the spoon, a small leaflet at the base of the stem, the adjacent tendril, the color of the fruit belly, and the sound of the thumped melon are helpful indices. They should also be harvested in the morning. Overripe watermelons will neither ship nor store satisfactorily and their presence in the market may depress prices and demand.

Post-harvest Handling

Muskmelons harvested at the full slip stage should be cooled rapidly. They can be held 5 days to 2 weeks at 32° to 35°F, but lower temperatures for this period may cause chilling injury. Less mature muskmelons should be stored at a holding temperature of 50 to 55°F. A relative humidity of 85 to 90% is suggested. A holding temperature for watermelons is suggested as 40 to 50°F for short storage. Lower temperatures result in chilling injury and higher temperatures in decay. Muskmelons are sometimes hydrocooled.

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Most varieties developed for the Southeast or Southwest are not normally adapted to Michigan, primarily because of different day lengths and/or disease problems.

OTHER MSU VEGETABLE PUBLICATIONS

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Extension Bulletin 598, Commercial production of asparagus in Michigan.

Extension Bulletin E 486, Micronutrients for vegetable and field crops.

Additional bulletins of interest to vegetable growers:

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U.S.D.A. Agr. Handbook 66, The Commercial storage of fruits, vegetables, and florist and nursery stocks.

The following abbreviations are used in this bulletin:

cwt — hundred weight
F — Fusarium wilt-resistant
F_1 — hybrid
K — potassium
K_2O — available potash
MR — mosaic-resistant
N — nitrogen
P — phosphorus
P_2O_5 — available phosphoric acid
V — Verticillium wilt-resistant
YR — Yellows-resistant

Authors of *Commercial Vegetable Recommendations for Michigan* are Clark W. Nicklow, extension specialist in horticulture; Robert C. Herner, assistant professor of horticulture; John D. Downes, professor of horticulture, and Robert E. Lucas, extension specialist in crop and soil sciences.

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1P—5M—5:70—MB

Onions

Major Production Areas — Newaygo, Ottawa, Allegan, Jackson, and Calhoun counties.

Acreage — Total 1968 acreage was 6,800 on muck soils, with average acre yield of 320 cwt.

Production Requirements

Each onion variety has its own day-length requirement for bulb initiation. For the 2½ to 3½-inch bulb size, plant a variety with a day-length for bulb initiation of 13 to 15 hours. (Do not use varieties grown in Texas. They will bulb prematurely in Michigan.)

The crop requires a fairly cool temperature during the early stages of growth to permit extensive foliage and root development before bulbing starts. High temperatures during the early growth period can cause premature bulbing. During bulbing, harvesting and curing, relatively high temperatures and low humidity are preferred.

Soils

The onion thrives on a wide range of soil conditions, provided adequate moisture, fertility, and good physical condition are maintained. Muck soils are ideal.

Varieties

Early

Early Yellow Globe
Early Harvest

Main Season

Trapp's Downing's Yellow Globe
Spartan Banner
Spartan Gem
Spartan Era
Spartan Bounty
Abundance

Lime and Fertilizer

Lime — Apply lime to muck soils if the pH is below 5.2 and to mineral soils to maintain a pH of 6.0 to 6.5.

Fertilizer — Based on soil test results, the following quantities of P_2O_5 and K_2O are recommended:

	Available soil phosphorus (Bray P_1) lbs. P/A						
	0–19	20–39	40–69	70–99	100–149	150–199	200+
	lbs. of P_2O_5 per acre recommended						
All soils	300	250	200	150	100	50	0

	Available soil potassium—lbs. K/A						
	<125	125–199	200–274	275–349	350–425	425–500	500–600
	lbs. of K_2O per acre recommended						
Organic soils	400	350	300	250	200	150	100

	<60	60–99	100–149	150–199	200–249	250+
Sandy loams	300	250	200	150	100	50

Nitrogen — With the above fertilizer, apply 60 pounds of nitrogen to muck soils and 120 pounds to sandy loam soils per acre.

Micronutrients — Use 5 pounds of manganese per acre in the band fertilizer if the pH is 5.8 to 6.4 and 10 pounds of manganese if the pH is above 6.4. Apply 4 pounds of copper per acre on muck soils if the pH is 5.8 to 6.4 and 2 pounds of copper per acre if the pH is above 6.5. Double these copper rates if the field has never received copper. Zinc at the rate of 3 pounds per acre is needed for several years on newly developed mucks or a yearly application of 2 to 3 pounds of zinc may be needed on mineral soils known to be deficient.

Organic soils of pH 5.5 or lower and soils high in iron may need molybdenum. Seed treatment suggested in this case is sodium molybdate at the rate of ½ ounce per acre dissolved in 3 tablespoons of water. Mix with the seed required for one acre. For foliar spray, use 2 ounces per acre.

See Extension Bulletin E 486 for additional details on micronutrients.

Fertilizer application — Apply in bands of 2 to 3 inches below the seed up to 500 pounds of fertilizer high in phosphorus. Broadcast the remaining fertilizer and disk in before planting.

Sidedress — Apply 200 pounds of pelleted ammonium nitrate or 160 pounds of urea per acre in early June.

Spacing and Planting

Space rows 16 inches apart with 8 to 12 plants per foot. The area desired per plant is about 25 square inches. Where jumbo onions are desired, as for French-fried onion rings, precision-seed so that plants are no closer than 2 inches between plants in the row.

Two to four pounds of seed per acre are required depending on germination, seed size, and spacing.

Weed Control

Consult the most recent revision of Extension Bulletin 433.

Insect and Disease Control

Consult the most recent revision of Extension Bulletin 312.

Sprout Inhibitor

For storage onions, apply maleic hydrazide (sold as MH-30) as a spray on the foliage approximately 1 to 2 weeks before harvest when the bulbs are mature, the tops are down, and 5 to 8 leaves are still green. Apply

5.3 pints of MH-30 in 100 gallons of water per acre of onions. Some green leaves are necessary for translocation of the chemical to the bulbs where it inhibits sprouting. Applying the spray too early when the tops are fully green will cause spongy, hollow necks, and storage decay will increase. Rain within 24 hours may reduce the effectiveness of the chemical. If applied correctly, maleic hydrazide should add several months of storage life to good storage cultivars.

Harvesting

When weather conditions permit, allow onion tops to dry down naturally before machine-harvesting. Under cutting the onion will hasten the drying down of the tops. If wet weather prevents drying down of the tops, this excess water must be removed in storage by ventilation and artificial heat. Some growers harvest onions with the tops attached but a problem of proper air circulation sometimes occurs resulting in hot pockets and wet bulbs which may decay.

Post-harvest Handling

For long-term storage, use only those varieties such as Trapp's Downing Yellow Globe and the Spartan lines. Poor-keeping onions such as Abundance and the early varieties should be marketed as rapidly as possible. Onions in bulk should not be piled more than 12 feet deep.

Curing of onions serves two purposes: (1) it removes moisture from the necks which dry and thus provides a barrier to disease organisms, and (2) it provides the proper conditions for the best color development of the skin.

Curing can take place in the field, in storage by circulating outside air through the onions, or in storage by using artificial heat. In all cases, approximately 100 pounds of water per ton of onions must be removed. The best natural curing occurs at 75 to 80°F and 60 to 70% R.H. If artificial heat is used, apply it using an external exhaust heater and force the air up through the pile to maintain a temperature of 85 to 90°F until the neck is tight. This may take 4 to 5 days. If onions next to the air ducts are excessively dry, compared to those on top of the pile, the volume of air has not been adequate. Air volume should be 1½ cubic feet per minute for each cubic foot of stored onions.

After curing, the storage temperature should gradually be decreased. Since most onion storages depend upon outside temperatures for cooling, the temperature should not be reduced too rapidly. If reduced too rapidly and several warm days occur, moisture will condense, resulting in bulb staining, sprouting, and decay. When the average outside temperature is 32°F the onion storage should be maintained at 32°F and 60 to 70% R.H. Good storage onion varieties should keep 5 to 6 months but should not be held beyond early March unless treated with maleic hydrazide. Onions held at higher temperatures will sprout earlier. Lower humidity will increase water loss. The use of sling psychrometers and thermometers for checking relative humidity and temperatures is highly recommended.

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1P—5M—5:70—MB

Green Peas

Major Production Areas — Sanilac, Saginaw, Ionia and Bay counties.

Acreage — In 1968, 5,000 acres for processing with a yield of 1.1 tons per acre. Acreage for fresh market is limited.

Production Requirements

The green pea is a cool season crop and will tolerate moderate freezes. It germinates well but slowly at soil temperatures below 50°F. Seed treatment to prevent damping-off and seed corn maggot often increases germination of the seed and is worth the nominal cost. Consult the latest revision of Extension Bulletin 312 for materials and rates.

Crop rotation is probably the most important single factor to prevent root rots and maintain high yields within a production area. Processors who have allowed peas to be grown on the same land only one year out of four have maintained essentially complete freedom from damage by root rots in peas. Days from planting to harvest are as few as 60 for the early maturing varieties and as many as 75 days for late maturing ones.

Soils

Select fields that are as uniform in fertility, soil type, slope and drainage as possible. Peas germinate slowly in wet, cool, and poorly aerated soils. Peas are injured by poor soil drainage at any time during the season. The best soils are usually well-drained silt loams, sandy loams, or clay loams. Root rot organisms become more destructive on poorly drained soils.

Varieties

The processor usually selects the variety to be grown for canning and freezing. The following are suggested:

Canning
Perfect strains
Alaska strains

Freezing
Frazer
Jade
Dark Green Perfection strains

Fresh Market
Progress strains
Little Marvel
Wando
Lincoln

Spacing and Planting

Spacing — Plant in rows 7 inches apart and seed to obtain a plant every 2 inches for processing. For fresh market, plant rows 28 to 36 inches apart with the same seeding rate per row. Place seed at no more than 1 inch depth unless soil is dry.

Seed — Depending upon seed size and percentage germination of seed, 2 to 4 bushels per acre for processing and ½ to 1 bushel per acre for fresh market should be required.

Time to plant — The first plantings can be made when the soil is tillable in late March or early April. To provide a spread in the harvest pattern, planting can continue through May 15 for harvest in late July. Late planting should be avoided due to the likelihood of hot July temperatures.

Weed Control

Consult the most recent revision of Extension Bulletin 433.

Lime and Fertilizer

Lime — Apply lime to bring soil pH between 6.0 to 6.8.

Fertilizer — Based on soil test results, the following quantities of P_2O_5 and K_2O are recommended:

	Available soil phosphorus (Bray P_1) lbs. P/A				
	0–19	20–39	40–69	70–99	100+
	lbs. of P_2O_5 per acre recommended				
All soils	150	100	50	50	0

	Available soil potassium—lbs. K/A					
	< 60	60–99	100–149	150–199	200–249	250+
	lbs. of K_2O per acre recommended					
Sandy soils	200	150	100	50	25	0
Clay loams	150	100	50	25	0	0

Nitrogen — Apply 40 to 50 pounds of nitrogen with the above fertilizer.

Fertilizer application — Drill fertilizer 2 inches to the side of the seed or broadcast and disk in prior to planting.

Sidedress — If nitrogen deficiency is likely, sidedress 20 to 30 pounds of nitrogen per acre when the peas are 4 to 6 inches tall. To avoid leaf burn, apply only when the plants are dry.

Insect and Disease Control

Consult the most recent revision of Extension Bulletin 312.

Irrigation

Peas respond favorably to irrigation if a soil moisture shortage develops as the peas approach maturity.

Harvesting

Most processors determine when to harvest based on a tenderometer reading. For fresh market, harvest while the peas are tender since this is what the market prefers.

Post-harvest Handling

Green peas tend to lose part of their sugar content, on which much of their flavor depends, unless they are promptly cooled to near 32°F after harvest. To extend storage life for fresh market it is desirable to pack peas in crushed ice.

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F_1 — hybrid	P_2O_5 — available phosphoric acid
K — potassium	V — Verticillium wilt-resistant
K_2O — available potash	YR — Yellows-resistant
MR — mosaicresistant	

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1P—5M—5:70—MB

EXTENSION BULLETIN E-675—O
Farm Science Series

April 1970
Cooperative Extension Service, Michigan State University

Peppers

Major Production Areas — Macomb, Monroe, Wayne, Berrien, Van Buren, Saginaw, and Bay counties.

Acreage — 1968, 1,300 acres which averaged about 75 cwt. per acre.

Production Requirements

The pepper, a warm season crop, yields best if night temperatures during the fruit-setting period are between 60 and 70°F. High temperatures coupled with a relatively low humidity result in poor fruit set and blossom end rot in many of the sweet green bell pepper types. Low moisture supply during the fruit setting period is also a cause of poor fruit set and blossom end rot. Peppers are ready to harvest between 60 and 80 days after transplanting or 100 and 120 days after field seeding. An individual fruit will usually reach maximum size 45 days after blossoming.

Soils

Peppers are best adapted to mineral soils. When early harvest is important, sandy or sandy loam soils are preferred. The soil should be well-drained and the pH preferably between 6.0 and 6.8. The pepper plant does poorly when grown in moderate to strong acid soils.

Varieties

Vinedale (early, small, green, somewhat pointed fruit)
Spartan Emerald (early, green bell, medium sized fruit)
Sweet Banana (early, yellow fruit, pointed, about 6 inches long)
Yellow Sweet Long (early)
Pennwonder (early, green bell, medium sized fruit)
California Wonder (early, green bell, blocky fruit)
Staddon's Select (early, green bell, good setting ability)
Delaware Bell (large fruited green bell, mosaic resistant)[1]
Yolo Wonder B (green bell, mosaic resistant)[1]
Hungarian Wax (early, fruit are hot, long, yellow and tapered)
Rumanian Wax (early, fruit are slightly pungent, long with slight taper)
Keystone Resistant Giant (large fruited, late, green bell, mosaic resistant)[1]

Lime and Fertilizer

Lime — It is important for good growth and a minimum of blossom end rot to maintain a soil pH between 6.0 and 6.5.

[1] *Tobacco mosaic only; none are resistant to cucumber mosaic or other viruses.*

Fertilizer — Based on soil test results the following quantities of P_2O_5 and K_2O are recommended:

	Available soil phosphorus (Bray P_1) lbs. P/A					
	0–19	20–39	40–69	70–99	100–199	200+
	lbs. of P_2O_5 per acre recommended					
All soils	250	200	150	100	50	25

	Available soil potassium—lbs. K/A					
	<60	60–99	100–149	150–199	200–249	250+
	lbs. of K_2O per acre recommended					
Sandy loam soil	300	250	200	150	100	50
Clay loam soil	250	200	150	100	50	25

Nitrogen — Add 75 to 100 pounds of nitrogen per acre to the above fertilizer for a preplant application.

Fertilizer application — Apply up to 300 pounds of a fertilizer high in phosphorus in a band 3 to 4 inches to the side and several inches below the plant at transplanting. If field-seeding, apply the same fertilizer 2 inches to the side and 2 inches below the seed at time of seeding. Apply the remainder of the fertilizer as a plow down or drill-in application before planting.

Sidedress — Sidedress shortly after the first fruits are set with an additional 30 to 75 pounds of nitrogen per acre, depending upon variety, soil, and rainfall.

Starter solution — Use a soluble fertilizer such as 15-30-15, 10-52-17, or 10-50-10 at the rate of 3 pounds per 50 gallons of water. Mix thoroughly and place about one pint at the base of each plant at the time of transplanting.

Spacing and Planting

(See Bulletin E-675—A, "Growing Transplants.")

Transplant or field seed between May 15 and June 1. Transplants should be in rows 3 feet apart and spaced 9 to 18 inches in the row depending upon variety and use. Processing peppers are usually planted closer than those for fresh market. Peppers can be field-seeded as close as 12 inches between rows and plants spaced 6 to 12 inches in the rows for processing.

Weed Control

Consult the most recent revision of Extension Bulletin 433.

Insect and Disease Control

Consult the most recent revision of Extension Bulletin 312.

Irrigation

Irrigate with ½ inch of water immediately after transplanting or field-seeding if rainfall is inadequate. Main-

tain adequate moisture levels throughout the growing season and particularly during the blossoming and fruit development period, to maintain a steady growth rate and to reduce blossom end rot.

Harvesting

Pepper fruits are generally harvested when they are firm and dark green (or when bright yellow in the case of the yellow fruited varieties). For certain uses processors allow green fruit to mature on the plant and harvest red fruit. Frequent picking will increase the yield by encouraging the growth of recently set fruit.

Post-harvest Handling

If peppers must be stored, a temperature of 45 to 50°F and 90 to 95% R.H. is recommended for sweet or bell peppers. Pepper fruits are subject to chilling injury below 45°F. Temperatures above 50°F encourage ripening and bacterial soft rot. Under the most favorable conditions they should not be stored longer than 2 to 3 weeks. Brush waxing and hydrocooling of pepper fruit can result in increased bacterial soft rot decay and therefore are not recommended.

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1P—5M—5:70—MB

EXTENSION BULLETIN E-675—P COMMERCIAL VEGETABLE RECOMMENDATIONS FOR MICHIGAN April 1970
Farm Science Series Cooperative Extension Service, Michigan State University

Pumpkin and Squash

Major Production Areas — Fresh market production is scattered over southern Michigan. Winter squash for processing is heaviest in west-central and southwest Michigan.

Acreage — Summer squash principally for fresh market; winter squash for processing; and pumpkins for Jack-O-Lanterns and some processing.

Production Requirements

Pumpkins and squash are warm season crops sensitive to frost. Under favorable growing conditions most varieties of summer squash produce the first usable fruits in 7 to 8 weeks if immature fruits are continually removed. Pumpkins and winter squash require the full Michigan growing season to mature a crop. Summer squash are eaten in the immature state while pumpkins and winter squash are generally used when fully mature.

Soils

These crops will grow well on almost any good well-drained mineral soil.

Fertilizer

Based on soil test results the following quantities of P_2O_5 and K_2O are recommended:

	Available soil phosphorus (Bray P_1) lbs. P/A				
	0–19	20–39	40–69	70–149	150+
	lbs. of P_2O_5 per acre recommended				
All soils	200	150	100	50	25
	Available soil potassium—lbs. K/A				
	< 60	60–99	100–149	150–199	200–249
Sandy loams	200	150	100	50	25
Clay loams	150	100	50	25	0

Nitrogen — Apply 30 to 60 pounds of nitrogen with the above fertilizer.

Fertilizer application — Apply 300 pounds of fertilizer high in phosphorus in a band, placed 2 inches to the side and 2 inches below the seed at planting. Drill in or broadcast and disk in the balance of the fertilizer recommended.

Sidedress — Supplemental nitrogen is often sidedressed on summer squashes to maintain leaf vigor and continued production. Occasionally, light sidedressings, when the vines begin to run, are applied to pumpkins and winter squashes if very low preplant applications were made or the leaf color (light green to yellowish) indicates a need. Excess nitrogen delays maturity and may result in lopsided or flattened fruits, which are often soft. These fruits fail to harden sufficiently for good storage before cool fall weather arrives.

Spacing and Planting

Direct field seeding of pumpkins and winter squash is the common practice when soils have warmed enough to allow germination (above 50°F) and the danger of frost is past. Spacing varies with variety and size of vine from 6 to 12 feet between rows and 1 to 3 feet between hills (1 to 3 plants per hill) in the row.

Summer squash are frequently field-seeded, but for early markets it may be profitable to transplant from peat pots or wood bands. Spacing varies with variety. Bush types are commonly spaced 1½ to 3 feet between hills in the row, with 4 to 6 feet between rows.

Plant seed ¾ to 1¼ inches deep, depending on soil texture and moisture. Sow enough to insure a stand which may later be thinned as needed. Seed required is as follows: winter squash and pumpkins 2 to 4 pounds per acre; summer squash, 4 to 6 pounds per acre.

Weed Control

Consult the most recent revision of Extension Bulletin 433.

Insect and Disease Control

Consult the most recent revision of Extension Bulletin 312.

Pollination

Being completely cross-pollinated crops, pumpkins and squash require bees. Inadequate pollination results in poorly shaped fruits as well as excessive blossom drop. Therefore, one hive of bees per acre is recommended.

Harvesting

Summer squash are harvested as immature fruits at 1- to 3-day intervals, packed in cartons or baskets, and quickly moved to market. Care should be taken not to damage the very tender skin as this permits disease organisms to enter.

Winter squash and pumpkins are not normally harvested until the rind or skin is completely hardened.

Post-harvest Handling

Summer squash are subject to chilling injury and can only be held 3 to 4 days at 32° to 40°F and 90% R.H. They deteriorate rapidly if removed from storage at temperatures below 50°F, and held too long at this temperature. For storage of 2 weeks, a temperature of 45 to 50°F is best with 90% R.H. Summer squash should be moved

through marketing channels as rapidly as possible. Pumpkins and winter squash are also subject to chilling injury when held at temperatures below 50°F.

Pumpkins should be held in good condition for 2 to 3 months at 50 to 55°F and 70 to 75% R.H.

Winter squash for storage should be well-matured and free from injury or decay. A 10- to 20-day curing period at 80 to 85°F before storage is often recommended but there is some evidence that this practice is not consistently beneficial. All winter squash should be held at 50 to 55°F and at 50 to 75% R.H. Hubbard squash should keep 6 months or more, Acorn types 5 to 8 weeks and Butternut squash 2 to 3 months. Squash should not be stored with ethylene producers such as ripe apples and pears because they will turn color, become stringy, and decay. It is important to keep them dry and have good air circulation.

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F — Fusarium wilt-resistant
F_1 — hybrid
K — potassium
K_2O — available potash
MR — mosaic-resistant
N — nitrogen
P — phosphorus
P_2O_5 — available phosphoric acid
V — Verticillium wilt-resistant
YR — Yellows-resistant

Authors of *Commercial Vegetable Recommendations for Michigan* are Clark W. Nicklow, extension specialist in horticulture; Robert C. Herner, assistant professor of horticulture; John D. Downes, professor of horticulture, and Robert E. Lucas, extension specialist in crop and soil sciences.

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EXTENSION BULLETIN E-675—Q COMMERCIAL VEGETABLE RECOMMENDATIONS FOR MICHIGAN April 1970
Farm Science Series Cooperative Extension Service, Michigan State University

Rhubarb and Miscellaneous Crops

Acreage — Very small in Michigan.

Production Requirements

Rhubarb is a cool weather perennial crop, and is rarely grown where the summer mean temperature is above 75°F. The cooler eastern and western lake shore areas in Michigan are suited to rhubarb production.

Soils

Rhubarb grows best on deep, fertile loams that are well-supplied with organic matter. Rhubarb grown on muck or marl soils has been harvested in the same year as transplanted. Muck soils produce very vigorous growth, and it has been estimated that 40 tons per acre are possible. Red petiole color generally declines with increased vigor and this can be an important factor for some processors.

Varieties

Victoria — poor petiole color but good vigor; few petioles per plant but petioles are large.

Valentine — good petiole color but medium vigor.

MacDonald — average to poor petiole color, medium plant vigor, but many petioles per plant.

Sutton (Sutton's Seedless) — average to poor petiole color, good plant vigor and few petioles per plant.

Lime and Fertilizer

Lime — Rhubarb is tolerant to soil acidity. It does best on a slightly to moderately acid soil; therefore, liming is seldom recommended.

Fertilizer — Based on soil test results the following quantities of P_2O_5 and K_2O are recommended:

	Available soil phosphorus (Bray P_1) lbs. P/A					
	0–19	20–39	40–69	70–99	100–149	150+
	lbs. of P_2O_5 per acre recommended					
All soils	250	200	150	100	50	0

	Available soil potassium—lbs. K/A						
	<60	60–99	100–149	150–199	200–249	250–300	300+
	lbs. of K_2O per acre recommended						
Sandy loams	300	250	200	150	100	50	25
Clay loams	250	200	150	100	50	25	0
Muck	500	400	300	250	200	150	100

Nitrogen — Apply 50 pounds nitrogen per acre with the above fertilizer and apply the same amount in early spring each year thereafter.

Fertilizer application — Plowing down the fertilizer places it at the best depth for rhubarb roots.

Sidedress — Two weeks after growth starts in the spring, sidedress with 50 pounds of nitrogen per acre.

Spacing and Planting

Planting — Buy new rhubarb roots or divide the crowns formed from previous growing seasons. New roots are obtained by cutting through the crown, between the buds, so as to leave as large a piece of storage root as possible with each large bud. Four or five new roots can usually be obtained from rhubarb that has been grown for at least 4 years. A number of viruses and other diseases reduce vigor of plants and yield. New Plants with vigorous growth should be staked during June and left until the following spring, then dug up and used as planting stock. The remainder should be discarded. Plant rhubarb roots as early as soil can be worked in the spring.

Spacing — Rows 3 to 4 feet apart and 3 feet apart in the row. This is a maximum of 4,840 plants per acre.

Weed Control

No chemical weed control is recommended. Consult the latest revision of Extension Bulletin 433 in case new materials are cleared for use. Cultivation should start early and should be shallow.

Insect and Disease Control

Rhubarb curculio can seriously damage rhubarb petioles. Destroy curled dock weeds near rhubarb plantings and consult the latest revision of Extension Bulletin 312 for control of this and other insects and diseases of rhubarb.

Irrigation

Rhubarb on mineral soil will often go through what has been referred to as "summer dormancy" in August and will die down. Irrigation delays these effects.

Harvesting

Flower stalks should be cut out while they are still small and, in any case, before the flowers open. This can conveniently be done when harvesting a crop for processing, but a separate operation will be necessary in crops for fresh harvest. No leaf stalks should be pulled from plants that are to be used for dividing for a new planting the following year. Also, at least one summer's growth should take place before any petioles are removed. The smaller stalks are often thinned to permit better development of those remaining. The harvest season should extend no more than one month (normally throughout June) in Michigan.

Post-harvest Handling

Fresh rhubarb stalks in good condition can be stored 2 to 4 weeks at 32°F and 95% R.H. However, ample air circulation should be provided or there is danger of heating and mold growth. Fresh rhubarb cut into one-inch pieces and packaged in one-pound perforated polyethylene bags can be held 2 to 3 weeks under the conditions stated above.

Chinese Cabbages — Consult suggestions for cabbage.

Varieties: Michihli, Wong Bok

Collards — Consult suggestions for field seeded broccoli. Post-harvest handling is similar to that given to lettuce.

Varieties: Vates

Eggplant — Consult suggestions for peppers. Verticillium wilt is a very serious problem in producing eggplant and rotation with crops other than tomatoes, potatoes or strawberries is important. Fumigation is necessary for soils infested with verticillium wilt. Post-harvest handling is similar to that for peppers.

Varieties: Black Beauty, Burpee Hybrid, Black Magic (F_1)

Endive — Consult suggestions for lettuce. Post-harvest handling is similar to that for lettuce.

Varieties: Full Hearted Batavian, Green Curled, Salad King, Florida Deep Heart

Kale — Consult suggestions for beets except that kale seeds are sown shallow and the soil does not require boron. Post-harvest storage requirements are similar to lettuce.

Varieties: Vates, Dwarf Blue Scotch

Parsley — Consult suggestions for beets except that parsley seeds are sown shallow and the soil does not require boron. Post-harvest handling similar to lettuce.

Varieties: Deep Green, Moss Curled, Hamburg

Popcorn — Consult suggestions for sweet corn. Allow corn to dry on stalk thoroughly; store cool, dry.

Varieties: Peppy Hybrid, Minhybrid 250

Radishes — Consult suggestions for beets except that radish seeds are sown shallow, in 7- to 9-inch rows, and the soil does not require boron. Radishes mature in about 21 days and thus can normally be seeded from early April through August, and no sidedressing is required. The cabbage root maggot is usually serious unless furrow treatment at planting time and later foliage sprays are provided. Consult the latest revision of Extension Bulletin 312. Follow the suggestions for club root control given for cabbage. Storage similar to topped carrots.

Varieties: Comet, Champion, Early Scarlet Globe (short top), Cherry Belle, Red Prince

Rutabagas — Consult suggestions for beets except that rutabaga seeds are sown shallow and the soil does not require boron. The cabbage root maggot is usually serious unless furrow treatment at planting time and later foliage sprays are provided. Consult the latest revision of Extension Bulletin 312. Follow suggestions given for club root control for cabbage. Rutabagas require the same storage conditions as topped carrots and are usually waxed prior to marketing.

Varieties: American Purple Top (Imp. Long Island), Laurentian, Macomber (White)

Spinach — Consult suggestions for lettuce except that spinach is usually seeded in 9-inch rows and 10 to 12 seeds per foot of row for processing and in 12- to 18-inch rows and 6 to 8 seeds per foot of row for fresh market. Spinach goes to seed (bolts) when days are long and temperatures are high. Post-harvest handling is similar to lettuce.

Varieties:

Market: Dark Green Bloomsdale (spring), Long Standing Bloomsdale (spring), Virginia Blight Resistant Savoy (fall).

Processing: Northland (spring), Viking (Heavy Pak) (spring), Packer (F_1) (fall), Chesapeake (F_1) (fall), Savoy Hybrid 612 (fall).

Turnips — Consult suggestions for beets except that turnip seeds are sown shallow and the soil does not require boron. The cabbage root maggot is usually serious unless furrow treatment at planting time and later foliage sprays are provided. Consult the latest revision of Extension Bulletin 312. Follow suggestions given for club root control for cabbage. Turnips require the same storage conditions as topped carrots.

Varieties: Purple Top White Globe, Just Right (F_1), Tokyo Market.

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EXTENSION BULLETIN E-675—R
Farm Science Series

COMMERCIAL VEGETABLE RECOMMENDATIONS FOR MICHIGAN
April 1970
Cooperative Extension Service, Michigan State University

Sweet Corn

Major Production Areas — Wayne, Washtenaw, Monroe, Macomb, and St. Clair counties, with some acreage scattered over southern Lower Peninsula.

Acreage — In 1968, 10,300 acres were harvested with average acre yield of 80 cwt. At least 95% of the Michigan crop is for fresh market.

Production Requirements

Mechanical harvesting of fresh market sweet corn is progressing rapidly among growers with large acreages. For mechanical harvesting, choose varieties that have high quality and are adapted to harvest by the given machine. Varieties vary greatly in quality. Earlier maturing varieties are generally lower in quality, but there is considerable variation in quality even among the early varieties.

Sweet corn may be grown on the same land year after year if one thoroughly plows under the corn stalks soon after harvest. Plowing under the stalks is particularly important if the stalks are infested with corn borers. Smut may be more severe with continuous corn rotation or where fresh manure is used. It is advisable to grow a winter cover crop and plow down 30 to 50 pounds of nitrogen with the cover crop.

Soils

Sweet corn grows on a wide range of soil types but the soil should be well drained. For early plantings, choose coarse-textured soils as they can be plowed early and are less subject to frost.

Hybrid Varieties

(days from planting to harvest)

First Early (of lower quality than later varieties)
Spring Gold (67)
Spring Bounty (69)
Seneca Beauty (65)
Earliking (66)

First Early (of better quality)
Morning Sun (72)
Seneca Star (66)

Second Early (good quality)
Northern Belle (74)
Northern Belle L (76)

Excellent Quality

Mid-Season (medium sized ears of high ear count)
Gold Cup (80)
Seneca Scout (81)

Mid-Season to Late (large ears)
Iochief (85)
Merit (84)
N.K. 199 (85)
Gold Eagle L (79)
Seneca Chief (82)
Silver Queen (89)

Processors generally suggest varieties for processing.

Lime and Fertilizer

Lime — Add lime to maintain a soil pH between 6.0 and 6.5.

Fertilizer — Based on soil test results, the following quantities of P_2O_5 and K_2O are recommended:

	Available soil phosphorus (Bray P_1) lbs. P/A				
	0–19	20–39	40–69	70–99	100+
	lbs. of P_2O_5 per acre recommended				
Mineral	200	150	100	50	25
Organic soils	150	100	50	25	0

	Available soil potassium—lbs. K/A					
	< 60	60–99	100–149	150–199	200–299	300
	lbs. of K_2O per acre recommended					
Sandy soils	250	200	150	100	50	0
Clay loams	200	150	100	50	25	0
Organic soils	300	250	200	150	100	50

Nitrogen — Apply 70 pounds of nitrogen with the above fertilizer.

Micronutrients — Organic soils may require 2 percent manganese, 1 percent zinc and/or ½ percent copper to be added to the banded fertilizer.

Fertilizer application — Apply up to 300 pounds of a fertilizer high in phosphorus in a band 2 inches to the side and 2 inches below the seed. Plow down the balance of the fertilizer if more is required.

Sidedress — Sidedress with 60 pounds of nitrogen in June (mineral soil only).

Spacing and Planting

Plant in rows 28 to 36 inches apart and space first early varieties 8 to 10 inches in rows and the remaining varieties 10 to 12 inches in rows. This will require 10 to 15 pounds of seed per acre depending on seed size, percentage emergence and spacing.

Growers may want to plant some sweet corn in early April when there are still risks of damage by frosts. Use only "first early" varieties as they are normally more vigorous under cool temperatures. After mid April or as soon as there is less danger from frost damage, plant the full range of varieties (first early, mid-season and late). Later planting should only be made using either the mid-season or late varieties in order to spread the harvest season. These later varieties are of better quality and are preferred by the markets.

Weed Control

Consult the most recent revision of Extension Bulletin 433.

Insect and Disease Control

Consult the most recent revision of Extension Bulletin 312.

Irrigation

Moisture is most needed for effective herbicidal activity, during the early stages of germination and plant emergence, and during silking and ear development. Supplemental irrigation should be provided to meet the moisture requirement at least during these critical periods.

Harvesting

Follow the maturity of the corn daily to determine when it should be picked. Harvest when the kernels are in the milk stage and the kernels at the tip of the ear are filled. Sweet corn will usually be ready to harvest around 21 days after 50 percent of the plants are in full silk. Stage to harvest for processing is usually determined by the processor.

Post-harvest Handling

Sweet corn can lose its quality rapidly after harvest. Sugar content, which largely determines quality of sweet corn, will be lost about four times as rapidly at 50°F as at 32°F. Hence, sweet corn should be cooled promptly after harvest. Usually corn is hydrocooled to near 32°F and top-iced for transit or storage to keep husks fresh and prevent denting. Vacuum cooling is also satisfactory if the corn is pre-wet and top-iced after cooling. Sweet corn should not be handled in bulk unless iced, because of the tendency to heat throughout the pile. It should be moved through marketing channels as rapidly as possible.

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EXTENSION BULLETIN E-675—S
Farm Science Series

COMMERCIAL VEGETABLE RECOMMENDATIONS FOR MICHIGAN April 1970
Cooperative Extension Service, Michigan State University

Tomatoes

Major Production Areas — Berrien, Van Buren, Monroe, Lenawee, and Macomb counties.

Acreage — Ten to 12 thousand acres. Acreage in Bay, Wayne and other counties is mainly for local markets.

Production Requirements

Tomatoes are a warm season crop, injured by light frosts and killed by freezing. Pollen is seldom shed and poor fruit set results at temperatures below 59°F and above 80°F. The time from transplanting to first ripe fruit varies with variety from 65 to 90 days or more. The time from flowering to fruit maturity varies from about 40 to 50 days. Early maturing varieties planted in mid to late May, especially those with the determinate or bushy type of vine growth, usually become senescent and unproductive by late August or early September. Late varieties normally have a fair load of green fruit when fall frosts terminate production.

Sites and Soils

Southern and eastern exposures warm up faster than western or northern ones and give earlier crops. Very gentle sloping or level land is preferred. For machine harvesting of processing tomatoes, nearly level land is essential for uniform maturity and proper machine operation. Early and market crops are most often grown on well-drained loamy sands or sandy loams. Processing tomatoes are sometimes grown on heavier soils such as silty or clay loams. For machine harvest, lighter, well-drained soils with irrigation are likely to provide more consistently high yields for processing tomatoes.

Varieties

Earliness, firmness, smoothness, relative freedom from cracking combined with medium to large size of fruit are all important considerations for the fresh market grower.

Season	Market	Processing
Early	*Fireball* *New Yorker* (V)[1] *Campbell 1327* (VF)[2] *Springset* (VF, F_1) Trial	*New Yorker* (V) *Heinz 1783* (VF) Trial (filed seeding)
Mid season	*Heinz 1350* (VF) *Cardinal Hybrid* (F_1)	*Heinz 1350* (VF) *Roma* (VF) *Heinz 1630* (VF) Trial *Campbell 1327* (VF)
Late	*Ace* *Ace 55 VF* (VF) *Burpee Hybrid*	*Heinz 1370*

[1] *(V) Verticillium wilt resistant.*
[2] *(VF) Verticillium and Fusarium wilt resistant.*

Resistance to *Fusarium* and *Verticillium* wilts are almost essential in Michigan. Improved varieties are needed, especially earlies, but those listed below have usually done well in Michigan and at the present constitute the bulk of the commercial production.

Lime and Fertilizer

Lime — Apply dolomitic lime to maintain a soil pH between 6.0 and 6.8.

Fertilizer — Based on soil test results, the following quantities of P_2O_5 and K_2O are recommended:

	Available soil phosphorus (Bray P_1) lbs. P/A					
	0–19	20–39	40–69	70–99	100–149	150–199
	lbs. of P_2O_5 per acre recommended					
All soils	300	250	200	150	100	50

	Available soil potassium—lbs. K/A					
	< 100	100–149	150–199	200–249	250–299	300–399
	lbs. of K_2O per acre recommended					
Sandy soils	300	250	200	150	100	50
Clay loams	250	200	150	100	50	0

Nitrogen — Add 70 pounds of nitrogen per acre with the above fertilizer.

Micronutrients and other fertilizer elements — Micronutrients are not normally needed for tomatoes but magnesium and calcium application may be beneficial. Where leaf mottling without virus symptoms occurs, a foliar application of Epsom salts (magnesium sulfate) at 10 to 20 pounds per 100 gallons of water may be applied and repeated if necessary. Calcium uptake can be suppressed by over fertilizing, causing blossom-end rot. If the soil calcium to soluble salts ratio in solution is less than 1:5, calcium chloride (36% calcium) can be applied to the foliage at the rate of 4 pounds per 100 gallons of water twice weekly. Calcium can be applied until the fruits are well sized and this can aid in reducing blossom-end rot. Avoiding root pruning that results from cultivating close to plants and maintaining adequate moisture supply by irrigation also aids in preventing blossom-end rot.

Fertilizer application — Apply up to 200 pounds per acre of a phosphate fertilizer such as 0-45-0, 1 to 2 inches directly beneath the seed for field seeded acreage and up to 300 pounds per acre of a fertilizer high in phosphorus in bands 3 to 4 inches to the side and several inches below at transplanting time for transplanted acreage. Plow down or drill in 3 to 4 inches deep the remainder of the fertilizer recommended.

Starter solution: For transplants use a starter solution made by dissolving 3 to 5 pounds of an all soluble high phosphorus fertilizer such as 11-48-0 or 10-50-10 in 50 gallons of water, following manufacturers suggestion. Place about one pint at the base of each plant.

Sidedress — Apply 30 to 90 pounds of nitrogen per acre when the first fruits are about the size of a half dollar.

High rates will generally retard maturity but give higher seasonal yield. Therefore, the lower rate is suggested when early maturity is desired. Less nitrogen is leached from heavier soils and hence these soils as well as soils high in organic matter usually require less sidedress nitrogen.

Spacing and Planting

(See Bulletin E-675—A, "Growing Transplants.")

The seed of early maturing varieties that are adapted to field seeding may be sown directly in the field using 2 to 4 rows per 5-foot bed. Use precision spacing, if possible, and space seed 4 to 6 inches apart in the rows. Thinning will not be required if seeds are spaced properly. Seed requirements vary from ½ to 1 pound depending on spacing. Seed ½ to ¾ inches deep. Field-seeding may become more popular, especially for canning crops maturing in late August or early September, as suitable improved disease-resistant early varieties become available. Chemical weed control is essential in field seeded crops. Field-seeding may begin as early as May 5 in southern Michigan but wait until the soil temperature is above 55°F.

More frequently, southern or locally grown 4- to 8-week-old transplants are set 1½ to 5 feet apart in rows 4 to 6 feet apart. In general, production increases as the number of plants are increased, but fruit size and yield per plant decline with the closest spacings. Varieties vary considerably in their response to spacing. Usually early maturing, small-vined varieties cannot fully utilize as much space as larger vined varieties.

The age of the transplant is very important in determining total yields. For maximum season yields, especially important in canning crops, transplants should be young (4 to 5 weeks old from first transplanting), and have no fruits, flowers or flower buds present when set in the field. Too early fruit setting stunts the plant and reduces its yield potential.

Although the crop is not frost-tolerant, a considerable portion of Michigan's fresh acreage is set in the field before the danger of frost in the spring is completely past. Where possible returns warrant, the risk of transplanting in early or mid-May is often practiced, sometimes using hot caps or hot tents which provide 4 to 6 degrees of frost protection. Transplants for such early plantings, especially if not protected by caps or tents, require that the plants be hardened by exposure to cool temperatures, withholding water for several days, followed by watering well just prior to setting in the field. Hot caps and tents must be ventilated to avoid excessive temperatures on warm sunny days.

Extra soluble nutrients, especially N and P, should be applied in solution either during the transplanting operation with bare rooted plants or a day to a few hours ahead for potted plants (see section on starter solutions).

Peat pots are not removed from the transplant but the upper edges of the pot must be thoroughly covered with soil to prevent the wick action of the pot from drying the contained soil and very seriously reducing the early growth and development of the transplant. It is not unusual to lose a number of peat potted plants, with survivors growing poorly for several weeks where carelessly set in the field.

Staking or trellising are not practiced commercially to any extent in Michigan, but plastic mulches and wire supports are used on a very limited scale to reduce ground spotting and soil rots.

Weed Control

Consult the most recent revision of Extension Bulletin 433.

Insect and Disease Control

Consult the most recent revision of Extension Bulletin 312.

Irrigation

Most of the commercial acreage is sprinkler irrigated to maintain the level of soil moisture in the top foot at or above 50% of field capacity during the major portion of the growing season. Canning crops for machine-harvest are usually irrigated only until fruits begin to ripen. Water is then withheld or applied sparingly to provide firm, crack-free fruit that will store on the vine for as long as possible to achieve a maximum once-over harvest.

Low soil moisture early in the season results in retarded plant growth and excessive blossom end rot of fruits. Excessive moisture, particularly early in the season, results in poor root development with later increased susceptibility to drought. Excessive moisture late in the season aggravates cracking, rots and poor color. Since the tomato is a deep rooted crop, many soils will require at least two inches of water during dry periods to saturate the soil in which most of the root system is located. During relatively warm, dry weather, from 1 to 2 inches of water are required each week by large tomato plants.

Harvesting

For fresh market, breaker (just beginning to show color at blossom end), pink or ripe fruits are hand-harvested as frequently as market conditions demand and to avoid losses due to overripening. Tomatoes are firmer, may be handled with less bruising, and will store longer when harvested at the breaker or pink stage. Processing tomatoes should be fully red ripe but relatively free of cracks and yellow coloration, and firm enough to harvest without bursting. Machines are available for one-over destructive harvesting.

Post-harvest Handling

A storage temperature of 50° to 55°F is recommended for tomatoes in the pink-red to firm-red stage. A relative humidity of 85 to 90% is suggested. The best ripening temperature for mature green tomatoes is 65 to 68°F. Tomatoes are subject to chilling injury when held at temperatures below 50°F.

Move processing tomatoes, particularly those mechanically harvested, as rapidly as possible to the processor.

Tomatoes

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Most varieties developed for the Southeast or Southwest are not normally adapted to Michigan, primarily because of different day lengths and/or disease problems.

OTHER MSU VEGETABLE PUBLICATIONS

Extension Bulletin 312, (latest edition), Chemical control of insects and diseases on commercial vegetables.

Extension Bulletin 433, (latest edition), Chemical weed control for horticultural crops.

Extension Bulletin 598, Commercial production of asparagus in Michigan.

Extension Bulletin E 486, Micronutrients for vegetable and field crops.

Additional bulletins of interest to vegetable growers:

Extension Bulletin E 550 (latest edition), Fertilizer recommendations for Michigan vegetables and field crops.

U.S.D.A. Agr. Handbook 66, The Commercial storage of fruits, vegetables, and florist and nursery stocks.

The following abbreviations are used in this bulletin:

cwt — hundred weight
F — Fusarium wilt-resistant
F_1 — hybrid
K — potassium
K_2O — available potash
MR — mosaic-resistant
N — nitrogen
P — phosphorus
P_2O_5 — available phosphoric acid
V — Verticillium wilt-resistant
YR — Yellows-resistant

Authors of *Commercial Vegetable Recommendations for Michigan* are CLARK W. NICKLOW, extension specialist in horticulture; ROBERT C. HERNER, assistant professor of horticulture; JOHN D. DOWNES, professor of horticulture, and ROBERT E. LUCAS, extension specialist in crop and soil sciences.

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