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AG FACTS

YIELDS OF MICHIGAN VEGETABLE CROPS

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Vegetable cultivars have a theoretical yield potential that is controlled by the plants' genes. This yield is rarely achieved because of soil, cultural and environmental factors that adversely affect plant growth and productivity. Although growers have little control over some environmental factors, their selection of an appropriate site and soil type for each crop will help achieve good yields. As growers become more experienced in producing specific crops, their yields usually increase.

Crop yields during any particular season will depend on the interaction of the crops' genetic makeup, the grower's experience and the environment, especially weather. Good records of cultivars, yields, cultural practices and weather will help growers understand their crops better and give them a basis for estimating future yields. Good yield records are also useful in dealing with lending institutions, insurance companies and government agencies.

FACTORS THAT AFFECT CROP YIELDS

Cultivar. Early-maturing cultivars of most crops are usually not as productive as main-season cultivars. However, early-maturing cultivars usually reach the market when supplies are limited and prices are higher.

Some crops have specific temperature, day length or other environmental requirements for growth and development. Cultivars of these crops have been developed for production during specific times of the year, at specific latitudes and/or under specific environmental conditions. These cultivars usually do not do well when grown in an inappropriate season or location.

Hybrid and open-pollinated (OP) cultivars have been developed for many crops. Hybrid seed is much more expensive than OP seed because of the increased expense of producing it. Hybrids usually have some advantages over standard OP cultivars, such as earliness, resistance to stress, and uniformity and quality of product. This is not always the case, however, and some OP cultivars are very productive. Cultivars, either hybrid or OP, should be selected on the basis of their characteristics and productivity in an area.

Weather. Weather is the least controllable of all the factors that affect yields. Frosts in the spring or fall, cold soils, lack of sunshine, warm nights during the summer, excess rainfall, drought, wind, and above- or below-average temperatures for a season have a direct effect on yield. Each crop has different environmental sensitivities and requirements and responds differently to these factors. Conditions that are adverse for one crop may be ideal for others. Ideal cultivars tolerate a wide range of weather conditions.

Adverse weather conditions may also indirectly affect yield. For instance, humid weather promotes the development of plant diseases. Foliar diseases can reduce yields of root, bulb or fruit crops by reducing the plants' ability to produce, even though the product itself is not affected by the disease. Foliar diseases directly reduce the quality of leaf crops such as celery, lettuce and cabbage and make them unmarketable.

Excessive rainfall makes harvesting difficult or impossible, and some crops become overmature and unmarketable when they can't be harvested on time. Large amounts of produce are destroyed while "mudding-out" the crops. When fields are flooded for several days, the entire crop may be destroyed. Even when the crop is not destroyed by the excess moisture, the quality may be reduced. Crops that have stood in water are usually dirty, do not store well after packing and therefore are unmarketable.

It is sometimes possible to minimize or avoid the potential effects of adverse weather conditions with proper site selection, cultural practices and equipment. Irrigation can provide moisture during dry periods. Properly designed and maintained tile and ditch systems will help minimize the effect of excessive rains. Similarly, the use of raised beds will help alleviate soil waterlogging, which is so detrimental to plant root systems. Mulches, tents and row covers can help warm the soil and air around plants in the spring and protect them from cold temperatures. Sprinkler irrigation can be used to protect plants temporarily from frost in the spring and fall.

Weeds. Weeds compete with crops for water, nutrients, light and space. Many vegetables are poor competitors and suffer large reductions in yields from only moderate weed interference. Crops are especially susceptible to weed competition during the first 6 weeks of growth. Weeds also interfere with harvesting of many crops. To obtain optimum yields, crops should be kept free from weed interference throughout the season.

Insects, Diseases and Nematodes. Pests can reduce plant stand, vigor and quality, and in some cases render a crop unmarketable, even when present in very low numbers. Plant breeders have developed cultivars that are resistant to many important crop diseases. By planting disease-resistant cultivars and applying pesticides, growers should be able to produce good quality vegetables. The presence of certain diseases and nematodes in the soil makes it very difficult to grow certain crops and may require rotation to non-susceptible crops.

Soil Type, pH and Fertilizer. Most vegetable crops can be grown on a variety of soil types. However, most crops are more productive on particular types of soil. The soil type may affect crop establishment. For instance, small-seeded crops often have difficulty emerging from heavy soils, especially if the soil has become crusted after rain. Root crops are affected by the physical properties of the soil. For instance, carrots grown on heavy clay soils tend to be short and mis-

shapen. Selecting crops to match the soil type will help growers attain optimum yields.

Soil pH has a direct effect on the availability of nutrients to crop plants. For most vegetable crops, the recommended pH is 6.5 to 6.8. As the pH drops below 6.2, several nutrients become less available to the plants. This effect can be partially overcome by adding more fertilizer to the soil or applying micronutrients to the foliage. However, plants growing in low-pH soil do not respond to added fertilizer as well as plants in soil with pH in the optimum range. Even slight nutrient deficiencies usually reduce yields. To avoid low pH problems, have soil tested and apply lime as recommended to raise the pH.

The amount of fertilizer applied for a crop directly affects yields. Applying fertilizer at recommended rates usually gives optimum yields. Applying excess fertilizer usually does not increase yields, may reduce yields or quality, and may contribute to groundwater contamination.

Plant Establishment and Spacing.

Crop yield is directly influenced by plant density in the field. In some crops, such as cabbage and cauliflower, a reduction in plant stand of 10 percent will cause a 10 percent reduction in yield. In other crops, such as vine crops, plants spread out and use the space available, so it takes a greater reduction in stand to reduce yields. Most crops have a plant density range at which they produce optimum yields and beyond which yields and quality decline.

Plant spacing in the field is detemined by a number of factors, including planting and tillage equipment available, pest control practices and harvesting methods. An ideal planting system meets these requirements at the optimum plant density per acre.

Other Cultural Factors. Most fruiting crops require pollination to form fruit. Some crops are self-pollinated (e.g., peppers and tomatoes) but others (e.g., cucurbits) require bees for pollination. Insufficient bees or low bee activity may reduce yields and quality.

The age of some crops at harvest affects total yield. For instance, celery can be harvested when plants are small or large. Production per acre will be greater when the plants are larger. Most vegetable crops have an optimum stage of development for harvest. If they're left unharvested beyond it, yield and quality deteriorate.

Type of Harvest. Some processing crops (e.g., cucumbers, peppers, tomatoes) can be harvested once by machine or several times by hand. The plants are usually destroyed during machine harvest. Multiple harvests usually result in higher total yields because the plants produce fruit over a longer period of time. Cultural practices often differ, depending on whether the crop is grown for hand or machine harvest.

Postharvest. Net yield is the marketable portion of a crop. During grading and packing, the unusable portion of the crop is discarded. This can be a sizable percentage of the total crop. Growers should make an effort to improve cultural practices to reduce cull material.

Vegetable crops in storage usually experience a significant amount of shrinkage (loss of marketable weight) due to disease and loss of moisture. Store only disease-free produce and maintain storage at recommended conditions to obtain maximum product packout.

Vegetable Yields. The figures in Table 1 are based on information from the Michigan Agricultural Statistics Service, processing companies, Cooperative Extension agents, farmers and experience in trials at Michigan State University. Where limited information was available from Michigan, sources from neighboring states were consulted. Three figures are given for each crop: low yields, good yields and excellent yields.

Low Yields are the lowest yields that experienced farmers should expect in adverse years. Under current market conditions, it would be very difficult for a farmer to make a profit producing crops at these yields.

Good Yields are average yields for experienced farmers growing the crop under good growing conditions. Fertilizer recommendations are based on this production level. These yields should be attainable by experienced farmers in most years unless adverse environmental conditions cause significant reductions in growth.

Excellent Yields are attained by careful, experienced farmers under optimum growing conditions. These yields are a result of favorable weather, sufficient moisture, adequate fertilizer, good weed and pest control and, above all, the personal attention of the farmer. Farmers who achieve these yields consistently will most likely make a profit in most years.

TABLE 1. Yields of Michigan vegetable crops

CROP	CROP YIELDS (tons/acre) Low	Good	Excellent
Asparagus	0.8	1	2
Beans, snap	2	4	5
Beets, red, topped	10	12	15
Broccoli (main heads)	2.5	4	5
Brussels sprouts	4	5	6
Cabbage, fresh market	10	15	20
Cabbage, processing	25	30	40
Cabbage, Chinese	7	10	12
Carrot, fresh market	10	13	15
Carrot, processing	30	35	40
Cauliflower	4	7	10
Celeriac	4	5	8
Celery, fresh market	20	30	36
Celery, processing	30	40	50
Corn, sweet	3	8	10
Cucumber, slicing	6	10	13
Cucumber, pickling[1] (hand harvest)	7	11	14
Cucumber, pickling[1] (machine harvest)	4	5	8
Eggplant	8	10	12
Endive, escarole	10	15	20
Greens (mustard, turnip tops, collards, kale)	5	6	9
Horseradish	3	4	5

Fresh market crops: packed, U.S. No. 1 produce; processing crops: total usable product.

CROP	CROP YIELDS (tons/acre) Low	Good	Excellent
Kohlrabi	7	10	15
Leek	7	8	9
Lettuce, head	12	20	25
Lettuce, bibb, Boston	5	8	10
Lettuce, leaf	10	12	15
Lettuce, romaine	14	18	22
Muskmelon	4	8	10
Okra	2	4	5
Onions, dry	15	20	25
Onions, green	8	9	10
Pak Choi	4	5	6
Parsley[2]	6	8	10
Parsnip	8	10	13
Pea, snap	1.5	3	4
Pea, in pod	3	4.5	7
Pea, shelled	1.5	2.3	3.5
Pepper, green bell	4	10	13
Pepper, banana (sweet & hot)	5	7	9
Pepper, cherry	4	5	6
Pepper, jalapeno	4	6	7
Potato	12	17	22
Pumpkin	15	20	25
Radish[3]	2	3	5
Rhubarb[4]	10	15	18
Rutabaga	15	18	20
Spinach	4	6	7
Squash, summer	10	15	20
Squash, winter	12	15	20
Strawberry	3	5	8
Sweet potato	5	7	12
Tomato, fresh market	10	15	20
Tomato, processing	20	25	35
Turnip	10	12	15
Watermelon	6	10	12

[1]Cucumbers with a maximum 2-inch diameter.

[2]Parsley: yields per cutting; each field is usually cut 3 times per season.

[3]Tons per acre per crop; 3 or 4 crops of radishes can be grown on the same land each year.

[4]Figures given are for one cutting of green or semi-red rhubarb. Red varieties usually yield about 50 percent less than green varieties.

TABLE 2. Common containers and package or unit weights for Michigan vegetable crops.

CROP	CONTAINER OR UNIT[1]	NET WEIGHT (Pounds)
Asparagus	pyramid crates, loose pack	32
Beans, snap	1-bu. baskets and crates	26-31
Beets, red, bunched	crates holding 2 doz. bunches	36-40
Broccoli	1⅑-bu. paper cartons	20-23
Cabbage	1¾-bu. crates and cartons sacks	50-60 45-50
Carrots	1-, 2-, 3- or 5-lb. plastic bags in 50-lb. masters plastic sacks, jumbos	50-55 50
Cauliflower	2-layer box containing 12 to 16 heads	25-30
Celery	14½-inch crates or cartons containing 2, 2½, 3 or 4 doz.	55-60
Sweet corn	crates or sacks containing 5 doz. ears	50
Cucumbers, pickling	bushel	50
Cucumbers, slicing	1⅑-bu. crates or cartons lugs, place pack	50-55 25
Eggplant	1⅑-bu. crates and cartons	25-30
Endive, escarole	1⅑-bu. cartons and crates	20-25
Greens (mustard, turnip tops, collards, kale)	1- or 1⅑-bu. baskets, crates, cartons; loose or 24 bunches	20-25
Horseradish	sacks	50-60
Leek	crates, 2 doz. bunches	24-30
Lettuce, head	1¾-bu. cartons containing 18 to 24 heads	45-50
Lettuce, romaine	celery crates, 24 heads	35
Muskmelon	crates or bushel baskets containing 12 to 16 melons	60-70

CROP	CONTAINER OR UNIT[1]	NET WEIGHT (Pounds)
Onions, dry	sacks boxes and masters with 12 or 16 3-lb. bags	50 36-50
Onions, green	cartons, 4 doz. bunches	12-16
Parsley	1⅑-bu. crates, 5 doz. bunches	20-22
Parsnip	cartons containing 12 1-lb. cello bags	12
Peppers, green bell	1- or 1⅑-bu. baskets, crates or cartons	28-30
Peppers, banana	bushel	27
Pepper, cherry	bushel	40
Potato	100-lb. sacks, 50-, 20-, 10-lb. bags or cartons	100, 50, 20 or 10
Pumpkin	usually shipped bulk or in bulk boxes	
Radish	6-oz. film bags packed 30 to a carton or 1-lb. film bags packed 14 to a carton	12-15
Rhubarb	cartons or crates, loose	20-30
Rutabaga	sacks or cartons	25 or 50
Spinach	1- or 1⅑-bu. cartons or crates, loose or bunched	20-25
Squash, summer	½-bu. crates or cartons	21
Squash, winter	1⅑-bu. crates or cartons	42-45
Strawberry	16-qt. crates 6-qt. flats	24 12-14
Tomato	cartons, loose pack 2-layer place pack	25-30 20-25
Turnip, root	cartons, film bags	25
Watermelon	usually shipped in bulk and sold by the piece	

[1]Processing crops are often contracted on a unit basis, but the product is handled in bulk.

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