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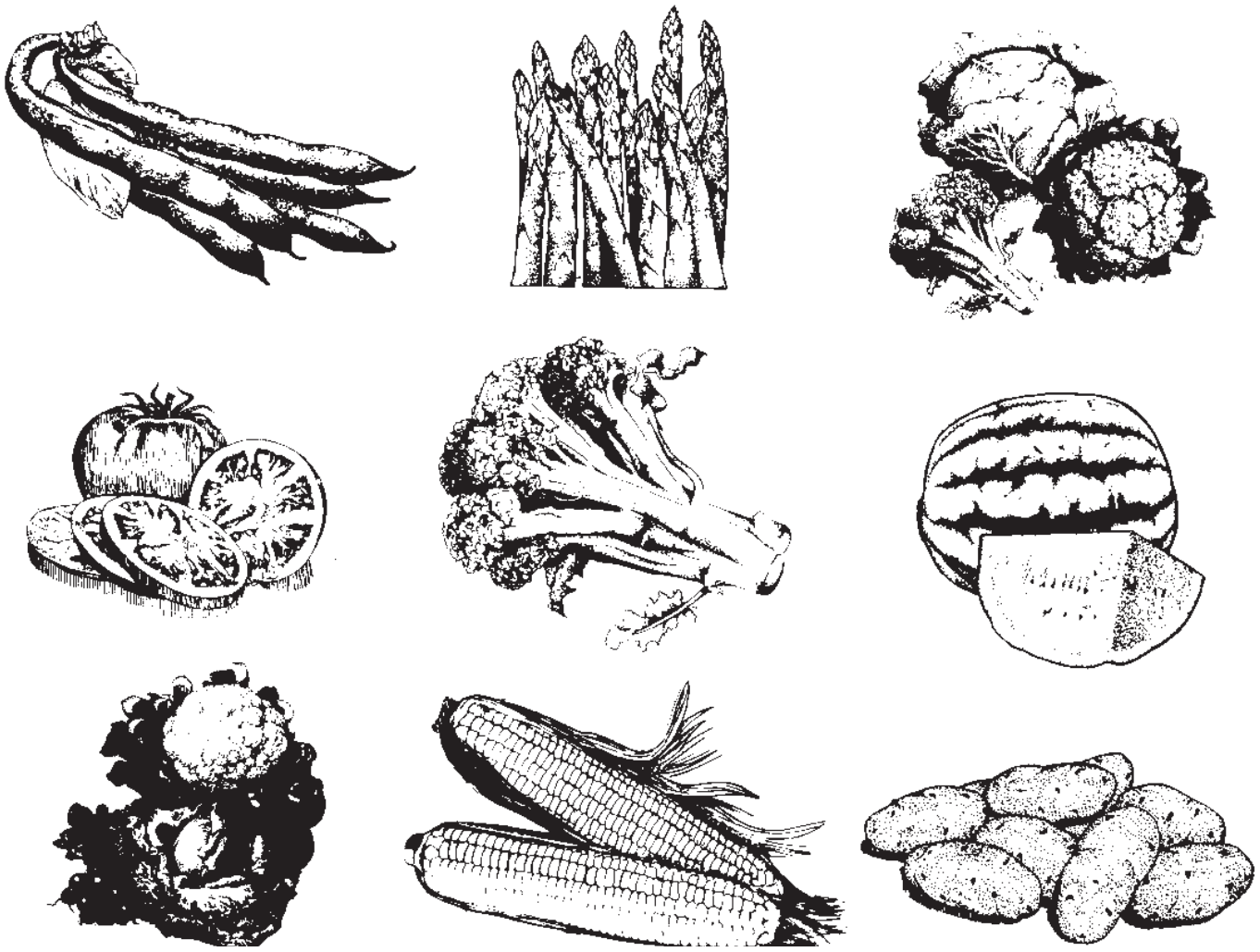
Farming a few acres of

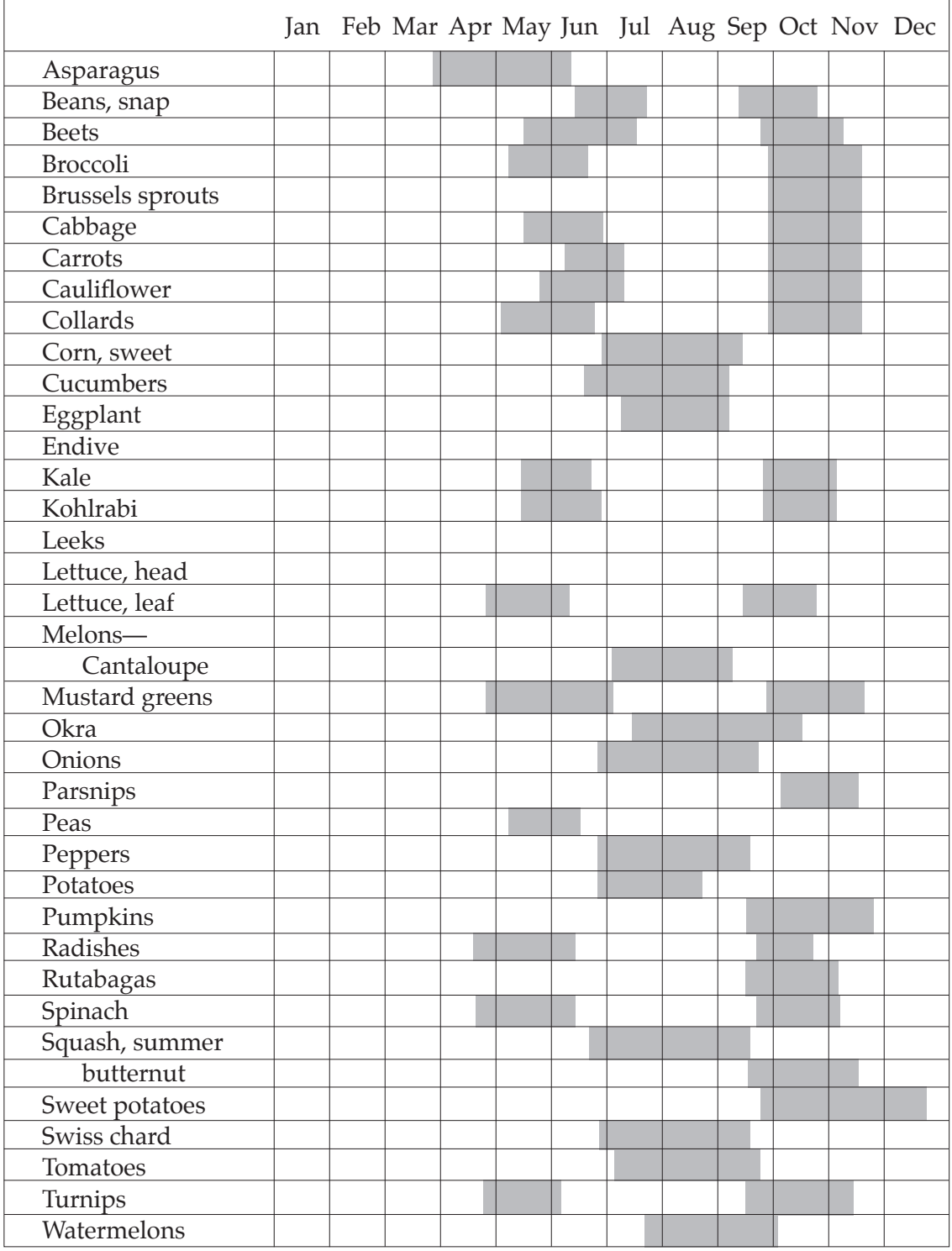
Vegetables

BY CHARLES W. MARR



KANSAS STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
AND COOPERATIVE EXTENSION SERVICE

Harvest Calendar (Months)
Vegetable Crops for Commercial Production in Kansas



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Disclaimer: Commercial suppliers are listed for information purposes only. In many cases, additional suppliers are available. Mention of commercial firms or products does not imply endorsement, nor is criticism of other sources intended.

Farming a Few Acres of Vegetables

Vegetables can be grown in a farming operation for several reasons:

- To increase family cash income or supplement farm income.
- As a step to full-time farming.
- As an aid in times of unemployment.
- To supply some of the family's food supply.
- To give children a farming experience.
- As a hobby.
- To aid in developing a farming system.

Growing vegetables probably fits into part-time farming better than most enterprises. It is relatively easy to enlarge a home vegetable garden to a small "commercial" operation. Produce from the farm must be sold to repay cost of production and realize a profit.

Existing farming operations may also consider growing a few acres of commercial vegetables to supplement family farm income and supply local needs. Many types of conventional equipment can be used, reducing the need for added investment.

Marketing is usually a problem until an outlet is established. This may take several years. Fortunately, roadside selling and pick-your-own operations offer good market opportunities for locally grown produce.

Advantages

1. Little capital is required to grow a vegetable crop. Excluding land, labor and machinery costs, about $150 to $250 per acre will cover the out-of-pocket costs until harvest.
2. A profitable enterprise can be started with as little as an acre of land.
3. Machinery is available for most farm operations such as plowing, discing, planting, cultivating and spraying.
4. Available herbicides, fungicides and insecticides can effectively control most pests of vegetable crops.
5. So many vegetable types exist that some crop or combination of crops is available to suit almost any land, labor, or market situation.

Disadvantages

1. Finding a suitable market outlet can be a problem. Many producers have difficulty filling the role of both grower and seller.
2. Part-time farming is usually limited to crops that have a low labor requirement, especially if only family labor is available. Labor should not interfere with other operations in family farms.
3. Pest control can be a problem for some crops. Vegetables require careful attention and repeated pest control for optimum results.
4. Growers may not have time to attend to both production and marketing, and may have to avoid perishable crops.
5. Lack of experience may be insurmountable, especially with vegetable crops that are difficult to grow. Lack of experience in marketing is a disadvantage when selling your produce. Often, growers have to accept a lower price because they lack either the experience or the time to market their produce.
6. A lack of management skills can be a disadvantage since the decisions made on a few acres are just as important as those on a large commercial farm. The grower should learn to use all sources of information available to him/her and to seek advice from reliable sources.
7. It is relatively easy to purchase too much equipment for a small, part-time farm and, thereby, increase production costs to the point where it is impossible to make a profit.

Is Vegetable Farming for You?

In determining what vegetable crop or combination of crops to grow, factors such as labor, location, soil, climate, mulching, machinery and equipment, insect and disease control, weed control and marketing must be carefully considered.

Important Considerations

1. Time and labor: Will family members have adequate time to care for the crops on a regular basis throughout the growing season?
2. Desire: Do enough family members have the interest and commitment to grow vegetables in view of the sustained time and effort required?
3. Capital: Can an appropriate amount of money be invested in equipment, tools and supplies to grow quality vegetables?
4. Technical knowledge, experience: Do family members have the necessary knowledge of the culture of the specific vegetables to successfully grow the crop? Are they willing to learn from appropriate references?

5. Markets: Are there dependable markets for the vegetables, some of which are highly perishable? Can you creatively sell vegetables in your or other local communities?

6. Adverse weather: Do family members understand that the weather during some seasons may result in crop damage or failure? Is the family able to accept this possibility and "weather the storm?"

7. Site: Does your farm provide a satisfactory soil and climate for successful crop production?

8. Time for business establishment: Does your family realize that few businesses become fully operational and successful in only 1 or 2 years? Is the family willing to work during a 3- to 5-year period to fully establish a business?

9. Quality products: Do family members realize that chances for successes are best when high-quality products are grown?

10. Cooperation: Are others in the area interested in growing vegetables so that some cooperative efforts are possible?

For the greatest chance of success, the answer to these questions should be yes. Questions where some reluctance exists deserve careful consideration before proceeding.

Inventorying and Analyzing Needed Resources

Soil

- Must be well-drained: county research and extension and soil conservation service personnel can provide assistance with irrigation and conservation techniques.
- Must be of appropriate reaction: pH 6.0–6.8, or adjusted as needed.
- Must have proper fertility level: Sample the soil and have it tested. County research and extension offices can provide information on soil testing.
- Must be supplied with fertilizer based on test results and recommendations.
- Should contain some organic matter. Organic matter can be added by using green manure crops, livestock manure, compost, or other material. Where possible, rotate soil-building crops such as grasses or legumes.

Climate

- Temperature: This factor can't be changed appreciably by the grower. The crop producer must settle for the temperature that prevails in the area. Early crops can be protected with hot caps, plant tents and sprinkler irrigation. Warm- and cool-season crops must be planted at appropriate times (see Table 1), and crop varieties selected according to season of maturity.
- Water: Ensure adequate soil drainage. Use irrigation where possible. Consider trickle irrigation as an alternative when water is not in plentiful supply.
- Light: Provide vegetable plants with as much daily light exposure as possible. Don't plant crops in the shade of buildings or trees.

Labor

Additional labor may be required at some time. Use care in selecting hired labor, making sure workers are able to complete the required tasks. Sources of labor include:

- Family labor, including a work "manager."
- Part-time high school students, retired adults, homemakers and vocational school students. One of the strengths of small-scale vegetable production is the opportunity to use family labor in a productive way.

Capital

Operating capital may be difficult to obtain for vegetable operations because the risk is greater and there are more variables in returns. One advantage is that fewer acres require a limited amount of total money. Potential sources of capital are:

- Family funds.
- Local banks.
- Other agricultural lending agencies. Determine capital needs based on crop production budget.

Equipment and Supplies

Depending on the crops to be grown, some basic tools and equipment are required. Equipment may be new, used or leased, or even occasionally borrowed or exchanged with neighbors. Select from the following categories the items that best fit the scale of your operation.

Estimated equipment costs

Equipment	New price	Used price
Tractor, with 3-point hitch, PTO, toolbar	$ 6,105	$ 2,000
Moldboard plow (12")	250	200
Disc	300	150
Planter	300	150
Cultivator	350	250
Rotary tiller (4 ft.)	1,410	750
Sprayer (20 gal.)	1,000	250
Miscellaneous	285	250
Total investment/acre	$10,000	$ 4,000
Investment/5 acres	2,000	800

Annual ownership costs per acre on 5 acres

	New price	Used price
Depr. (10 years, new)	$200	
(5 years, used)		$160
Interest @ 12%	120	48
Taxes & insurance (2%)	40	16
Total annual cost	$360	$224
Repairs (5% new)	100	
(8% used)		64

You may have equipment already available for supporting a small-scale vegetable operation. In such cases, the equipment budget will need to include only those prices of equipment deemed necessary to purchase. *Important:* No single crop budget can be used without considering your individual equipment cost as it "fits" into your other farming operations. *Remember this as you build a crop production budget to meet your own situation.*

Other Items

An excellent listing of equipment and materials for vegetable production is found each year in the July issue of *The American Vegetable Grower* magazine (see Appendix). Also, managers of the local equipment dealers, hardware stores and garden centers can be helpful in providing essential production equipment and supplies.

Determining the Cropping System

Important considerations in selecting crops to be grown on a farm include the following:

1. Cultural requirements: Some crops are easier to grow than others. In general, tomatoes, cucumbers, or muskmelons are very demanding in terms of cultural requirements.
2. Crop value: Some crops are valued more than others. Crops such as cabbage, radish and turnips tend to be low per unit value crops. Asparagus and tomatoes are examples of high-per-unit value crops.
3. Perishability and storage requirements: Crops such as asparagus, sweet corn, peas and muskmelons are highly perishable. Crops such as potatoes and onions are suited to longer-term storage; immediate marketing is not of great urgency.
4. Production costs: Some crops are more expensive to produce than others. For example, it costs much more to grow an acre of tomatoes than it does an acre of sweet corn.
5. Personal preference: The choice of crops depends to some extent on personal preference. Growers tend to do better with crops they like and have had some experience and success growing.

Table 1. Some common vegetables grouped according to planting times and weather requirements.

Cold-hardy plants for early spring		**Cold-tender or heat-hardy plants for late spring, early summer**		**Hardy plants for late summer or fall**	
Very hardy (plant 4 to 6 weeks before frost-free date)	*Hardy (plant 2 to 4 weeks before frost-free date)*	*Not cold-hardy (plant on frost-free date)*	*Require hot weather (plant 1 week or more after frost-free date)*	*Medium tolerant (good for summer planting)*	*Plant 6 to 8 weeks before first fall freeze*
Broccoli	Beets	Beans, snap	Eggplant	Squash	Beets
Cabbage	Carrots	Okra	Peppers	Sweet corn	Broccoli
Lettuce	Chard	Squash	Sweet potato	Pumpkin	Cauliflower
Onions	Mustard	Sweet corn	Cucumber		Cabbage
Peas	Parsnip	Tomato	Melons		Lettuce
Potato	Radish				Mustard
Spinach					Spinach
Turnip					Turnip

One important consideration is the number of crops to plant. Because of the cost of installing special production and handling procedures, the trend is for larger-scale producers supplying wholesale or district markets to *specialize*, producing larger amounts of fewer crops. On the other hand, small market gardeners selling to local markets, farmers markets and on-farm retail outlets may find an advantage in having a *diversity* of crops throughout the season.

First, analyze the market—determining what crops and how much of each might be sold and at what price. This will help determine a total gross return possible for the operation. Next, carefully evaluate each crop for its labor requirements, special growing requirements and compatibility with the existing farming operation.

One especially important point to remember is that no two operations need to be done exactly the same. In fact, there may be an advantage in differing operations in the same community. For example, if one local grower plans to grow tomatoes for the local market, then other growers in the area may be wise to consider other crops such as cucumbers or melons, which will not compete directly, but will generate interest, in the local produce available to consumers.

Crop Production Procedures

Cultural practices used for growing various vegetables depend chiefly upon the nature of the plant and type of products desired. Because providing specific technical information for growing particular vegetables is beyond the scope of this publication, the reader is referred to the publications on page 16. Publications listed give specific details for producing and marketing the various commodities. Additional production guides will continue to be developed.

To be successful in growing vegetables, the grower should be concerned with the following:

- Site selection
- Varieties
- Seed and plants
- Soil preparation, fertility maintenance and improvement
- Planting techniques
- Cultural practices
- Harvesting, handling and storage

Table 2. Approximate number of days from planting to market maturity for vegetables grown under optimum conditions.

Vegetable	Early variety	Late variety
Bean, broad		120
Bean, green	48	60
Bean, lima	65	78
Beet	56	70
Broccoli*	55	78
Brussels sprout*	90	100
Cabbage	62	120
Carrot	50	95
Cauliflower*	50	125
Chard, Swiss	50	60
Chinese cabbage	70	80
Collard	70	85
Corn, sweet	64	95
Cucumber, pickling	48	58
Cucumber, slicing	62	72
Eggplant*	50	80
Endive	85	100
Kale		55
Kohlrabi	50	60
Lettuce, butterhead	55	70
Lettuce, leaf	40	50
Melon, honeydew		110
Muskmelon	85	95
Mustard	35	55
Okra	50	60
Onion, dry	90	150
Onion, green	45	60
Parsley	70	80
Parsnip		120
Pea	56	75
Pea, edible pod	60	75
Pea, southern	65	85
Pepper*	65	80
Potato	90	120
Pumpkin	100	120
Radish	22	30
Rutabaga	90	
Spinach	37	45
Squash, summer	40	50
Squash, winter	85	110
Sweet potato	120	150
Tomato*	60	90
Turnip	40	75
Watermelon	75	95

*Additional time for transplants

Table 3. Approximate number of days from pollination to market maturity for vegetables under warm growing conditions.

Bean	7-10	Squash, summer	
Corn		Crookneck	6-7[2]
Market[1]	18-23	Early Prolific	
Processing	21-27	Straightneck	5-6[2]
Cucumber		Scallop	4-5[2]
Pickling (3/4 - 1/8" dia.)	4-5	Zucchini	3-4[2]
Slicing	15-18	Squash, winter	
Eggplant		Acorn	55-60
(2/3 max. size)	25-40	Banana	70-80
Muskmelon	42-46	Boston Marrow	60-70
Okra	4-6	Buttercup	60-70
Pepper		Butternut	60-70
Green stage		Golden Delicious	60-70
(max. size)	45-55	Hubbard	80-90
Red stage	60-70	Tomato	
Pumpkin		Mature green	35-45
Connecticut	80-90	Red ripe stage	45-60
Dickinson	90-110	Watermelon	42-45
Small Sugar	65-75		

[1]From 50 percent silking
[2]For a weight of 1/4 to 1/2 pound
Source: Adapted from *Knott's Handbook for Vegetable Growers*

Marketing the Crop

Possibilities for marketing produce from the small farm, based on greatest opportunity for dollar return, include the following:

- Retailing from a roadside market.
- Community farmer's market.
- Combination pick-your-own roadside market.
- Pick-your-own operation.
- Selling to large area farm markets, local grocery stores or wholesale commission houses.

Where you are going to sell your crop is an important question to answer. It is difficult to determine how well a crop may sell in any given year or what other crops may have potential. Some suggested outlets are described in more detail.

1. "Roadside" or direct sales: Quality, fresh produce at or near the farm is the keystone of a farm market. A market does not have to be elaborate, but it does need to be neat, clean and organized. Prices need to be displayed and accurate weight provided. Parking, directional or road signs and paved or gravel walks for customers are also needed.

Friendly and courteous attitudes in dealing with customers will pay big dividends. Be sure to "listen" to customers for ideas for crops you may be able to sell and suggest crops you will have later.

2. Pick-your-own: Many customers enjoy picking their own crops, especially for crops where labor costs increase the price of the products. You will need to direct pickers to the appropriate areas and discourage indiscriminate "wandering" through the field. Containers may need to be provided and sales by weight will eliminate questions over volume measures. Beans, sweet corn, cole crops, tomatoes, cucumbers and root crops are all adapted to pick-your-own operations.

3. Community farmer's markets: Many Kansas communities are forming farmer's markets that provide an outlet for local growers (and additional customers for local businesses) on market day, usually Saturday. Small growers with only a few items to sell can "fit together" to make a successful market. Farmer's markets encourage local grower cooperation and good will.

4. Local stores or wholesale produce dealers: Small growers often have difficulty supplying local or wholesale dealers because uniform packaging, consistent quality and steady supply for a longer period are hard to guarantee. Also, do not attempt to supply local stores *and* sell to the public in direct competition unless the store understands what you are planning to do. Check with local stores or buyers long in advance, determine the requirements for supply, packaging, quality, delivery and be alert to correct any problems with quality.

Information on wholesale prices may be obtained from the *USDA Market News for Fruits and Vegetables*, Fruit and Vegetable Division, Market News Branch, 610 S. Corral St., Rm. 1060, Chicago, IL 60607 or 208 N. Broadway, Room 1010, Federal Building, St. Louis, MO 63102. The national weekly newspaper, *The Packer*, 10901 W. 84th Terrace, Lenexa, KS 66214, is available for insight into current crop, marketing and price situations. *The Packer* also has a computerized daily price information system, Pro Net, available on a subscription basis with a computer hookup.

Advertising

One problem in establishing a vegetable growing operation that sells from the farm or roadside stand is letting people know you are there and have produce to sell. "Word of mouth" and personal contacts

are excellent means of generating business, but this is a slow building process. Professional advertising is expensive, but it may be necessary in some cases.

- Allow some money in your crop production budget for advertising.
- Consider brief newspaper or "spot" radio announcements. They are much less expensive than block ads or longer commercials.
- Use bulletin boards in public places or any free sources such as radio call-in shows, trade publications, or merchant publications.
- Feature stories in local newspapers are excellent. Often, newspapers will be interested in new services and products for the community. Check with your local editor.

A Profit: The Bottom Line

It is vitally important to accurately estimate a crop-production budget, adjusting it as changes occur, to determine how much a given crop costs to produce. A fair or accurate "price" of the crop cannot be estimated until this amount is known. Items to include in a crop production budget include:

COSTS	YOUR COSTS
Variable costs (supplies necessary to grow the crop)	
Seed or plants	_____
Fertilizer	_____
Chemicals, herbicides	_____
Insect, disease control	_____
Containers, other marketing costs	_____
Advertising	_____
Fuel, oil, repairs	_____
Hired labor	_____
Interest on operating capital	_____
Subtotal A	_____
Fixed costs (overhead costs)	
Machinery cost, depreciation, taxes	_____
Land cost, rent or interest, taxes	_____
Irrigation equipment costs, depreciation	_____
Labor (self or family members)	_____
Subtotal B	_____
Total production expenses A + B =	_____
Returns	
Expected yield _____ x Price/unit	_____
Returns _____	
Net returns = Returns - Total costs	

Variable or direct costs will vary with the crop grown and can be adjusted depending on crop conditions and needs.

Fixed or indirect costs are overhead costs that are often overlooked. Machinery, land and labor costs need to be calculated into a production budget. Be sure to calculate depreciation, taxes, insurance and interest costs and establish a modest return for labor.

Use this "bottom line" production cost total of variable and fixed cost so you know that melons cost 4¢ per pound or asparagus 71¢ per pound, etc., so you will know what you must have to break even.

Profit will come by keeping costs low and maximizing yield or price per unit. There is no single more important factor than quality that will influence your ability to charge a fair price. People will pay a fair price for good produce.

Monitoring prices of other growers or stores will indicate if you are too far "off base." However, growers need not be competitive in price with each other. Many growers stress quality and emphasize that their product is worth more — and it is.

A Review of Some Important Production Practices

Variety Selection

Varieties perform according to their genetic potential and the environmental conditions and cultural practices to which they are exposed. Choosing the best varieties for an individual situation is difficult, partly because a large number of varieties exist, and also because environmental conditions can vary considerably. A variety that performs well during a year of adequate rainfall may perform poorly during an excessively wet or dry season. Good varieties perform well under a range of environmental conditions. Those recommended by K-State have been tested for several years at various locations or have been observed for their performance in commercial production.

In selecting varieties, take into account the preference of your particular market, the times at which the varieties can be expected to mature, method of culture, possible disease problems and the adaptability of the varieties to the soil and climate. It is advisable to test new varieties and hybrids on a limited scale to judge their potential for the area, use and market. Some factors that influence the performance of a variety or hybrid are climate (temperatures, rainfall, humidity); soil type, fertility, and drainage; cropping season (spring, summer or fall); culture (planting distances, training methods, mulching and fertilizer treatment); method of harvest; and intended use (fresh, storage, processing, or marketing).

These factors will vary in importance in different locations.

Commercial growers often find hybrids superior to older, open-pollinated varieties because they have several desirable characteristics such as uniformity of plant and fruit type, uniform maturity, disease resistance, quality and vigor. A hybrid is the result of crossbreeding two parental lines (or varieties) that are different in one or more important characteristics. The resulting plant grows more vigorously and gives higher yields. Hybrid seed is usually more expensive than seed from an open-pollinated variety; however, seed labeled "hybrid" does not make it superior to established varieties. Resistance to diseases and insects and other factors should be considered when planting any new variety.

Do not depend entirely on a local garden center for varieties that are suitable for an area. Use the winter months to study variety trial results, recommendation lists and seed catalogs. No seed company can provide all the best varieties for each individual operation, so check several sources.

Sites and Soils

Part-time farmers often have a limited selection of suitable sites. In some cases, it may be better not to grow a crop than to risk failure with a poor site. When alternative sites are available, consider the location relative to the market, topography, water supply and soil type of your area.

1. Location: Although a fertile, well-drained soil improves production, location near a market may be just as important a consideration. For a pick-your-own operation or roadside market, accessibility is critical. Before you begin growing vegetables, determine how and where you will sell your produce. If you grow vegetables near a small city, you may draw enough buyers and also avoid the high price of land or taxes of a major metropolitan area.

Road quality must also be considered. Hard-surfaced roads close to the farm are almost a necessity for either shipping or direct marketing. Unimproved roads may prevent deliveries during rainy periods and produce is more subject to injury when trucked on bumpy roads.

2. Topography: Southern or southeastern exposures on a gentle slope are preferred for early spring vegetables and fall crops. A sunny slope dries and warms earlier in the spring than a northern exposure. Because a sloped site generally has good air drainage, there is less likelihood of early autumn frost. Good air and water drainage will also help reduce disease problems. Sandy or sandy loam soils, found in several areas of Kansas, are excellent for vegetables. River valley soils are excellent except some low fields may serve as "frost pockets."

Tractors and Tillage Implements

Except when plowing, you may not need a large tractor for many vegetable operations. A small tractor with 25 to 45 horsepower can handle most routine farm tasks. It should have a high clearance of 20 inches or more to allow for spraying and cultivating. Plowing and initial discing can often be arranged with neighbors or contracted from another farmer. Final seedbed preparation can be accomplished with a small (5- to 6-foot wide) disc or rototiller.

A large tractor may also be required if vegetables are planted on raised beds. A power bedder can make the bed in one operation; however, a set of disc tillers and a bed shaper does the job but requires less power.

Direct Seeding

Planting vegetable seeds in an environment suitable for proper germination and growth is more difficult than it sounds. Cold or crusted soils, improper depth or shallow seed placement and nonviable seeds can all result in poor germination and an uneven stand. A poor stand not only results in lower yields, it wastes fertilizer, pesticides and time. Using viable seed, preparing a good seedbed and placing seed at the proper depth will help eliminate uneven stands. Direct seeding may result in lower disease losses from seed-borne disease because it avoids the crowding of transplant beds.

Commercial growers cannot afford to try to save money on seed—buy it fresh each year. Although it may seem wasteful to dump unused seed, it is more economical in the long run. Seed storage can be tricky and is generally not worth the effort.

It is not difficult to prepare a seedbed. Often what's *not* done to the soil is more important than what is. Do not plow, disc, or rototill wet ground. If possible, do not drive machinery or trucks across a wet field or even walk across it. Working wet soil destroys the soil structure and promotes crusting after the first heavy rain. The soil should be moist enough to form a ball in the fist, but dry enough to crumble between two fingers.

Several vegetable planters are available for use on small acreages, most of which can be divided into seed drills and precision planters.

Seed drills open a small furrow, allow seed to flow through a hole to a specified depth and then close the furrow. The standard Plantet Jr. planter is an example of a drill that can be pushed by hand or mounted on a tractor tool bar. It can be fitted with a regular single-row shoe or mounted with a scatter shoe to spread seed within a narrow band. Plates with holes of various sizes for most vegetable seeds are available.

Precision planters are generally more expensive than seed drills but may reduce or eliminate the need for thinning. They place the seed not only at the desired depth, but also at the specified spacing within the row. They are available in one-row, hand-push models, or they can be mounted on a tool bar. Old plate planters used for corn can often be adapted for vegetable seeds if the proper size plate can be obtained. Precision planters work well when the seedbed is properly prepared and can reduce or entirely eliminate the costly operation of thinning.

Transplanting

Vegetables are transplanted to ensure an earlier harvest and a good stand. As direct seeding technology is improved, only the early crops of most vegetables may need to be transplanted. You can grow your own plants or obtain them from southern transplant growers or local greenhouses. Homegrown or locally produced plants are generally superior but are also more expensive. Southern field-grown plants are usually shipped as bareroot stock and are more likely to carry disease organisms. You can minimize the risk of disease by purchasing certified plants that have been inspected for diseases and that have been grown under conditions that minimize disease potential. You may have to grow your own plants or make local arrangements to obtain the variety you want. For information on how to grow plants, see the Commercial Production Guide, *Vegetable Transplants*.

Moderately expensive single- and multiple-row mechanical transplanters that set bareroot plants, rooted plants, or plants in peat pots are available. The single-row unit can be drawn behind most small tractors. Two people and a tractor driver can plant several acres in a single day. Transplanters that punch holes through plastic mulch and set plants are also available. Because timeliness is an important concern of fresh market growers, a transplanter may be a worthwhile investment. Another of its advantages is that starter solution is applied to each plant immediately after setting.

Plastic Mulch and Row Covers

Mulch traps heat from the sun's rays and warms the soil earlier than usual, increasing the chances of an early harvest. Although mulch is expensive, it is sometimes worth the cost because early vegetables command the highest prices. In northern Kansas, mulching can improve muskmelon or watermelon crops. Mulching with black plastic is also an effective method of weed control, especially on crops for which no good herbicides are available. Generally, plastic mulch will benefit muskmelons, watermelons and early crops of cucumbers, summer squash, peppers, tomatoes and sweet corn. If laying more than one acre of plastic mulch, purchasing a mechanical mulch layer would be wise.

Mulching can be done with either black or clear plastic. Clear plastic warms the soil best but also allows weed growth, thus necessitating the additional use of herbicides. Because some herbicides are dangerous under these altered environmental conditions, black or opaque plastic is usually preferred. Keep the area under the plastic free of weeds with labeled herbicides or cultivation.

Clear plastic row tunnels not only warm the soil, but protect the plant from hail or wind injury. Although expensive, they can be used on limited acreage for a very early harvest, with or without black plastic on the ground. The tunnel is supported by oval hoops made of 9- to 16-gauge wire. Two separate sheets of clear plastic are laid on either side of the plant rows and clipped in the middle above the plants. One side can be pulled down on sunny days for ventilation. Pre-ventilated single sheets that do not have to be opened during the day and closed at night are now available as well.

A new type of floating cover is being used on cucurbits and seeded crops such as carrots, beans and lettuce. The material, a spun-bonded fabric that allows gas exchange and water percolation, does not require hoops because it lies directly on the plants.

Mulches can significantly reduce weed populations, especially of annual grasses and broadleaf weeds, but cannot control perennial weeds. For most vegetable crops, with the definite exception of sweet corn, no sustained-action, broad-spectrum herbicide can be used to control weeds under clear plastic. Black polyethylene mulches keep sunlight from germinating weed seedlings and stop their growth. In general, however, it is usually most economical to use herbicides for weed control even when black plastic mulch is used.

Irrigation

Growing vegetables require a constant supply of soil moisture. Even brief periods of drought can reduce crop yield and quality. Dry periods early in the growing season can delay harvest and reduce yields. Shortages of moisture later in the season, especially during the maturation period, can severely impair quality. Irrigation may be needed to establish seedlings or ensure good germination and emergence.

Critical water-use periods for vegetable crops

Broccoli, cabbage, cauliflower, lettuce	Head development
Carrot, radish, beet, turnip	Root enlargement
Sweet corn	Tasseling and ear development
Cucumber, eggplant, pepper, melon, tomato	Flowering, fruit set and fruit enlargement
Bean, pea	Flowering and pod development
Onion	Bulb development
Potato	Tuber initiation and development

Shallow-rooted crops should not be without water for more than 7 to 10 continuous days. Other crops must receive adequate moisture, especially during critical periods in their development. Most vegetables require from l.0 to 1.5 inches of water per week during their peak growing period. Apply no more than 0.25 inch per hour to ensure good soaking and prevent runoff. Covering too much acreage in a certain time will result in poor uniformity.

Although irrigation equipment and an adequate water source are expensive investments, they may pay for themselves in one year of low rainfall. Fresh market growers are encouraged to consider the investment. The type of equipment used will depend on the crop being grown and its potential value, as well as on soil drainage, topography, source water availability and financial resources. The most common irrigation system used on medium to small vegetable farms is a portable pipe system with risers and sprinkler heads. Recently, many producers have favored traveling guns with flexible or rigid hoses. Large operations may choose center-pivot systems, but smaller growers may prefer trickle systems. Consult a local irrigation distributor or manufacturer to design a suitable system. Refer to Commercial Production Guide—*Drip Irrigation,* MF-1090.

Pest Management

Successful vegetable production depends on the ability of the grower to minimize losses from diseases, insects and weeds. These pests can significantly affect yields and quality — and, therefore, profits — if not controlled. Economic returns can also be reduced by the unexpected expense of the extra labor involved in harvesting and grading weedy or pest-damaged fields.

Agricultural scientists and growers generally agree that pests can cause excessive yield and quality losses, and large commercial growers can rarely rely exclusively upon nonpesticide methods of control. However, growers can improve the efficiency of pesticides by paying close attention to pest populations and by timing applications correctly. Integrated Pest Management (IPM) is a system that uses all suitable pest control techniques to keep pest populations below economically injurious levels. With IPM, each pest management technique should be environmentally sound, compatible with other production practices and effective.

Organic farmers have chosen not to use manufactured pesticides in their pest management plans. They often sell their vegetables at markets specializing in produce that is grown without pesticides. The higher per-unit price these vegetables receive often compensates for the normally reduced yields. As long as a market exists and prices are high, organic farmers may be able to afford nonchemical means of pest suppression. Organic farming will probably be possible only in small plantings and where markets exist for visually blemished or imperfect produce.

Pesticide Legislation

Growers have nothing to fear from the law as long as they use pesticides according to the current label only on the crops specified, in the amount specified and at the times specified. Keep a record of the products and trade names used, the percentage of active ingredients, the dilutions, the rates of application per acre and the dates of application. By following label directions, you can be sure that your vegetables will have no excessive pesticide residues. Vegetables marketed with residues exceeding the Federal Drug Administration tolerances may be injurious to consumers and may be confiscated. Growers who misuse chemicals may also face legal action.

Chemical manufacturers are hesitant to recommend and sell a pesticide for a vegetable unless

humans have a high tolerance to it. Lawsuits have forced manufacturers to withdraw pesticides for some crops from the market. Never use a pesticide on a crop for which it is not labeled. It can injure the crop, or worse, the consumer. The Environmental Protection Agency classifies pesticides as GENERAL USE or RESTRICTED USE. A grower wishing to apply a pesticide classified for restricted use must be certified as a private or commercial pesticide applicator by the Kansas Department of Agriculture. Contact a county Extension agent for details.

Pesticides should be locked in dry, well-ventilated areas to deny access to children, animals and irresponsible people. Protection and application precautions printed on container labels should be followed. Empty containers should be disposed of according to label instructions. ***Never put them into a sewage disposal system.***

Pesticides are classified as having high, moderate, low, or slight toxicity. Highly toxic pesticides display a drawing of a skull and crossbones and the words "Danger-Poison," moderately toxic pesticides have the word "Warning," and pesticides with low and slight toxicity display the word "Caution."

Weed Control

Whether to use herbicides or other means of weed control depends on the severity of past infestations. In some instances, mechanical control is sufficient or may be needed to supplement herbicide use. Some crops may need several herbicides.

The most commonly used herbicide application methods are broadcast soil application (uniform application over an entire specific area), foliar application (application to the leaves and stems) and preplant soil incorporation (using tillage equipment or irrigation to mix the herbicide with the surface soil). Less commonly used methods are band application (application to a strip or band of soil parallel to crop row) and directed application (aiming the herbicide at a portion of the plant).

Most herbicides are applied preemergence or are preplant-incorporated. Preemergence refers to the use of a herbicide before the crop or weeds emerge, or after the crop emerges but before the weeds appear. Preplant incorporated refers to the use of a herbicide before the crop is planted. The advantage of preplant-incorporated herbicides is that they are in contact with soil moisture and usually do not require immediate rain or irrigation water to become activated. Preemergence applications usually need at least a small amount of moisture for weed kill.

There are usually several herbicides for preplant incorporation or preemergence application, depending on the crop species, soil type, climate and weed species. Most herbicides have selective action and control only certain weeds, but in some situations herbicide combinations can increase the control spectrum. Growers must make the final choice on the basis of soil type, the crop and the weed history of the specific field.

To apply preemergence and postemergence herbicides safely, it is important to select the right equipment and nozzles and to adjust the spray pressure correctly. Carefully monitor the pattern and amount delivered by the sprayer before and during application.

Cultivation is an accepted weed control practice, and its benefits are well known. Some generally accepted advantages are that it physically destroys weeds and increases soil aeration. Shallow cultivation is the ideal practice because deep cultivation causes root pruning and injures the crop. Several "rolling" types of cultivators are available besides the standard shovel-type cultivator that is mounted on or pulled by a tractor.

Toxicity rating	Label signal words	Oral LD_{50} (mg/kg)	Dermal LD_{50} (mg/kg)	Inhalation LD_{50} (mg/liter or ppm)	Lethal oral dose for 150 lb person
High	Danger-Poison	0-50	0-200	0-2,000	Few drops to 1 teaspoon
Moderate	Warning	50-500	200-2,000	2,000-20,000	1 teaspoon to 1 tablespoon
Low	Caution	500-5,000	2,000-20,000	20,000+	1 tablespoon to 1 pint
Slight	Caution	5,000+	20,000+	20,000+	Over 1 pint

Insect Control

Commercial vegetable growers find it impossible to produce vegetables profitably unless they control insects with maximum effectiveness and minimum cost. Today's consumer will not accept unsightly, wormy vegetables. The vegetables are unappetizing, and the waste from trimming increases food costs. Commercial vegetable growers must produce a quality product that is acceptable as well as safe. Careful use of the right insecticides can make this possible.

Vegetable insect pests can be divided into the following groups:

- Caterpillars or worms that feed on foliage and sometimes on fruit.
- Aphids, or plant lice, in large numbers that suck plant juices from new foliage.
- Beetles that chew holes in plant foliage.
- Adult and immature plant bugs that suck plant juices from foliage and fruit.
- Cutworms, earworms and borers that tunnel into corn ear tips, tomato fruit and bean pods.
- Seed and soil maggots that feed inside newly-planted seed and plant roots.

Insect pests can completely destroy a vegetable crop, damage its edible parts and render the crop unsalable, or contaminate the vegetables as they are being processed. They can reduce plant vigor by sucking juices from the leaves, stems and fruit. Some insects carry diseases to specific vegetables or from plant to plant, resulting in crop losses.

Cultural practices that reduce pest populations should be combined with an appropriate chemical means for effectively controlling plant-damaging insects. Sanitation and crop rotation are among the most effective means of reducing insect populations in vegetable crops. Plowing to eliminate or reduce crop residues in the field after harvest is an effective sanitation method that will reduce populations of:

- Stalk borers such as European corn borers whose larvae overwinter by boring into stalks.
- Cucumber, bean and flea beetles that often overwinter as adults in crop residue.
- Defoliating caterpillars, such as tomato hornworms and cabbage worms, that overwinter as pupae on or near the soil surface.
- Squash bugs and other plant bugs that overwinter as adults in crop residue.

Alternating vegetable crops in one field or alternating vegetables with unrelated crops can reduce insect populations the following season. For example, the corn rootworm, a root-feeding insect, can seriously attack sweet corn roots and reduce yields. Growing sweet corn one year and an unrelated crop the following year will help solve this problem. In general, a vegetable should be grown in a certain field only once every three years.

Insects can also be controlled biologically. There are two recognized forms of control: that which occurs naturally and that which is applied. Non-applied, or naturally occurring, biological insect controls that limit insect pest populations include:

- Parasites, including the larvae of certain wasps and flies.
- Predator insects, including ladybird beetles, aphid lions and stinkbugs.
- Birds and other predatory animals.
- Naturally occurring viruses, bacteria and fungi.

Some of these controls are applied to field vegetables on a small scale and can be quite effective on a greenhouse crop. The bacterial agent, Bacillus thuringiensis (BT), is currently applied to control caterpillars in cabbage and related crops and in tomatoes. When ingested, BT spores effectively kill susceptible caterpillars by destroying their gut. Additional applications are made every
5 to 7 days.

Predator and parasitic insects are available from biological supply firms and may be purchased to control other insects. However, the success of this practice is questionable. Introduced parasites and predators always require a dependable source of food, and some predators and most parasites are specific to certain insect species. It is not easy to meet all these needs in field situations.

Disease Control

To control diseases economically, the farm must have an overall management system. Records should be kept on what crops have been planted, what problems have occurred and what pesticides have been applied.

The use of resistant varieties is the simplest and most effective method of controlling diseases. A variety may be completely immune to a disease or able to tolerate it while suffering only reduced damage. The immunity type of resistance exists for the control of many vegetable diseases and is often present in new hybrids and horticulturally superior varieties. Because varieties are resistant only to specific races or biotypes of pathogens, they should be carefully observed for the presence of new races of biotypes.

Tolerant cultivars are not immune to disease. It is important to minimize disease development by carefully choosing the planting time and site and by taking equal care with other cultural decisions. Tolerant cultivars that have some resistance may be used in combination with a fungicide program.

It is important to remember that tolerant cultivars can carry disease. Under certain environmental conditions, yield losses are very low and aboveground symptoms do not develop; however, the disease is moved through seed tubers to other areas, infesting previously uninfested soil and damaging susceptible varieties.

Disease-free planting materials (seed, tubers, transplants, bulbs) have been widely used to control vegetable diseases and are perhaps the most fundamental part of an integrated disease management program. One approach is to produce one's own transplants or to buy healthy, certified, disease-free transplants. This is the cheapest insurance for the vegetable grower and is an important initial step that will often prevent serious epidemics. Another approach is to treat seeds to remove infected or infested units or to free them of pathogenic organisms. Hot water soaks have been used on crucifer seed to eradicate seedborne diseases such as black rot and blackleg. Recently, systemic fungicide soaks have been used to disinfect seed of cole crops and celery. Fermentation and bleach or acid soaking of tomato and pepper seed help eliminate or reduce bacterial spot and bacterial canker infestations. Most commercial seed dealers supply seed that has been properly treated and is free of disease.

For pathogens that have become established in production fields, eliminating crop residues is one effective method of control. Other methods include eradicating alternate host plants such as weeds, eliminating cull piles, removing individual diseased plants, maintaining sanitary equipment and storage facilities, and rotating crops. The advantages of rotation have been recognized since ancient times. Many plant pathogens cannot survive in the soil in the absence of their host, and most plant pathogens attach to members of only one plant family. For this reason, members of different plant families should be used in rotation schemes.

Growers can protect plants by using fungicides, nematicides and bactericides to prevent infection, eradicate soilborne organisms and seedborne fungi or bacteria, protect seeds and seedlings from decay or seedling blight organisms, and disinfect storage areas and packing cases. Foliar applications of fungicides or bactericides break down and must be repeated regularly to protect new plant growth.

Vegetable crops by family

Solanaceae	Tomato, potato, pepper, eggplant, cherry tomato
Cruciferae	Cabbage, cauliflower, broccoli, rutabaga, turnip, radish, kale, mustard, watercress, brussels sprout, kohlrabi, Chinese cabbage
Cucurbitaceae	Cantaloupe, muskmelon, watermelon, honeydew melon, cassaba melon, squash, pumpkin, cucumber
Umbelliferae	Carrot, parsnip
Liliaceae	Onion, shallot, garlic, chives
Gramineae	Sweet corn

Insecticides are often used to control insects that transmit disease-causing organisms, such as cucumber beetles, which carry the bacterium that causes wilt disease of vine crops. Insecticides are also used to kill aphids that carry virus diseases of pepper and potatoes.

In greenhouse situations, the environment (temperature, relative humidity, light and other factors) can be modified to prevent infections. In the field, knowledge of environmental factors such as soil temperature, drainage, prevailing winds and blowing soil can help the grower avoid certain disease problems. Following proper cultural techniques (planting at the proper time, handling plants carefully and using biological controls) further helps prevent disease.

Pest Control Equipment

Vegetable growers generally need two sprayers, one to apply herbicides and the other to apply insecticides and fungicides. If only one is used, clean the sprayer and tank thoroughly between applications. Even with specialized cleaning solutions, there is always a risk of contamination and damage to crops.

Herbicides may be applied with sprayers capable of producing pressures of 30 to 40 pounds per square inch. Fungicides and insecticides must be thoroughly applied and require a positive displacement pump that can produce pressures of up to 200 pounds per square inch. Although piston pumps are often more expensive than roller pumps of similar size, they can be used for both liquid formulations and wettable powders. All pumps and sprayers should be fitted with mechanical agitators to keep formulations in suspension.

Table 4. Vegetable crops for farming a few acres.

Crop	Marketing	Labor requirements	Equipment requirement	Climate unsuitable or hard to grow	Serious insect and disease problems	Comments
Asparagus	RS or WS	Medium	Little	No	No	Perennial
Beans, snap	RS or WS	High	Little	No	No	
Beets	RS	Medium	Little	No	No	
Carrots	RS	High	Sprayer	Yes	Yes	
Cabbage	RS or WS	Medium	Sprayer	No	Yes	
Cauliflower	RS or WS	High	Sprayer	Yes	Yes	
Broccoli	RS	Medium	Sprayer	No	Yes	Perishable
Eggplant	RS	Low	Little	No	Yes	
Lettuce	RS	Low	Little	No	No	
Muskmelon	RS or WS	Low	Little	No	Yes	
Onions	RS	High	Sprayer	No	Yes	
Peas	RS	High	Little	Yes	No	
Peppers	RS	Medium	Little	No	Yes	
Potatoes	RS or WS	High or mechanize	Digger Sprayer	No	Yes	
Parsnip	RS	High	Little	No	Yes	Little demand
Radish	RS	High	Little	No	Yes	Little demand
Turnip	RS	High	Little	No	Yes	
Spinach	RS	High	Little	No	Yes	
Sweet corn	RS or WS	Low	Sprayer	No	Yes	
Sweetpotato	RS or WS	Low	Little	No	No	
Watermelon	RS	Low	Little	No	No	
Tomatoes	RS or WS	High	Sprayer	No	Yes	
Summer squash	RS	Medium	Little	No	Yes	
Winter squash	RS or WS	Medium	Storage	No	No	

RS — Retail sales, direct farm or pick-your-own
WS — Wholesale, supply to other retail outlets

Table 5 Yield potential of vegetable crops

Vegetable	Average yield per acre	Vegetable	Average yield per acre
Asparagus	3,000 lbs	Peas	140 bu
Beans, green or wax	150–200 bu	Peppers	350 bu
Beets, topped	275 bu	Potatoes	200 100-lb bags
Beets, bunches	1,100 doz	Radish	600 bu
Broccoli	10,000 lbs	Rhubarb	475 bu
Cabbage	475 bu	Spinach	300 bu
Sweet corn	1,000 doz	Squash, summer	475 bu
Cucumbers, pickling	400 bu	Squash, winter	16,000 lbs
Cucumber, slicing	300 bu	Sweet potato	250 bu
Eggplant	500 bu	Tomatoes, staked or caged	600 bu
Lettuce	1,200 doz bunches	Tomatoes, field or flat	400 bu
Muskmelon	20,000 lbs	Turnip	400 bu
Onions	600 50-lb bags	Watermelon	20,000 lbs
Parsnips	300 bu		

Sources of Information on Vegetable Production

K-State Research & Extension Personnel

1. Contact an agent at your county research and extension office.

2. Additional help is available from specialists in K-State Research & Extension, Horticulture, Manhattan, Kansas.

Vegetable production and culture	Charles Marr Horticulturalist Throckmorton, K-State Manhattan, KS 66506
Handling and marketing	Karen Gast Horticulture Specialist Throckmorton, K-State Manhattan, KS 66506
Vegetable disease problems	Ned Tisserat, Plant Pathologist Throckmorton Hall, K-State Manhattan, KS 66506
Irrigation and engineering	Danny Rogers Ag Engineer, Seaton Hall, K-State Manhattan, KS 66506
Insect problems	Bob Bauernfeind Entomologist Waters Hall, K-State Manhattan, KS 66506

Publications

The following publications are available through your local county office or from K-State Research & Extension Horticulture, Waters Hall, Manhattan, KS 66506:

Commercial Production of Asparagus
Commercial Production of Cole Crops (Cabbage, Broccoli, and Cauliflower)
Commercial Production of Snap Beans
Commercial Production of Sweet Corn
Commercial Production of Watermelons
Commercial Production of Muskmelons
Commercial Production of Tomatoes
Commercial Production of Sweet Potatoes
Commercial Production of Vegetable Transplants
Commercial Production of Greenhouse Cucumbers
Commercial Production of Greenhouse Tomatoes
Drip Irrigation
Plastic Mulches
Fertigation
Hydroponics
Vegetable Investigations - current year's results of tests and trials with vegetable crops statewide.

Magazines and Periodicals

American Vegetable Growers, available subscriptions from Meister Publishing Co., 37841 Euclid Ave., Willoughby, OH 44094. The July issue is a buyer's guide, with useful information on equipment, products and supplies.

The Packer: National Weekly Business Newspaper of the Fruit and Vegetable Industry, available subscriptions from 1019 W. 84th Terrace, Lenexa, KS 66214

Books

Knotts Handbook for Vegetable Growers by O.A. Lorenz and D.N. Maynard. John Wiley & Co., 605 Third Ave., New York, NY 10016

Producing Vegetable Crops, Interstate Publishing Co., Danville, IL 61832

Vegetable Growing Handbook, AVI Publishing Co., Westport, CT 06880

Organizations

Kansas Vegetable Growers Association, Charles Marr (Secretary), Division of Horticulture, Throckmorton Hall, K-State, Manhattan, KS 66506. The KVGA sponsors an annual meeting in December for Kansas vegetable growers.

Marketing/Product Promotion

Marketing Division, Kansas State Board of Agriculture, 109 Ninth Street, SW, Topeka, KS 66612

Vegetable Seed Companies

Abbott and Cobb, Box 307, Feasterville, PA 19047
Agway Seeds, Rt. 4, Zeager Rd., Elizabethtown, PA 17022
Asgrow Seed Co, Box 48503, Doraville, GA 30340
Burpee Seed Co., 622 Town Road, West Chicago, IL 60185
Burrell Seed Growers, Box 150, 405 N Main, Rocky Ford, CO 81067
Chesmore Seed Co., Box 8368, St. Joseph, MO 64508

Comstock and Ferre, 363 Main St., Wethersfield, CT 06109
Ferry Morse, Box 4938, Modesto, CA 95352
Harris Moran Seed Co., 4511 Willow Rd.-Suite 3, Pleasanton, CA 94588
Harris Seed Co., 60 Saginaw Dr., Rochester, NY 14692
Herbst Bros., 1000 N. Main, Brewster, NY 10509
Hollar Seed Co., Box 106, Rocky Ford, CO 81067
Johnnys Select Seeds, Foss Hill Rd., Albion, ME 05901
Liberty Seed Co., Box 806, New Philadelphia, OH 44663
Midwest Seeds, 10550 Lackman Rd., Lenexa, KS 66219
Musser Seed Co., 301 4th Ave. S., Twin Falls, ID 83303
Park Seed Co., Greenwood, SC 29647
Peto Seed, Box 4206, Saticoy, CA 93003
Reed's Seeds, 3334 NYS Rt. 215, Corland, NY 13045
Robson Co., 1 Seneca Circle, P.O. Box 270, Hall, NY 14463
Rogers-NK Seeds, P.O. Box 4188, Boise, ID 83711
Royal Sluis Seed Co., 627 Brunken Ave., Salina, CA 93901
Sakata Seed American, P.O. Box 880, Morgan Hill, CA 95038
Stokes Seeds, Box 548, Buffalo, NY 14240
Sun Seeds, 18460 Sutter Blvd., Morgan Hill, CA 95037
Takii Seed Co., 301 Natividad Rd., Salina, CA 93906
Thompson and Morgan, Box 1308, Jackson, NJ
Twilley Seed Co., Box 65, Trevose, PA 19047
Vermont Bean Seed Co., Garden Lane, Bomoseen, VT 05732
Vilmorin Inc., P.O. Box 707, Empire, CA 95319
Willhite Seeds, P.O. Box 23, Poolville, TX 76487

Plants

Berry Patch, Rt. 1, Box B, Cleveland, MO 64734
Dixie Plant Farms, P.O. Box 86, Tifton, GA 31793 (912) 382-9390
H.C. Dodson Plant Farms, Inc., Rt. 1, Tifton, GA 31794 (912) 382-3872
Mobley Plant Co., Rt. 8, Box 634, Moultrie, GA 31768 (912) 985-5544
Nourse Farms, 41 River Road, South Deerfield, MA 01373
Piedmont Plant Co., P.O. Box 224, Albany, GA 31703 (912) 435-0766
Plants of Ruskin, Inc., Box 994, Ruskin, FL 33570 (813) 645-2528
Speedling Inc., Box 98, Sun City, FL 33586

Irrigation Equipment

American Plant Products, 9200 NW 10th, Oklahoma City, OK 73127 1-800-654-4583 (Drip-trickle)
Chesmore Seed Co., Box 8368, St. Joseph, MO 64508 (816) 279-0865
NETAFIM Irrigation, 311 Nautilus Avenue, Austin, TX 78738 (515) 261-3007
Good Earth Gardens, Rt. 1, Box 139, Clearwater, KS 67026 (316) 773-1494 (Drip-trickle)
Schumacher Irrigation, P.O. Box 218, Main Street, Platte Center, NE 68653
Smith Irrigation, Box 232, N. Main St., Kensington, KS 66951 (785) 476-3270
Sons Drip Irrigation, 1102 Summit View Drive, Fort Collins, CO 80524 (303) 667-1961

Tillage Equipment and Bedders

AMTI, 1015A S. San Gabriel Blvd., San Gabriel, CA 91776 (213) 285-7287
Befco, Inc., Box 6036, Rocky Mount, NC 27801 (919) 977-9920
George F. Ackerman Co., Box 157, Curtice, OH 43412 (419) 836-7735
Guy Farm Equip. Co., 15219 Hwy. 14, Woodstock, IL 60098 (815) 338-0600
Howard Rotavator Co., 102 Howard Ave., Muscoda, WI 63573 (608) 739-3106
Kennco Mfg., Inc., Box 1158, Ruskin, FL 33570 (813) 645-2591
Larchmont Eng. & Irig., 11 Larchmont Ln., Lexington, MA 02173 (617) 862-2550
Lely Corporation, Box 1060, Wilson, NC 27893 (919) 261-7050

Transplanting Equipment

Ellis Manufacturing Co., Box 246, Verona, WI 53593
Holland Transplanter Co., 510 E. 16th St. Holland, MI 49423
Mechanical Transplanter Co., Box 1008B, Holland, MI 49423
Powell Manufacturing Co., P.O. Drawer 707, Bennettsville, SC 29512
Speedling Mfg. Co., Box 283, Sun City, FL 33586

Seeding Equipment

Cnockaert Farming Entp., St. Thomas, Rt. 7, Ontario, N5P 3T2 (Webb Precision Seeder)
Cole Mfg. Co., Box 9216, Charlotte, NC 28299 (Planet Jr. Seed Drill)
Earthway Products, Box 547, Briston, IN 46507

(Garden planter)
George F. Ackerman Co., Box 157, 300 Mill St., Curtice, OH 43412 (419) 836-7735
K-C Tool Co., Inc., Rt. 4, Box 0-36, Delphi, IN 46923 (317) 268-2362
Laporte - U.S., 411 Hackensack Ave., Hackensack, NY 07601 (Fluid drill)
Triangle M Tractors, Old 41 N., Morocco, IN 47963 (219) 285-2377 (Mahan System planter, Stanhay precision seed drill)
Winslow Pacific Co., 6100 Avenida Encinas, Carlsbed, CA 92008 (Centra-Flo Precision Planter)

Containers and Packaging

Adelman-Fisher Packaging, 207 Walnut St., Kansas City, MO 64106
Aargus Poly Bag Co., 1415 Redeker Rd., Des Plaines, IL 60016 (312) 356-3341
Agri-Pack Div., Liberty Carton Co., 870 Louisiana Ave., Minneapolis, MN 55425 (612) 540-9615
Allied Fastener Corp., 133 N. 25th Ave., Melrose Park, IL 60521 (312) 345-0063
Alton Packaging Corp., 401 Alton St., Alton, IL 62002 (618) 466-6552
Anderson Box Co., Park Fletcher Station, Box 41264, Indianapolis, IN 46241 (317) 248-8086
Chesmore Seed Co., Box 8368, St. Joseph, MO 64508 (816) 279-0865
Cordage Packaging, 8112 W. Thomas St., Apt. 3, Justice, IL 60458 (312) 496-3152
International Paper Co., 635 Northwest Ave., Northlake, IL 60164 (312) 562-6900
Package Research Laboratory, 2406 Shooting Park Rd., Peru, IL 61354 (815) 223-7700
Packaging Corp. of America, 1603 Orrington, Evanston, IL 60204 (312) 492-6956

Specialized Sprayer Equipment

Ag Tec Crop Sprayer, 4900 Viking Drive, Minneapolis, MN 55435
Agrotec, Inc., Box 215, Salisbury, MD 21801
Broyhill Co., North Market Square, Dakota City, NE 68731
Chemtrol, Box 2343, Kansas City, KS
Chesmore Seed Co., Box 8368, St. Joseph, MO 64508 (816) 279-0865
Electro-Spray Mfg., 6500 NW 42nd, Lincoln, NE 68524 (402) 470-2685
Grower Equipment and Supply Co., Rt. 1, Box 7, Grayslake, IL 60030
Mann Orchard Supply, 1210 Normal St., Woodbine, TX 51571
RHS Fertilizer/Sprayer Systems, Rt. 4, W. Oregon St., Hiawatha, KS 66434
Westheffer, Inc., Box 363, Lawrence, KS 66044

General Supplies

In addition to the following sources, you can contact local dealers.

The July issue of the *American Vegetable Grower* is a valuable buyer's guide that lists major supply companies and manufacturers. Also check the classified section of *AmericanVegetable Grower* (periodical), *The Great Lakes Vegetable Growers News* (periodical) and your local paper for used equipment.

ADI Distributors, Inc., Box 643, 430 West Carmel Dr., Carmel, IN 46032 (317) 844-8221
Ball Seed Co., Box 335, West Chicago, IL 60185 (312) 231-3500
P.A. Bonvallet's Sons, Inc., Rt. 3, Box 481, St. Anne, IL 60964 (815) 427-8222
Carlin Sales Corp., 8964 N. 51st St., Milwaukee, WI 52332 (414) 355-2300
Cearmo Co., Inc., Box 384, Jackson, MO 63755 (314) 243-3138
Chesmore Seed Co., Box 8368, St. Joseph, MO 64508 (816) 279-0865
The DAO Corp., Box 659, Terre Haute, IN 47808 (812) 466-4242
Florists Products, 2242 N. Palmer Dr., Schaumberg, IL 60195 (312) 885-2242
Grower Equipment & Supply Co., Rt. 1, Grayslake, IL 60030 (312) 223-3100
Illinois Fruit Growers Exchange, Box 438, Cobden, IL 62920 (618) 893-2194
KPR Sales, Inc., Box 163, LaCrosse, IN 46348 (312) 331-1606
A.M. Leonard, Inc., 665 Spiker Rd., Piqua, OH 45356 (513) 773-2694
Mellingers, 2310 W. South Range Rd., North Lima, OH 44452 (216) 549-9861
Michigan Orchard Supply Co., Box 321 S. Haven, MI 49090 (616) 637-1111
Nasco, 901 Janesville Ave., Fort Atkinson, WI 53538 (414) 563-2446
Stuppy, Box 12456, North Kansas City, MO 64116 1-800-821-2132

Charles W. Marr
Vegetable Crops Specialist

Publications from Kansas State University are available on the World Wide Web at: http://www.oznet.ksu.edu

Kansas State University Agricultural Experiment Station and Cooperative Extension Service
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