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Growing and Harvesting

the cole crops

BROCCOLI
BRUSSELS SPROUTS
CABBAGE
CAULIFLOWER
KOHLRABI

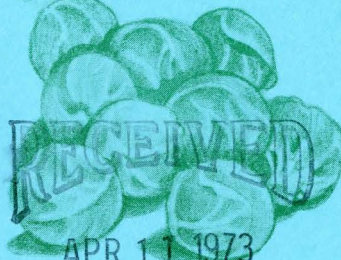
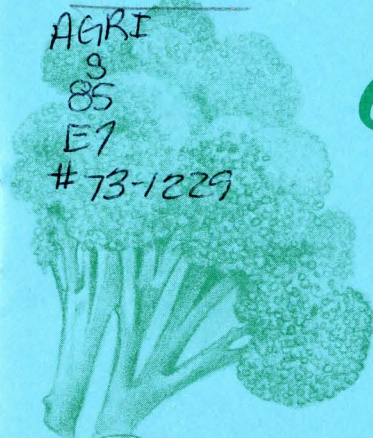
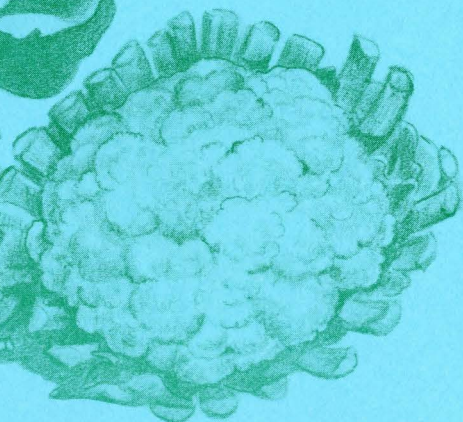
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GROWING and HARVESTING the Cole Crops

BROCCOLI, BRUSSELS SPROUTS, CABBAGE, CAULIFLOWER AND KOHLRABI

R. E. Neild

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Broccoli, brussels sprouts, cabbage, cauliflower and kohlrabi are a group of vegetables called cole crops. They belong to a plant family named *Cruciferae* because its members bear flowers with four petals in the shape of a cross. Turnips, horseradish, watercress, kale and radishes are other vegetable members of this family.

Cole crops are hardy and will tolerate brief exposure to temperature as low as 20° F. They thrive in cool weather so are best grown as spring and fall crops in Nebraska. Cole crops require relatively small space. Depending on variety, one plant requires 2 to 3 square feet. Cabbage, kohlrabi and broccoli are easily grown from transplants or seed. Brussels sprouts and cauliflower are more difficult for beginners.

Cole crops may be served raw in crisp salads or cooked in a variety of ways. They are high in minerals, a good source of Vitamin C and provide bulk in the diet to aid digestion. They contain between 20 to 45 calories per 100 grams. Raw cabbage stores well and is excellent when preserved by fermentation into kraut. Most of the fresh quality of broccoli, brussels sprouts and cauliflower is preserved well when frozen.

Varieties

The cole crops are all members of a single species botanists have named *Brassica oleracea* which has a remarkable natural tendency for thickening of plant parts. The various cole crops look different at maturity yet can be readily cross-fertilized. This is an ultimate test for plants of the same species.

During crop domestication selective emphasis on thickening of certain parts resulted in uniquely different plant forms necessitating further subclassification into easily recognizable botanical varieties.

A discussion of these varieties, giving the scientific botanical name associated with common name, follows:

Broccoli or *Brassica oleracea italica* was developed through selection of plants with thickened immature floral stems and florets. Broccoli has a crisp, relatively sweet "nutlike" flavor. It gets its common name from the Italian word "brocco" meaning arm or branch. Varietal strains are available with maturities ranging from 50 to 80 days between transplanting and harvest. Early maturing varieties are best when planted in the spring. Later maturing varieties are best for a fall crop.

Cleopatra and Green Comet are two new early maturing hybrid varieties best used as spring and summer crops. Depending on temperature, they will be ready for harvest in 50 to 55 days. Cleopatra is slightly earlier than Green Comet. Both produce uniform vigorous plants with more resistance to heat and disease than later strains. Green Comet was selected an All American Winner in 1969.

Spartan Early and De Cicco are two open-pollinated selections that perform well when spring-planted. They are slightly later than the early hybrids but produce a large central head and abundant side shoots. Waltham 29 is a later variety requiring 75 to 80 days to harvest. It should only be planted for a fall crop. It withstands cool fall weather and makes a heavy crop of sideshoots after the central head is harvested. The side shoots are excellent for freezing. Waltham 29 is widely adapted and is successfully grown in many regions.

Brussels sprouts or *Brassica oleracea gemmifera* was developed by selecting plants producing thickened buds in the axils of leaves on an elongated stem.

Brussels sprouts are difficult to grow in the Great Plains and do well only when planted for a fall crop in Nebraska. They are more difficult to grow in eastern than in western Nebraska. The small heads are harvested after frost in November or early December. This improves their flavor. Brussels sprouts require 80 to 95 days for maturity.

Jade Cross (an early maturing hybrid and an All American Winner) and Long Island are two popular varieties. Jade Cross produces higher yields, is more widely adapted and easier to grow than other varieties.

Cauliflower or *Brassica oleracea botrytis* was developed by selecting plants producing a thickened head of immature florets (broccoli produces side shoots as well). Varietal strains have

maturities ranging from 50 to 95 days from planting to harvest. Some strains produce white heads if they are blanched by tying over leaves when immature. Others produce purple heads that become green, resembling broccoli, when cooked. Strains with purple heads are easier to grow.

Snow King is a very early hybrid capable of producing heads 50 days from transplanting. It tolerates heat better than later varieties and grows a firm head averaging about 2 pounds. It was selected an All American Winner in 1969. Snowball, another early strain, is reliable and adapted over a wide area. It matures 5 to 10 days later than Snow King and is good for freezing. Purple Head is a later maturing strain that requires 85 to 90 days from transplanting. It produces large purple heads and should be grown only as a fall crop in Nebraska.

Kohlrabi or *Brassica oleracea gongylodes* was developed by choosing plants having thickened stems that are used as the food part. Kohlrabi is easy to grow and the thickened "bulb-like" stem is excellent sliced raw or cooked. It has a mild flavor resembling a blend of turnip and cabbage. Two strains are available. One, Early White Vienna, matures its green bulbous stem about 55 days from transplanting. The other, Purple Vienna, is slightly larger and later. It has a reddish-purple skin but a crisp white flesh like Early White Vienna.

Cabbage or *Brassica oleracea capitata* was developed from plants producing a rosette of thick leaves in the form of a head on a shortened stem. Strains range in maturity from 60 to over 100 days. Head shapes may be round, pointed or flattened with green or reddish purple leaves. Leaves may be smooth or crinkled. Cabbage is the most common and easily grown cole crop.

As with other cole crops, early strains of cabbage are best planted as a spring crop. They produce smaller, looser heads than later strains but have a tendency to split if left too long in the garden. Early strains are excellent for making crisp salads and slaw after the spring lettuce harvest is over.

Mid-season strains mature 70 to 80 days from transplanting and are more heat-tolerant than earlier ones. Late maturing strains produce larger and firmer heads than the earlier groups and keep longer in storage. Heads of late strains have less tendency to split. They are better for making kraut.

Highly pigmented strains produce medium sized reddish-purple heads that add color to salads and are desirable for cooking. Savoy type strains with crumpled leaves grow loose heads that resist splitting. Savoy cabbage is less odorous while cooking and is preferred for this reason. A listing of different cabbage characteristics is given in Table 1.

Crop Requirements

Cole crops can be successfully grown on most soils if drainage is good and the crop is supplied with adequate water and nutrients, particularly nitrogen. Light-textured soils usually produce earlier crops but heavier soils hold more moisture and produce crops holding quality longer at maturity.

Cole crops have shallow root systems and should not be allowed to suffer from lack of moisture. Inadequate moisture may cause small heads to form prematurely on cauliflower. Rainfall or irrigation following a prolonged dry spell may cause splitting of cabbage and kohlrabi. Supplemental irrigation is important for growing cole crops in Nebraska.

Cole crops grow best between 60 and 70^o F. Late strains will continue to grow at fall temperatures as low as 41^o F but few strains make much growth above 78^o F. Young plants can tolerate colder and warmer temperature than older plants. This favors the use of transplants for early spring crops and seed for fall crops.

Cabbage, kohlrabi and broccoli, in that order, are the easiest cole crops to grow. Cauliflower and brussels sprouts are more difficult. When irrigated, both yield and quality of cole crops increase from east to west across Nebraska. Excellent yields of high quality cauliflower have been harvested in the fall at the North Platte and Scottsbluff Experiment Stations.

Soil Preparation and Planting

Rotate cole crops to avoid planting in the same area of the garden more frequently than once in four years. Cole crops need a fertile soil for high yields. Most Nebraska soils are well supplied with potassium and some with phosphorus also. A soil test can be used to determine phosphorus needs. Nitrogen fertilizer should be applied and worked into the soil before planting unless it has received a

recent application of manure or compost. Apply 1 lb of actual nitrogen per 1000 square feet (equivalent to 6 cups of ammonium nitrate or 10 cups of ammonium sulphate).

Transplants of early maturing varieties are preferred for spring planting and early summer harvest. Although tolerant of frost, cole crops should not be transplanted until temperature has become sufficiently warm to support young seedling growth.

The usual time when such conditions can be expected to first occur and the latest time for transplanting for different regions in Nebraska are shown in Table 2. Transplants may be purchased or home grown when proper conditions are available.

E.C. 72-1226, "Growing Vegetable Transplants," available from your county agent or Department of Information, College of Agriculture, University of Nebraska, Lincoln, Nebraska 68503, contains information on growing cole crop transplants. Set transplants 10 to 12" apart in rows 24 to 36" wide. Use the wider spacing for later maturing strains. Cole crops transplant easily but will suffer less shock with little check in growth if water is applied when they are set in the field.

Suggested periods for seeding cole crops for fall harvest are also given in Table 2. Later maturing strains of the different crops are best suited for fall production. The crops can be seeded where they will grow to harvest or, if space is at a premium, may be seeded in some smaller garden area for transplanting at a later date.

Late cole crops can be seeded or transplanted in an area cropped to lettuce, peas, spinach or snap beans but should not follow radishes or other crucifers. Rows should be 24 to 36" apart with transplants set or seedlings thinned to 18 to 24" apart. Plant seed about ¼" deep. The proper spacing for seeded plants is best accomplished if 3 or 4 seeds are dropped in one place and later thinned to a single plant before they become overcrowded.

Weed Control

Cole crop roots grow near the surface so cultivation and hoeing should be shallow. This is particularly important as plants increase in size and root injury is more likely to occur. Weeding is usually necessary until plants are about half grown to sufficiently shade the soil and reduce weed competition. Timely cultivation is important since weeds are best controlled when they are small.

Cultivation and hoeing are preferred weed control methods in small gardens but chemical herbicides are available for larger plantings. Dacthal (DCPA) at a rate of 10 lb per acre (7 to 8 tbsp per 1000 square feet) after seeding but before weed seeds germinate or Treflan at a rate of 1 lb per acre (2 tsp per 1000 square feet) before setting if transplants are used are suggested chemicals. If Dacthal is used be sure to keep the spray mixture well agitated and irrigate if no rain falls within 3 days. Treflan should be incorporated into the upper two inches of soil.

Irrigation and Side-Dressing Fertilizer

For good yields and quality, cole crops should grow at a rapid and regular rate. This is particularly important with broccoli and even more so with cauliflower to avoid premature formation of small heads.

Maintaining adequate moisture and nitrogen are essential for continuous rapid growth. Roots of cole crops are shallow so irrigation should be more frequent but lighter than for deeper rooted crops. Apply water immediately after transplants are set and whenever the soil surface begins to appear dry. Several irrigations may be required when rainfall is infrequent. Avoid over-irrigating as poor drainage as well as lack of water is harmful.

An application of $\frac{1}{4}$ pound of actual nitrogen per 100 feet of row (equivalent to about 1 cup of ammonium nitrate or $1\frac{1}{2}$ cups of ammonium sulfate) about two weeks after transplanting and a second application about two weeks before harvest will assure adequate nitrogen is available. Nitrogen can be side-dressed when cultivating or hoeing or applied and irrigated into the soil.

Insects^{1/}

Aphids (Soft-bodied, small, sucking insects): Control by spraying with 2 teaspoons 25% emulsifiable diazinon or 2 teaspoons 50% emulsifiable malathion per gallon of water. Sprays must contact insects to be effective.

Caterpillars (cabbage "worms"): Cabbage loopers (pale-green measuring worms) and cabbage worms (velvety green caterpillars)

^{1/}Recommendations by R. E. Roselle, Department of Entomology, College of Agriculture, University of Nebraska.

cause severe damage to cole crops. Control is difficult. Use *Bacillus thuringiensis*, a safe biological spray material sold under trade names of Biotrol, Dipel and Thuricide. Spray late in evening, as ultra violet rays will destroy this material. Naled (Dibrom) or endosulfan (Thiodan) may also be used for control of cabbage caterpillars. Follow package directions for mixing these materials, as formulations will vary. Applications will need to be made every 5 to 8 days with *Bacillus thuringiensis* or Dibrom.

Harlequin bugs (black, brilliantly colored with red or yellow, shield shaped, sucking insects): Apply a spray of endosulfan (Thiodan), diazinon, or naled (Dibrom). Follow package directions.

Caution: Insecticides are poisons and must be used with care. Read label instructions carefully before mixing. Labels specify the time that should expire between last application and harvest. Use care to avoid skin contact by insecticides.

Diseases

Use of resistant strains and crop rotation are the best ways to avoid diseases of cole crops. Fusarium yellows, a disease that causes cabbage and kohlrabi plants to become stunted and their leaves to turn yellow and drop off, is a common disease present in soils formerly cropped to cole crops. Strains are available that are resistant to this disease and are usually so designated by the letters YR after the varietal name.

Black rot, recognized by blackened leaf veins and a dark ring in the stem when cut across, and black leg (ashen-grey spots speckled with tiny black dots) are other diseases of cole crops.

Use of disease free seed and a crop rotation with no crucifers more frequent than once in 4 years are the best ways to avoid these diseases.

Harvesting and Storage

Broccoli is first harvested when the central head is compact but before the flowers open, showing their yellow color. Depending on growing conditions, central heads may range from 3 to 6 inches across when mature. Cut the heads, allowing 6 to 8 inches of tender succulent stem attached to each head.

A second harvest of side shoots is usually possible. These smaller shoots, 1 to 3 inches across, develop after the central head is

removed. The smaller side shoots are of equal quality with the central head and are excellent for freezing. Broccoli is quite perishable and should be promptly refrigerated following harvest where it can be kept for about 10 days.

Cauliflower. It is important to tie developing cauliflower to prevent the enlarging head from spreading leaves apart for exposure to sunlight. The longest leaves should be gathered over the small head and tied with a cloth strip, soft twine or rubber band.

Plants may develop heads at different times so it is advisable to go through the planting every 2 to 3 days after the first observed heads are about the diameter of a quarter. Using a different colored string or band each time provides a color coding to later identify plants of similar maturity for harvest.

In warm weather a cauliflower head may reach a harvestable size in 4 to 6 days after being tied. Longer time may be required in cooler weather. Heads are in prime condition when they are fully developed, compact and white. Cut with a sharp knife, leaving at least one whorl of leaves attached to protect the head. Heads may be kept two to three weeks if refrigerated.

Cabbage. The time for harvesting cabbage is based on solidity of heads. Cabbage continues to grow after heading begins so yield is greatest and quality best if harvest is delayed until heads are quite firm. Some early cabbage usually is cut when heads are relatively soft. Timing of harvest is not as critical as with other cole crops. Cut heads from the stem with a sharp kitchen knife. If heads are not for immediate use, leave 3 to 6 green wrapper leaves to protect the heads during handling and storage.

Heads of early cabbage may split if left too long in the garden. Splitting is less with the fall crops which can be left in the garden until about mid-November unless a severe freeze is forecast. Any damage due to freezing temperature above 22 to 24^o F usually does not penetrate deeply into the head and can be trimmed off at harvest. Cabbage is best stored at about 32^o F with high humidity. Early cabbage may be kept 3 to 6 weeks. Late fall varieties may keep 3 to 4 months under proper conditions.

Brussels sprouts. Harvesting of Brussels sprouts usually begins about 60 to 75 days from transplanting. Since the sprouts are progressively less mature from lower to upper portions of the stem the crops may be picked over several times. Begin harvesting before

the bottom leaves become yellow or the sprouts will be tough. Break off only those leaves below the points to be harvested and twist the mature sprouts from the stem. Brussels sprouts do not keep as well as cabbage. When not immediately used they may be kept satisfactorily about a month if refrigerated.

Kohlrabi has the best flavor when the young globes are not much over a 3-inch diameter. Harvest by pulling the plant from the soil and cut off the small portion of unswollen stem and roots at the base of the globe. Young leaves are removed and can be cooked like spinach. Globes can be sliced and consumed raw or cooked by steaming without peeling. If harvest has been delayed too long the skin is best removed before cooking. Kohlrabi keeps 2 to 4 weeks if refrigerated.

Table 1. Characteristics of some strains of cabbage.

<i>Group</i>	<i>Strain</i>	<i>Approximate days to harvest</i>	<i>Head weight lb</i>	<i>Remarks</i>
Early	C-C Cross	60	3-4	Uniform maturity, good quality, not yellows resistant.
	Emerald Cross	62	4-6	Hybrid with solid heads and uniform maturity.
	Early Jersey Wakefield	63	2½-3	Cone-shaped head. Yellows resistant, sensitive to heat.
	Golden Acre	65	3-4	Round heads with tender sweet leaves.
	Stonehead	65	3-4	Very uniform hybrid with round hard head that stands well at maturity. Tolerant to yellows disease.
Mid-season	Copenhagen Market	70	5-6	Solid round heads. Dependable yield.

Table 1. (continued)

<i>Group</i>	<i>Strain</i>	<i>Approximate days to harvest</i>	<i>Head weight lb</i>	<i>Remarks</i>
	King Cole	72	4-6	Hybrid with resistance to yellows disease.
	Marion Market	72	4-5	Yellows resistant, matures uniformly.
	Bonanza	75	4-5	Solid head, tolerates hot weather.
	Harvester Queen	75	4-5	Uniform maturing hybrid with yellows resistance and tolerance to heat AAS 1965.
Late	Badger Ballhead	100	6-7	Yellows resistant, good keeper.
	O-S Hybrid	100	8-10	Very uniform in maturity and size.
	Wisconsin Hollander	105	6-8	Yellows resistant, keeps well.
Red	Ruby Ball	72	3-4	Small round firm head AAS 1972
	Red Acre	75	4-5	Good color, stands well without splitting.
	Red Head	85	4-5	Yellows resistant, very solid head AAS, 1972.
	Mammoth Red Rock	95	6-8	Round solid head, good for pickling.
Savoy	Chieftan Savoy	88	3-4	Firm head, crumpled leaves
	Savoy King	92	4-6	Hybrid with heat and disease tolerance AAS 1965.

Table 2. Time for transplanting and seeding cole crops.

	<i>Region in Nebraska</i>		
	<i>East</i>	<i>Central</i>	<i>Panhandle</i>
Transplanting for early harvest	April 5-May 5	April 10-May 10	April 15-May 20
Seeding for fall harvest	June 25-July 15	June 20-July 10	June 15-July 5