

The Agricultural Experiment Station
OF THE
Colorado Agricultural College

CABBAGE GROWING

BY

E. R. BENNETT

The Agricultural Experiment Station

FORT COLLINS, COLORADO

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CABBAGE GROWING ON THE IRRIGATED LANDS OF COLORADO

By E. R. BENNETT

As the irrigated tracts of land in Colorado have become more thickly settled the price of land has risen. With this the character of the crops grown has changed from the extensive to the intensive. That is, where a few years ago farmers depended on wheat, oats, and hay as their money-making crops they have found that at the present valuation of land in many places these crops do not pay a satisfactory interest. This condition has forced the extensive crops to a great extent to give place to such crops as sugar beets, potatoes, cabbage, and onions.

The culture of these crops under irrigated conditions is a somewhat different problem from that of the unirrigated country, so that new comers may save considerable trouble and expense by following the system which has been worked out and found to give the best satisfaction here.

HISTORY OF THE INDUSTRY.

Cabbages have been grown for home consumption since the early settlement of the country. About 1880 the potato buyers of the Greeley district found there was a considerable demand for cabbage in the southern markets and that they could be shipped satisfactorily in the same cars with potatoes. From that time the industry has gradually grown till the output is now from five hundred to one thousand cars per year. Greeley is near the center of the industry, though more or less acreage is devoted to the crop throughout the northern Colorado districts. So far comparatively few have been grown in the mountain districts of the State, because of the lack of transportation facilities in the high mountain valleys.

SOIL.

The soil best adapted to the growth of the cabbage is a cool, moist loam. An abundant supply of available nitrogen tends to promote leaf growth at the expense of fruit or seed. As the edible portion of cabbage, lettuce, etc., is the leaf rather than the seed, an excess of this element in the soil is beneficial. For this reason the bottom land or peaty lands are generally considered best for cabbage. Nearly any of the soils of this State, however, will grow cabbage successfully if sufficient decaying vegetable matter and manure are added to put them in good condition and to provide the necessary fertility.

CLIMATE.

None of the horticultural products have a wider range as to climate than the cabbage. This vegetable is grown more or less successfully from the semi-tropics to the arctic circle in Alaska. When grown in the South it must be planted so as to mature before the extreme heat of summer. This is also true to a less degree in the northern states and in Colorado, except in the higher altitudes of the mountain valleys. The most favorable climate is found in this State at the altitudes between six and nine thousand feet where the nights are always cool and the days not extremely warm.

PREPARATION OF THE LAND.

Much of the land used for cabbage growing is considered too valuable to rotate in the usual way. If alfalfa sod is used the land may be sufficiently fertile to produce a crop without the addition of manure. In most cases, however, cabbage follow cabbage on the same soil for several years. One successful grower at Greeley has produced a crop of cabbages on the same land fourteen years in succession. In cases of this kind manure is added to the soil at the rate of twenty tons per acre every two years, or ten tons per acre each year.

After the crop is taken off in the fall, the plow is run under each row, turning the old stumps and leaves of the cabbage under. This leaves the surface rough, so as to catch the snows of winter, and exposes more of the soil to the action of the frost. If manure is to be applied it is generally spread on this land during the winter. In the spring before the soil becomes too hard and dry the harrow is run over the tract lengthwise of the furrows, which smooths the surface down to its original level. Following this the ground is plowed to a depth of from eight to twelve inches.

SEEDING.

Seed must be sown from six to seven weeks before it is desired to set the plants in the field. The time of setting early plants necessarily varies

somewhat with the season. For early cabbage the first seed are sown from March 1st to 15th. At least two sowings should be made to avoid danger of accidents and a possibility of the first plants becoming too large before the weather will permit setting.

Seed for early cabbage are sown either in flats in a forcing house or in hotbeds. If sown in flats, the seedlings soon begin to crowd and are pricked out of the seed flats as soon as the first leaf appears. In this operation the plants may be put into other flats one inch apart each way, or they may be put into hotbeds or coldframes. If the seed are sown in hotbeds the seedlings are not generally transplanted at all till time to set in the field. In this case the seed must be sown more sparingly or the young seedlings must be thinned so as not to crowd. Young plants either in the forcing house or hotbed are apt to be tender and are very susceptible to a disease known as the "damping-off fungus." This trouble is the result of a too high temperature, not enough fresh air, or too much water. The disease is hard to control after it once gets a foot-hold, but may be checked to some extent by remedying these conditions and sprinkling dry sand among the plants. When plants are grown in the forcing house or hotbed, great care must be exercised to properly harden them off before setting in the open ground. In the forcing house this is done by keeping the temperature low and giving all the ventilation possible when the weather will permit. If the hotbed is used, the sash may be first partly removed and later taken off during pleasant weather. Properly hardened plants will endure temperatures of from ten to twenty degrees below freezing point after setting in the field. If not properly hardened off, exposure to freezing temperatures often prove fatal.

For late planting the seed is usually sown in the open ground. If large fields are to be planted, two, three, or even four sowings are made. The first seeding is made about the tenth of April with the others following at intervals of about seven days.

The seed in the open ground is sown in a double row system. That is, two rows are sown from ten to sixteen inches apart with space enough between to run a cultivator and a ditch for irrigation. Since the cucumber flea beetle has caused so much damage to the young plants, some growers are growing the plants for late setting in coldframes. In this case the seed are sown in rows in the frames six inches apart and are allowed to grow in this way until setting in the field. These frames are found to be most convenient if made twelve feet long by six feet wide, or in a multiple of those proportions. The frames are made of boards or planks twelve or fourteen inches high on the back or north side, and lower in front. The covers used for this purpose are made of cheap unbleached muslin stretched on three by six-foot frames. By keeping these covers on the beds during the time the plants are pricking through the ground, the beetles are prevented from getting to the plants. A coldframe of the size mentioned will produce enough plants for about one acre of land.

In planning for the crop it is estimated that one pound of seed will produce plants for four or five acres of land, or fifty thousand plants. This, of course, varies with the germinating power of the seed and weather conditions during seeding time.

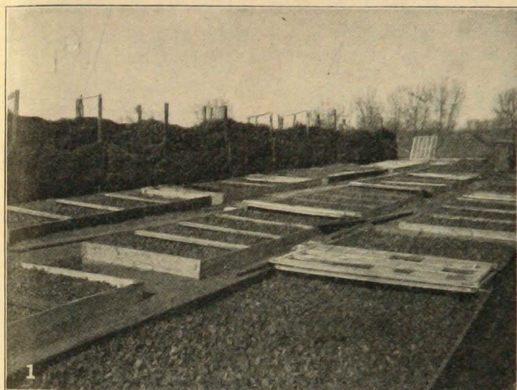
PLANTING.

The operation of setting the plants differs more from setting in the humid districts than does other operations connected with the industry. In the East, plants may be set even in fairly dry soil without watering, and few, if any, of these plants sustain permanent injury. The intense sunshine and rapid evaporation of moisture in Colorado are such as to make this method impracticable here.

Setting the plants for the late crop is done sometime during the month of June. After the land has been put in a good state of tilth by the use of the harrow, ditches are made with a shovel plow. These ditches or rows are made in the direction which will make irrigation the most advantageous. The distance between ditches differs somewhat with the variety of cabbage to be grown, and varies from twenty-four to thirty-six inches. The majority of growers plant late cabbage in rows twenty-eight inches apart. These ditches are eighteen to twenty inches wide at top and from six to nine inches deep. After the ditches are made, one man goes along the row dropping plants. These are placed from fifteen to eighteen inches apart in the ditch. Another man follows the dropper to set the plants. In this operation the finger or a sharpened stick is used to make a hole in the side of the ditch about half way from the top to the bottom. The plant is placed in this hole, then the soil pushed back around the roots. Water is

allowed to run in a small stream as closely as possible behind the man who is setting the plants. Working in this way, two persons can set from eight to fifteen thousand plants per day.

From four to eight days after the plants have been set, the water is run through the rows, and sometimes this is repeated two or three times before the ditches are filled. When the plants have become sufficiently established the land is leveled. This is done sometimes by hand with a garden rake, but can be done as well and at less cost with a horse and garden cultivator of the Planet Junior twelve-tooth or Iron Age type. Several



COLO. EXPT. STA.

1. Cold Frames

2. Filling in Furrows after Plants have become established

3. Harvesting

4. A Cabbage Field

shallow cultivations are given during the season, and it is usually necessary to go over the field once or twice with the hoe to cut the weeds from the rows.

After the first ditches are filled and irrigation becomes necessary, the shovel plow is run between the rows, making a ditch sufficiently deep to run water across the field without flooding the plants.

IRRIGATION.

Few crops are more particular about water than the cabbage. Although it is a gross feeder, it will soon wilt and stop growing if the soil is dry, and on the other hand, if the land becomes water-logged the plants will turn yellow and stop growth. The frequency and number of irrigations then depends on the character of the soil and the amount of rainfall. If

soils are light and gravelly, with good under drainage, the irrigations must be frequent, and there is little danger of over-watering.

HARVESTING.

The harvesting of cabbage is a very simple operation, as the markets reached are not exacting.

The wagon is driven into the field, the heads cut with a knife, so as to leave just enough of the green leaves to cover the white tissue of the head, then thrown onto the wagon. Not all the heads will be ready for market at the same time, so the fields have to be gone over two or three times before all the crop is taken off.

If the crop is to be shipped, the cabbages are hauled direct to the cars. After being weighed the cabbages are either crated, sacked, or sometimes loaded onto the cars loose.

INSECT PESTS AND DISEASES

Comparatively few insects and diseases have so far troubled the cabbage in this State.

FLEA BEETLE.

One of the most serious insect pests up to the present time is the little black flea beetle (*Epitrix cucumeris*). These insects feed on the stems and cotyledons of the plants just as the seedlings break through the ground. If the insects are plentiful they sometimes destroy all the plants. Growers frequently fail to locate the trouble because of the small size of the insects and their habit of jumping away from the plants when disturbed. This pest is particularly troublesome if the soil forms a crust so that the insects can find protection under the crust as the seedling comes up.

Several remedies, such as ashes, ground tobacco stems, lime and insect powder have been used with varying degrees of success. If the insects are numerous, the only method of preventing the trouble is to grow the plants in coldframes where the insects can be shut out till the plants are large and tough enough to resist the attacks.

CABBAGE APHIS.

This aphis, commonly called the cabbage louse, occasionally causes serious loss. The attacks usually occur after the plants are partly grown. The lice suck the juices from the leaves and cause the leaves to curl. After this curling occurs it is difficult to get at the insects to kill them. The multiplication of these insects is so rapid that the infestation soon spreads and becomes a serious menace to the crop if not checked.

REMEDIES.

Ordinarily this pest is held in control by parasites. When the parasites do not prevent the multiplication of the lice they can be held down by spraying the infested plants with some contact poison as tobacco decoction or kerosene emulsion.

CABBAGE WORM.

The common green cabbage worms that eat the leaves of the cabbage and cauliflower are the larvae of the small yellow, white or spotted butterflies that may be seen flying over the plants during the growing season. The larvae of these butterflies are so nearly alike in appearance and habits that they are hard to distinguish and may all be treated in the same way.

Little or no attention is paid to them in the larger fields, as they seldom become numerous enough there to cause serious damage. The only effectual remedy is to dust on some form of arsenical poison, as Paris green, before the plants are too much matured. There is comparatively little danger in using these remedies on cabbage, as the head is formed from the center, so that what little poison adheres to the plant will be on the old outside leaves rather than in the edible portion of the head.

CUT WORMS.

These insects, too, are the larvae of several different species of moths. Most of these lay the eggs on plants in August or September. The larvae hatch and become partly grown during the fall, then hibernate in the soil till spring, when they are ready to eat the young plants when set. The late crop is not apt to be troubled with these insects, for at the time the plants are set the larvae have become developed, stopped eating, and have gone into the pupal stage.

Probably the best remedy is shallow, late fall plowing. This exposes

the half-grown worms to the frequent freezing and thawing and kills off the larger part of them.

THE HARLEQUIN CABBAGE BUG.

This insect is a true bug, similar to the squash bug, and feeds by sucking the juices. Where this insect is prevalent it is a serious menace to the industry because of the difficulty of combating it. The remedy is to spray with a contact poison, but the insect is difficult to combat, because of its habit of hiding among the leaves. So far the pest has not become general over the State, but has been found in a few places.

CABBAGE MAGGOT.

So far this insect, which is a serious menace to the industry in some parts of the East, has not been reported in this State. The maggot is the larvæ of a small fly. The adult lays the eggs on the young plant, near the surface of the ground, and the maggots feed in the stem of the plant under ground and destroy the plant.

FUNGUS AND BACTERIAL DISEASES

The cabbage in Colorado seems to be almost immune to fungus diseases.

Black rot of cabbage occurs intermittently. Some years the crop has been seriously affected with this disease and, the year following, the same land in cabbage did not show any signs of the disease.

CLUB FOOT.

This dreaded eastern cabbage disease is hardly known in the State. Turnips have occasionally been found affected by the fungus, so that it is probably that, because of some peculiarity of Colorado soils, such as the alkalinity, the fungus does not thrive here.

COST OF GROWING AND AVERAGE PRICE OF CROP.

The cost of growing crops necessarily depends upon the character of the soil, condition of the land, distance from market, etc., so that an exact estimate is hard to make.

The following figures are estimated on the basis of the cost of growing and marketing potatoes and sugar beets as given by the Greeley Commercial Club:

Fertilizer (10 tons per acre).....	\$ 5.00
Plowing	2.50
Leveling and harrowing.....	1.00
Seed50
Growing plants	1.80
Setting plants	6.00
Cultivation and ditching.....	2.50
Hoeing	2.00
Irrigating	1.50
Cutting and hauling.....	10.00
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	\$32.80

This cost is two dollars and twenty cents less than for potatoes, and twelve dollars and twenty cents less than for sugar beets.

Like all perishable truck crops, the price of cabbages varies inversely with the size of the crop. By far the larger part of the crop is shipped out of the State, so that local consumption makes no difference with the price. Neither does the size of the crop in the State seem to make any material difference in the price, because other competing cabbage-growing districts produce the larger part of the total output.

The following table, taken from the books of one of the potato and cabbage buyers at Greeley, shows the price paid the growers each year for a consecutive period of ten years:

Year 1899.....	\$.40 per hundred
Year 1900.....	.50 per hundred
Year 1901.....	.75 per hundred
Year 1902.....	.25 per hundred
Year 1903.....	.40 per hundred
Year 1904.....	.25 per hundred
Year 1905.....	.50 per hundred
Year 1906.....	.25 per hundred
Year 1907.....	.50 per hundred
Year 1908.....	.75 per hundred

THE COLORADO EXPERIMENT STATION.

This makes an average price for ten years of 45.5 cents per hundred pounds. The average yield per acre for the State is difficult to obtain. Theoretically, with from twelve to fifteen thousand plants to the acre, there should be a yield of five pounds per head, or from fifty to seventy-five thousand pounds per acre. In practice, only from fifty to seventy-five per cent. of the plants ever make heads. As many pounds per acre could be obtained by placing the plants much farther apart. Large heads, however, are undesirable for shipping, so the size per head is cut down by thick planting. The actual yield per acre is from fifteen to fifty thousand pounds.

The minimum yield at the average price makes a gross return of about seventy-five dollars per acre and a net return of something over forty dollars. This year some fields near Greeley have brought a gross return of \$355.25 per acre.

MARKETS AND STORING.

When the market will permit, the crop is sold direct from the field. Some seasons, however, the market at harvest time is over supplied, so that storing becomes necessary. Several methods of storing are used in various parts of the country. In any case, cabbage for storing should be left in the field as long as possible before harvesting. The heads should be dry and not frozen when handled. Undeveloped heads may be stored in trenches, the roots buried in soil and the tops covered with straw or manure as for seed. In this way many of them will make marketable heads in January or February that were soft in the fall. Mature cabbage may be cut as for market and stored in bins in the potato or onion dugouts, providing plenty of air circulation all around the cabbage is given and the temperature is kept close to the freezing point.

VARIETIES.

It has been found that cabbage, like potatoes, are more satisfactory for market if only a few well-known varieties are grown in a community. At Greeley, Winningstadt, Hollander, and Cross are grown almost exclusively.

The two former varieties are too well known to warrant a description. The true name of the latter is "Ne Plus Ultra," but is much better known as "the Cross" cabbage. This cabbage is the result of an accidental cross made in 1894 between the Winningstadt and Henderson's Excelsior Flat Dutch. These two cabbages are radically different in type, the former being decidedly conical in form and early, while the latter is late and decidedly flat in form. The Cross is as nearly as possible half way between the two parents in season and form, being medium early and nearly globular.

The originator, Mr. John Leavy, of Greeley, says: "To the growers it needs no recommendation, as they willingly paid \$10 per pound for the seed. * * * Its advantages over all the so-called standard varieties are as follows: Fine texture, more solid and compact, crispness, and a heavier yielder than any variety grown at Greeley." Though this cabbage has been grown from select seed heads since 1895, there is still a tendency to revert to one or the other of the parents. Each year, while the majority of the heads in the field will be globe-shaped, there are many that are conical or flat. This variety has never been listed on the market, except locally at Greeley and Fort Lupton, for notwithstanding the price of seed has been two or three times as high as other varieties, there has never been more than enough seed to supply the local demand.