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Cabbage

By

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and

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CABBAGE

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This bulletin contains the results of several years' experiments with cabbage; together with general cultural directions based upon the experiments. The cultural suggestions will not hold equally true in all sections of the state, but the fundamental principles are applicable to these different sections.

Time of Sowing Seed.

Cabbage, if properly hardened, will stand temperatures as low as 15 degrees above zero for brief periods. As a rule, therefore, in Alabama, cabbage grown from seed sown in October and transplanted to the field can easily be carried through the winter, and at the same time will make considerable root growth. The proper time for sowing the seed is from the middle of October to late spring. Plants produced from seed sown prior to the first of October are prone to run to seed in the early spring, instead of heading. Several times at the Experiment Station here, seed was sown as early as the last week in August, with the result that more than 50 per cent of the plants ran to seed. Sowing the seed too early gives the plant an equivalent of two growing seasons. Cabbage is a biennial. Sowing seed early in the fall gives the plant a period of active growth. The advent of cold weather then abruptly checks growth, introducing a period of rest, which practically marks off the equivalent of one season's growth. On resuming growth in the spring, the tendency is to set about seeding instead of the formation of a head.

Seed.

Great care should be exercised in securing the best seed, as the best is none too good. One may purchase poor seed with the view of saving a small sum, and on the other hand lose several hundred times that amount in the crop. It is essential that the seed be fresh, vigorous, of a pure strain and true to type, in order to

produce an early maturing crop, and be harvested in two cuttings.

The Seed Bed.

In the southern portion of the state large seed-beds are prepared in the open, while in the northern part of the state cold frames or hot-beds are used. If the seed-bed is prepared in the open it should be made in a new place each year. For the hot-bed, select an elevated place where drainage is good. A southern or southeastern slope is preferable, with a fence or building, when possible, on the north or northwest as a windbreak. A pit should be dug 10 or 12 inches deep, 6 feet wide, and long enough to accommodate as many plants as desired. Construct a frame of good heart lumber, 1½ to 2 inches thick. The board for the back should be 14 inches wide, and the one for the front 8 inches wide, with the end pieces sloping to fit. The frame should fit into the place excavated, resting on the manure. Strips of 2x4 inch material are nailed across the frame at intervals of three feet, to hold the sash. The standard sash is 3x6 feet in size, exclusive of the drip board at the foot, which projects a few inches beyond the side of the frame on the lower side. The excavation should be filled with fresh stable manure, which has been thoroughly moistened and mixed. It should be reworked each day until it heats uniformly. It is then leveled, packed down firmly and a layer of dark, rich sandy loam soil is put on top of the manure to the depth of 4 inches.

It would be rather troublesome to move the cold frame or hot-bed, so the best method would be to fill the frame with new soil each season. The soil should be taken from an area on which neither a crop nor a seed-bed of cabbage or any species of the cabbage family has grown for several years. One should take this precaution as a safeguard against disease.

The soil used for the seed-bed should be of a light, loamy character, fairly rich, and one that will not bake. It should be thoroughly pulverized, and all rocks sticks, and trash of any kind should be removed. The seed may be sown broadcast or in close drills, the latter being commonly preferred. The drills are made by using a narrow board with a straight edge. The edge of the board is pressed into the soil so as to make a furrow about three-fourths of an inch deep. Sow the

seed thinly in the furrow, and pack the soil lightly, covering the seeds from ½ to ¾ of an inch deep. As the plants break through the soil they will be greatly benefited by a light stirring of the soil along the rows. When they have put on the third leaf, or first real leaf, they should be transplanted into another bed into rows farther apart, and given at the same time more space in the rows. Four inches between rows and two inches in the rows will be ample. This transplanting enables the plants to grow more stocky, and makes them form a better root system. The plants remain in the second bed or frame until large enough to set in the field.

Plants produced under sash in mid-winter have to be hardened off before planting in the field. Grown in a hot-bed or cold frame and protected by sash, plants are quite tender when young, but may be gradually hardened to stand severe weather. To "harden off" plants, remove the sash entirely on warm days and wholly or partially close the bed at night. From day to day accustom the plants gradually to the open air, until at last the sash is left off entirely. Should there be a sudden drop in the temperature during the hardening-off period, the sash should be pushed over the frame and propped up slightly at the ends, allowing the air to pass under the sides. If properly handled, the plants can be made tough enough to plant in the field in from ten to twenty days.

Soil.

Cabbage will grow in any fairly good soil, from a light sandy to a rich alluvial bottom land, but a rich loam with a good porous clay subsoil is to be preferred. By incorproating sufficient organic matter, poor soils may be made to produce excellent crops. Unless the soil is carefully broken and prepared, good results can not be expected. One should use a good two-horse turning or disc plow, running deep enough to turn up about an inch of the clay subsoil. If the subsoil be hard, or there is found a hard-pan, fall-breaking in connection with the use of a subsoil plow is desirable.

Further preparation consists in thorough harrowing with a spiked-tooth or disc harrow until the surface is thoroughly pulverized. Lay off rows 3 to 3½ feet apart, using a shovel plow and opening out a good

furrow. The fertilizer should be strewn along in the furrow at the rate of 1,000 to 1,500 pounds per acre. Mix thoroughly with the soil by running the shovel plow in the furrow one or more times. One time will be sufficient if the soil is very loose. List on the furrows in which the fertilizer is distributed, throwing up a small ridge. Flatten the top of this ridge with a hand rake or drag a heavy piece of timber over the rows, leveling several at a time. General preparation of the land should be in the fall or at least several weeks before planting. If the land is prepared early, delay by the heavy winter rains when ready to plant may be prevented.

Planting.

The time to plant will vary greatly for the different sections of the state. Plants will be ready to set in 5 to 7 weeks from the time the seed is sown. They should be set on the south side of the ridge or bed thrown up by the shovel plow, in preference to planting on top, as this gives protection from cold northwest winds. Set plants from 15 to 24 inches apart in the row, according to the variety. The small pointed-head varieties will permit much closer planting than the large flat-head types. If the field be level, it is preferable to check the rows, so as to allow horse cultivation both ways. The check rows are 24 to 30 inches apart.

With proper precautions, the plants may be transplanted to the field with very small loss. Plants should not be transplanted on windy days, as the excessive evaporation will result in a heavy loss of plants. A still, cloudy day is best, or late in the afternoon. Transplanting should not be done unless there is plenty of moisture in the soil; otherwise moisture should be supplied artificially. Transplanting is best accomplished by one person dropping the plants, and another with a dibble setting them out as they are dropped. The plant bed should be thoroughly watered before taking up the plants. If they are to be carried some distance the roots should be dipped in a clay puddle, which will prevent them drying out. A piece of wet sheeting spread over the plants in the basket or tray, will aid in keeping them in a fresh condition. A few plants are taken at a time and set as they are dropped, in order that they may be protected as much as possible.

Cultivation.

Surface tillage may begin at once, or at least as soon as the plants have had time to establish themselves in the soil. The small tooth cultivator is the best implement, as it cultivates shallowly and finely. By running this implement twice in each middle at intervals of a week or ten days, a good, mellow mulch will be maintained. This aerates the soil and conserves moisture and also keeps down weeds. Where the rows are not laid off both ways, the hoe should be used to break up the crust between the plants and to pull a little soil to any plants that need it. The hoeing or cultivation should be frequent and thorough, but not deep, and should be continued until the plants are fairly well headed.

Fertilizers.

Cabbage soil can hardly be made too rich, but the plant food materials should be in a well balanced form. When possible a liberal application of stable manure or a green crop should be turned under in the fall previous to planting. Sufficient quantities of animal manures cannot always be secured, neither may green crops be available at the time. Commercial fertilizers must then be used instead. If used at planting time, the formula should have a reasonable quantity of phosphoric acid and potash, but not the full amount of nitrogen, that will ultimately be needed. When the plant is small it can use only a limited amount of nitrogen, while the remainder of the application might be leached out and lost. When nitrogen is applied to the soil it stimulates a succulent leaf growth. Hence, much nitrogen tends to make the young plants too tender to stand severe freezing weather. If made to grow slowly, cabbage plants will stand a temperature as low as 12 degrees F., the lowest temperature recorded at the Experiment Station during the test. Since, in maturing the cabbage crop, it is leafy growth we desire, nitrogen is necessary in the fertilizer, but most of it should be applied at the approach of the growing season rather than at planting time.

For use in the furrow at planting time let the fertilizer be what is known as a *complete* fertilizer. Such a fertilizer may be made up as follows:

Acid phosphate	437 pounds
Nitrate of Soda	375 pounds
Muriate of Potash	180 pounds

Apply at the rate of at least 1,000 pounds per acre. If there has been much leaching due to heavy rains during the winter, a second application of 400 to 500 pounds per acre of a complete fertilizer should be given several weeks later.

At the approach of the growing season, which will vary considerably in the different sections of the state, the plants should be stimulated by a side or top dressing of 75 to 100 pounds of nitrate of soda per acre. If the plants are slow about heading the top-dressing of nitrate of soda should be repeated in 15 to 20 days. Care should be exercised in the use of nitrate of soda, as an excess will cause the formation of a succulent head which will not hold up well in shipping. On the other hand, the use of potash tends towards firmness.

Fertilizer Experiments.

The table below gives some results of experiments with fertilizers at Auburn.

The complete formulas, except for Plot 4, were made up so as to analyze seven per cent. phosphoric acid; six per cent. nitrogen; and nine per cent. potash. The mixtures were applied at the time of planting, at the rate of 1,500 pounds per acre.

Formula 4 was made up of low grade materials, and contains 5¼ per cent. phosphoric acid, 4½ per cent. nitrogen, and 6¾ per cent potash, but it was applied in excess to give the same number of pounds of actual fertilizing material used in the three formulas above.

Acid phosphate and Thomas phosphate were compared, as shown on plots 3 and 5. The average for two years shows a difference in yield of 6,216 pounds per acre in favor of Thomas phosphate. Plot 5 which received the Thomas phosphate, produced the highest yield of any of the plots receiving complete fertilizers.

Note the difference in the source of nitrogen in Plots 1, 2, 3, and 4.

Plot 3, with nitrate of soda as the source of nitrogen, gave highest average yield with the highest average increase over unfertilized plot, the other ingredients being the same in kind and quantity, except slight differences seen in Plot 4. This Plot, with cotton seed

meal as the source of nitrogen, gave second highest yield with second highest increase.

Plot 1, with sulfate of ammonia as the source of nitrogen, gave an average yield of 679 pounds of cabbage per acre less than cotton seed meal (Plot 4.)

Plot 2, with dried blood as the source of nitrogen, gave the lowest average yield of the complete fertilizers, but an increase of 10,753 pounds of cabbage per acre over the unfertilized plot.

Observe that the omission of potash in Plot 6 did not decrease the yield as compared with Plot 2, where a complete formula was used. While in Plot 10, where potash was used alone, the average increase for two years was only 707 pounds per acre over the unfertilized plot.

Comparing results on plots 8, 9, 10, 11, and 12, where the several fertilizer ingredients were used singly, dried blood gave the highest average yield with the highest average increase over the unfertilized plot.

Figure 1.

On right of basket, fertilized plot.
On left, unfertilized plot. Note difference in the size of an average head from the two plots, as shown by the two heads on the top of the bushel basket.

Fertilizer Experiments with Cabbage at Auburn

Plot Number	Amount fertilizer per acre	KINDS OF FERTILIZER USED	Yields in pounds per acre				Averages	
			1912		1913			
			Yield per acre	Increase over unfertilized plot	Yield per acre	Increase over unfertilized plot	Yield per acre	Increase over unfertilized plot
	Lbs.							
1	656	Acid phosphate	27332	15982	20068	8458	23700	12220
	450	Sulphate ammonia						
	270	Muriate potash						
2	656	Acid phosphate	27105	15755	17361	5751	22233	10753
	643	Dried blood						
	270	Muriate potash						
3	656	Acid phosphate	31286	19936	18008	6398	24647	13167
	562	Nitrate soda						
	270	Muriate potash						
4	494	Acid phosphate	28224	16874	20534	8924	24379	12899
	1285	Cotton seed meal						
	218	Muriate potash						
5	583	Thomas phosphate	31585	20235	30141	18531	30863	19383
	562	Nitrate soda						
	270	Muriate potash						
6	656	Acid phosphate	27850	16500	16800	5190	22325	10843
	643	Dried blood						
7		No fertilizer—check	11350		11610		11480	
8	1285	Cotton seed meal	17248	5898	14516	2906	15882	4402
9	656	Acid phosphate	11499	149	12649	1039	12074	594
10	270	Muriate potash	13740	2390	10634	—976	12187	707
11	643	Dried blood	21354	10004	18668	7058	20011	8531
12	562	Nitrate soda	19414	8064	18524	6914	18969	7489

Co-operative Fertilizer Test at Bessemer, Ala.

This work was done under the Local Experiment Law and in co operation with the Tennessee Coal and Iron Company

The test was continued for three years. The results are shown in the following table. From the average yields for each kind of fertilizer, we derive the following conclusions regarding the values of the various fertilizer constituents used:

The use of slaked lime, even at the extremely low rate of 207 pounds per acre, in addition to a complete fertilizer, appears to have increased the yield by 2,278 pounds of cabbage per acre. (Plot 5 without lime: Plot 6 with lime.)

An application of 310 pounds of nitrate of soda per acre, in addition to acid phosphate and muriate of potash, gave an increase of 4,311 pounds of cabbage

per acre. (Plot 2 without nitrate of soda; Plot 5 with nitrate of soda.)

The use of 207 pounds of muriate of potash per acre, in addition to acid phosphate and nitrate of soda, gave an increase of 473 pounds of cabbage per acre. (Plot 4 without potash; Plot 5 with potash.)

The use of acid phosphate, at the rate of 620 pounds per acre, in addition to nitrate of soda and muriate of potash, gave an increase of 1,915 pounds of cabbage per acre. (Plot 3 without acid phosphate; Plot 5 with acid phosphate.)

An application of 885 pounds of Thomas phosphate per acre, in addition to cotton seed meal and muriate of potash, resulted in an increase of 1,021 pounds of cabbage per acre. (Plot 9 without Thomas phosphate; Plot 8 with Thomas phosphate.)

In a complete fertilizer, Thomas phosphate gave an increase over acid phosphate of 486 pounds of cabbage per acre. This increase, also noted in experiments carried on at Auburn, may have been partly or entirely due to the lime contained in Thomas phosphate. The beneficial effects of lime are indicated in Plot 6. (Plot 5 with acid phosphate; Plot 7 with Thomas phosphate.)

In whatever combination used, cotton seed meal gave better results than nitrate of soda. This would probably be expected, since all the fertilizers were applied before the plants were set. Nitrate of soda is most effective when used as a top-dressing. (a) Used with muriate of potash only, cotton seed meal gave an increase over nitrate of soda, of 3,156 pounds of cabbage per acre. (Plot 3 with nitrate of soda; Plot 9 with cotton seed meal.) (b) Used with muriate of potash and Thomas phosphate, cotton seed meal gave an increase over nitrate of soda of 1,776 pounds of cabbage per acre. (Plot 7 with nitrate of soda; Plot 8 with cotton seed meal.) (c) Used with acid phosphate only, cotton seed meal gave an increase over nitrate of soda of 441 pounds of cabbage per acre. (Plot 4 with nitrate of soda; Plot 10 with cotton seed meal.)

The fertilizer combination giving the highest yield per acre for the three years was that used on Plot 6; namely, acid phosphate 620 pounds per acre, nitrate of soda 310 pounds per acre, muriate of potash 207

pounds per acre, slaked lime 207 pounds per acre. This plot yielded at the rate of 20,909 pounds of cabbage per acre, an increase of 8,364 pounds per acre over the average of the two unfertilized plots. The fertilizer mixture used on Plot 8, which is a close second, was the following: Thomas phosphate 885 pounds per acre, cotton seed meal 650 pounds per acre and muriate of potash 207 pounds per acre. This plot yielded at the rate of 20,893 pounds of cabbage per acre, an increase of 8,348 pounds per acre over the average of the two unfertilized plots.

Note that in the two unfertilized plots in the several tests that the yields are practically the same, being much lower than any of the plots receiving a complete fertilizer.

Results obtained from both experiments at Auburn and Bessemer show that potash did not increase the yield sufficiently to warrant its use on loam or clay soils. On sandy soils, which are very deficient in potassium, this element must be included in the fertilizers applied.

Yields for Cabbage in Cooperative Fertilizer Test at Bessemer, Ala., 1912, 1913 and 1914.

Plot Number	Amount fertilizer per acre	KIND OF FERTILIZER USED	1912		1913		1914		Average	
			Yield per acre	Increase over unfertilized	Yield per acre	Increase over unfertilized	Yield per acre	Increase over unfertilized	Yield per acre	Increase over unfertilized
	Lbs.		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	----	No fertilizer	7900	----	7181	----	21612	----	12231	----
2	620	Acid phosphate	10804	2004	9778	1461	22369	1851	14320	1775
	207	Muriate of potash								
3	310	Nitrate of soda	11502	2702	15768	7451	23878	3360	16716	4171
	207	Muriate of potash								
4	620	Acid phosphate	13883	5083	16078	7761	23493	2975	18158	5613
	310	Nitrate of soda								
5	620	Acid phosphate	13302	4502	20195	11878	22397	1879	18631	6086
	310	Nitrate of soda								
	207	Muriate of potash								
6	620	Acid phosphate	13418	4618	25643	17326	23667	3149	20909	8364
	310	Nitrate of soda								
	207	Muriate of potash								
	207	Slaked lime								
7	885	Thomas phosphate	15510	6710	22654	14337	19187	—1331	19117	6572
	310	Nitrate of soda								
	207	Muriate of potash								
8	885	Thomas phosphate	16904	8104	21159	12842	24616	4098	20893	8348
	650	Cotton seed meal								
	207	Muriate of potash								
9	650	Cotton seed meal	15277	6477	22261	13944	22078	1560	19872	7327
	207	Muriate of potash								
10	620	Acid phosphate	14057	5257	20371	12054	21368	850	18599	6054
	650	Cotton seed meal								
11	----	No fertilizer	9700	----	9453	----	19424	----	12859	----
1 11	----	Average of two unfertilized plots	8800	----	8317	----	20518	----	12545	----

VARIETIES.

The Wakefield and Drumhead types are best suited for general use in the South. The Early Jersey Wakefield is one of the best early varieties, while Extra Early Pilot has matured 3 to 5 days earlier. Charleston Wakefield is the best second-early, both for home use and for market. The Drumhead and Flat Dutch varieties are best for late planting and are heavy yielders. Some of the late varieties do not head. A few varieties are briefly described below:

Extra Early Pilot.—This variety is the earliest in cultivation; heads are perfectly solid, long, conical shaped; size, small, averaging one to two pounds each;

flavor, good. It will permit much closer planting than the larger varieties, and is highly recommended for home use and for market.

Early Jersey Wakefield.—The heads of this variety are extremely solid, are conical in shape, and have few outside leaves. This variety is commonly planted for the earliest, but is several days later than Extra Early Pilot. It is a good grower, and is highly recommended for both home use and market.

Charleston Wakefield.—Heads are solid, larger and more roundish than the Early Jersey Wakefield, and a week or ten days later. The crop matures in a short period. One of the best second-early varieties for market and home use.

Figure 2.

Upper; Cross section of Charleston Wakefield cabbage.
Lower; Cross section of Early Drumhead cabbage.

Early Drumhead.—This variety makes an excellent succession for the varieties named above, being a few days later than Charleston Wakefield. Heads uniformly compact, large, broad and flattened; hence this variety requires more room than varieties producing smaller heads. It is a good shipper, and is highly recommended for home use and for market.

Flat Dutch.—Heads are very large, somewhat depressed in shape, very full and firm. There are numerous outer leaves, large and crimped. It is exceedingly hardy; matures a few days later than Drumhead; recommended for home use.

Variety tests at Auburn.

Yields in Pounds per Acre.

Name of Variety	1911	1912	1913	1914	1915
First Crop			9184		
Early Jersey Wakefield	14934	11283			11200
Volga			24890		
Grand Duke	18669	13067			19600
Flat Dutch	35842	19287			18668
Indian Summer	11896	11200			
Charleston Wakefield	10752	13769	12445		24641
Early Drumhead	28076	16800	16502		24641
Louisville Drumhead	18667	14934			
Danish Ball Head	12445	16801			
Red Rock (Failed to head)				Crop Stolen	
Selected Jersey Wakefield		11410			12842
Extra Early Pilot		10708			6933
Premium Large Drumhead		17423	21057		
Drumhead Savoy		11200			
Surehead		15764			
Large Green Glaze (failed to head)					
Succession		9707	14583		12395
Improved Brunswick		13067			
All Head Early			12246		
Victor Flat Dutch		12134			
Taits May Queen		13515			
All Season		17174	15382		15576
Early Winnigstadt		14306			

Variety tests at Bessemer, Ala.

Yields in pounds per acre.

Name of Variety	1912	1913	1914
Charleston Wakefield	14,354	21,247	17,310
Flat Dutch	14,328	7,447	24,053
Dwarf Flat Dutch		24,462	
Jersey Wakefield	13,373		
Succession	13,347	11,155	
Drumhead			26,321
Large Drumhead		28,362	
Early Winnigstadt		23,270	

Harvesting and Marketing.

Cabbages are usually harvested as soon as they have attained good marketable size, earliness being an important factor in prices. The stem is cut close up to the head, and the coarse outer leaves removed. Heads that are not sound and firm should never be shipped. The average yield of cabbage in home garden in Alabama is about three tons per acre, but much higher yields than this are frequently made. The yield in the Gulf Coast section of the state is generally from 150 to 200 100-pound crates. Prices vary from fifty cents to $2.00 per crate; there is little or no profit if the price is less than $1.00 per crate.

The package most commonly used is the square-ended , rectangular crate, 17x17x30 inches in size, which holds about a barrel or 100 pounds. In packing, care should always be taken to place the stem-end of the cabbage outward, as the stem-end is better able to resist bruising against the sides of the crate. The heads should be packed tightly into the crate, for there will always be considerable shrinkage. It is customary and advisable to mark on the outside of the crate the number of heads contained.

In many cases cabbages are shipped by express, but this is necessarily an expensive method. Growers in a community should co-operate and ship in car-lots, and thus save on the important item of transportation. When shipping in car-lots, close attention must be paid to ventilation, or there may be great loss from heating and decay in transit.

Cabbage is a good cropper. Prices are subject to considerable fluctuation, but quite often nice sums are realized from the crop. The size of the cabbage crop held over in storage in the North should be carefully considered by the southern trucker in planning his acreage of early cabbage, since a large crop stored in the North usually means low prices for the southern crop.

Insects and Diseases.

In the production of many crops, clean culture is of great importance in controlling injurious insects and diseases. This includes, in addition to the regular cultivation of any particular crop, the destruction of all nearby weeds and rubbish which may serve either as food or as hiding places. Destroy all crop remnants when the cabbage is harvested. This may be done by

burning or by plowing them under deeply. As a rule, insects which chew or suck juices from the leaves of plants, can be more easily controlled than can fungus diseases, which frequently attack the internal tissues of leaves, stems, or roots.

The cabbage louse (*Aphis brassicae*) is frequently injurious to cabbages and related plants. The best remedy is a soap solution, made as follows: Into two gallons of water, shave thinly one pound of ordinary laundry soap. Boil and stir until the soap is completely dissolved, and then add two gallons of cold water. This solution should be thoroughly and forcibly sprayed so as to completely wet the under sides of all leaves of affected plants. "Black Leaf 40," which is a nicotine extract from tobacco, is effective also for plant louse control.

Cutworms of several species are very common. These "worms" feed not only on cabbage and other garden plants, but also on grass and weeds; hence the importance of clean culture with the previous crop. Beyond this, the best remedy is poisoned bran-mash, made by thoroughly mixing while dry either one ounce of Paris green with five pounds of wheat bran, or one ounce of white arsenic with ten pounds of wheat bran, and then stirring in a mixture of cheap molasses and water until the "mash" consistency is reached. Fairly satisfactory results may be had by using the mash along the rows at each plant after the cabbage plants have been set. It is better, however, where the ground to be planted was in sod or very grassy during the preceding fall, to take action before planting is done. The soil should be well prepared and thoroughly disked to remove all green food plants that might compete with the poisoned bait, then scatter at evening, green grass, oats or clover dipped in a mixture of one ounce of Paris green in a pailful of water. The baits should be placed at intervals over the bare ground and treatment may be repeated after two or three days and before planting is done. Be careful not to allow chickens to have access to the poisoned mash.

Cabbage worms, which cause the large holes in the leaves of cabbage and related plants, can be most effectively controlled by spraying or dusting the plants prior to heading, with arsenate of lead. If applied in

dust form, one pound of arsenate of lead powder should be thoroughly mixed dry with from ten to twenty pounds of air slaked lime, or dry wood ashes, and dusted thinly on the leaves of affected plants. If a spray is preferred, use one pound of arsenate of lead powder to 50 gallons of water, and apply with spray-pump.

No danger of poisoning.—The cabbage heads from within outwards, not by a folding in of the outer leaves as is occasionally supposed. There is no danger of poisoning therefore if the remedies here suggested are used prior to the time the head is half-formed. Most of the cabbage, especially throughout the northern part of the country, is thus treated with arsenical poisons for cabbage worm control. Chemical tests have shown that it would be necessary to eat many hundred pounds of cabbage at one time to convey a poisonous quantity to a human being three weeks after the treatment is given.

The harlequin cabbage bug, or "calico-back" (*Murgantia histrionica*), which sucks sap from the leaves of cabbage and other cruciferous plants, cannot be destroyed by the use of arsenical or stomach poisons. They are also very resistant to kerosene emulsion. Clean culture and hand-picking are important measures of control. This insect is more troublesome on the late crops than on early cabbage. Mustard, planted early, or in advance of the later crops, may be used as a trap-crop. The bugs will first congregate on the mustard and deposit quantities of eggs thereon. The mustard may then be sprayed with pure kerosene, or covered with straw and burned.

Root-knot:—Roots attacked become knotty at irregular intervals. The trouble is caused by tiny worms (nematodes) which are present in old southern garden soils, especially those which are light and sandy. Since nematodes cannot live on the roots of all kinds of plants, it is possible to partly starve them out by practicing rotation of crops. Some of the plants on which nematodes do not live are corn, oats, Iron and Brabham varieties of cow-peas, peanuts, velvet beans, and crab-grass.

Club-Root:—This disease is caused by the presence of a myxomycete, *Plasmodiophora brassicae,* (a low form of plant life) within the cells of the roots, and is

apt to be confused with root knot. In club-root, however, the roots swell into larger finger-like masses or "clubs." The disease is worst in acid or poorly drained soils. The best remedy is slaked lime, applied several weeks before planting at the rate of fifty to seventy-five bushels per acre every few years. Rotation of crops is also important. Avoid plants from soils infested with the disease.

Black Rot is a serious bacterial disease, in which the cabbage plant becomes dwarfed or one-sided in growth. A cross-section of the stem of diseased plants will show a dark brown or black ring in the stem just beneath the bark. In severe cases this blackening can usually be traced upward into the cabbage head. In extreme cases, the plant may die. Plants of all ages are attacked. There is no certain method of controlling the disease, but a knowledge of the following facts may enable the grower to prevent it or to hold it partly in check. The disease may be carried by infected seed, by insects, by live stock, or by running water. It might be spread over a large area by throwing a diseased plant on the manure heap instead of burning it.

Wilt ("Yellows"), which is very common on cabbage in this state, does not affect any other crop. It is first seen in the lower outer leaves. The whole leaf may turn yellow at the margin or between the veins, later turn brown as if scorched by fire, and finally drop off. Sometimes only half of the leaf is affected while the other half remains green. This is the more usual characteristic of the disease. The lowest leaf is the first to drop off, and is followed by those above in rapid succession until the bare stock remains. Crop-rotation should be practiced, to extend over a period of 5 to 8 years.

"Damping-off" attacks young seedlings. Under certain conditions damage is often rapid and extensive. It is caused by two or more species of fungi, the spores of which occur in many old garden soils. In the seed-bed where plants are crowded, the soil kept too moist, or the humidity kept too high, with poor circulation of air and insufficient light it is most apt to appear. The young seedlings are attacked at the surface of the soil, the stems are soon girdled and the plants fall over

and die, although the tops appear healthy. Seed should not be sown in soil where "damping-off" has occurred. Do not keep the soil wet by too frequent watering. During the winter or early spring when plants are kept under sash, always water in the morning, rather than in the afternoon. Spraying with weak Bordeaux mixture, or applying road dust, fire-dried sand, slaked lime, or sulfur about the base of the plants will greatly aid in checking the disease.

Soft-Rot is a bacterial disease which enters at the root or crown and spreads rapidly throughout the whole plant. The bacteria rarely enter uninjured plants. The greatest damage is done to ripe cabbage, or those in storage. Heavy losses have been sustained where the heads were improperly stored. The disease spreads rapidly over the outer leaves, making the cabbage unsightly and affecting the market value. Avoid fields where the disease has been known to occur. Handle the crop carefully when harvesting, so as to bruise the heads as little as possible. See that the heads are dry before putting them in storage.

Related Crops.

Cauliflower, Kohlrabi, and Brussels Sprouts require practically the same treatment as cabbage, as regards soil, time of planting, and culture; except that they are somewhat more sensitive towards both the extreme cold in winter and the heat in summer. Seed should be sown in the cold frame the middle of October, and the young plants hardened off until January, when they should be transplanted into rows in the field. They must be started early enough in the field to avoid the heat of early summer. One of the best varieties of Cauliflower is Early Snowball; of Kohlrabi, White Vienna; of Brussels Sprouts, Long Island.

Collards and Kale are so commonly and so easily grown that no discussion of their culture seems necessary.