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CABBAGE GROWTH STAGES

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INTRODUCTION

Terminology describing crop growth stages of many commodities is often regional and can vary greatly among growers and others involved in agriculture. This lack of standardization can easily lead to misunderstandings and mistakes in crop management. To overcome this problem, the growth stages of such crops as corn, wheat, soybeans, and sugar beets have been described and given specific terms to which anyone involved in production can refer (2).

Presently there is no standard terminology for describing cabbage growth stages. Although terminology such as "head formation" and "cupping" does exist, it can be ambiguous and confusing if not properly defined. More accurate descriptions and precise terminology of cabbage growth stages would be useful to those involved in cabbage production to standardize the timing of agronomic and pest control events relative to crop growth.

Accurate cabbage growth stage descriptions would be particularly useful in pest management, since plant susceptibility to cabbage pests varies with the crop stage and pesticide treatments must be applied accordingly. For example, treatment thresholds for control of the major caterpillars on cabbage [diamondback moth, *Plutella xylostella* (L); imported cabbageworm, *Pieris rapae* (L); and cabbage looper, *Trichoplusia ni* (Hubner)] larvae have been developed according to crop growth stages (1). However, these crop growth stages must be well defined and understood by growers, researchers, extension agents, and agribusiness personnel if treatment thresholds are to be used effectively.

This publication describes cabbage growth in terms of specific growth stages with appropriate terminology for each stage. Furthermore, we describe the susceptibility of these different stages to damage from various insect pests, diseases, and physiological disorders in New York.

SUSCEPTIBILITY OF GROWTH STAGES TO CABBAGE PESTS

Various pest species (insects and diseases) that attack cabbage may or may not cause economic injury depending on the growth stage of the plant. Preventing crop injury by implementing a control practice (usually a pesticide) is only economically justified if the benefit from implementing the practice is greater than the cost of the practice. An economic loss in cabbage marketability can be reflected in either weight or grade. For fresh market cabbage the grade could be reduced if even slight damage occurs on the wrapper leaves or head. In stages 1-6, however, the wrapper leaves are not yet present, and damage need only be prevented if a loss in head weight (yield) is expected.

The grade of processed cabbage (sauerkraut) is seldom affected by foliage feeding insect pests because all the green leaves, regardless of insect injury, must be trimmed from the head before it is processed into sauerkraut (3); therefore, only a potential reduction in head weight would make a pesticide treatment worthwhile. In upstate New York, normal populations of foliage feeding cabbage pests do not play as important a role in reducing yield as do soil and climatic factors (4). Additionally, as the plant produces more leaves it can withstand more insect damage without yield loss.

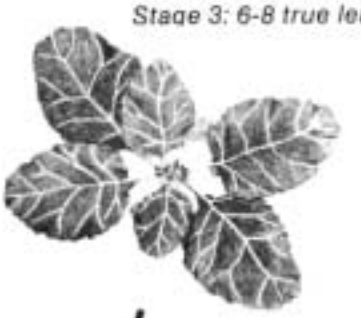
This is the rationale for proposing different treatment thresholds at different crop stages for larvae of the diamondback moth, imported cabbageworm, and cabbage looper (Table 1).

Some pests, because they are present throughout the season can attack cabbage at any growth stage, but only affect cabbage grade or yield at susceptible growth stages. Other pests (diseases, thrips, tipburn)

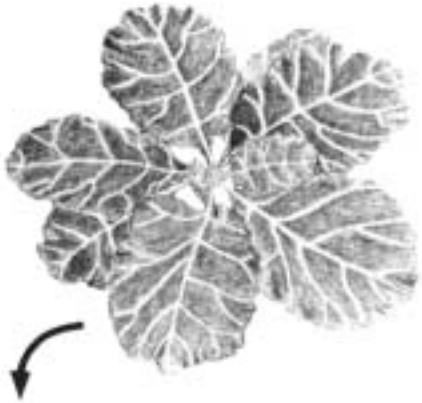
Stage 1: Cotyledon (seed leaves). No true leaves present.

Stage 2: Seedling. Up to 5 true leaves.

Stage 3: 6-8 true leaf.



Stage 4: 9-12 true leaf. Base of stem still visible from above.



Stage 5: Precupping (approximately 13 to 19 leaves). By the end of this stage, the base of the stem and the bases of all leaves are concealed when the plant is viewed from above. The innermost heart leaves are growing in an upright fashion and are visible without moving any of the surrounding leaves.

*These are generalized based on the cultivar actual number of leaves occurring in stages 5 vary according to variet fertilization.

Stage 6: Cupping (approximately 20 to 26 leaves). The innermost heart leaves, which are still growing in an upright fashion, are concealed by the larger, older leaves surrounding them. All visible leaves will later become the frame leaves (leaves not touching the mature head) of the mature plant.

Stage 9: Mature (approximately 6-12" diameter head). No new visible leaf production will occur after the head has attained maximum hardness and size. The head is ready for harvest and may split if not harvested in time.

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Stage 8: Head fill (approximately 3-8" diameter head). A firm round head is visible within the wrapper leaves (the 4 outer loose leaves that touch the mature head). The head has not yet fully developed and thus, is not of harvestable size.

Stage 7: Early head formation (approximately 2 1/2-4" diameter head). The inner heart leaves, now quickly developing as a ball-like structure of overlapping leaves, are concealed by the surrounding larger leaves. These leaves do not press tightly against the developing head and will later unfold to become frame leaves.

Table 1.—Treatment thresholds for control of diamondback, imported cabbageworm, and cabbage looper larvae based on cabbage growth stages.[1]

Growth Description	Cabbage Growth Stage	Treatment Thresholds Expressed as Avg. Larval Units/Plant[2]	
		Sauerkraut	Storage/Fresh
Early Vegetative[3]	Stage 4 - 5	0.50	0.50
Cupping	Stage 6	1.30	1.30
Early Head Formation	Stage 7	1.75	0.50
Late Head Formation	Stage 8 - 9	2.50	0.50

1/ Treatment may be necessary sooner than stated above if larval feeding is directly on inner heart leaves or developing head, and/or cabbage growth is poor.

2/ Equivalent to 1 larval unit:
1.0 large (longer than ⟵) cabbage looper
1.5 small (shorter than ⟵) cabbage loopers
1.5 large (longer than ⟵) imported cabbageworms
10.0 small (shorter than ⟵) imported cabbageworms
10.0 diamondback moth larvae of any size

3/ Stricter control will be required in the stages prior to "Early Vegetative."

may occur at specific growth stages and may cause different degrees of damage depending on variety. The following descriptions serve as a guide to the time when potential injury from the usual cabbage pests may occur at specific growth stages in upstate New York.

Stage 1: Cotyledons.—Flea beetles are the most important problem during the cotyledon stage, causing small "shot" holes in the cotyledons and stems and sometimes cutting the stem. Besides cutworms, other insect pests are usually not present. Diseases such as black leg and black rot are very hard to detect at this stage and often go unnoticed.

Stage 2: Seedling.—Flea beetle feeding may still be damaging. Cabbage maggot injury to the roots or hypocotyl region is likely to appear at this stage and/or later and could kill **the** young seedling. Diamondback moth and imported cabbageworm larvae can occasionally be found on plants at this stage depending on time of planting. Symptoms of black rot or black leg may show up in this or any succeeding growth stage. Seedlings with 5-6 true leaves would be adequate for transplanting, if growing conditions are ideal.

Stage 3: 6-8 true leaf.—Flea beetle feeding becomes less important as the plants get larger. Cabbage maggots could still cause serious root injury. Larvae oi the diamondback moth and imported cabbageworm may feed on the heart leaves and cause damage. Plants in this stage are better suited to withstand adverse growing conditions when transplanted than the smaller seedlings.

Stage 4: 9-12 true leaf.—Flea beetle feeding damage is usually not harmful to the plant at this and succeeding stages. Maggot injury is less important as the roots become better established. Diamondback moth, imported cabbageworm, and cabbage looper (Lepidoptera) larvae may be present and could require control measures.

Stage 5: Precupping.—At this, and succeeding stages, cabbage maggots will only reduce yield if the infestation is severe or if plants are under drought stress. This stage is not susceptible to thrips injury, but during the early cupping stage thrips may become protected by the cabbage leaves if they are feeding in the heart leaves. Thus, control measures may need to be implemented at the end of the precupping stage to suppress developing thrips populations. Lepidopterous larval population densities may reach treatment thresholds. **Stage 6: Cupping.**—Thrips can become protected in the heart leaves starting at this stage, thus making topically applied insecticides with no systemic activity ineffective. Lepidoptera may reach treatment thresholds.

Stage 7: Early Head Formation.—Thrips can reproduce and cause damage in the developing head. Lepidoptera may reach treatment thresholds. Wrapper leaves begin to appear and must be protected from foliage feeding insects, alternaria, downy mildew, and sclerotinia in storage and fresh market cabbage. Secondary black rot infection may occur and may warrant control in wet conditions.

Stage 8: Head Fill.—Thrips can reproduce in the head where they are protected from insecticides. Storage and fresh market cabbage must be protected from foliage feeding insects as the wrapper leaves and head could be damaged; however, only severe infestations would affect the grade of processing cabbage. New infections of black rot may not affect the head but may cause spotting of the wrapper leaves. Storage and fresh market cabbage should be protected from the diseases alternaria, downy mildew, and sclerotinia. Tipburn and black petiole could result from unfavorable growing and nutritional conditions during this stage.

Stage 9: Mature.—Storage and fresh market cabbage must be protected from alternaria, downy mildew, sclerotinia, and foliage feeding insects. Black rot symptoms are inconsequential to yield, but may affect the marketability of cabbage. Yield or grade of processing cabbage is affected only by a severe infestation of any pest.

REFERENCES CITED

1. Anonymous. 1981. New York State Pesticide Recommendations (Redbook), Cornell University, Ithaca, N. Y. 422 pp.
2. Russell, H. L., S. H. Gage, and T. H. Prokrym. 1981. Cooperative Crop Monitoring System Manual. Michigan State University, East Lansing, Ml.
3. Shelton, A.M. and J. T. Andaloro. 1982. Effect of lepidopterous larval populations on processed cabbage grades. J. Econ. Entomol. 75: 141-143.
4. Shelton, A. M., J. T. Andaloro, and J. Barnard. 1982. Effects of lepidoptera on fresh market and processing cabbage. J. Econ. Entomol. 75:742-745.

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