

# Association of Common Ragweed with Sclerotinia Rot of Cabbage in New York State

H. R. DILLARD, Assistant Professor, and J. E. HUNTER, Professor, Department of Plant Pathology, New York State Agricultural Experiment Station, Cornell University, Geneva 14456

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## ABSTRACT

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Sclerotinia rot of cabbage caused by *Sclerotinia sclerotiorum* was observed in the field in close association with a known susceptible weed host, common ragweed (*Ambrosia artemisiifolia*). Ragweed flower parts and whole plants were infected with *S. sclerotiorum* and bridged the infection to cabbage. In laboratory tests, ascospores of *S. sclerotiorum* infected male ragweed flowers and fruits, and cabbage leaves became infected when in contact with these infected tissues. Ragweed pollen alone served as a substrate for *S. sclerotiorum* but only resulted in leaf infections of cabbage when present in large clumps. Ascospores did not infect ragweed or cabbage leaves without an exogenous food base.

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About 4,400 ha of cabbage (*Brassica oleracea* L. var. *capitata*) are grown in New York State for sauerkraut, storage, and fresh market. In 1984, Sclerotinia rot, caused by *Sclerotinia sclerotiorum* (Lib.) de Bary, was unusually serious in the central and western regions of the state. The disease can cause serious losses in the field, in storage, and under transit and market conditions (15,16). Walker (17) reported that the vegetative cabbage crop is usually affected in the field after midseason and that the fungus advances

up the main stem from the soil, causing a soft cortical rot that eventually advances to the cabbage head. McLean (8), however, emphasized that *S. sclerotiorum* infections of cabbage seed plants in Washington State occurred beneath fallen senescent cabbage petals. Further studies (9) showed that the extent of infection in cabbage seed plants was related to the frequency of precipitation during the flowering period, which caused the blossom parts to adhere to the foliage. McLean (9) also showed that cabbage blossoms may become infected before they fall but did not speculate on the importance of this phenomenon.

Although infections may occur on the stem at the soil line, on the foliage at their bases, or where the foliage comes in contact with the soil (12,17,18), we observed infections originating at the top or on the sides of midseason to mature

cabbage heads. Infected areas first appeared as water-soaked spots and soon became covered by white, cottony mycelial growth. The host tissue became soft and watery as the disease progressed. The fungus eventually colonized the entire cabbage head, and large black sclerotia were produced on diseased tissue.

Infections were initiated on the upper part of cabbage heads in New York State; therefore, ascospores were assumed to be the primary inoculum. Because ascospores of *S. sclerotiorum* cannot invade healthy green tissues directly without an exogenous supply of nutrients (2,3,11,13), our objective was to identify such nutrient sources in cabbage fields. Although there appeared to be more than one naturally occurring source of nutrients in the field, the most frequently observed source was common ragweed (*Ambrosia artemisiifolia* L.), a known host of *S. sclerotiorum* (10,14). Details of field observations and laboratory experiments are reported in this paper.

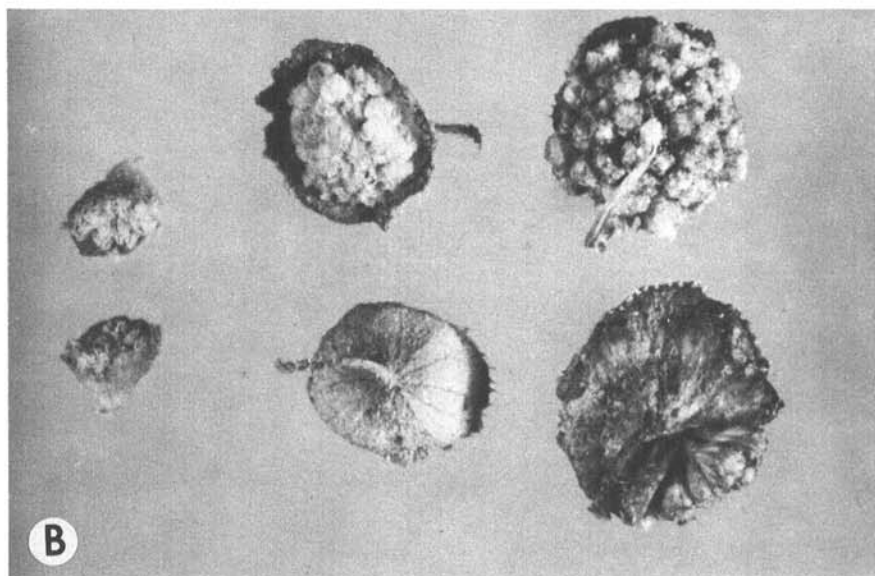
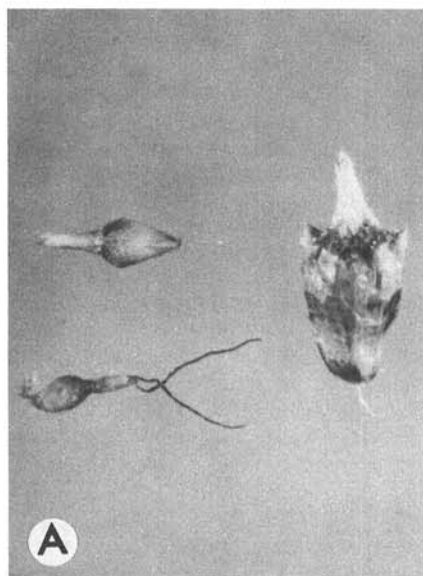
## MATERIALS AND METHODS

Twenty-two fields in four counties were examined for presence of characteristic symptoms of Sclerotinia rot. Selected cabbage plants were brought to the laboratory, and mycelial fragments, sclerotia, and water-soaked lesions were placed on Difco potato-dextrose agar (PDA) to verify the presence of *S.*

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**Fig. 1.** Common ragweed parts used as an exogenous nutrient source by *Sclerotinia sclerotiorum* for infection of cabbage leaves. **(A)** (Left to right) Small green achenes and mature achene. **(B)** (Left to right) Pollen-producing staminate involucres, senescing staminate involucres, and senescent staminate involucres.

*sclerotiorum*.

Several cabbage fields were infested with high populations of ragweed. Ragweed flower parts and whole plants were collected, and suspected lesions were surface-sterilized in 10% Clorox for 1 min and placed on PDA to verify infection by *S. sclerotiorum*. A detached cabbage leaf assay was developed to determine the ability of ragweed flower parts to serve as an exogenous nutrient source for ascospore infection of cabbage. In the first three trials, inoculated leaves were placed on wire racks in plastic crisper boxes and held in a mist chamber at 22 C. This method provided excessive moisture and encouraged invasion by secondary organisms. To avoid this problem, the following petri plate method was developed and used for all results reported.

Excised leaves from 8-wk-old cabbage plants were placed in plastic petri plates (100 × 15 mm) on moistened Whatman No. 1 filter paper. Ragweed plant parts and bean blossoms were inoculated by placing them directly over apothecia produced in petri dishes in controlled-environment chambers (1). When the petri dish tops were removed, the ascospores were forcibly discharged into the air surrounding the ragweed or bean tissues (7). The inoculated plant parts were then placed individually on single cabbage leaves in petri plates. Plates were opened in a mist chamber, and a thin film of moisture was allowed to form on the surface of the plant parts. The plates were then covered, sealed with Parafilm, and incubated at 22 C. The ragweed parts used in this study were pollen-producing staminate involucres, senescing staminate involucres, senescent staminate involucres, ragweed pollen clumps, green achenes, mature achenes, green ragweed leaves, and green ragweed leaves + snap bean



**Fig. 2.** Cabbage plants infected with *Sclerotinia sclerotiorum* where contact occurred (arrows) with previously infected common ragweed plants in the field.

blossoms previously infected with *S. sclerotiorum* (Fig. 1). Two additional treatments were cabbage leaves without an exogenous energy source and cabbage leaves with snap bean blossoms, which are known to be an excellent substrate for *S. sclerotiorum* (3). All treatments were compared with uninoculated controls. Leaves were rated for disease incidence 7 and 12 days after inoculation. Ragweed flower parts and snap bean blossoms were surface-sterilized with propylene oxide overnight before use to avoid contamination with other fungi. Cabbage leaves were not surface-sterilized. The experiment was repeated four times, and each treatment was replicated five times, except the ragweed pollen treatment, which was replicated three times.

**RESULTS AND DISCUSSION**

*Sclerotinia* rot of cabbage frequently was associated with field infestations of common ragweed in New York State. Ragweed flower parts often were infected with *S. sclerotiorum*, and these appeared to provide the required exogenous nutrients for the fungus to infect whole ragweed plants. Cabbage plants in contact with infected ragweed male flowers, fruits, or whole plants subsequently became infected (Fig. 2).

The excised cabbage leaf assay confirmed field observations (Table 1) and verified the need for a readily available energy source for infections by *S. sclerotiorum* to occur. All three ages of ragweed male flowers that were tested (pollen-producing staminate involucres,



Fig. 3. Dislodged achenes and male flowers adhering to cabbage leaves (arrows) in the field. Center arrow points to a dislodged male flower in the middle of a lesion caused by *Sclerotinia sclerotiorum*.

Table 1. Effects of exogenous nutrient sources on infection of cabbage leaves by *Sclerotinia sclerotiorum*

Nutrient source <sup>a</sup>	No. of infected leaves/no. inoculated <sup>b</sup>
Ragweed pollen-producing staminate involucre	5/5
Ragweed senescing staminate involucre	5/5
Ragweed senescent staminate involucre	5/5
Ragweed leaf + snap bean blossom	5/5
Snap bean blossom	5/5
Ragweed green achenes	3/5
Ragweed mature achenes	3/5
Ragweed pollen	2/3
Ragweed leaf	0/5
No nutrient source	0/5

<sup>a</sup> Inoculated with ascospores and placed on a detached cabbage leaf in a closed moist chamber.

<sup>b</sup> All uninoculated nutrient sources remained healthy.

senescing staminate involucre, and senescent staminate involucre) supported growth of *S. sclerotiorum* and bridged the infection to cabbage. Pollen is a rich source of nutrients and has been reported previously to stimulate germination of conidia of *Botrytis cinerea* (5). Ragweed pollen alone could serve as a substrate for *S. sclerotiorum*, but it only resulted in leaf infections when present in large clumps. Ragweed pollen is sticky when first formed, and when shed, it tends to remain in clumps that may fall and spot the leaves and stems with yellow patches (6). Greatest release is in the early morning, and ragweed pollen clumps that fall on dew-covered cabbage leaves may remain intact in sufficient quantity to support the growth of *S. sclerotiorum*. The two growth stages of ragweed fruit

that were tested (green achenes and mature achenes) were able to serve as intermediaries for infection of cabbage leaves. Healthy green leaves of ragweed or cabbage could not serve as a food base for ascospores; however, when snap bean blossoms were inoculated and placed on cabbage or ragweed leaves, the leaves became infected.

The importance of an exogenous nutrient supply for ascospores of *S. sclerotiorum* to infect healthy green tissues has been discussed previously for other hosts (2,11,13). Moreover, McLean (8,9) stressed the importance of cabbage blossoms for infections of cabbage seed plants in Washington State and proposed that infections were related to the frequency of precipitation during the flowering period because the moisture caused the blossom parts to adhere to the cabbage foliage. In the field, the dislodged ragweed achenes and male flowers on cabbage leaves adhered to the leaves against gravity (Fig. 3).

Cabbage is planted in May and June in New York State and harvested from August through October. Normally, *Sclerotinia* rot occurs on less than 5% of the crop. The 1984 growing season was unusually wet, however, and 28.4 cm of rainfall occurred between 15 July and 15 September, whereas the average rainfall for that same period for the preceding 3 yr was only 12.2 cm. The abundant precipitation occurred during the ragweed-bloom and cabbage head-formation period and during the time of year when heavy dews are most likely to form. Thus ideal environmental conditions for *Sclerotinia* rot of cabbage were present and normal cultivation for control of weeds was prevented.

In Florida, Moore et al (10) reported that ragweed harbored and increased *Sclerotinia* rot in and around cultivated

fields and suggested that ragweed perpetuates the fungus. We have further characterized the intimate relationship between *S. sclerotiorum*, common ragweed, and cabbage in fields in New York State. Because of the extremely large host range of *S. sclerotiorum* (4,14) on cultivated crops and weeds, there are undoubtedly several additional weed species that can bridge *S. sclerotiorum* infections to cabbage. Thus control of *Sclerotinia* rot in cabbage fields may require better weed control or the use of foliar fungicides during the weed-blooming period; however, timing of fungicide sprays for control of *Sclerotinia* rot of the vegetative cabbage crop has not been studied.

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