OCCURRENCE OF SCLEROTINIA WILT OF SUNFLOWER AND PRELIMINARY RESULTS ON BREEDING FOR RESISTANCE

G. N. FICK and T. J. GULYA*

INTRODUCCION

Sunflower (*Helianthus annuus* L.) production in the United States has increased from less than 90,000 hectares in 1970 to an estimated 2.3 million hectares in 1979. This rapid expansion has resulted in intensive cultivation of sunflower in much of Minnesota and the Dakotas with short intervals between sunflower crops. Researchers and growers alike have become increasingly concerned about the occurrence and possible build-up of certain soilborne diseases, especially Sclerotinia wilt incited by *Sclerotinia sclerotiorum* (Lib.) de Bary.

Sunflower and several other crops important to the region are hosts for Sclerotinia, as are many common weed species (5). The main phases of the disease on sunflower in this area are root stem infections usually appearing near flowering time and resulting in wilting of leaves and sudden death of plants. At present crop rotation with non-host crops and control of weed hosts are recommended as the primary means of control. Genetic differences in susceptibility have been reported (2), but all current varieties are considered susceptible. Information on the occurrence of Sclerotinia wilt, and on the relative susceptibility of common weeds, could help to identify areas where disease control measures are needed and to recommend management practices that might aid in Sclerotinia control. Genetic resistance woul be a useful control measure but only limited data are available as to whether resistant varieties can be developed. This paper presents information on the severity of Sclerotinia wilt in Minnesota and the Dakotas, the relative susceptibility of commonly occuring weed species, and preliminary results on breeding for resistance.

* SIGCO Research, Breckenridge, MN and U.S.D.A., SEA, AR Fargo, ND.

MATERIALS AND METHODS

Ninety-seven sunflower fields representing 6250 hectares in the major production areas of North Dakota, Minnesota and South Dakota were inspected for the occurrence of Sclerotinia wilt during the first two weeks of September, 1979. The fields were selected on the basis of their location at or near 47 sites laid out on a 48 km^2 grid system. In each field a minimum of 500 plants on a diagonal line through the field were examined, and percent of Sclerotinia infected plants estimated. In fields with isolated areas of infected plants, the affected area was estimated as a percentage of the total area of the field.

To obtain information on susceptibility of various weeds the number of both healthy and infected plants of sunflower and eight weed species were recorded from severely infected areas of one field in southeastern ND. Plants were identified as infected with Sclerotinia on the basis of wilting, a soft necrotic lesion, and white mycelium and sclerotia on or in the stem.

The relative susceptibility of 50 hybrids, open-pollinated varieties, and inbred lines of sunflower was determined by planting in a naturally infested field having a 10-year history of severe Sclerotinia infestation on sunflower and dry beans (*Phaseolus vuglaris* L.). Each entry was planted in two-row plots, 7 m long, with four replications. Number of days to flower plant height, percent lodging, and percent plants infected with Sclerotinia (6 weeks after flowering) were recorded for each plot. Reactions of the entries to downy mildew (*P. halstedii*), Verticillium wilt (*V. dahliae*) and early ripening were on the basis of pedigree and previous evaluations.

RESULTS AND DISCUSSION

Sclerotinia wilt was observed in 32 of 97 or 33% of the sunflower fields that were inspected. Most infected fields had only a trace of Sclerotinia estimated at less than 0.5% (Table 1). The highest level of infection was 25%, and average infection over all fields was 1.2%. Infected fields were most common in the Red River Valley area of eastern ND and western MN where the history of sunflower production and other susceptible crops is the longest. The higher incidence of Sclerotinia wilt in this area agrees with other survey information obtained in 1979 which showed infection in 105 of 184 fields in west

central MN (4). Rotation with non-host crops may be especially important in these areas to prevent future build-up of Sclerotinia.

Analysis of soil samples taken from Sclerotinia infected areas of the surveyed fields showed no apparent relationship between disease incidence and the soil parameters of textural class, organic matter, or pH. This supports the view that the most significant component of soil affecting survival of sclerotia is biological (1).

Infection percentages of sunflower and eight weed species from severely infected areas of one field in southeastern ND showed that several commonly occurring weeds were highly susceptible to Sclerotinia (Table 2). All weeds were less susceptible than sunflower, with wild mustard, Canada thistle, giant and common ragweed showing infection percentages ranging from 17 to 42%. Lambsquarters, kochia, pigweed, and foxtail were resistant with few or no plants infected. It is likely that some of these weeds, especially wild mustard which occurs very commonly in the area, are a significant factor in the spread and survival of Sclerotinia. Control of weed hosts thus appears essential for effective control of Sclerotinia wilt.

Highly significant differences in susceptibility to Sclerotinia were found among the 50 sunflower hybrids, varieties, and inbred lines evaluated. Infection ranged from 4 to 33% with an average of 19%. Although the data are from only one year of evaluation they were in general agreement with preliminary results obtained for some of the same entries tested in 1978 ($r = 0.43$).

Relative susceptibility to Sclerotinia was not closely correlated with days to 50% flowering ($r = 0.05$) nor to plant height ($r = 0.04$). Percent Sclerotinia infection was significantly correlated with percent stalk lodging ($r = 0.32$) which would be expected since lodged plants were likely weakened by root infection. No apparent relationship existed between Sclerotinia infection and reaction to downy mildew, Verticillium wilt or early ripening. Thus, among the traits evaluated there did not appear to be an association that would either impede or aid materially in selecting for Sclerotinia resistance.

Among the entries evaluated for Sclerotinia resistance were 20 hybrids produced using 11 lines as female parents and 6 lines as male parents. Infection percentages of the female and male parents ranged from 4 to 33% and 20 to 28%, respectively, all of the latter being considered relatively susceptible. To determine if the differences among the female parents were transmitted to their hybrids, the female parent-offspring regression was calculated. The resultant regression coefficient of $b = 0.31$ suggested that the differences were in fact heritable although at a relatively low level.

The results indicating differences in resistance support previous observations that significant variation exists among sunflower genotypes for Sclerotinia infection (2,3). The indication that these differences are heritable is encouraging and suggests that it should be possible to develop hybrids or varieties with an improved level of resistance.

ACKNOWLEDGEMENTS

We acknowledge the assitance of Virgil Jons and Robert MacArthur in obtaining the survey data, and Gordon Auwarter in collecting the data on weed species and sunflower genotypes.

TABLE 1

Severity of Sclerotinia Wilt in Sunflower fields in North Dakota, Minnesota and South Dakota in 1979

Percentage infection	Number of fields
None	65
Trace (<0.5)	16
1-2	8
5-10	6
>10	2

TABLE 2

Number of total plants and percentage of plants of sunflower and several weed species infected with Sclerotinia

Name of species	Total Plants	% Sclerotinia infected
Sunflower *(Helianthus annuus* L.)	272	92
Wild mustard *(Brassica kaber* (DC.))	1269	42
Canada Thistle *(Cirsium arvense* (L.) Scop.)	159	32
Giant Ragweed *(Ambrosia trifida* L.)	73	23
Common ragweed *(Ambrosia artemisiifolia* L.)	12	17
Lambsquarters *(Chenopodium album* L.)	48	4
Kochia *(Kochia scoparia* (L.) Roth)	136	0
Pigweed *(Amaranthus retroflexus* L.)	17	0
Foxtail *(Setaria viridis* (L.) Beauv.)	42	0

ABSTRACT

Surveys of sunflower (*Helianthus annuus* L.) fields in Minnesota and the Dakotas in 1979 showed that Sclerotinia wilt (*Sclerotinia sclerotiorum* (Lib.) de Bary) was present in about one-third of the fields that were inspected, but generally affected a very low percentage of the plants. Several commonly occurring weed species were identified as highly susceptible to infection from Sclerotinia, thus suggesting the need for good weed control in crop rotation schemes designed to reduce the incidence of the disease.

Significant differences in disease severity were found among inbred lines and hybrids in trials conducted on naturally infested soils. The relative susceptibility to Sclerotinia wilt was not closely related to days to flower or plant height, nor to susceptibility to downy mildew (*Plasmopara halstedii* (Farl.) and de Toni), Verticillium wilt (*Verticillium dahliae* Kleb.) or early ripening (*Fusarium* spp.). Selection of breeding lines and development of hybrids with an improved level of tolerance to Sclerotinia wilt appear feasible.

REFERENCES

(1) Adams, P. B. and W. A. Ayers, 1979. Ecology of Sclerotinia species. Phytopathology 69: 896-899.

(2) Fick, G. N., 1979. Breeding and genetics. p. 279-338. In J. F. Carter (ed.) Sunflower Science and Technology. ASA, 677 S. Segoe Road, Madison, WI 53711.

(3) Putt, E. D., 1958. Note on differences in susceptibility to Sclerotinia Wilt in sunflowers. Can. J. Plant Sci. 38: 380-381.

(4) Sederstrom, S., 1979. Sunflower crop pest management summary for 1979. University of Minnesota, West Central Experiment Station mimeo.

(5) Zimmer, D. E. and J. A. Hoes, 1978. Disease. p. 225-262. *In* J. F. Carter (ed.) Sunflower Science and Technology. ASA, 677 S. Segoe Road, Madison, WI 53711.