RESPONSE OF SUGAR BEET CULTIVARS TO APHANOMYCES AND RHIZOCTONIA ROOT ROTS UNDER OPTIMUM CONDITIONS IN THE GREENHOUSE

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ABSTRACT

Rhizoctonia root and crown rot has been present in western Nebraska for many years, and is considered the most widespread and consistently damaging disease of sugar beets in the state. Aphanomyces root rot has been more recently reported in Nebraska, but its known incidence and distribution has rapidly expanded. It is also becoming more common to find both diseases occurring simultaneously in fields. Resistant cultivars are available for both diseases, but no one cultivar with resistance to both has been developed for use in the Central High Plains. Therefore a greenhouse study was begun to investigate the response of a *Rhizoctonia*-resistant (Betaseed 4546) cultivar and an *Aphanomyces*-resistant (Crystal 205) cultivar, each planted into soils infested with *A. cochlioides*, *R. solani*, and both pathogens combined. The experiment was conducted in controlled temperature boxes at a constant rhizosphere temperature of 27 C for 3 months. Data collected prior to harvest included seedling mortality and stand establishment, and leaf area and dry weights at 10 leaf stage. At harvest, taproots were rated for disease severity on a scale of 0-4, and dry weights were obtained from foliage and roots. Seedlings from treatments including *Rhizoctonia* alone and combined with *Aphanomyces* began dying within a week of emergence, whereas disease due to *A. cochlioides* was not apparent until 2-3 weeks after emergence. *Rhizoctonia solani* also caused more severe damage to plants, as measured by disease ratings and dry plant weights. In general, Betaseed 4546 responded better to both diseases than did Crystal 205. Because *R. solani* appears to be more aggressive and causes more extensive damage to plants than *A. cochlioides*, it may be more important for growers to place an emphasis on managing Rhizoctonia root rot in situations where both pathogens are present simultaneously.

INTRODUCTION

Rhizoctonia solani Kuhn, the pathogen that causes Rhizoctonia root and crown rot of sugar beet, has been present in Nebraska for many years. This disease is well known to producers and is considered to be the most widespread and consistently damaging sugar beet disease in this area (Harveson et al. 2002). Aphanomyces root rot, caused by *Aphanomyces cochlioides* Drechs. has been more recently identified from Nebraska sugar beet fields (Harveson 2000), and the incidence and known distribution of the disease has rapidly expanded over the last several years. It is also becoming more common to find both pathogens occurring simultaneously in production fields. Due to their soilborne nature, both pathogens are difficult to manage, however, genetic resistance is likely to prove the most practical technique for effectively reducing sugar beet yield losses. Resistant cultivars are available for both pathogens, but no one cultivar with resistance to both has been developed for the Central High Plains growing region. Therefore, in an attempt to investigate methods for managing both diseases simultaneously, a study was begun to determine the response of *Rhizoctonia*-resistant and *Aphanomyces*-resistant cultivars to both pathogens, individually and combined.

MATERIALS AND METHODS

The study was conducted in the greenhouse in environmentally controlled growth chambers at a constant rhizosphere temperature of 27 C for a period of 3 months. PVC tubes (30 cm in length) were filled with unsterilized field soils, and artificially infested with *A. cochlioides*, *R. solani*, and both pathogens combined. Two cultivars – Betaseed 4546 (*Rhizoctonia*-resistant) and Crystal 205 (*Aphanomyces*-resistant) were planted into pathogen- treated and - untreated control soils. Each treatment was replicated 9 times for a total of 72 treatments per growth chamber.

Final seedling stand counts were made approximately one month after emergence. Diseased seedlings were assayed to confirm identity of pathogen. Prior to harvest, data collected included leaf area and fresh weights of newest fully expanded leaves from each entry at the 10 true leaf stage (Tab. 1). At harvest, data collected included a root disease severity index, dry weights of crown and foliage, and dry root weights (Tab. 2). The soil core from each tube was divided in half, and washed. All roots from both halves were collected separately and allowed to air dry before being weighed.

RESULTS

It was surprising to observe that *R. solani* was more aggressive on seedlings than *A. cochlioides*, irrespective of the cultivar used. Those soil treatments containing *Rhizoctonia* exhibited symptoms and began dying within one week of emergence, whereas no evidence of disease due to *Aphanomyces* appeared until 2-3 weeks after emergence. After one month, any treatment with *Rhizoctonia* resulted in significantly lower stand counts than with *Aphanomyces* (Fig. 1).

Rhizoctonia also tended to cause a greater degree of damage overall to plants than *Aphanomyces*, particularly as measured by the root disease index and dry root weights (Tab. 2). Not surprisingly, the treatments containing both pathogens combined, in general, caused a greater degree of damage for many parameters compared to each pathogen alone. It was also noted that the *Rhizoctonia*-resistant cultivar (B4546) responded better to *A. cochlioides* infection than the *Aphanomyces*-resistant cultivar (C205) did to infection by *R. solani*. This was true with both the seedling and root rot disease phases.

Fig. 1. Final stand of 25 planted seeds of cultivars taken one month after emergence.

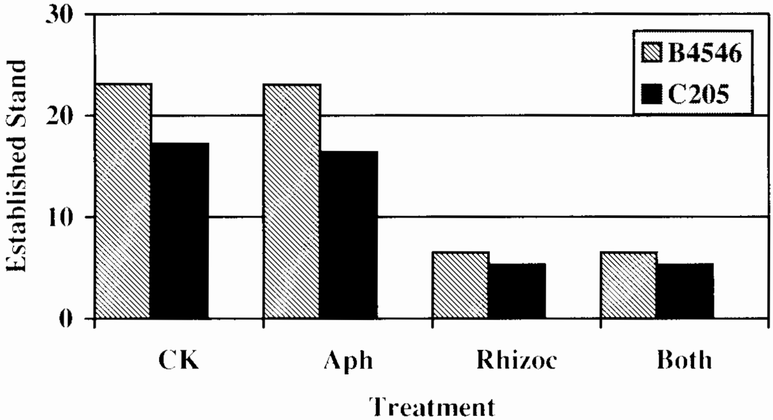

Table 1. Fresh weight and areas of newest fully expanded leaf at 10 true leaf stage.

Treatment[a]	Fresh wt. (g)	Leaf area (cm^2)
B4546 – CK	4.70a	111.29a
B4546 - Aph alone	2.48c	72.23b
B4546 - Rhizoc alone	2.18cd	65.14cd
B4546 - Both combined	1.42d	40.62d
C205 – CK	3.64b	97.65ab
C205 - Aph alone	2.99b	81.45b
C205 - Rhizoc alone	2.42cd	61.82cd
C205 - Both combined	0.54e	20.32e

[a]Aph = Aphanomyces; Rhizoc = Rhizoctonia

Means followed by the same letter are not significantly different according to the LSD test (P=0.05)

CONCLUSIONS

It was observed that *R. solani* was more aggressive and attacked seedlings more rapidly than did *A. cochlioides* under identical environmental conditions. As the experiment progressed, Rhizoctonia also tended to induce higher levels of root disease on both cultivars than did *Aphanomyces*. Although *A. cochlioides* damage was not as severe as *Rhizoctonia* under the conditions of this experiment, it could still be problematic if environmental conditions were more conducive. *Aphanomyces* tends to be more problematic in very moist soils (Schneider and Whitney 1986a), whereas the requirements for *R. solani*

Table 2. Yield and disease data collected after three months duration of experiment.

Treatment[a]	Top wt.[b]	Bot wt.[c]	Taproot[d]	DI[e]
B4546 - CK	16.98a	3.15ab	24.29a	0.00d
B4546 - Aph alone	11.42bc	1.22cd	11.78b	1.94c
B4546 - Rhizoc alone	12.73bc	2.43bc	11.53b	2.17bc
B4546-Both combined	7.10de	0.64cd	3.09c	3.22a
C205 - CK	19.05a	5.20a	20.14a	0.00d
C205 - Aph alone	15.39ab	2.83b	13.04b	1.77c
C205 - Rhizoc alone	10.24cd	1.30cd	4.07c	3.05ab
C205 - Both combined	4.25e	0.18d	0.62c	3.78a

[a]Aph = Aphanomyces; Rhizoc = Rhizoctonia; [b]Dried top weight, including crown, petioles and leaves; [c]Feeder roots collected from bottom half of each tube; [d]Taproot and feeder roots collected from top half of each tube; [e]DI = disease index based on a 0-4 severity rating with 4 being the worst.

Means followed by the same letter are not significantly different according to LSD test (p=0.05)

are not as specific. *Rhizoctonia* can cause disease over a wider range of environmental conditions than *Aphanomyces* (Harveson and Rush 1994, Rush 1990, Schneider and Whitney 1986b).

These data suggest that it may be more advantageous for growers to place an emphasis on managing Rhizoctonia root and crown rot over Aphanomyces root rot when faced with the knowledge of both diseases being present in their production fields. It also encouraging that the *Rhizoctonia*-resistant cultivar performed better under the same conditions as the *Aphanomyces*-resistant one. This cultivar is well adapted to this area, and if the use of B4546 is combined with other Rhizoctonia resistant, regionally adapted cultivars and several new promising strobilurin fungicides, effectively managing Rhizoctonia root and crown rot may become a better reality.

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