EVALUATION OF FUMIGATION AND A SYSTEMIC ACQUIRED RESISTANCE INDUCER ON RHIZOMANIA OF SUGARBEET

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Rhizomania, caused by *Beet necrotic yellow vein virus* (BNYVV), has spread throughout the Red River Valley of Minnesota and North Dakota and is highly prevalent in the southern Minnesota sugarbeet production region. The use of longer crop rotations and resistant cultivars have been the primary methods of control. Strains of BNYVV have recently been found in Europe (Harju et al., 2002) and California (Liu et al., 2003; Liu et al., 2004) that are able to defeat the *Rz1* gene for resistance. The appearance of "blinkers" in sugarbeet fields planted to rhizomania resistant cultivars in the Red River Valley and southern Minnesota sugarbeet production areas may also indicate the presence of new strains of BNYVV that are able to defeat the *Rz1* gene (Dr. Charlie Rush, personal communication). Due to these concerns, additional methods of controlling rhizomania may be needed until more durable resistant genes are identified and incorporated into commercial cultivars. The use of fumigation has been evaluated for control of rhizomania in California, Texas, and the United Kingdom (Harveson and Rush, 1994; Henry et al., 1992; Martin and Whitney, 1990). Fumigation was also evaluated in Glyndon, MN in 2003 (Bradley et al., 2004). The systemic acquired resistance (SAR) inducer 1,2,3-benzothiadiazole-7-thiocarboxylic acid-S-methyl-ester manufactured by Syngenta and known as Actigard in the U.S. and BION in Europe has been evaluated for control of rhizomania in Germany (Mouhanna and Schlosser, 1998). This product was also evaluated in Glyndon, MN in 2003 (Bradley et al., 2004).

OBJECTIVE

The objective of this study was to evaluate the effect of fumigation with Telone II and seed treatment with Actigard on rhizomania susceptible and resistance sugarbeet cultivars.

MATERIALS AND METHODS

The sugarbeet cultivars Van der Have 46177 (rhizomania resistant) and Crystal 952 (rhizomania susceptible) were planted 27 April 2004 at Glyndon, MN. Plots were 6 rows wide on 22 in. centers, 30 ft long, and organized as a randomized complete block design with 4 replications. The treatments consisted of: plots fumigated with Telone II (dichloropropene) at 12 gal/acre on 9 October 2003, plots planted to seed treated with Actigard 50 WG at 3 g/kg seed, and an untreated control. The trial was harvested 7 October 2004 and quality was determined at the ACSC Quality Laboratory in East Grand Forks, MN. A minimum of 5 plants per plot were collected for BNYVV testing. Root hairs were removed from each beet and analyzed using a double-antibody sandwich enzyme-linked immunosorbent assay (DAS ELISA) technique with a BNYVV reagent set (Agdia, Elkhart, IN). Absorbance values of each ELISA reaction were obtained using an ELISA plate reader at 405 nm, which is a quantitative measurement of virus titer present. The general linear model procedure (PROC GLM) in SAS (SAS Institute, Inc., Cary, NC) was used for statistical analysis. Comparison of means was made with Fisher's protected least significant difference (LSD).

RESULTS AND DISCUSSION

No significant cultivar × treatment interactions were detected; therefore, main effects only are reported. The rhizomania resistant cultivar VDH 46177 had significantly ($P \leq 0.10$) less BNYVV titer (absorbance) than the susceptible cultivar (Table 1). The resistant cultivar VDH 46177 also had significantly ($P \leq 0.10$) greater sucrose concentration and recoverable sugar per ton than the susceptible cultivar. No significant differences occurred between cultivars for loss to molasses, recoverable sugar per acre and root yield.

No significant differences among treatments occurred for BNYVV titer (absorbance), although plots fumigated with Telone II had approximately 10-fold less titer than the untreated control (Table 2). Sucrose concentration and loss to molasses were significantly ($P \leq 0.10$) reduced in Actigard and Telone II treated plots compared to the untreated control. Recoverable sugar per acre, recoverable sugar per ton, and root yields were significantly ($P \leq 0.10$) reduced in the Telone II treated plots compared to the untreated control; however, these variables did not significantly differ between Actigard and untreated control plots.

From this study, it is apparent that the use of a resistant cultivar was the best of the management practices that were evaluated. The resistant cultivar reduced BNYVV titer and had greater sucrose concentration and more recoverable sugar per ton than the susceptible cultivar. The Telone II and Actigard treatments did numerically reduce the amount of BNYVV titer, but was not statistically significant. The overall performance of the sugarbeets in the untreated control plots were better or equal to the Actigard and Telone II treated plots. In our study, Telone II appeared to have a negative effect on the performance of the sugarbeets compared to the untreated control. This was reported to happen on a few sugarbeet cultivars in some years by Harveson and Rush (1994). This study indicates that Actigard as a seed treatment and Telone II fumigant are not suitable as rhizomania management practices in the Red River Valley sugarbeet production region.

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Table 1. Comparison of rhizomania resistant and susceptible sugarbeet cultivars at Glyndon, MN in 2004.

Cultivar	Absorbance	Sucrose (%)	Loss to molasses (%)	Recoverable sugar (lb/t)	Recoverable sugar (lb/A)	Root yield (t/A)
VDH 46177	0.112	16.5	0.88	313	5503	18
ACH 952	0.531	16.3	0.89	307	6113	20
$P > F$	0.072	0.097	0.677	0.093	0.177	0.105

Table 2. Comparison of Telone II fumigant, Actigard seed treatment, and an untreated control at Glyndon, MN in 2004.

Treatment	Absorbance	Sucrose (%)	Loss to molasses (%)	Recoverable sugar (lb/t)	Recoverable sugar (lb/A)	Root yield (t/A)
None	0.592	16.7	0.93	315	6402	21
Actigard	0.330	16.4	0.88	311	5955	19
Telone II	0.043	16.1	0.86	305	5066	17
$P > F$	0.155	0.039	0.046	0.070	0.064	0.051
LSD 0.05	NS[a]	0.4	0.05	NS	NS	NS
LSD 0.10	NS	0.3	0.04	7	924	3

[a] Not statistically significant (NS).