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Report

Differences in tolerance to soil borne pathogens in sugar beet varieties 2010

Provning av betsorters toleransnivå mot jordburna patogener

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Sammanfattning

Sockerbetor kan angripas av flera jordburna patogener. Den viktigaste i Sverige är *Aphanomyces cochlioides*. Plantbortfall under uppkomsten kan förhindras genom att fröet betas med Tachigaren med den verksamma beståndsdelen hymexazol. Denna betning räcker i cirka fyra till sex veckor. Senare angrepp kan ge kroniska skador på rötterna. Sedan några år tillbaka provas nya sorter i Sverige på naturligt infekterad mark. Resultaten från dessa försök har visat att det finns stor variation mellan sockerbetssorter vad gäller tolerans mot jordburna patogener. Under 2010 provades totalt 17 sorter i ett försök i Skåne. I försöket gjordes bedömningar av plantantal och rotbrandsangrepp under uppkomst samt kroniska rotskador efter skörd.

Plantornas sundhet i juni visade på ett samband med bedömningen av kroniska rotskador som gjordes efter skörd. Den kyliga våren gjorde att de första tidiga angreppen uteblev, och det blev få kroniska skador på rötterna i form av deformationer. Men det varma vädret i juli och den rikliga nederbörden i augusti gjorde istället att tillväxten hämmades av angrepp av *A. cochlioides* vilket ledde till små betor, framförallt för de mottagliga sorterna. Detta tyder på att *A. cochlioides* kan angripa plantorna genom hela växtsäsongen. Sena angrepp gör att tillväxten hämmas och rötterna blir små.

Det fanns även ett tydligt samband mellan sockerskörd och bedömningen av kroniska rotskador efter skörd.

Sockerskörden för Mixer, den toleranta kontrollsorten, blev 9,9 ton per hektar.

Den mottagliga sorten Opta utan hymexazol hade den lägsta sockerskörden, 7,0 ton per hektar. Sockerskörden för Opta med hymexazol blev 7,5 ton per hektar.

Tre av de testade sorterna hade sockerskördar över 9,5 ton per hektar: HI 0971, HI 0944, HI 0813. Dessa utgör ett nytt lovande tolerant material för framtiden.

Fyra sorter hade sockerskördar under 8 ton per hektar: Sabrina KWS, ST_S_Aph_102, ST_S_Aph_103 och Rosalinda KWS. Dessa är troligen känsliga för infektioner av *A. cochlioides.*

Summary

One of the most important soil borne pathogens in Sweden is *Aphanomyces cochlioides*. The disease occurs in two phases, one early causing damping-off after emergence and one later chronic phase which may cause severe root deformations. New varieties are routinely tested every year in Sweden on naturally infested soil. Disease severity during emergence, plant number and yield was evaluated in one trial 2010, at Skibaröd in Skåne.

Plant vigour in June showed a relationship to chronic root rot indicating that *A. cochlioides* may interfere with growth of the plants during the early growing period. The roots showed only minor symptoms of severe root deformations

during 2010 mainly because of the lack of early root rot infections. However, the sizes of the roots of the susceptible varieties were highly reduced.

There was a strong correlation between sugar yield and chronic root rot.

The sugar yield for Mixer, the tolerant control variety was 9.9 tons per hectare.

The susceptible variety Opta without hymexazol had the lowest sugar yield 7.0 tons per hectare. The sugar yield for Opta with hymexazol was 7.5 tons per hectare.

Three test varieties had sugar yields above 9.5 tons per hectare: HI 0971, HI 0944, HI 0813 and these are promising new tolerant varieties.

Four varieties had sugar yields below 8 tons per hectare: Sabrina KWS, ST_S_Aph_102, ST_S_Aph_103, Rosalinda KWS and are most likely susceptible to *A. cochlioides.*

Five varieties had sugar yields between 8 and 9.1 tons per hectare: HI 0941, Jenny, 9R21, MA 2007, MA 4001, Jaquelina and these are probably intermediate in tolerance to *A. cochlioides.*

Introduction

One of the most important soil borne pathogens in Sweden is *Aphanomyces cochlioides*. The disease occurs in two phases, one early causing damping-off after emergence and one later chronic phase (Harveson and Rush, 1993; Windels, 2000). Resulting problems are reduced plant number and root yield. *A. cochlioides* can be found in most soils in Sweden and around 25% of the fields have a medium to high risk of Aphanomyces root rot. Identification of fields with high risk is important for disease control (Olsson *et al.*, Soil Biology and Biochemistry, In press.). Control methods include seed treatment with hymexazol, growing tolerant varieties and liming. New varieties are by routine tested every year in Sweden on naturally infested soil.

Materials and methods

Field trials

One field trial was sown on naturally infested soil at Skiberöd. Mixer was used as tolerant control and Opta with and without hymexazol as susceptible control. The trial design was a random complete block design with four replications.

Evaluations

The number of plants in each plot was counted three times (at 20%, 50%, max and final emergence). Plant vigour was evaluated twice. Evaluation of damping-off was performed twice in early spring. The first evaluation took place when the plants had developed cotyledons and the second evaluation two weeks later. In the sample area 20 randomly chosen plants were dug up and each plant was evaluated for symptoms of damping-off and classified into one of six groups: 0 (healthy), 10, 25, 50, 75 and 100% (dead plants). A disease index was calculated using the following equation developed by Larsson and Gerhardson (1990):

DSI = ((n_0 * 0 + n_{20} * 20 + n_{50} * 50 + n_{75} * 75 + n_{100} * 100)/plant number)

where n = number of beets in each class.

After harvest, the beets in each plot were evaluated for symptoms of chronic root rot using a scale from 1–7 (table 1). The evaluation of chronic root rot was carried out at the central tare house in Örtofta (Agri Provtvätt, Örtofta Sockerbruk, Nordic Sugar).

Table 1. Scale 1–9 for evaluation of chronic symptoms of root rots

Scale	
1	Healthy root
2	
3	Only slight deformation of the root
4	
5	Root deformed and of reduced size
6	
7	Root severly deformed and very small
8	
9	Root completely rotted

Statistical analyses

All variables measured in the field trial were analyzed using analysis of variance (Proc GLM, SAS) and pair wise differences were analyzed with Fischer's LSD test.

Results and discussion

Sugar beets were drilled in the beginning of April in the Swedish growing area. The weather was very cold after emergence which resulted in low infestation levels despite irrigation of the trials. The weather in July was very warm and dry. In contrast, a lot of rain fell in August which provided good conditions for late infections of *A. cochlioides*.

The occurrence of *A. cochlioides* in the soil at Skibaröd was verified by isolations of the pathogen from plants collected in the field.

Plant number

Plant numbers at 50% and 100% emergence, at Skibaröd are shown in figure 1 and 2. There were significant differences between the varieties in 50% emergence. The variety with the lowest number of plants was MA2007 (39.9) and with the highest HI 0944 (95.8), Prob = <0.0001, LSD = 11.4. There were also significant differences between the varieties at 100% emergence. The variety with the lowest number of plants was Opta without hymexazol (99.2) and with the highest HI 0944 (117.2), Prob = 0.0007, LSD = 6.2. The plant number for Opta with hymexazol was 108.8. This was significantly higher than for Opta without hymexazol.

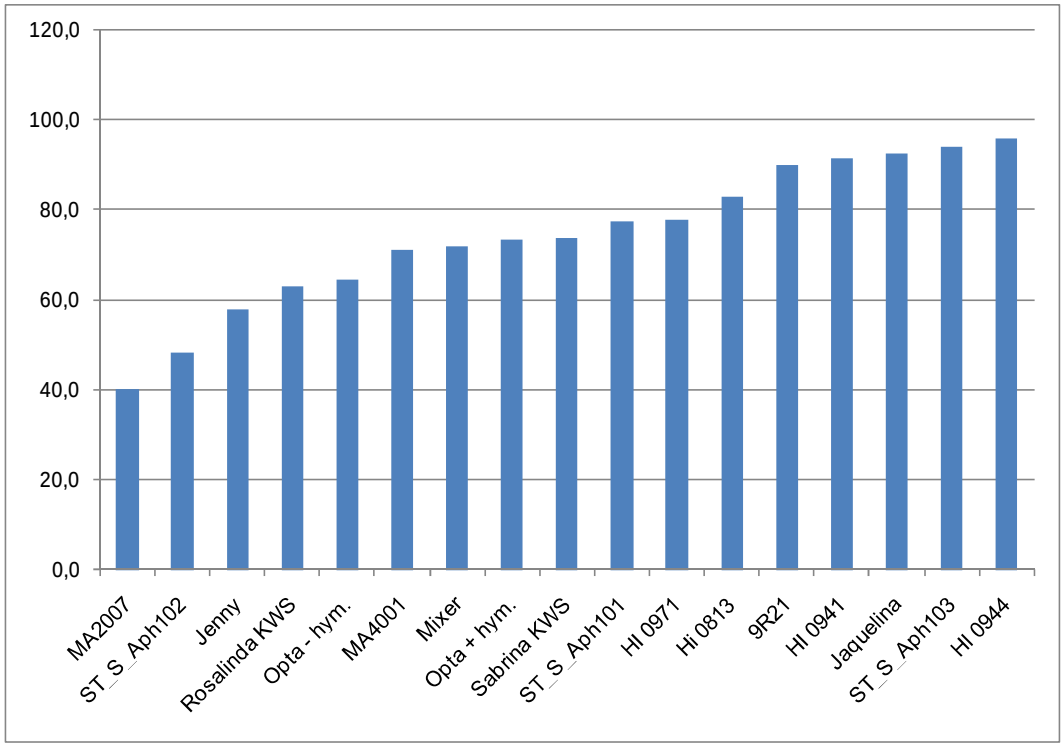

Figure 1. Plant number (1000 per hectare) at 50% emergence, 3 May, Skibaröd. Prob = <0,0001, LSD = 11.4.

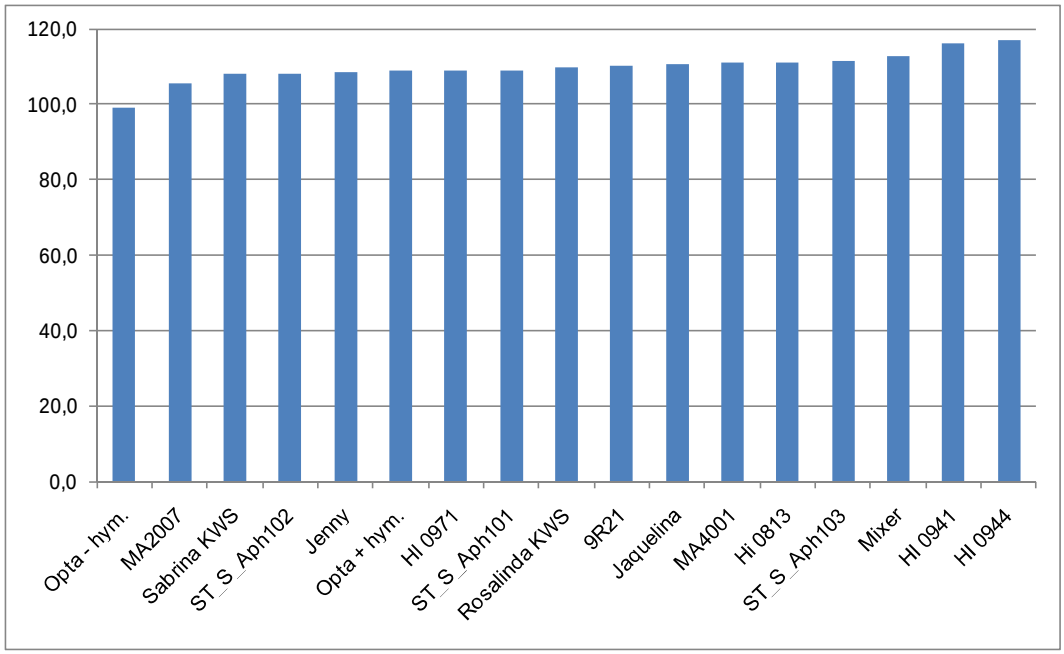

Figure 2. Plant number (1000 per hectare) at 100% emergence, 5 August, Skibaröd. Prob = 0.0007, LSD = 6.2.

Disease severity – early phase

Early root rot infections were generally low 2010, because of the cool temperatures after drilling. There were no significant differences between the varieties in DSI 1 (Figure 1). The tolerant control variety Mixer had the lowest DSI (32.2). The susceptible control Opta – hymexazol had DSI 1 = 45.0 and Opta + hymexazol 40.9.

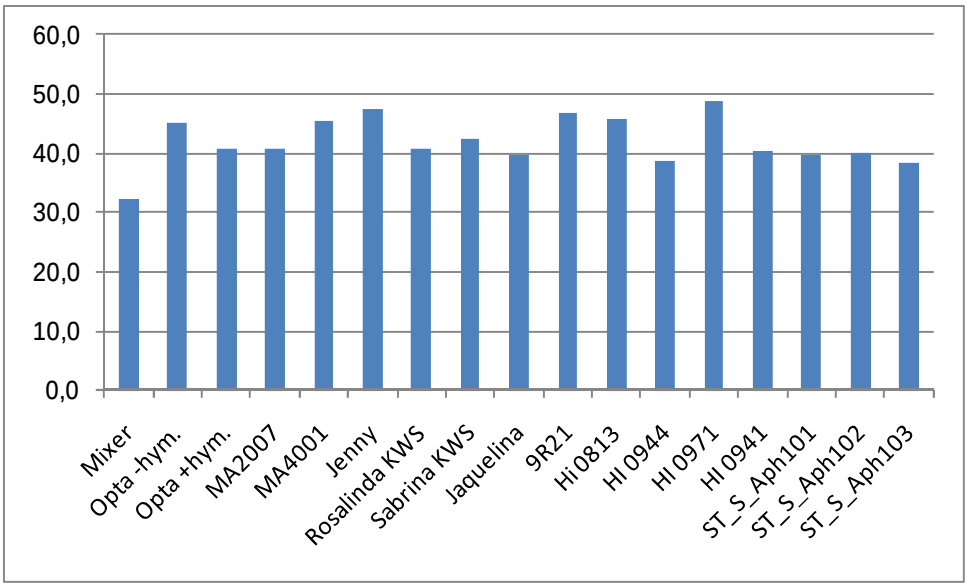

Figure 3. Disease severity 4 June 2010, Skibaröd. Prob = NS.

Sugar yield

The sugar yield for Mixer, the tolerant control variety was 9.9 tons per hectare. The susceptible variety Opta without hymexazol had the lowest sugar yield, 7.0 tons per hectare. The sugar yield for Opta with hymexazol was 7.5 tons per hectare.

Four varieties had sugar yields above 9.5 tons per hectare: Mixer, HI 0971, HI 0944 and HI 0813.

Five varieties had sugar yields below 8 tons per hectare: Sabrina KWS, Opta + hymexazol, ST_S_Aph_102, ST_S_Aph_103 and Rosalinda KWS.

Six varieties had sugar yields between 8 and 9.1 tons per hectare: HI 0941, Jenny, 9R21, MA 2007, MA 4001 and Jaquelina.

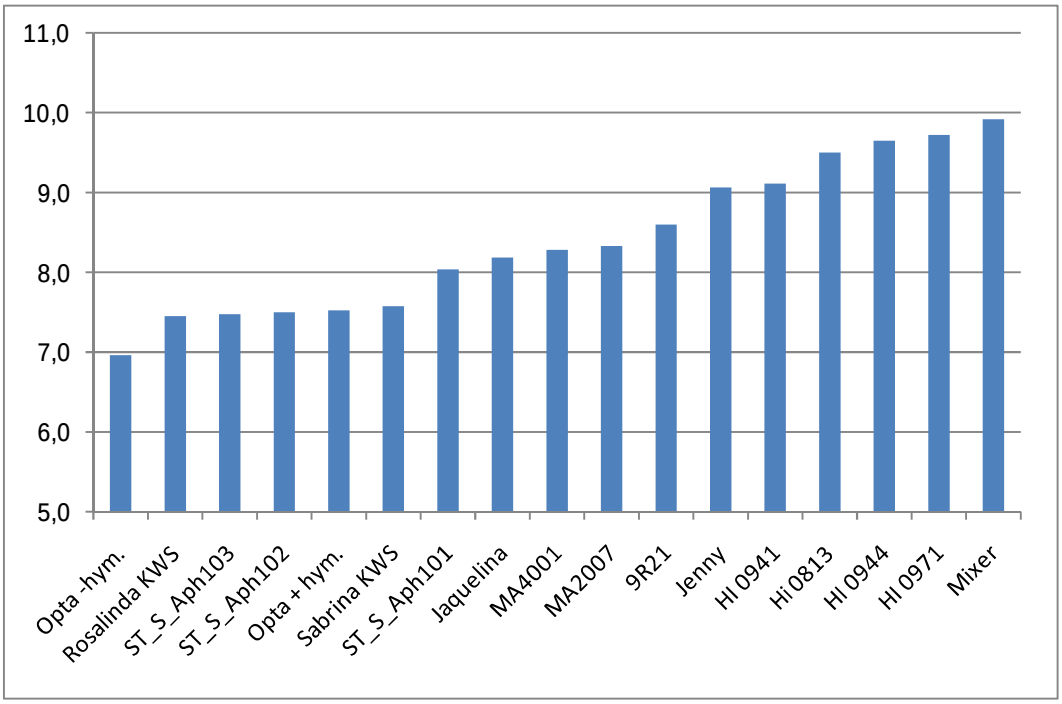

Figure 4. Sugar yield, Skibaröd. Prob = <0.0001, LSD = 0.7.

Relationship between growth parameters and chronic root rot

Plant vigour was evaluated twice in the trial, 18 and 29 June. The relationship between vigour and chronic root rot is shown in figures 5 and 6. The relationship between sugar yield and root rot symptoms is shown in figures 7.

Plant vigour in June showed a relationship to chronic root rot indicating that ***A. cochlioides*** may interfere with growth of the plants during the early growing period. There was also a relationship between chronic root rot and row coverage (Figure 7.).

There was a good correlation between sugar yield and chronic root rot, R^2 = 79% (Figure 8.).

The evaluation of chronic root rot is shown in figure 9.

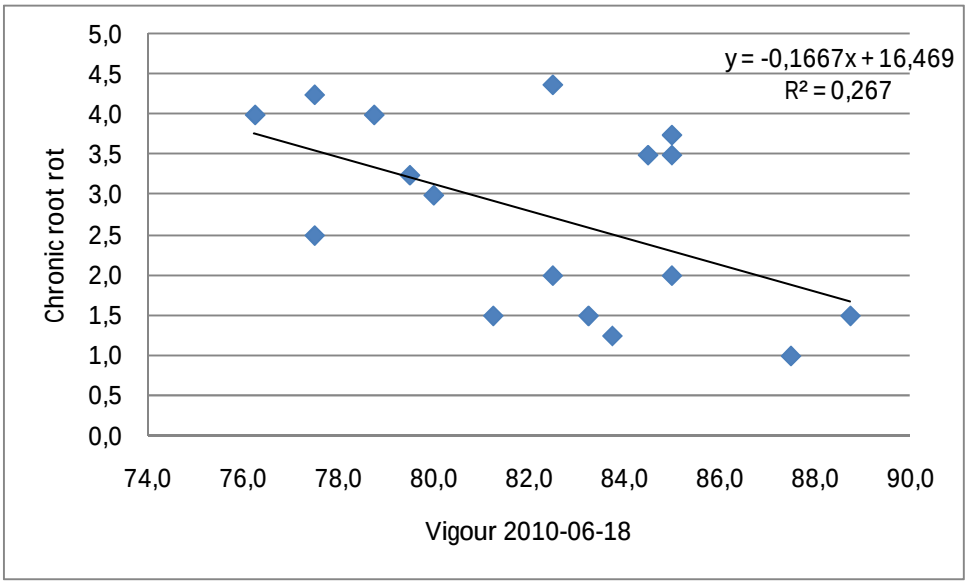

Figure 5. Plot of vigour 18 June 2010 and chronic root rot evaluation after harvest for all 17 varieties.

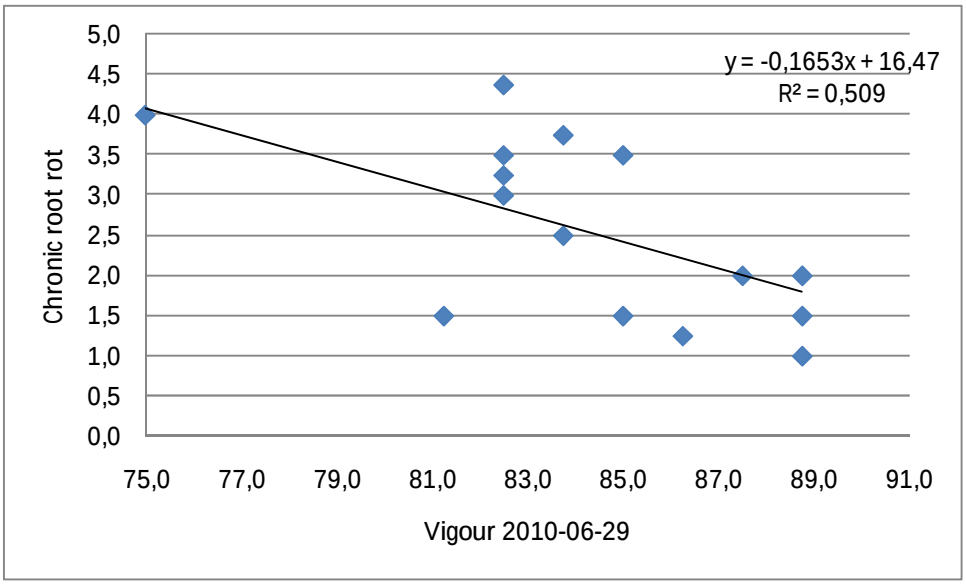

Figure 6. Plot of vigour 29 June 2010 and chronic root rot evaluation after harvest for all 17 varieties.

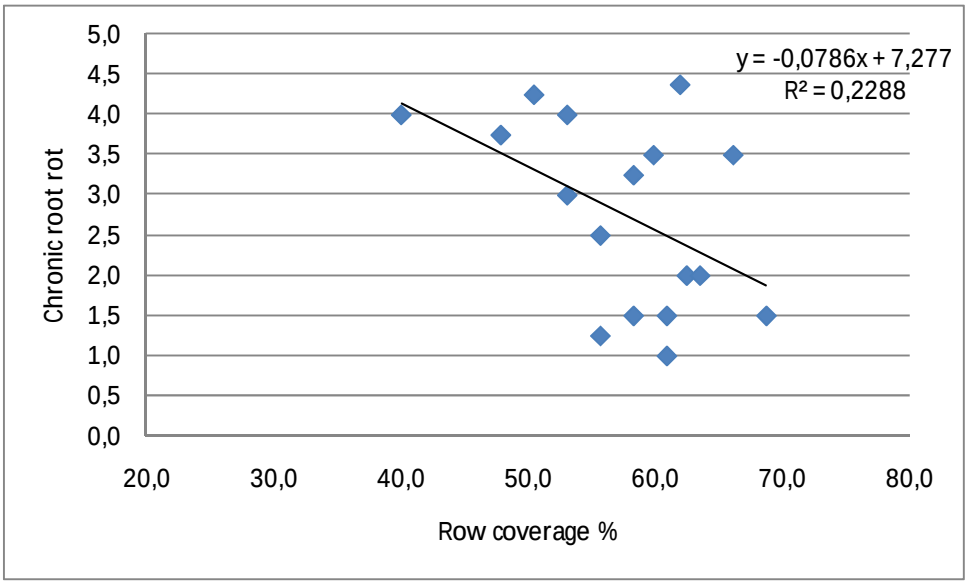

Figure 7. Plot of row coverage 29 June 2010 and chronic root rot evaluation after harvest for all 17 varieties.

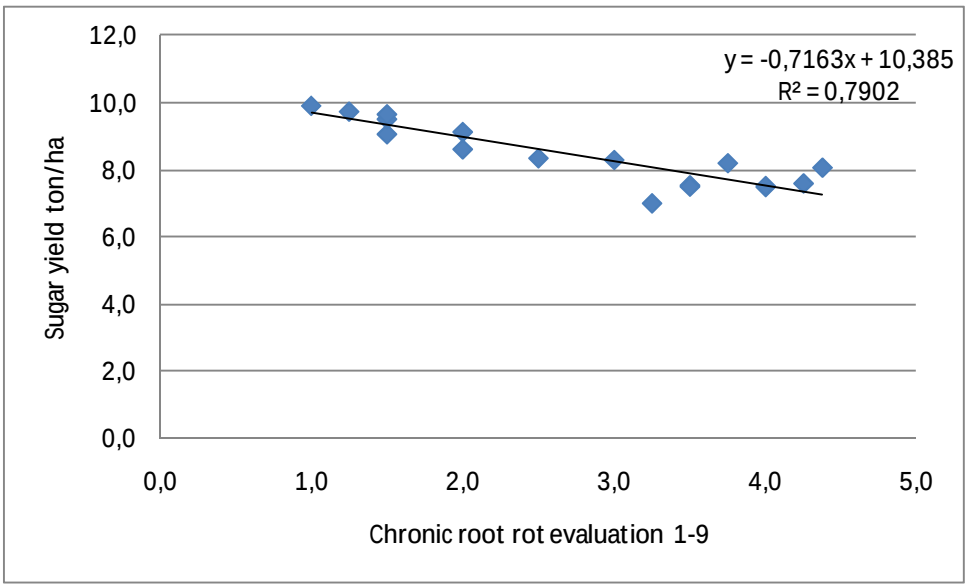

Figure 8. Plot of sugar yield, tons per hectare and chronic root rot evaluation for all 17 varieties.

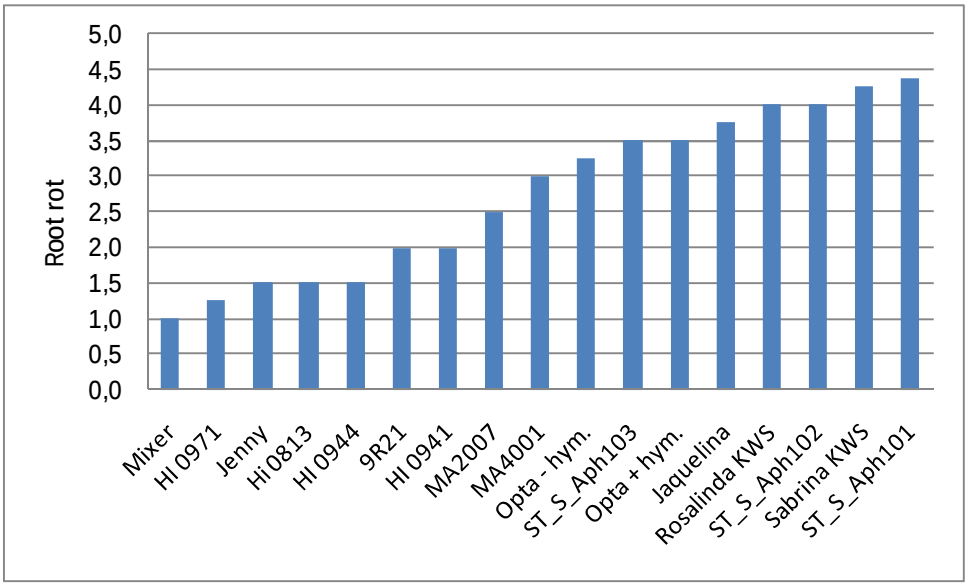

Figure 9. Chronic root rot in the 17 varieties tested at Skiberöd 2010. Prob < 0.0001, LSD = 1.2.

Conclusions

Plant vigour in June showed a relationship to chronic root rot indicating that *A. cochlioides* may interfere with growth of the plants during the early growing period.

The roots showed only minor symptoms of severe root deformations during 2010 mainly because of the lack of early root rot infections. However, the sizes of the roots of the susceptible varieties were highly reduced.

There was a good correlation between sugar yield and chronic root rot.

The sugar yield for Mixer, the tolerant control variety, was 9.9 tons per hectare.

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References

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Borgeby in November 2010

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