424-2010
GEP Report

Svampbetning mot jordburna svampsjukdomar 2010

Seed treatments against soil borne fungi 2010

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Seed treatments against soil borne fungi in sugar beets 2010

Sammanfattning

Denna försöksserie utfördes på uppdrag av DuPont Sverige AB och hade som mål att prova tre olika doser av hymexazol (14, 18 och 30 g aktiv substans per enhet) som är den verksamma substansen i Tachigaren. Försöken låg på tre olika fält (i Ormastorp, på Skibaröds gård i Löberöd och på Västergård i Tågarp). I Sverige används för närvarande 14 g hymexazol på allt sockerbetsfrö som säljs till lantbrukare. Betorna i odlingsområdet såddes i början av april men vädret efter sådd var kyligt och regnigt, vilket gjorde att angreppsgraden av rotbrand generellt blev låg i början av året.

I försöken gjordes planträkningar vid fyra tillfällen (20, 50 och 100 % samt slutlig uppkomst) och sundhet samt rotbrandsbedömningar vid två tillfällen. Samtliga försök skördades och betorna bedömdes också för sena angrepp av *Aphanomyces* rotröta.

Resultaten från årets försök visar att svampbetning med hymexazol inte gett någon signifikant ökning av antalet plantor per hektar, främst beroende på den låga infektionsnivån under våren. Sett över alla 21 försök som legat sedan 2004 är ökningen av antalet plantor per hektar 6 700 för standarddosen 14 g hymexazol. I de elva försök 2004–2010 som haft en hög infektionsnivå var ökningen av plantor per hektar för 14, 18 och 30 g hymexazol 11 000, 10 600 och 12 400 jämfört med kontrollen. Resultaten visar att svampbetning är ett bra sätt att försäkra sig om ett tillräckligt högt plantantal.

I försöket på Skibaröd fanns det signifikanta skillnader i sundhet mellan obehandlat å den ena sidan och de tre doserna av hymexazol å den andra (obehandlat 73,8 och 81,3, 82,5 samt 83,8 för 14, 18 och 30 g hymexazol, Prob < 0,0231, LSD = 6,3). Detta visar att betning med hymexazol har en positiv inverkan på plantornas sundhet. Trots tidiga skillnader i sundhet mellan leden blev det inga signifikanta skillnader i sockerskörd mellan de olika doserna av hymexazol. Detta hänger till stor del samman med det mycket regniga vädret i augusti som medförde kraftiga sena angrepp av *A. cochlioides*. Vid denna tid är hymexazol inte längre verksam. De sena symptomen 2010 visade sig på betorna som var kraftigt reducerade i storlek men utan de typiska insnörningarna under betnacken.

I genomsnitt över 21 försök 2004–2010 gav svampbetning med hymexazol 2 % ökning av sockerskörden och sockerhalten ökade signifikant med cirka 0,1 %. Om enbart de elva försök med kraftiga infektioner summeras, ger svampbetning med hymexazol 5 till 6 % signifikant ökning av sockerskörden. Även rotvikten var högre. Kvalitetsparametrarna blåtal och K+Na var också signifikant lägre i de svampbetade leden.

Summary

The aim of these trials was to test the effect of 14, 18 and 30 g hymexazol on damping-off caused by *Aphanomyces cochlioides*. The trials were located on three different fields: Ormastorp and Västergård in the north west part of Skåne and on Skibaröds gård in Löberöd. The standard dose of hymexazol in Sweden is 14 g and it is used on all commercial seed.

There were no significant differences in final plant number between the seed treatments in 2010. This is probably due to the very cold spring which resulted in low infestation levels of *A. cochlioides*.

Compared to previous years (10 trials 2004–2010 with low infestations levels) 14, 18 and 30 g hymexazol has increased the final plant number compared to the control with around 1,900; 2,600 and 3,800 plants/ha.

The increase in plant number for 14, 18 and 30 g hymexazol in 11 trials with high infestation level 2004-2010 was 11 000, 10 600 and 12 400 compared to the control.

Evaluation of plant vigour (0–100) in June at Skibaröd showed significant differences between the control (73.8) and the seed treatments (81.3, 82.5 and 83.8 respectively, for 14, 18 and 30 g hymexazol), Prob < 0.0231, LSD = 6.3. This difference indicates a positive effect of the seed treatments on plant vigour.

There were no significant differences between the seed treatments in sugar yield in any of the three trials 2010. This is probably an effect of the rain in August which provided good conditions for late infections of *Aphanomyces* root rot when hymexazol is no longer active.

There was a significant increase in sugar yield (11 trials with high infestation levels 2004–2010) for the fungicide treatments with 5 to 6% compared to the untreated control. Root weight was significantly higher and amino-N and K+Na significantly lower than in the untreated control.

Introduction

A number of soil borne pathogens may cause substantial damage in sugar beet fields. One of the most important pathogens in Sweden is *Aphanomyces cochlioides*. In warm and wet soils, *A. cochlioides* infect young seedlings two to three weeks after emergence (Harveson and Rush, 1993; Windels, 2000). The hypocotyl rots and the seedling die. Early seedling infections of *A. cochlioides* may result in low plant numbers and permanent damage to the root, resulting in severe deformations. The pathogen infects sugar beet roots through the whole growing period thus causing a general growth reduction. *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.).

Early infections can be controlled by treating the seed with hymexazol, the active ingredient of Tachigaren. The standard dose used on all sugar beet seed in Sweden is 14 g/unit. The seed treatment remains effective for four to six weeks. On highly infested fields it is important to use a tolerant sugar beet variety in combination with hymexazol.

Hymexazol is the only registered product that is effective against *A. cochlioides*. In this trial series, hymexazol is combined with 6 g fludioxonil, the active ingredient in Maxim tech. Fludioxonil is a broad spectrum, non systemic fungicide with effect against several soil borne fungi such as some *Fusarium* spp., *Rhizoctonia* and *Sclerotinia* (Olaya and Barnard, 1994; Mueller et al., 1999; Munkvold and O'Mara 2002; Dorrance et al., 2003; Broders et al., 2007).

Materials and methods

In late autumn 2009, soil samples were taken from a number of different locations in the south of Sweden. The soil samples were analyzed for infestation level of soil borne pathogens. Sugar beet seeds were sown in pots with test soil and then put in greenhouse under conditions favorable for infection. The evaluation of the risk of damping-off (soil index 0–100) is shown in table 1. Three trial locations were chosen on the basis of the result from the soil tests. The results of the analyses of soil type on each locality are shown in the appendix.

Table 1. The risk of infection in soils analyzed for disease severity index

Index	Risk	Evaluation
0 – 20	No risk	-
20 – 40	Low	Normally no problems
40 – 70	Medium	Growing sugar beets could be hazardous
70 – 100	High	Under favourable conditions, damping-off is highly likely

This trial series included three seed treatments that were compared in three field trials and one experiment performed under controlled green house conditions.

The field trials were drilled on three locations (at Ormastorps gård and Västergård, Tågarp in the north west part of Skåne and at Skibaröds gård in Löberöd in the central part of Skåne). The trial design was a randomized complete block design with four replications. To be able to remove plants for analyses, an extra sample area was sown adjacent to the original plot.

Plant number

The number of plants in each plot was counted three times during emergence (20%, 50%, maximum and finally after inter-row cultivation (full emergence).

Plant vigour and row coverage

Plant vigour was assessed once in each trial using a scale from 0 to 100 where values below 50 indicate plants in severely reduced growth (50% yield reduction), 50–79 indicates some-what reduced growth that probably will affect yield. Values between 80 and 90 indicates that the plants only show minor damage that seldom has any effect on yield and values above 90 are nearly healthy plants.

Disease severity index

Assessment of disease severity index was performed twice in early spring. The first assessment took place when the plants had just developed cotyledons and the second two weeks later. In the sample area 20 randomly chosen plants were dug up and each plant was assessed for symptoms of damping-off and classified into one of six groups: 0 (healthy), 10, 25, 50, 75 and 100% (roots totally rotten, plant dead). A disease index (DSI) was calculated using the following equation developed by Larsson and Gerhardson (1990):

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

where n = number of beets in each class.

The results are shown in the appendix. Pieces of roots were put on agar plates and fungi were determined to genera and species based on morphology.

Harvest

After harvest, the beets in each plot were assessed for symptoms of chronic root rot using a scale from 1–9. The evaluation of chronic root rot was carried out at the tare house in Örtofta (Agri Provtvätt, Örtofta Sockerbruk, Nordic Sugar).

Table 2. 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 severely deformed and very small
8	
9	Root completely rotted

Green house experiment

Soil was collected from a field naturally infested with soil borne fungi. The soil was divided between six pots per treatment and replication and put in a green house in a randomized complete block design. Ten seeds of the variety Sapporo were sown in each pot. The pots were checked daily for any dying sugar beet plants. After four weeks all remaining plants were washed from soil and inspected for symptoms of root rot. A DSI was calculated according to Larsson and Gerhardson (1990).

Statistical analyses

All variables were analyzed using Proc GLM in SAS, SAS Institute Inc. All shown treatment means are adjusted means (LSmeans) unless otherwise stated. In case of no missing values in the data set, LSmeans are equal to the aritmethic means.

Results and discussion

The soil tests showed that the DSI before drilling was 88 at Ormastorps gård, 95 at Skibaröds gård and 75 at Västergård. The occurrence of *A. cochlioides* in the soil at all locations was verified by isolations of the pathogen from plants collected in the field.

Plant number

There were no significant differences in final plant number between the seed treatments in 2010 (figure 1). This is probably due to the very cold spring which resulted in low infestation levels of *A. cochlioides*. Compared to previous years (10 trials 2004–2010 with low infestations levels), 14, 18 and 30 g hymexazol has increased the final plant number compared to the control with 1,900; 2,600 and 3,800 plants per hectare.

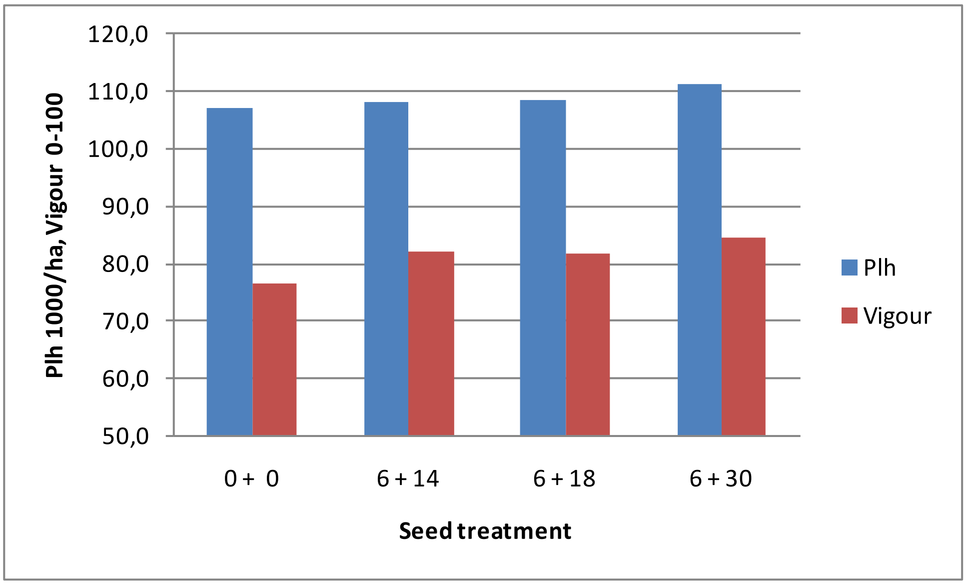

Figure 1. Average plant number and vigour in three trials 2010. Plant number, prob = ns; vigour, prob = 0.0507 and LSD = 5.5.

The increase in plant number for 14, 18 and 30 g hymexazol in the trials with high infestation level 2004–2010 was 11,000; 10,600 and 12,400 compared to the control.

Disease severity

Table 3 shows the results of isolations that were done on plants collected in the field.

Table 3. Soil borne pathogens and fungi isolated from plants collected in the three field trials

Location	Fungi	DSI
Ormastorp	*Aphanomyces cochlioides, Fusarium culmorum, Rhizoctonia*	88
Skibaröds gård	*A. cochlioides, F. redolens*	95
Västergård	*A. cochlioides, Pythium, F. culmorum*	75

The cold and wet weather after emergence resulted in low infestations of *A. cochlioides*. There were no significant differences in DSI 1 and 2 between the seed treatments. However, the second assessment of DSI at Ormastorps gård showed that the seed treatments were close to significantly different from the control (Prob = 0.0583) (figure 2).

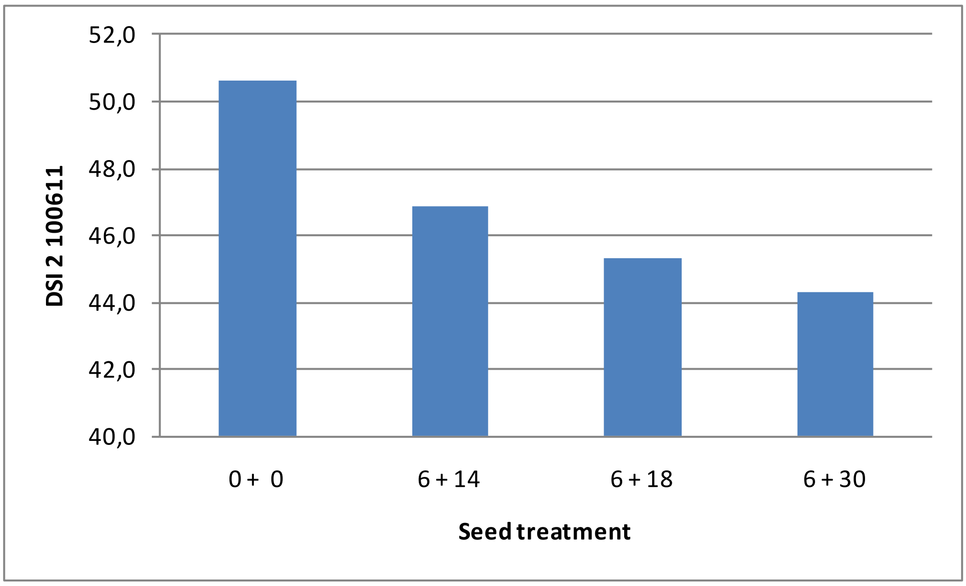

Figure 2. DSI 2 at Ormastorps gård assessed 2010-06-11. Prob = 0.0583.

The average DSI 1 and 2 in 21 trials 2004–2010 showed that all seed treatments (14, 18 and 30 g hymexazol) had significantly lower DSI than the control treatment.

The average DSI 2 in 11 trials 2004–2010 with high infestation level showed that all seed treatments (14, 18 and 30 g hymexazol) had significantly lower DSI than the control treatment. DSI 2 for 14, 18 and 30 g hymexazol was 30.1, 30.0 and 28.5 respectively compared to 33.5 in the control treatment.

Green house experiment

The average DSI from six green house trials showed that all treatments, 14, 18 and 30 g hymexazol had significantly lower DSI than the untreated control. There was no significant difference between the three doses of hymexazol. The average DSI in six green house trials on naturally infested soil showed a significant difference between the seed treatments on the one hand and the control on the other, Prob < 0.0001, LSD = 3.1 (figure 3).

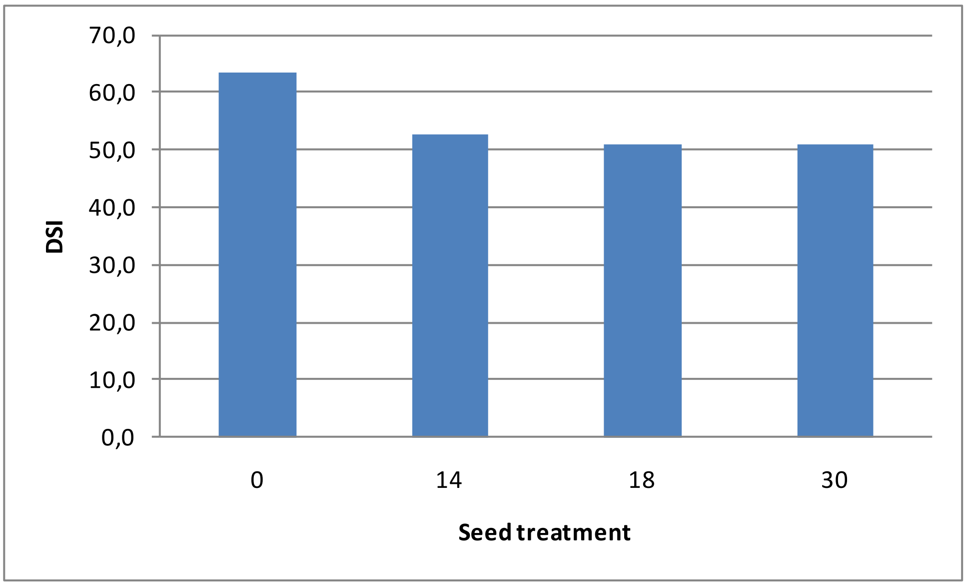

Figure 3. Average DSI in six green house experiments 2005–2010 in 0, 14, 18 and 30 g hymexazol, Prob < 0.0001, LSD = 3.1.

Sugar yield

Assessment of plant vigour at Skibaröd 2010-06-18 showed significant differences between the control (73.8) and the seed treatments (81.3, 82.5 and 83.8 respectively, for 14, 18 and 30 g hymexazol), Prob < 0.0231, LSD = 6.3. This difference indicates a positive effect of the seed treatments on plant vigour. However, there were no significant differences between the seed treatments in sugar yield in any of the three trials. This is probably an effect of the rain in August which provided good conditions for late infections of *Aphanomyces* root rot when hymexazol is no longer active.

Sugar yield 2004–2010

Yield parameters have been investigated in a total of 21 field trials during 2004–2010. The average over all 21 trials indicates a tendency for 2% higher sugar yield in the seed treatments compared to the control. There was also significantly higher sugar content and lower amino-N and K+Na in the seed treatments.

When the average sugar yield was calculated in 11 trials with high infestation levels, there was a significant increase in sugar yield for the fungicide treatments with 5 to 6% compared to the untreated control (figure 4). Root weight was significantly higher and amino-N and K-Na significantly lower than in the untreated control. In addition, there was a tendency for higher cleanness and higher sugar content in the seed treatments with hymexazol.

For the trials where very low infestations was observed there were no significant difference in yield between the treatments.

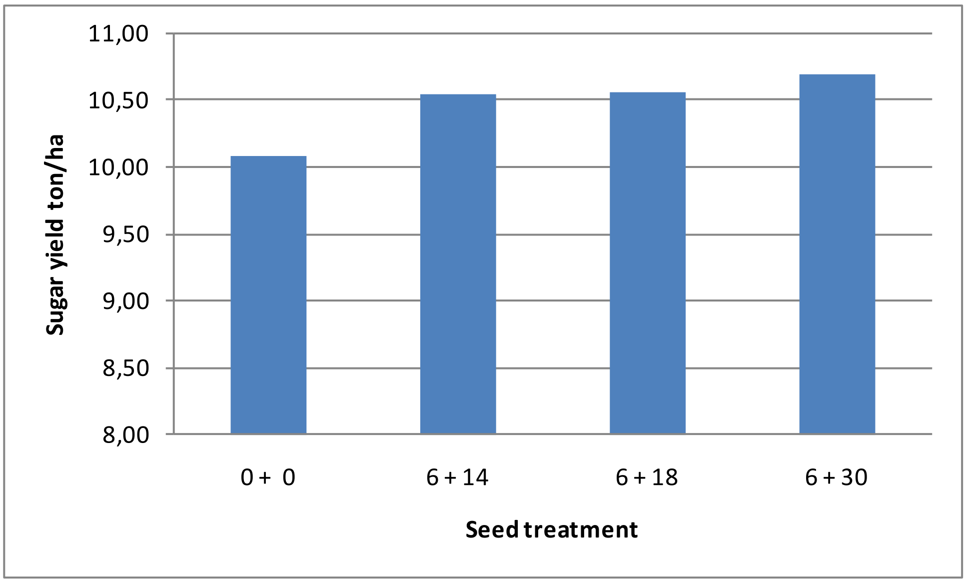

Figure 4. Average sugar yield in 11 trials with high infestation levels 2004–2010 (LSD = 0.3, Prob = 0.0009).

Conclusions

There were no significant differences in final plant number between the seed treatments in 2010. This is probably due to the very cold spring which resulted in low infestation levels of *A. cochlioides*.

Compared to previous years (10 trials 2004–2010 with low infestations levels), 14, 18 and 30 g hymexazol has increased the final plant number compared to the control with around 1,900; 2,600 and 3,800 plants per hectare.

The increase in plant number for 14, 18 and 30 g hymexazol in 11 trials with high infestation level 2004–2010 was 11,000; 10,600 and 12,400 compared to the control.

Evaluation of plant vigour (0–100) in June at Skibaröd showed significant differences between the control (73.8) and the seed treatments (81.3, 82.5 and 83.8 respectively, for 14, 18 and 30 g hymexazol), Prob < 0.0231, LSD = 6.3. This difference indicates a positive effect of the seed treatments on plant vigour.

There were no significant differences between the seed treatments in sugar yield in any of the three trials 2010. This is probably an effect of the rain in August which provided good conditions for late infections of *Aphanomyces* root rot when hymexazol is no longer active.

There was a significant increase in sugar yield (11 trials with high infestation levels 2004–2010) for the fungicide treatments with 5 to 6% compared to the untreated control. Root weight was significantly higher and amino-N and K+Na significantly lower than in the untreated control.

References

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GEP information

No of series and title	424-2010 Seed treatments against soil borne fungi
Objective	To evaluate the effect of hymexazol on soil borne fungi
Claimant	DuPont Sverige AB Jan-Åke Svensson Box 839 201 80 Malmö
Testing unit	Nordic Beet Research Foundation Borgeby slottsväg 11 237 91 Bjärred, Sweden Phone: +46 709 53 72 62 Fax: +46 46 71 36 62 www.nordicbeet.nu
Trial manager	Åsa Olsson, NBR
Technical manager/organisation	Jörgen Mårtensson, HS Malmöhus
Trial seed	Trial seed was ordered by NBR. Variety: Mixer
Methodology	Description of methods and evaluations: See field plan for references to PM in NBR quality handbook (Sweden).

Non conformances

Tågarp: Plotno 4232 harvest rows moved to rows 2 and 3. Row 4 very bad due to problems during drilling. Plotno 4227: harvest rows moved. Row 3 has too many missing plants because of problems during drilling. Plotno 4223: harvest rows moved to rows 4 och 5. Row 3 has too many missing plants because of problems during drilling.

Trial locations

Sten Olsson, Skibaröds gård, 240 33 Löberöd
Lars Håkansson, Västergård 1047, 260 22 Tågarp
Charlie Svensson, Ormastorps Gård 153, 260 30 Vallåkra

Tested materials All seed treated with Gaucho 60 g a.i.

Product	Active ingredient	Dose	Treatments
Tachigaren	Hymexazol	14,18, 30 g/unit	2, 3, 4
Maxim tech	Fludioxonil	6 g/unit	1, 2, 3, 4

Identification of reference Entry no. 1 untreated with fungicides.

Styrelsen för ackreditering och teknisk kontroll (SWEDAC) - SE

Test facilities are accredited by the Swedish Board for Accreditation and conformity Assessment (SWEDAC) under the terms of Swedish legislation. The accredited test facilities meet the relevant requirements for GEP accreditation in SS-EN ISO/IEC 17 025 (2005).

Försöksstationer ackrediteras av Styrelsen för ackreditering och teknisk kontroll (SWEDAC) enligt svensk lag. Den ackrediterade verksamheten vid försöksstationerna uppfyller för GEP-ackreditering relevanta delar av kraven i SS-EN ISO/IEC 17025 (2005).

De i rapporten återgivna resultaten gäller enbart de provade produkterna.

Borgeby in December, 2010

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Åsa Olsson	Robert Olsson
Project manager	Technical Manager