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Efficacy testing of hymexazol in sugar beets, Sweden 2014

HUSEC project code: HU-1402
NBR project code: 424-2014

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Trial ID HU-1402/Study technicians:

HUSEC ID	**NBR ID**	**Trial responsible**	**Site**	**Coordinates**	
HUG021	21	Jörgen Mårtensson	Skibaröd	55.81128	13.53868
HUG022	22	Jörgen Mårtensson	Vallåkra	55.96763	12.86837
HUG023	23	Jörgen Mårtensson	Västergård	55.92008	12.98058

Method: Field trials with randomised complete block design.
Green house experiments

Purpose of trials: Efficacy of hymexazol against *Aphanomyces cochlioides* on sugar beet.

Trial quality: According to GEP standards and EPPO guidelines PP 1/152(4) and PP 1/181(4).

Contents

Summary

One of the most important pathogens is *Aphanomyces cochlioides*. In warm and wet soils, *A. cochlioides* infect seedlings two to three weeks after emergence. Early infections are controlled by treating the seed with hymexazol (active ingredient in Tachigaren). The standard dose used on all commercial sugar beet seed in Sweden is 14 g a. i./unit. The seed treatment is effective for four to six weeks.

This project included three field trials with 7; 14; 18; and 28 g hymexazol compared with 7 g thiram and an untreated control (in total six treatments).

The weather conditions during 2014 were very favourable for development of damping off. Seed treatment with hymexazol resulted in high yield increases in both harvested trials. The highest increase in sugar yield (700–800 kg/ha compared to untreated) was found in 18 and 28 g a.i. hymexazol (average two trials 2014).

There were no phytotoxic effects in terms of necrosis or chlorosis observed on the plants in the field trials.

Since 2004, a total of 21 trials have been performed on highly infested soil. Seed treatment with hymexazol increases plant number significantly compared to the control with more than 7,000 plants/ha on highly infested fields.

Seed treatment with hymexazol has a positive impact and increases sugar yield, sugar content, clean weight and cleanness, average 32 trials 2004–2014.

Sammanfattning

Ett flertal jordburna patogener kan ge upphov till stora skador och skördeförluster i sockerbetor. En av de allvarligaste är *Aphanomyces cochlioides*. Det är framförallt under regniga och varma vårar som problemen kan bli stora med betydande plantbortfall. De tidiga angreppen kan minskas genom att fröet betas med hymexazol. Hymexazol är verksamt cirka fyra veckor efter uppkomst.

Vädret under 2014 var mycket gynnsamt för utveckling av rotbrand. Sockerskörden påverkades positivt av betning med hymexazol och i leden med 18 och 28 g a.i. hymexazol blev det stora skördeökningar, med mellan 700–800 kg socker jämfört med obetat (medel två försök 2014).

Inga fytotoxiska symptom kunde ses på plantorna i fältförsöken.

Totalt har 21 försök utförts sedan 2004 på kraftigt infekterad jord. Hymexazol ökar plantantalet signifikant med minst 7,000 plantor/ha.

Totalt har 32 försök utförts 2004 till 2014 på jordar med olika infektionsnivå. Betning med hymexazol ökar rotvikt, plantantal, sockerskörd och renhet signifikant jämfört med obetat.

Introduction

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 dies. Early seedling infections of *A. cochlioides* may result in low plant number. *A. cochlioides* is found in most soils in Sweden and approximately 25% of the fields have a medium to high risk of *Aphanomyces* root rot.

Early infections can be controlled by treating the seed with hymexazol, the active ingredient of Tachigaren. Hymexazol is the only registered product that is effective against *A. cochlioides*. The standard dose used on all sugar beet seed in Sweden is 14 g/unit.

Materials and methods

General field trial information

Three field trials were conducted in 2014 according to GEP (Good Experimental Practice) standards and the following EPPO guidelines: PP 1/152 (4) Design and analysis of efficacy evaluation trials; PP 1/181 (4) Conduct and reporting of efficacy evaluation trials including GEP.

Experimental design: Randomised complete block design with four replicates. The trials were located as indicated in Figure 1 and Table 1. The single net plot size was 2.88 x 9 m = 25.92 m^2. The gross plot length was 13 m which made it possible to dig up plants for evaluation of root rot.

Table 1. Trial series in HU-1402 2014. General information

HUSEC ID	NBR ID	Trial responsible	Site	Coordinates	
HUG021	21	Jörgen Mårtensson	Skibaröd	55.81128	13.53868
HUG022	22	Jörgen Mårtensson	Vallåkra	55.96763	12.86837
HUG023	23	Jörgen Mårtensson	Västergård	55.92008	12.98058

Treatment information

Treatments 1, 2, 3, 4, 5 and 6 were tested in three field trials (table 2).

Table 2. Treatment information of trial series HU-1402 in 2014

Trtm No.	Treatment Fungicide	g a. i. /unit	Insecticide g a. i. /unit
1	Untreated	0	Imidacloprid 60
2	Thiram	7	Imidacloprid 60
3	Hymexazol	7	Imidacloprid 60
5	Hymexazol	14	Imidacloprid 60
6	Hymexazol	18	Imidacloprid 60
7	Hymexazol	28	Imidacloprid 60

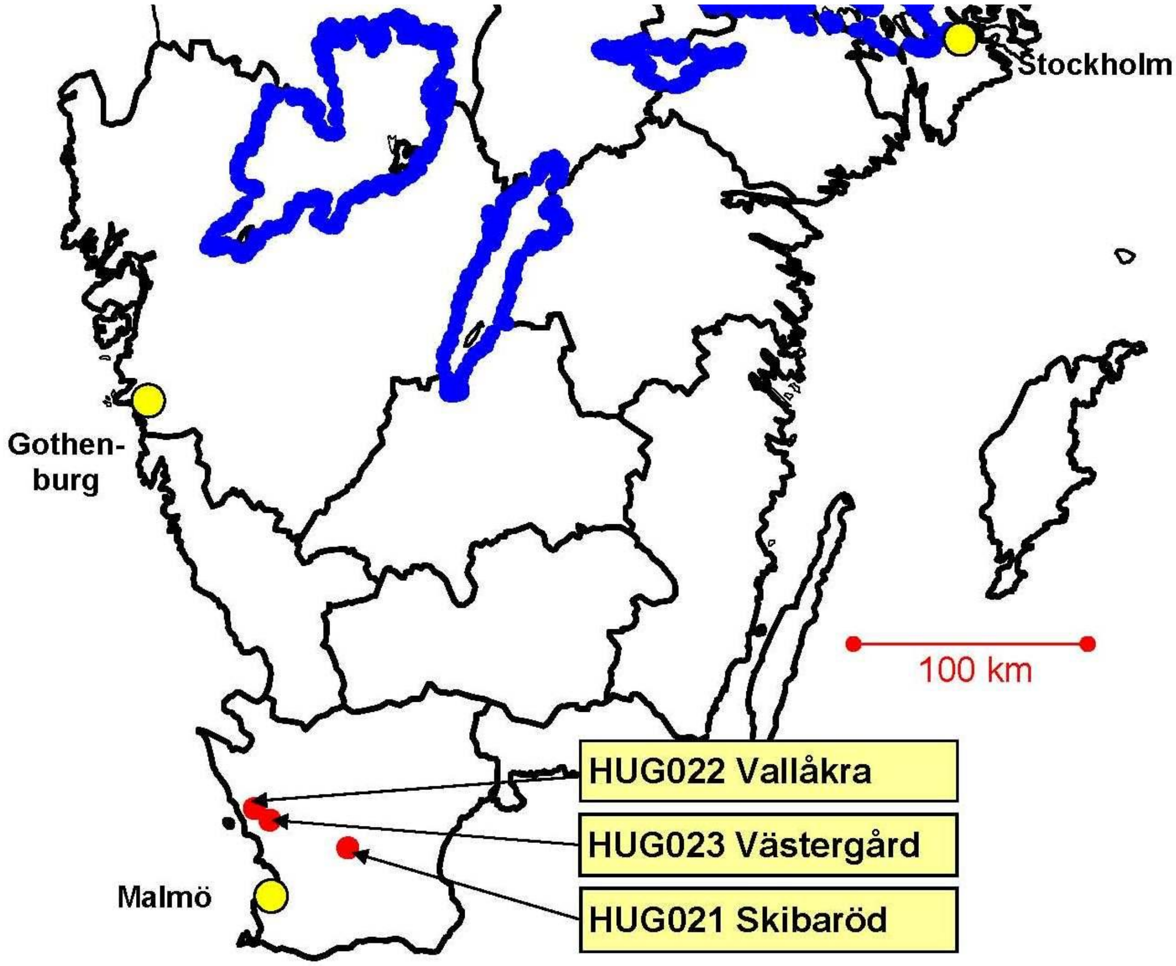

Figure 1. Location of the three trials in series HU-1402 2014.

In late autumn 2013, soil samples were taken from a number of different locations in the south of Sweden and tested for root rot potential in a bioassay. Sugar beet seeds were sown in pots with test soil and then put in greenhouse under conditions favorable for infection of soil borne pathogens.

Table 3. The risk of infection in soils analyzed for disease severity index (Ewaldz, 1992)

Index	Risk	Evaluation
0 – 20	No risk	-
20 – 50	Low	Normally no problems
50 – 70	Medium	Growing sugar beets could be hazardous
70 – 100	High	Under favourable conditions, damping-off is highly likely

The soils are classified into one of four risk groups (Ewaldz, 1992); no risk; low; medium and high (table 3). Three field trial locations were chosen on the basis of the results from the soil tests. The results of the analyses of soil type on each locality are shown in the appendix.

Plant number

The number of plants in the harvest rows, rows three and four, was counted three times during emergence (20%, 50% and final emergence).

Disease severity index

Assessments of disease severity index on field collected seedlings were performed twice in early spring. The first assessment was done when the plants had developed cotyledons and the second assessment 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 placed 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 1–7. The evaluation of chronic root rot was carried out at the tare house in Örtofta (Agri Provtvätt, Örtofta Sockerbruk, Nordic Sugar).

Table 4. Assessment of chronic symptoms of Aphanomyces root rot

Score	Evaluation
1	Big healthy roots without deformations
2	Big healthy roots, some with deformations
3	Roots of normal size, several with slight deformations
4	Roots with reduced size, most with slight deformations
5	Roots with reduced size, most with medium deformations
6	Roots with reduced size, most with severe deformations
7	Very small roots, all with severe deformations

Statistical analysis

All variables were analysed 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

Weather conditions 2014

Temperature and accumulated rainfall during 2013 and 2014 in Borgeby is shown in Appendix 1.

Field trials

The pre-testing of soils for the field trials showed that the DSI before drilling was 86 at Vallåkra, 80 at Skibaröds gård and 80 at Tågarp. *Aphanomyces cochlioides* was isolated from plants in the bioassay as well as from plants collected in the field trials.

Plant number

The trial at Skibaröd was drilled 17 April and Vallåkra 23 April.

Disease development started early at Skibaröd. Emergence at 20% in the untreated control was 20,600 plants/ha and 23,100 in treatment 6 with 28 g a.i. hymexazol (prob. 5% ns).

Emergence at Vallåkra was slightly delayed in treatment 6, 28 g a.i. hymexazol. Disease development started later than at Skibaröd.

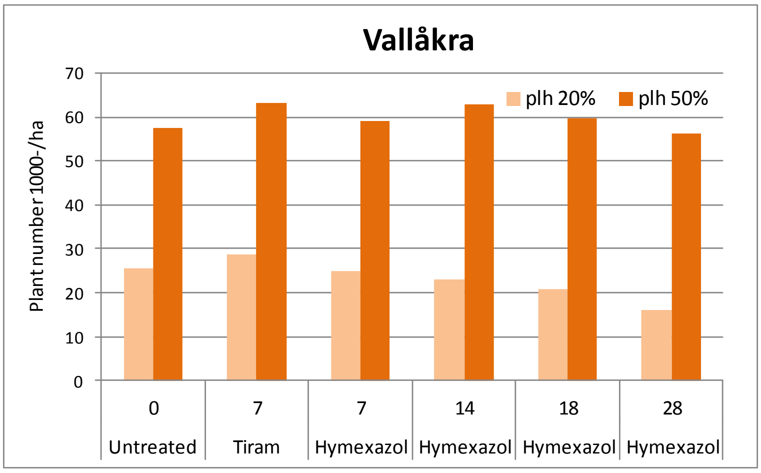

Figure 2. Plant number at 20% and 50% at Vallåkra 2014.
Plh 20%: prob = ns;
Plh 50%: prob = ns.

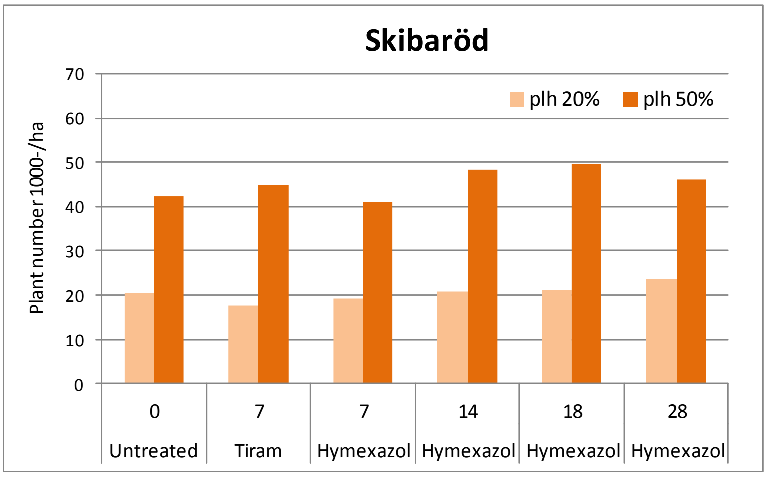

Figure 3. Plant number at 20% and 50% at Skibaröd 2014.
Plh 20%: prob = ns;
Plh 50%: prob = ns.

Final plant number was significantly higher in the treatments with 18 and 28 g a.i. hymexazol than in the untreated control (figure 4). The highest final plant number was found in the treatment with 18 g a.i. hymexazol.

Since 2004, a total of 21 trials have been performed on highly infested soil. Seed treatment with hymexazol increases plant number significantly compared to the control with more than 7,000 plants/ha on highly infested fields (figure 5).

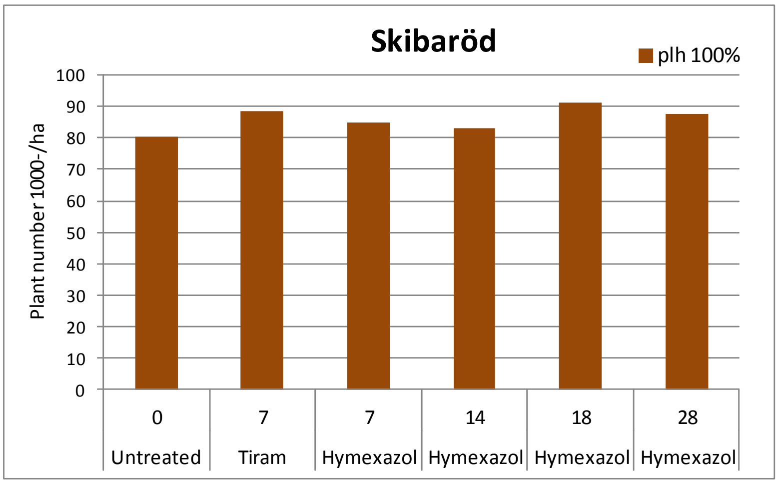

Figure 4. Plant number at 100%, average 2 trials 2014.
Plh 100%: prob = 0.0388,
LSD 5% = 7.0.

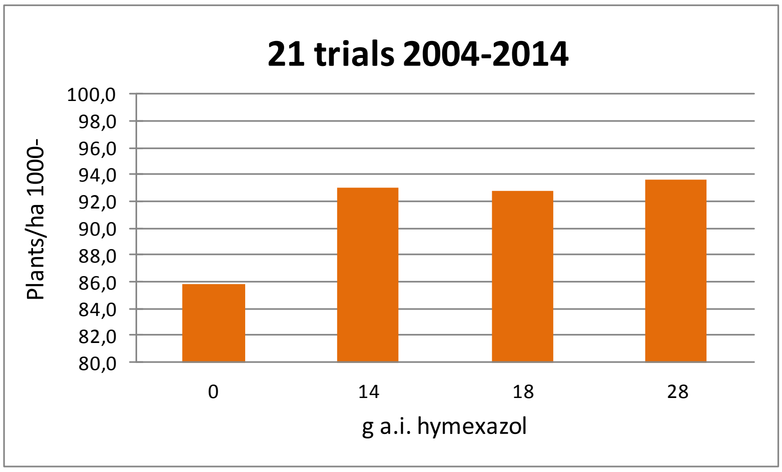

Figure 5. Plant number at 100%, average 21 trials 2004–2014 with high infestation level.
Plh 100%: prob < 0.0001,
LSD 5% = 0.3.

Phytotoxicity

There were no phytotoxic effects in terms of necrosis or chlorosis observed on the plants in the field trials.

Disease severity 2014

DSI 2 at Vallåkra was significantly lower in treatment 6 and 7 with 18 and 28 g a.i. hymexazol, respectively, than in the untreated control (figure 6).

There were no significant differences in DSI 1 or 2 between the treatments at Skibaröd or Tågarp.

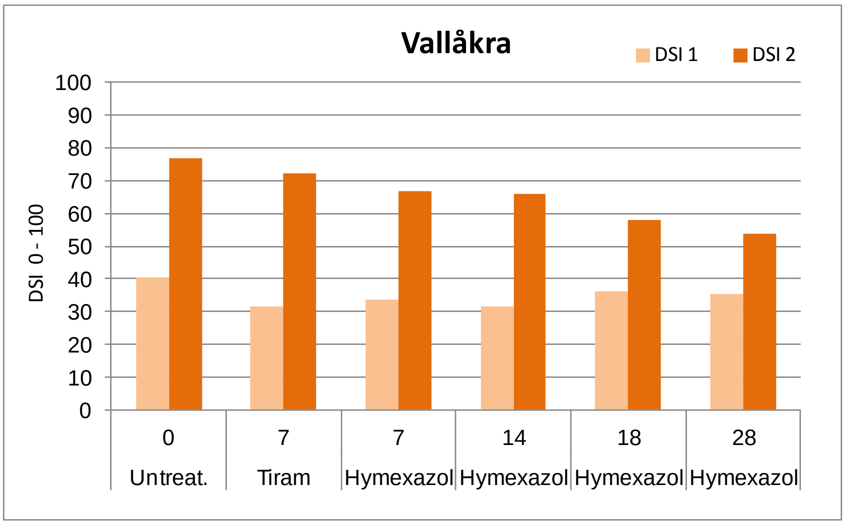

Figure 6. DSI 1 and 2 at Vallåkra 2014.
DSI 1: prob = ns;
DSI 2: prob = 0,0329, LSD 5% = 14.2.

Sugar yield 2014

The trial at Västergård in Tågarp was cancelled from harvest due to problems with uneven plant number. The main cause for this was heavy rain shortly after drilling which resulted in very compacted soil surface.

Seed treatment with hymexazol increased sugar yield with more than 900 kg/ha for 18 and 28 g a.i. hymexazol, in the trial at Vallåkra, prob = ns (figure 7).

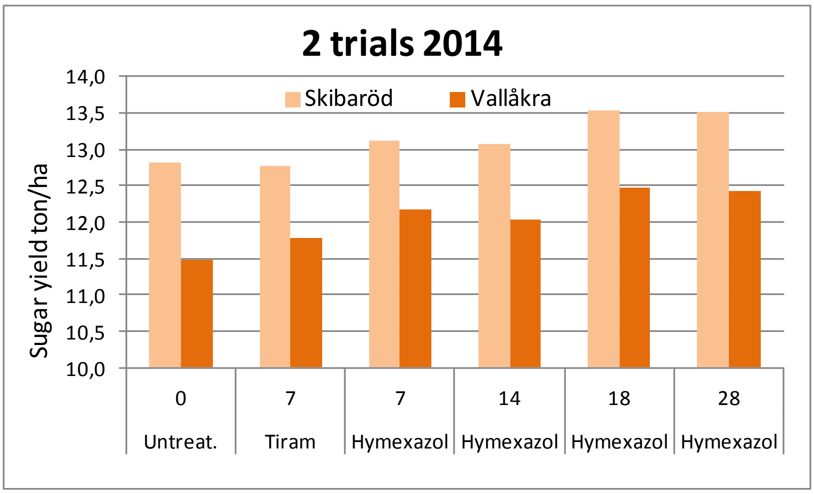

Figure 7. Average sugar yield in 2 trials 2014, prob = ns.

Sugar yield 2004–2014

Since 2004, a total of 21 trials have been performed on highly infested soil. The results from these trials have shown that seed treatment with hymexazol increases sugar yield significantly with at least 400 kg/ha (figure 8).

Since 2004 an total of 32 trials with three dosis og hymexazol has been performed. Sugar yield was increased significantly with more than 200 kg/ha also in these trials (figure 9). Clean weight, sugar content and cleanness were also significantly increased compared to untreated.

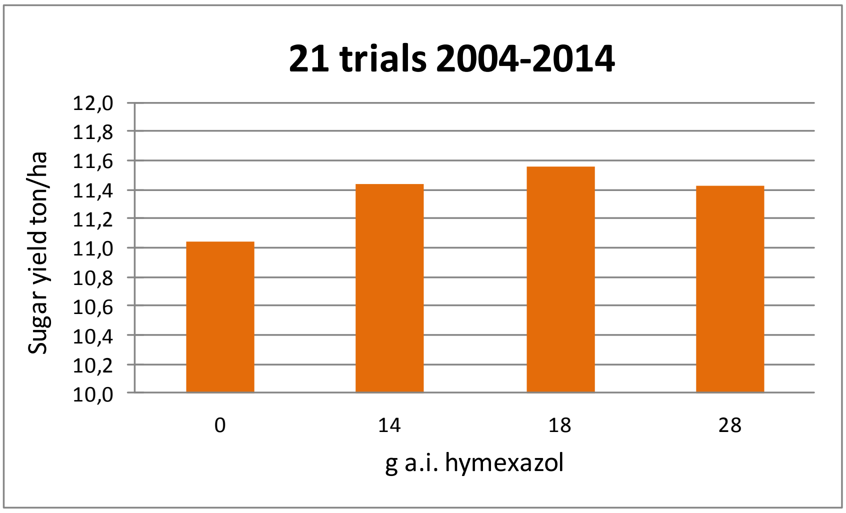

Figure 8. Sugar yield in 21 trials 2004–2014 with high infestation level.
Prob. = 0.0001,
LSD 5% = 0.2.

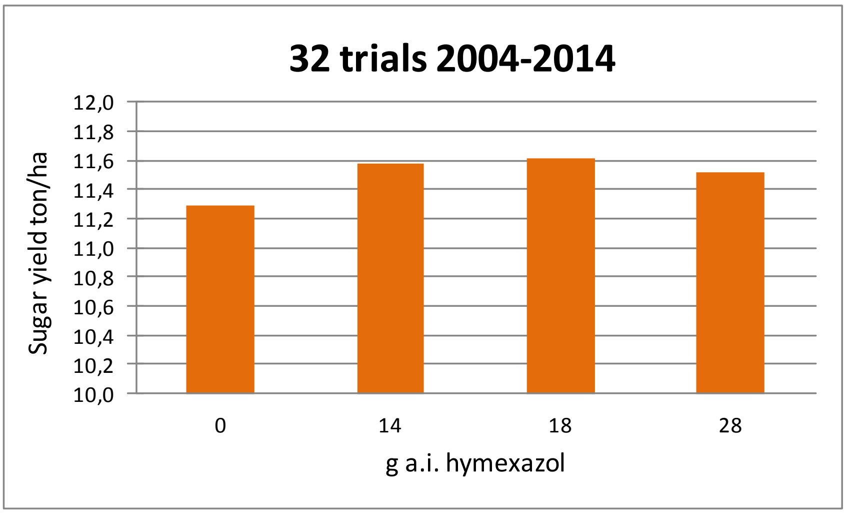

Figure 9. Sugar yield in 32 trials 2004–2014.
Prob. = 0.0013,
LSD 5% = 0.2.

Conclusions

The weather conditions during 2014 were very favourable for development of damping off. Seed treatment with hymexazol resulted in high yield increases in both harvested trials. The highest sugar yield (more than 900 kg/ha compared to untreated) was found in 18 and 28 g a.i. hymexazol (Vallåkra).

There were no phytotoxicity in terms of necrosis or chlorosis observed on the plants in the field trials.

Since 2004, a total of 21 trials have been performed on highly infested soil. Seed treatment with hymexazol increases plant number significantly compared to the control with more than 7,000 plants/ha on highly infested fields.

Seed treatment with hymexazol has a positive impact and increases sugar yield, sugar content, clean weight and cleanness, average 32 trials 2004–2014.

References

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Borgeby in December 2014

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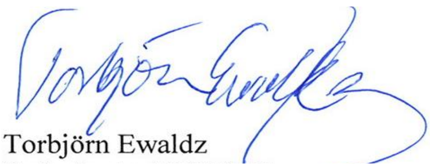
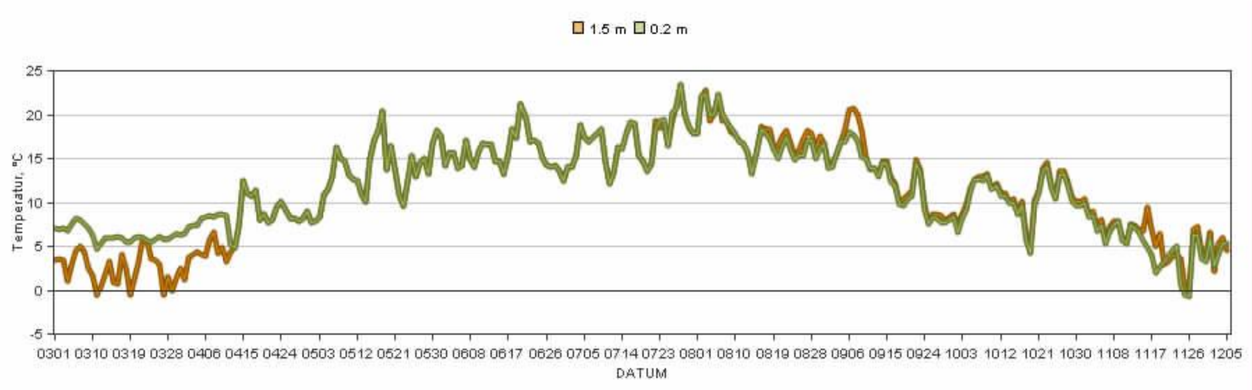


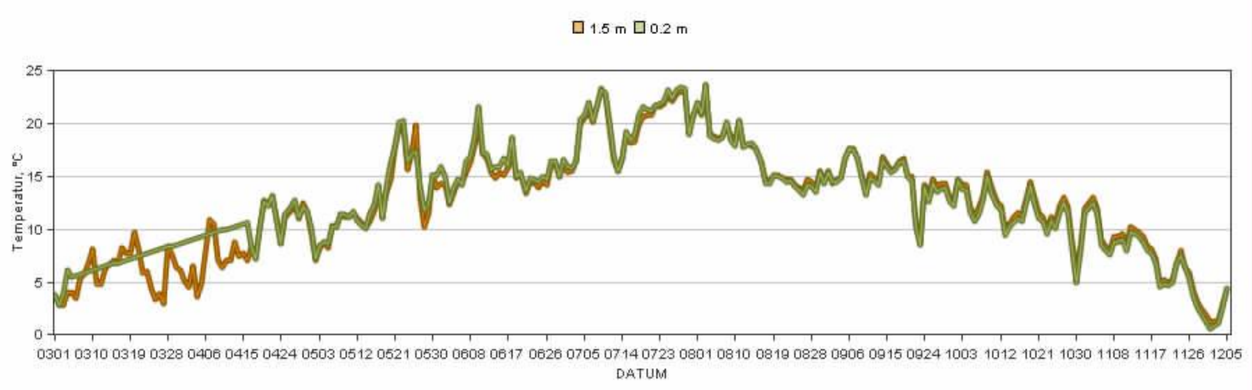
Torbjörn Ewaldz

Study director HS M HUSEC

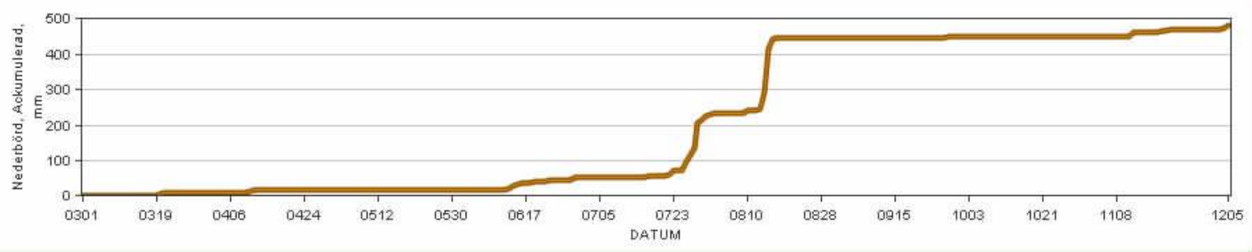
Appendix 1



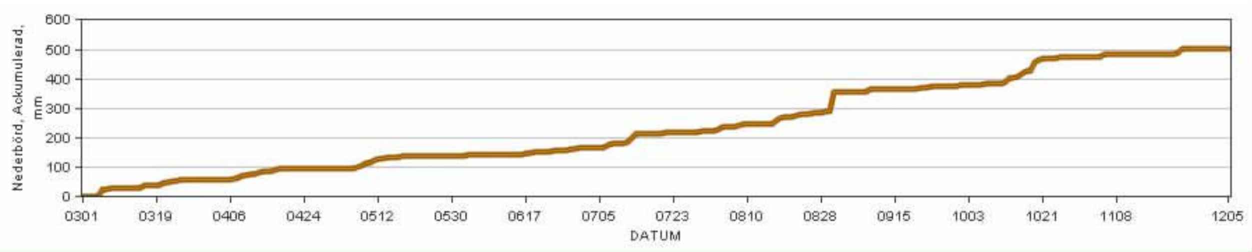
Average temperature per day 1 March to 5 December in Borgeby 2013, data from Lantmet (www.ffe.slu.se)



Average temperature per day 1 March to 5 December in Borgeby 2014, data from Lantmet (www.ffe.slu.se)



Accumulated rain (mm) 1 March to 5 December in Borgeby 2013, data from Lantmet (www.ffe.slu.se)



Accumulated rain (mm) 1 March to 5 December in Borgeby 2014, data from Lantmet (www.ffe.slu.se)