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Nordic Beet Research

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GEP

Efficacy testing of hymexazol in sugar beets, Sweden 2013

HUSEC project code: HU-1343
NBR project code: 424-2013

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Trial ID/ Study technicians:			
	HUF102	Skibaröd	Jörgen Mårtensson
	HUF103	Norrehem	Jörgen Mårtensson
	HUF104	Östrabo	Jörgen Mårtensson

HUSEC and NBR trial IDs:	HUSEC	NBR
	HUF102	= 21-424 Skibaröd
	HUF103	= 22-424 Norrehem
	HUF104	= 23-424 Östrabo

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

Purpose of trials: Evaluation of 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

Several soil borne pathogens can cause substantial damage to sugar beet roots. 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 3.5; 7; 14; 18; 28 and 56 g hymexazol compared with 7 g thiram and an untreated control (in total eight entries).

At 20% emergence in the field trials, the seed treatments with 56 g hymexazol showed significantly slower emergence than all other treatments, mean 3 trials 2013, prob = 0,0045, LSD 5% = 6.1. There were however no significant differences in final plant number between the seed treatments.

No phytotoxic effect following seed treatment with hymexazol in terms of chlorosis or necrosis was observed on the plants in the field. No stunting was observed on the plants treated with 28 or 56 g hymexazol.

In addition this report has analyzed the effect of seed treatment during a ten-year period.

DSI (Disease Severity Index) has been investigated in a total of 30 field trials 2004-2013. Seed treatment reduced DSI significantly in 2013 as well as in all 30 trials.

In total, 30 trials with 0, 14, 18 and 30 g hymexazol have been analyzed 2004–2013. The results show that a seed treatment with hymexazol has a significant positive impact on all yield parameters; root weight, sugar content, sugar yield, amino-N and K+Na. Sugar yield is increased by 280 kg/ha in the standard dose 14 g hymexazol.

The plant number in treatments with hymexazol is also significantly increased with more than 5000 plants/ha compared to untreated (30 trials, 2004-2013; prob. = <0.0001, LSD 5% = 2.3).

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 skadorna ger också upphov till kroniska skador på rötterna. Senare på tillväxtsäsongen, framförallt vid mycket regn, reduceras tillväxten. De tidiga angreppen kan minskas genom att fröet betas med hymexazol. Hymexazol är verksamt cirka fyra veckor efter uppkomst.

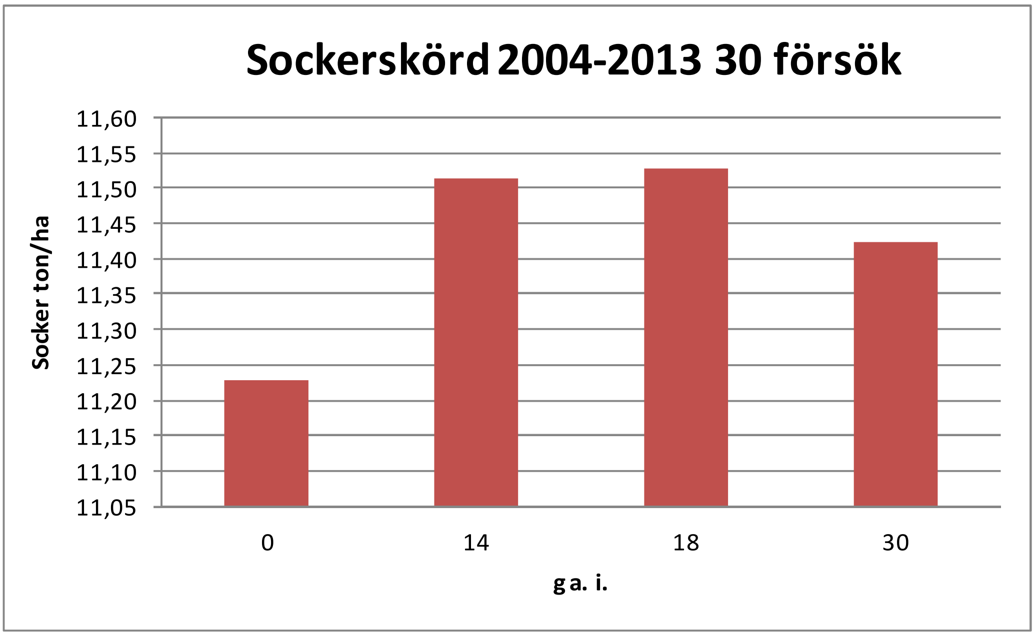
I denna försöksserie testades sex doser av hymexazol (3,5; 7; 14; 18; 28 och 56 g) i tre fältförsök utlagda i Skåne (Skibaröd i centrala Skåne, Norrehem utanför Löddeköpinge och Östrabo söder om Anderslöv). Som kontroll användes helt obetat men pelleterat frö samt ett led endast betat med 7 g tiram.

Vid 20% uppkomst hade ledet med 56 g hymexazol signifikant lägre uppkomst än övriga led (3 försök 2013, prob = 0,0045, LSD 5% = 6.1). Det fanns inga signifikanta skillnader mellan leden i slutligt plantantal.

Inga fytotoxiska skador kunde observeras på plantorna i fältförsöken.

DSI (Disease Severity Index) har undersökts i totalt 30 försök 2004-2013. Betningarna med hymexazol reducerar DSI signifikant vid båda bedömningstillfällena under uppkomst.

Totalt har 30 fältförsök med 0, 14, 18 och 30 g hymexazol gjorts mellan 2004–2013. Resultaten visar att betning med hymexazol har en signifikant positiv inverkan på alla skördeparametrar: rotvikt, sockerhalt, sockerskörd, blåtal och K+Na. Sockerskörden ökar med 280 kg/ha för standarddosen 14 g a.i. hymexazol.



Resultaten visade också att även plantantalet påverkas positivt av betning med hymexazol. Plantantalet ökar med fler än 5000 plantor/ha jämfört med obehandlat (30 försök, 2004-2013; prob. = <0.0001, LSD 5% = 2.3).

Introduction

Several soil borne pathogens can cause substantial damage to sugar beet roots. 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 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* is found in most soils in Sweden and approximately 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.*, 2010.).

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 2013 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-1343 2013. General information

Trial ID HUSEC	Location	Coordinates WGS 84	Soil type
HUF102	Skibaröd	WGS 84: N 55.81123 Ö 13.53795	Medium humus rich light sand
HUF103	Norrehem	WGS 84: N 55.35901 Ö 13.32294	Medium humus rich loam soil
HUF104	Östrabo	WGS 84: N 55.77418 Ö 13.02982	Loam soil

Trial ID HUSEC	Previous crop	Variety	Sowing date	Seed distance, seeds/m
HUF102	Winter wheat	Harpoon	21 April	5.4
HUF103	Spring barley	Harpoon	9 April	5.7
HUF104	Winter wheat	Harpoon	19 April	5.7

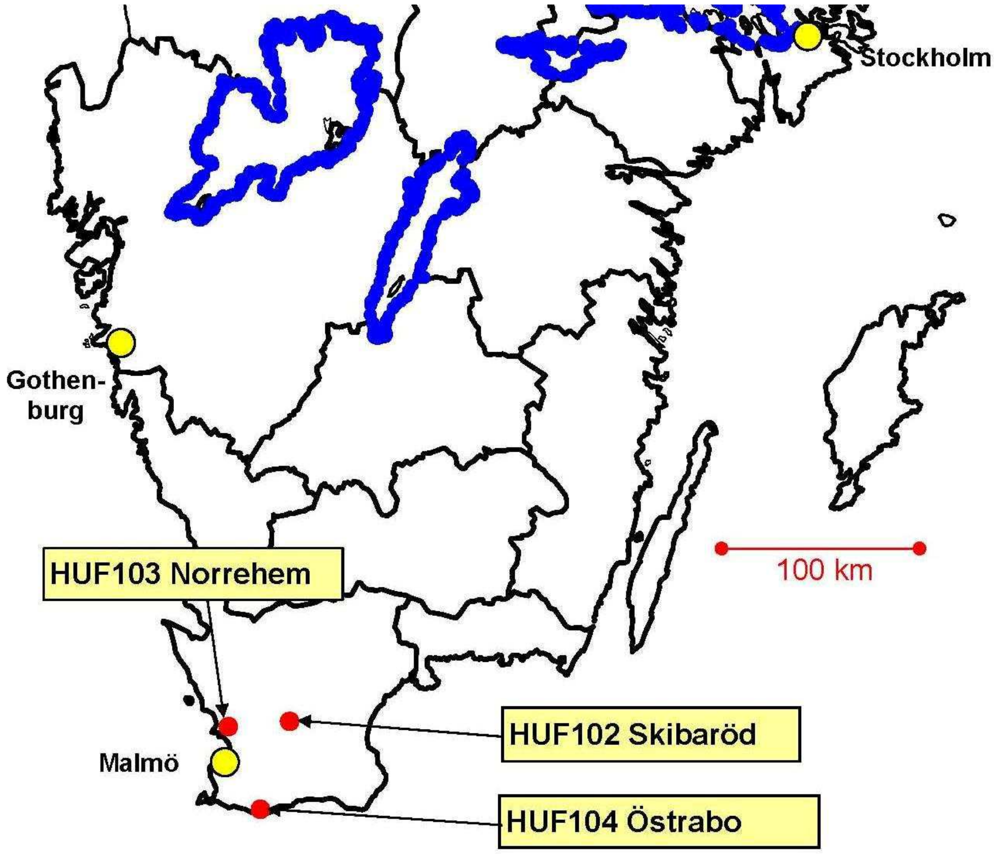


Figure 1. Location of the three trials in series HU-1343 2013.

Treatment information

Treatments 1, 2, 3, 4, 5, 6, 7, 8 were tested in three field trials (table 2).

Table 2. Treatment information of trial series HU-1343 in 2013

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	3,5	Imidacloprid 60
4	Hymexazol	7	Imidacloprid 60
5	Hymexazol	14	Imidacloprid 60
6	Hymexazol	18	Imidacloprid 60
7	Hymexazol	28	Imidacloprid 60
8	Hymexazol	56	Imidacloprid 60

In late autumn 2012, 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).

Plant vigour

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 indicate somewhat 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

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 2013

Temperature and accumulated rainfall 2012 and 2013 at Borgeby and Anderslöv is shown in Appendix 1. The growing conditions after drilling 2013 were cold which led to low disease development.

Field trials

The pre-testing of soils for the field trials showed that the DSI before drilling was 66 at Norrehem, 66 at Skibaröds gård and 74 at Östrabo. *Aphanomyces cochlioides* was isolated from plants in the bioassay as well as from plants collected in the field trials.

Plant number

When the plant number was counted at 20% emergence in the field trials, the seed treatments with 56 g hymexazol showed a significantly slower emergence than all other treatments, mean 3 trials 2013, prob = 0,0045, LSD 5% = 6.1 (figure 1). There were however no significant differences in final plant number between the seed treatments.

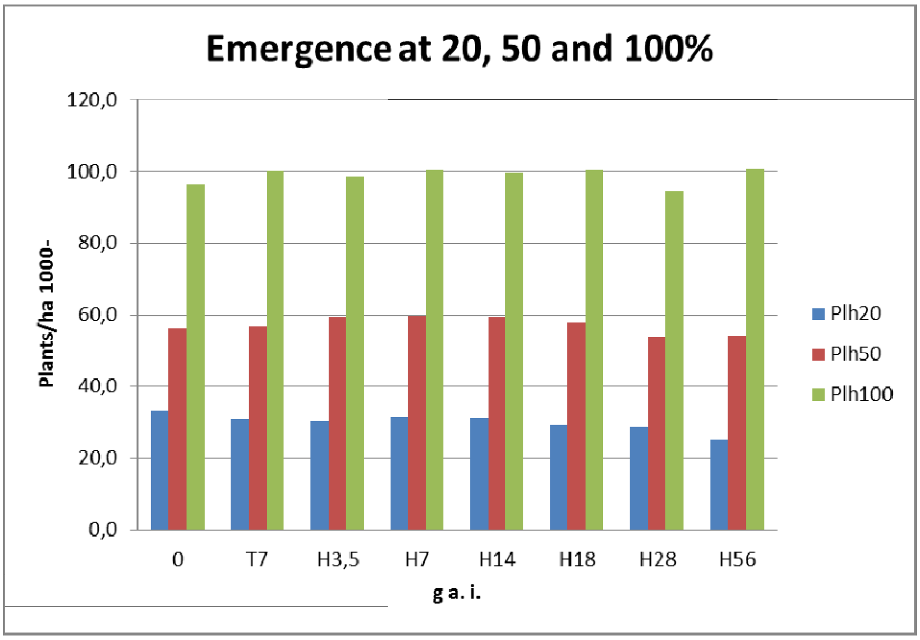


Figure 1. Plant number at 20%, 50% and 100% emergence, average over three trials 2013. Plh20%: prob = ns; Plh50%: prob = 0.0298 LSD 5% = 4.3; Plh100%: prob = ns. T7 = tiram 7g.a.i; H3,5-H56 = hymexazol 3,5-56 g.a.i

Vigour

There were significant differences in vigour between the treatments at Skibaröd 7 June, prob = 0.0031, LSD 5% = 6.1 (figure 2).

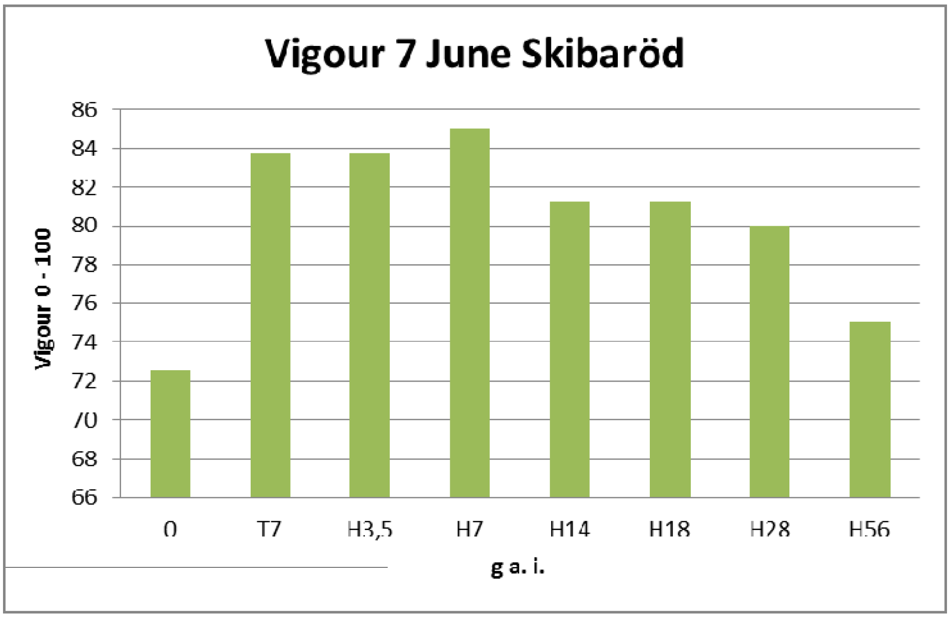


Figure 2. Evaluation of vigour at Skibaröd 2013, 7 June. T7 = tiram 7g.a.i; H3,5-H56 = hymexazol 3,5-56g.a.i.

Disease severity 2013

The cold weather after emergence resulted in low infections of *A. cochlioides*. There were no significant differences in DSI 1 and 2 between the seed treatments in 2013.

Disease severity 2004-2013

DSI has been investigated in a total of 30 field trials 2004-2013. Seed treatment reduces DSI significantly in both evaluations.

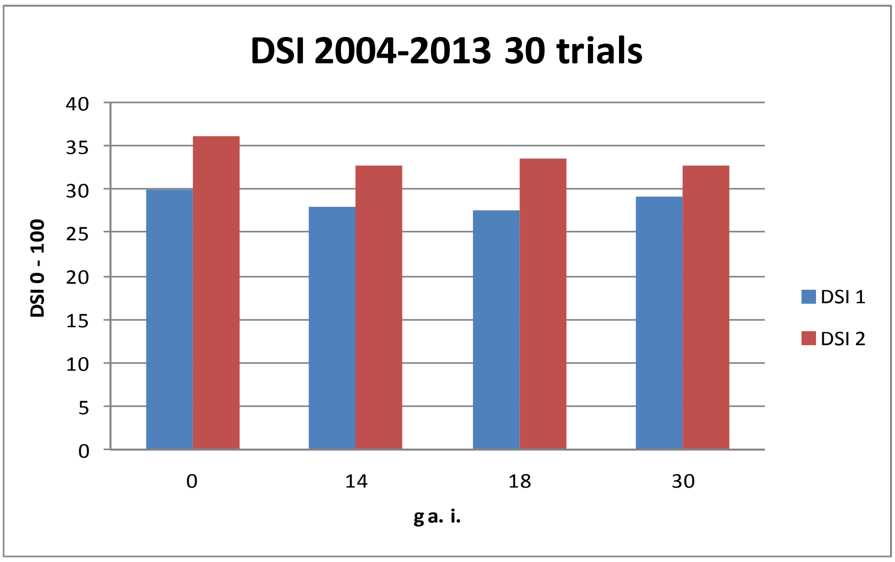


Figure 3. Evaluation of DSI, 30 trials 2004-2013. DSI 1 Prob. = 0,0024, LSD 5% =1.4; DSI 2 Prob. = 0,0003, LSD 5% =1.7. Numbers under the bars indicate amounts of ingredient hymexazol (g.a.i/seed unit).

Sugar yield 2013

There were no significant differences in yield 2013.

Sugar yield 2004–2013

In total, 30 trials with 0, 14, 18 and 30 g hymexazol have been studied since 2004. The results show that a seed treatment with hymexazol has a significant positive impact on all yield parameters; sugar content, sugar yield, amino-N and K+Na.

Sugar yield is increased by 280 kg/ha in the standard dose 14 g hymexazol.

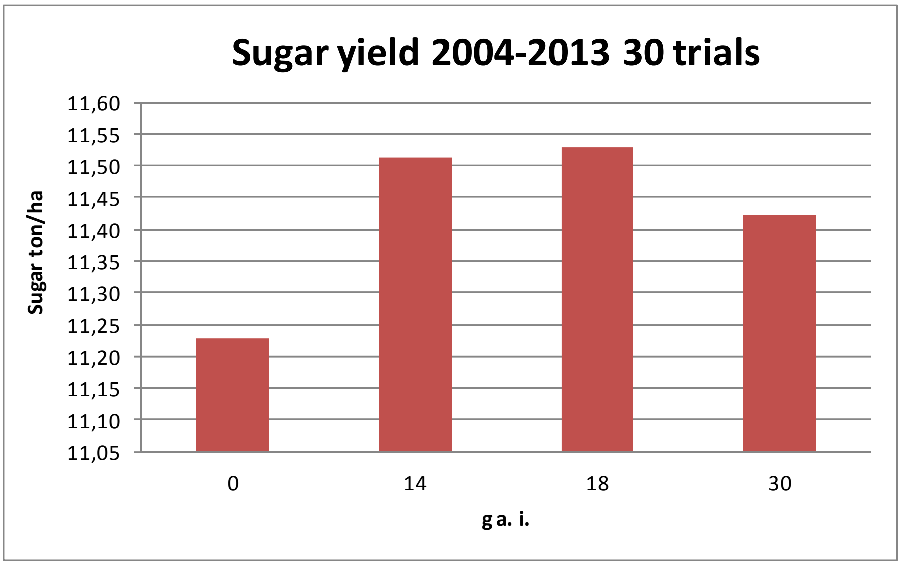


Figure 4. Sugar yield in 3 trials 2004–2013. Prob. = 0.0057, LSD 5% = 0.2.Numbers under the bars indicate amounts of ingredients hymexazol (g.a.i/seed unit)

Phytotoxicity

When the plant number in the field trials was counted 2013 at 20% emergence, the seed treatments with 56 g hymexazol showed a significantly slower emergence than the other tested doses and the control at Östrabo. There were no significant differences in the other trials.

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

Conclusions

When the plant number in the field trials was counted at 20% emergence, the seed treatments with 56 g hymexazol showed a significantly slower emergence than all other entries in one of the three trials. Final plant number was however not affected.

No phytotoxic effect due to seed treatment with hymexazol in terms of chlorosis or necrosis was observed on the plants in the field. No stunting was observed on the plants treated with 28 or 56 g hymexazol.

In total, 30 trials with 0, 14, 18 and 30 g hymexazol have been analyzed 2004–2013. The results show that a seed treatment with hymexazol has a significant positive impact on all yield parameters; root weight, sugar content, sugar yield, amino-N and K+Na. Sugar yield is increased by 280 kg/ha in the standard dose 14 g hymexazol.

The plant number in treatments with hymexazol is also significantly increased with more than 5000 plants/ha compared to untreated (30 trials, 2004-2013; prob. = <0.0001, LSD 5% = 2.3).

References

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Borgeby in January 2014

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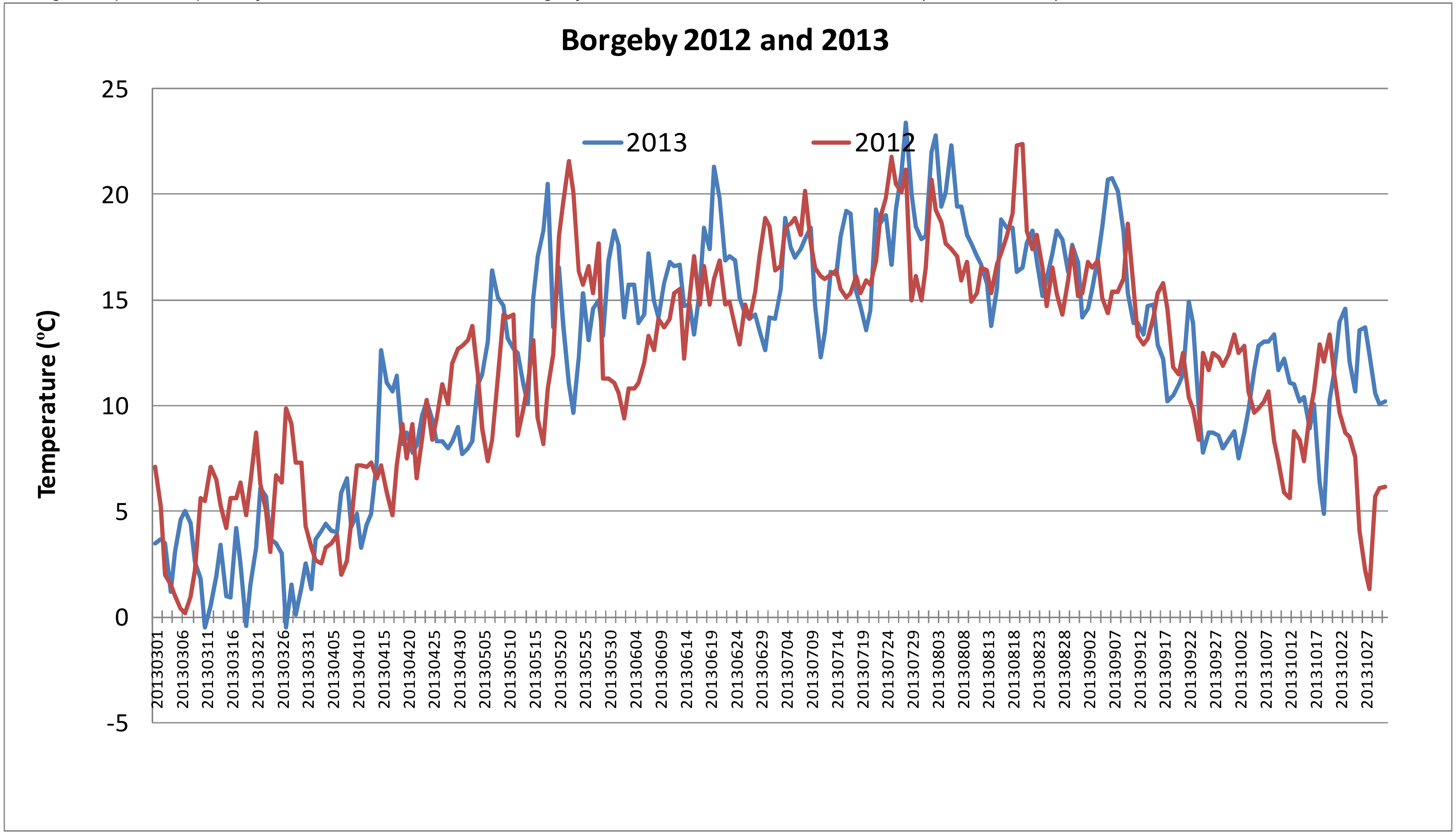
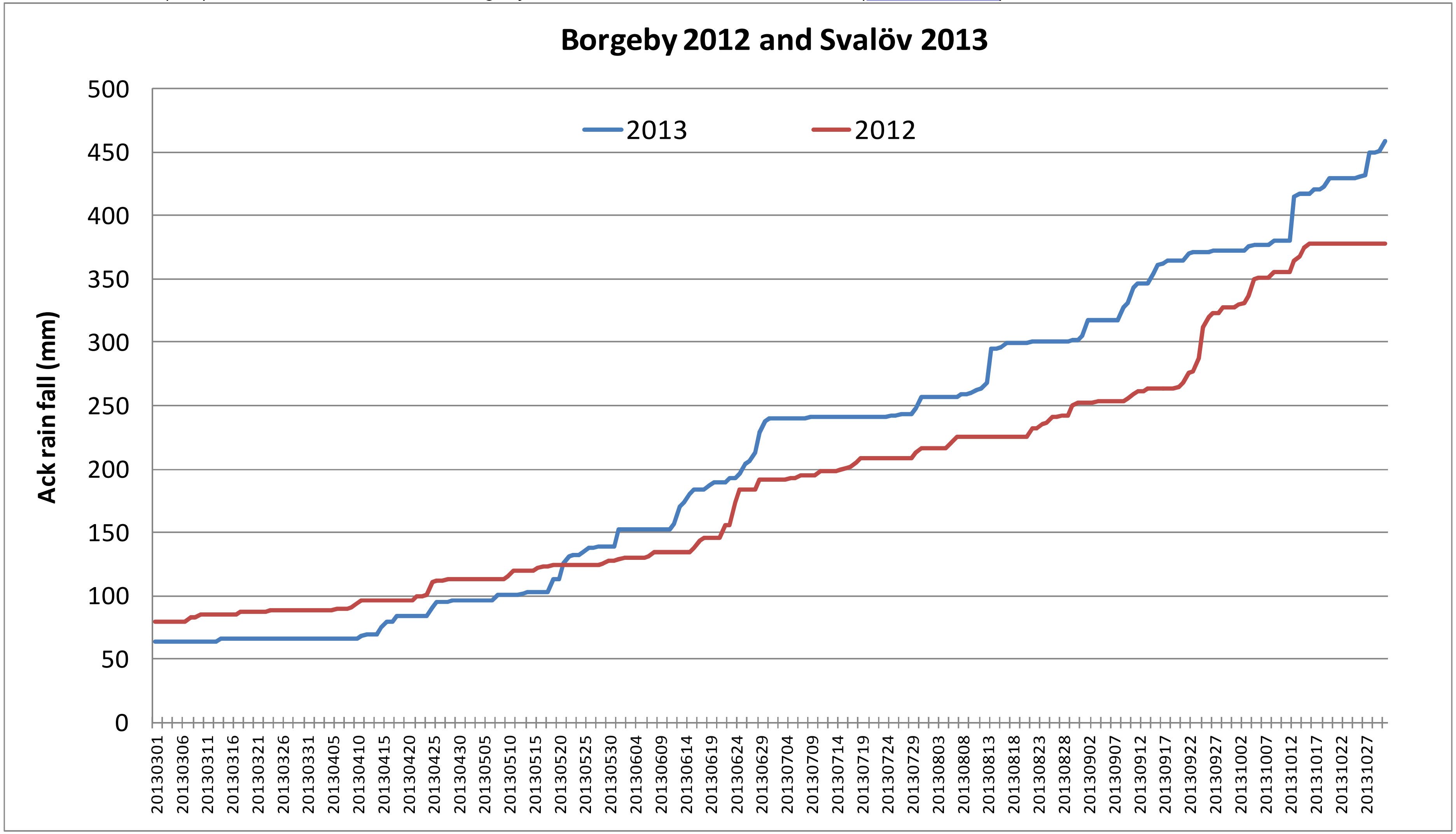
Appendix 1

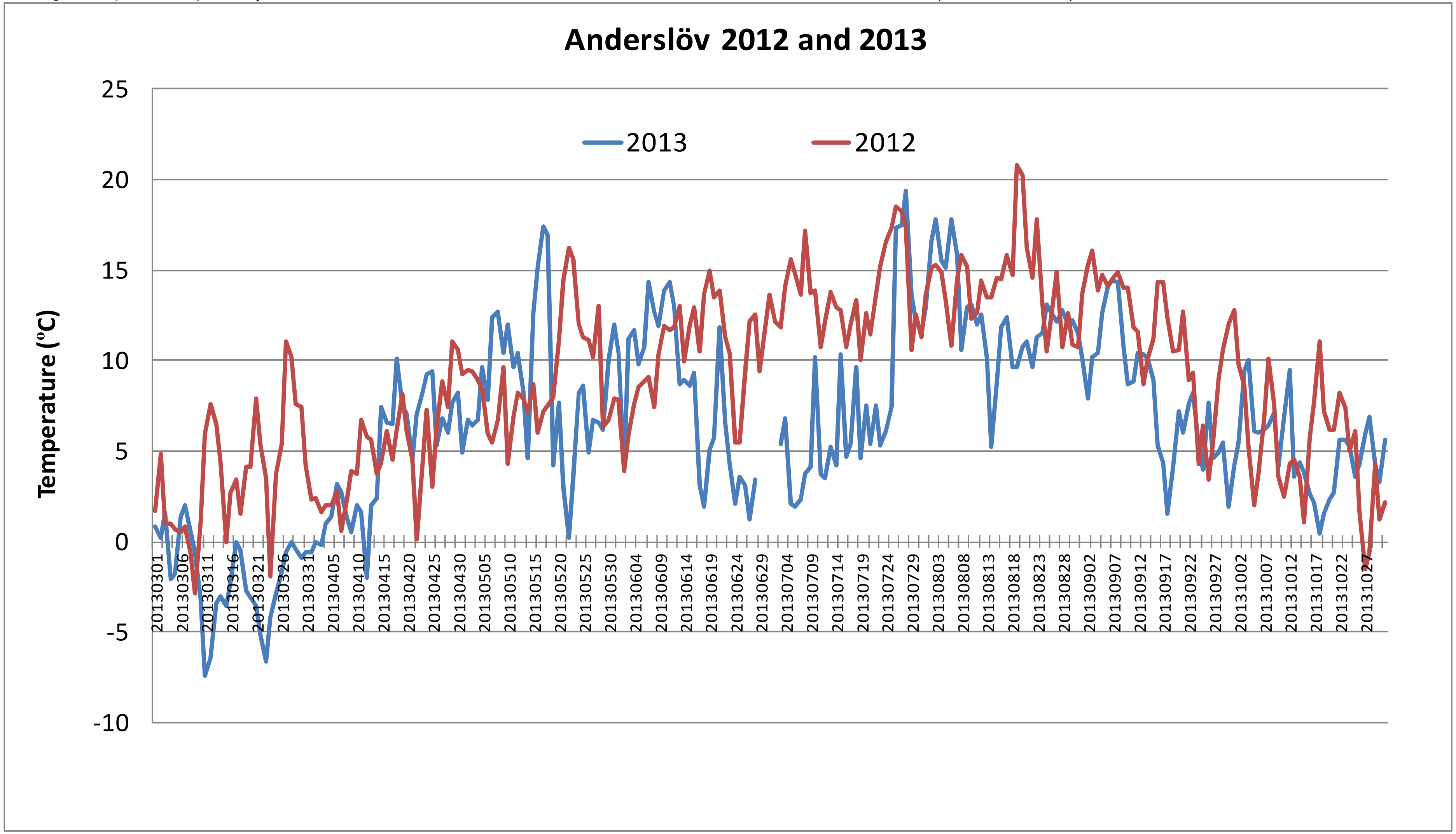
Average temperature per day 1 March to 31 October in Borgeby 2012 and 2013, data from Lantmet (www.ffe.slu.se)



Accumulated rain (mm) 1 March to 31 October in Borgeby 2012 and 2013, data from Lantmet (www.ffe.slu.se)



Average temperature per day 1 March to 31 October in Anderslöv 2012 and 2013, data from Lantmet (www.ffe.slu.se)



Accumulated rain (mm) 1 March to 31 October in Anderslöv 2012 and 2013, data from Lantmet (www.ffe.slu.se)