424-2009
GEP Report

Svampbetning mot jordburna svampsjukdomar 2009

Seed treatments against soil borne fungi 2009

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Seed treatments against soil borne fungi in sugar beets 2009

Sammanfattning

Denna försöksserie utförs på uppdrag av DuPont Sverige AB och har som mål att prova tre olika doser av hymexazol (14, 18 och 30 g aktiv substans/enhet) som är den verksamma substansen i Tachigaren. Försöken har legat på tre olika fält (Ekebergs gård i Kristianstad, Skiberöds gård i Löberöd och Västergård i Tågarp). I Sverige används för närvarande 14 g hymexazol på allt frö som säljs till lantbrukare. Odlingsåret 2009 började med en relativt tidig sådd och medelsådatum blev en vecka tidigare än femårsgenomsnittet. Vädret efter sådd var torrt och varmt, vilket gjorde att angreppsgraden av rotbrand generellt blev låg.

I försöken gjordes planträkningar vid fyra tillfällen (20, 50, 100 % samt slutlig uppkomst) och sundhet samt rotbrandsbedömningar vid två tillfällen. Samtliga försök skördades och betorna bedömdes också för kroniska rotbrandsskador.

Resultaten från årets försök visar, i likhet med tidigare år, att svampbetning med hymexazol har stor effekt på antalet plantor som ökar med 6 000–7 000 per hektar. Svampbetning är ett bra sätt att försäkra sig om ett tillräckligt högt plantantal. Sett över alla 18 försök som legat sedan 2004 är ökningen av antalet plantor per hektar 9 000–10 000.

I genomsnitt över 18 försök gav svampbetning med hymexazol 2 till 3 % ökning av sockerskörden. Även sockerhalten ökade signifikant med ca 0,1 %.

Summary

In 2009, the sugar beets were drilled early, in the beginning of April. Because of the very dry spring, root rot infections were generally low in the whole growing area. Three trials where drilled, one at Ekebergs gård in Kristianstad, one at Skiberöds gård in Löberöd and one at Västergård in Tågarp).

Despite the very low root rot infections during 2009, seed treatment with fungicides increased the number of plants with around 6 000–7 000 plants per hectare. The average increase in plant number in hymexazol treated treatments compared to the untreated control over all 18 trials (2004–2009) is 9 000–10 000 plants per hectare.

Yield parameters have been investigated in a total of 18 field trials during 2004–2009. The average over all 18 trials shows that seed treatment with hymexazol (14, 18 and 30 g) has a significant positive effect on sugar content and sugar yield. The sugar yield is increased by 2 to 3 percent. There is also a tendency for higher root weight and lower amino-N.

Introduction

A number of soil borne fungi may cause substantial damage in sugar beet fields. One of the most important fungi in Sweden is *Aphanomyces cochlioides*. Particularly in warm and wet soils, *A. cochlioides* infect young seedlings two to three weeks after emergence. The hypocotyl (region between root and cotyledons) rots and the seedling is killed. Early seedling infections of *A. cochlioides* can result in low plant numbers on the field. The disease also exists in a chronic form that appear later in the growing season, often following periods with heavy rains. The symptoms of this stage of the disease are a general reduction of the growth and often a severely and a typically deformed tap root.

Early infections can be controlled by treating the seed with hymexazol, the active ingredient of Tachigaren. The standard dose used on all 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, Tachigaren 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 2008, 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 fungi. Sugar beet seeds were sown in pots with test soil and then put in greenhouse under conditions favourable 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 appendix 3.

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 five 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 (Ekebergs gård in Kristianstad in the north east of Skåne, Skiberöds gård in Löberöd in the central part of Skåne and Västergård in Tågarp in the north west 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)). The results are shown in appendix 5.

Plant vigour and row coverage

Plant vigour was evaluated 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 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. The results on plant vigour are shown in appendix 5.

Disease severity index

Evaluation of disease severity index was performed twice in early spring. The first evaluation took place when the plants had just 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% (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 appendix 7. Pieces of roots were put on agar plates and fungi were determined to genera and species based on morphology. A summary over 15 trials is shown in appendix 7.

Harvest

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

Table 1. Evaluation of chronic symptoms of root rot

1 = Weak symptoms on max. 25% of the beets
2 = Weak symptoms on max. 50% of the beets
3 = Weak symptoms on max. 75% of the beets
4 = Strong symptoms on 25% of the beets
5 = Strong symptoms on 50% of the beets
6 = Strong symptoms on 75% of the beets
7 = Severe symptoms on all beets

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). The results are shown in appendix 6.

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 analyses of DSI with the purpose of choosing trial locations showed that the DSI was 82 at Ekebergs gård, 67 at Skiberöds gård and 88 at Västergård.

The final number of plants at Skiberöd was significantly increased for the fungicide treatments (14, 18 and 30 g) compared with the control. The increase was over 10 000 plants per hectare.

Table 2 shows the results of isolations that were done on plants collected in the field.

Table 2. Soil borne fungi isolated from plants collected in the three field trials

Location	Fungi	DSI
Ekebergs gård	*Aphanomyces, Fusarium culmorum*	82
Skiberöds gård	*Aphanomyces, Fusarium culmorum, F. redolens*	67
Västergård	*Aphanomyces, Pythium, Fusarium culmorum*	88

The evaluation of DSI 2 at Ekebergs gård showed that there were significant differences between the control and the fungicide treatments, which had lower DSI 2. The average DSI 2 for the treatments with 14, 18 and 30 g hymexazol, respectively, over all three trials was also lower than in the control (not significant).

There were no chronic symptoms of root rot observed in any of the trials 2009.

Green house experiment

The results from the green house trial showed that all treatments, 14, 18 and 30 g hymexazol had significantly lower DSI than the untreated control. The average over five experiments show that the DSI for 14, 18 and 30 g is below 50. The DSI for the untreated control was 60.1. There was no significant difference between the three doses.

Yield 2009

The average over three trials 2009 showed no significant differences in yield between the treatments. However, in two of the trials, Skiberöd and Ekeberg, 18 and 30 g hymexazol showed higher yield (not significant). At Ekebergs gård the increase was 3 and 4%, respectively, higher than in the control treatment, and at Skiberöd, 6% for both 18 and 30 g.

Yield 2004–2009

Yield parameters have been investigated in a total of 18 field trials during 2004–2009. The average over all 18 trials show that seed treatment with hymexazol has a significant positive effect on sugar content and sugar yield (appendix 9). The sugar yield was increased by 2 to 3%. There was also a tendency for higher root weight.

When the average yield was calculated in the trials where high infestation levels were observed, there was a significant increase in sugar yield for the fungicide treatments with 5 to 6% compared to the untreated control. Root weight and sugar yield were significantly higher, amino-N and K-Na was significantly lower than in the untreated control.

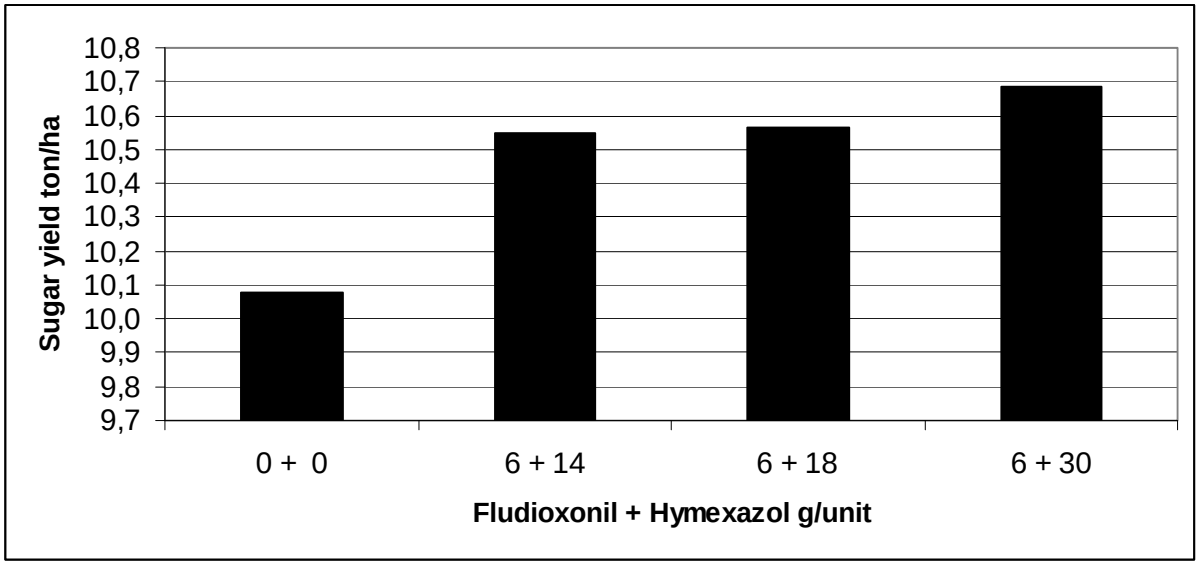

Figure 1. Average sugar yield in the trials with high infestation levels (LSD = 0.3, Prob = 0.0009).

For the trials where very low infestations was observed there were no significant difference in yield between the treatments. However, there was a significant difference in plant number which was increased by 2 000–3 000 plants per hectare in the fungicide treatments compared to the untreated control.

Conclusions

The average increase in plant number in hymexazol treated treatments compared to the untreated control (18 trials 2004–2009) is 9 000–10 000 plants per hectare.

The average over 18 trials 2004–2009 show that seed treatment with hymexazol has a significant positive effect on sugar content and sugar yield.

In the trials with high infestation levels (11 trials 2004–009), there was a significant increase in sugar yield for the fungicide treatments with 5 to 6% compared to the untreated control. Root weight and sugar yield was significantly higher, amino-N and K+Na was significantly lower than in the untreated control.

In the trials with low infestation levels (7 trials 2004–2009), there were no significant difference in yield between the treatments. However, there was a significant difference in plant number which was increased by 2 000–3 000 plants per hectare in the fungicide treatments compared to the untreated control.

References

Broders, K. D., Lipps, P. E., Paul, P. A. and Dorrance, A. E. 2007. Evaluation of *Fusarium graminearum* associated with corn and soybean seed and seedling disease in Ohio. Plant disease 91(9): 1155–1160.

Dorrance, A. E., Kleinhenz, M. D., McClure, S. A. and Tuttle, N. T. 2003. Temperature and seed treatment effects on *Rhizoctonia solani* root rot of soybean. Plant disease 87(5): 533–538.

Larsson, M. and Gerhardson, B. 1990. Isolates of *Phytophthora cryptogea* pathogenic to wheat and some other crop plants. Journal of Phytopathology 129: 303–315.

Mueller, D. S., Hartman, G. L. and Pedersen, W. L. Development of Sclerotia and apothecia of *Sclerotinia sclerotiorum* from infected soybean seed and its control by fungicide seed treatment. Plant disease 83(12): 1113–1115.

Munkvold, G. P. and O'Mara, J. K. 2002. Laboratory and growth chamber evaluation of fungicidal seed treatments for maize seedling blight caused by *Fusarium* species. Plant disease 86 (2): 143–150.

Olaya, G., Abawi, G. and Barnard, J. 1994. Response of *Rhizoctonia solani* and binucleate *Rhizoctonia* to five fungicides and control of pocket rot of table beets with foliar sprays. Plant disease 78(11): 1033–1037.

Persson, L. and Olsson, Å. 2006. Åtgärder mot jordburna svampar i sockerbetor under odling och lagring 2003–2005. Project report SBU. http\:rapporter.sockerbetor.nu.

GEP information

No of series and title	424-2009 Fungicide treatments against soil borne fungi in sugar beet
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: Jesper
Methodology	Description of methods and evaluations: see appendix 1 (field plan) for references to PM in NBR quality handbook (Sweden).

Non conformances

Skiberöd, block II: plot length corrected to 6.5 m due to error during plant sampling.
Tågarp: Plot no = 4240, block I, rows 4 and 5 harvested.
Plot no = 4245, block IV, rows 2 and 3 harvested.
Plot no = 4248, block IV, rows 4 and 5 harvested.

Trial locations

Trial no	Location
58	Lennart Nilsson, Ekebergs gård, 291 92 Kristianstad
59	Sten Olsson, Skiberöds gård, 240 33 Löberöd
60	Lars Håkansson, Västergård, 260 22 Tågarp

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).

Borgeby 26 January, 2010

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Åsa Olsson
Project manager

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Borgeby 26 January, 2010

Åsa Olsson
Project manager

Appendix 1

GEP - Betning mot jordburna svampsjukdomar i sockerbetor 2009

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Syfte/aim:

Att prova Tachigaren i tre olika doser mot *Aphanomyces cochlioides* . Fält och växthusförsök.

Trial plan

Led	Produkt	Fungicid	g a.i/unit	Insecticid		g a.i/unit
1	Obehandlat	-				
2	Maxim tech	fludioxonil	6	Gaucho	imidacloprid	60
	Tachigaren	hymexazol	14			
3	Maxim tech	fludioxonil	6	Gaucho	imidacloprid	60
	Tachigaren	hymexazol	18			
4	Maxim tech	fludioxonil	6	Gaucho	imidacloprid	60
	Tachigaren	hymexazol	30			

Serie	Försöksvärd (namn och telefon):		
424	Ekeberg	Lennart Nilsson, Ekebergs gård, 291 92 Kristianstad	0702-45 54 27
424	Skiberöd	Sten Olsson, Skiberöds gård, 240 33 Löberöd	0709-36 76 98
424	Västergård	Lars Andersson, Västergård, 260 22 Tågarp	0705-14 03 39

	Ekeberg				Skiberöd				Tågarp				
	4	1	3	2	3	1	4	2	4	3	1	2	
IV	4213	4214	4215	4216	4229	4230	4231	4232	4245	4246	4247	4248	
													Provtagningsyta
													Provtagningsyta
	3	4	2	1	2	4	3	1	3	2	4	1	
III	4209	4210	4211	4212	4225	4226	4227	4228	4241	4242	4243	4244	
	1	2	4	3	4	2	1	3	1	4	3	2	
II	4205	4206	4207	4208	4221	4222	4223	4224	4237	4238	4239	4240	
													Provtagningsyta
													Provtagningsyta
	2	3	1	4	1	3	2	4	2	1	4	3	Led
I	4201	4202	4203	4204	4217	4218	4219	4220	4233	4234	4235	4236	Bricknummer

GEP - Betning mot jordburna svampsjukdomar i sockerbetor 2009

Ekebergs gård

Analyser och bedömningar Analysis and evaluations	**Tid** Time	**PM** PM	**Kommentarer** Comments	**Utförare** Responsible	**Datum** Date	**Signatur** Signature
Generalprov 6		2.6.1		HS	22/1	JM
Svampprov	jan-febr	2.6.1	Soil test for DSI (L. Eriksson)	HS	22/1	JM
Utstakning i fält		2.4.1		HS	22/1	JM
Parcellvis sådd		2.4.2		HS	15/4	JE,HJ
Planträkning 20		2.5.4		HS	27/4	JM,RM
Planträkning 50		2.5.4		HS	28/4	JM,RM
Planträkning max		2.5.4		HS	9/6	MW,UDM
Planträkning slutl		2.5.4		HS		
Rotbrandsbed. 1	BBCH 10-11	2.5.8	In sampling area	HS	7/5	ÅO,JE,MW
Rotbrandsbed. 2	BBCH 14-15	2.5.8	In sampling area. Two weeks after first evaluation	HS	19/5	JM,SH,RM
Sundhet	BBCH 10-19	2.5.20		NBR	24/6	ÅO
Radtäckning	BBCH 10-19	2.5.6		NBR	24/6	ÅO
Besiktning inför skörd				NBR		
Skörd		2.4.7		HS	17/9	JM,OK
Leverans till provtvätt		2.4.7		HS	24/9	JM
Svampangrepp efter skörd		2.5.10		NBR		
Analys av skördevariabler		-		DS	25/9	

GEP - Betning mot jordburna svampsjukdomar i sockerbetor 2009

Skiberöd

Analyser och bedömningar Analysis and evaluations	**Tid** Time	**PM** PM	**Kommentarer** Comments	**Utförare** Responsible	**Datum** Date	**Signatur** Signature
Generalprov 6		2.6.1		HS	22/1	JM
Svampprov	jan-febr	2.6.1	Soil test for DSI (L. Eriksson)	HS	22/1	JM
Utstakning i fält		2.4.1		HS	22/1	JM
Parcellvis sådd		2.4.2		HS	3/4	JE,HJ
Planträkning 20		2.5.4		HS	17/4	JM,HJ
Planträkning 50		2.5.4		HS	20/4	JE
Planträkning max		2.5.4		HS	18/5	JE,MW
Planträkning slutl		2.5.4		HS		
Rotbrandsbed. 1	BBCH 10-11	2.5.8	In sampling area	HS	5/5	JM,JE,MW
Rotbrandsbed. 2	BBCH 14-15	2.5.8	In sampling area. Two weeks after first evaluation	HS	18/5	JE,MW
Sundhet	BBCH 10-19	2.5.20		NBR	24/6	ÅO
Radtäckning	BBCH 10-19	2.5.6		NBR	24/6	ÅO
Besiktning inför skörd				NBR		
Skörd		2.4.7		HS	19/10	JM,OK,DR
Leverans till provtvätt		2.4.7		HS	19/10	DR
Svampangrepp efter skörd		2.5.10		NBR		
Analys av skördevariabler		-		DS	20/10	

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Västergård

Analyser och bedömningar Analysis and evaluations	**Tid** Time	**PM** PM	**Kommentarer** Comments	**Utförare** Responsible	**Datum** Date	**Signatur** Signature
Generalprov 6		2.6.1		HS	3/2	JM
Svampprov	jan-febr	2.6.1	Soil test for DSI (L. Eriksson)	HS	3/2	JM
Utstakning i fält		2.4.1		HS	3/2	JM
Parcellvis sådd		2.4.2		HS	14/4	JM,JE
Planträkning 20		2.5.4		HS	24/4	JM,RM
Planträkning 50		2.5.4		HS	27/4	JM,RM
Planträkning max		2.5.4		HS	19/5	JM,RM
Planträkning slutl		2.5.4		HS		
Rotbrandsbed. 1	BBCH 10-11	2.5.8	In sampling area	HS	6/5	JE,MW
Rotbrandsbed. 2	BBCH 14-15	2.5.8	In sampling area. Two weeks after first evaluation	HS	20/5	ÅO
Sundhet	BBCH 10-19	2.5.20		NBR	30/6	ÅO
Radtäckning	BBCH 10-19	2.5.6		NBR	4/6	ÅO
Besiktning inför skörd				NBR		
Skörd		2.4.7		HS	24/9	JM,OK,DR
Leverans till provtvätt		2.4.7		HS	30/9	JM
Svampangrepp efter skörd		2.5.10		NBR		
Analys av skördevariabler		-		DS	9/10	

GEP - Betning mot jordburna svampsjukdomar i sockerbetor 2009

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Jordanalys / Soil analyses

		Ekebergs gård	Klass	Skiberöd	Klass	Västergård	Klass
pH-värde		6,8		6,4		7,3	
P-AL (mg/100 g jord)		12	*IVA*	11	*IVA*	11	*IVA*
K-AL (mg/100 g jord)		16,0	*III*	22,0	*IV*	17	*III*
Mg-AL (mg/10 g jord)		16,0		6,8		10	
K/Mg-kvot		1,0		3,2		1,2	
Ca-AL (mg/kg jord)		740		130		420	
K-HCl (mg/100 g jord)		280	*4*	100	*2*	350	*4*
Cu-HCl (mg/kg jord)		21,0		4,6		10	
P-HCL mg/100 g		96	*5*	74	*4*	66	*4*
Mullhalt (%)	Organic matter (%)	10,1		2,6		4	
Lerhalt (%)	Clay (%)	25		10		32	
Sand + grovmo (%)	Sand+fine sand (%)	25		59		29	
Jordart	Soil type	mr ML		nmh Imo		mmh ML	

Particle size

Sand	Sand = 2-0,2 mm
Grovmo	Fine sand = 0,02-0,06 mm
Finmo	Coarse silt = 0,06-0,02 mm
Mjäla	Silt = 0,02-0,002
Lera	Clay = <0,002 mm
Finler	Fine clay = <0,0006

Soil type

nmhlSa = medium humus rich light sand
mmhlSa = humus rich light sand
mmhlMo = humus rich fine sand soil
mmhmoLL = humus rich loam soil
mfsaLL = humus poor sandy loam soil
mflSa = humus poor clay sand soil
mf lMo = humus poor fine sand
mf moLL = humus poor loam soil
nmhsaLL = medium humus rich sandy loam soil
mr ML = humus rich clay

Appendix 4

GEP - Betning mot jordburna svampsjukdomar i sockerbetor 2009

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Fertilizer and plant protection

Datum Date	**Produkt och dos / Product and dose**					
	G Goltix	**B** Betanal	**T** Tramat	**S** Safari (g)	**P** Pyramin	**Olja / oil**
Skiberöd						
24-apr	1,0	1,5		10		1
8-maj	2,0	1,5	0,15	25	0,5	0,7
Ekeberg						
24-apr	1,7	1,7				0,5
5-maj	2,0	2,0				0,5
13-maj	1,0	2,0		20		0,3
25-maj	1,0	2,0		30	1	0,3
Västergård						
29-apr	1,0	1,5	0,1			0,5
10-maj	1,3	1,5	0,1			0,5
19-maj	1,3	1,5	0,1			0,5
2-jun 0,6 Matrigon						
15-jun 2,0 Mangan				30		0,5

Gödsling / Fertilization

Datum Date	**Produkt och giva / Product and dose** Amount	Product	**N**	**P**	**K**
Skiberöd					
2-apr	650 kg/ha	Probeta			
Ekeberg					
14-apr	375 + 175 kg/ha	N27 + Besal			
Västergård					
14-apr	700 kg/ha	Probeta			

Bladsvampar / Leaf diseases

Datum Date	**Produkt och giva / Product and dose**
Skiberöd	0,5 l Comet/ha
Ekeberg	-
Västergård	-

Försöksinformation / Trial info

	Precrops	**Row spacing**	**Seed distance**
Skiberöd	Höstvete / winter wheat	48 cm	5,4 seeds/m
Ekeberg	Höstvete / winter wheat	48 cm	5,4 seeds/m
Västergård	Höstvete / winter wheat	48 cm	5,4 seeds/m

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	Treatment	g a.i.	Plh, 1000/ha 20%	50%	100%	Row cov %	Vigour 0-100
Ekeberg			*27.apr*	*28-apr*	*9-jun*	*24-jun*	*24-jun*
1	Untreated	0 + 0	36,5	95,5	93,2	88,0	87,5
2	Fludioxonil + Hymexazol	6 + 14	39,6	93,8	94,9	88,0	84,5
3	Fludioxonil + Hymexazol	6 + 18	40,5	90,3	97,5	87,0	87,0
4	Fludioxonil + Hymexazol	6 + 30	37,9	93,5	96,9	87,0	89,3
	RSQ		12,1	42,1	80,3	41,3	64,4
	CV		23,5	9,7	4,0	4,4	3,9
	LSD		14,5	14,4	6,2	6,1	5,4
	Prob		0,9215	0,8716	0,4150	0,9589	0,3166
Skiberöd			*17-apr*	*20-apr*	*18-maj*	*24-jun*	*24-jun*
1	Untreated	0 + 0	8,4	27,5	84,2	78,6	90,3
2	Fludioxonil + Hymexazol	6 + 14	9,5	28,6	94,9	80,2	85,5
3	Fludioxonil + Hymexazol	6 + 18	12,7	36,5	95,2	84,4	94,0
4	Fludioxonil + Hymexazol	6 + 30	13,3	31,8	96,6	84,4	95,0
	RSQ		47,8	50,6	98,2	45,2	61,9
	CV		39,8	18,2	2,9	8,5	9,0
	LSD		7,0	9,1	4,3	11,2	13,1
	Prob		0,3633	0,1844	0,000355	0,5755	0,3979
Tågarp			*24-apr*	*27-apr*	*19-maj*	*30-jun*	*4-jun*
1	Untreated	0 + 0	28,9	59,9	94,3	88,0	87,5
2	Fludioxonil + Hymexazol	6 + 14	21,1	48,9	90,9	88,0	84,5
3	Fludioxonil + Hymexazol	6 + 18	23,4	53,0	94,6	87,0	87,0
4	Fludioxonil + Hymexazol	6 + 30	24,6	55,0	94,0	87,0	89,3
	RSQ		38,4	26,0	19,0	41,3	64,4
	CV		23,7	18,7	7,4	4,4	3,9
	LSD		9,3	16,2	11,1	6,1	5,4
	Prob		0,3418	0,5184	0,8556	0,9589	0,3166
Average							
1	Untreated	0 + 0	22,4	61,5	88,7	82,5	90,6
2	Fludioxonil + Hymexazol	6 + 14	24,6	61,2	94,9	84,7	88,8
3	Fludioxonil + Hymexazol	6 + 18	26,6	63,4	96,4	86,5	92,5
4	Fludioxonil + Hymexazol	6 + 30	25,6	62,6	96,8	85,2	93,6
	RSQ		84,9	94,4	9,4	14,8	30,6
	CV		25,7	13,2	12,8	8,2	7,1
	LSD		6,5	8,4	12,4	5,7	5,3
	Prob		0,5996	0,9467	0,5179	0,5612	0,3019

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Summary of disease severity index in green house experiments 2005-2009

			Rotbrand / Damping-off DSI 0-100						
			1	2	3	4	5	6	5 trials
		g a. i./unit	2005	2005	2006	2007	2008	2009	Average
1	Kontroll / untreated	-	47,8	68,1	65,8	65,0	61,8	59,5	60,1
2	Hymexazol	14	29,0	64,4	55,7	63,5	45,3	50,0	49,2
3	Hymexazol	18	36,9	54,2	54,4	67,3	35,8	52,5	47,5
4	Hymexazol	30	30,6	51,0	52,9	63,5	50,8	54,8	47,4
	RSQ %		81,2	82,2	36,1	35,5	91,8	66,0	63,6
	CV		13,3	8,2	12,0	7,5	8,1	5,3	12,2
	LSD 5%		9,7	7,8	3,9	7,8	6,3	4,5	3,1
	Prob.		0,0015	0,0022	<0,0001	0,6748	0,00005	0,00380	<0,0001

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	Treatment	g a.i.	Damping off I Weight	Damping off I DSI I	Damping off II Weight	Damping off II DSI II	RI 1-7
Ekeberg			*6-maj*		*19-maj*		
1	Untreated	0 + 0	0,2	32,9	1,2	39,6	
2	Fludioxonil + Hymexazol	6 + 14	0,2	33,3	1,4	22,7	
3	Fludioxonil + Hymexazol	6 + 18	0,2	34,2	1,2	29,7	
4	Fludioxonil + Hymexazol	6 + 30	0,2	38,9	1,3	23,9	
	RSQ		65,6	29,8	79,8	78,4	
	CV		11,2	17,3	9,6	16,7	
	LSD		0,0	9,7	0,2	7,8	
	Prob		0,87689	0,4999	0,1522	0,0031	
Skiberöd			*6-maj*		*19-maj*		
1	Untreated	0 + 0	0,4	6,3	1,9	26,6	
2	Fludioxonil + Hymexazol	6 + 14	0,4	6,1	1,9	24,8	
3	Fludioxonil + Hymexazol	6 + 18	0,3	6,3	1,7	25,7	
4	Fludioxonil + Hymexazol	6 + 30	0,4	5,2	1,6	26,5	
	RSQ		51,5	26,7	37,3	84,6	
	CV		21,1	44,6	20,1	17,1	
	LSD		0,1	4,3	0,6	7,1	
	Prob		0,27615	0,92205	0,6175	0,9353	
Tågarp			-	*6-maj*	*20-maj*		
1	Untreated	0 + 0	-	36,1	1,4	24,6	
2	Fludioxonil + Hymexazol	6 + 14	-	33,7	1,6	22,9	
3	Fludioxonil + Hymexazol	6 + 18	-	29,9	1,5	22,2	
4	Fludioxonil + Hymexazol	6 + 30	-	33,7	1,4	21,7	
	RSQ			45,2	54,9	29,5	
	CV			11,6	15,1	28,6	
	LSD			6,2	0,4	10,5	
	Prob			0,2205	0,5162	0,9282	
Average							
1	Untreated	0 + 0	0,3	25,1	1,5	30,3	
2	Fludioxonil + Hymexazol	6 + 14	0,3	24,3	1,6	23,5	
3	Fludioxonil + Hymexazol	6 + 18	0,3	23,5	1,5	25,9	
4	Fludioxonil + Hymexazol	6 + 30	0,3	26,0	1,4	24,0	
	RSQ		73,0	91,8	39,7	21,6	
	CV		23,3	17,2	18,3	28,8	
	LSD		0,1	3,5	0,2	6,1	
	Prob		0,3997	0,5304	0,3623	0,1227	

GEP - Betning mot jordburna svampsjukdomar i sockerbetor 2009

Skörd / Yield

	Treatment		Plh final	Roots		Sugar		Amino-N	K+Na	Clean-ness
		g a.i.	1000/ha	t/ha	%	t/ha	Rel	mg/100 g beet	mM/100 g beet	%
Ekeberg										
1	Untreated	0 + 0	93,2	69,1	17,49	12,08	100	14	4,9	91,8
2	Fludioxonil + Hymexazol	6 + 14	94,9	69,3	17,50	12,11	100	14	4,9	92,2
3	Fludioxonil + Hymexazol	6 + 18	97,5	69,9	17,76	12,41	103	14	4,9	92,6
4	Fludioxonil + Hymexazol	6 + 30	96,9	71,0	17,70	12,56	104	14	4,9	92,1
	RSQ		80,3	67,0	12,3	77,1	-	20,6	73,3	35,2
	CV		4,0	4,8	3,2	3,8	-	11,9	2,9	0,9
	LSD		6,2	5,3	0,9	0,7	-	2,6	0,2	1,3
	Prob		0,4150	0,8566	0,8641	0,4439	-	0,9303	0,9237	0,5931
Skiberöd										
1	Untreated	0 + 0	84,2	64,1	19,12	12,26	100	7,5	3,9	93,4
2	Fludioxonil + Hymexazol	6 + 14	94,9	65,1	19,06	12,40	101	8	3,8	93,2
3	Fludioxonil + Hymexazol	6 + 18	95,2	67,7	19,14	12,96	106	7	3,7	93,2
4	Fludioxonil + Hymexazol	6 + 30	96,6	68,2	19,09	13,03	106	7	3,8	93,4
	RSQ		98,2	69,0	67,6	67,3		52	37,4	40,0
	CV		2,9	3,9	0,6	3,9		13,4	5,7	0,5
	LSD		4,3	4,2	0,2	0,8		1,5	0,3	0,8
	Prob		0,0004	0,1446	0,6958	0,1351		0,3686	0,6170	0,9121
Tågarp										
1	Untreated	0 + 0	94,3	71,2	19,96	14,21	100	10	4,0	93,9
2	Fludioxonil + Hymexazol	6 + 14	90,9	68,5	20,06	13,66	96	9	4,1	93,3
3	Fludioxonil + Hymexazol	6 + 18	94,6	68,4	19,83	13,56	95	9	4,1	93,8
4	Fludioxonil + Hymexazol	6 + 30	94,0	70,0	20,12	14,08	99	9	4,1	93,4
	RSQ		19,0	25,4	79,6	23,4	-	12,9	58,1	19,5
	CV		7,4	8,4	0,6	8,6	-	9,2	3,5	1,5
	LSD		11,1	9,3	0,2	2,0	-	1,4	0,2	2,2
	Prob		0,8556	0,8855	0,0283	0,8504	-	0,8017	0,4813	0,9267

GEP - Betning mot jordburna svampsjukdomar i sockerbetor 2009

Skörd / Yield

	Treatment		Plh final	Roots		Sugar		Amino-N	K+Na	Clean-ness
		g a.i.	1000/ha	t/ha	%	t/ha	Rel	mg/100 g beet	mM/100 g beet	%
3 trials 2009										
1	Untreated	0 + 0	90,6	68,16	18,86	12,85	100	10	4,3	93,0
2	Fludioxonil + Hymexazol	6 + 14	93,6	67,63	18,87	12,73	99	10	4,3	92,9
3	Fludioxonil + Hymexazol	6 + 18	95,8	68,67	18,91	12,98	101	10	4,2	93,2
4	Fludioxonil + Hymexazol	6 + 30	95,9	69,74	18,97	13,22	103	10	4,3	93,0
	RSQ		53,6	75,9	99,2	92,2	-	99,5	98,8	91,2
	CV		3,5	2,1	0,6	2,2	-	2,9	1,7	0,3
	LSD		6,5	2,8	0,2	0,6	-	0,6	0,1	0,5
	Prob		0,2570	0,3852	0,6815	0,2884	-	0,1156	0,8304	0,6839
18 trials 2004-2009										
1	Untreated	0 + 0	84,9	61,43	17,53	10,82	100	12	4,2	89,3
2	Fludioxonil + Hymexazol	6 + 14	92,4	62,85	17,64	11,12	103	12	4,1	89,6
3	Fludioxonil + Hymexazol	6 + 18	92,5	62,88	17,57	11,09	102	11	4,2	89,8
4	Fludioxonil + Hymexazol	6 + 30	93,8	63,02	17,60	11,13	103	11	4,2	90,0
	RSQ		79,6	94,5	99,5	97,0	-	97,5	98,3	97,2
	CV		5,2	3,1	0,6	3,1	-	4,8	1,8	1,1
	LSD		3,1	1,3	0,1	0,2	-	0,4	0,1	0,6
	Prob		<0,0001	0,0544	0,0244	0,0261	-	0,0851	0,0115	0,1630

GEP - Betning mot jordburna svampsjukdomar i sockerbetor 2009

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Skörd / Yield

	Treatment		Plh final	Roots		Sugar		Amino-N	K+Na	Clean-ness
		g a.i.	1000/ha	t/ha	%	t/ha	Rel	mg/100 g beet	mM/100 g beet	%
7 trials 2004-2009 with low or no infestation of *A. cochlioides*										
	Average all treatments		**91,5**	**67,04**	**17,78**	**11,93**		**12**	**4,1**	**88,8**
1	Untreated	0 + 0	89,3	67,41	17,74	11,97	100	12	4,1	88,8
2	Fludioxonil + Hymexazol	6 + 14	91,4	67,34	17,83	12,00	100	12	4,1	88,8
3	Fludioxonil + Hymexazol	6 + 18	92,4	67,05	17,76	11,91	100	12	4,1	88,7
4	Fludioxonil + Hymexazol	6 + 30	92,8	66,35	17,80	11,84	99	12	4,1	88,8
	RSQ		93,7	83,4	99,6	96,6	-	98,1	95,1	99,2
	CV		2,3	2,4	0,6	2,5	-	5,3	2,2	0,9
	LSD		2,4	1,8	0,1	0,3	-	0,7	0,1	0,9
	Prob		0,0287	0,6185	0,5056	0,7217	-	0,8974	0,9546	0,9802
11 trials 2004-2009 with high infestation of *A. cochlioides*										
	Average all treatments		**90,5**	**59,69**	**17,46**	**10,47**		**11**	**4,2**	**90,2**
1	Untreated	0 + 0	82,0	57,63	17,40	10,08	100	12	4,3	89,6
2	Fludioxonil + Hymexazol	6 + 14	93,0	59,99	17,52	10,55	105	11	4,2	90,1
3	Fludioxonil + Hymexazol	6 + 18	92,6	60,22	17,45	10,56	105	11	4,2	90,5
4	Fludioxonil + Hymexazol	6 + 30	94,4	60,91	17,47	10,69	106	11	4,2	90,7
	RSQ		80,7	95,6	99,3	97,3	-	96,8	99,2	88,7
	CV		5,7	3,0	0,6	3,2	-	4,3	1,4	1,2
	LSD		4,5	1,6	0,1	0,3	-	0,4	0,1	0,9
	Prob		<0,0001	0,0012	0,0663	0,0009	-	0,0118	0,0001	0,0685