SBU
Sockernäringens
BetodlingsUtveckling

Differences in tolerance against root rot fungi in sugar beet varieties

Motståndskraft mot jordburna svampsjukdomar

2003

SBU Projektkod 2003-1-1-412

SBU Sockernäringens BetodlingsUtveckling AB är ett kunskapsföretag som bedriver försöks- och odlingsutveckling i sockerbetor för svensk sockernäring.

SBU ägs till lika delar av Danisco Sugar och Betodlarna.

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Differences in tolerance against root rot fungi in sugar beet varieties

Summary

The conclusions that can be drawn from this investigation are based on three trials only and should be regarded with some caution. The differences between the varieties are generally small but point in the same direction (table 2). Some preliminary conclusions are indicated below:

- Several varieties show a consistently good tolerance to soilborne fungi across all evaluated trials in 2002-03: Envol, Sapporo, Anemona and Ballade (DI1 < 30). Two of these are also rhizomaniaresistent varieties (Anemona and Ballade). Slightly less tolerant varieties are Fidelia (DI1 = 36,2) and the rhizomania resistent variety Avance (DI1 = 37,9).
- A somewhat less tolerant variety than the varieties mentioned above is Saigon (DI1 = 40,6).
- Varieties with moderate to low tolerance (relatively high values for DI1 as well as RI at Skiberöd, see table 2) are Jakarta, Belmonte, Philippa and Nemakill.
- The lowest tolerance is found in Ymer.

Introduction

Root rot occur frequently in many sugar beet fields in Sweden. Recent inventories show that the problems seem to be particularly serious in the northwestern part of the province of Skåne but may occur in other regions as well (Olsson 2002, 2003, Olsson and Olsson 2004).

Root rot can be caused by a number of fungi, e. g. *Pythium* spp. and *Fusarium* spp., but the most important in Sweden is the water mold *Aphanomyces cochlioides* (Persson 2002). This fungus survive in soil by thick walled oospores, or so called resting spores. The oospores may survive in soil for at least 20 years. During the growing season the fungus produce short lived, motile zoospores that represent the asexual and infectious stage of the life cycle. The infected root become brown and water soaked and in severe cases the hypocotyl as well as the cotyledones rot. The development of the disease is dependent on weather conditions. *Aphanomyces cochlioides* infect roots particularly in warm and wet soil. However, infected plants can often continue to grow if the soil dries up but the roots are often permanently deformed.

The control measures against root rot includes mainly cultural practices such as early drilling to avoid warm soil and a sufficient amount of years between the beet crops. During the first weeks after drilling the seedlings can be protected by adding fungicides to the pelleting material. The standard fungicide used in Sweden on all commercially sold sugar beet seed is Tachigaren (active ingredient hymexazol). Until now, very little has been known about differences in tolerance against root rot fungi in the commercially grown sugar beet varieties in Sweden. During 2002 – 2003 differences in tolerance against root rot fungi has been investigated in three field trials: Sandby gård 2002 (SLU variety test, pilot study), Skiberöd 2003 (on infected soil), and Fjärestad 2003 (SBU variety test).

Materials and methods

Sandby gård 2002

The trial at Sandby gård in the southeastern part of Skåne, was initially part of the official variety tests performed by the Swedish University of Agricultural Sciences 2002 but had to be discarded due to severe infections of root rot fungi. At that time very little information was known regarding tolerance to root rot fungi in sugar beet varieties and we decided to use this trial as a first preliminary investigation. The trial was harvested and the beets in each plot were evaluated in the tare house for chronical symptoms of root rot. In each plot the number of beets with very weak, weak and strong symptoms of chronical root rot were counted and a root rot index (RI) was calculated (appendix 1).

Yield data (sugar content, clean weight, K + Na, amino-N) was also analyzed and the amount of extractable sugar calculated. Just before harvest, nine soil samples were taken from the area between the blocks to obtain a measure of the infection pressure in the soil. No beets were grown in this area and the soil has been left bare during the growing period. Beets were sown in the soil samples and the number of dying beets were recorded. After three weeks all remaining plants were washed clean from soil and the roots were evaluated for their degree of infection. A disease index (DI) was calculated (Larsson and Gerhardson 1990).

Skiberöd 2003

The purpose of this trial was to test if market varieties differ in tolerance against root rot fungi. A number of soils were tested for their infestation risk and the locality Skiberöd (20 km east of Lund) was chosen (moderate infestation risk). Sixteen varieties were drilled in a randomized complete block design with four replications. Between block I and II, and block III and IV a sampling area was drilled in which plants could be removed for evaluation of damping-off.

Twice during emergence, 20 seedlings of each variety and replication were dug up in the sampling area and brought back to the lab for evaluation of damping-off. The first evaluation was done when the plants had just developed cotyledons and the second evaluation approximately two weeks later. A disease index was calculated (Larsson and Gerhardson 1990).

The trial was harvested and the beets in each plot were evaluated in the central tare house for chronical symptoms of root rot (very weak, weak and strong). A root rot index was calculated (appendix 7).

Fjärestad 2003

This trial was part of the variety approval system at SBU AB during 2003. The trial was harvested and the beets in each plot were evaluated in the central tare house for chronical symptoms of root rot. In each plot the number of beets with very weak, weak and strong infections were counted and a root rot index was calculated.

Statistical analyses

The seedlings sampled from each plot were classified into five groups representing the percentage of the root that was infected by fungi (0, 20, 50, 75 and 100%, Larsson and Gerhardson 1990) and a disease index (DI) during the seedling stage was calculated:

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

where n = number of beets in each class.

A root rot index (RI) at harvest (0 – 3) was calculated:

$RI = (0 * n_0 + n_1 + 2 * n_2 + 3 * n_3)/\text{total no. plants in the plot}$

where n = the number of plants in each category.

A root rot index below one indicates minor deformations on the beets whereas a root rot index close to three indicates severly deformed beets.

Correlations between yield variables, DI and RI was investigated with Pearson product moment correlation coefficients (Proc CORR, SAS).

All variables were analyzed using analysis of variance (Proc GLM, SAS) and pairwise differences were analyzed with Fischer's LSD test.

Results and discussion

Sandby gård 2002

The average soil index over all nine samples taken from the trial at Sandby gård was 50, which is considered as a moderate risk of infection.

Results from the evaluation in the tare house (RI and yield data) is shown in appendix 1 and 2. There were significant differences between the varieties for all yield variables. The mean number of infected beets over four blocks range from 2,9% in the variety KWS 2S36 to 45,3% in the variety Ymer. The RI for KWS 2S36 was 0,04 and for Ymer 0,97. The root rot index for Envol was 0,17.

The investigation at Sandby gård showed that the tested market varieties as well as the not yet approved varieties show differences in tolerance to root rot fungi. However, since the test was carried out under field conditions the infection pressure in the soil may differ between the plots. The results should therefore be regarded as preliminary.

Fjärestad 2003

Among the market varieties, the most heavily damaged variety was Ymer with a RI of 0,42. Also Nemakill had a high RI (0,38).

The varieties with the lowest RI was Anemona, Sapporo, Envol, Saigon and Ballade, all with a RI below 0,10, (0,02, 0,04, 0,07, 0,08 and 0,09 respectively).

Skiberöd 2003

All varieties had a final plant number above 90 000 plants/ha except Ymer (89 900), Medina (87 000) and Pernilla (87 000), (appendix 7).

The lowest DI was found for the variety Sapporo, closely followed by Anemona and Envol (appendix 8). The highest DI was found in the variety Ymer. The difference in DI between Sapporo, Anemona and Envol on the one hand and Ymer on the other was significantly different. In the second evaluation of DI the average disease level had decreased and was below ten for all varieties except Medina and Nemakill.

In the evaluation of chronical symptoms of root rot (RI, appendix 8), the lowest index was found for Anemona and Fidelia (RI = 0,02). The largest RI was found for Ymer (RI = 0,37), Medina (RI = 0,27) and Pernilla (RI = 0,24). The RI for Philippa was 0,19 which is significantly larger than for Anemona and Fidelia (RI = 0,02, LSD = 0,12).

Pearson product moment correlations coefficients show that RI is negatively correlated with sugar yield (-0,5403, $p<0,001$) whereas DI1 and DI2 are not correlated with sugar yield (table 1). RI showed a weak tendency to be positively correlated with DI1 (0,24, $p=0,0528$, NS). There was no correlation between RI and DI2.

Table 1A, B. Pearson product moment correlation coefficients, probability and number of observations shown for yield, DI1, DI2 and RI variables at Skiberöd 2003 (page 5 and 6). Plants = no. plants/ha at harvest, weight = clean weight, e. sugar = extractable sugar, DI = disease index, RI = root rot index.

A.	Plants	Weight	Sugar %	Amino-N	K+Na	Sugar t/ha	E. sugar %	t/ha	Cleanness
Plants	**1,00000**								
	64								
Weight	0,13360	**1,00000**							
	0,3006								
	62	62							
Sugar	0,13306	0,18885	**1,00000**						
%	0,3026	0,1416							
	62	62	62						
Amino-N	-0,23990	0,04300	0,09879	**1,00000**					
	0,0604	0,7400	0,4449						
	62	62	62	62					
K+Na	-0,12840	0,23952	0,08719	0,48988	**1,00000**				
	0,3199	0,0608	0,5004	<,0001					
	62	62	62	62	62				
Sugar	0,14877	0,98640	0,34672	0,06111	0,24861	**1,00000**			
t/ha	0,2485	<,0001	0,0058	0,6371	0,0514				
	62	62	62	62	62	62			
E. Sugar	-0,00906	-0,24852	-0,49222	-0,46957	-0,80971	-0,32339	**1,00000**		
%	0,9443	0,0515	<,0001	0,0001	<,0001	0,0104			
	62	62	62	62	62	62	62		
t/ha	0,15108	0,98951	0,31378	0,02609	0,19187	0,99714	-0,25129	**1,00000**	
	0,2411	<,0001	0,0130	0,8405	0,1352	<,0001	0,0488		
	62	62	62	62	62	62	62	62	
Cleanness	0,03851	0,01950	-0,15988	0,07441	-0,05999	-0,00874	0,09287	-0,00177	**1,00000**
	0,7663	0,8804	0,2145	0,5655	0,6433	0,9462	0,4728	0,9891	
	62	62	62	62	62	62	62	62	62

Table 1B.

B.	Plants	Weight	Sugar %	Amino-N	K+Na	Sugar t/ha	E. sugar %	E. sugar t/ha	Cleanness	RI	DI1	DI2
RI	-0,28460 0,0227 64	-0,55559 <,0001 62	-0,08453 0,5136 62	0,20974 0,1018 62	0,16210 0,2081 62	-0,54305 <,0001 62	-0,02197 0,8654 62	-0,55620 <,0001 62	-0,17915 0,1636 62	**1,00000** 64		
DI1	-0,04723 0,7109 64	-0,01786 0,8904 62	-0,01123 0,9309 62	0,20100 0,1172 62	0,15798 0,2201 62	-0,01687 0,8964 62	-0,05197 0,6883 62	-0,02238 0,8629 62	0,01948 0,8805 62	0,24318 0,0528 64	**1,00000** 64	
DI2	0,07930 0,5334 64	0,04065 0,7538 62	0,13254 0,3044 62	-0,08152 0,5288 62	0,08480 0,5123 62	0,05932 0,6470 62	-0,10592 0,4126 62	0,05011 0,6989 62	0,03070 0,8128 62	-0,15777 0,2131 64	0,29491 0,0180 64	**1,00000** 64

Table 2. Summary of DI and RI for the investigated varieties at Sandby gård 2002, Fjärestad 2003 and Skiberöd 2003. The varieties are sorted according to increasing RI at Skiberöd 2003.

	Sandby gård		**Fjärestad**		**Skiberöd**		
Variety	DI	RI	DI	RI	DI1	DI2	RI
Anemona	-	-	-	0,02	28,8	7,8	0,02
Fidelia	-	-	-	0,11	36,2	3,5	0,02
Sapporo	-	-	-	0,04	27,0	4,2	0,05
Envol	-	0,17	-	0,08	28,8	6,5	0,05
Saigon	-	-	-	0,07	40,6	5,3	0,06
Avance	-	0,25	-	0,10	37,9	6,7	0,07
Ballade	-	-	-	0,09	30,2	3,5	0,09
Jakarta	-	-	-	0,14	43,7	7,2	0,10
Nemakill	-	0,67	-	0,38	33,1	12,5	0,16
Philippa	-	-	-	0,10	39,4	5,5	0,19
Belmonte	-	-	-	0,25	39,2	8,5	0,23
Etna	-	-	-	0,11	-	-	-
Ymer	-	0,97	-	0,42	43,8	8,7	0,37

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Tables and figures

Borgeby den 6 maj 2004

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Motståndskraft mot jordburna svampsjukdomar

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Appendix 1

Rotbrand/Damping-off **Sandby gård 2002**

Sådd/drilling:	**Chronical phase**
Skörd/harvest:	**Root rot index**
Soil index before drilling: unknown	**0 - 3**
Variety Datum/Date	
1 HIL **Ymer**, HM 1457	0,97
2 HIL **Envol**, 1746 2x	0,17
3 DA **Kalmar**, 2025 2x	0,24
4 HIL **Avance**, 0136 2xRH	0,25
5 HIL **Nemakill** 2xNR	0,67
6 HI 0012 2XRZ	0,31
7 HI 0019 2X	0,79
8 HI 0033 2XRZNR	0,79
9 HI 0034 3X	0,46
10 HI 0037 2X	0,52
11 HI 0041 2XRZ	0,23
12 HI 0071 2X	0,54
13 HI 0105 2X	0,52
14 HI 0106 2X	0,30
15 DS 2046 2X	0,64
16 DS 2051 2X	0,58
17 DS 2043 2X	0,40
18 DS 3043 3X	0,72
19 DS 4052 2XRZ	0,47
20 KWS 2R28 2XRZ	0,65
21 KWS SR35 2XRZ	0,42
22 KWS 2S22 2X	0,19
23 KWS 2S23 3X	0,14
24 KWS 2S35 2X	0,20
25 KWS 2S36 2X	0,04
26 KWS 2S37 2X	0,22
27 KWS 2S38 RZ	0,58
28 KW S2S39 2X	0,25
29 S 2204 (SW)	0,65
30 H 66708 (SW)	0,31
31 H 66709 (SW)	0,36
32 H 46505 (SW) RZ	0,40
33 STR 1903, **ACHAT** (SW) RZ	0,20
34 STR 1909, **MARS** (SW) RZ	0,49
CV	57,84
LSD 5%	0,35
RSQ %	60
Prob.	<0,0001
Prob., parvis/pairwise	<0,0001

In general, the infection pressure has been relatively high at Sandby gård. The variety with the highest root rot index has been Ymer, index = 0,97. The root rot index for Envol was 0,17. Only one variety had a lower root rot index than Envol; the variety KWS 2S36 (entry 25, root rot index = 0,04).

Motståndskraft mot jordburna svampsjukdomar

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Appendix 2

Skörd/Harvest **Sandby Gård 2002**

	Behandling Treatments	No. plants Ant. plantor 1000-nds/ha 1000-tal/ha	% strongly infected plants % starkt angr. plantor	% weakly infected plants % svagt angr. plantor	% infected plants % angripna plantor	Clean weight Renvikt ton/ha	Sugar content Sockerhalt %	Sugar Polsocker ton/ha	Amino-N Blåtal mg/100g beta	K + Na mM/ 100 g beta	Extractable sugar Utvinnbart socker %	Extractable sugar Utvinnbart socker ton/ha
1	HIL Ymer, HM 1457	103,5	6,8	38,5	45,3	59,4	17,50	10,41	18	4,0	90,2	9,4
2	HIL Envol, 1746 2x	105,8	1,4	6,3	8,2	68,7	17,41	11,96	17	3,9	90,3	10,8
3	DA Kalmar, 2025 2x	107,3	2,5	7,4	11,5	57,0	17,35	9,93	19	3,6	90,6	9,0
4	HIL Avance, 0136 2xRH	101,3	2,4	7,3	12,6	66,2	17,26	11,43	18	3,4	90,8	10,4
5	HIL Nemakill 2xNR	102,8	5,1	25,2	31,2	55,0	16,61	9,14	18	4,2	89,2	8,2
6	HI 0012 2XRZ	99,0	5,6	6,4	13,0	56,7	17,35	9,84	15	3,7	90,7	8,9
7	HI 0019 2X	101,0	4,6	32,7	37,3	64,7	17,52	11,33	17	3,8	90,5	10,3
8	HI 0033 2XRZNR	100,5	3,7	33,8	37,4	54,9	16,12	8,84	21	4,4	88,4	7,8
9	HI 0034 3X	92,3	2,9	19,0	21,8	58,2	17,40	10,13	17	3,5	90,8	9,2
10	HI 0037 2X	109,0	3,5	20,6	24,0	59,8	17,67	10,56	19	3,8	90,5	9,6
11	HI 0041 2XRZ	104,3	0,7	10,4	11,2	64,0	17,60	11,27	18	3,4	91,1	10,3
12	HI 0071 2X	100,3	2,0	23,4	26,8	64,2	17,51	11,26	19	3,8	90,5	10,2
13	HI 0105 2X	95,3	2,3	22,4	24,7	60,6	17,32	10,50	20	3,7	90,4	9,5
14	HI 0106 2X	103,0	4,7	7,1	14,1	58,0	17,96	10,43	17	3,8	90,8	9,5
15	DS 2046 2X	107,8	4,7	24,7	29,4	61,6	17,05	10,49	19	3,8	90,1	9,5
16	DS 2051 2X	108,0	1,4	26,4	28,7	59,9	17,48	10,47	15	3,8	90,5	9,5
17	DS 2043 2X	103,8	1,9	17,0	18,9	63,6	17,39	11,08	20	3,6	90,5	10,0
18	DS 3043 3X	97,0	5,6	27,5	33,2	65,2	17,69	11,53	19	3,7	90,7	10,5
19	DS 4052 2XRZ	100,3	3,4	18,4	21,8	57,7	18,31	10,58	18	3,8	91,1	9,6
20	KWS 2R28 2XRZ	104,0	9,1	19,0	28,1	61,1	17,67	10,81	19	3,5	91,0	9,8
21	KWS SR35 2XRZ	103,3	5,7	12,3	17,9	69,4	17,26	11,97	14	3,5	90,9	10,9
22	KWS 2S22 2X	104,8	1,2	7,9	9,1	63,9	17,73	11,32	16	3,7	90,9	10,3
23	KWS 2S23 3X	98,0	0,2	6,2	7,2	66,7	18,44	12,30	16	3,7	91,4	11,3
24	KWS 2S35 2X	104,5	0,9	8,5	9,4	71,0	17,95	12,73	16	3,8	90,9	11,6
25	KWS 2S36 2X	102,8		1,0	2,9	65,0	17,80	11,56	16	3,4	91,3	10,6

Forts. / Continued **Sandby Gård 2002**

Behandling **Treatments**	No. plants Ant. plantor 1000-nds/ha 1000-tal/ha	% strongly infected plants % starkt angr. plantor	% weakly infected plants % svagt angr. plantor	% infected plants % angripna plantor	Clean weight Renvikt ton/ha	Sugar content Sockerhalt %	Sugar Polsocker ton/ha	Amino-N Blåtal mg/100g beta	K + Na mM/ 100 g beta	Extractable sugar Utvinnbart socker %	ton/ha
26 KWS 2S37 2X	103,5	0,2	10,4	10,8	68,2	17,75	12,12	16	3,3	91,3	11,1
27 KWS 2S38 RZ	111,3	6,0	18,8	27,4	65,1	17,69	11,50	18	4,1	90,2	10,4
28 KW S2S39 2X	106,0	1,1	8,8	13,7	68,8	17,45	12,01	18	4,0	90,1	10,8
29 S 2204 (SW)	97,5	10,0	17,7	27,7	57,1	17,46	9,96	20	3,3	91,0	9,1
30 H 66708 (SW)	94,0	4,2	9,0	13,2	67,1	17,94	12,05	16	3,8	90,9	11,0
31 H 66709 (SW)	95,0	3,5	12,7	16,5	67,3	18,16	12,23	16	3,5	91,4	11,2
32 H 46505 (SW) RZ	113,8	2,7	15,9	18,7	72,0	17,74	12,77	15	3,8	90,8	11,6
33 STR 1903, ACHAT (SW) RZ	109,5	0,7	8,3	10,7	73,9	17,88	13,22	15	3,7	91,0	12,0
34 STR 1909, MARS (SW) RZ	108,3	4,6	16,4	23,1	66,7	17,18	11,46	15	3,6	90,6	10,4
CV	5,7	96,7	61,0	54,7	10,2	1,90	10,79	16	7,2	0,4	10,8
LSD 5%	8,2	4,6	13,8	15,5	9,1	0,47	1,69	4	0,4	0,6	1,5
RSQ %	0,50	0,49	0,61	0,61	0,46	0,72	0,51	0,51	0,53	0,76	0,52
Prob. block	0,9418 ns	0,0001	<0,0001	<0,0001	0,2604 ns	<0,0001	0,1136 ns	<0,0001	0,1152 ns	0,0132	0,0957
Prob. led	<0,0001	0,0013	<0,0001	<0,0001	0,0004	<0,0001	<0,0001	0,0305	<0,0001	<0,0001	<0,0001
Prob., parvis/pairwise	<0,0001	<0,0001	<0,0001	<0,0001	<0,0001	<0,0001	<0,0001	0,0034	<0,0001	<0,0001	<0,0001

Motståndskraft mot jordburna svampsjukdomar

SBU projektkod 2003-1-1-412
Antal försök 1

Fältkort

Appendix 3

Försöksvärd		Odlarnummer
		52 279
Gård	Adress	Telefon
Skiberöd		

Syfte: Att prova nya betsorters motståndskraft mot jordburna svampsjukdomar

Uppdragsgivare: SBU

Försöksled

1	Envol	
2	Ymer	
3	Philippa	
4	Medina	
5	Belmonte	
6	Avance	
7	Ariana	
8	Sapporo	
9	Nemakill	
10	Fidelia	KWS 1S09
11	Saigon	DS 2048
12	Avista	HI 0065
13	Jakarta	HI 0233
14	Pernilla	KWS 1S01

Försöksled

15	Ballade	STR 2103
16	Anemona	KWS 1R12

Bricknr i försöket:	1601 - 1664	**Försökets totala yta, m²:**	3 134
Skördeyta/parcell, m²:	2 r x 10 m	**Bruttoyta/parcell, m²:**	6 r x 17 m

Kontaktperson + telefonnr: Åsa Olsson 0709-53 72 62, Robert Olsson 0709-53 72 60

För försökets utförande ansvarig person + telefonnr:

Krav på försöksplats: Hög infektionsrisk av rotbrand.
Provtagningsytor mellan block I och II samt mellan block III och IV.
Utsädesmängd: 5 frö/m.

Försöksuppgifter:

Såmaskin, märke	Monozentra SP
Sådd, datum	14/4
Radavstånd, cm	48
Antal frö per m	5,1
Sort	Enligt plan ovan
Betning, produkt	Enl. plan
Uppkomst, datum	02-maj
Fullständig växtföljd, år	2002 korn
"	2001 potatis
"	2000 korn
"	1999 betor
Gödsling	Se "Behandlingsdata"
Ogräs	Se "Behandlingsdata"

Försöksåtg.:	PM		Datum/Sign.
Generalprov pkt 6	2.6.1	HS	1/4 LJ
Utstakning i fält	2.4.1	HS	9/4 TB, AH
Parcellvis sådd	2.4.2	HS	14/4 TB, AH
Svampprov	2.6.1	HS	dec 2002 LJ
Planträkning 50	2.5.4	HS	2/5 LJ
Planträkning max	2.5.4	HS	28/5 HG
Planträkning slutl	2.5.4	HS	26/6 TB, AE
Rotbrand 2 ggr	2.5.8	HS/SBU	14/5 LJ, TB, AE
Sundhet 1, 2	2.5.20	SBU	
Skörd	2.4.7	HS	16/10 LJ, TB
Lev. provtvätt	2.4.7	HS	17/10 TB
Analys	-	DS	

20030324ÅO

Försöksdata kontrollerat (datum+sign.): 20031125 LJ

Fältplan

Skiberöd

IV	9	11	5	7	4	3	2	14	12	1	15	13	6	8	10	16
III	4	6	16	2	15	14	13	9	7	12	10	8	1	3	5	11
II	5	7	1	3	16	15	14	10	8	13	11	9	2	4	6	12
I	1	3	13	15	12	11	10	6	4	9	7	5	14	16	2	8

20030321/ÅO

Analysdata/Analyses **Skiberöd**

Jordanalys/Soil analyses		**Datum/Date + sign.**	
Provtagningsdatum		pH-värde	7
Mullhalt (%)	2,9	P-AL (mg/100 g jord)	21
Lerhalt (%)	12	K-AL (mg/100 g jord)	15
Sand + grovmo (%)	52	Mg-AL (mg/10 g jord)	8,1
Benämning	nmh lMo	K/Mg-kvot	1,9
T-värde (mekv/100g jord)	13	Ca-AL (mg/kg jord)	210
S-värde (mekv/100g jord)	11,5	K-HCl (mg/100 g jord)	120
Basmättnadsgrad beräkn	>80	Cu-HCl (mg/kg jord)	10
Volymvikt (kg/l)		Bor (mg/kg jord)	0,99
		Na-AL (mg/100 g jord)	

Behandlingsdata

Ogräsbekämpning **Skiberöd 2003**

Datum	**Produkt och dos**
7/5	1,75 G + 1,75 B + 0,08 T + 1 superolja
16/5	1,5 G + 2 B + 0,1 T + 1 superolja
22/5	0,5 G + 1,75 B +0,25 T + 1 P + 1 superolja

Gödsling **Skiberöd 2003**

Datum	**Produkt och giva**	**N**	**P**	**K**
07-apr	Probeta NPK 680 kg/ha	102	25	46

Noteringar/ Notes
The trial was irrigated twice to assure a high infection pressure.

Planträkningar/Plant number

Skiberöd

Behandling/Treatment		**Planträkning 1000-tal/ha Plant number 1000nds/ha**		
Sådd/drilling:	14/4			
Skörd/harvest:	16/10 LJ, TB	**50%**	**Max**	**Slutlig/Final**
	Datum/Date	030502	030528	030626
1 Envol		47,7	92,7	92,5
2 Ymer		49,0	96,9	89,9
3 Philippa		47,1	88,0	97,1
4 Medina		43,0	96,1	87,0
5 Belmonte		51,0	89,3	92,2
6 Avance		50,0	92,2	93,2
7 Ariana		47,7	96,1	96,9
8 Sapporo		53,7	97,7	95,1
9 Nemakill		32,6	93,2	94,3
10 Fidelia		50,5	90,4	96,9
11 Saigon		50,3	96,9	90,9
12 HI 0065		56,8	90,6	94,8
13 HI 0233		54,7	88,8	91,7
14 Pernilla		48,4	92,7	87,0
15 Ballade		43,0	90,4	95,3
16 Anemona		49,7	95,3	95,3
CV		12,2	4,7	4,1
LSD 5%		8,4	6,2	5,5
RSQ %		65,7	50,7	51,5
Prob.		0,0004	0,0229	0,0038
Prob., parvis/pairwise		<0,0001	0,0029	0,0007

All varieties had a final plant number above 90 000 plants/ha except Ymer (89 900), Medina (87 000) and Pernilla (87 000).

Rotbrand/Damping-off **Skiberöd**

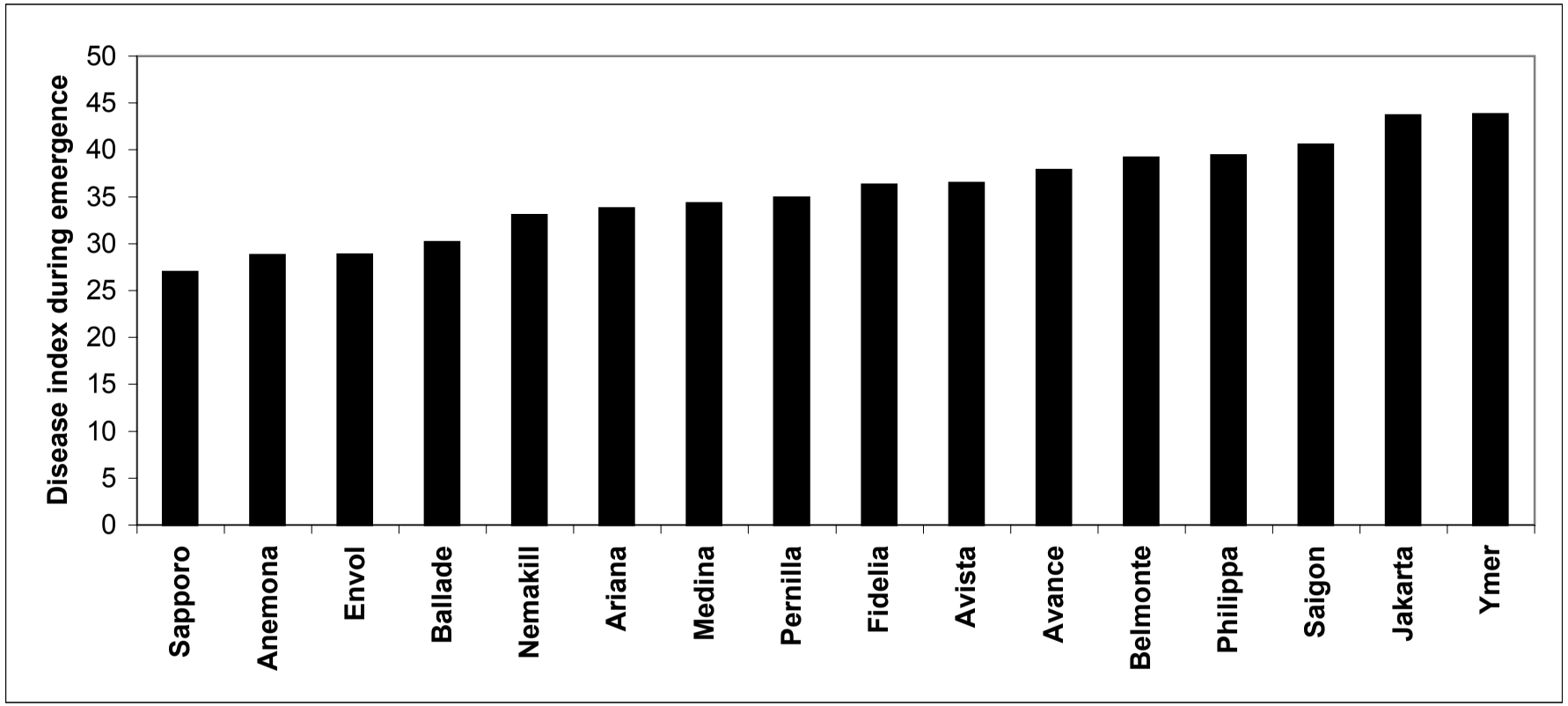
		Disease index	Chronical phase
Sådd/drilling:	14/4	Seedling stage	Root rot index
Skörd/harvest:	16/10 LJ, TB	0 - 100	0 - 3
Soil index before drilling: 56			

Variety	Datum/Date	030514	030603	031020
1 Envol		28,8	6,5	0,05
2 Ymer		43,8	8,7	0,37
3 Philippa		39,4	5,5	0,19
4 Medina		34,3	13,3	0,27
5 Belmonte		39,2	8,5	0,23
6 Avance		37,9	6,7	0,07
7 Ariana		33,8	6,9	0,10
8 Sapporo		27,0	4,2	0,05
9 Nemakill		33,1	12,5	0,16
10 Fidelia		36,3	3,5	0,02
11 Saigon		40,6	5,3	0,06
12 Avista		36,5	6,2	0,19
13 Jakarta		43,7	7,2	0,10
14 Pernilla		34,9	9,0	0,24
15 Ballade		30,2	3,5	0,09
16 Anemona		28,8	7,8	0,02
CV		20,1	49,5	63,49
LSD 5%		10,1	5,1	0,12
RSQ %		55	57,1	66
Prob.		0,0280	0,0104	<0,0001
Prob., parvis/pairwise		0,0046	0,0003	<0,0001

There were significant differences between the varieties in both evaluations of DI during the seedling stage. However, the symptoms on the roots had decreased in the second evaluation and was in almost all varieties less than ten, which is very low.

Appendix 8

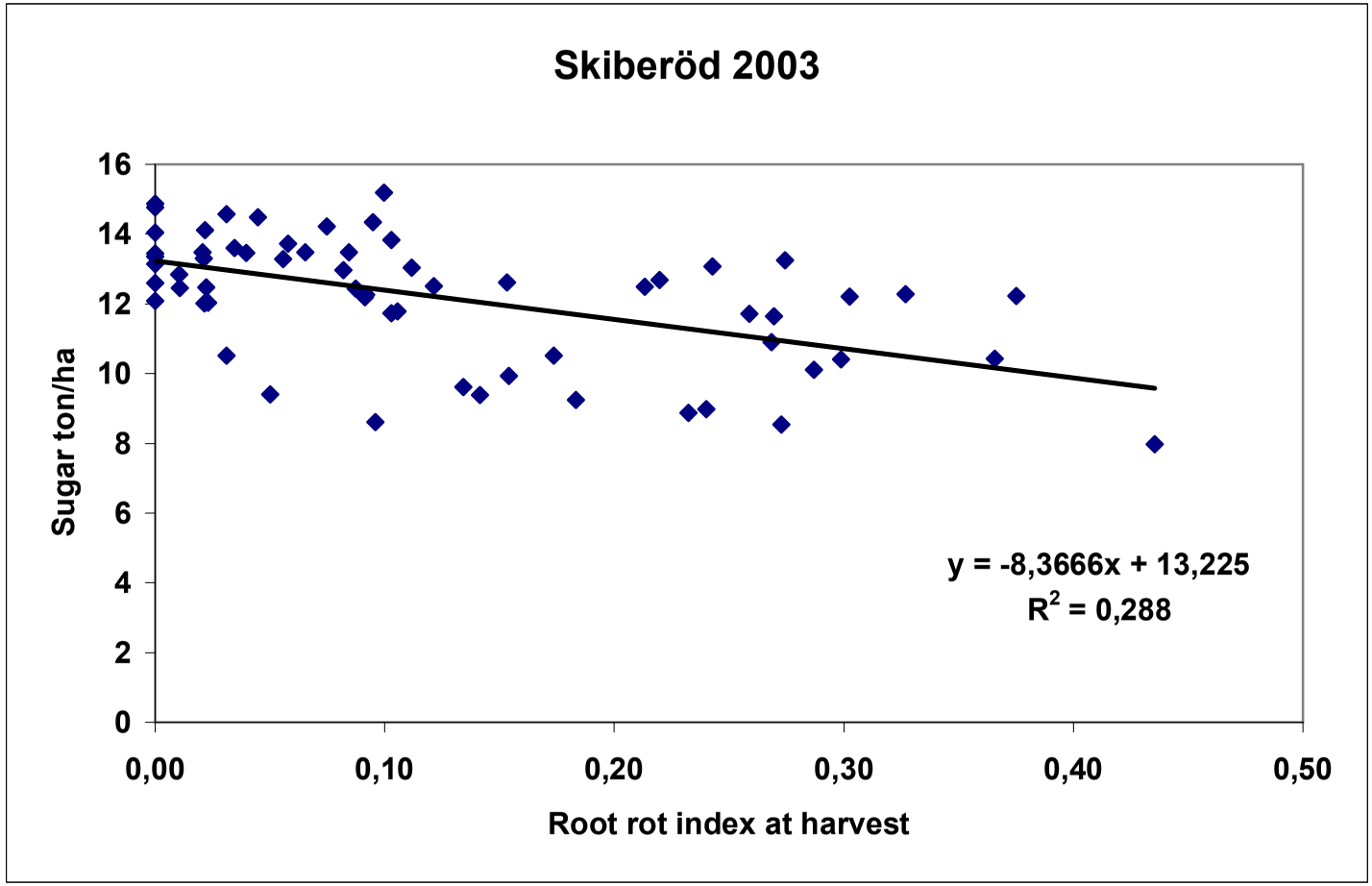
Disease index (seedling stage) **Skiberöd**



The figure shows the average DI measured during emergence in each of the four plots in the 16 varieties tested at Skiberöd. The lowest DI was found for the variety Sapporo, closely followed by Anemona and Envol. The highest DI index was found in the variety Ymer. The difference in DI between Sapporo, Anemona and Envol on the one hand and Ymer on the other was significantly different.

Kronisk rotröta/Chronical root rot

Skiberöd



The figure shows the relationship between root rot index (measured on a scale from 0 to 3) and sugar yield in the 16 varieties tested at Skiberöd. The regression line shows that on average 0,84 ton sugar/ha is lost for every increase in index by 0,1 unit in the interval 0 - 0,4 (RI).

Appendix 10

Skörd/Harvest **Skiberöd** **2003**

Behandling/Treatments	No. plants Ant. plantor	Clean weight	Sugar content Sockerhalt	Sugar Socker	Amino-N Blåtal	K + Na	Extractable sugar Utvinnbart socker			Cleanness Renhet
Sådd/drilling: 14/4	1000-nds/ha	Renvikt			mg/100g	mM/				
Skörd/harvest: 16/10 LJ, TB	1000-tal/ha	ton/ha	%	ton/ha	beta	100 g beta	%	ton/ha	rel 1	%
1 Envol	92,45	59,84	19,66	11,77	11	5,77	88,30	10,39	100	91,51
2 Ymer	89,85	53,55	19,56	10,49	12	5,95	88,10	9,23	89	91,81
3 Philippa	97,14	63,50	19,54	12,41	10	5,57	88,71	11,01	106	91,55
4 Medina	86,98	59,82	19,11	11,44	12	6,22	88,21	10,08	97	92,04
5 Belmonte	92,19	61,22	19,37	11,87	11	6,08	88,21	10,46	101	90,42
6 Avance	93,23	62,65	19,46	12,20	9	5,62	88,74	10,82	104	91,97
7 Ariana	96,88	57,26	19,42	11,14	10	5,63	88,73	9,86	95	91,59
8 Sapporo	95,05	65,86	20,12	13,25	12	6,19	86,31	11,43	110	91,96
9 Nemakill	94,27	58,59	18,36	10,75	11	6,41	87,89	9,44	91	92,03
10 Fidelia	96,88	73,34	19,17	14,05	8	5,53	88,86	12,48	120	91,48
11 Saigon	90,89	64,21	19,15	12,32	10	5,80	88,67	10,92	105	92,66
12 Avista	94,79	66,59	19,13	12,73	10	5,89	88,68	11,29	109	91,71
13 Jakarta	91,67	66,99	18,97	12,71	11	5,61	89,18	11,33	109	91,98
14 Pernilla	86,98	63,23	19,52	12,36	9	5,92	88,33	10,91	105	91,38
15 Ballade	95,31	66,62	19,41	12,93	10	5,66	88,72	11,47	110	92,66
16 Anemona	95,32	64,99	19,14	12,44	7	5,58	89,17	11,08	107	92,26
CV	4,14	11,23	1,51	11,65	12	5,21	0,72	11,48	-	1,35
LSD 5%	5,49	10,30	0,42	2,07	2	0,44	0,92	1,80	-	1,80
RSQ %	51,5	55,1	71,6	55,4	69,6	63,4	67,9	55,1	-	19,2
Prob.	0,0083	0,0781 ns	<0,0001	0,0912 ns	<0,0001	0,0021	<0,0001	0,0673 ns	-	0,8177
Prob., parvis/pairwise	0,0005	-	<0,0001	-	<0,0001	0,0002	<0,0001	-	-	-

The largest yield was found for Fidelia (12,48 ton/ha) and the lowest for Ymer, Nemakill and Ariana, who all had less than 10 ton extractable sugar/ha. The difference between Fidelia on the one hand and Ymer, Nemakill and Ariana on the other was not significant.

Kronisk rotröta/Chronical root rot **Fjärestad 101 2003** **Appendix 11**

Sådd/drilling: 14/4
Skörd/harvest: 16/10 LJ, TB
Soil index before drilling: unknown

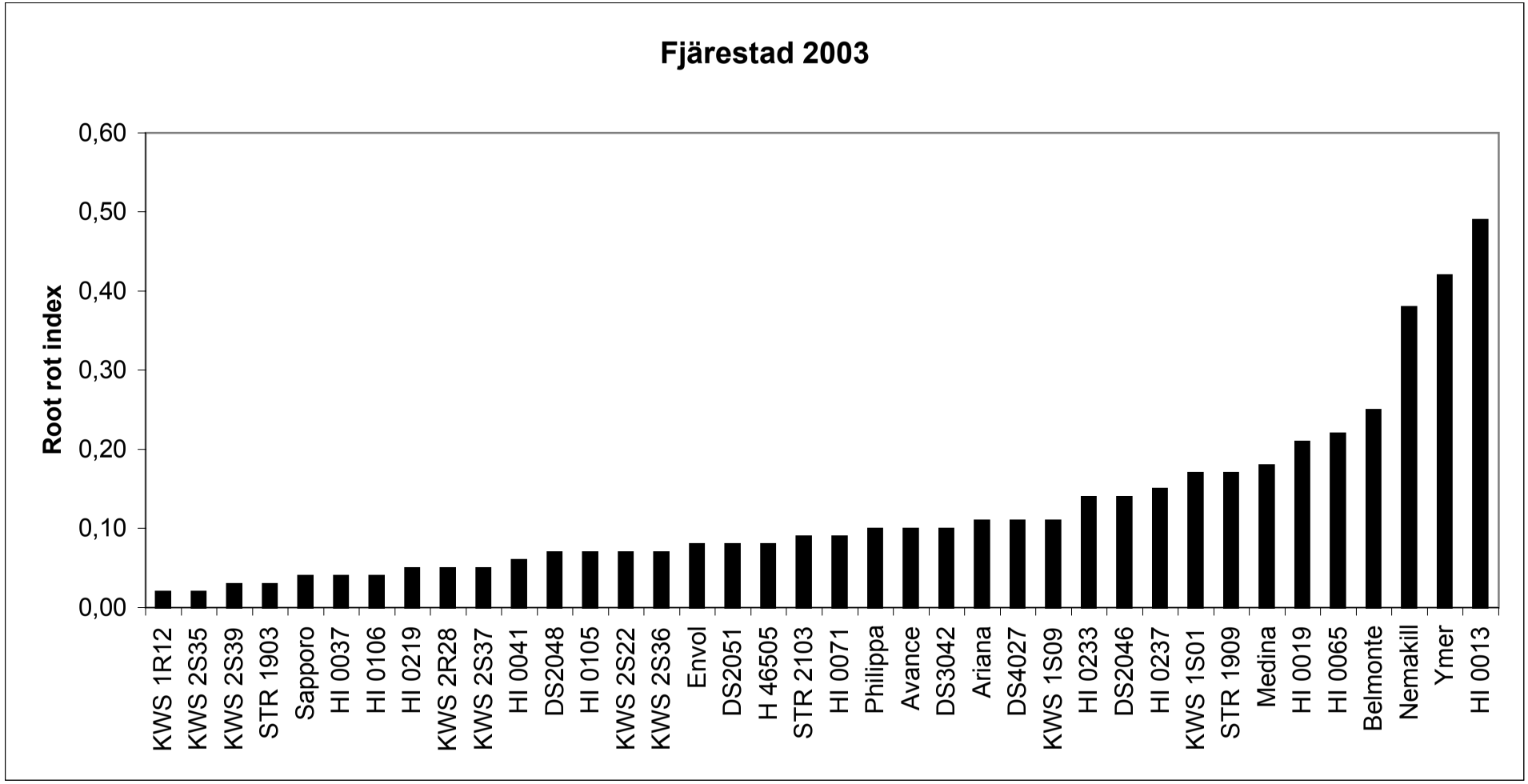
Chronical phase
Root rot index
0 - 3

Variety	Datum/Date	031013
1 Envol		0,08
2 Ymer		0,42
3 Philippa		0,10
4 Medina		0,18
5 Belmonte		0,25
6 Avance		0,10
7 Ariana		0,11
8 Sapporo		0,04
9 Nemakill		0,38
10 HI 0013		0,49
11 HI 0065		0,22
12 HI 0219		0,05
13 Jakarta	HI 0233	0,14
14 HI 0237		0,15
15 Saigon	DS2048	0,07
16 DS3042		0,10
17 Etna	DS4027	0,11
18 KWS 1S01		0,17
19 Fidelia	KWS 1S09	0,11
20 Anemona	KWS 1R12	0,02
21 Ballade	STR 2103	0,09
22 HI 0019		0,21
23 HI 0037		0,04
24 HI 0041		0,06
25 HI 0071		0,09
26 HI 0105		0,07
27 HI 0106		0,04
28 DS2046		0,14
29 DS2051		0,08
30 KWS 2R28		0,05
31 KWS 2S22		0,07
32 KWS 2S35		0,02
33 KWS 2S36		0,07
34 KWS 2S37		0,05
35 KWS 2S39		0,03
36 H 46505		0,08
37 STR 1903		0,03
38 STR 1909		0,17
CV		63,00
LSD 5%		0,11
RSQ %		72,8
Prob.		<0,0001
Prob., parvis/pairwise		<0,0001

Among the market varieties, the most heavily damaged variety was Ymer with an index of 0,42. The varieties with the lowest root rot index (0,02) was Anemona and KWS 2S35.

Motståndskraft mot jordburna svampsjukdomar **Appendix 12**

Root rot index **Fjärestad 101 2003**



The figure is based on the evaluation of root rot index done at Fjärestad 2003. The varieties are sorted in order of increasing root rot index.

Motståndskraft mot jordburna svampsjukdomar

SBU projektkod 2003-1-1-412

Appendix 13

Skörd/Harvest **Fjärestad 101** **2003**

Behandling/ treatment Sådd/drilling: 8/4 Skörd/harvest:		No. plants Ant. plantor 1000-nds/ha 1000-tal/ha	Clean weight Renvikt ton/ha	Sugar / Polsocker %	Sugar / Polsocker ton/ha	Sugar / Polsocker rel 1	Amino-N Blåtal mg/100g beta	K + Na mM/ 100 g beta	Extractable sugar Utvinnbart socker %	Extractable sugar Utvinnbart socker ton/ha	Extractable sugar Utvinnbart socker rel 1	Cleanness Renhet %	Cleanness Renhet %	Soil tare Jordhalt %
1	Envol	92,63	65,11	19,23	12,51	100	7	3,72	91,39	11,43	100	93,30	93,72	2,73
2	Ymer	94,34	66,67	18,89	12,60	101	9	3,87	91,46	11,52	101	93,00	93,48	2,98
3	Philippa	91,74	70,18	18,64	13,09	105	7	3,54	92,05	12,05	105	93,70	94,21	2,23
4	Medina	88,09	70,68	18,71	13,21	106	9	4,09	91,11	12,03	105	93,23	93,62	2,83
5	Belmonte	95,31	67,45	18,71	12,62	101	6	3,73	91,80	11,58	101	93,28	93,60	2,86
6	Avance	90,93	63,38	18,72	11,86	95	6	3,35	92,27	10,94	96	93,58	93,97	2,47
7	Ariana	92,62	69,85	18,79	13,13	105	6	3,88	91,60	12,03	105	93,47	93,79	2,65
8	Sapporo	101,67	71,56	19,51	13,96	112	7	3,76	91,06	12,71	111	93,31	93,64	2,82
9	Nemakill	97,01	66,82	18,34	12,25	98	7	4,05	91,13	11,17	98	92,96	93,50	2,96
10	HI 0013	93,46	65,74	18,78	12,34	99	8	3,93	91,55	11,30	99	92,86	93,42	3,04
11	HI 0065	97,46	69,45	18,54	12,89	103	7	3,95	91,42	11,78	103	93,16	93,78	2,66
12	HI 0219	101,61	73,02	19,84	14,49	116	7	3,67	90,39	13,10	115	93,72	94,09	2,35
13	HI 0233	98,67	70,43	18,59	13,08	105	7	3,93	91,49	11,97	105	94,13	94,36	2,06
14	HI 0237	89,54	68,60	18,76	12,87	103	6	3,28	92,36	11,89	104	94,16	94,34	2,08
15	DS2048	90,62	69,00	18,97	13,10	105	6	3,48	92,06	12,05	105	93,43	93,86	2,59
16	DS3042	96,05	68,62	19,07	13,08	105	6	3,74	91,61	11,98	105	93,00	93,39	3,08
17	DS4027	95,02	69,48	19,21	13,34	107	6	3,35	91,96	12,27	107	94,08	94,39	2,04
18	KWS 1S01	88,73	67,32	18,94	12,75	102	5	3,72	91,75	11,69	102	93,84	94,14	2,29
19	KWS 1S09	96,20	76,93	18,83	14,48	116	6	3,49	92,08	13,33	117	92,87	93,44	3,02
20	KWS 1R12	100,59	74,02	18,28	13,55	108	5	3,55	91,89	12,45	109	93,72	94,22	2,21
21	STR 2103	100,67	67,67	18,81	12,72	102	6	3,59	92,00	11,70	102	93,11	93,67	2,78
22	HI 0019	94,08	70,13	18,75	13,14	105	7	3,57	91,90	12,07	106	93,42	93,75	2,70
23	HI 0037	99,87	69,15	19,24	13,31	106	7	3,62	91,58	12,18	107	93,36	93,62	2,83
24	HI 0041	90,42	69,68	18,77	13,06	104	7	3,21	92,41	12,06	106	94,33	94,50	1,92
25	HI 0071	98,31	71,84	18,90	13,57	108	10	3,79	91,51	12,42	109	93,59	93,96	2,48

Forts. / Continued

Fjärestad 101 2003

Behandling/ treatment Sådd/drilling: 8/4 Skörd/harvest:	No. plants Ant. plantor 1000-nds/ha 1000-tal/ha	Clean weight Renvikt ton/ha	Sugar / Polsocker %	Sugar / Polsocker ton/ha	Sugar / Polsocker rel 1	Amino-N Blåtal mg/100g beta	K + Na mM/ 100 g beta	Extractable sugar Utvinnbart socker %	Extractable sugar Utvinnbart socker ton/ha	Extractable sugar Utvinnbart socker rel 1	Cleanness Renhet %	Cleanness Renhet %	Soil tare Jordhalt %
26 HI 0105	101,62	72,61	19,18	13,93	111	7	3,79	91,41	12,73	111	93,74	94,16	2,27
27 HI 0106	94,25	64,71	19,68	12,73	102	6	3,52	91,09	11,60	101	93,61	93,96	2,48
28 DS2046	99,01	71,27	18,62	13,27	106	8	4,10	91,22	12,10	106	93,14	93,70	2,75
29 DS2051	98,87	72,14	18,60	13,42	107	7	3,56	91,97	12,34	108	93,54	94,06	2,38
30 KWS 2R28	91,94	67,50	19,06	12,87	103	6	3,57	91,84	11,82	103	93,10	93,68	2,77
31 KWS 2S22	86,96	68,42	19,34	13,23	106	6	4,11	90,86	12,02	105	93,31	93,79	2,66
32 KWS 2S35	94,31	69,63	19,10	13,29	106	8	3,87	91,24	12,13	106	93,48	93,97	2,47
33 KWS 2S36	92,67	70,81	18,90	13,38	107	6	3,56	91,99	12,31	108	92,47	93,05	3,43
34 KWS 2S37	85,01	73,14	19,37	14,16	113	7	3,89	91,08	12,90	113	93,65	94,05	2,38
35 KWS 2S39	93,63	70,03	18,49	12,94	103	7	4,13	91,16	11,80	103	93,72	94,10	2,33
36 H 46505	100,35	74,85	18,71	14,00	112	6	3,61	91,99	12,88	113	93,84	94,06	2,37
37 STR 1903	100,07	70,00	19,04	13,34	107	6	3,39	92,08	12,28	107	93,64	93,87	2,57
38 STR 1909	100,19	71,74	18,22	13,07	105	5	3,81	91,44	11,96	105	94,30	94,41	2,02
Rel. precision, %	106,1	100,0	102,0	100,0	-	100,0	100,8	104,2	102,0	-	101,6	101,5	101,5
CV	4,40	7,50	1,15	7,19	-	18,22	2,77	0,26	1,80	-	0,47	0,35	8,45
LSD 5%	8,67	10,57	0,44	1,92	-	0,44	0,21	0,50	1,76	-	0,88	0,67	0,70
RSQ % (RCB)	63,40	31,80	78,60	36,20	-	54,30	88,20	82,10	35,30	-	55,40	57,60	57,60
Prob.	<0,0001	0,3159 ns	<0,0001	0,0858 ns	-	0,0001	<0,0001	<0,0001	0,1174	-	<0,0001	<0,0001	<0,0001
Prob., parvis/pairw.	<0,0001	-	<0,0001	-	-	<0,0001	<0,0001	<0,0001	0,1174	-	<0,0001	<0,0001	<0,0001