427–2013
Report

Treatment against leaf diseases in sugar beet 2013

Behandling mot bladsvampar i sockerbetor 2013

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Sammanfattning

I tre försök 2013 provades olika strategier för bekämpning av bladsvampar. De produkter som testades var Comet Pro (pyraclostrobin 200 g/l) som är en strobilurin och Armure (difenoconazol 150 g/l och propiconazol 150 g/l) och Barkley Bolt XL (propiconazol 25,4 vikts-%) som tillhör gruppen triazoler. De olika behandlingsstrategierna omfattade en ensam behandling i augusti och upprepad eller delad behandling där den första gjordes i augusti och den andra tre veckor senare. Produkterna testades var för sig och i tankblandning.

Alla fungicidbehandlingar hade viss effekt mot de bladsvampar som förekom. Jämfört med obehandlat gav de en friskare blast i oktober, med undantag för en försöksplats där betkonditionen var god även i obehandlade led. I genomsnitt över alla försök gav en fungicidbehandling 6 procent högre sockerskörd vilket motsvarade 850 kg per hektar.

En ensam behandling i mitten av augusti höll rost- och mjöldaggsangreppen på en låg nivå till mitten av september men därefter ökade svampangreppen. Delad behandling gav bättre långtidseffekt, både avseende mjöldagg och rost. Dosnivån hade mindre betydelse och effekten mot både mjöldagg och betrost var god även vid de lägre dosnivåerna.

Armure och Barkley Bolt XL hade detta år sämre effekt än Comet Pro och bidrog inte till att förstärka effekten i tankblandning med Comet Pro.

Summary

In three trials in 2013, Comet Pro (pyraclostrobin 200 g/l), Armure (difenoconazol 150 g/l, propiconazol 150 g/l) and Barkley Bolt XL (propiconazol 25.4 weight-%) were tested against naturally occurring leaf diseases in sugar beets. The fungicides were applied in different dosages, as a single application in mid-August or as a split application with a three week interval. Also tank mixtures of Comet Pro and Armure or Barkley Bolt XL were tested.

All fungicide applications reduced the infection of leaf diseases to some extent. The beneficial effect was also seen as more green leaf area in October compared to untreated, except at Arendala where beet condition was good even in untreated plots. The increase in sugar yield was on average 850 kg per hectare corresponding to 6 percent.

Although a split application was more effective, especially later in the season, a single application in mid-August reduced the infection of powdery mildew (*Erysiphe betae*) and rust (*Uromyces betae*) to low levels until mid-September.

The dose level was of less importance this year.

Armure and Barkley Bolt XL did not prove to be as effective as Comet Pro this year and did therefore not improve the efficacy when in a tank mixture with Comet Pro.

Aim

Leaf diseases, especially powdery mildew (*Erysiphe betae*), *Ramularia beticola* and beet rust (*Uromyces betae*), are often causing yield reduction in sugar beets. The aim of this trial series was to investigate new promising fungicides against leaf diseases in sugar beets. The fungicides were tested in different dosages and as single or split applications. Also different application strategies, minimizing the risk of resistance development, were tested. The efficacy against the disease was assessed, as well as the effect on sugar yield.

Material and methods

Trial sites and trial design

Three trials were conducted in 2013, at Egonsborg, Arendala and Remmarlöv. The trial sites were chosen with respect to high risk of infection by powdery mildew or beet rust. At all trial sites this year the sugar beet variety was SY Muse (RZ, AT). Except for fungicide treatments, the trials were fertilized and treated with herbicides in the same way as the rest of the field and according to normal practise in the growing area.

The experimental design was a randomized complete block design with four replications. In order to promote fungicide infections, the areas between blocks and in a strip of 6 meters on each side of the trial area were left untreated.

Each plot was 6 rows wide, corresponding to 2.88 meters, and 11 meters long which gives a plot size of 31.68 m^2.

This trial series also includes three trials in 2011 and three trials in 2012. Some of the treatments by Comet Pro may also be compared to the results of earlier trial series since this product has been tested in field trials since 2008. Investigations of Comet Pro now comprise 22 trials in all.

Fungicide treatments

The fungicides tested were Comet Pro (pyraclostrobin 200 g/l), Armure (difenoconazol 150 g/l and propiconazol 150 g/l) and Barkley Bolt XL (propiconazol 25.4 weight-%). The fungicides were applied in different dosages, as a single application in the beginning of August or as a split application with a three week interval. Also tank mixtures of Comet Pro and Armure or Barkley Bolt XL were tested. Compared to Comet, the formulation of Comet Pro is altered and the amount of active ingredient slightly less, 200 g/l instead of 250 g/l. Thus, 0.5 l/ha of Comet corresponds to 0.6 l/ha of Comet Pro.

Regarding a resistance strategy, the active ingredient of Comet Pro, pyraclostrobin, is a strobilurin and belongs to the fungicide family QoI fungicides. These fungicides are site-specific and therefore prone to resistance development. Also the active ingredients of Armure and Barkley Bolt XL, the triazols difenoconazol and propiconazol, are site-specific fungicides but they belong to a different group of fungicides, the demethylation inhibitors (DMI). In order to reduce the risk of resistance development it is often recommended to limit the number of applica-

tions in a given season, or the number of consecutive applications. It is also recommended to mix fungicides with different modes of action.

The first application (TI) was set to be carried out in the beginning of an infection, normally when 5 percent of the leaves are infected. This is normally during the first two weeks of August. The second application (TII) was set to be carried out 2–3 weeks later, normally in late August or early September.

The fungicides were applied with low drift nozzles at a pressure of 2.5 bars and a spray volume of 150 l/ha, which will give medium sized droplets.

Table 1. Experimental treatments in 2013

Treatment		Dose level	No	TI Day 0	TII Day 19-20	Active ingredient, g/ha
1	Obehandlat					
2	Comet Pro	0,25N	1	0,3	-	60
3	Comet Pro	0,5N	1	0,6	-	120
4	Armure	0,5N	1	0,4	-	120
12	Comet Pro + B Bolt XL	0,25N+0,35N	1	0,3+0,35	-	150
13	Comet Pro + Armure	0,25N+0,25N	1	0,3+0,2	-	120
16	Comet Pro + Armure	0,25N+0,35N	1	0,3+0,28		144
5	Comet Pro	1N	2	1,2	1,2	480
6	Comet Pro	0,5N	2	0,6	0,6	240
7	Comet Pro	0,25N	2	0,3	0,3	120
8	Armure	0,5N	2	0,4	0,4	240
9	Comet Pro + Armure	0,5N+0,5N	2	0,6+0,4	0,6+0,4	480
10	Comet Pro + Armure	0,25N+0,25N	2	0,3+0,2	0,3+0,2	240
11	Comet Pro + Armure	0,125N+0,125N	2	0,15+0,1	0,15+0,1	120
14	B Bolt XL	0,5N	2	0,5	0,5	254
15	Comet Pro + B Bolt XL	0,25N+0,35N	2	0,3+0,35	0,3+0,35	300

Comet Pro: pyraclostrobin, 200 g/l

Armure: difenoconazol 150 g/l + propiconazol 150 g/l

Barkley Bolt XL: propiconazol 25,4 weight-%

TI In the beginning of an infection, normally 1-10/8

TII 2-3 weeks after TI

Assessments

In order to evaluate various treatments, the effect on the sugar beets and on the disease infestation was assessed as follows.

- Plant number was counted in August.
- Plant vigour was estimated in each plot as percentage of green leaf area in late September.
- In late October, an area of 8.64 m^2 in each plot were harvested and analysed according to standard procedures.

- Disease development on each site was assessed on 5 occasions, TI, TI+10 days, TII, TII+10 days and TII+20 days, by counting the number of infected leaves in a sample of 100 randomly picked leaves.
- The efficacy against powdery mildew was assessed in each plot in August, September and October, as percentage of leaf area infested.
- The efficacy against Ramularia was assessed in each plot in August, September and October, following a scale of 0–100 showing the amount of leaf spots per plant.
- The efficacy against beet rust was assessed in each plot in August, September and October, following a scale of 0–100 showing the disease development from small spots to withered leaves.

Results and conclusions

Disease severity

By the time of the first application at Egonsborg, 18 percent of the leaves were infected. The infestation was caused by equal amounts of powdery mildew and Ramularia. At Arendala and Remmarlöv infestations were smaller. At both sites beet rust was present at 1 percent of the leaves. At Remmarlöv sugar beets were also infected by Ramularia and spots were shown on 5 percent of the leaves.

By the time of the second application the disease levels were high. At Egonsborg 73 percent of the leaves were infested, powdery mildew and Ramularia being the main diseases. Also at Remmarlöv the disease levels were high with 72 percent of the leaves infected. At this site Ramularia was the main disease but a small infection of rust was also present. At Arendala disease infections were smaller. 34 percent of the leaves were infested and mainly by Ramularia.

The threshold values used today for chemical control of leaf diseases in sugar beets are 5 percent infected leaves until August 15 and 25 percent from August 15 until August 31. Thus, the threshold values were exceeded by the time of application at Egonsborg and Remmarlöv but not by the time of the first application at Arendala.

Table 2. Disease level at application time I and II, assessed as % of infested leaves

Plats Location	**Beh** Treatm.	**Sprutdatum** Application date		**Mjöldagg** Mildew		**Ramularia**		**Cercospora**		**Rost** Rust		**Totalt antal angripna blad** Total no of infested leaves	
		I	II	I	II	I	II	I	II	I	II	I	II
Egonsborg	Obeh	13-aug		9		9		0		0		18	
	TI		03-sep		56		41		0		15		73
Arendala	Obeh	13-aug		0		0		0		1		1	
	TI		03-sep		0		27		8		0		34
Remmarlöv	Obeh	15-aug		0		5		0		1		6	
	TI		03-sep		0		70		0		7		72

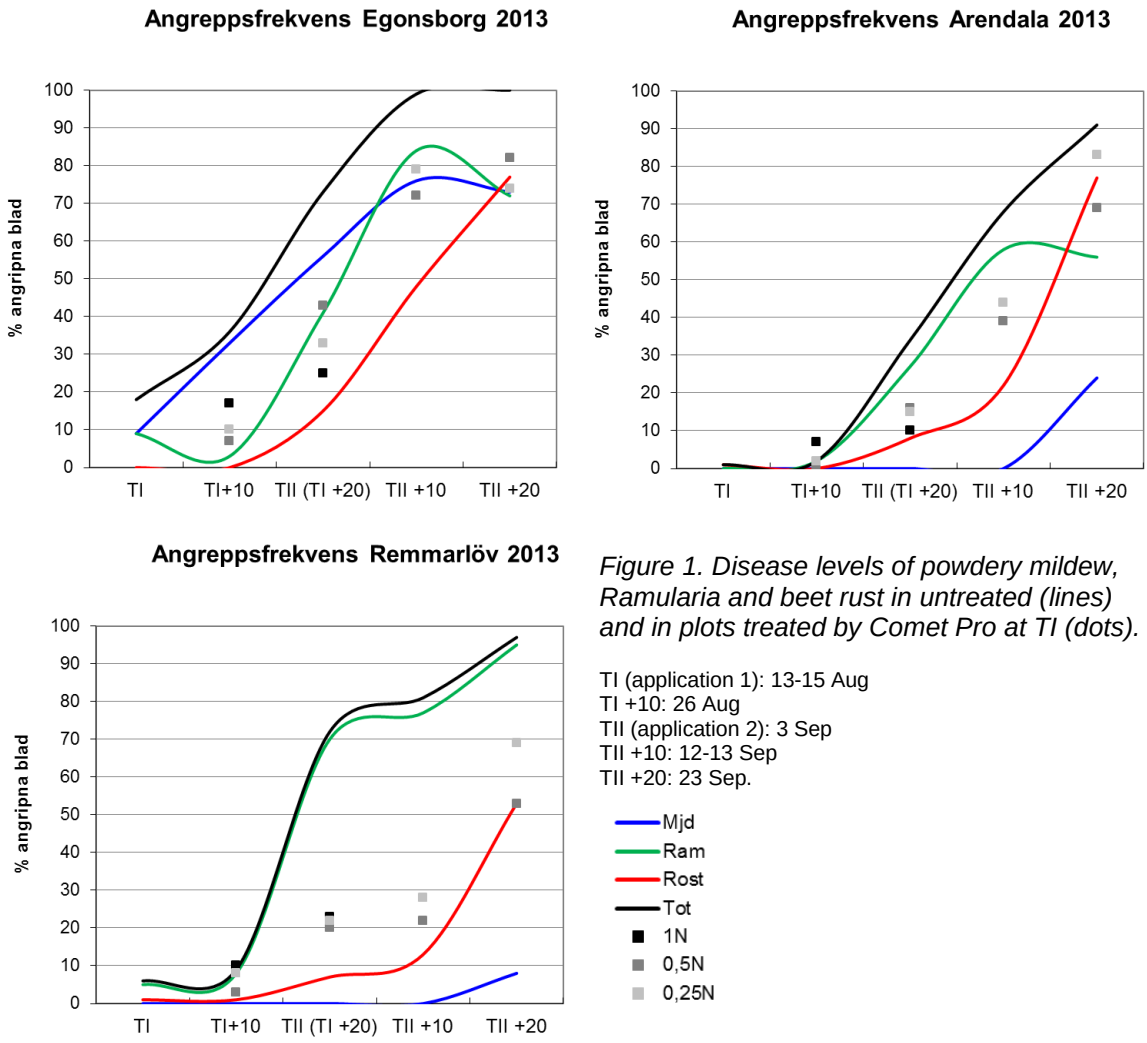


Figure 1. Disease levels of powdery mildew, Ramularia and beet rust in untreated (lines) and in plots treated by Comet Pro at TI (dots).

TI (application 1): 13-15 Aug
TI +10: 26 Aug
TII (application 2): 3 Sep
TII +10: 12-13 Sep
TII +20: 23 Sep.

Plant number and plant vigour

Final plant stand was high and homogeneous with no significant differences between treatments.

Plant vigour, assessed as green leaf area in September, increased when treated by fungicides. At Arendala and Remmarlöv there were small differences between treatments but at Egonsborg there were significant differences depending on products and strategies.

Repeated applications had a significant impact on the results at Egonsborg. Two applications gave significantly better plant vigour than only one application. These results are also consistent with earlier trials in this trial series.

The dose level did not have a big impact on the results. The small effect of different dosages on green leaf area has also been seen in earlier trials, especially in strategies with repeated applications.

Armure as a single application did not increase plant vigour as much as Comet Pro in these trials this year. However, in previous trials Armure and Comet Pro have shown equally good results, also as single products.

Barclay Bolt XL, as a single product applied twice or in combination with Comet Pro, showed good results but not as a single application. This has also been indicated by previous trials.

The results at Egonsborg showed a strong correlation between green leaf area and the disease level, such as higher disease levels giving lower green leaf area. At this site, in comparison with the other sites, leaf diseases and especially powdery mildew were present in relatively large amounts already by the time of the first application. The disease pressure was also high throughout the growing season.

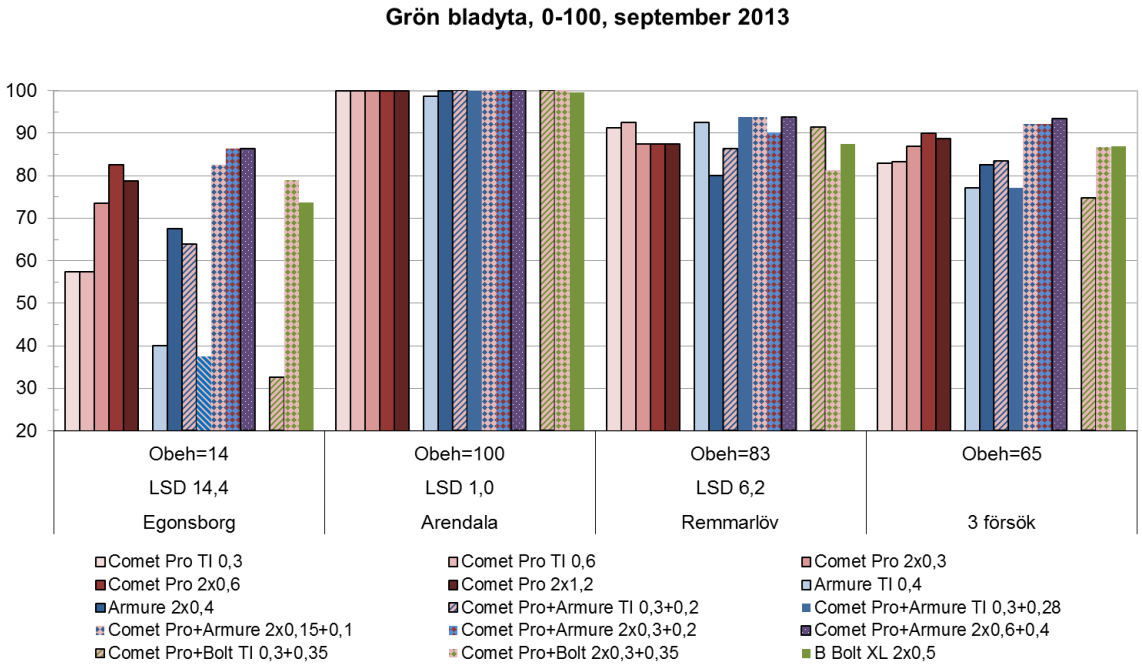


Figure 2. Green leaf area in September

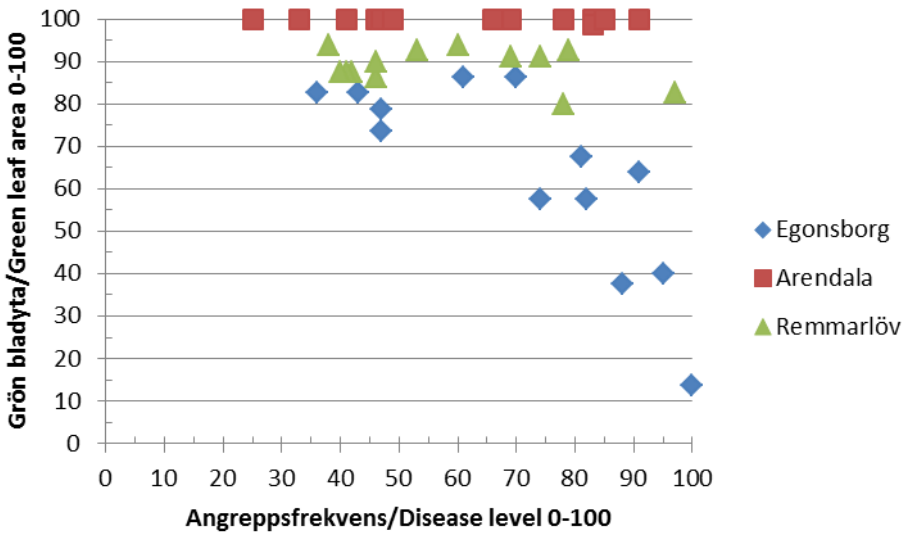
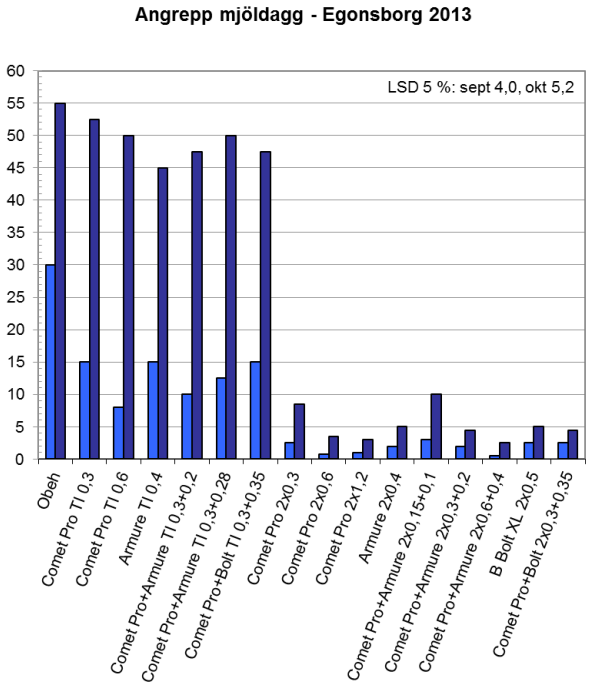
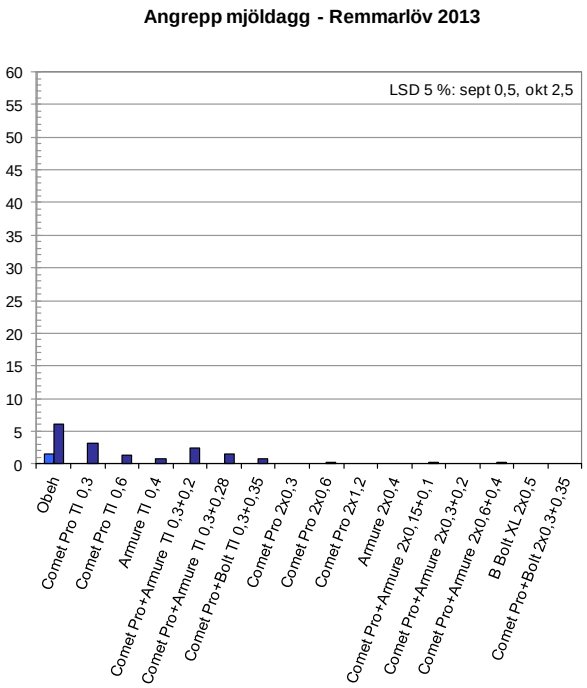


Figure 3. Relationship between disease severity and green leaf area in September.

Efficacy against powdery mildew

Powdery mildew was present in high amounts at Egonsborg, both at the time of the first and the second application. At the other trial sites powdery mildew was seen in small amounts later in the season.





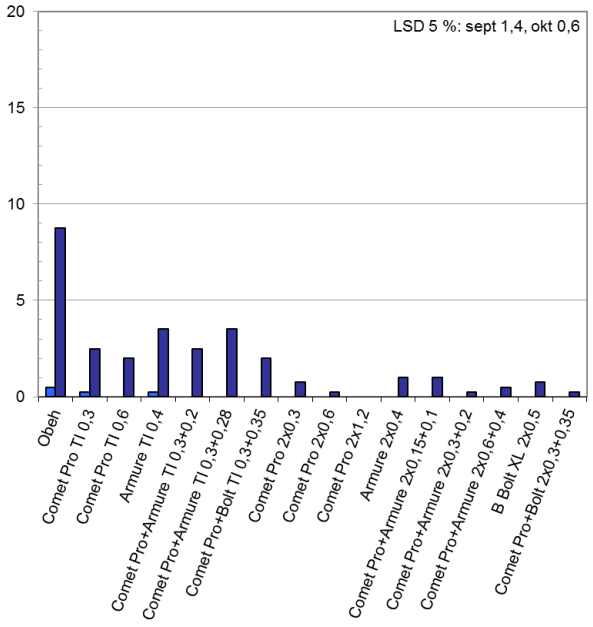


Figure 4. Efficacy against powdery mildew, assesses as percentage of leaf area covered by mildew:

17–19 September, 2 weeks after application II, 5 weeks after application I
16–19 October, 6 weeks after application II, 9 weeks after application I.

Repeated applications were essential in order to retain good efficacy later in the season. Increasing the dose level in a strategy with a single application did not achieve the same protection as two applications with a lower dose. This was seen both at the site Egonsborg, where the powdery mildew was present early in the season, and at the other sites, where powdery mildew occurred later in the season. These trials, as well as earlier trials, show that in order to achieve long term protection against powdery mildew two applications are needed.

The dose level was not important when two applications were made. The same results have been shown in previous field trials.

Armure and **Barkley Bolt XL,** in a tank mixture with Comet Pro, did not increase the efficacy compared to Comet Pro alone. Though, earlier results have shown that combining Armure or Barkley Bolt XL with a low dose of Comet Pro may give sufficient protection against powdery mildew.

Efficacy against Ramularia

By the time of fungicide application Ramularia was present, to some extent, at all trial sites. The disease pressure also increased throughout the season. In general, all fungicide treatments reduced the infestation of Ramularia but there were small differences between treatments.

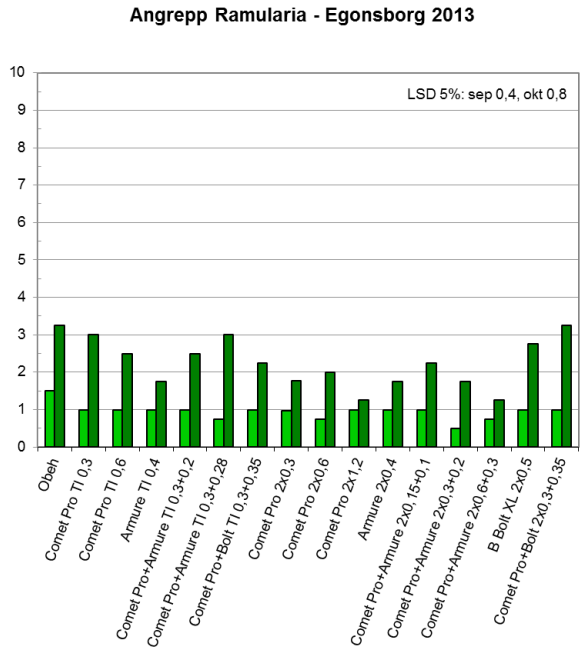
Efficacy against beet rust

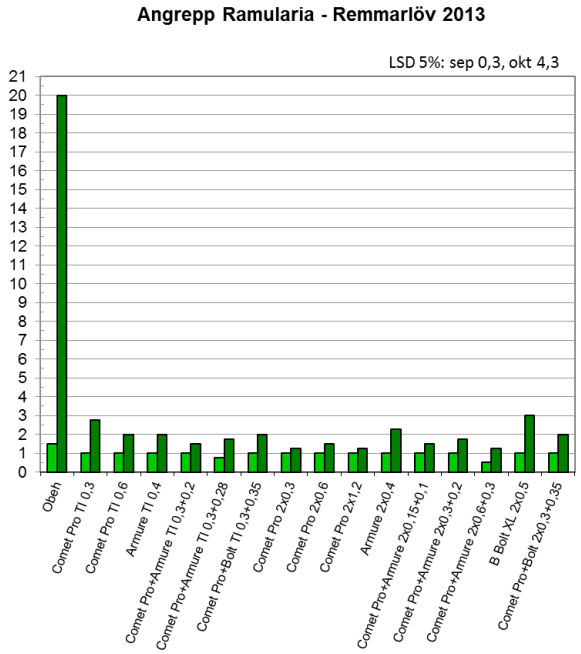
Beet rust was present at all trial sites later in the season, by the time of the second application and onwards.

Repeated applications were necessary in order to retain good efficacy later in the season. In these trials, a single application was efficient in supressing the disease until September. For good efficacy in October two applications were needed. Increasing the dose level in a strategy with a single application did not achieve the same protection as two applications with a lower dose. These trials, as well as earlier trials, show that in order to achieve long term protection against beet rust two applications are needed.

The dose level was not crucial at Egonsborg. However, at Arendala and Remmarlöv, the lowest dose level of Comet Pro was not always sufficient for long term protection even if applied twice. Also previous field trials have shown a dose response when it comes to long term efficiency.

Armure and **Barkley Bolt XL** were not as efficient as Comet Pro against beet rust in these trials. In a tank mixture with Comet Pro, the addition of Armure or Barkley Bolt XL did not increase the efficacy compared to Comet Pro alone. Though, earlier results have shown that Armure in combination with a low dose of Comet Pro may improve the control of beet rust compared to Comet Pro alone.





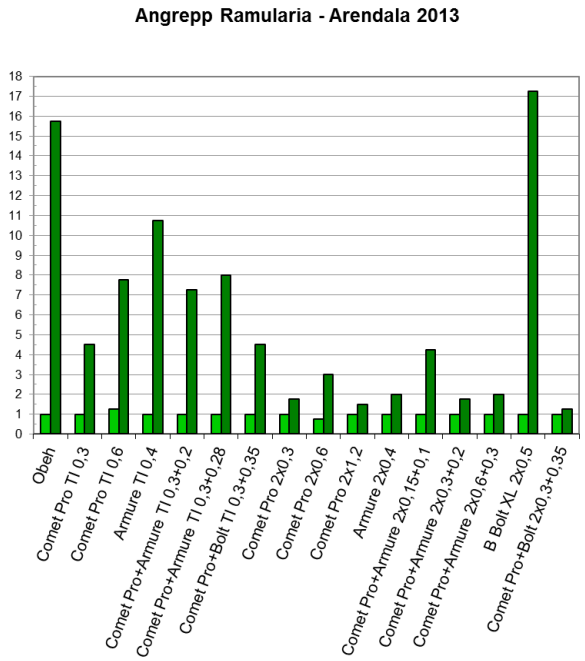


Figure 5. Efficacy against Ramularia, assesses according to a scale of 0–100 where:
5: less than 10 spots per plant
10: less than 20 spots per plant
20: more than 20 spots per plant

17–19 September, 2 weeks after application II, 5 weeks after application I
16–19 October, 6 weeks after application II, 9 weeks after application I.

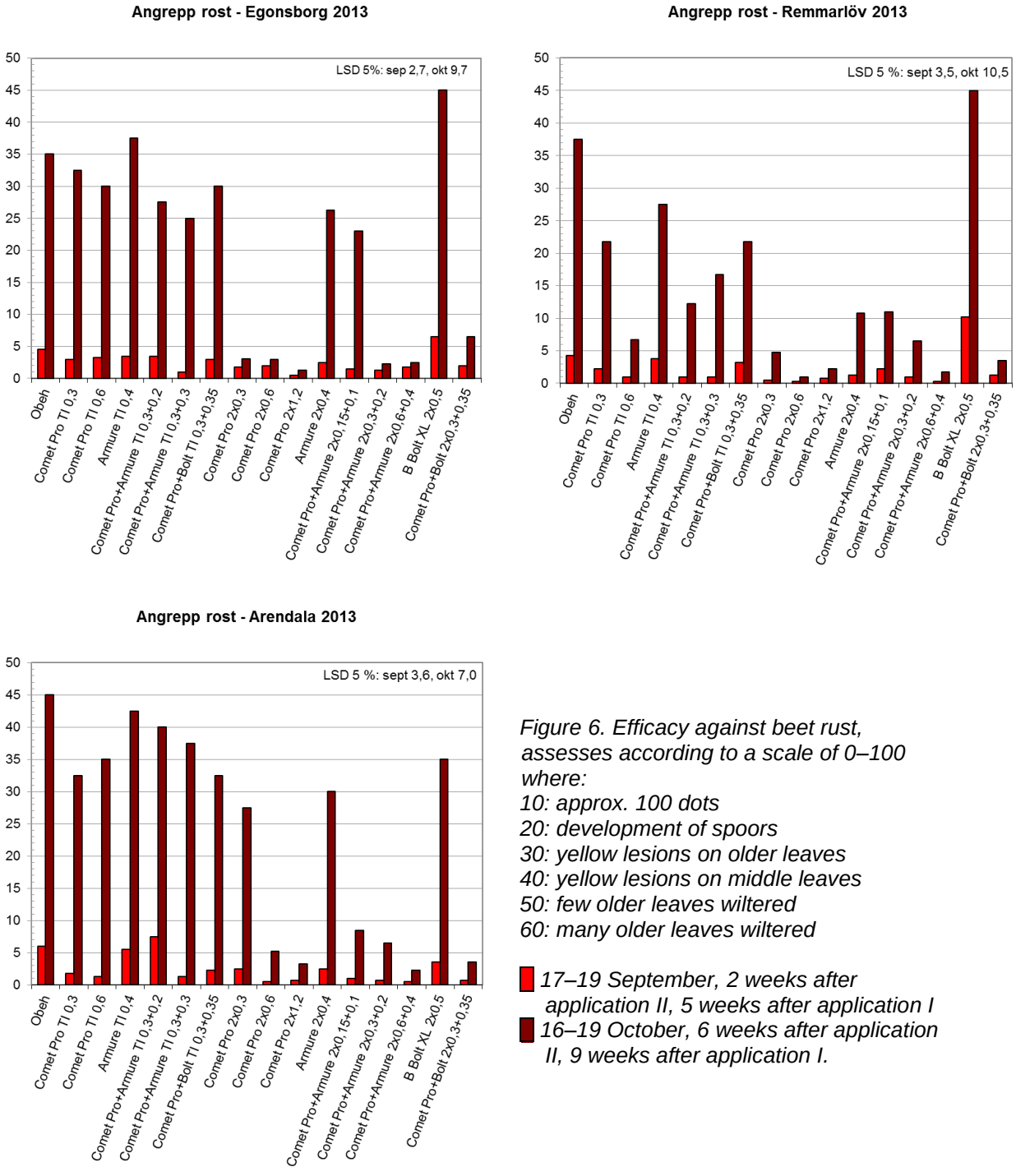


Figure 6. Efficacy against beet rust, assesses according to a scale of 0–100 where:
10: approx. 100 dots
20: development of spoors
30: yellow lesions on older leaves
40: yellow lesions on middle leaves
50: few older leaves wiltered
60: many older leaves wiltered

17–19 September, 2 weeks after application II, 5 weeks after application I
16–19 October, 6 weeks after application II, 9 weeks after application I.

Sugar yield

All fungicide treatments at Egonsborg and Remmarlöv increased the sugar yield but there were no differences between treatments. The beneficial effect of a fungicide treatment was seen as both an increase in root yield and of the sugar content. At Arendala, sugar yield was in general increased in plots with two

applications including Comet Pro alone or in a tank mixture but the differences were not statistically significant.

For a statistically significant yield increase it was required 900 kg sugar per hectare at Egonsborg, 1,100 kg per hectare at Arendala and 1,500 kg per hectare at Remmarlöv. The average yield increase of all treatments was 940 kg per hectare at Egonsborg, 430 kg per hectare at Arendala and 1,180 kg per hectare at Remmarlöv.

As an average of these three trials in 2013 the yield increase was 850 kg of sugar per hectare, corresponding to 6 percent. This is in agreement with earlier results of this trial series. The average yield increase of all fungicide treatments during 2011–2013 is 770 kg of sugar per hectare, corresponding to 5 percent.

Repeated applications had, on average in 2013, no significant effect on the sugar yield compared to a single application. Looking at the average of 9 trials during 2011–2013, a second application increased the sugar yield compared to a single application, by 240 kg of sugar per hectare, but the increase was not statistically significant. Further analysis of the results of 22 trials during 2008–2013 show, that a second application may increase the sugar yield, if the disease infection is high. The yield increase varied between 240–440 kg per hectare depending on the disease. It was also shown that two applications with a lower dose gave equal or higher sugar yield compared to a single application with a higher dose.

The dose level did on average in 2013 not influence the sugar yield, which seems natural since the dose level this year was not essential for the crop protection against the diseases. Also in previous trials in this series no significant differences have, on average, been found between lower and higher dose levels. Analysing 22 trials from 2008–2013 more thoroughly with respect to level of disease infection, it was shown that the dose level indeed is less important than the number of applications. Even at trial sites with a high level of infection the yield increase as a result of increased dosage is limited and also not significantly different compared to the yield increase received in trials with a lower level of infection.

Armure and **Barkley Bolt XL** applied alone or in a tank mixture with Comet Pro gave the same results as the comparable amount of Comet Pro alone, in spite of a lower efficacy against the leaf diseases present this year. Adding Armure or Barkley Bolt XL to a tank mix of a low dosage of Comet Pro did not improve the efficacy or the yield return this year.

Of the quality parameters measured in the harvest, the sugar content was improved by fungicide treatments. On average in 2013 the sugar content increased by 0.2 units.

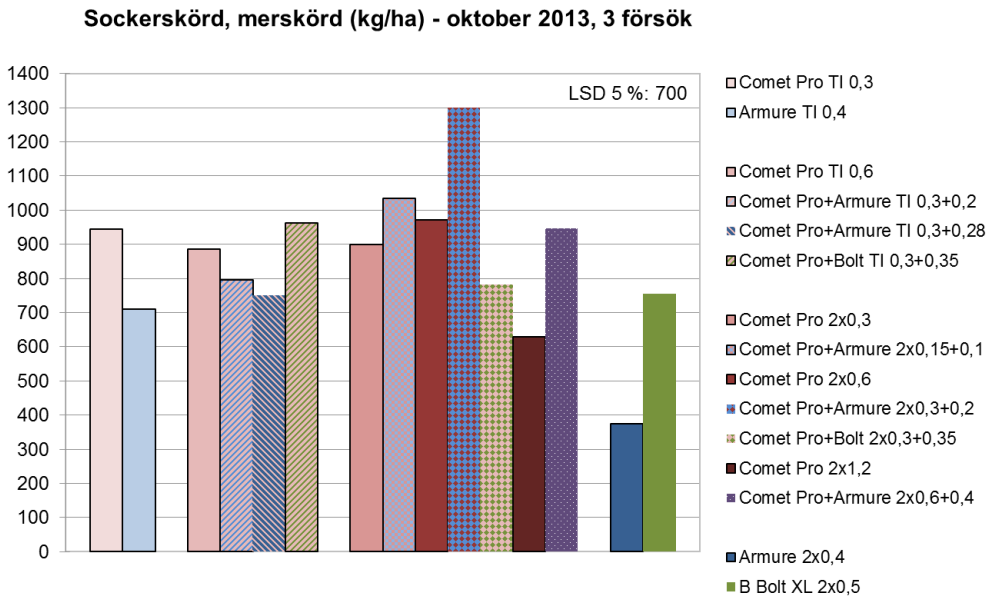


Figure 7. The increase in sugar yield in 2013 compared to untreated. Average of 3 trials.

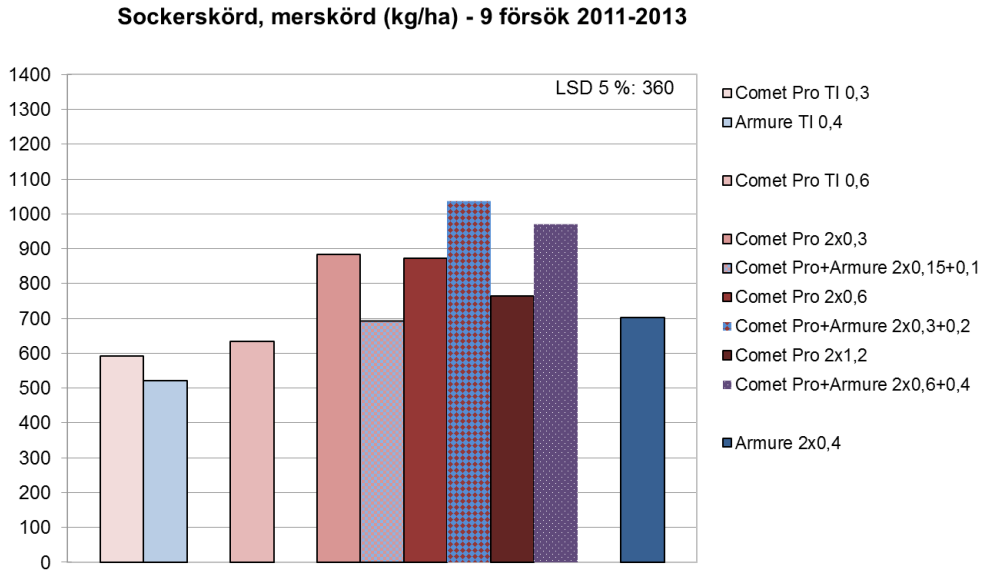


Figure 8. The increase in sugar yield in 2011–2013 compared to untreated. Average of 9 trials. These trials include Armure applied alone or in a tank mixture with Comet Pro.

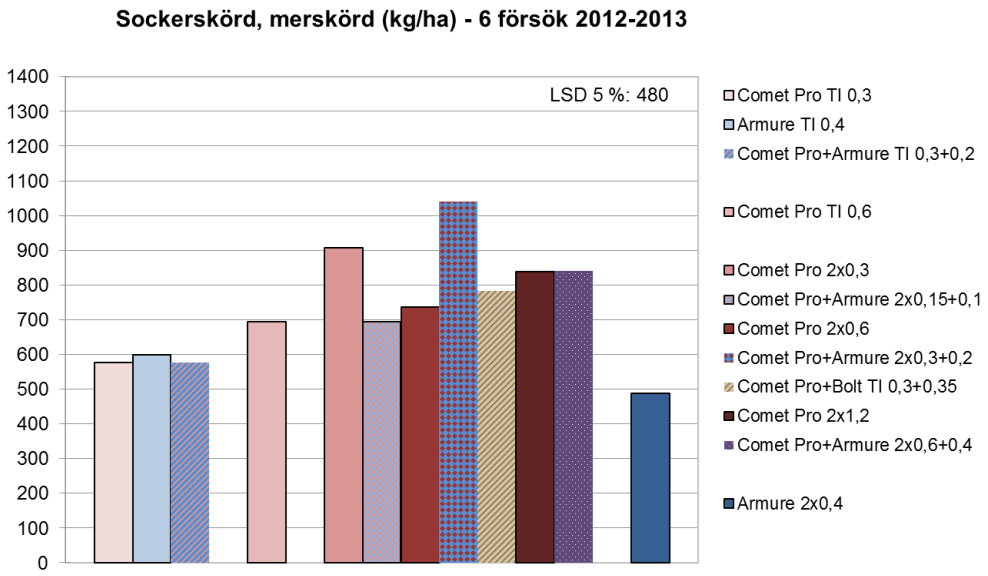


Figure 9. The increase in sugar yield in 2012–2013 compared to untreated. Average of 6 trials. These trials also include Barkley Bolt XL in a tank mixture with Comet Pro.

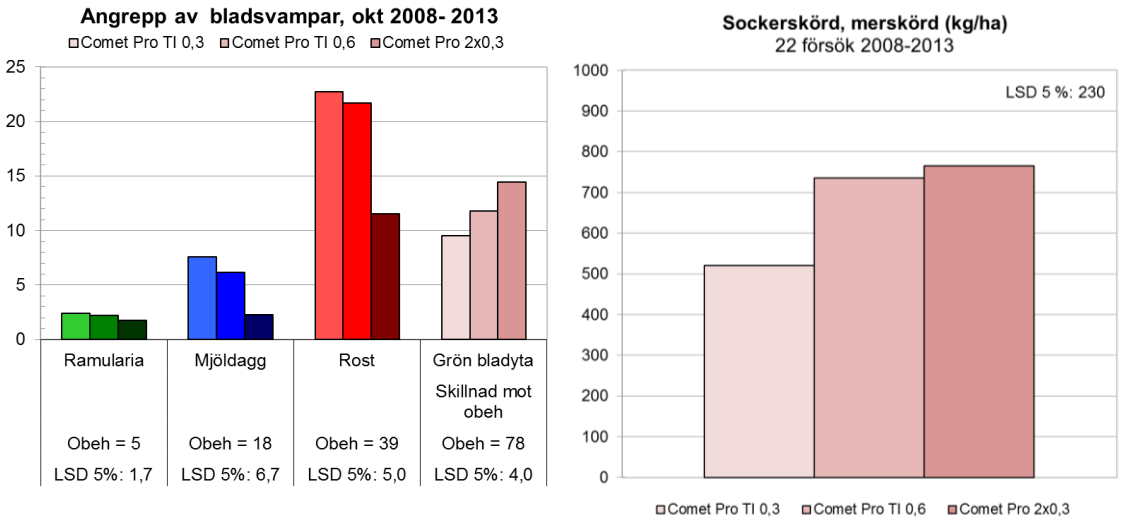


Figure 10. The effect of treatments by Comet Pro on leaf diseases, green leaf area and sugar yield in 2008–2013. The green leaf area and the sugar yield are expressed as differences compared to untreated. Average of 22 trials.

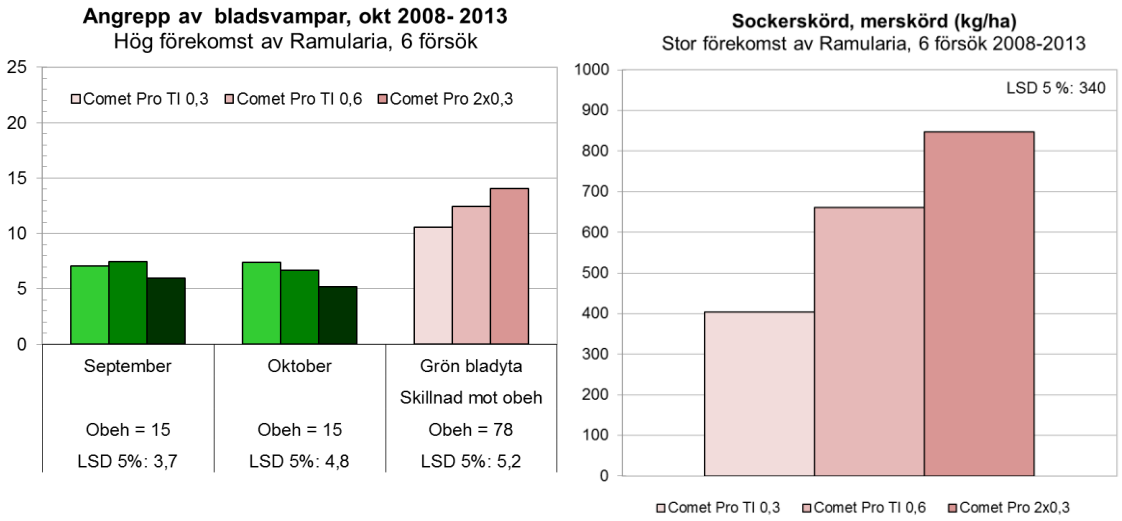


Figure 11. The effect of treatments by Comet Pro on infestation by Ramularia, green leaf area and sugar yield in 2008–2013. The green leaf area and the sugar yield are expressed as differences compared to untreated. Average of 6 trials with a high infection level of Ramularia.

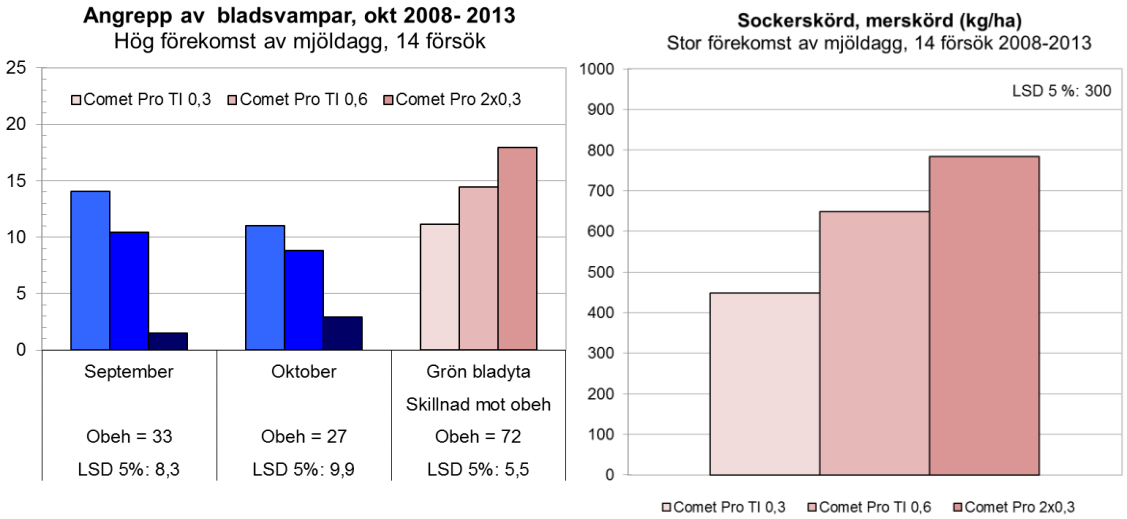


Figure 12. The effect of treatments by Comet Pro on infestation by powdery mildew, green leaf area and sugar yield in 2008–2013. The green leaf area and the sugar yield are expressed as differences compared to untreated. Average of 14 trials with a high infection level of powdery mildew.

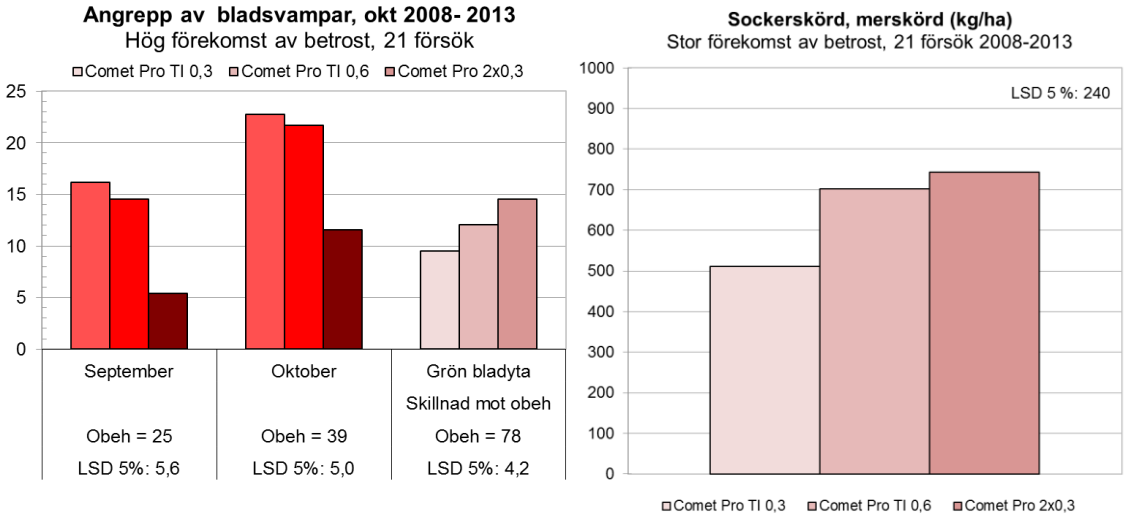


Figure 13. The effect of treatments by Comet Pro on infestation by beet rust, green leaf area and sugar yield in 2008–2013. The green leaf area and the sugar yield are expressed as differences compared to untreated. Average of 6 trials with a high infection level of beet rust.

Conclusions

In the field trials in 2013 the main diseases were powdery mildew and Ramularia. A small infestation by beet rust was present late in the season at all trial sites. By the time of the first application the threshold values were acceded at Egonsborg. By the time of the second application the infection level was high at all trial sites. The main leaf diseases present later in the season were at Egonsborg powdery mildew and beet rust, at Arendala beet rust and at Remmarlöv Ramularia and beet rust.

All treatments at Egonsborg improved the green leaf area in October, especially treatment with two applications. At Remmarlöv there were small differences between treatments. At Arendala all plots showed a beet stand in very good condition, even the untreated. As to the effect on the sugar yield, all fungicide treatments increased the sugar yield at Egonsborg and at Remmarlöv. At Arendala there were no statistically significant differences but a tendency of a higher return when treated twice. For a statistically significant yield increase it was required 900 kg sugar per hectare at Egonsborg, 1,100 kg per hectare at Arendala and 1,500 kg per hectare at Remmarlöv. The average yield increase of all treatments was 940 kg per hectare at Egonsborg, 430 kg per hectare at Arendala and 1,180 kg per hectare at Remmarlöv. As an average of these three trials in 2013 the yield increase was 850 kg of sugar per hectare, corresponding to 6 percent.

Regarding the efficacy against the leaf diseases it was required split applications in order to receive a long term efficacy of powdery mildew and beet rust. The dose level was of less importance this year. However, previous trials have shown that a long term control of beet rust might require a higher dosage. Although improved control of the leaf diseases of split applications, there were small differences in sugar yield between one and two applications. A more thorough analysis of the results of in all 22 trials during 2008–2013 show that when the

disease infection is high, the yield increase was higher when applying a lower dose of Comet Pro twice compared to applying a higher dose once.

Armure and Barkley Bolt XL in a tank mixture with Comet Pro did not improve the efficacy against the leaf diseases this year, as was indicated previous years.

Borgeby in December 2013

Åsa Olsson
Project Manager
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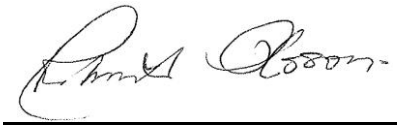

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