



Faculty of Science



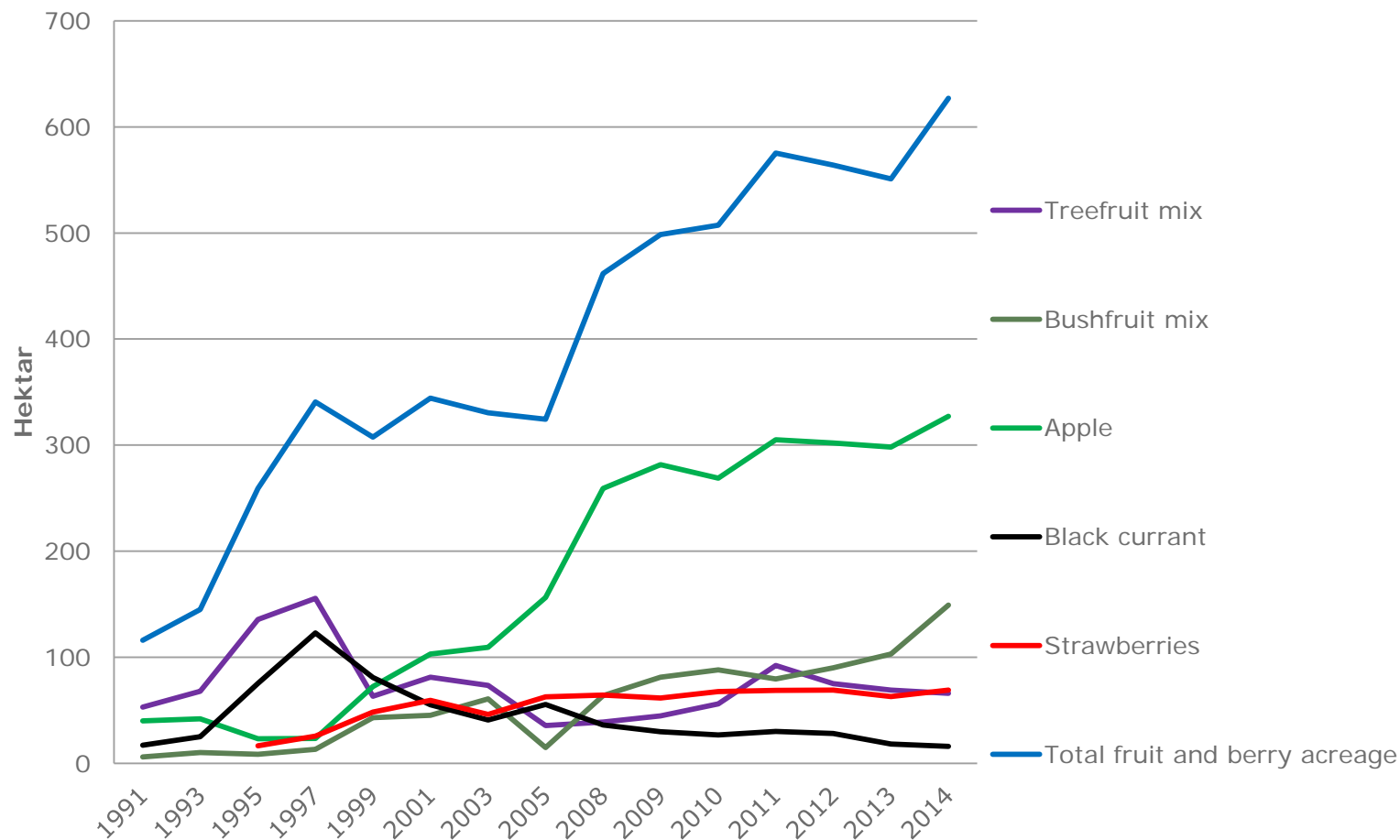
Effect of Strategic Irrigation on infection of Apple scab (*Venturia inaequalis*)

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Organic grown area with fruit and berries in Denmark 1991-2014 (ha)



Source: www.naturerhverv.dk

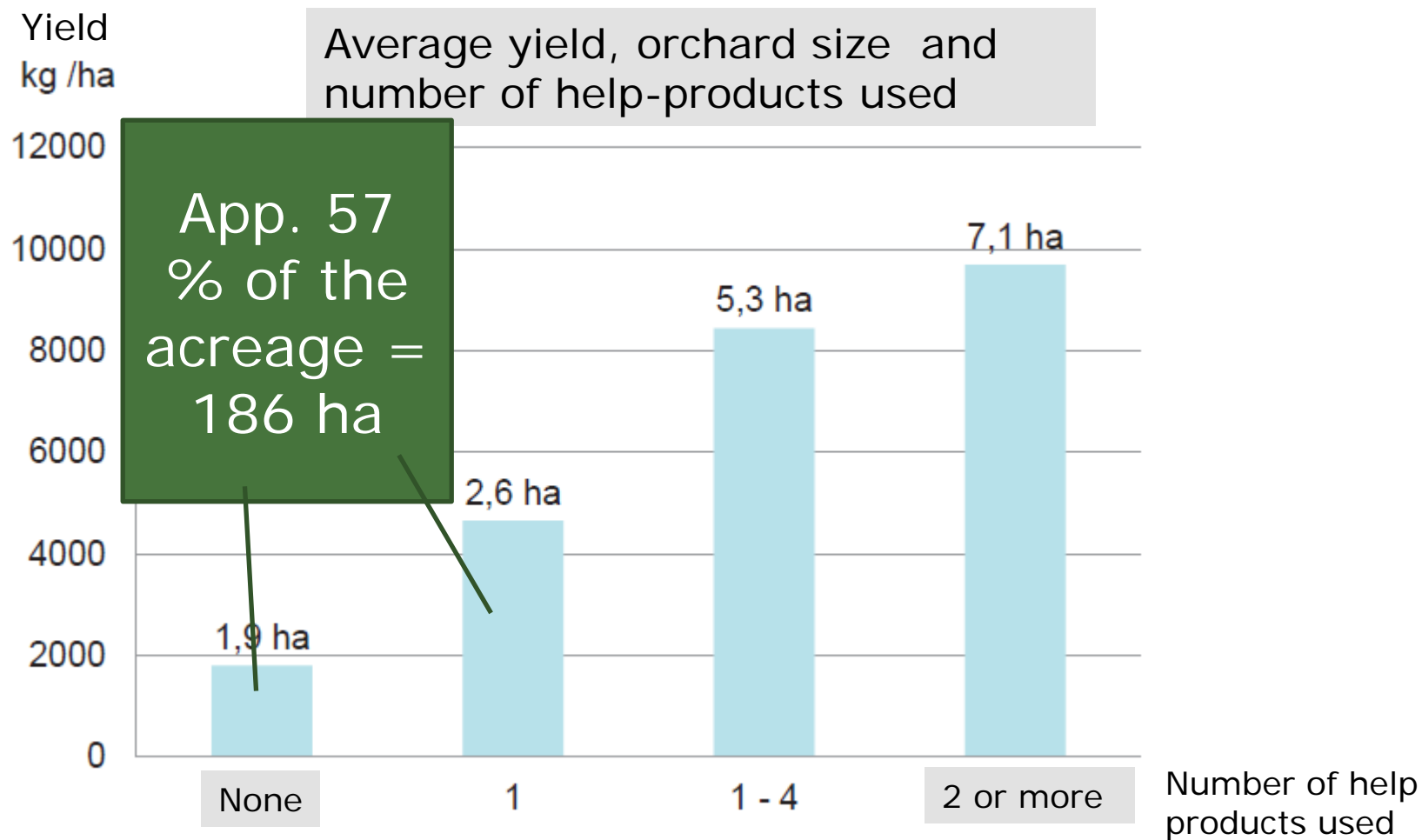


Organic Fruit- and Berry-crops in Denmark 2014

Crop	Certified org. area. or 3. year conversion Ha	Under con- version Ha.	Total organic Ha	Total area in Denmark Ha	% of total DK fruit-area
Apple	305	22	327	1510	21.6 %
Strawberry	58	11	69	1221	5.7 %
Blueberry	21	3	24	67	35.8 %
Rhubarb	18	0	18	34	52 %
Black Currant	16	0	16	1569	1.1 %
Hazelnuts	7	10	16	28	58.8 %
Pear	11	4	15	307	4.9 %
Grapes (for wine)	9	5	14	62	23.1 %
Red Currant	13	0	13	247	5.6 %
Rosehips	9	3	12	159	7.5 %
Elderberry	6	2	8	12	73.5 %
Raspberry	6	0	6	28	22 %
Plum	3	2	6	63	9.5 %
Sweet cherry	5	0	5	154	3.2 %
Blackberry	3	0	3	3	90.3 %
Sour cherry	3	0	3	1071	0.3 %
Gooseberry	2	0	2	33	5.1 %
Total	558 ha	69 ha	627 ha	6706 ha	9.3 %



Many organic apple growers use very few "help"-products



You can grow robust, but not Vf-resistant cultivars without fungicides



Discovery
Red Aroma
Alkmene
Filippa
Holsteiner Cox



Santana (↑) and Pirouette (↓)



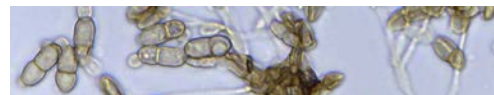
3 growers have invested in rainroofs



You can grow even sensitive cultivars successfully and profitable under roof.

In unsprayed orchards we need all methods possible to prevent apple scab

- Known methods: Rain-roofs, robust cultivars, removal/degrading of old leaves, pruning, plant distances.
- Strategic irrigation is a supplement to these methods, and in dry springs it can add scab control.
- The strategic irrigation method uses water to prevent apple scab.
- The method was tested in 5 organic orchards in 2011 and 2012.(financed by FØL)
- Since 2012 it has been developed at the Pometum, University of Copenhagen as part of the projects FruitGrowth and ProtecFruit (Financed by the Ministry of Environment and Food of Denmark, part of the Organic RDD program, coordinated by ICROFS.)



Strategic irrigation is used in the spring to “lure” the ascospores to eject under dry conditions. Eventually they dry out in the dry tree without infecting the leaves. This way the pool of ascospores is reduced.

Ascospores are ejected when it rains, or when we irrigate.

The challenge is to make it feel like real rain!

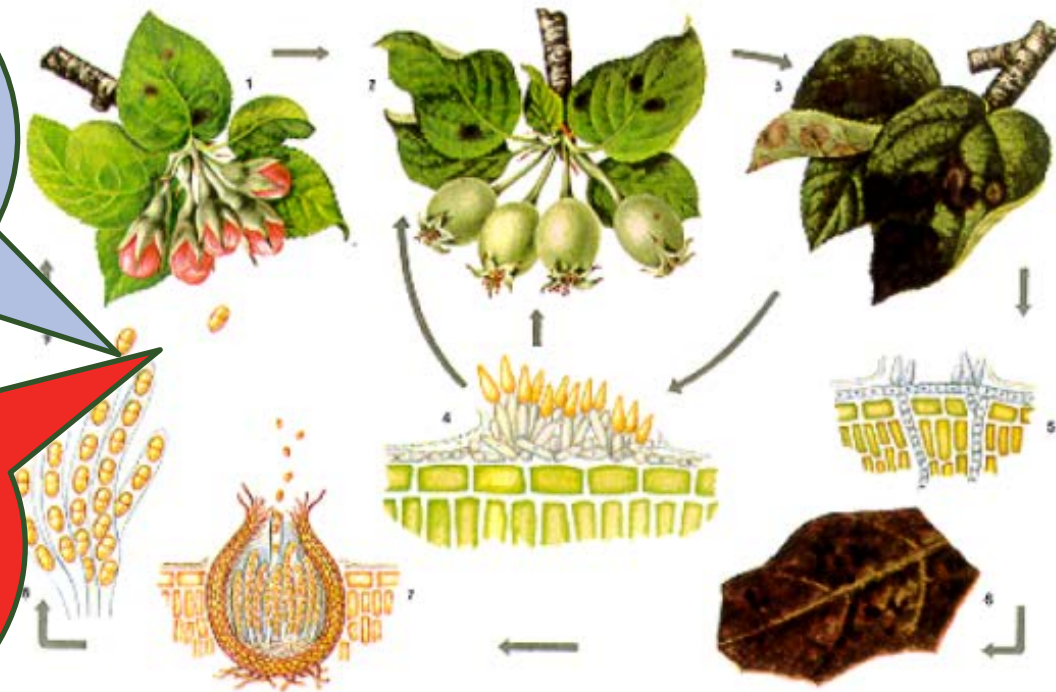
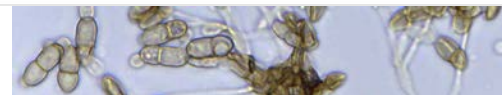


Abb. 1: Der Entwicklungszyklus von *V. inaequalis* auf seinem Wirt (*Malus*). 1: Primärbefall an jungen Laub- und Kelchblättern durch Ascosporen; 2 - 4: Sekundärbefall an Blättern und Früchten durch Konidien, die von subcuticulärem Myzel (4) gebildet werden; 5: Beginn der saprophytischen Phase mit Eindringen des Myzels in das Blattinnere nach Blattfall; 6: überwintertes, mit Myzel durchwachsesenes Blatt; 7: reifes Pseudothecium mit Ascii; 8: freigesetzte Ascosporen (nach Paul, 1981).



The best effect of Strategic Irrigation was reached in 2012 by using this "Waterwaggon" in an organic orchard.



Scab was reduced from 47 % to 12 % in fruits of 'Rubens', after 5 times of strategic irrigation.

The compressor was removed from an old mist-sprayer. A sprinkler bar and a larger pump was added. It worked well and was rather cheap: 12.000 DKR (1600€)

5 days during spring, the grower irrigated 2 x 0,2 mm water with 1 hour interval. He irrigated from 7.30 p.m. to 8.30 p.m. with a forecast of dry weather 2 days ahead.

The two locations of trial in 2014 and 2015, Lærkehøj and the Pometum



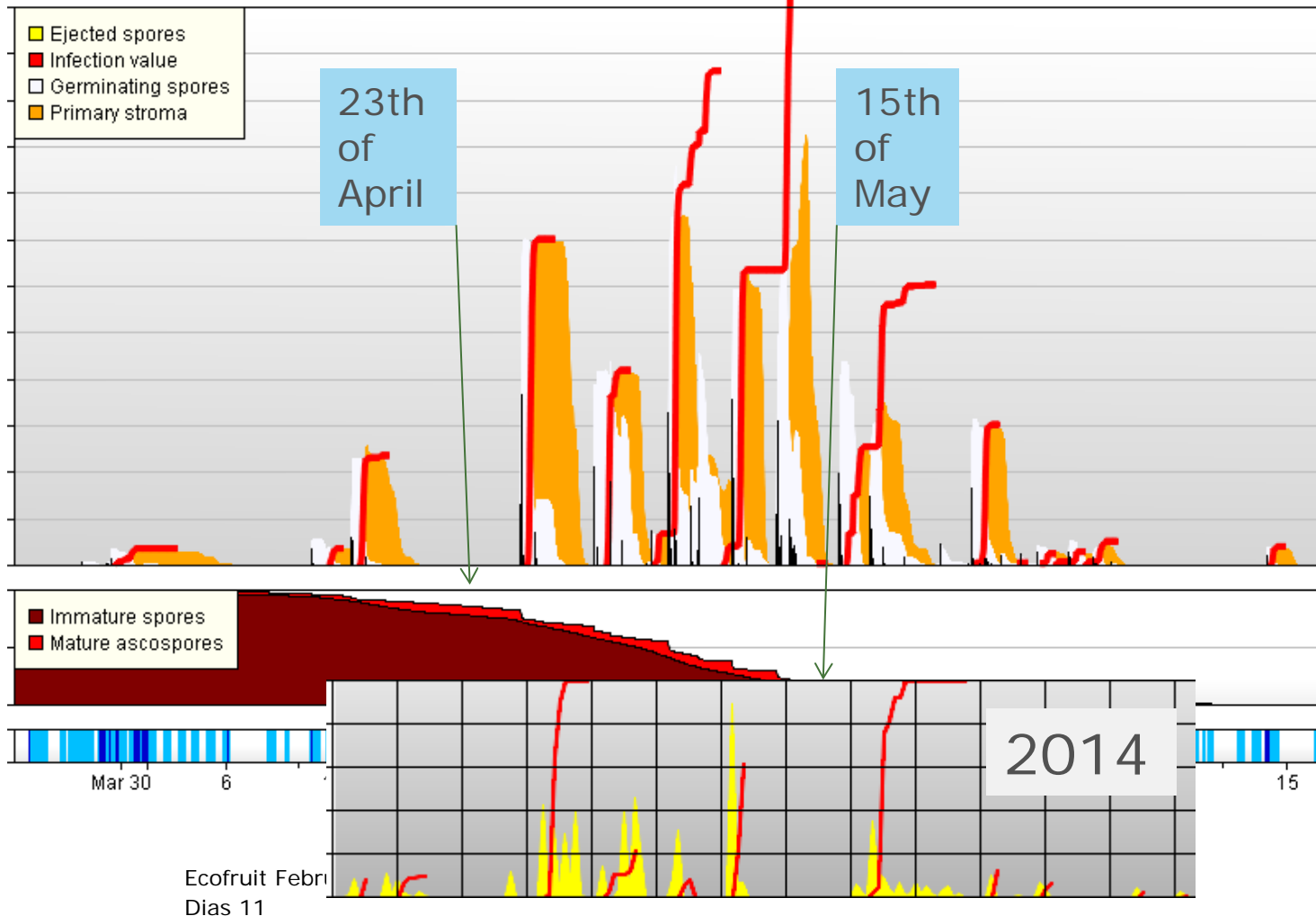
Ecofruit February 2016

Dias 10



Only twice in 2015 it got possible to make a strategic irrigation

RIMpro-Venturia location: Kagerup - 2015

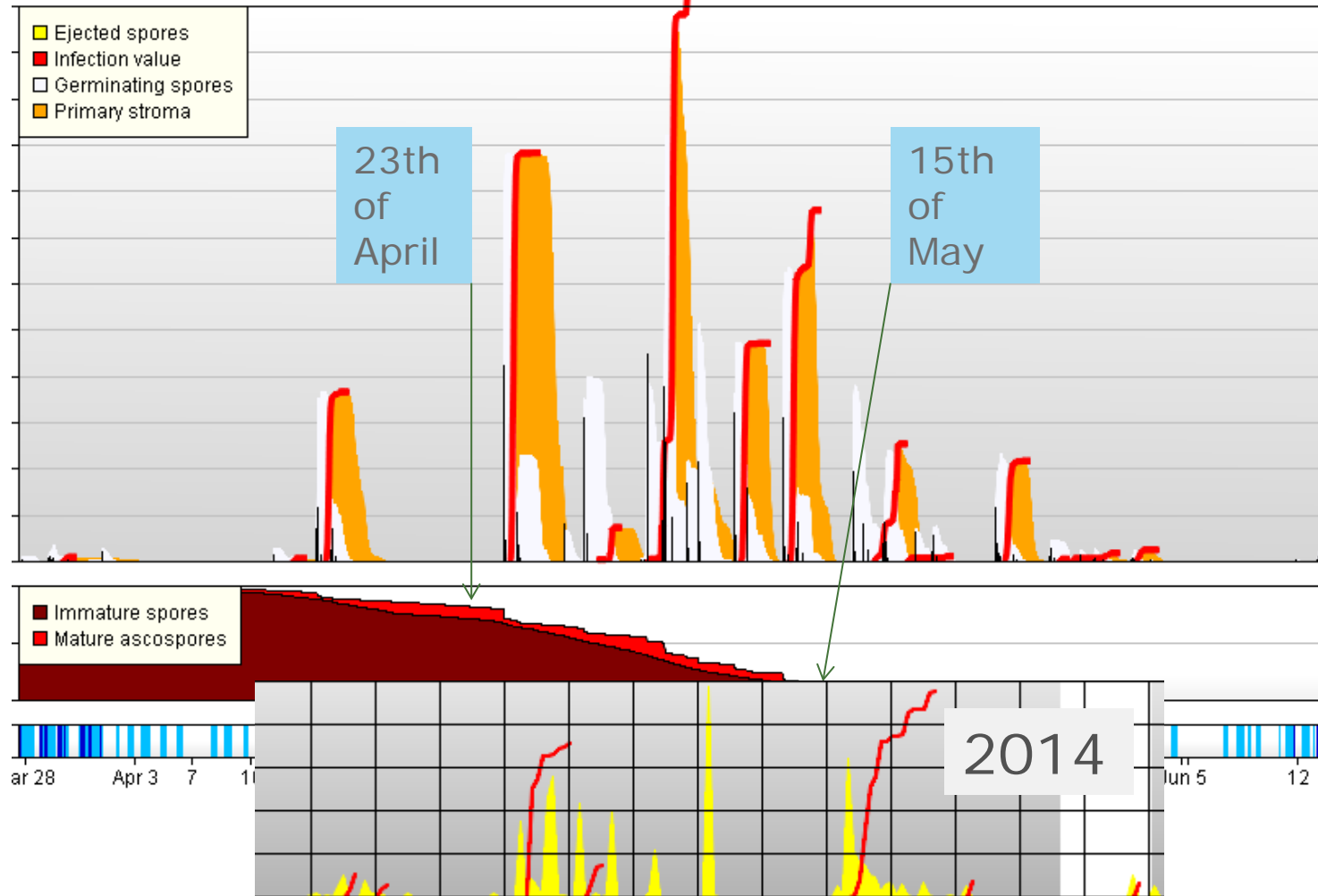


1. Rimpro shows a minimum of app. 5 % ripe ascospores
2. The weather forecast promises dry weather with RH < 85 % the next 24 hours.
3. Rain is forecasted afterward



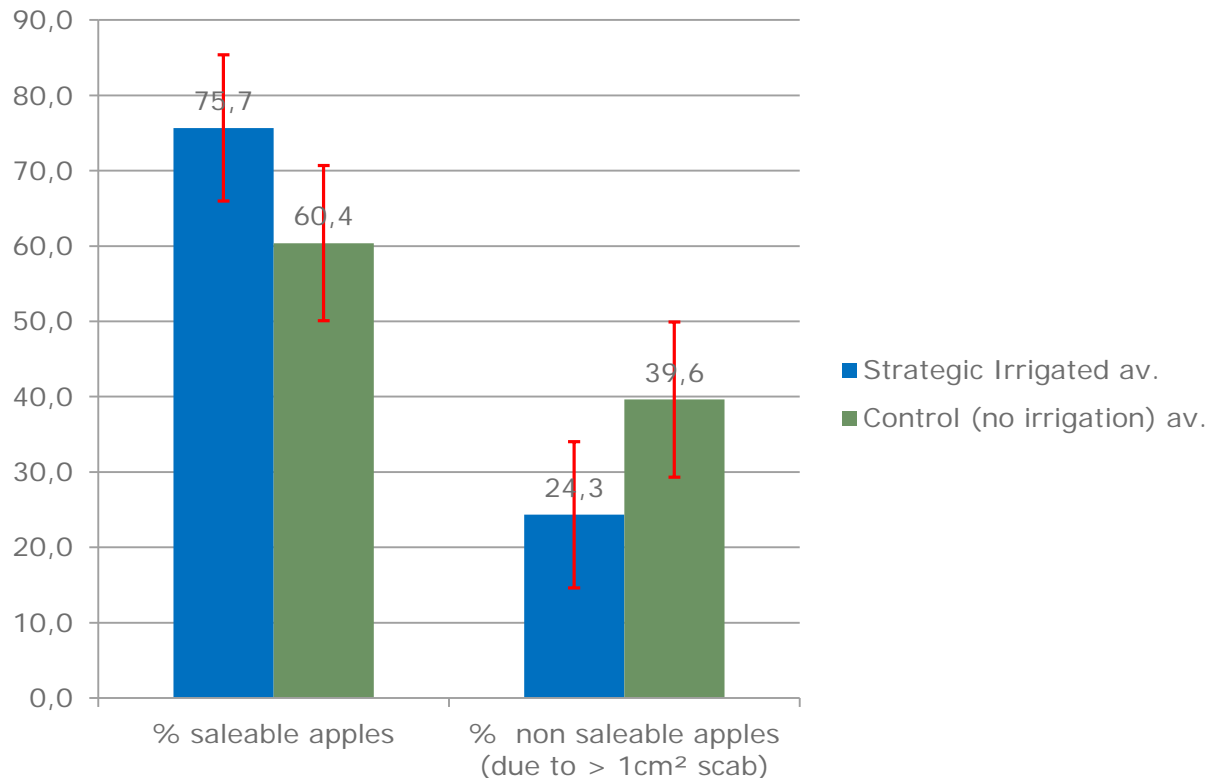
Same picture at both locations in 2015

RIMpro-Venturia location: Pometet - 2015



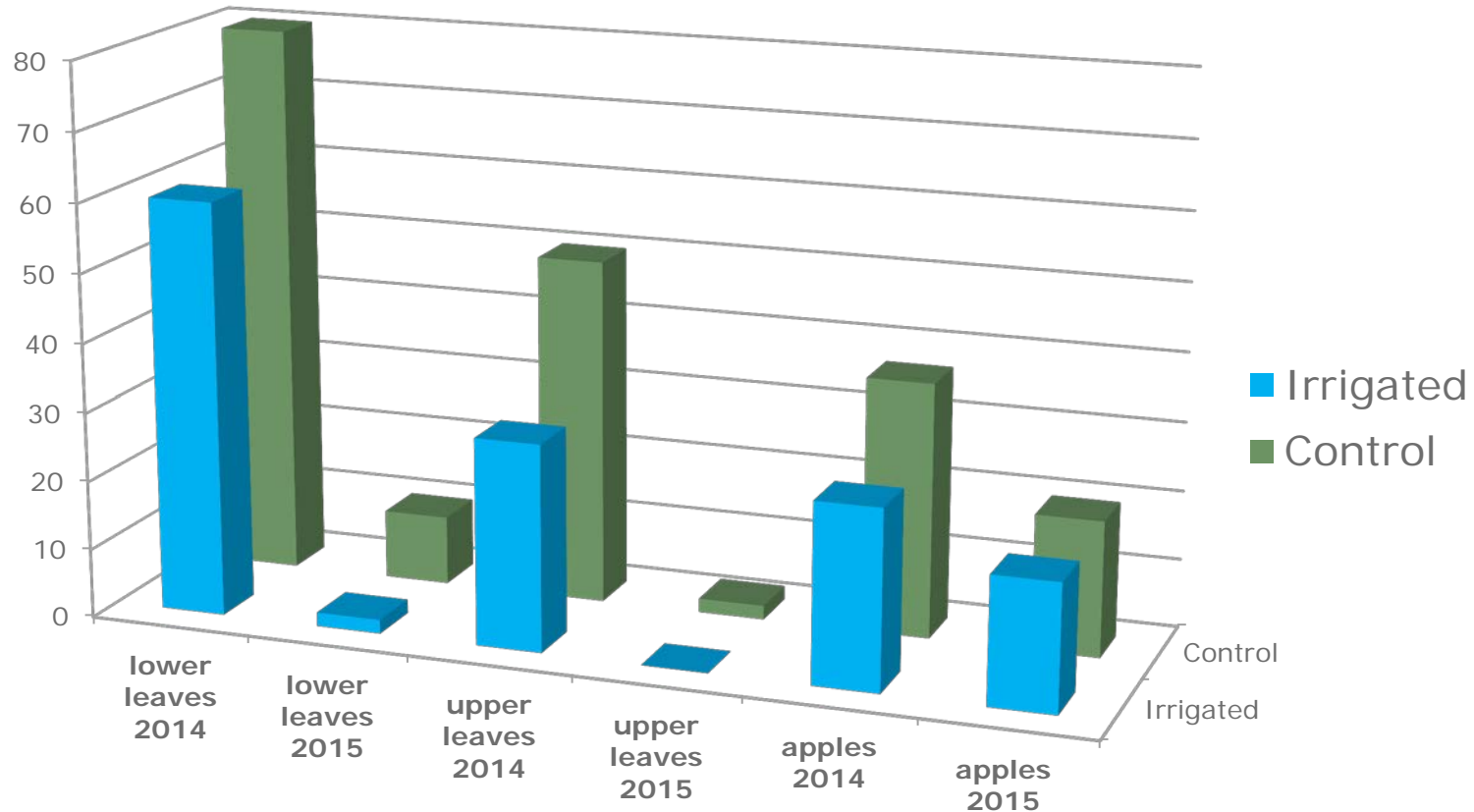
In 2014 the strategic irrigation in Elshof-apples at the Pometum had apparently a nice effect on Apple scab

25 % more apples got saleable due to Strategic Irrigation
They were irrigated three times: the 2/4, 25/4 and 2/5
with 1,7 mm, 2,4 mm and 3,6 mm.



Effect of strategic irrigation on apple scab in 'Elshof' apples at the Pometum 2014 and 2015

Medians % leaves with scab and % discharged 'Elshof'



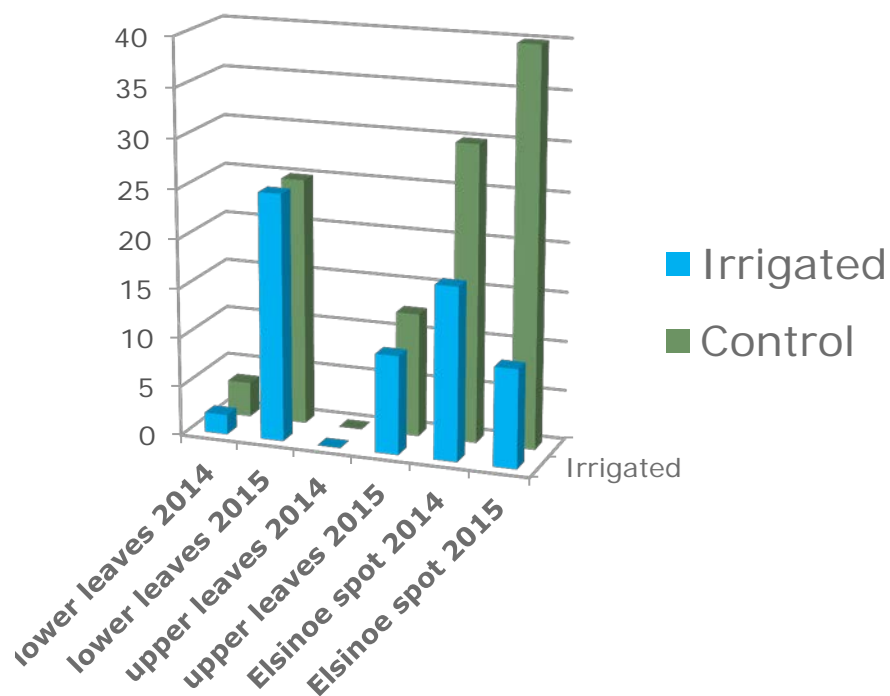
Effects of strategic irrigation in Elshof in 2014 and 2015 at the Pometum. All estimates are significant at 95 % level.

	Estimate	Lower	Upper
Percentage points of scab in lower part of the tree	-16.9% *	-27% *	-6.8% *
Percentage points of scab in upper part of the tree	-11.1% *	-21.4% *	-0.9% *
Percentage points discharged apples	-0.7% *	-0.9 *	-0.5 *

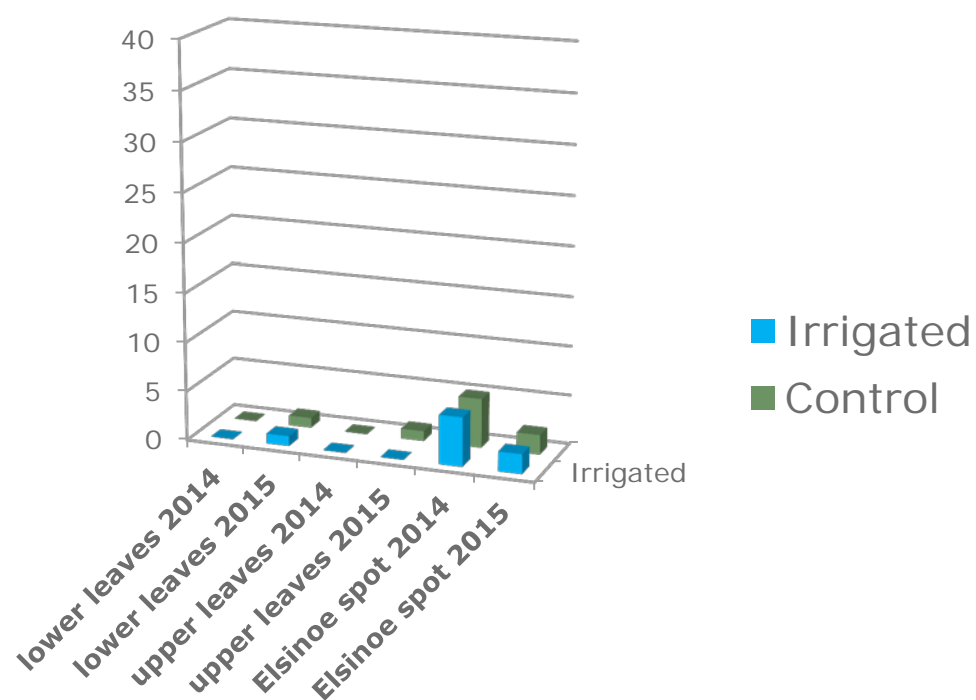


Effects of strategic irrigation in the unsprayed orchard Lærkehøj 2014 -2015

Median % leaves with scab and Elsinoe spot in 'Collina'

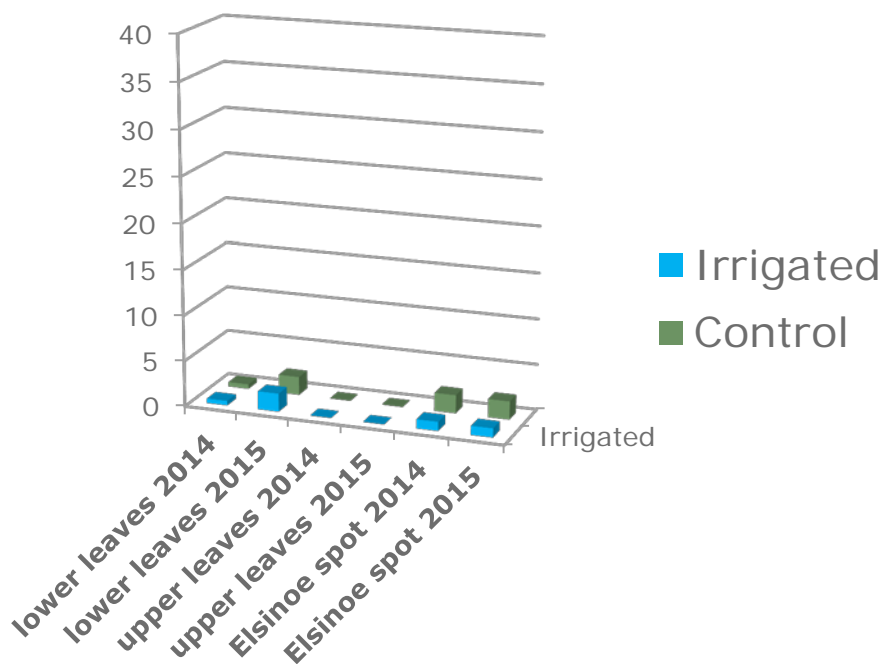


Median % leaves with scab and Elsinoe spot in 'Red Aroma'

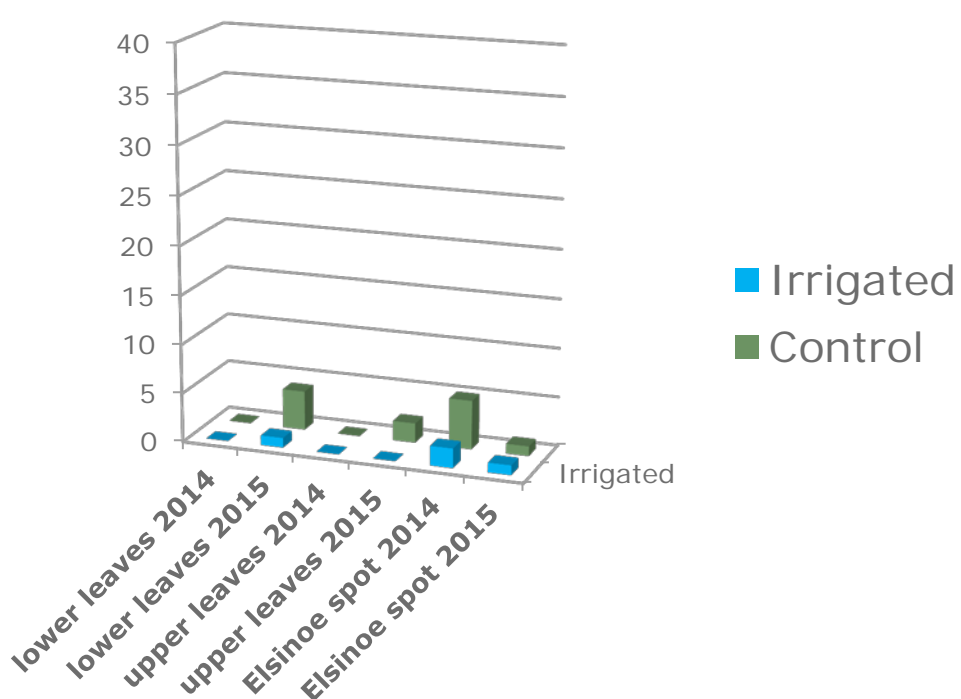


Effects of strategic irrigation in the unsprayed orchard Lærkehøj 2014 -2015

Median % leaves with scab and Elsinoe spot in 'Holst. Cox'



Median % leaves with scab and Elsinoe spot in 'Alkmene'



Effects of strategic irrigation in 'Collina', 'Red Aroma', 'H. Cox' and 'Alkmene' in 2014 and 2015 at the orchard Lærkehøj.

All estimates marked with *) are significant at 95 % level.

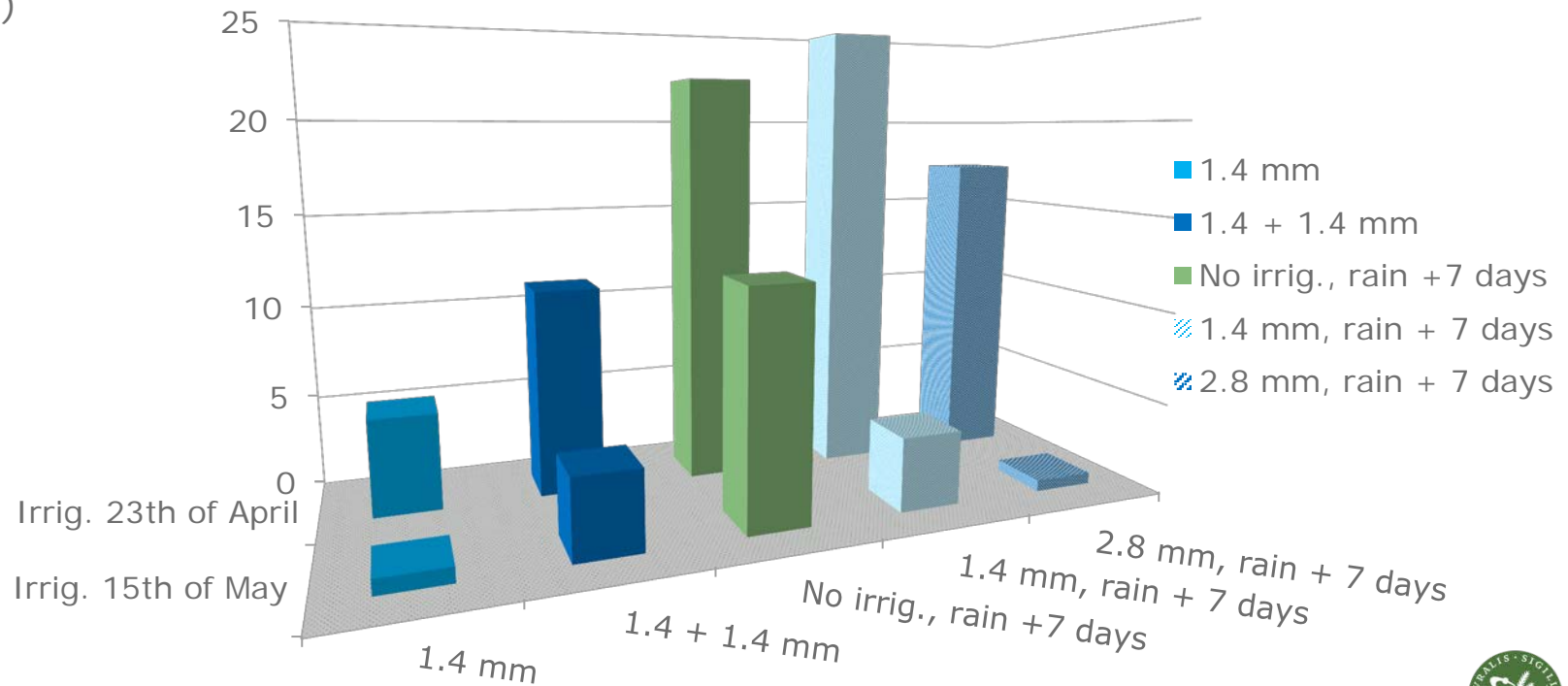
Effect on Percentage points of leaves with:	Cultivar	Year	Estimate	Lower	Upper
Scab in upper part of the tree	Collina, Red Aroma, H. Cox, Alkmene	2014 & 2015	-0.44*	-0.64	-0.24
Scab in low part of tree	Collina	2014	-1,12	-3.78	0.99
Scab in low part of tree	Collina	2015	-0.48	-3.10	2.15
Scab in low part of tree	Red Aroma	2014	-0.68	-2.2	0.86
Scab in low part of tree	Red Aroma	2015	-1.46*	-2.84	-0.08
Scab in low part of tree	Holst. Cox	2014	-0.13	-2.75	2.50
Scab in low part of tree	Holst.Cox	2015	-0.93	-3.28	1.43
Scab in low part of tree	Alkmene	2014	0.23	-2.40	2.86
Scab in low part of tree	Alkmene	2015	-4.40*	-6.76	-2.06
Elsinoe leaf spots	Collina, Red Aroma, H. Cox, Alkmene	2014	-0.31	-0.77	0.16
Elsinoe leaf spots	Collina, Red Aroma, H. Cox, Alkmene	2015	-0.66*	-1.09	-0.24



Sporetraps indicate how ascospores react to irrigation and rain



% ejected ascospores
(of total ascospores in 2015)



Suggested guidelines for strategic irrigation during the season of primary infection of apple scab

Irrigate only, when these 3 conditions are fulfilled:

1. Rimpro shows a minimum of app. 5 % ripe ascospores (often after 4-5 days of dry weather)
2. The weather forecast promises dry weather with RH < 85 % the next 24 hours. (www.yr.no can tell that)
3. Rain is forecasted afterwards

Irrigate in the morning at 7-9 a.m. with one hour interval

Irrigate with at least 1.4 mm (in total: 2.8 mm)

Use sprinklers producing big drops, pointing downwards, wetting only the soil surface and not the tree.

In the period from mouse ear to petal fall it will be advantageously to irrigate often, while the ascospores are ripening fast in these weeks.



Acknowledgements and thanks to:

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Thank you
for your
attention!