



ORGANIC PRODUCTION OF STRAWBERRIES, EXPERIENCES FROM PRACTICE AND RESEARCH IN DENMARK, NORWAY AND SWEDEN

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My present 3 places of work

www.pometet.dk



www.laerkehøjfrugt.dk



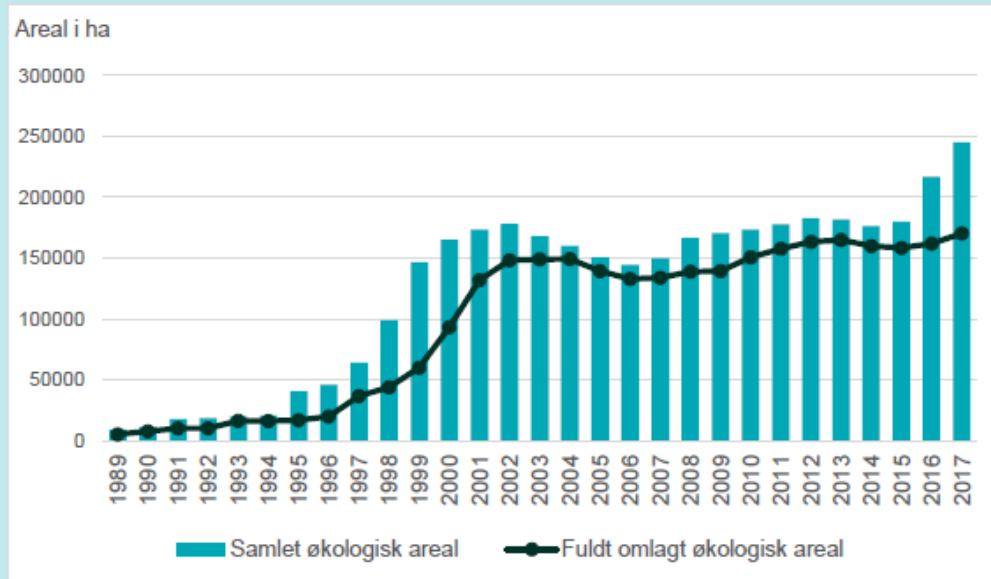
www.ecoadvice.dk

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The organic area in Denmark is rising again

FIGUR 1. Udvikling i økologiske bedrífers indberettede produktionsareal med angivelse af fuldt omlagt økologisk areal for perioden 1989-2017.



Source: Statistik over økologiske bedrifter 2017. www.lbst.dk

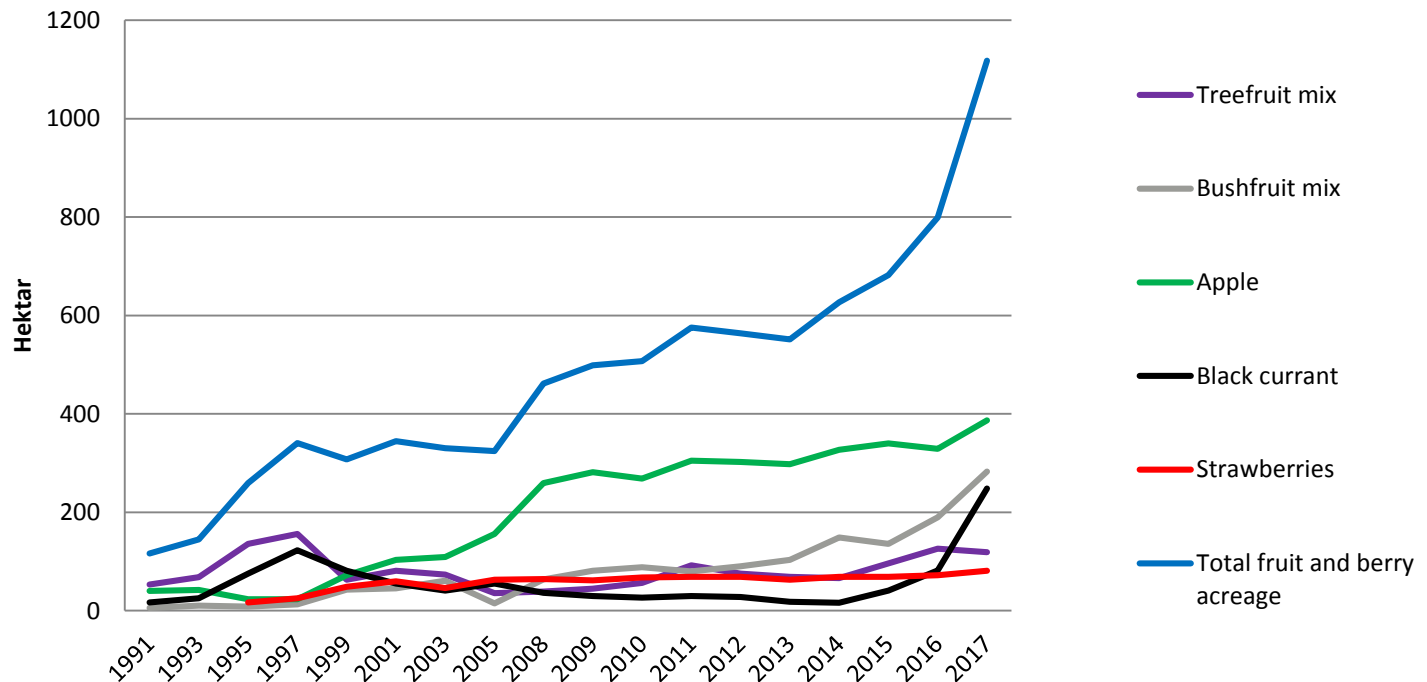
3.469 farms (8,8 %) are organic in DK in 2017 (7,9% in 2016) (3/9-18: 3.577 org. farms)

App. 245.159 ha (9,2%) were cultivated organically in 2017. (8,1 % in 2016)

Former government goal: to double the organic acreage in 2020 in rel. to 2007.

The Danish organic fruit and berry-acreage increased with 29% in 2017

Organic grown area with fruit , berries and rhubarb in Denmark 1991-2017 (ha)



Organic area in Denmark 2017	Certified org. area. or 3. year conversion Ha	Under conversion Ha.	Total organic Ha	Total area in Denmark Ha	% of total DK fruit-area
Apple	321	66	387	1444	26,8
Black Currant	57	191	248	578	42,9
Strawberry	77	4	81	1191	6,8
Rhubarb	36	4	40	69	58,0
Grapes (for wine)	20	24	44	88	50,0
Blueberry	16	5	21	74	28,4
Sour cherry	2	26	28	659	4,2
Red Currant	14	38	52	242	21,5
Hazelnuts	17	8	25	36	69,4
Pear	13	10	23	303	7,6
Other tree-fruit	10	9	19	37	51,4
Mixed fruit	12	13	25	48	52,1
Black chokeberry	19	0	19	20	95,0
Other bush-fruit	12	7	19	44	43,2
Sweet cherry	8	7	15	182	8,2
Elderberry	10	2	12	14	85,7
Rosehips	6	3	9	138	6,5
Raspberry	7	2	9	30	30,0
Plum	7	0	7	69	10,1
Gooseberry	5	7	12	41	29,3
Blackberry	2	1	3	3	100,0
Quince	2		2	3	66,7
Sea buckthorn	15	3	18	18	100,0
Total	688	430	1118	5331	20,97

The legislation of Organic production and Organic organizations

EU 834/2007 new proposal

The organic growers are controlled by the state- for free.



Interestgroups / NGO's:

IFOAM www.ifoam-eu.org

Organic Denmark www.okologi.dk



Biodynamic association

www.biodynamisk.dk



Danish organic production of strawberries

- Planting Frigoplants in may.
- Removal of flowers in the year of planting.
- **You must plant organic plants (if available)**
- 2 years of harvesting, maybe 3.
- The main part is grown on bare soil, some are grown on plastic mulch, some in tunnels and some in greenhouse.
- Yields: 6-9 t/ha, but 12-15 t/ha is also possible. The lowest yield is in Pick-your-self-fields. In trials 24 t/ha is possible.
- Prices from app. 22 dkr/kg to app. 50 dkr/kg, depending on season and type of trade.
- The organic premium in relation to conventional berries is from 0 to 15 % .
- Organic strawberries to the supermarket is payed app. 25-26- dkr/kg in average.

Main challenges in production of organic strawberries

Leadership concerning picking crew and trade

To get healthy plant material without diseases

To control weeds.

Grey mold and *Anthonomus rubi*. Some times mites, mildew and others are bothering.

Example from Bakkegården, Gyrstinge. www.bakkegarten.dk

app. 1,5 ha. Organic strawberries since 2004 (now they grow strawberries on plastic mulch)



Strategi against weeds:

Year 1:

Delayed preparation of planting bed in April and May

Planting of frigopants late May

Weed harrowing and row cultivation with finger wheels all summer

Hand hoeing in August

Year 2 and 3:

4 x weed-harrowing plus adding a little Biogrow in the row before covering with flees

Row cultivation with finger wheels

Hand hoeing right before spreading out the straw

Covering with straw in between the rows

Picking

After harvest: cutting the top and row cultivation to cut the runners and incorporate the straw.

Row cultivation with finger wheels the rest of the season.

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Duborg organic strawberries

By Grete and Peter Schmidt, Tinglev.

6,5 ha strawberries for supermarkets

www.duborgjordbaer.dk Organic strawberries since 1998



Precrop: grainfield

Planting of fresh plants in august

Plant distance 90 cm x 29 cm

Weed-strategi: Rowcultivator + fingerwheels (in year of planting)

3 x hand-hoeing: in April, just before picking in June, and just after picking in July/August

Sometimes the plants are topped, but it depends on growth, weed-level etc.

Is using bumblebees+Trichoderma with good effect. He is now spraying Trichoderma out instead of using bumble-bees.

He once had problems with strawberry-moths. It was controlled with 8 sprays with *Bac. thuringiensis* after harvest.

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Plant only on a clean field, without perennial weeds

Croprotection is essential!

If possible: choose a field, that never had strawberries before.

Keep at least a 6 year interval between two strawberry crops.

Good precrops before strawberries are Broccoli or other cabbages. Well cleaned fields of Rye or Wheat are also fine precrops.

Avoid the following in the crop-rotation: Potato, Alfalfa, Fababeans, Flax, Oat, Maize, Carrot, Parsnip or Squash, while they can increase diseases and nematodes in strawberries.

Avoid also old grass-fields or old fruit-orchards as precrop for strawberry.



Rowcultivator plus harrowing in row





Kress fingerweeders are
efficiently reducing hand-
hoeing

Kress fingerweeder on row cultivator



Rowcultivator for incorporating the straw after harvest



Hoeing by hand is still necessary



Time used for hand hoeing: app. 225 hours/ha according to swedish data.



Electric one-man weeding/picking-waggon



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This is a clean strawberry field. The yield was far above 10 ton/ha. The cultivar is 'Honeoye'.



A mechanical cleaned field in spring



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A strawberry- and sheep-farm in Sweden



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Plastic mulch with cut grass/weed in between rows



Machinery for placing the plastic mulch



The sheep sometimes crossed the fence..



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Old leaves and runners should be removed by brushing the plastic surface in the spring.



Planting on plastic mulch is done by hand



‘Rumba’ in a tunnel at Ventegodtgaard in Denmark, also on a plastic mulch



The cover is ready for frostprotection



A swedish organic greenhouse production



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A pot of minimum 4 liter plus fertigation



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Fertilization of strawberries

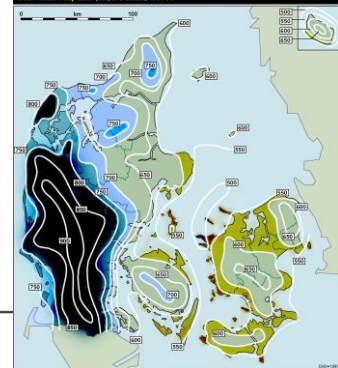
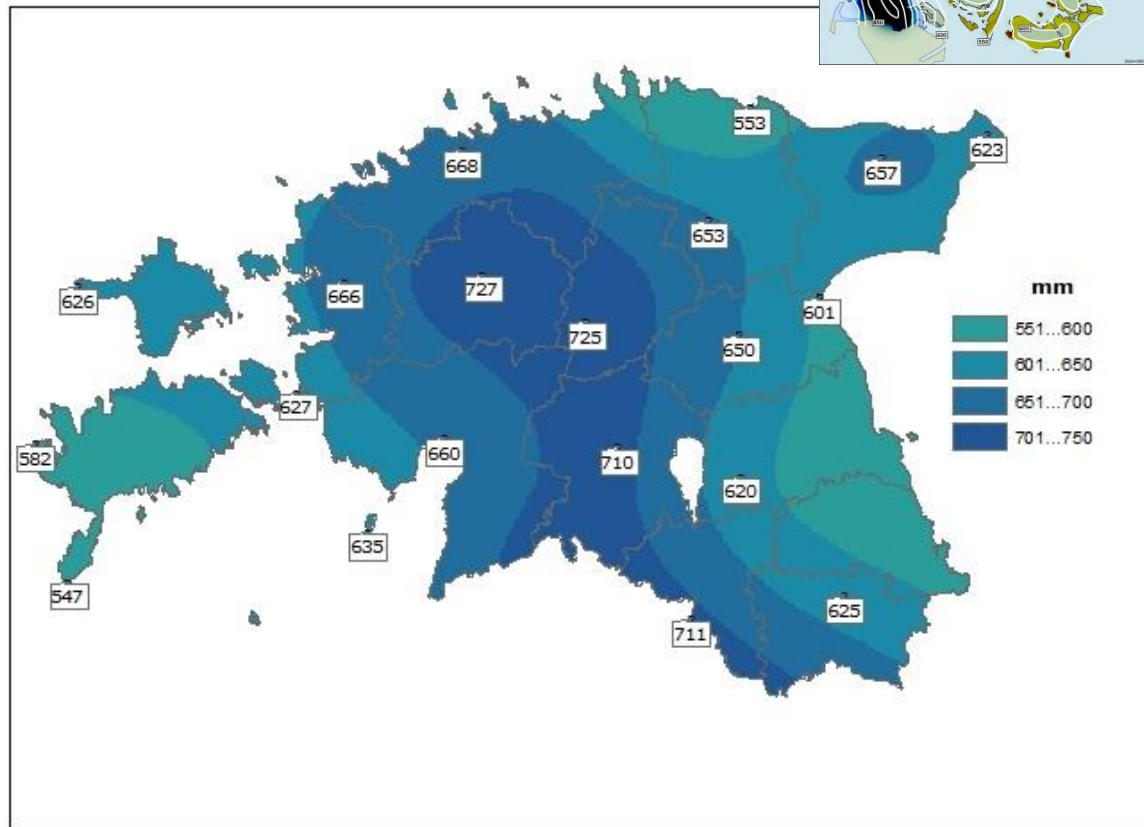
- Before planting, you can add 15-20 T manure/ha (app. 120 kg total N/ha)
- On clay-soil, this can be sufficient N for all 3 years with strawberries.
- On lighter sandy soil, you can add app. 30-40 kg total N/ha in august, right after harvest. This will fertilize the plant in the period of flower-production.

Choose a rather dry climate for organic growing of strawberries.

The yearly precipitation in Denmark varies from below 500 mm to more than 900 mm.

In the darkblue areas it rains so much, that the risk of fungus diseases in open-air strawberries is (too) high. Tunnel-production is always possible.

It seems to be almost the same story in Estonia



Strawberry cultivars for organic production

Cultivar	Season	Robustness	Yield	Taste and quality
‘Honeoye’	Early	Very robust to grey mold. Sensitive to verticil., mildew, Phytophthora and winterfrost	High	Acidic taste. Firm. Not suited for tunnel.
‘Rumba’	Early	A little sensitive to grey mold, but rather robust. Dense plant. Some sensitivity to winterfrost.	High	Middel taste, better in tunnel. Big. Firm.
‘Sonata’	Mid-early	Rather sensitive to grey mold and nematodes, but robust to others. Robust to winterfrost.	Med	Fine taste. Medium red.
‘Polka’	Mid-early	Rather sensitive to grey mold, more robust to others. Very dense plant. Robust to winterfrost.	High	Fine taste. Dark (smaller) berries.
‘Salsa’	Mid-late	Some sensitivity to grey mold. Rather robust to diseases. Robust to winterfrost and springfrost.	High	Middel taste. Big and firm.
‘Symphony’	Mid-late	Robust to most diseases, some suscept. to mildew and mites. Some sensitivity to winterfrost.	High	Middel taste. Firm. Nuts are very visible.
‘Florence’	Late	Robust, but sensitive to Black rot, Verticillium and winterfrost	High	Middel taste. Firm.
‘Malwina’	Very late (3 weeks after Elsanta	Some sensitivity to grey mold. Rather robust to others. Robust to winterfrost.	Med	Fine taste



Rumba (in tunnel)



Malwina



Norwegian economical experiences

Organic production is not very common

Tunnel-production and plastic-mulch in open air is popular because of a rainy climate

Open air: Yield 4-9 T/ha, only 50% saleable berries because of Botrytis

In tunnel, the yield of 'Polka' is app. 18 T/ha saleable berries.(50 Nkr/kg..)

'Sonata' and 'Polka' in tunnel yield app. 75% saleable berries.

'Florence' and 'Korona' yield 30-40 % saleable in tunnel. The reason is, that mildew is a larger problem in tunnel, than in open air production.

'Rondo' is a tasty everbearing norwegian cultivar. In tunnels, 'Rondo' yields app.16 T/ha. The first harvest in the normal season, the next in august till medio october.

'Rondo' is quite soft and is only suitable for direct marketing.

Source: <http://agder.lr.no/fagartikler/15127/>

Nordic experiences at the internet

www.bioforsk.no : Norwegian growing-guide

Results from Norwegian organic trials:

<http://agder.lr.no/fagartikler/15127/>

Swedish growing-guide:

<https://webbutiken.jordbruksverket.se/sv/artiklar/jo1625.html>

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Disease	Prevention/control
All fungus diseases	Well drained, fresh, soil without any strawberry-history. Dry climate. Drip irrigation. Healthy plant material.
<i>Verticillium dahliae</i> (wilt disease)	Test the level of contamination in a soil sample. If there is a high risk, then avoid the cultivars 'Honeoye', 'Korona' and 'Florence'
<i>Botrytis cinerea</i> Grey mold	Weed-harrow the old, dry leaves in spring. Chose robust cultivars. Use evt. <i>Trichoderma</i> . (best at temperature > 20 °C) Always pick and remove the rotten berries too.
Mildew	Choose robust cultivars. Irrigate before the plants are suffering from thirst Do not fertilise in spring, and do not fertilise with too much nitrogen. If the plants get mildew, then top them after harvest in 10-15 cm's height.

Molded berries should always be picked and removed



Grey mold is reduced by quick cooling



Cooling of the strawberries right after picking, in the field, reduces losses with 30% due to less Grey mold (Botrytis)

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Example from Ole Nørby, who grows strawberries with greater distance between plants.

(Organic strawberries on Stevns since 1998. app. 1,5 ha)

Every plant is kept as a single plant in the row with a plantdistance of 0,4-0,5 meter and 1 meter distance between rows. It reduces problems with grey mold and produce an optimal quality. Even 'Honeoye' becomes sweet!



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Irrigation gives a higher (+40 to 60%) yield and a more stable yield. But the taste gets diluted as well.

Drip-irrigation reduces the risk of fungus diseases like Grey mold.

If you use sprinkler irrigation, you should avoid irrigating during flowering to minimize infections of grey mold.

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It is always wise to share
experiences with colleges.





Pests	Prevention /control
Larvae of Strawberry tortrix	<p>Spray with <i>Bacillus thuringiensis</i> on small larvae. Largest effect on 2. generation in August-September.</p> <p>Sow out flowerstrips with Buckwheat to increase the natural enemy of the strawberry tortrix: <i>Copidosoma aretas</i>.</p>
Snails	Ferriphosphate.
Strawberry mites (<i>Tetranychus Urticae</i>)	Spread the natural enemy: <i>Phytoseiulus persimilis</i> after the risk of night frost is over
Birds	Flying dragons are quite effective.
Roedeer	Fence the field with a min. 1,60 m high fence.

Healthy plant material is essential

Heat-treatment of runners kills all strawberry-mites.
10 minutes at 46 °C, there after in cold water.



90 % of the pollinating insects in strawberry consists of wild bees.

Kilde: Ahrenfeldt, E; Klatt BK; Arildsen, J; Trandem, N; Andersson, G; Tscharnkte, T; Sigsgaard, L. 2012. The spatial distribution and the composition of wild bee species available for pollination of early strawberry varieties in four different countries. IOBC/wprs Preceedings. Vol. 75, 2012:5-8.







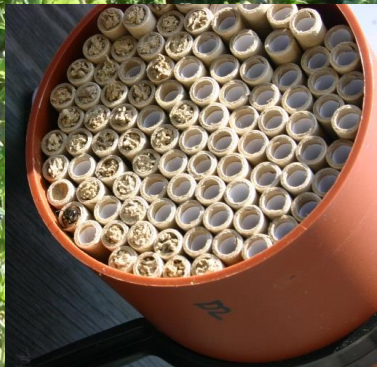
Honeybees often prefer the winter rape to the strawberries. Bumble bees are more stable.

Bumble bees for pollination plus distribution of
Trichoderma. "The Flying Doctor"



Trichoderma is an antagonistic fungus, that can reduce grey mold.







Allowed agents for regulation of pests and diseases in organic production*

I: Azadirachtin (Neem) (only ev. 3th.year)

I: Hydrolysed proteins

I: Lecithin (as basic substance)

I: Fructose, Sucrose (basic s.)

I: Plant oils

I: Pyrethrum (natural) (derogation)

I: Quassia (going out?)

I: Rotenon (Derris)

I, F: Microorganisms

(*Bac. Thuringiensis* and

Virus against codling moth,

Bac. subtilis among others)

I: Spinosad (derogation)

*)According to the EU council regulation EU 834/2007.

I: Pheromones (only in dispensers or traps)

I: Fatty acid potassium salt (soap, only in greenhouse)

S: Iron-orthophosphate (Ferramol)

F: Copper

F: Calcium hydroxide (basic s.)

F: Potassium permanganate

F: Potassium bicarbonate (Armicarb)

F: Sulphur

F: Lime sulphur

F: Laminarin (algae)

I, F: Paraffin oil/ mineral oil

Some are not permitted by the Danish environmental authorities (shown in black).

Buckwheat against strawberry tortrix

Organic strawberry fields have such low numbers of strawberry tortrix, that there is no need for control.

The most common egg-larvae-parasite of the strawberry tortrix is the parasitoid *Copidosoma aretas*. You can enhance that by sowing Buckwheat (*Fagopyrum esculentum*). There is a higher mortality among larvae close to flowerstrips with buckwheat.

There is a tendency to more insect-pathogenic nematodes in organic fields, but less *C. aretas*. The overall level of parasiting was the same in organic and conventional systems.

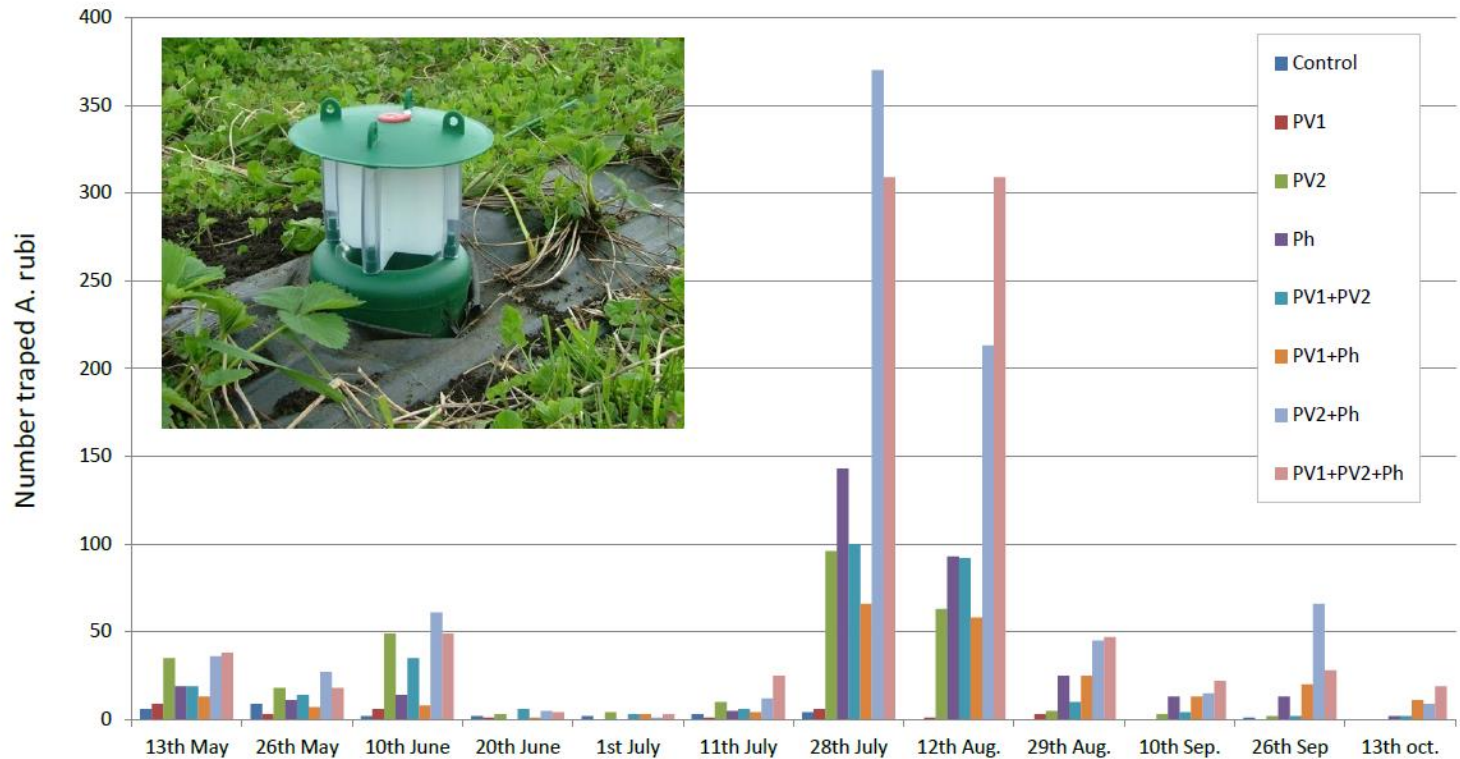
Natural insect-pathogenic fungus was present, but not enough to effect the control of larvae of strawberry tortrix.



Kilde: "The effect of floral resources on parasitoid and host longevity: Prospects for conservation biological control in strawberries." www.insectscience.org/13.104/i1536-2442-13-104.pdf

af Lene Sigsgaard, Cathrine Betzer, Cyril Naulin, Jørgen Eilenberg, Annie Enkegaard og Kristian Kristensen

Previous study, trapping strawberry blossom weevil:



The traps are sold at af www.sentomol.com and www.bioplant.dk

Marketing and sale.

The biggest challenge in any strawberry production

15.15-16.15 Exchange of tips concerning marketing of fresh strawberries, pick-your-self, industry-production etc

Local sales, requires
a good location, for
instance a busy road
nearby



Pesticide-cocktails in conventional strawberries in EU in 2013 – a reason for buying organic

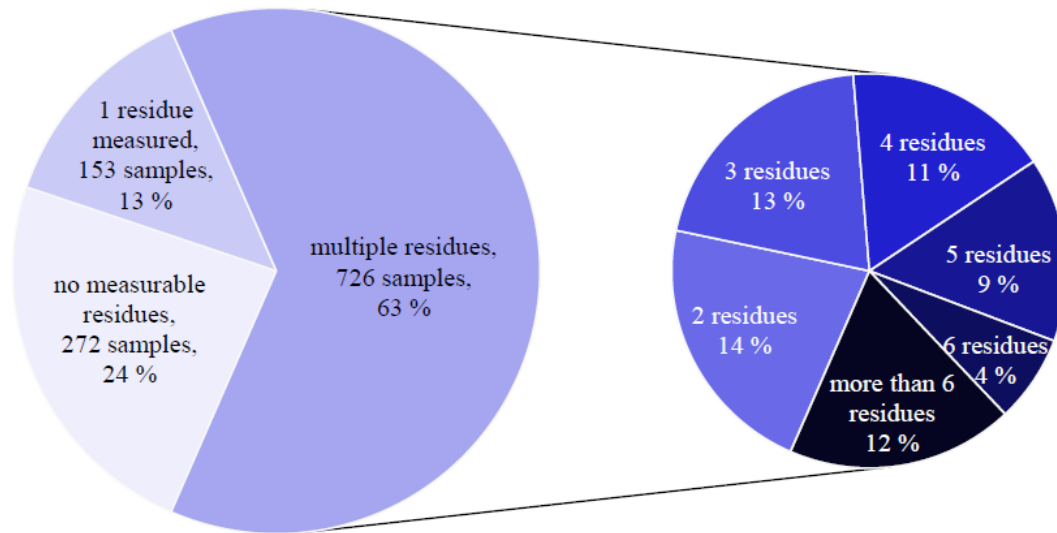


Figure 2-18: Number of detectable residues in individual strawberry samples

In 2.5 % of the samples (29 samples), the residue concentration exceeded the MRL. The proportion of non-compliant samples was 1.2 % samples (14 samples).

Source: European Food Safety Authority, 2015. The 2013 European Union report on pesticide residues in food. EFSA Journal 2015;13(3):4038, 169 pp. online: www.efsa.europa.eu/efsajournal

Organic strawberries are sweeter

Cultivar	Production-system	% sugar	% acid	Sugar/acid
Elsanta	Organic	9,6	0,63	15,2
	Integrated Production	8,7	0,79	11,0
Honeoye	Organic	10,3	0,95	10,9
	Integrated Production	7,7	1,02	7,5

Source: The assessment of allergenicity risk of selected strawberry cultivars on the guinea pig model. M. Jasinska-Stroschein et al. 2012

Swedish economical calculations

<http://webbutiken.jordbruksverket.se/sv/artiklar/ekonomi-i-barodling.html>



Ekonomi i bärödling
Kalkyler för jordgubbar och hallon

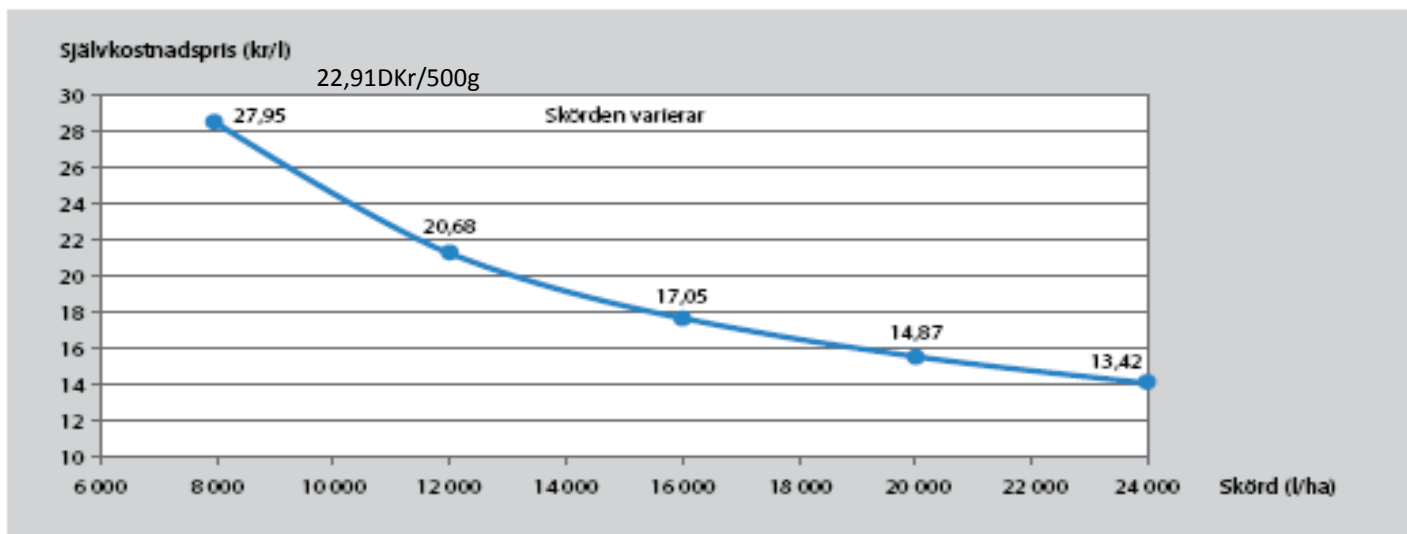


It is always important to demand the right price for your product.

The figure shows the Production-price SKr/500 g in relation to yield.

Farm with 1 ha organic strawberries on plastic mulch. 2011-prices .

JORDGUBBAR 

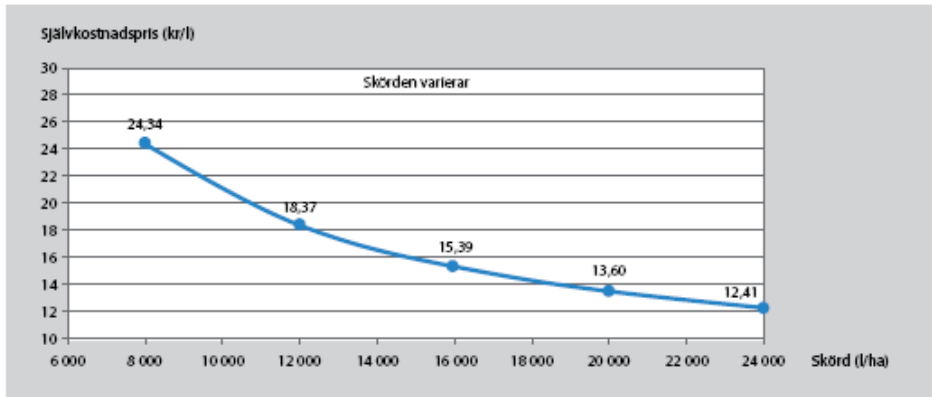


Figur 7. Känslighetsanalys för hur skörden påverkar självkostnadspriset för ekologisk jordgubbsodling, dubbelrader på plastlist, typföretag 1 (mindre företag)

Yield-level in Danish trials: 4-24 ton organic strawberries/ha.

Production-price in SKr/500 g in relation to yield. Farm with 10 ha Eco-strawberries on plastic mulch. 2011-prices

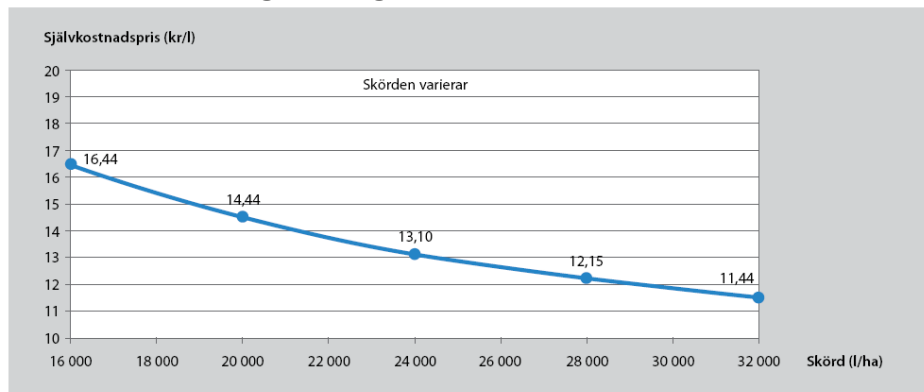
JORDGUBBAR



Figur 8. Känslighetsanalys för hur skörden påverkar självkostnadspriset för ekologisk jordgubbsodling, dubbelrader på plastlist, typföretag 2 (större företag)

Conventional growing

JORDGUBBAR



Figur 9. Känslighetsanalys för hur skörden påverkar självkostnadspriset för konventionell jordgubbsodling, dubbelrader på plastlist, typföretag 2 (större företag)

Good economy in the strawberry-production is very dependent on good picking. A good instruction will give a good result.





Holtgaard offers to book time for Pick yourself

<https://holtgaard.dk/>



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**Thank you for your
attention!**

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