Marianne Bertelsen and Hanne Lindhard
Danish Research Service for Plant and Soil Science
Department of Pomology
Kirstinebjergvej 12
DK-5792 Aarslev, Denmark

Apple Sawfly

Occurence, cultivar suseptibilities and control measurements

Introduction:

In 1987 an ecological trial including 11 commercially grown apple cultivars was established at the Danish Research Centre for Horticulture in Aarslev. The purpose of this trial is to compare differences between cultivars in susceptibility to pests and diseases. From time of trial establishment sawflies have been a small, but growing problem. In 1992 the situation worsened in so far as the cultivar 'Discovery' suffered a sever attack of apple sawfly. The yield was reduced by 50% in comparison to previous years and 20% of the mature fruits were damaged by corky scars and malformations. The damage to the other cultivars were of minor importance averaging from 1-4% damaged fruit.
However, due to the problems experienced with 'Discovery', it was decided to monitor the occurrence of apple sawfly in 1993 and record the level of attack of each cultivar. If necessary an ecological accepted control agent (bark extracts of the tropical tree *Quassia amara*) would be applied in order to reduce the damage.

Materials and Methods:

Two white traps coated with glue (trademark REBELL) were used to monitor the of occurrence of apple sawflies in the trial. The traps were placed in 'Discovery' trees in a height of 1.5 m on the 28 th of April at pink buds. The number of apple sawflies caught on the traps were counted at different intervals during the flowering season.
On the 17-18 th of may, around petal fall, the number of flower clusters infested by eggs of the apple sawfly was assessed.
This was done by inspecting 100 flower clusters of each cultivar for egg-laying slits turned brown.
Seven cultivars with more than 30% of the flower clusters infested were subsequently treated with Quassia.
Quassia was applied on the 19 th of May in a 2% concentration using rape seed oil as a surfactant. Ten days after spraying the efficiency of the Quassia application was assessed. For this purpose 50 infested fruitlet clusters of each treatment were examined for signs of superficial tunnels made by the first instar larva.
The yield was recorded after harvest and so was the number of fruits damaged by the characteristic corky scars of the apple sawfly (only data from early cultivars can be presented here).

Results:

Table 1. Flowering data 1993.

Variety	Date in May 1993
	4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Discovery	oooooooooooooooooooBBBBBBBBBBBBBBBBBxxxxxxxxxxxxxxxxx
Summerred	ooooooooooooooBBBBBBBBBBBBBBBBBBBBBBBBxxxxxxxxxxxxxxxxxxxx
Cox Orange	oooooooooooooooBBBBBBBBBBBBBBBBBxxxxxxxx
Elstar	ooooooooooooooooBBBBBBBBBBBBBBBBBxxxxxxxxxxxxxx
Boskoop	oooooooooooooooBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBxxxxxxx
Ingrid Marie	ooooooooooooBBBBBBBBBBBBxxxxxxxxxxxxxxxxxxx
Jonagold	oooooooooooooooooBBBBBBBBBBBBBBBBBBBBxxxxxxxxxxxxx
Spartan	ooooooooooooBBBBBBBBBBBBxxxxxxxxxxxxxxxxxxx
Gloster	oooooooooooooBBBBBBBBBBBBBBBxxxxxxxxxxxxxx
Aroma	ooooooooooooBBBBBBBBBBBBBBBBBBBBBBBxxxxxxxx
Mutsu	ooooooooooBBBBBBBBBBBBBBBBBBBBBBBBxxxxxxxxxxx
o = first flower	B = bloom x = petal fall

Reference: Grauslund, J. 1993.

Figure 1. Number of apple sawflies caught on white traps during the flowering season 1993.

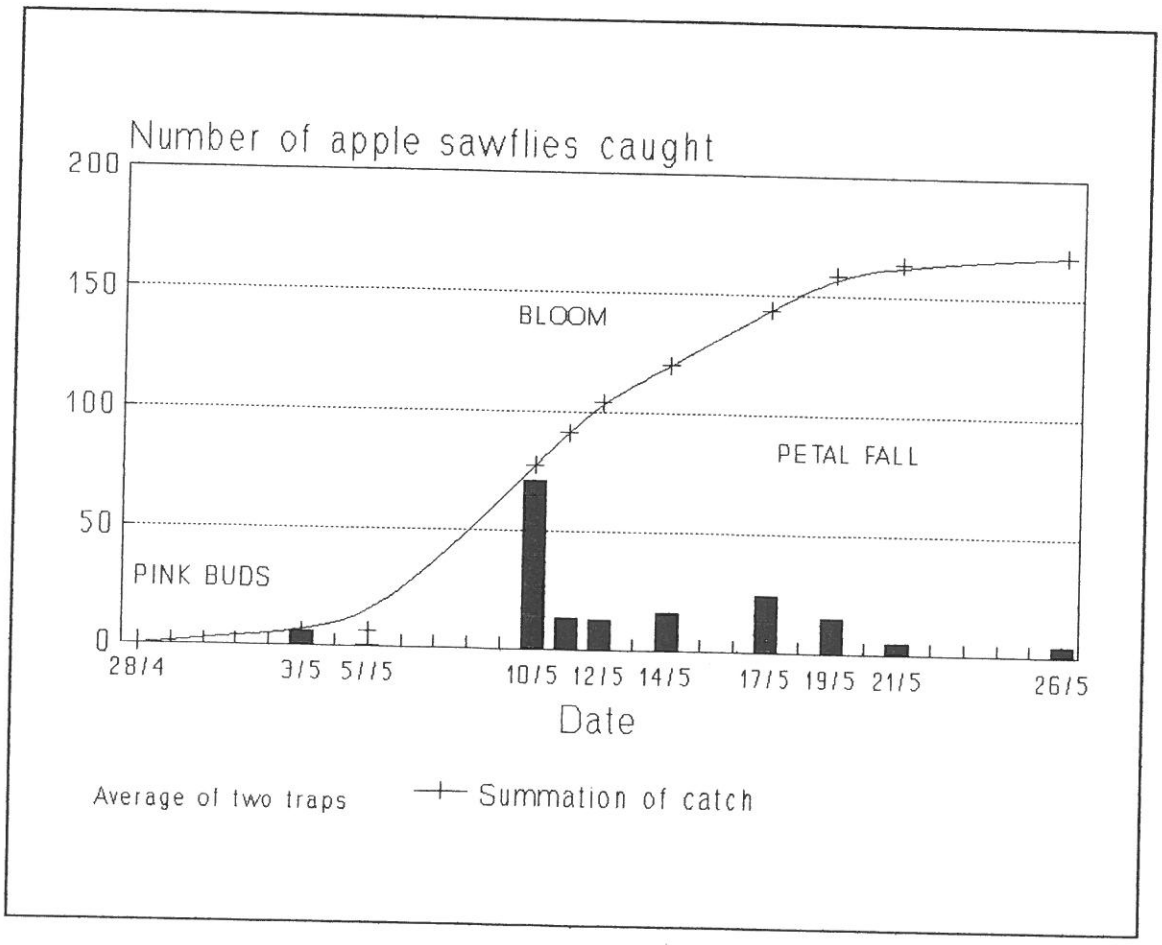
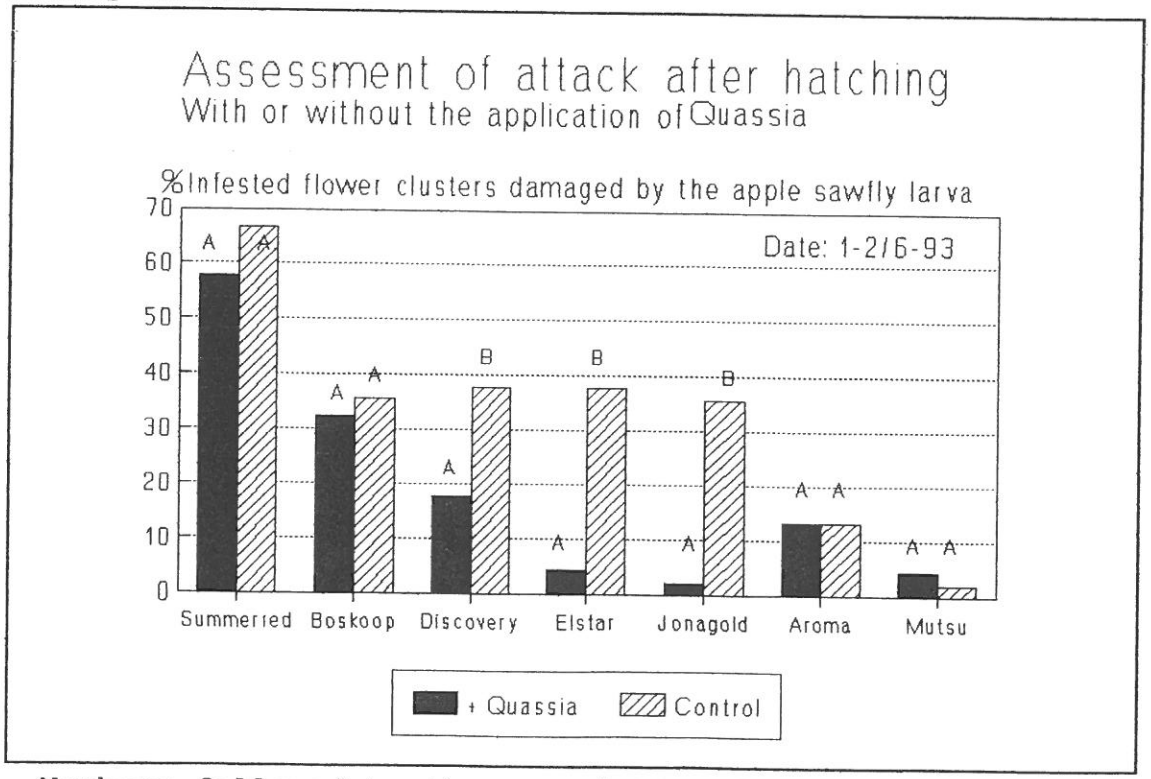


Table 2. Percentage of flower clusters infested by eggs of the apple sawfly at petal fall, based on the inspection of 100 flower clusters from each cultivar.

Cultivar	Percentage of flower clusters with at least one visible egg-laying slit	Cultivar	Percentage of flower clusters with at least one visible egg-laying slit
Summerred	65,6% A	Jonagold	27.8% CDE
Discovery	56.7% AB	Ingrid Marie	17.8% DFE
Mutsu	51.1% B	Cox Orange	16.7% DFE
Aroma	33.3% C	Gloster	14.4% FE
Boskoop	31.1% CD	Spartan	4.4% F
Elstar	31.1% CD		
Numbers followed by the same letter do not differ significantly from each other (P<0.05)			

No well-defined economical threshold level exist at the moment. However it is suggested that a threshold level of 30% of flower clusters infested by eggs of the apple sawfly is appropriate when flowering is sufficient to produce a normal crop (Noack 1993). This threshold was applied when deciding which cultivars to spray.

Figure 2. Effect of Quassia application on hatching of the apple sawfly larva.



Numbers followed by the same letter do not differ from each other (P<0.05). Only valid comparing treatments by cultivar.

Table 3. Recordings of yield and corky scar damage caused by the first instar larva.

Cultivar	Yield		% damaged fruit	
	+ Quassia	- Quassia	+ Quassia	- Quassia
Discovery	26,2 t/ha	32,2 t/ha	30%	20%
Summerred	48,3 t/ha	44,7 t/ha	36%	16%

Damage assessment is based on the inspection of 450 fruits.

Discussion:

The experiment showed that white traps coated with glue are useful in order to determine when the apple sawflies emerge, when they are most numerous and when the flight is over (Figure 1). But the trapping is not reliable to predict the level of attack, except in cases where only few apple sawflies are caught, where the attack is likely to be of no importance.

The visual inspection of the flower clusters (table 2) revealed that the level of infestation varied greatly between cultivars. This variation has previously been ascribed to how well the flowering period of a given cultivar coincide with the apple sawfly occurrence (Noack 1993). In this trial it was predominantly cultivars with early or intermediate flowering dates that were attacked by the egg-laying apple sawfly. Late flowering cultivars like 'Gloster'and 'Cox Orange', and cultivars where the bloom was of a short duration like 'Spartan' and 'Ingrid Marie' were the least affected. However, a significant difference in the level of infestation could also be recorded for cultivars with nearly identical flowering dates like 'Jonagold' and 'Discovery'. Factors other than flowering date and duration of the bloom must be responsible for this difference.

The most striking result of the spraying trial was the high natural egg mortality as recorded in the control treatment where no quassia was applied (Figure 2). No explanations can be offered on basis of this one year trial.

The effect of the Quassia application varied with cultivar. No differences between treatments were found for 'Summerred', 'Belle de Boskoop', 'Aroma' and 'Mutsu', whereas the number of successfully hatch larva was reduced by 50-90% for 'Discovery', 'Elstar' and 'Jonagold'. This result may be somewhat blurred by the fact that the Quassia application wasn't timed correctly to prevent hatching in all cases. Therefore a number of fruitlets were damaged by the first instar larvae prior to their death.

The dead larvae left a short superficial tunnel that continued to grow with the apple, leaving a corky scar on the mature fruit. A greater proportion of the larvae survived in the control treatment, they consequently attacked the seeds of the fruitlet causing it to drop, and thereby leaving no visible sign of damage. This explains why the final number of damaged fruits in the Quassia treatment exceeds the number of the control treatment (Table 3).

Because of a rich flowering and subsequent hand thinning it is unlikely that any differences in yield can be ascribed to apple sawfly attack.

Conclusion:

- The level of infestation by apple sawflies varies greatly between cultivars. This variation is to a certain extent explained by how well the flowering period of a given cultivar coincide with the apple sawfly occurrence. However, other unknown factors are also of importance to the susceptibility.

- The present trial confirms earlier reports that the egg mortality can reach a very high level. Egg mortality varied from 30 - 90% dependent on the cultivar in question. Because of the high level of mortality it is difficult to predict the level of damage arising from even high infestation levels.

- The application of Quassia reduced the number of first instar larva by 0 - 90%. However, incomplete data on yield and the degree of damage recorded on mature fruits shows no positive effect of the Quassia application.
  It is crucial that the Quassia is applied close to, but prior to hatching, or application may lead to a large number of damaged fruits remaining on the tree.

References:

Grauslund, J. 1993. Personal communication.
Noack, B. 1993. Die Apfelsägewespe. Obstbau 30 (5) 237-240.