ORGANIC FRUIT GROWING

Annual report 2001 LBI organic fruit growing research

including plans for 2002

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LOUIS BOLK INSTITUUT
natuurwetenschappelijk onderzoek

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There is more and more collaboration in research projects where researchers of the institute work together with scientists from other institutes or universities on human health, organic agriculture and whole-food nutrition.

The agriculture department of the Louis Bolk Institute was established in 1987. The scientists work to develop and support organic and bio-dynamic agriculture. To do so, they research locally on farms, participate with farmers to formulate questions to be tested on farms and perform fundamental research in experimental gardens. They exchange their knowledge and insights with the farmers and who are involved.

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1 General

1.1 Organic fruit growing in 2001

To put our work into context we will first outline some important developments in the organic fruit sector.

Scaling up

Despite the positive image organic fruit has on occasion had in the press, (after the article in Nature 19-4-2001) the hectarage of organic fruit in the Netherlands is expanding only slowly. The prospects for organic fruit growing are uncertain: the market for EKO-fruit is not picking up, it is difficult for growers to sell fruit during the transition to organic growing (the price is far lower than for organic), the approval of control agents is very uncertain and there is no significant financial assistance.

Hectarage in 2001

Only one fruit farm converted in 2001. This makes a total of around 35 orchards with approximately 180 ha of organic fruit, around 115 ha pomaceous fruit in conversion and around 45 ha of organic small and forest fruits in the Netherlands. The harvest in 2001 consisted of around 2000 tonnes of apples and 170 tonnes of pears from 10 conversion growers and around 1800 tonnes of certified organic apples and 90 tonnes of certified pears from 18 growers. In addition to these there are many organic orchards which include some fruit, making the SKAL totals slightly higher than the totals above.

Total SKAL-certified fruit in the Netherlands in 2001

fruit type	ha	fruit type	ha
apples	333	berries	35
pears	57	blackberries / raspberries	1.7
plums	23	various soft fruits	7.6
cherries	6	strawberries	10
morellos	2	nurseries	?

Organic planting material and new varieties

This year for the first time a reasonable amount of organic planting material was available from Dutch nurseries, of both the usual varieties and new varieties. A number of growers ordered and planted new apple varieties which are less susceptible to scab: Santana and Topaz. Currently fairly little is known about many of their characteristics such as growth, cultivation requirements and storage qualities, and particularly the susceptibility to scab, canker and aphids. But the growers have accepted this uncertainty, and after years of postponing new planting, they have started ordering new material again. The availability of organic Topaz in the Netherlands is still a problem.

Approval of control agents

In organic agriculture, the fruit growing sector in particular still needs a few more (environmentally friendly) control agents for scab, rosy apple aphid, sawfly, tortrix moths and apple blossom weevil.
Maintaining and improving an effective package of agents for organic fruit growing is a matter of considerable concern. After the revocation in 2000 of the approval for copper a temporary exemption was introduced for lime sulphur. Lime sulphur lapsed halfway through the 2001 season because there was insufficient data and companies did not want to invest in extra research. This left only the moderately effective powdered sulphur to combat scab. The approval for sulphur was extended in 2001, but due to an error, no extension for apples and pears was applied for. The approval of Spruzit for pomaceous fruit lapsed at the end of 2001, so problems can be anticipated with apple blossom weevil next year.
With each more or less 'natural' control agent the discussion again turns on how strict the application requirements for approval should be. This procedure creates a climate of uncertainty in the sector. The pest-

cide industry, trade and growers now all seem to be in a state of await. At the end of 2001 an Organic Fruit Crop Protection Commission was established with government funding via the *Biologica* forum, to iron out problems relating to crop protection agents in the coming year.
The vegetable product Neem oil to control the rosy apple aphid and the vegetable-based Quassia extract to control apple sawfly are also on the waiting list for approval in the Netherlands. An application has been made for the approval of Neemazal T/S.

1.2 The 2001 season

To put the 2001 research results into the proper context it is useful to have an understanding of the specific characteristics of the season.
The year began with a warm, wet winter with only light frost. Conditions were good for leaf decomposition and the first scab ascospores ripened around mid-March. At Easter in mid-April, the night frost took a heavy toll in places, resulting in areas of poor fruitset. Pear and apple blossomed relatively late. Many blossoms were concentrated in the summery second week of May. This was followed in the third week of May by further wet and cold weather when the first leaf scab was observed in every orchard. The fourth week was warm with wet nights. Despite this there was far less apple russeting than expected.
June began with autumn weather with local hailstorms and it stayed cool and wet even into July. This led to fine leaf arrangement, ample uptake of water and minerals, a great deal of scab, few aphids, large, sweet fruits and local hail damage. There were large harvests of cherries, plums and berries.
A heat wave in mid-August combined with sustained spraying with sulphur caused sunscald on many apples. In September there was a prolonged period of rain which seriously hampered apple and pear picking. Growers were ready to harvest but the fruit took a long time to ripen. Many roots suffered from lack of air and aisles were seriously damaged by vehicles. In October it grew dry with unusually warm and pleasant picking weather. The combination of heavy fruit scab, a wet September and warm October, led to a great deal of fruit rot in the late apple harvest.

1.3 Research by LBI

The LBI primarily selects projects involving close cooperation with organic fruit growers. The role of the growers is to provide their orchard as a practical context for the research, to help the researchers develop a relevant experimental design, to carry out some of the practical activities and to assist in the evaluation of the results. In addition, the LBI selects fundamental research projects that focus on innovative issues relevant to organic agriculture. In fruit cultivation, our main emphasis is still on apple and pear, focusing specifically on growth regulation and fruit bearing, soil care, scab and canker, fruit quality and sales. The institute is currently investing across the board in research in new areas of product quality and socio-economic research in agriculture.

Fruit growing research at the LBI was carried out in 2001 by Joke Bloksma (senior researcher), PieterJans Jansonius (researcher), and Marleen Zanen (junior researcher from September) in collaboration with the fruit growers.
The Louis Bolk Institute celebrated its 25th anniversary in September 2001. In December 2001 we took possession of a new building on the same site with extra space and better conference facilities.

Overview of projects, funding bodies and partners in 2001 and plans for 2002

1. 'Improving production in apples and pears', a project allied to research into nitrogen supply in organic fruit growing by the PPO (=Institute for Applied Plant Research Fruit). The object is to design and evaluate practical measures to regulate mineral uptake, growth and fruit-cropping, and to anticipate sudden changes in conditions such as frost, drought, extreme precipitation or an off year. 1999-2002: LBI 480 days, funded by government.
2. 'Pear scab and fruit tree canker', a number of small projects in which LBI collaborates with the PPO 2001-2003: LBI 45 days, funded by government and the private sector.

3. 'Classy Apples' project to improve the internal and external quality of organic apples in the growing phase, in collaboration with growers, trade, extension services and the PPO. Funded by growers, trade, Rabobank and government. 2001-2003: LBI 360 days.
4. 'Parameters for apple quality': Fundamental methodological project to identify meaningful criteria for internal quality for the organic market. Donations from our own sponsors, Triodos-bank, Software Stiftung(D), Treuhandstelle (D) and investment by partners Kwalis (D), Heilmann (D) and Meluna (NL). 2000-2001 season LBI: 170 days. 2002-2003 season LBI: 93 days applied for.
5. Working group on organic fruit growing. The LBI provides the secretariat.
6. Small assignments. Financed by private funds, and assignments by partners, presentations, excursions, workshops, lectures at home and abroad, commentary on drafts, private business consultancy. In 2001 LBI: around 12 days.

2 Soil management

2.1 General

Our objectives in soil management research cover a number of issues: soil fertility, production, fruit quality, regulation of growth, prevention of night frost damage, leaf disintegration (scab) and practical feasibility. This will result in different regimes of weed control, fertilisation, foliar feeding and watering for each plot. The evaluation criteria remain particularly difficult to assess.

How do you evaluate leaf analysis where there are affected leaves?

Target values for nitrogen in leaf analyses in August were once drawn up by P. Delver based on the link he found between high nitrogen values in the leaf and a fairly assured fruitset the following spring. Fruit quality was a minor consideration at the time. This resulted in advice to aim for a high nitrogen value 'to be on the safe side'.
In organic fruit growing we often see low nitrogen values in leaf analyses. Do they have something to do with scab lesions or suction damage caused by spider mites or suckers. Leaf samples taken in mid-August with 3 different levels of spider mite damage were analysed. The conclusion was that the nitrogen and magnesium contents were clearly reduced as suction damage increased. This seems logical since these are the elements that are present in chlorophyll. The leaf cells with suction damage are empty and dehydrated and look like silver dots. Thus less nitrogen will be withdrawn from such leaves during the autumn for storage in reserves. If you want to get a picture of the situation in a plot it is best to sample a representative quantity of leaf with spider mite damage as well. In comparative trials on nutrient uptake it is a good idea to standardise on leaves with a particular level of damage.

Leaf analyses of Elstar in August with various levels of spider mite damage on the leaf

Spider mite damage	%N	%P	%K	%Ca	%Mg	ppm Zn	ppm Mn	ppm B
mite free	2.34	0.19	1.68	0.33	2.19	23	35	36
slight leaf browning	2.24	0.17	1.69	0.31	2.29	22	34	34
heavily bronzed leaf	2.16	0.18	1.74	0.32	2.35	24	35	36

2.2 Basis fertilisation and over-fertilisation

While basic fertilisation in the winter has long been used as the basis for organic fruit growing, much attention has been paid in recent years to other fertilisation strategies. The reason for this change is dissatisfaction in organic fruit farming with the level of production, particularly the risk of weak buds, and the expectation that production can be increased by using a different fertiliser regime (perhaps with higher levels, different timing or quick-acting fertilisers).
The point of departure for the LBI is still that manure is a rare commodity in organic agriculture and should

be used sparingly. The requirement to apply only fertiliser which originates from organic agriculture will simply reinforce this position over time. Other important issues concern the side effects of a higher level of fertilisation, particularly on the susceptibility of the tree to pests and diseases and the effect on fruit quality. It is pointless to increase gross production only to have that increase eaten away by pests and diseases. A number of trials are currently being conducted on increasing production capacity by applying larger amounts of fertiliser and applying them at different times.

Improvement of nutrient reserves in late summer / autumn with fertiliser applications to the soil or leaves

In the summer and autumn of 2000, a number of experimental fertilisation trials in four replications of Elstar and Conference were laid out at the Ter Linde Orchard, a fruit farm which often has very low nitrogen levels in leaves. The object was to investigate which quantities of fertiliser could raise the leaf nitrogen content and whether this produced any visible benefit for production or adverse effect on fruit quality. Fertiliser was applied in late summer and autumn with a view to reinforcing the nutrient reserves in the tree for the winter. The hope was that this would lead to stronger blossom and better fruitset, and, particularly in pears, less fruit drop.

Two trials with pears (Conference) with 6-7 foliar sprayings in autumn of a total of around 120 l/ha Bio-Trissol and soil application of 87 kg N in the form of poultry manure granules following the harvest did not produce any notable changes in the nitrogen levels in the leaves in 2001. There was no difference in setting. In autumn 2001 these trials were pursued with higher doses of fertiliser via the soil, but the treatment with foliar feeding in the autumn was discontinued.

An apple trial (Elstar) was established with four levels of fertilisation with poultry manure (1 Sept. 2000) and a treatment with foliar feeding with 7 sprayings of Bio-Trissol (in total 140 l/ha = 4.2 kgN/ha) between harvest and leaf drop. Around blossoming in 2001 there was no evidence of higher fertilisation levels, less night frost damage, a better blossom score or better fruitset. However, bud and leaf analyses in 2001 did show a clear increase in nutrient levels. Better leaf colour and strong growth were very striking and remained in evidence throughout the season. The trees with higher fertilisation levels also retained their leaves longer, which meant more assimilation and accumulation of reserves, which is beneficial. We thus cautiously conclude that the fertilisation of September 2000 was too late to influence the strength of the buds, but continued to work in the following season. The trial continues and the trees were fertilised again in July 2001.
Here too, no results were obtained with foliar spraying. This treatment was changed in the summer to a treatment which can be watered separately by mini-sprinklers. The object of this is to investigate how much the nutrient level of the tree can be increased by using only water to regulate the mineralisation of the soil. Because of the amount of rain in August, the results of the unwatered treatment were lost this year. This strategy will be adopted again in 2002.
High levels of fertilisation in this trial led to higher levels of N in the fruits, while the levels are all still so low that they are not as yet undesirable.

Effect of fertilisation on nitrogen levels in Elstar (planting year. 1994), Ter Linde Orchard 2001

	treatment	%N bud 29-03-'01	%N leaf 10-8-'01	N fruit in mg/100gr at harvest '01	% leaf fall above post 9-11-'01
1	0 kg N	2.3	1.4 a	31	55
2	50 kg N	2.5	1.6 ab	-	45
3	100 kg N	2.7	1.8 b	40	35
4	150 kg N	2.8	1.8 b	48	25
5	Bio-Trissol	2.2	1.5 a	-	43

Various letters in the same columns indicate that the averages differ from each other with 95% certainty

Time of application of poultry manure

On the same plot of Elstar as the above trial, a follow-up experiment was started this summer with 5 different timings for fertiliser applications of 150 kg N in the form of poultry manure granules. The object is to track developments in productivity and fruit quality for several years and anticipate the restrictions which HACCP will place on this type of animal manuring (not in the last three months before harvest). The treatments chosen are: 1. unfertilised, 2. Jan / Feb., 3. Mar / Apr., 4 mid-June, 5 begin Aug. and 6. immediately after harvest.

2.3 Ground cover

A planted tree strip has many advantages for soil structure, soil life and the accumulation of organic matter. Anywhere where the competition from ground cover is acceptable or can be counterbalanced with fertiliser and water, ground cover at the tree strip offers good prospects for the organic system without too much mice pressure.
The Louis Bolk Institute has for years been conducting research on different strategies for ground cover such as: narrowing the tree strip, 'sandwich' ground cover on the narrow strip between the trees, clover islands around the tree, late summer sowings (LBI publication LF62) and permanent ground cover of white clover. The suitability of the system depends at the orchard conditions and the age of the trees. Ground cover is certainly not an option for fruit growers with insufficient means for mechanical weed control. Just controlling the ground cover itself requires a certain amount of mechanisation.

Clover on the tree strip

The following characteristics emerged from previous research at orchards using permanent sowings of white clover. Advantages include better soil structure, more soil life, more accumulation of humus, extra nitrogen fixation and calcium uptake from the 2nd year onwards, less competition than with weeds, but more than when kept free of growth, and less phythophtora fruit rot. Disadvantages include extra risk of mice, particularly after invasion of grasses (remedy: short in winter); risk of night frosts in spring (fair: 0-1 °C low); risk of excessive competition (watering partially compensates) and the risk of premature invasion of grasses (then re-sow). Permanent clover appears to be suitable for orchards where the clover may be invaded by grasses in a number of years and thereafter a mowing regime, vigorous growth and heavy soil, good natural humidity or sufficient rainfall. In a young orchard clover can be sown from the 2nd or 3rd year onwards.

A multi-year demonstration experiment has been set up in collaboration with the consultancy DLV at the Ruissen orchard. This is designed to build up experience in large-scale management of white clover, to find the best variety of clover and investigate effects on fruit quality. The 3 varieties (Gwenda, Riesling and Barbian) were sown in three replications on 17 July 2000, developed well in 2000 and were mown on 18 June 2001 to get rid of the tall weeds. No difference can yet be seen between the varieties. After the first year Louis Ruissen is enthusiastic about managing this system, but as yet we have not had any experience with prolonged dry conditions.
With clover we found significantly higher levels of nitrogen, potassium and calcium (but also more pips). No difference in vigour or leaf colour was observed in the trees. At this orchard, with high nitrogen levels in the leaves, further nitrogen uptake is not necessary, but at the same time it does not lead to undesirably high levels in the fruits. The increase in calcium and dry matter is beneficial for the storage quality. Otherwise no striking differences were found in fruit quality. The experiment continues with the accent on practical management and possible differences between the clover varieties.

Observations of leaf and fruit quality with and without clover ground cover at the Ruissen orchard

Elstar 1986	leaf analysis 14-8-2001			fruit analysis 18-6-2001			
tree strip	% N	% K	% Ca	% N	% K	% Ca	# pit
target value	2.3-2.5	1.1-1.5	1.8-2.2	low		high	>4
white clover	2.6 a	1.30 b	1.72 b	1.06 a	1.40 b	0.21 b	5.0 b
clean / weed	2.5 a	1.17 a	1.59 a	0.99 a	1.33 a	0.19 a	4.3 a

Elstar 1986	fruit analysis 21-9-2001 (picked relatively ripe)								
tree strip	mg N	mg K	mg Ca	% d.s.	hardness	Brix	acidity	Streif	# pip
target value	< 50		> 5.0		> 7	>12	9-10	0.2-0.3	>4
white clover	43 b	106 a	5.3 b	15.1 b	5.6 a	12.6 a	6.9 a	0.11 a	4.4 a
clean / weed	37 a	102 a	4.7 a	14.7 a	5.6 a	12.7 a	7.4 b	0.10 a	4.0 a

Different letters in the same columns indicate that the averages differ from each other with 95% certainty.

A multi-year trial is running at the van den Elzen holding with various types of ground cover strategies on vigorous soil aimed at controlling vigour, enhancing fruit quality and practical soil management: different types of ground cover (weed, clover, chickweed, ground ivy), various widths (entire tree strip or just sandwich) and starting at different times (1st or 2nd year after planting). 2002 is the last observation year.
The trees which were clean-cultivated the first year showed a clear lead in volume and bearing capacity, regularity and ramification. The ground crop provides for growth regulation and, particularly in this rich soil, competition for water and very little competition for nutrients. Weed cover reduces growth slightly more than clover. As anticipated, sandwich cover falls between clean cultivation and full cover. Even in this fertile soil ground cover costs young trees something in volume and production. Things would probably have been better if regrowth had been prevented by strategic watering during dry periods.

Set against this is the beneficial effect of vigour control on fruit quality. Here too, clover produces the higher N, K, Ca and dry matter contents in fruit and leaf compared with weed. The higher level of calcium is beneficial to this farm while the increase in nitrogen is not. Weed produces the least nitrogen in the fruits, but decreases the volume and cropping the most.

Effect of cover crop on mineral uptake in Santana at the Van den Elzen Orchard

Santana planting year 1999	Fruit 20-6-2001				Fruit 4-9-2001					leaf 14-8-2001		
tree strip	%ds	%N	%K	%Ca	%ds	MgN	mgK	mgCa	Ca / K+Mg	%N	%K	Ca
target value						<50		>5	high	2.2-2.5	1.16-1.46	1.8-2.2
Sandw' 99 bare, hoed	14.2	1.2	1.2	0.13	14.9	61	111	4.0	0.072	2.5	1.2	1.6
Sandw'99 weed										2.5	1.4	1.7
Sandw'99 white clover	13.8	1.3	1.4	0.15	15.7	65	124	4.6	0.070	2.5	1.4	1.8
Cover'00 chickweed										2.4	1.2	1.8
Cover'00 white clover	14.5	1.1	1.1	0.13	16.5	64	136	5.8	0.077	2.5	1.3	1.9
Cover'00 weed	14.6	1.0	1.0	0.12	16.1	54	122	4.3	0.070	2.3	1.3	1.8
Sandw'00 white clover										2.6	1.0	1.7
Sandw'00 weed										2.5	1.1	1.5

'Cover' indicates that the entire tree strip was covered, and 'Sandw.' indicates that a strip of around 30 cm wide between the tree trunks was covered and the area outside that strip was kept free of growth up to the aisle.

2.4 Foliar feeding

General

A number of experiments were carried out in the autumn of 2000 and the spring of 2001 with foliar feeding of apple and pear. There was only marginal success in the foliar feeds to increase the values in buds and foliage. Foliar feeding did not achieve the desired effects of stronger flower buds in Elstar and less fruit drop in Conference. This year's experience again adds weight to our perception that foliar feeding of nitrogen with the agents approved for organic growing is not worth the time and expense.

Foliar feeding in Conference in spring and summer

The leaf condition and productivity of Conference are often disappointing at organic orchards. The trees often lose a lot of fruit during the June drop. In this trial we investigated whether foliar feeding could strengthen the trees in such a way as to ensure that more fruits survived the drop.

Untreated trees were compared with trees in which a full foliar feed programme was implemented, analogous to that recommended for conventional growing by consultant Jan Peeters. The Conference was in the sixth growing year and had had consistently low levels of N, K, Mn and Zn in recent years. Both treatments were sprayed with 0.6 l/ha Zinflow (lot for Zn) on 8 April with the normal farm spraying. In the trial plot sprayings were carried out against scab with lime sulphur (mainly before blossoming) and sulphur. In addition there was blanket spraying with copper as a foliar feed. These products have an adverse effect on leaf condition. The trial was laid out with 20 fully randomised replications, each of a single tree.

During the two months after blossoming, between 20 April and 20 June, the following sprayings were carried out (often combinations of products) with the backpack pump with 1000 l water/ha:
7 x Goëmar BH86, made from seaweed with extra B (total 27 l/ha)
5 x Bio-Trissol made from vinasse with a high level of N and K (total 19 l/ha)
3 x MgSO4 with a lot of Mg (total 15 kg/ha)
3 x Mantrac with a lot of Mn (total 3 l/ha)

Effects of an extensive foliar feeding programme in Conference on foliage analyses on 28 June 2001 in a mixed leaf sample

Treatment	N (% ds)	P(% ds)	K (% ds)	Mg (% ds)	Ca (% ds)
target value	2.5	0.18	1.35	0.41	--
Untreated	2.2	0.18	0.88	0.49	2.24
Foliar feeding	2.2	0.17	0.78	0.50	2.14
	Zn (mg/kg ds)	Mn (mg/kg ds)	Cu (mg/kg ds)	B (mg/kg ds)	Fe (mg/kg ds)
target value	>20	>40	--	>25	--
Untreated	19	21	128	19	62
Foliar feeding	20	208	148	29	57

Effects of an extensive foliar feeding programme in Conference on number of flower clusters and number of pears after the drop on 17 July 2001

Treatment	Average number of flower clusters per tree and (variation)	Average number of pears/100 flower clusters (variation)
Untreated	71 (42-114)	48 (22-86)
Foliar feeding	75 (39-125)	45 (26-85)

The Conclusion is that the foliar feeding programme with the products and quantities used here did not lead to a greater yield. It was striking that it scarcely increased nutrient levels in the leaves. There are various possible explanations for this: a) the products used were not sufficiently effective, b) there was not enough spraying, c) the negative impact of spraying for scab overshadowed the foliar feeding regime.

In cases a) and b) it is possible that a different spraying programme would achieve better results. In case c) we would have to conclude that there is only very little scope for improvement as long as we are forced to control scab with agents which damage the leaf condition.

3 Regulating growth and crop

3.1 General

We assume that significant improvement can still be achieved in average production levels and in fruit quality on organic fruit farms by means of good crop and growth regulation. Organic cultivation, however, differs in a number of respects from conventional growing, and research is directed towards finding appropriate adaptations for organic practice. Differences relating to crop regulation are that the nutrient level is often lower, the crop experiences stress due to applications of sulphur, and less effective disease and pest control mean that there must be enough leeway for later fruit thinning for quality. Differences relating to growth regulation are mainly in the slow release of fertilisers, and the lack of fertigation to prevent adverse effects of root pruning.

3.2 Effect of timing of thinning, fertilisation and bearing on production and fruit quality

Experimental design of ter Linde Orchard trial 2000-2003

In 2000 a multi-year trial was set up at the ter Linde Orchard to investigate the relationship between different combinations of fruit-bearing levels, fertilisation levels and thinning strategy for level and regularity of production and fruit quality in Elstar (planting year 1992). Can a higher level of fertilisation facilitate higher and more stable production, or permit of a later thinning without the increase in production having to be sacrificed to a poorer fruit quality or increasing pressure from pests and diseases? We are using a combination of 18 objects in 10 replications, see the 2000 annual report for further background and preliminary results. The trial is intended to run until the end of blossoming in 2003.
In 2000 we were successful in achieving the desired levels of fruit bearing (30, 40 and 50 tonne/ha) and three levels of early thinning (4 weeks after the end of blossoming: 150, 225 or 300 fruits/tree).
Two fertilisation levels are applied in this trial: one unfertilised and one where we strive for the conventional nitrogen levels in the leaf. In 2000 and again in 2001 in this trial around 130 kg N was applied in the form of poultry manure granules. Around 2/3 as a basic application in the early spring and 1/3 in the summer. The plan for the coming year is to slightly increase the high fertilisation level and to stabilise the lower level.

Night frost in 2001

In 2001 most trees looked as if they would again bloom well, even those which had achieved high production in 2000. However, a night frost on 14 April caused unusually severe damage: a large proportion of the flower clusters ceased to develop and fell off. The planned blossom evaluation was carried out just before full bloom. Since a large proportion of the flower clusters had already fallen off, the blossom scores averaged 3 to 4 points less than if there had not been a night frost. It was clear that we would not achieve the desired high levels of fruit bearing this year.
This night frost gave us a perfect opportunity to investigate whether the differences in fruit bearing and fertilisation in 2000 had led to changes in bud strength. To this end we labelled a comparable branch in each tree on which we determined the fruitset on the year-old and older wood. There proved to be large differences in fruitset which were largely to do with the level of fertilisation: a higher level of fertilisation in 2000 had produced considerably better fruitset. In combination with the higher blossom scores this pro-

duced big differences between the fertiliser levels at harvest time. Thus it seems that a higher fertilisation level here clearly increased the cropping capacity.

Side effects of higher fertilisation levels

In the summer of 2001 it was evident that the growth in these trees with a poor bearing capacity was increased by extra fertilisation. In the summer we had the impression that the more heavily fertilised trees had more spider mite damage. It was not possible to verify this in a limited count of leaf samples. We did not establish effects on the fruit quality due to the variable and generally low production.

Effect of fertiliser applications on blossoming, fruitset and production of Elstar in the night frost year 2001

	%N in August leaf analysis		Blossom figure[1]	Fruitset[2]	Production 2001	
Fertilisation	2000	2001	2001	2001	apples/tree	kg/tree
Low	2.0	1.6	1.3 a	20 a	34 a	5.5 a
High	2.1	2.1	2.1 b	41 b	64 b	10.9 b

1)=blossom figure on the scale of 0 (no blossom) to 10 (full white blossom). Without the night frost these figures would have been 3 to 4 points higher. 2)=fruitset in # fruits/100 flower clusters.
Various letters in the same columns indicate that the averages differ from each other with 95% certainty.

3.3 Demonstration trials on thinning times and bearing capacity on 4 fruit farms, 2001-2002

Many growers are preoccupied by the question of what the optimal fruit bearing capacity is for fruit quality, bud formation and growth regulation. And also whether this capacity can be increased by fertilising or early thinning. The answer will vary from plot to plot. We laid out small trials in Elstar and Santana with four fruit growers to evaluate the magnitude of the problem. Since the weather was good, we expected fruit bearing in 2001 might be relatively high. The most interesting evaluation, that of bud formation, will not take place until the blossoming period in 2002.
However, the fruit quality was evaluated in 2001. This demonstrated that on all four farms the increasing fruit bearing led to a decrease in growth, firmness, brix and acidity, colour, N, P, K and an increase in Ca. At one farm it was clear that early thinning (in May instead of June) led to an improvement in firmness, brix, dry matter, N, P, K and no change in Ca and acidity. At another farm the fertilisation was applied a little too late and had little or no effect on fruit quality.

3.4 Blossom thinning with lime sulphur

As in conventional agriculture, it is important in organic fruit cultivation to have access to an effective blossom thinning method in a year when there are a great number of flowers. LBI carried out research in 1999 and 2000 into the prospects for lime sulphur as a blossom thinning agent (see last annual report) and the results were published in 2001 (LBI publication LF61). Application in practice will depend on future approval of lime sulphur as a thinning agent.

3.5 Root pruning

General

Trials have been conducted to investigate the prospects for organic growers of apples and pears of root pruning without fertigation to regulate over-vigorous growth in the off years in an alternate bearing cycle. Experiments have recently been conducted at 2 orchards with different soil types: sandy clay allowing only shallow rooting and Meuse clay allowing deep rooting.
After a number of objects responded well to root pruning with growth regulation, fruit colour and calcium

content, the negative effects of reduced nutrient uptake on fruit size and blossom scores became apparent. A number of treatments were given extra fertiliser or water to replace conventional fertigation. By so doing it was possible to increase growth and production again, but the fruit quality suffered. In 2002 the trials culminated in the publication of a report. The most striking results from 2001 are outlined below.

Effect of watering on fruit quality after root pruning in winter 1999/2000 on Meuse clay

The object was to compensate for the negative effect of pruning in 1999 / 2000 on mineral uptake by applying extra fertiliser and water. Both fertiliser and water applied by mini-sprinklers proved to produce extra (undesirable) growth and slightly higher production. Fertiliser in particular led to greater mineral uptake in leaf and fruit and a reduction in fruit quality (less sugar, acidity, firmness, dry matter). Extra water without fertiliser produced the same amount of mineral uptake and a slight reduction in fruit quality.

Rapid and short-lived recovery of fully undercut tress on Meuse clay

The excessively vigorous Elstar, which were fully root pruned in the spring of 1999 in an off year situation showed exemplary growth in 2000 and produced a good 50 tonne / ha of good quality apples. However in 2001 these trees were again without blossom and the roots in this third season after undercutting had already recovered so well that the growth was almost excessive again. The growth-retarding effect of a drastic and expensive measure such as undercutting was short-lived in this case. Two factors were significant here: the fact that, after one year of good fruit bearing, the trees again went into an off year, and the vigour of the plot concerned which is related to deep rooting permitted by the soil type.

4 Apple and pear scab

4.1 Pear scab (*Venturia pirina*): reduction of conidia production using lime sulphur

Early sprayings with high concentrations of lime sulphur reduced conidia production at the twig scab pustules, see 2000 annual report. In collaboration with the PPO (Fruit Research Station) and two farms, two trials have again been run this year with Conference. At the first farm it was not possible to make useful observations due to a disappointing number of fruits. At the second farm the trial went well and spraying was carried out on two occasions prior to blossoming with different concentrations of lime sulphur. Thereafter uniform spraying continued with lime sulphur and sulphur in accordance with the farm strategy.

Effect of 1 or 2 early spray applications of lime sulphur on pear scab, Conference, ter Linde orchard.

	% lime sulphur[1] in 1200 l / ha		Affected fruits per 50 clusters[2], in 4 repetitions, 21 May 2001				average number of affected fruits, per 50 clusters [3] 21 May 2001
	22 / 3	9 / 4	A	B	C	D	
1.	0	0	*	12	18	1	13,4 a
2.	6	0	23	*	16	3	12,6 a
3.	15	0	14	5	16	1	8,7 ab
4.	6	6	16	7	7	0	7,3 bc
5.	15	6	7	3	9	0	4,6 c

1) 22 March=far advanced green tip in buds and 9 April=half-inch tip stage.

2) Observations of 50 random clusters per block spread over five trees.

3) Different letters in the same columns indicate that the averages differ from each other with 95% certainty, poisson distributed regression analyses.

Effect in May gone by harvest

Two treatments with lime sulphur before bloom reduced fruit scab with 55%. in May. One treatment was insufficient. 15% lime sulphur is not significant better than 6%. Significant differences in scab had however disappeared by harvest time. As in the previous year, spraying did not result in damage such as russeting or leaf burn.
The approval for lime sulphur in the Netherlands was revoked during the course of 2001.

Relationship between twig scab and early fruit scab

There were considerable differences in the level of infection in replications A to D. There is a clear relationship with the twig scab infection determined the previous December on the new (year-old) wood.

	A	B	C	D
number of twig scab lesions per metre of year-old wood, December 2000	30	14	23	1
average number of scabby fruits per 100 clusters, 21 May 2001	30	14	26	2

From this arose the question of whether the complete removal of all year-old shoots would produce less fruit infection. This indeed turned out to be the case: whereas with normal pruning 27% of the clusters were already infected on 21 May, in the object without year-old wood this was only 17%. this initial advantage could however not be maintained through the summer. By harvest time both objects had around 45% fruits with scab.

4.2 Comparison of spraying schemes with sulphur, copper and lime sulphur

In the following table we assume that copper is used in low doses with a maximum of three kg Cu / ha per year. Copper (Cu) or lime sulphur (LS) is added to spraying sulphur (S) if the weather conditions or the degree of infection is such that sulphur alone is insufficiently effective. Following the ascospore period, only spray sulphur was used on all treatments. If LS is used for a longer period, the visible residue on the fruits and the negative effect on natural enemies become increasingly disadvantageous.

Advantages and disadvantages of a spraying scheme with sulphur, copper or lime sulphur for scab control

	S	S+Cu / S	S+LS / S
effectiveness against apple scab	++	++++	+++
effectiveness against pear scab	+	+++	++
side effects against sooty blotch on apple	-	-	++
side effects against mildew on apple	++	+	++
possible use as blossom thinning agent on apple	-	-	++
leaf burning apple	+	+/++	+/+++
leaf burning pear	++	+	++/+++
fruit russeting	+	+/++	+/+++
reduction of natural enemies	+	+	++
harmful to the soil	+	++	-/+
harmful to surface water	-	+	-
kilograms of agent used	++++	++	+++
unpleasant for fruit grower to use	+	+	++
Cost	+	+	+/++

5 Canker (*Nectria galligena*)

5.1 Storage lime as a preventive agent against infection during the leaf drop period

During recent years a series of experiments has been carried out in cooperation with the Fruit Research Station PPO which showed that several sprayings with storage lime during the leaf drop period can reduce the number of infections on the leaf scars by around 40%. The experiments also showed that more frequent spraying may increase effectiveness. An important practical problem is that under wet conditions in the autumn it is often impossible to drive through the orchard with a spraying machine. In years when this is the case, as in the autumn of 2000, growers are often unable to apply sufficient preventive sprayings. A possible solution for this problem could be the application of storage lime using an overhead sprinkler system. In order to test the experimental results from recent years in practice, we began a trial with three growers in the autumn of 2000 to explore the possibilities of using storage lime applied through the sprinkler system to control fruit tree canker. There are two parts to this problem:

1. How can you ensure that the overhead sprinkler system can apply lime over the entire orchard as quickly and evenly as possible?
2. What effect does this have on the number of canker infections arising on the leaf scars?

At the beginning of June 2001 the number of cankers per tree were counted. We were unable to measure a reduction of more than 40% anywhere. Only on one farm was this result also statistically reliable. The explanation for this disappointing result was first sought in the small number of treatments. The trial was repeated in autumn 2001 at the van Ruissen orchard. This time six treatments were achieved. We also tried a finer grade storage lime which could help to solve the problem of blocked sprinklers. The efficacy of the treatment will be determined in spring 2002. This application in fruit tree growing will also be tried out in collaboration with PPO fruit in 2002-2003.

The effect of overhead sprinkling with storage lime in winter 2000-01 on canker in June 2001 at three orchards.

treatment	Ruissen orchard		Stoop orchard		Konijn orchard	
# of sprinkler applications	3x+1x		3x		6x	
	#cankers	%reduction	#cankers	%reduction	#cankers	%reduction
Untreated	7.5 a		3.3 c		0.3	
application in autumn	4.5 b	40%	2.0 c	39%	0.4	none
application in autumn and spring	4.8 b	36%				

Various letters after the average indicate significant differences of 95% within a single farm
On the Konijn farm there was too little infection pressure to be able to measure results.

6 Insect pests

6.1 Apple Sawfly (Hoplocampa testudinea)

This year a trial was carried out on two farms with a new Quassia extract with a guaranteed quantity of the active ingredient Quassine. This dose-effect-trial (0, 6, 12, 18 g. Quassine / ha) was also carried out in various other places in Europe. While the management of the trials was excellent, in the Netherlands we did not find any significant differences due to the wide variation in infestation, see internal report. The impression given by the international research was that both the bought preparation from Biofa (from 12 g. Quassine / ha) and the home-made preparation of 30 kg / ha wood chips were reasonably effective (see

Proceedings of the 10th International Conference on Cultivation Techniques in Organic Fruit-growing, Weinsberg 2002).

7 Fruit quality

7.1 'Classy Apples' Project (2001-2003)

Fruit quality is becoming an important theme in organic fruit cultivation. Now that supermarkets have begun to dominate the market, different demands are being placed on fruit quality compared with before, when most sales were through farmers markets, fruit 'boxes' or health food stores. Scaling up is the only option to allow converted fruit growers to find the market they require, and supermarkets offer the greatest potential for increasing the size of the market. With organic cultivation methods, the high demands placed on the external quality of fruit are not always attainable. But the more expensive organic apple must in any case have an excellent internal quality.
The LBI has already obtained funding for the first two years of a three year project to explore problems and obstacles to fruit quality in the various market sectors by working with fruit growers and traders. The next step is to study the extent to which these problems can be solved with the existing cultivation and storage expertise of the extension services and, where necessary, to initiate supplementary research. Communications about quality in the chain are also a point for consideration. This project will be carried out in close cooperation with the growers, traders, Biologica, the extension service and researchers. Two progress reports were issued in 2001.

Elstar monitoring

In 2001 all the apples from the 1st, 2nd and 3rd pickings from representative trees at 11 Elstar orchards were collected and stored and will be evaluated in 2002 for internal and external quality. This monitoring process must provide the factual material for a discussion of current and potential quality and points for consideration in extension in 2002.

Flavour groups

In collaboration with the Swiss FIBL, growers and traders the COOP marketing concept of 'Sorten-Archetypen' (variety archetypes: groups of comparable varieties sold in a recognisable bag) has been adapted for the Dutch market. This should offer the opportunity to market (new scab-resistant) varieties. The slightly sweet to sweet varieties go into the yellow bag (e.g. Golden D, Jonagold, Gala). The strong, sour-sweet varieties (e.g. Alkmene, Elstar, Santana, Topaz) go in the red bag, and the slightly sour varieties (e.g. Boskoop) go in the green bag. At the end of 2001 these 'flavour groups' have been made available to Dutch supermarkets by suppliers Jansen Dongen.

Chain discussions

In 2001 there have been various chain discussions between groups of fruit growers and the traders they deal with about delivered and desired quality. One of these groups was the biodynamic fruit growers who were concerned about how to profile the Demeter label in the market.
A visit to New Zealand is planned for Spring 2002 to find out about growing conditions and quality management of organic apples in an export market.

7.2 The search for relevant parameters for 'vitality'

Organic or wholefood consumers are very concerned that their food should be 'vital' as well as 'tasty', 'natural' and 'safe'. They expect organic products to have greater 'vitality' than conventional products, but there is confusion about the concept and how it can be quantified.

International network on 'Food, Quality and Health'

For the purposes of this research the Louis Bolk Institute (nutrition and agricultural departments together) set up the 'Food, Quality and Health' (FQH) research programme which is being implemented by an international network of researchers. The object of FQH is to develop a new quality concept through the selection and further development of life processes and relevant methods of measurement. The research findings must help growers to produce products of high 'vital quality' and help consumers to recognise products of high 'vital quality'.

The impact of ripening, bearing capacity, sun and shelf life on the quality of Elstar in 2000-2001

The first project in the FQH programme was on apples. To this end 20 lots of 120 Elstar apples were especially grown for this project at the ter Linde Orchard, with a slightly different growing regime for each lot. Differences were introduced into the time of picking, crop load, exposure to sunlight, the use of biodynamic preparations and maturation after storage.
Various quality aspects of all these apple samples were measured by various laboratories in the Netherlands and abroad. Both the usual quality features and experimental, more holistic characteristics were determined: size, colour, hardness, flavour, nutrient contents, bio-photons, electrochemical characteristics, cupric crystallisation pictures, capillary dynamolyses, etc. All these quality aspects have been brought together and the plan is to find a coherent all-encompassing quality concept in which all the parameters have their place. This has led to the provisional concept of 'vital product quality'. This research confirmed many known facts about the influence of ripening, crop load, sun and ageing of apples on the usual quality characteristics such as colour, hardness and sugar content. What was new was that so many difference quality characteristics were identified in the same apples, so that the less familiar characteristics could be related to the usual ones. There is a lot of interest in this project. Various reports have already been published (English language scientific report FQH-01, summaries in three languages on the LBI website) and lectures given (LBI workshop on fruit quality for fruit growers, Biodynamic researchers Järna) and more are planned for 2002.

The concept of 'vital quality' connects the grower to the consumer

The novel aspect of this quality approach is that it ties in with the life processes of 'growth' and 'differentiation' of the growing crop. It also proved useful to distinguish between the degree of integration of the two processes. In conversation with fruit growers these concepts prove meaningful and can be easily translated into cultivation measures to bring about the desired corrections. In dialogue with consumers and trade the three aspects of growth, differentiation and their integration are translated into corresponding properties of the harvested product, namely, vitality, structure and cohesion. This total quality concept has been introduced as 'vital quality'. Follow-up research, to include other crops as well, must clarify whether the concept can be further reinforced and made more quantifiable. Then a selection can be made from all the characteristics, so reducing the expense of routine inspection for one or several representative characteristics from each of the three aspects.
This approach is very much in keeping with the type of quality to which organic producers and consumers aspire. At the same time, the confusing concept of 'vitality' is now more precisely described as the result of growing processes.

Impact of use of fertilisers and preparations on the quality of Elstar in 2002-2003

Funding has been requested for a second apple research project. The research set-up will be comparable to the first with series of Elstar with different fertilisation regimes, with and without biodynamic preparations. The trials were laid out in 2001 and treated for evaluation of the harvest in 2002.

8 Socio-economics

8.1 New section at the LBI

The expansion of organic agriculture has resulted in interest from growers and traders who entered the organic field for economic reasons. These entrepreneurs bring with them a high level of specialisation and expertise and their concerns are different from those of their more idealistic, all-round predecessors: cost price reduction, more security in cultivation, strict monitoring of standards, etc.
We should guard against this one-sided emphasis on cost price reduction making organic fruit growing identical to its conventional counterpart. Thought must be given to marketing strategies and advisory services, and we need to reconsider motivation and standards and how we deal with risks. In response to these concerns the Louis Bolk Institute set up a new 'socio-economics' department in 2002, which will provide support to the fruit growing and other departments.

8.2 SWOT-analysis of marketing of Dutch organic apples

Within the framework of the 'Classy Apples' project the LBI conducted a market analysis of the strengths and weaknesses of the marketing of Dutch organic apples with points for consideration for the future.

Strengths:

- consumer image of organic ('bio') foods,
- consumer image of 'home grown', (produced in the Netherlands)
- reliability of SKAL-certification approval,
- apples are important in the organic range,
- strong growers' association in Prisma,
- availability of foreign organic apples for year-round supply,
- Dutch apple varieties (Elstar, Jonagold, Santana) are delicious.

Weaknesses:

- high retail price,
- risk-laden cultivation (high cost price, reticence to convert, little government support),
- long conversion period (3 years),
- Dutch apple varieties (Elstar, Jonagold, Santana) only moderately productive,
- dependence on approvals of crop protection products (as for conventional apple growing, but different agents / products),
- dependence on availability casual labour (also applies to conventional apple growing),
- communicating with organic consumers about crop protection agents is problematic,
- inadequate attention to fruit display and storage in wholefood shops resulting in loss of quality (hardness, rot) ,
- insufficiently matured imported fruit on the shelf with disappointing flavour,
- lack of transparency of the market, too many 'middlemen' in the chain, inadequate continuity of deliveries,
- too much poor quality (third picking) offered in the autumn, which is damaging to the market.

Opportunities:

- in potency the flavour of an organic apple is better than that of a conventional apple,
- more efficient trade which could reduce prices,
- more firm agreements in the trade which could raise quality,
- consumer information about growers and farms which would encourage consumers to pay more,
- if the wholefood trade is successful supermarkets will automatically follow suit.

Threats (possible threats in the future):

- government policy on crop protection which could make organic apple growing impossible in the Netherlands,
- scandal caused by mixing up conventional and organic apples in the market,
- incorrect assumption that it is possible to grow organic apples elsewhere in the world without spraying.

Challenges:

- increasing the Dutch hectarage of organic apples, more effective conversion scheme,
- increasing sales and points of sale (supermarkets, apples for school, canteens, processed products in the catering industry),
- improving logistics of supply and demand, more efficient trade chain,
- effective package of crop protection agents for fruit growing in the Netherlands,
- adequate labour force,
- broadening range of organic products (strawberries, foreign fruit, etc.),
- improving communications between producers and consumers about cultivation and price structures,
- traceability and reliable monitoring (in a market with a big price difference between conventional and organic),
- food safety, but should not be taken to extremes,
- demonstrating and monitoring better flavour of organic apples,
- better and more uniform quality table fruit,
- more opportunities for fruit for processing at a good price (facilitates stricter sorting of table fruit),
- training organic greengrocers how to handle fruit.

8.3 Uncertainty management

Farmers now converting to organic growing value security more than the more idealistic pioneers. The Louis Bolk Institute collaborated with Wouter van Teeffelen (AccoN) in applying uncertainty management strategies, familiar from industrial practice, to the contingencies experienced by organic fruit growers. In these uncertain times coping with contingencies is important for the entire sector: the existing organic growers, all conventional fruit growers who want the option to convert at a later stage, researchers, extension workers and policy-makers. Wouter gave a lecture on this at the LBI workshop for organic fruit growers in March 2001 and a publication on this topic was included in the LBI series (LFR65).

Uncertainties in organic fruit growing

Conventional fruit growing is fraught with uncertainty, and organic fruit growing would appear to be even more susceptible to risks such as diseases and plagues, insufficient labour for hand thinning, doubts about selection of varieties, and increasing imports from countries where production conditions are better. In the past, the market for organic fruit was stable and growers could be sure of a good price. Now, however, the market has become restless as a result of supermarkets' increasing interest in organic produce. This greatly adds to the uncertainty faced by newcomers to organic fruit growing, due in particular to the erratic buying habits of supermarket shoppers.

The EKO mark is a well-known and reliable label, but considerable effort will be required if this measure of security is to be ensured in the future. Another significant factor of uncertainty is government policy regarding incentive measures and the authorisation of pesticides. And of course, for those still in the conversion process, a greater degree of contingency is inherent to adopting a new production system.
In organic agriculture there is even more uncertainty in the area of crop protection agents and artificial fertilisers. In organic practice the non-chemical alternatives to these products are often less effective. This creates uncertainty, and certainty must therefore be sought elsewhere.

Reducing and coping with uncertainty

In Business Management, there are different strategies for contingency management. The various strategies are discussed in the light of practical examples form organic fruit growing. To some degree, contingencies can be reduced by gathering information, by investing in technology, by playing the market, by finding other funding partners, or entering into stable contracts with buyers, personnel, lobby groups and marketers. Co-operation and product pools may also lead to more stability in the market.
However, it is unrealistic to expect all risks associated with organic growing to be resolved. Even research will not be able to achieve that. Contingency management, therefore, should concentrate on the acceptance of some degree of contingency and learning how to cope with it. Growers must learn to evaluate their situation with respect to important decisions, for example about when to innovate. When do the advantages of being a pioneer exceed the disadvantages? Is specialisation the way to go, or should one focus on diversifying the farm? How can the strengths of professional expertise be utilised in specialisation without forgetting risk management? How can the farm be made more flexible? Would it be possible to take a gradual approach? How can risks be shared?

9 Knowledge transfer

9.1 In the Netherlands

In March 2000 we organised a workshop for the Prisma organic fruit growers' cooperative. We presented LBI research at open days for converting growers. As well as providing advisory services, the LBI put out an updated version of its information booklet on organic fruit growing (LF64). Pieterjans and Joke of the LBI are both advisors to Prisma. The LBI was involved in setting up and supervising various research projects.

9.2 International

The LBI participated in and provided speakers for a number of international conferences in 2001, including Weinsberg (D), Järna (S), in Jork (D), in Lille (F). The LBI is an active member of an international working group (EUGROF) of researchers who work intensively with organic fruit growers and are involved in the further development of organic fruit growing. A overview of research and participants can be found on the FIBL website (www.fibl.ch).

9.3 Working group on organic fruit growing (WBF)

The objective of the working group is to identify problems in the development of organic fruit growing and if possible develop initiatives to solve them. The working group has the status of a programme advisory committee for research on organic fruit growing and is much consulted for advice on priorities and problems. The working group met five times in 2001. The input from people in the field was increased in 2001: more fruit growers joined, replacements were appointed, payment of expenses was arranged and the chairmanship will rotate between fruit farmers at six month intervals.

The 2001 agenda

The working group discussed developments in the sector (see above). We have evaluated current and completed research projects and indicated priorities in applications for new research. These related to research funded by both the Horticulture Commodity Board and the Ministry of Agriculture, Nature Management and Fisheries. In the latter case the focus was on the multi-year programmes for 'Sustainable fruit growing' and 'Crop protection'. The WBF requested that more emphasis be placed on European canker (Nectria g.) in the Crop Protection Programme. A working visit was made to the experimental station in Gorsem (Belgium) to improve international harmonisation of the research. The WBF urged the setting up of a separate Commission on Crop Protection in Organic Fruit Growing to deal with all technical and procedural matters re-

lating to the creation of an effective package of products for organic fruit growing. Much time and specific expertise was required for proper discussion of this topic in the working party.

9.4 The concept of 'naturalness' for the development of standards

The Centre for Agriculture and the Environment announced that the concept of 'naturalness' could be used to improve the profile of organic agriculture. In 2001 the Louis Bolk Institute conducted a survey of consumer perception of 'naturalness' in organic production methods. This indicated that consumers have a much more romantic image of the working methods of organic farmers and growers than reality merits. This makes marketing vulnerable. Philosophical reflection made us realise that the concept 'natural' only has meaning for organic agriculture if it is simultaneously applied on three levels: First by replacing chemical synthetic agents with agents of natural origin. Secondly by strengthening natural processes and ecosystems. And thirdly by interpreting naturalness in the sense of 'respecting and supporting the intrinsic nature and value of the organism. (H. Verhoog, M. Matze, E. Lammerts van Bueren, T. Baars, 2002: How 'natural' is organic agriculture? Report NWO-ethics & Policy. Den Haag 2002).
In 2002 the Fruit Cultivation Department will elaborate this concept for fruit growing in the expectation that this will provide clarity when profiling quality and in discussion about standards in eco- and biodynamic fruit growing.

10Publications

10.1 Binder Fruit growing research

In 2001 seven new titles were published in the fruit growing series The policy of including both research results and lectures in the publications is unchanged. Members of the Prisma cooperative automatically receive copies of publications.

10.2 Other publications in 2001

- Bloksma, J, 2001: Soil Management in Organic Fruitgrowing. Proceedings Forum Organic Fruit and Vegetables, 10 +11 Dec 2001 in Bouvines (Fr).
- Bloksma, J. en P.J. Jansonius, 2001: Kalkzwavel voldoet als bloemdunner (Lime sulphur adequate as blossom thinner). FruitteeIt 91,14, p.13.
- Bloksma, J, Northolt, M, M, Huber, 2001: Parameters for apple quality and an outline for a new quality concept. LBI Driebergen FQH 01.
- Bloksma, J, Northolt, M, M, Huber, 2001: Meten van vitale kwaliteit bij appels (Measurement of vital quality in apples). Ekoland 11, p.27-29.
- Jansonius, P.J.; J. Bloksma, B. Heijne, P.J. de Jong, 2001: Beregening met celkalk tegen vruchtboomkanker hoopvol (Overhead sprinkling of storage lime hopeful for treating fruit tree canker). FruitteeIt 91, 38, p. 8-9.

10.3 Publications still available from LBI Fruit Growing binders

LO3	*all available publications in binder 1 up to 5 (1990-2001) excl. porto*	€ 100.00
	all publications in binder 5 (1999-2001)	€ 30.00
LO4	*subscription on current year incl. porto*	€ 27.50
	If the title is repeated in foreign language you will find a summary in that language	excl.porto

1990, tweede jaargang, map 1:

LF2	Bloksma, J, 1990: De **bewaarkwaliteit van appels**; verslag van een vergelijkend onderzoek naar de bewaarkwaliteit van biologisch geteelde Rode Boskoop op 8 verschillende bedrijven in 1989 *(Lagerqualität von biologisch gezüchteten 'Roter Boskop'-Aepfeln bei 8 verschiedenen Betreiben in 1989; Preservationquality of organic grown 'Red Boskoop' apples of 8 different orchards in 1989)*, LBI. (46 p.)	€ 3.59
LF6	Bloksma, J, 1990: **Kaliumprofiel** bij 5 verschillende fruittelers, LBI (4 p.)	€ 1.14
LF9	Bloksma, J, en M. van Brakel, 1990: De **zelfontbindingstest** als mogelijke kwaliteitsbepaling bij appelen. *(Der selbstzerstörungstest bei Aepfel; the selfdecompositiontest of apples).* LBI (12 p.)	€ 3.40
LV7	Baars, T, 1990: Het **bosecosysteem** als beeld voor het bedrijfsorganisme in de biologisch dynamische landbouw, LBI & Ver. v.BD-landbouw. (32 p.)	€ 5.68

1991, derde jaargang, map 2:

LF12	Bloksma, J. en M. Vandewall, 1991: **Morellen**, tak-en bloesemsterfte bij zure kers – 3 (5p.)	€ 1.14
LF13	Bloksma, J. en T. Wijnen, 1991: Minimaliseren van **zwavelbespuitingen**, LBI (4p.)	€ 1.14
LF14	Wijnen, T. en J. Bloksma, 1991: **Minerale en plantaardige olie tegen groene appelwants en bladluizen**, LBI (5p.)	€ 1.14
LF15	Wijnen, T. en J. Bloksma, 1991: De invloed van **oorwormen op de luizenaantasting** in appelbomen. *The effect of earwigs on aphid in appletrees. Observations in the orchard of Korstanje in Holland 1986-1991.)* LBI (30p.)	€ 4.54
LF16	Bloksma, J, en H. van Noort, 1991: **Valeriaan-preparaat** ter stimulering van nieuwe bloemknopvorming na nachtvorstschade bij aardbeien, tussentijds verslag, LBI (4p.)	€ 1.14
LF17	Bloksma, J, 1991: **Aantekeningen over luizen** *(Remarks on Aphid on apple and plum; Aufzeichungen über Blattläusebefall von Apfel- und Plaumenbäumen)* LBI (56 p.)	€ 6.80
LF18	Bloksma, J, 1991: **Jaarverslag 1991** onderzoek fruitteelt LBI met plannen voor 1992, LBI (16p.)	€ 3.40

1992, vierde jaargang, map 2:

LF19	Bloksma, J. en G. Brouwer, 1992: **Studiereis** biologische Fruitteelt; Venlo-Keulen-Herford-Das Alte Land, 31 juli tot en met 2 augustus 1992. (28 p.)	€ 6.80
LF20	Wijnen, T. en J. Bloksma, 1992: Waarnemingen van de **vroege fruitmot** *(Pammene rhediella*) en bestrijding door Bacillus thuringiensis en Neem-extrakt. *Observations of the fruitlet mining tortrix moth and control by Bacillus thuringiensis and Neem-extract;* LBI (14 p.)	€ 3.40
LF21	Wijnen, T. en J. Bloksma, 1992: Het voorkomen van **oorwormvervuiling** van appels door aanbieden van schuilplaatsen. *(Less earwig excrements by hanging up hiding-place sacks; Weniger Ohrwurmverschmutzung durch Aufhängen von Schlupfsäckchen)* LBI (4 p.)	€ 2.26
LF22	Bloksma, J. 1992: Telling van **schurftconidiosporen** tussen de knopschubben bij biologische fruitbedrijven. LBI (4 p.)	€ 2.26
LF24	Bloksma, J. 1992: **Jaarverslag 1992** Fruitteeltonderzoek LBI (18p.)	€ 3.40

1993, vijfde jaargang, map 2:

LF25	Bloksma, J. 1993: **Zwavel als schurftbestrijdingsmiddel**. *(Evaluation of the use of sulfur for scab control in organic fruit production)* LBI (70 p.)	€ 6.80
LF27	Bloksma, J. 1993: Evaluatie van 4 behandelingen van uitgesneden **kankerwonden** bij appelbomen. *(Vergleich von 4 Behandlungen von Wunden an Apfelbäumen nach dem Ausschneiden des Obstbaumkrebses, Nectria galligena)*. LBI (8 p.)	€ 2.26
LF28	Wijnen, T. en J. Bloksma, 1993: Bestrijding van **vruchtbladroller** met Bacillus thuringiensis. *(Bekämpfung des Apfelschalenwicklers Adoxophyes orana mit Bacillus thuringiensis; Manage-*	€ 2.26

ment of summer fruit tortrix moth Adoxophyes orana with Bacillus thuringiensis). LBI (8 p.)

LF30 Bloksma, J. 1993: **Jaarverslag 1993** Fruitteeltonderzoek LBI. (15p.) € 3.40

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