

Calcium uptake and Fruit Quality Improving calcium uptake in an 'organic' way *Kalziumaufnahme und Fruchtqualität*

Joke Bloksma, PieterJans Jansonius ¹

Zusammenfassung

Die positive Korrelation zwischen ein hohes Kalziumgehalt in den Früchten und gute Innerqualität wird zusammen gefasst vom Literatur. Die traditionelle Kalziumspritzen sind nicht ideal (Synthetische Ursprung, Schalenberostung, Sonnebrand). Wir Forschen nach Möglichkeiten für Obstbauern weniger abhängig zu sein von Kalziumchlorid und doch gute Innerqualität Obst zu bekommen.

Bei unserer Beurteilung der Kulturmaßnahmen in Bio Obstbau ist Kalziumgehalt der Früchte einer der Kriterien. Positiv in diesem Rahmen haben sich gezeigt: ein lebendiger Boden, Begrünung, besonders Klee, Begrenzung des Wuchsniveaus, gute Qualität Rosettenblätter, Früchte an der Basis des Triebes und Früchte mit viele Samen.

Calcium improves quality

We already know from several fruit growing researchers the positive relation between high calcium content in the fruit and its quality. Summarising these relations with high calcium content in the fruit flesh:

- Better firmness, more sugar
- Less storage disorders (bitter pit, senescent breakdown, scald, etc)
- More skin elasticity, that means less waterloss in storage and less sunburn in the orchard.
- Delayed maturation, so a longer storage period.

These benefits of calcium are of great importance for the fruit grower.

Spraying calcium is not the only possibility

The calcium content in the fruit is not related to the content in the soil or to the content in the leaves. Uptake from the soil and transport through the tree are the main factors to determine what amount of calcium reaches the fruits. It is a quite complicated physiological matter to get insight into these casual factors and to know what to do in fruit growing management to improve calcium uptake. Easier is to spray soluble calcium in the second half of the growing season to enlarge the calcium content as an 'insurance' for calcium. These calcium sprays are on bad terms with the principles of organic growing and have some unfavourable side effects (synthetical origin, damage of the fruit skin, sunburning).

Which possibilities do fruit growers have to be less dependant of calciumchloride to obtain good quality?

¹ Louis Bolk Institute, Hoofdstraat 24, NL-3972 LA Driebergen, the Netherlands, tel. 0031-343-517814, email: p.jansonius@louisbolk.nl and j.bloksma@louisbolk.nl

Dissolve the chalk in your soil

We need to examine the calcium stream through the tree more in detail. For the later quality the calcium uptake by the young fruits in the first 6 weeks after blossom is of most importance. This is the period in which the cells in the fruit are still dividing

Uptake from a calcious soil is favoured by acid root exudates and carbondioxide from soil life, by humidity, by a high content of soil colloids and a moderate supply of nitrogen, potassium and magnesium. For growers this means:

- Animal manure, grass mulch (unless where is to much potassium).
- **Undercover** or weeds to stimulate soil life and production of carbondioxide that solves chalk
- Water if dry in this period
- To supply chalk if the soil has a shortage in soil analyses.

In our soil management experiences calcium uptake and fruit quality always is part of the justification. Some examples

Orchard 1: lmy light clay, Elstar, 1997 *Betrieb 1: kalkreiche leichte Ton, Elstar, 1999*

Tree strip management	<i>Baumstreifen</i>	Calcium in leaves <i>Kalzium in Blätter</i> Juni in % dm	Calcium in fruits at harvest <i>Fruchtkalzium bei Ernte</i> mg/100g fresh.
grass, unfertilized	<i>Gras, ungedüngt</i>	1,4	3,7
grass, 60 kgN March	<i>Gras, 60 kgN März</i>	1,4	3,0
grass, 60 kgN August	<i>Gras, 60 kgN August</i>	1,4	2,3
2 ^o year white clover	<i>2^o Jahr Weißklee</i>	1,5	4,2
clean/weeds	<i>Schwarz/Beikraut</i>	1,1	2,4

Orchard 2: light clay, Conference, 1999 *Betrieb 2: leichte Ton, Conference, 1999*

Tree strip management	<i>Baumstreifen</i>	Calcium in leaves <i>Kalzium in Blätter</i> July in % dm	Calcium in fruits at harvest <i>Fruchtkalzium bei Ernte</i> mg/100g fresh
Clean cultivated	<i>Schwarz</i>	2,4	4,2
3 ^o year white clover	<i>3^o Jahr Weißklee</i>	2,7	5,8
1 ^o year white clover	<i>1^o Jahr Weißklee</i>	2,3	5,0

Calcium arrives by the water flow

Evaporating leaves suck the water flow from the roots and take the minerals with it up into the leaves and into the young fruits. Fruit belonging to a high evaporating cluster or shoot are easier fed than fruits at the top of a shoot or poorly arranged cluster. In the first 6 weeks after bloom the quality of rosette leaves is very important and we must be carefully with tytotoxicity by pest and disease treatments or natural causes as frost (Peeters, 1999).

Growth control

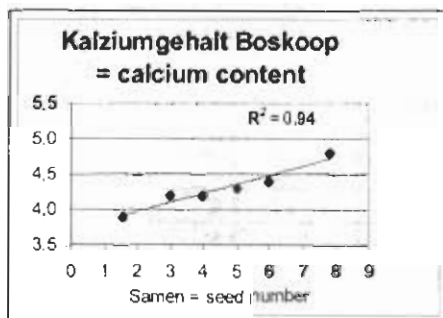
If calcium is taken up by the roots, it is not sure it also goes into the young fruits. Young growing shoots are big competitors for calcium. So all adequate measurements for growth control are favourable for calcium content in the fruit: good winter pruning, summer pruning, root pruning (also see results from Ahweiler 1999).

Place in the tree

Calcium moves through the tree by the water stream (xylem) and not by the assimilate stream (floem) as most nutrients do. The place in the tree is of great importance for the calcium uptake by the fruit. A fruit beside a grown out shoot profits by sucking of water and nutrients by the evaporating shoot, without the disadvantage of the competition of the growing point. Fruits at these places in the tree have the highest calcium content. Fruit besides a strong growing shoot have less. This is a point for training your tree.

Seeds are calcium sinks

Some researchers (f.e. Jones and Samuelson 1983) have proved the relation between the amount of seeds and calcium content. And we do again for Boskoop in 1999 and also found a positive relation with sugar and acid (still unpublished).



A minimum of 3-5 seeds is necessary to grow out the fruit in a regular and big form. Beside that it is though that the auxine production by the seeds acts as a sink for calcium and other nutrients in the fruit. This idea is a possibility to explain the better

quality of high seed fruits. At the other hand, auxines decrease flowerbud initiation for the next year. Already 1 or 2 pips a cluster do reduce as severe as 10 pips (Tromp a.o). When the fruit grower tries to find the optimum in amount of seeds to balance fruit quality this year and fruit production next year, he has to reduce the amount of clusters with fruits and not the amount of seeds in the fruit.

For seeds in the fruit there is not too much to manage. The amount of pips changes from year tot year and depends much on weather during flowering time and is not manageable. But the grower can manage in the way of

- sufficient pollinator insects and pollination trees in the orchard,
- no aggressive sprays in blossom period and
- good nutrition for good fruit set and a severe juni-dropping (=selection on fruits with many seeds).
- early thinning in case of heavy load.

Does organic fruit growing differ in amount of seeds from regular?

We sometimes noticed that the amount of pips were higher by organic growers than by regular fruit growers. We start to look at it more in detail because we wonder if this was a part of the explanation for the better fruit quality and for the less fruit set we often see in organic orchards. In 1998 we looked only at a few orchards and saw a higher amount of seeds by organic. In 1999 we again counted seeds by many orchards and there was a extreme high amount by both organic and by regular orchards because of excellent flowering weather.

Notice the influence of limesulphur as a thinning method in some experimental fields and its reduction of seeds!

Number of seeds a fruit in relation to scab treatments, also see our poster

Anzahl Samen /Frucht in Relation mit Schorfbekämpfungsmittel, siehe Poster

Jonagold		# seeds/fruit # Samen/Frucht
untreated	<i>Unbehandelt</i>	4,2
sulphur + Mycosin	<i>Schwefel + Mycosin</i>	3,9
sulphur + copper	<i>Schwefel + Kupfer</i>	3,8
Captan + scala	<i>Konventionel</i>	3,7
sulphur	<i>Schwefel</i>	3,6
limesulphur	<i>Schwefelkalk</i>	3,5
Heliosoulfre	<i>Flüssig Schwefel</i>	3,4

Number of seeds a fruit in relation to flower thinning at 2 orchards
Anzahl Samen /Frucht in Relation mit Fruchtausdünnung bei 2 Betriebe

Elstar		Orchard A	Orchard B
untreated	<i>Unbehandelt</i>	5,5	5,0
limesulphur	<i>Schwefelkalk</i>	5,1	4,6

Summary

The positive relation between high calcium content in the fruit and its inner quality is summarised from literature. The conventional treatments with soluble calcium are on bad terms with the principles of organic growing and have some unfavourable side effects (synthetical origin, damage to fruit skin, sunburning). We investigate which possibilities fruit growers have to be less dependant on calciumchloride to obtain good quality.

In our evaluation of organic fruit growers' management calcium content is one of the points. Positive in this way were a living soil, undercover, especially white clover, moderate control of growth, good quality cluster leaves, fruits located at the basis of a shoot, and fruits with a high number of seeds.

Literature

- Bloksma, J. and P.J. Jansonius, 2000: Kwaliteit van Boskoop in relatie tot het aantal pitten. Intern verslag LBI, Driebergen.
- Jones H.G. and T.J. Samuelson, 1983: Calcium uptake by developing fruits. *J. of Hort. Science* 58 (2): 173-190.
- Peeters, J, 1999: Gleichbleibende Produktion vom 2. Standjahr an. *Obstbau* 12.
- Stoll, K, 1997: *der Apfel*, Zürich.
- Tromp, a o, 1973: *Grondslagen der Fruitteelt.*'s Gravenhage Nederland.