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The RIMpro Fruit Thinner

A practical tool to optimize fruit and flower thinning

Info

RIMpro
www.rimpro.eu is an Internet platform offering forecast models for pest and diseases. Growers and consultants can connect their weather stations, or create a virtual station for their location. The real time model information is used to optimize decisions in production and crop protection. RIMpro is used in more than 40 countries worldwide.

Fruit thinning is an essential but critical task in fruit production. Over- or under thinning has important economic consequences. When the decision has been made to thin, many factors influence the timing, product choice and doses to be used. Here the professional skills of the fruit grower are challenged to the max.

Like models for pest and diseases, fruit-thinning models cannot tell *if* fruit thinning is necessary. But models can help by indicating the potential success of pollination, and showing the moments that the tree is most sensitive to chemical thinning. The RIMpro Fruit Thinner builds upon thinning models proven effective in Europe and North America.

Flower thinning

Modern fruit trees need not more than 100-150 fruits per tree for an optimal balance between yield, fruit size, and return bloom. After 150 flowers have set fruit, all later flowers lead to potential over cropping. These should be thinned away already as flower during bloom, or later as young fruits.
From the date of start of bloom provided by the user, the model opens new flowers every day. As soon as the day temperature reaches 10 °C, these flowers are supposed to be pollinated by insects. The growth of the pollen tubes in the styles of the flowers is shown as blue descending lines in the upper graphs of Example 1 and 2. The model indicates when 10-50-90% of the pollen have reached and fertilized the seeds in the ovary. If pollen tube growth is too slow, not all seeds can be reached in time. These fruits get none, or only a few seeds, and have more chance to drop.

Check in the orchard on what date about 150 flowers per tree are open. Follow the blue line of pollen tube growth of the flowers that opened that day. The date these flowers are 10-50% fertilized, you have enough fruits for an optimal crop. On that date you can start applying your flower-thinning agents such as ATS in IPM, or lime sulphur in organic production, to abort all later flowers.

Fruit thinning

Whether hard or mild thinning actions are required is determined by local orchard factors like variety, initial fruit set, and fruit crop in the previous year. This estimation and the choice of thinning materials need professional judgement.
Fruits are susceptible to fruit thinning from about 6 till 35 days after full bloom. The labels of fruit-thinning products indicate the optimal timing as a range of days after full bloom, or as mm of fruit size.
In practice there are two 'schools' for optimal timing fruit thinning:
1) Based on fruit size, where fruits between 8 and 14 mm are considered most susceptible. Sprays are targeting this fruit size, and weather conditions suitable for spaying and uptake of the chemical determine the definite application date. This is the way most growers and consultants in Europe time the sprays.
2) Based on carbohydrate balance. Fruits are most susceptible to chemical fruit thinning when the tree suffers from a lack of carbohydrates to feed all growing fruits and shoots. 3 to 5 successive days of low light conditions at reasonable temperature, or artificial shading, lead to natural fruit drop and higher susceptibility to fruit-thinning agents. The carbohydrate balance is used by growers and consultants in the US and Canada

to decide on the timing and dose of their thinning applications. Until now this information is hardly used in Europe.

Using the best of both worlds

Looking at the average of the results of many fruit thinning trials, the susceptibility of fruits increases after full bloom till a maximum around 10-12 mm, and than declines. So it is not bad to look at fruit size to find the most effective moment. But there is a lot of variation in these trial results. Thinning can be much less, or much stronger than expected for that fruit size. This is the effect of the carbohydrate balance in the days following the treatment.

RIMpro calculates and forecasts the early fruit growth from the air temperature (Thin black line and pink area in the upper graphs of Example 1 and 2). From this fruit size the 'baseline sensitivity' to thinning is calculated and shown as a wider black line in the upper graphs, with the maximum when fruits are 10-12 mm in diameter. Who does not believe in the role of the carbohydrate balance, can use this curve to predict when the fruits are 10-12 mm in size and have their max sensitivity to fruit-thinning agents.

The lower graphs of Example 1 and 2 show the net carbohydrate production during daytime (green), and the carbohydrate use during the night (red). The black line is the carbohydrate balance accumulated over the following 96 hours. Who only believes in carbohydrate balance for the timing of thinning treatments, can follow this curve for the timing of his/her applications.

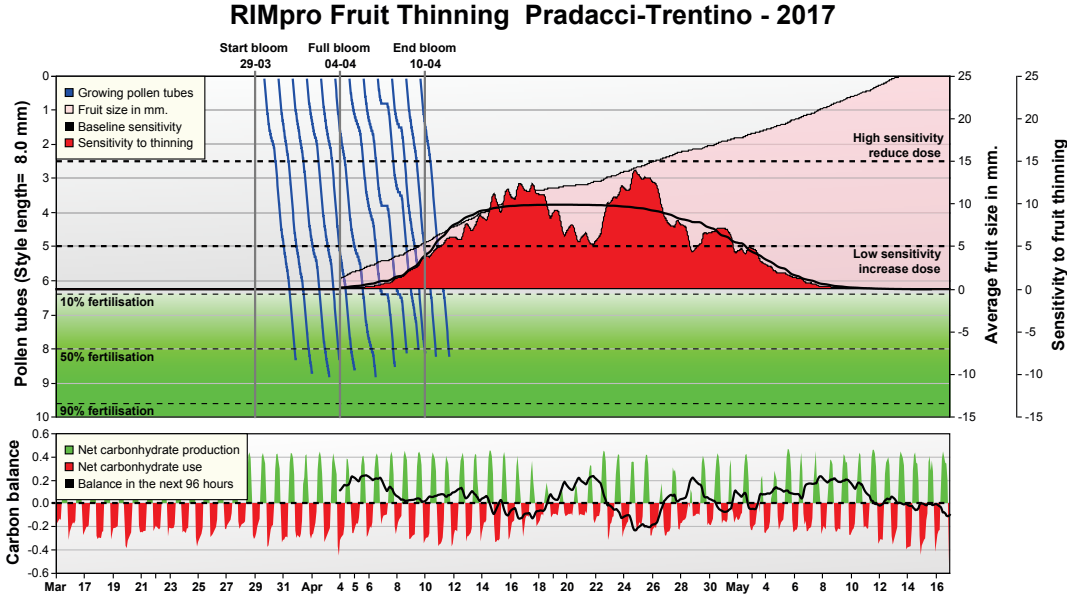
In RIMpro this information is combined. The sensitivity of the tree to fruit thinning (red curve) is calculated form the 'baseline sensitivity' (based on mm fruit size), that is corrected for the effect of the carbohydrate balance in the following 96 hours.

Once enough fruits have been set, you can start applying your flower-thinning agents. *EFM*

Practical use of the model

On days indicated by the model as high sensitive to fruit thinning, the effect of chemical thinning agents can be expected to be optimal. But in contrast, in plantings where no fruit thinning is required, on these days extra care should be taken not to apply any material that damages the leaves, reduces photosynthesis or could stimulate fruit drop.

Traditional fruit-thinning agents increase competition between fruits and shoots for carbohydrates and so promote fruit drop. When applied on days with very high thinning susceptibility, and ideal weather conditions for uptake of the chemistry, the risk for over-thinning develops. When applications have to be made on days with low thinning sensitivity and/or at lower temperatures, the dose of the thinning agent



Example 1: Pradacci, Trentino, Italy

The flowering period in Pradacci reaches from March 29 till April 10. All flowers get well fertilized within a few days after opening. Supposed that 150 flowers per tree are open on April 1, on April 4 these 150 flowers are already successfully fertilized, and flower-thinning agents may be applied from April 4 onward to abort all later flowers. The 'normal' moment of fruit thinning on 10-12 mm fruit size, April 20, is not the most effective date. Peaks of high sensitivity due to carbon stress occur on April 16 and April 25. These dates are ideal to apply fruit-thinning agents.

should be increased to force sufficient thinning. The dose of the thinning materials always needs to be adjusted to the situation. Read and follow the information on the product label for this.

The new fruit-thinning product Brevis (*metamitron*) has a different mode of action. It is a photosynthesis blocker. Basically it does the same as a strong natural carbohydrate stress that lasts for 3-5 days. Brevis can be used to increase the effect of a natural carbohydrate deficit. When a Brevis application is followed by a strong natural carbohydrate deficit, the risk for over-thinning develops. Working with Brevis needs awareness of the interaction between natural, and chemically induced periods of carbohydrate deficits in the tree. Read and follow the information on the product label.

Background of the models

The flower-thinning model is based on the concept of effective pollination period (EPP) as introduced by Wilson in 1970. The RIMpro implementation uses data from more recent publications on EPP and pollen tube growth. It is inspired by the work of Yoder and Peck at Virginia Tech institute (United States).

The levels of 10-50-90% fertilization result form an average style length of 8 mm, with a standard deviation of 0.8 mm. Variations in growth rate of individual pollen tubes is not yet accounted for. At high and low temperatures, the lifespan of the embryo limits the chance of the germ tubes to reach the ovary in time for effective fertilization. A relation between temperature and lifespan of the ovary was derived form data published by Wilson in 1970, Sansol and Herrero in 2000, and several other publications.

The carbon balance model is based on published and unpublished experiences with fruit thinning by shading. The implementation is inspired by the work of Lakso and Robinson at Cornell University, New York (United States). The RIMpro implementation runs a continuous photosynthesis and respiration model using hourly information on global radiation, VPD and air temperature. Other factors influencing photosynthesis like CO^2 and nitrogen level, and water supply are considered optimal. Respiration is modelled as a Q10 relationship where The Q10 temperature coefficient is 2.2, but reduced under high VPD conditions.

As on-farm weather stations do not record global radiation, the global radiation data are taken from the short term MeteoBlue forecast for that location.

Example 2: Randwijk, the Netherlands

Flowering in Randwijk started April 13, but development was delayed by low temperature and night frosts. The tree was living on its carbon reserves during most of the blooming period. Several days were not suitable for insect pollination. Many flowers were hardly fertilized, and could only form a few seeds. Based on these model results, flower thinning should be strongly discouraged.

In orchards where fruit thinning was to be considered, around May 16 would be the perfect period. On that day initial fruitset can be judged, and the carbon stress supports the efficacy of the thinning products.

In the orchards in this region a moderate initial fruit set was observed, and many fruits dropped during June without any additional thinning action.