Considerations for Winter Break and Flowering in Deciduous Fruit Trees

Recommendations for a good flowering, fruit set and fruit retention

During the winter period, we begin with the preparations for the start of a new agricultural season, trying to be very attentive to the evolution and accumulation of winter cold (chill hours based on 7 °C, portions, etc.), given that historically it has been the most monitored parameter to have notions of adequate bud break/flowering and to predict a good fruit set. Without a doubt, the quantity and quality of chill hours will be crucial in the activation of the plant and its development during the first phenological states. However, we must remember that we are defining the productive potential much earlier, specifically during the moments of floral induction and differentiation (Figure 1), we must also remember that the accumulation of reserves will be very important when sustaining growth and development during early spring, especially parameters such as nitrogen, starch, phosphorus, potassium (Figure 3). Another important point to consider is the uniform fall of leaves, since the process of accumulation of hormones and other inhibitory compounds (dormancy induction) will be more homogeneous, and therefore the dormancy interruption (bud break/flowering) should also be more uniform.

Figure 1. Evolution of floral cherry buds. Modified from Fadón et al. 2017

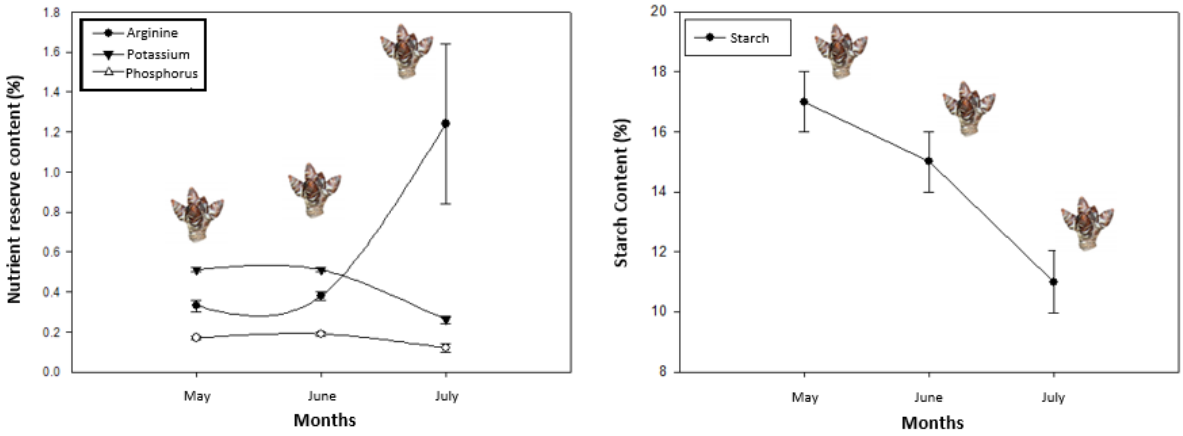

Figure 3. Dynamics of arginine, potassium, phosphorus and starch in cherry buds.

What is happening at the physiological level?

As we approach autumn, and the conditions of luminosity and temperature start to change, internally, signaling and regulation of internal physiology processes begin, which results in the generation and accumulation of reactive oxygen species (ROS), abscisic acid, ethylene and other metabolites, which results in foliage abscission and keeps the plant dormant during winter (Figure 2**).**

Figure 2. Illustrative diagram of the evolution until autumn.

What mechanism does the plant use to induce dormancy?

Plants, as well as other living beings, have an internal clock (circadian clock), whose role is to coordinate the physiological functioning of the plant through the perception of photoperiod changes and temperature. A relationship that coordinates the expression and blockage of the genes that regulate the aforementioned phenomenon.

What is the role of cold during winter?

Precisely the quantity and quality of winter cold will be the sign that will trigger an internal signaling process, in which, compounds such as abscisic acid, ethylene and ROS will be degraded and/or blocked, while growth promoting compounds such as Cytokinins, Auxins and Gibberellins will increase their synthesis-accumulation, promoting dormancy interruption (Figure 4). The practical impact of the above, is that an adequate and homogeneous start of the season, will have a positive impact on the floral synchronization and therefore on the fruit set (effective pollination period), also directly impacting fruit retention and the potential caliber. For this reason, the monitoring of winter cold (quantity and quality), added to the use of products that stimulate a uniform development of floral/vegetative buds, will be essential as an initial strategy in the season.

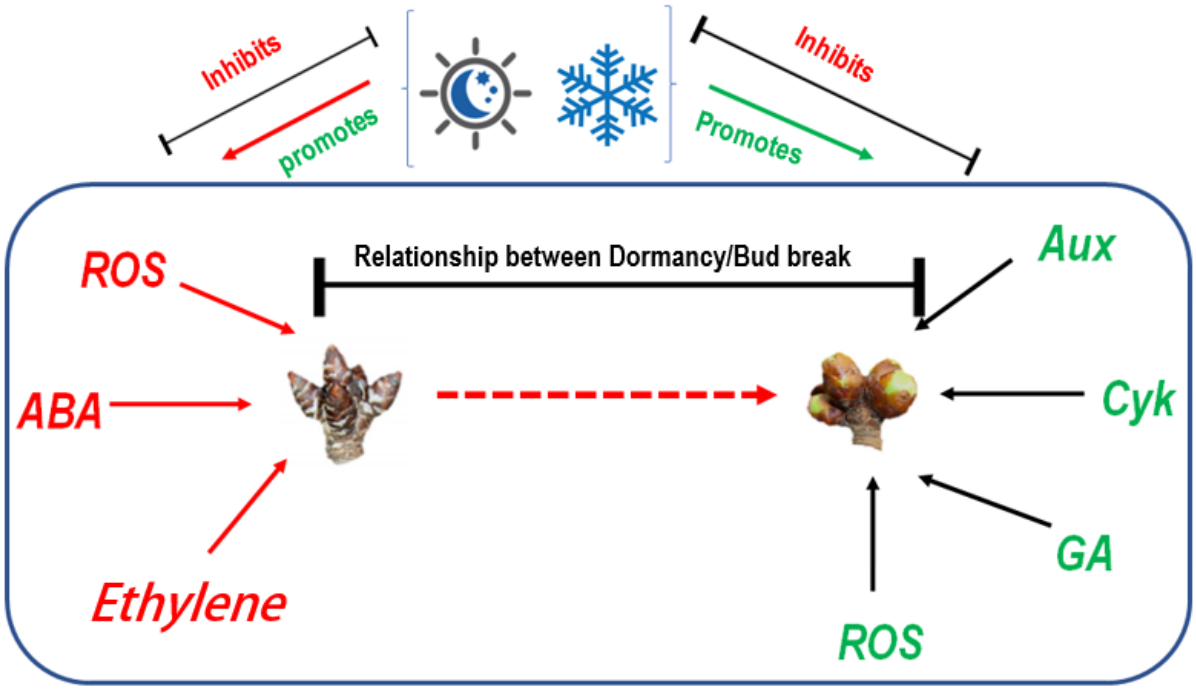

Figure 4. Physiology of winter dormancy in deciduous fruit trees.

Considering that the first strategy is covered, the next step is to focus on the fruit set and retention process.

What should we consider from the physiological point of view? In the first instance we must understand that one of the plant hormones that leads the fruit set process is Auxin, which plays the role of promoting the growth of the pollen tube and supporting cell division in the first stages of fruit fertilization, generation of vascular bundles in the fruit, etc. (Figure 5).

What considerations should we have from the practical point of view? The plant is capable of synthesizing the hormone in optimal amounts at temperatures between 20 to 25 °C, which is why the auxinic load is directly supported directly through hormonal products or indirectly through nutrients such as boron and zinc, which fulfill the role of protecting it from degradation and promoting its synthesis, respectively.

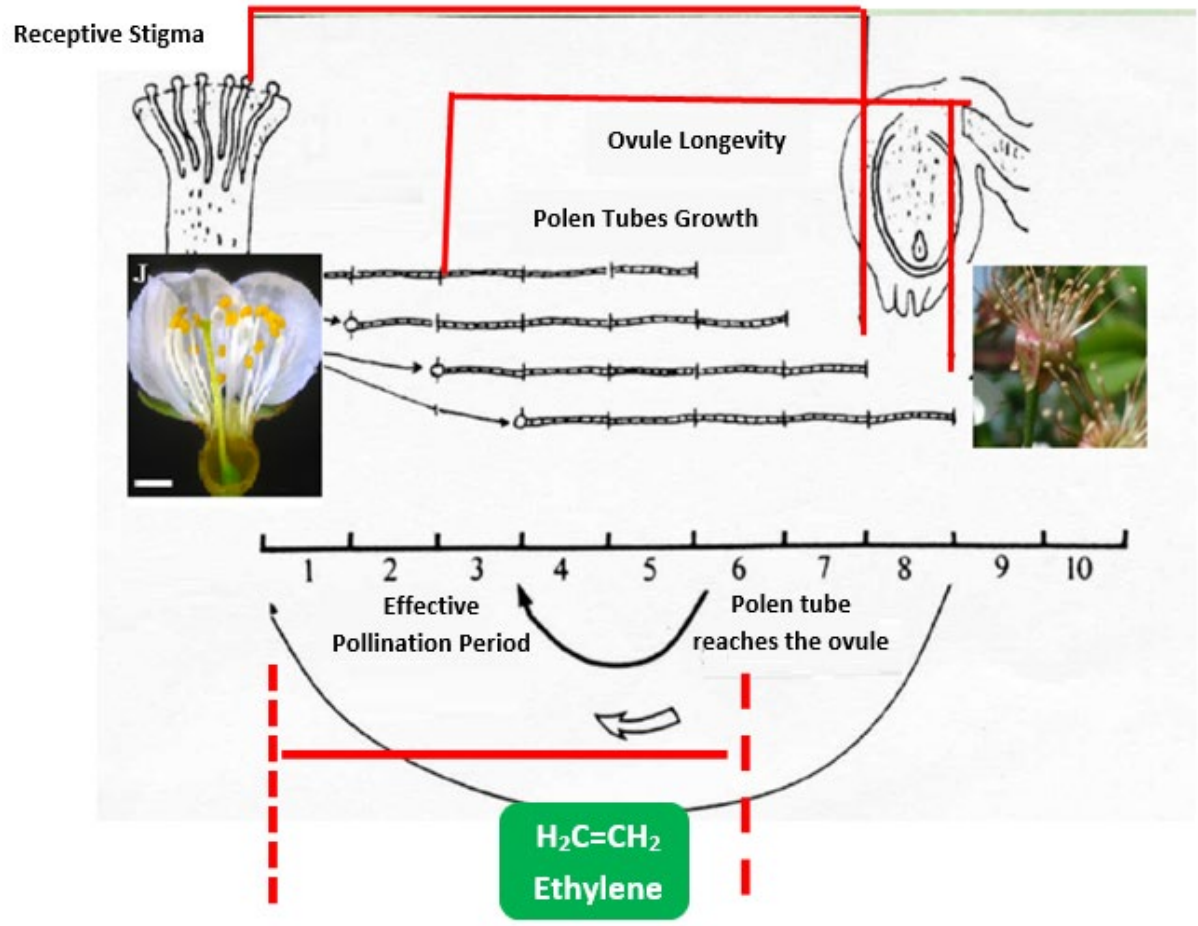

Figure 5. Summary of the flowering process. Extracted from Yuri, 2009 and modified by Maldonado.

Another hormone that we must consider as critical during the flowering period is ethylene, since its generation will be favored by adverse environmental conditions (low temperatures, rainfall, etc.) and by the flowering process.

What implication will it have in the fruit set process? The presence of ethylene in the environment will promote the senescence of the floral tissue, and may cause a decrease in fruit set, given the shortening of the effective pollination period, or an increase in abscission, due to an incomplete fruit set or an excess of the stress hormone (Figure 5).

Strategies to solve the problem

If we consider from the winter dormancy period up to flowering, the logical strategy would be to focus on stimulation with growth promoters (Auxin, Gibberellins, Cytokinins) at bud break. In the case of flowering-fruit set, the ideal would be to stimulate with Auxins or nutrients that promote auxinic activity (Boron, Zinc), in addition to compounds that block ethylene (Cobalt).

At an international level it is possible to find publications in various species that corroborate the importance of the use of growth promoters with the aim to improve production, such as during: winter break, flowering, fruit set and fruit retention. Some of the experiences we have carried out in Chile, confirm the effectiveness of the use of growth promoters during bud break, promoting better floral development (Figure 6), fruit set and retention (Table 1). A similar situation occurs when using Auxins plus nutrients such as Boron and Zinc during flowering, increasing fruit set (Figure 7) and therefore the yield at the end of the season.

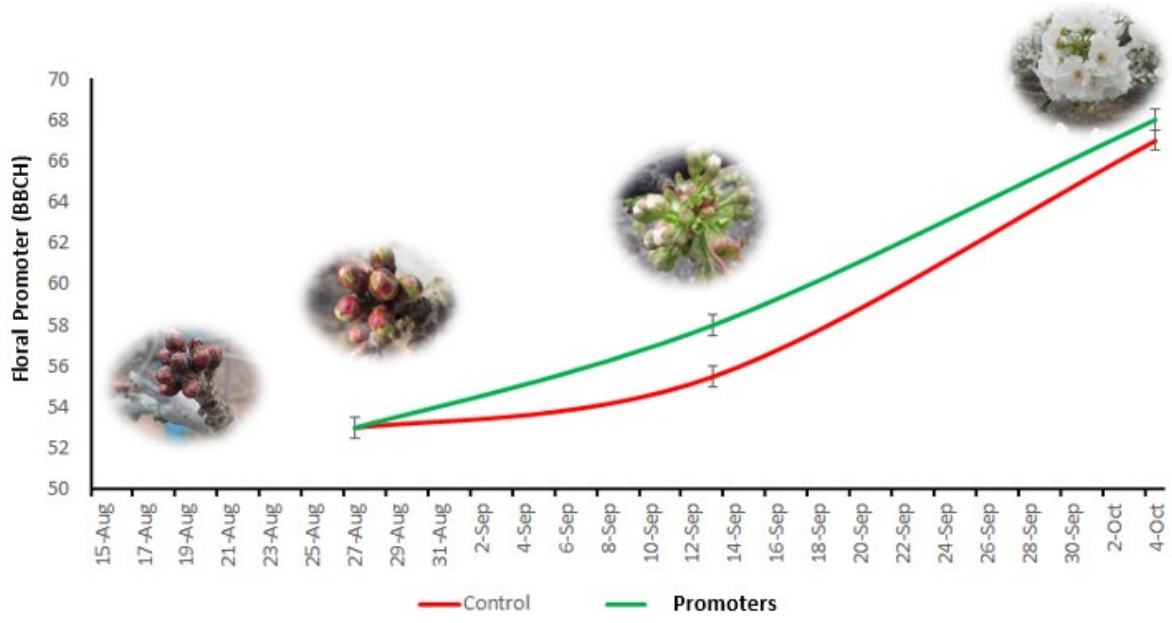

Figure 6. Floral Development based on BBCH scale in Cherry cv. Lapins

	Fruit set Fruit/Bud cluster	No. Fruits Fruit/ Bud cluster	Retention (%)	Fruit weight (g)
Control -T0	4.7 a	4.2 a	89	11.9
Growth promotors – T1	6.0 b	5.6 b	93	12.2
Significance	*	*	-	-
P-value	0.04	0.02	-	-

Table 1. Results of Fruit set, number and weight of fruits in Cherry cv. Santina after the application of growth promotors during winter dormancy period.

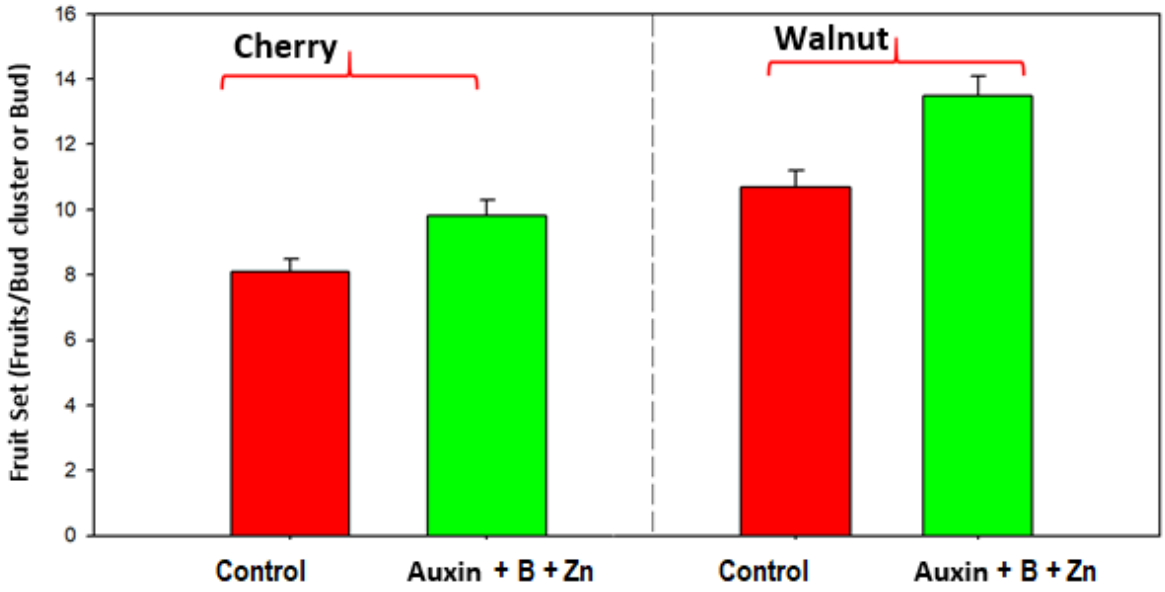

Figure 7. Fruit set in Cherry cv. Bing and Walnut cv. Serr in trials carried out during the 2018-2019 season.

As a company we are committed to continue providing knowledge and innovation to our customers.

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