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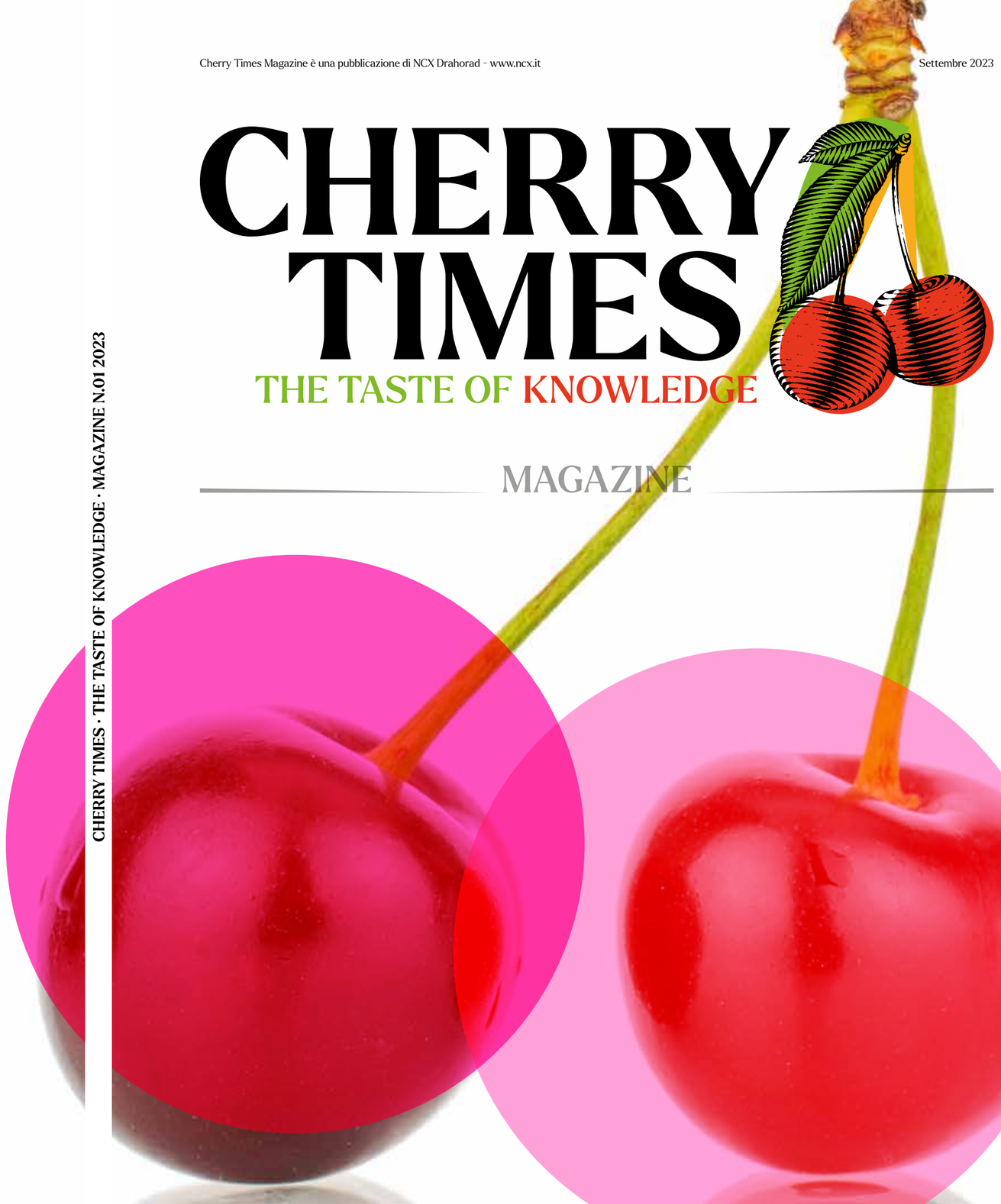
Settembre 2023

CHERRY TIMES

THE TASTE OF KNOWLEDGE

MAGAZINE



CHERRY TIMES · THE TASTE OF KNOWLEDGE · MAGAZINE N.01 2023

NCX Drahorad

SERVING EARTH

NCX Drahorad is an Italian service company for the fresh produce industry, specialized in international trade and a global network of professional media.

SL Fruit Service by Stefano Lugli is a company founded in 2023 operating in the organisation of national and international technical and scientific events in the fruit sector and in the development of information and training projects aimed at a professional audience at global level. Its main collaborations are currently with Cesena Fiere in the coordination of the Macfrut nursery exhibition and varietal innovation and with NCX Drahorad in the scientific editorial coordination of Cherry Times, the new magazine entirely dedicated to the cherry world.

CHERRY TIMES

THE TASTE OF KNOWLEDGE

EDITORIAL

In the age of information, the success of any industry depends largely on the availability of accurate and up-to-date knowledge. This is also true for the cherry industry, a global agricultural sector that requires in-depth knowledge to meet challenges and seize opportunities. Cherry Times is an ambitious publishing project that aims to provide high-quality information and education on all things cherry for a worldwide professional audience.

Cherry Times' broad scope spans the entire cherry supply chain, from research to sourcing and from the production process to trade. Its content covers a wide range of topics, including research and development on cherry varieties, the use of rootstocks, advanced cultivation techniques, sustainable management, quality control, post-harvest aspects, crop protection strategies, and the economic mechanisms that drive the market. This wide range of topics makes Cherry Times an essential resource for all those involved in every aspect of the cherry industry.

A major goal of Cherry Times is to become the global reference for the vast community of professionals revolving around cherry. This community includes researchers dedicated to the creation of new cherry varieties, nurserymen skilled in plant propagation, agronomists who study best cultivation practices, crop management technicians, cherry growers, packers and traders who bring the product to market, wholesale and retail distributors who connect cherries to end consumers, and of course the consumers themselves who enjoy this delicious fruit. Cherry Times is not only limited to agricultural aspects, but also extends to emerging technologies and trends related to the cherry industry.

The key to Cherry Times' success lies in its professionalism, depth of content, and the dynamic and international approach with which it addresses cherry-related issues. The articles and resources published are the result of thorough research and detailed analysis, always ensuring a reliable and authoritative source of information. In addition, regularity in publication ensures that readers can stay up-to-date with the latest industry news.

A distinctive aspect of Cherry Times is its openness to collaboration with businesses. Companies are invited to actively participate in the production of content and the creation of customized communication projects. This synergy between industry professionals and Cherry Times promises to bring innovation and new ideas to the cherry industry, contributing to its sustainable development and competitiveness.

To ensure the quality and relevance of the information presented, Cherry Times is supported by an international scientific technical committee. This committee is composed of renowned experts in the field of cherry and ensures that every article and resource published is accurate, up-to-date and cutting-edge.

Cherry Times is the result of a joint effort by two leaders in the field, SL Fruit Service and NCX Drahorad. Both companies bring extensive experience and expertise in the cherry industry and join forces to grow and develop this ambitious publishing project.

In conclusion, Cherry Times is more than just a source of cherry information; it is an indispensable resource for anyone involved in this industry. It is a bold project that promises to contribute to the success and growth of the cherry industry on a global scale. Whether you are a researcher, producer or consumer, Cherry Times offers a comprehensive and informative perspective on one of the world's most beloved fruits. Don't miss the opportunity to be part of this revolution in cherry information. Knowledge is the key to a prosperous future, and Cherry Times is here to open the door to a world of opportunity in the cherry.

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1. A RESEARCH POINTS TO CALCIUM AS A POSSIBLE REMEDY AGAINST CRACKING

Fruit cracking is still one of the most critical factors for cherry production, mainly because no effective solutions are available to solve this problem. Cultivation under rain covers or in tunnels significantly reduces the occurrence of cracking (except in exceptional cases) but involves higher production costs.

Foliar applications of calcium salts (Ca) appear to reduce cracking, but the results available to date are still uncertain. Studying the phenomenon, several mechanisms have been proposed for the possible function of Ca in reducing cracking. First, the **effects of Ca have been attributed to a decrease in osmotic potential**, resulting in decreased water uptake.

However, based the Ca concentrations used, the fruit osmotic potential and the absence of significant turgor in the fruit, the decrease in osmotic strength can be considered negligible. The decrease in water absorption due to this osmotic effect can therefore be ruled out as a factor. **Ca is also known to increase the cross-linking of cell wall components**. This phenomenon is also present in the epidermis of sweet cherry fruits. In fact, the most likely explanation for the microscopic observations on cracking is a reduction of intracellular liquids (edema) resulting in increased cell-cell adhesion.

The studies conducted so far have thus led to the creation of the "egg-box model". In arriving at the creation of this model, studies have focused on the role of Ca in cell-cell adhesion during the pre-harvest and post-harvest periods, as well as in relation to fruit quality characteristics, such as flesh firmness. In the study conducted by researchers at the University of Hanover (Germany), on the other hand, the **effect of calcium on epidermal cell wall thickening** was evaluated through microscopic measurements both in vivo on peel sections and in vitro on extracted cell walls.

The **results show that intracellular fluids are reduced with increasing $CaCl_2$ concentration**. Also in vitro, Ca chlorides reduced edema, thereby increasing cell wall adhesion of adjacent cells. However, the effect of pH must also be considered in this context, because unlike the effects of Ca, pH has an irreversible effect on edema. When cell walls previously exposed to a low pH are transferred to a solution with a higher pH, they retain a larger size but at the same time exhibit a lack of Ca binding.

In conclusion, the **results show that Ca reduces cracking susceptibility by decreasing cell wall swelling**. The divalent and trivalent cation salts significantly reduce cell wall edema, presumably by cross-linking the median pectin lamellae. The reduction in edema maintains and enhances cell-cell adhesion, an essential factor in reducing cracking susceptibility in sweet cherries. Thus, Ca salts are considered effective and have also shown an acceptable eco-toxicological profile.

However, their inability to effectively penetrate the healthy cuticle is a significant limitation. **Ca must contact emerging fractures to exploit its potential to reduce cracking susceptibility**. This can be achieved by applying Ca spray during or immediately after precipitation.

2. SOON THE CHERRY TREES WILL BE PRUNED BY ROBOTS

Major crops, viticulture and, at least to some extent, fruit growing and industrial horticulture, have largely benefited from the **technological innovations introduced into production processes through mechanisation**. In contrast, the fruit sector for the fresh market still remains highly dependent on manual labour, particularly for pruning and harvesting operations.

"Cherry growers need tried and tested, research-validated, efficient and cost-effective technical solutions in order to **increase plant efficiency, maintain high product quality according to market demands and, above all, reduce production costs**. These include the possibility of mechanising some cultivation operations, such as pruning and harvesting'. Prof. Matthew Whiting of WSU announced it at the opening of the keynote lecture he gave at last year's ICS at Macfrut (Whiting, 2022): "the future lies here".

The **declining availability of skilled labour and the rising costs** of raw materials and labour are seriously jeopardising the economic sustainability of the entire supply chain. It is precisely on the economic balance sheet of the enterprise that the future of specialised cherry farming is at stake.

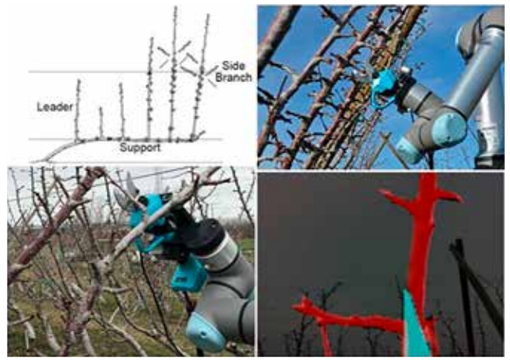


Fig. 1. (Top left) A diagram of a UFO cherry tree structure, including the side branches to be pruned from the vertical leaders. (Top right and bottom left) Our pruning robot uses a manipulator mounted on a mobile base with an eye-in-hand RGB-D sensor and electric bypass shears. Bottom right) Segmented image taken during the approach to the pruning point.

Counting in hand, producing cherries in modern, covered facilities **costs on average between EUR 3.20 and EUR 3.55/kg**, depending on the type adopted. 60-70% of production costs are attributable to harvesting and pruning (Ghelfi and Palmieri, 2022).

DEVELOPMENT OF PLANAR BREEDING SYSTEMS

At Washington State University and Oregon State University, a multidisciplinary team of agronomists and engineers has studied various **methods to improve production efficiency, with a focus on pruning and harvesting.**

The long-term goal is to improve production efficiency and profitability while maintaining or improving fruit quality. "In order to achieve this goal," Whithing continues, "our group has perfected **cherry tree breeding forms with two-dimensional, compact fruit parcels based on the UFO** - Upright Fruiting Offshoots - model. Furthermore, engineering solutions for pruning,

pollination, and mechanical thinning have been developed and studied, as well as both fully mechanical and mechanically assisted harvesting systems.

It is clear that the forms of cultivation will have to **adapt to current and future automation and mechanisation technologies**, and similarly, research into such technologies cannot take place without consulting the opinion of those working in the sector, both from an operational and a re-search perspective.

The gradual evolution of training forms, from large three-dimensional structures to planar structures strictly and geometrically trained in narrow walls with renewable vertical cords, together with the adoption of precision techniques in canopy management, therefore offer the opportunity to adopt mechanisation and consequently **reduce pruning costs.**

One of the initial key objectives that American researchers had set themselves in the development of new 2D forms of plant breeding was precisely to **simplify the interventions required for production pruning** as much as possible.

Fig. 2. Our pruning setup, consisting of a Universal Robots UR5e robot mounted on a linear axis. The end effector consists of a set of electric bypass pruners along with a RealSense D435 RGBD camera.

SELECTIVE MECHANICAL PRUNING

The current research project at the two American universities aims to develop an **autonomous pruning system that can be adapted to farming systems with relatively simple pruning rules**, such as the Upright Fruiting Offshoot. The integrated system includes a seven-degree-of-freedom robot with an 'eye-in-hand' pruning end effector.

The **robot uses online visual feedback** and a fully simulation-trained controller to precisely guide the cutting device to the targeted pruning point. The system is capable of operating completely autonomously and requires minimal control of the environment.

The robot's performance has been validated through field trials in a cherry orchard achieving a **58% cutting success rate.** Although not fully robust and requiring improvements in productivity, this automated system is the first to operate on fruit trees and represents a useful baseline platform for the near future (You et al, 2022).

FONTI

R. Ghelfi, A. Palmieri (2022). Planting a new cherry orchard system: evaluation of economic efficiency. ITALUS HORTUS.

A. You, N. Parayil, J.G. Krishna, U. Bhattarai, R. Sapkota, D. Ahmed, M.Whiting, M. Karkee, C.M. Grimm, J.R. Davidson (2022). An autonomous robot for pruning modern, planar fruit trees. JOURNAL OF ROBOTICS AND AUTOMATION LETTERS.

M. Whiting (2022). Optimizing sweet cherry production efficiencies with mechanization. ITALUS HORTUS.

3. THE SWEET CHERRIES: A SUCCESS STORY

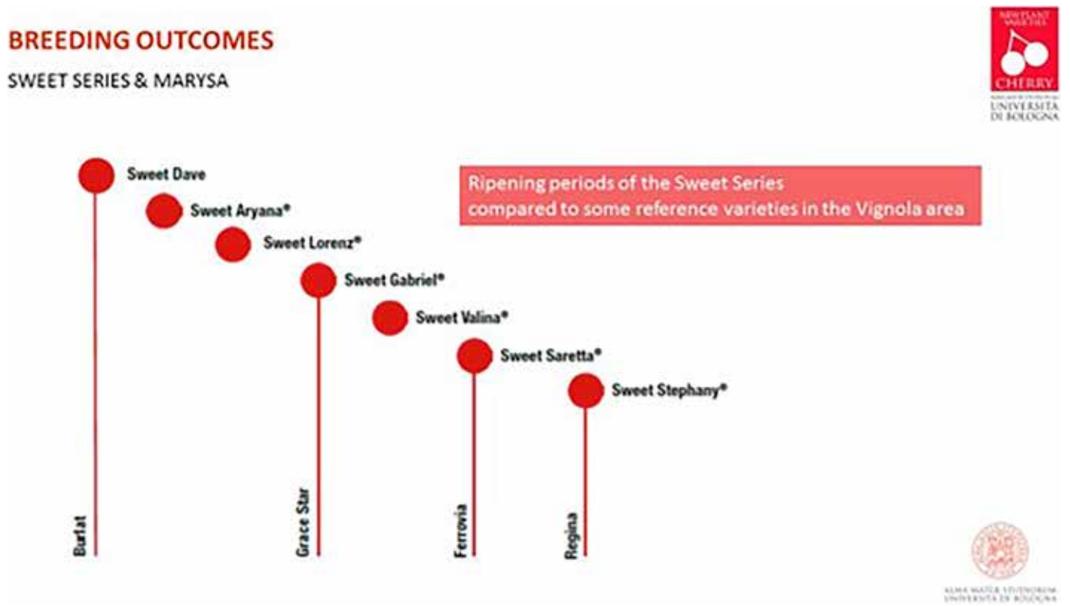
First names are Aryana, Dave, Lorenz, Gabriel, Saretta, Stephany and Valina, the names of the children of those who invented and selected them. **Their surnames are Sweet**, testifying to one of their salient features, sweetness. Born from the '30 e lode' project, the cherry varieties of the Sweet series by Alma Mater Studiorum celebrate 10 years since their release.

Sweet but with a good level of acidity to enhance the aroma, uniform and bright red colour, large and firm: these are the characteristics sought and obtained for the new Sweet cherry varieties.

To do this, the university researchers **started from some old native varieties, the famous Duroni di Vignola**, bearers of valuable characteristics such as sweetness, texture and aroma, and combined their characteristics with those of some American varieties, bearers of excellent aesthetic characteristics such as large size, appearance and bright colour. The aim was to create a series of new high quality varieties, ripe at different times and able to cover a harvest calendar of 30-40 days, i.e. the whole short seasonality of the cherry product.

The breeding programme from which the Sweet cherries originated started at the beginning of the century in the experimental fields of the University of Bologna in Vignola, the Italian cherry capital. To focus on the objectives of the programme, a preliminary survey was conducted to identify the expectations of all stakeholders, but reversing the priorities that are normally followed in such programmes. Thus, the expectations of consumers were considered first, followed by those of industry and trade, and ending with those from the world of production.

Without using gene transformation techniques, the Alma Mater researchers worked for more than 10 years trying out crosses and selections according to traditional methods, but also making use of

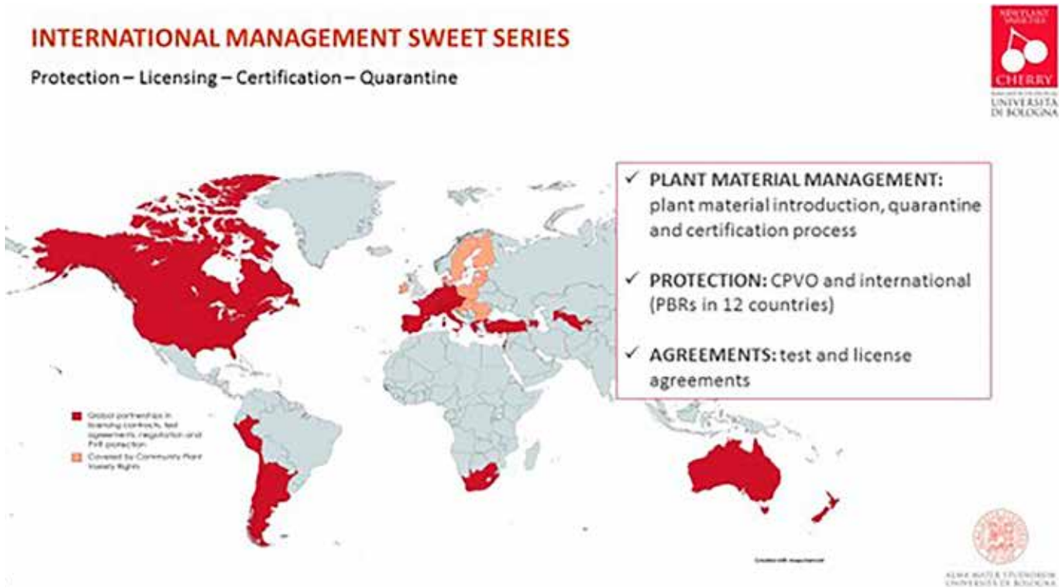


Timing of the start of harvest of Sweet series cherry varieties compared with some reference varieties. Ripening times refer to Emilia Romagna.

modern technologies. Thanks to biotechnology, it was possible, for example, to create a genetic identity card for Sweet cherries and to check their health status. Biochemical methods have been used to identify the aromatic substances that give these fruits their characteristic fragrance and to identify the nutraceutical components that identify their functional and health value. For quality assessment, a tool patented by the University of Bologna has been used, the Cherry Mater, which allows rapid and precise assessment of the degree of ripeness of the drupes, combined with the most classic of systems, sensory analysis using panel and consumer tests.

At the end of this selection process, which started from a progeny of several thousand cherries, only seven of these were chosen and became new varieties: seven sisters, all with one highest common denominator, high quality. The seven Sweet varieties have therefore been protected by Community and international trademarks and patents owned by UNIBO and commercially diffused in all the countries of the world with exclusive agreements thanks to the valuable work of UNIBO's Knowledge Transfer Office – KTO, a strategic sector of the University created to protect and enhance the patents of the Alma Mater.

In the ten years since their presentation to the general public, Sweet cherries have won several awards: the 'Oscar all'Innovazione' award on the occasion of their christening at Macfrut, the 'Best Cherry in Italy' prize awarded to Sweet Lorenz and that of 'Most Beautiful Cherry in Italy' awarded to Sweet Valina by the jury of the National Association of Cherry Towns of Italy, the inclusion of the Sweet varieties in the PGI Ciliegia di Vignola and, the icing on the cake, the Guinness World Records obtained last year by Sweet Stephany, the largest cherry in the world.



Exclusive licensing contracts of Sweet varieties made by the University of Bologna worldwide (Source: KTO UNIBO, 2022)

VARIETAL PROFILES

Sweet Dave® PA8UNIBO*

Origin: University of Bologna, Italy by S. Lugli, R. Correale and M. Grandi. Tested as DCA BO A1A70. Community trademark and trade mark in the process of filing.

It is the latest from Alma Mater Studiorum. Sweet Dave® has good vigour and a good habitus that makes it adaptable to different planting patterns, densities and shapes. Self-incompatible, the variety has an S1S4 allelic profile. Flowering time is early and it is well pollinated by Sweet Aryana® (S3S4') and Sweet Lorenz® (S3S4). The production yields recorded so far are very good and in line with the values expressed by other early varieties of the same group. The ripening of the fruits coincides with the main staccato of Burlat and starts on 20–25 May and then continues for a week and more. The fruits are good-looking, cordiform-depressed and large, purple-red, with juicy, crisp and firm flesh. The flavour is sweet, aromatic and well balanced in the ratio of sugars to acids.

Sweet Aryana® PA1UNIBO*

Origin: University of Bologna, Italy by S. Lugli, R. Correale and M. Grandi. Tested as DCA BO A1A1; EU Patent 48925/2018.

Early, self-fertile variety, ripens 3–5 days after Burlat. Fruits have medium to large size, bright dark red colour, flesh with good texture, crispy, sweet taste and fair acidity. Fruits ripen uniformly, have a good in-plant retention with a harvest window of 10 days, but are susceptible to cracking, a phenonomen that in rainy years is mostly found in the peduncular zone and at the apex. The tree has an intermediate vigour, expanded habit, with a good attitude to branching laterally, and standard fruiting habitus. It produces mainly on darts and flower buds placed at the base of one-year branches. Productivity is constant and high on both vigorous (14–15 t/ha) and weak (15–17 t/ha) rootstocks and fruiting is early (3rd or 4th year after planting). It is self-fertile with allelic profile S3S4' with early flowering.

Sweet Lorenz® PA2UNIBO*

Origin: University of Bologna, Italy by S. Lugli, R. Correale and M. Grandi. Tested as DCA BO A1C27; EU Patent 48926/2018.

Early variety of which the first plantings are being made in Italy. Ripens 8–10 days after Burlat. Cordiform fruits have medium-high size, bright red colour, flesh with excellent texture and crispness, good sweet taste, low acidity and aroma. Fruits ripen uniformly, have a good retention in the plant with a harvest window of 14 days. The tree has high vigour and semi-expanded habit with good branching and standard fruiting habitus. It produces mainly on darts and on flower buds at the base of one-year branches with a consistently high average quantity especially on weak rootstocks (13–15 t/ha). Fruiting is early (3rd or 4th year after planting). Flowering is early, it is self-incompatible with allelic profile S3S4 and is well pollinated by Sweet Gabriel® and Sweet Saretta®.

Sweet Gabriel® PA3UNIBO*

Origine: Università di Bologna, Italia da S. Lugli, R. Correale and M. Grandi. Testata come DCABO A1C40; UE Patent 48927/2018.

A recently introduced variety which, like all those in the Sweet group, is just beginning to be planted in Italy. Ripens at an intermediate stage, 14–16 days after Burlat. Fruits have medium-high size, bright red colour, excellent flesh consistency, good sweet flavour, low acidity. The drupes ripen uniformly with excellent retention on the plant (harvest window of 12–14 days). The tree has medium-high vigour and expanded habit, well branched with standard fruiting habitus. It produces mainly on darts and flower buds at the base of one-year-old branches. The variety is very productive and constant when grafted onto weak rootstocks (16–18 t/ha), has early fruiting and is suitable for different types of planting and training forms. Flowering is medium early, similar to Burlat, it is self-incompatible with allelic profile S1S4 and is well pollinated by Sweet Aryana®, Sweet Lorenz®, Sweet Valina® and Sweet Saretta®.

Sweet Valina® PA4UNIBO*

Origin: University of Bologna, Italy by S. Lugli, R. Correale and M. Grandi. Tested as DCA BO B5D23; EU Patent 48928/2018.

It ripens at an intermediate stage, 18–20 days after Burlat. Fruits have medium-high calibre (60% are over 30 mm), bright red colour, good flesh texture, good sweet taste (>19 °brix and acidity 9 g/l), ripen uniformly and have a good in-plant retention with a harvest window of 10–12 days. The tree has high vigour and a semi-expanded, well-branched habit with standard fruiting habitus. It produces mainly on darts and flower buds at the base of one-year branches, has a fairly good productivity and constant production (12–14 t/ha), with medium-early fruiting. It is susceptible to cracking. Flowering is +3/4 Burlat, is self-incompatible with allelic profile S3S4 and is well pollinated by Sweet Garbiel® and Sweet Saretta®.

Sweet Saretta® PA5UNIBO*

Origin: University of Bologna, Italy by S. Lugli, R. Correale and M. Grandi. Tested as DCA BO B5A87; EU Patent 48927/2018.

Recently established variety that ripens medium-late, 22–24 days after Burlat. Fruits are medium to large in size, bright red in colour, good flesh consistency, good flavour tends to be balanced, ripens uniformly and has a fairly good in-plant retention with a harvest window of about ten days. The tree has high vigour and expansive habit, well branched with standard fruiting habitus. It produces well and mainly on darts and flower buds at the base of one-year branches; in combination with dwarfing rootstocks productivity is constant (15 t/ha), and it has a very early fruiting. It is susceptible to cracking. Flowering is +2/3 Burlat, it is self-fertile with allelic profile S3S4.

Sweet Stephany® PA7UNIBO*

Origin: University of Bologna, Italy by S. Lugli, R. Correale and M. Grandi. Tested as DCA BO B5A89; EU Patent Application 2594/2015.

Recently established variety, ripens medium-late, 25-27 days after Burlat. Fruits have a very high average size, bright vermilion red colour, excellent flesh consistency, good flavour, ripen uniformly and have a discrete in-plant retention with a harvest window of about ten days. The tree has high vigour and intermediate bearing, well branched with standard fruiting habitus. It produces mainly on darts and flower buds at the base of one year branches; very good in combination with dwarfing rootstocks (15 t/ha), has very early fruiting and is very susceptible to cracking. Flowering is +1/2 Burlat, it is self-fertile with allelic profile S3S4'.

Stefano Lugli – SL Fruit Service
Cherry Times - Chair of technical-scientific committee

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4. WITH THIS YEAR'S FINAL® VARIETIES, SANIFRUTTA CHERRY SEASON WILL END ON A HIGH NOTE AT THE END OF JULY

The four **varieties of the Final® series derive from a breeding programme conducted by Peter Stoppel in Kressbronn (Germany)** on a population of seedlings obtained by crossing an old native variety, Spate von Wedler, and a self-fertile variety of Canadian origin, Sweetheart®.

The aim of the project was to obtain new late-ripening varieties, after Regina, to be proposed as possible alternatives to the Canadian varieties, e.g. Sweetheart® and Staccato®, varietal types that are poorly adapted to the soil and climatic conditions of the cherry growing area in the Bodensee.

The Final® varieties were presented in 2019 at the International Cherry Symposium in Vignola (Italy). The salient and most interesting traits of the four sisters marketed under the Cerasina® brand are, at least on paper, the **extra-long ripening time, the high productivity and the high quality standards of the cherries**.

Here are the video and the english article of Peter Stoppels› contribution at ICS 2019 in Vignola.

Image 1. Peter Stoppel

Image 2. New Final® series rootstocks

SANIFRUTTA'S NEW PROJECT

Thanks to an exclusive contract signed four years ago with Cerasina® and valid for North-West Italy, Sanifutta, a Piedmontese company that is a member of Op Joinfruit, wanted to extend the variety offer in the late harvest period, so as to **continue after Kordia-Regina and for at least three to four weeks the offer of high-quality cherries**.

Sanifrutta's goal is to reach a total of 70 to 80 hectares planted with late harvest cherries in the next 4 to 5 years, with a volume of approximately 1000 to 1200 tonnes per year of product.

The four self-fertile varieties of the Final® series ripen at different times and with differences in days to Regina varying from one environment to another and from one year to another. For the current season (2023) in Piedmont the harvest of Final 10.4 started on 28 June (+10 days Regina).

This is followed by Final 11.3 (+14 days Regina), Final 12.1 (+17 days Regina) and Final 13.1 (+23 days Regina).

The **main characteristics** of the Final® series varieties are summarised below.

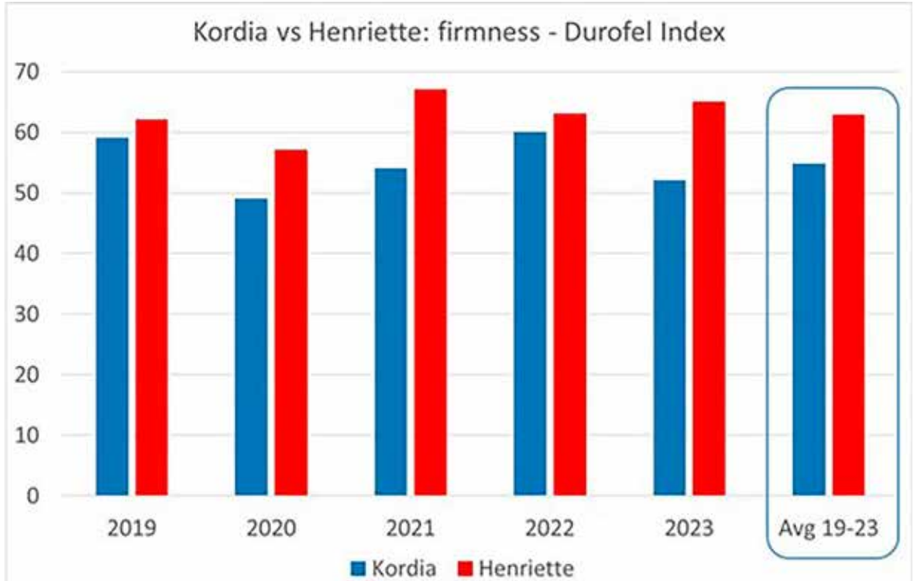


Image 3. Final® 10.4

Image 4. Final® 11.3

Image 5. Final® 12.1

Image 6. Final® 13.1

Stefano Lugli – SL Fruit Service
Cherry Times – Chair of technical-scientific committee

5. ROYAL HELEN: THE FAIREST OF THEM ALL

The cultivar (cv) Royal Helen® produced by a young producer from the province of Modena (IT) was awarded the title of 'Most Beautiful Cherry in Italy' 2023. Congratulations to Riccardo Bergonzini. The jury of the competition that rewards Italian excellence every year during an initiative now in its XXIV edition, supported by teams of renowned chefs and qualified experts of this fruit of paradise, decreed the Californian maiden as the most charming of cherries, but not the tastiest.

The fine palates of the commission decided that the award for the best cherry should go to an elderly lady from Campania, now at the end of her career, the variety Spernocchia.

Old hen makes good stock? Wisdom comes with age? It depends on the point of view. I share a thought by Oscar Whild that seems pertinent: With age comes wisdom, but sometimes age comes alone.

Valutazione Generale Riepilogativa

COMUNE	N°	AZIENDA	VARIETÀ	VAL. ESTETICA	VAL. GUSTO	VAL. GLOBALE
Castelnuovo R. MO	1	Az. Agr. Melagoli	Summit	120	137	257
Chiusa Sclafani PA	2	Az. Agr. Caronia	Lapins	142	131	273
Bracigliano SA	3	Izzo Antorio e Tommaso	Spernocchia	126	145	271
Castegnero VI	4	Az. Agr. Pietro Lazzari	Ferrovia	110	101	211
Bracigliano SA	5	Az. Agr. Franco Albano	Spernocchia	149	133	282
Vignola MO	6	Az. Agr. G. Micagni	Skeena	158	141	299
Montoro AV	7	Az. Agr. Basile	Spernocchia	140	135	275
Maenza LT	8	Centra Nicola	Ferrovia	120	121	241
Bracigliano SA	9	Bracigliano Natura	Spernocchia	141	119	260
Savignano s. P. MO	10	Giuseppe Quartieri	Ferrovia	147	128	275
Bracigliano SA	11	Coop 2 G.	Spernocchia	133	117	250
Zocca MO	12	Barbieri Elia	Grace Star	125	130	255
Sant'Alfio CT	13	Mendola Giuseppina	Ferrovia	129	85	214
Marano s. P. MO	14	Ferrari Ioele	Canada Giant	137	132	269
Bracigliano SA	15	Bracigliano Ciliegie	Spernocchia	138	138	276
Savignano s.P. MO	16	Az. Agr. Bergonzini	Royal Helen	160	136	296
Vignola MO	17	Consorzio della Ciliegia	Canada Giant	126	118	244
Turi BA	18	Valentini Giorgio	Ferrovia	132	123	255

Image 1. Classification of the national 'Cherries of Italy' competition 2023

Image 2. Spernocchia

ROYAL HELEN'S VALUE

A pragmatic view, supported by experimental experience and direct observations in orchards, leads us to say that **Royal Helen® should rightfully be included in the top ten of the new late season cherry varieties**. For these three reasons: high aesthetic standards, excellent cherry quality and high production performance.

The varieties of the Royal® series, the Californian cherries of Zaiger Genetics, were presented to the general public four years ago at the International Cherry Symposium in Vignola (IT). Among them is the cultivar Royal Helen®.

Image 3. Royal Helen®

ROYAL HELEN*

Late ripening: - 7 days Sweetheart®

IPS INTERNATIONAL PLANT SELECTION

Habit: semi erected
Vigor: strong
Fruit bearing: strong and dense - spur
Productivity: high
Fruit set: rapid

Flowering time: Early - Sweetheart® time
Self-fertile variety - Alleles: S1S4'

Shape: soft kidney shape
Color: carmine red colour (CTIFL code 4/5)
Dominant fruit size: 28/30 mm - Average fruit weight: 9-12 (g)
Stem: thick with meduim length
Texture: creamy and juicy
Organoleptic qualities: sweet, strong aromatic componants
Firmness: 65/75 D25
Brix: 17/19%
Acidity: 11/12 meq/100ml
Cracking tolerance: medium

Image 4. Main features of Royal Helen®

6. WIDENING THE CHOICE OF CHERRY ROOTSTOCKS: THE KRIMSK® SERIES

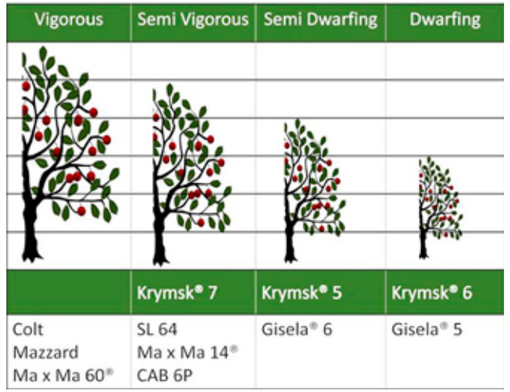
The origins of Krymsk® rootstocks **date back to the middle of the last century**, when Gennady Eremin started a selection programme on stone fruit rootstocks (cherry, peach and plum) in the experimental station of the same name located in southern Russia, between the shores of the Black Sea and the foothills of the Caucasian chain.

The objectives of this project were to **obtain dwarfing or semi-dwarfing rootstocks capable of adapting to that environment**: soils that tend to be clayey and a hot, dry summer climate. As a starting point for his work, Eremin collected thousands of wild landraces, thus creating one of the world's largest gene libraries of the Prunus genus.

The selection carried out on this germplasm bank allowed researchers at the Krymsk station to **identify genotypes deemed suitable for intraspecific crosses** and, after several years, to arrive at the desired goals. The merit of Eremin and his research team was that they conducted the experiment under extreme soil and climatic conditions, with little or no irrigation and minimal fertiliser use.

As a result of this work, the **new Krymsk® rootstocks are more resistant than others of similar vigour** available on the international nursery market.

For the cherry tree, both sweet and sour, **three rootstocks have been licensed, patented and commercially distributed**: Krymsk® 5, Krymsk® 6 and Krymsk® 7. The company Variety International based in Oregon (USA) manages the worldwide propagation of Krymsk® rootstocks through exclusive licences to nursery companies in the main cherry and sour cherry producing countries.



KRYMSK® 5 – VSL-2*

Origin: *Prunus fruticosa x Prunus lannesiana*

Compatible rootstock for sweet and sour cherry varieties. Induces a similar or slightly higher vigour than Gisela® 6 and shows high and early productivity. Compared to Gisela® 6 it has a better anchorage and greater adaptability to heavy, moist soils. It shows moderate suckering activity on these soils. Krimsk® 5 withstands cold climates well in winter and tolerates high temperatures and conditions with limited water availability during the spring-summer season.

KRYMSK® 6 – LC-52*

Origin: *Prunus cerasus x (Prunus cerasus x Prunus maackii)*

Rootstock compatible with both sweet and sour cherries. Induces a vigour similar to Gisela® 5, about 10-20% lower than Krymsk® 5. Has a very early fruit set and comparable productivity to Gisela® 5. Compared to the latter, it has shown greater adaptability to heavy, moist soils. It withstands cold winter and hot summer climates well. Has moderate resistance to lime.

KRYMSK® 7 – L2*

Origin: *Prunus lannesiana*

Rootstock compatible with sweet cherry varieties. Induces lower vigour than the franc (Prunus avium), similar to that of the magaleppo (Prunus mahaleb). The earliness of fruiting and productivity are superior to franc and Colt and comparable to those obtained with Prunus mahaleb. This rootstock also tolerates winter cold, hot summers, heavy soils and water stress well.

The breeding project of the Krymsk Research Station continues. Promising new rootstock selections for the cherry tree (see table below) are being tested in several countries, including Italy.

Thanks to an inter-regional project supported by Battistini Vivai and co-ordinated by Stefano Lugli of SL Fruit Service, the evaluation of these new genotypes is being carried out in Trentino (Coop Sant'Orsola), Emilia-Romagna (University of Modena and Reggio Emilia and Apofruit), Marche (Polytechnic University of Ancona) and in Apulia (Agrimeca Fruit Consulting) with experimental trials on different varieties, planting distances and training forms.

ROOTSTOCK	CODE	VIGOUR*
P. serrulata	42-2-16	70
P. serrulata	42-2-16 N. 1	70
(P. maackii x P. cerasus) x P. lannesiana nr. 2	RVL-4	70
(P. cerasus x P. pseudocerasus) x (P. fructicosa x P. lannesiana)	C 56-12 x VSL-2	60
(P. avium x P. incisa) x (P.fructicosa x P. lannesiana)	A-9 x VSL-2	60
(P. maackii x P. cerasus) x P. lannesiana nr. 2	RVL-7	60
P. canescens x P. cerasus	18-7-17	50
P. serrulata x P. sachalinensis		50
P. mahaleb x P. fruticosa		50
(P. cerasus x P. maackii) x (P. fructicosa x P. lannesiana)	Rulan 8	50

* 100 = Mazzard (Prunus avium). Sorce: Mass, 2019

BATTISTINI VIVAI: 70 YEARS OF RELIABLE AND PRODUCTIVE CHERRY TREES AND ROOTSTOCKS

Battistini Vivai is a 'historical' company with more than 70 years of activity and composed of a young and motivated team, a combination of solid experience with strong roots in the agricultural tradition of Romagna region (Italy) and an ambitious and innovative approach.

What distinguishes your company on the nursery scene?

Thanks to our origins and our distinctive traits, we have a solid presence in various international markets, which are very different from each other and are constantly growing. This is an important stimulus for research into new varieties that can satisfy our increasingly demanding customers, who also require assistance with practical advice on the agronomic and technical management of future plantings.

In what aspects can you define yourself as a nursery specializing in cherries?

The cherry trees and rootstocks we produce are intended for all agricultural entrepreneurs, whether small or large, but we pay attention to many factors, including how companies are structured, the choice of rootstocks that are best suited to their soils, the varietal choice, and the destination of the final product in the various consumer markets. Even the availability of labour is a key aspect to consider.

How do you deal with the wide availability of new cherry varieties resulting from breeding programmes?

Within the cherry sector, Battistini nurseries invests every year to introduce more and more reliable varieties that can have an impact on the market, trying to optimize the production result, always in strong cooperation with our end customers, because their satisfaction makes our company have reason to exist and continue to grow. The future is all to be built, one cherry at a time.

Cherry cultivation is not exempt from the challenges facing the fresh produce supply chain. What are currently the hottest issues for the producers and the market?

Looking to the future, the aspects that will have the most development will concern a certain 'production sustainability', so self-fertile varieties with resistance to negative climatic factors will be increasingly common. Disease-resistant and health-certified varieties will be sought. This is true regardless of whether we are talking about cherry, apricot or peach, because we must not forget that our stakeholders are professional farmers who have to earn money and unfortunately, we have to take into account that this income is getting thinner and thinner every year, as a result of ever more prevailing globalization and accelerated climate change.

What are the distinguishing features of the products and services you offer your farmer customers?

As mentioned earlier, the advantages and special features of our products within our sector concern the production of high quality, certified materials at the highest level and therefore able to facilitate orchard management within the various farms.

7. POST-HARVEST PHYSIOLOGY AND TECHNOLOGY OF SWEET CHERRY

World production of sweet cherries has steadily increased in recent decades. The introduction of many new cultivars and the development of new, more intensive cultivation systems attest to this reality. **The market recognizes a number of key quality characteristics for cherries**: a brightly colored fruit with a strong "cherry" flavor on a green, turgid stalk.

Several **new post-harvest technologies have been developed to extend the fruit's shelf life** and thus enable export of cherries by ship to more distant markets. The adoption of some of these technologies has allowed cherries to be stored for 35–45 days (depending on variety) enabling, for example, Chile to ship cherries to China.

Sweet cherries deteriorate rapidly after harvest. This is due to several factors, including high respiration rate, extreme tissue sensitivity to physical damage and pathogen infection. At the same time, the stalk is subject to water loss and thus shriveling and browning.

Image 1. High sensitivity to mechanical damage can induce surface pitting.

Under uneven storage temperatures, decay is the main cause of fruit loss. **Pathogen infections occurring in the pre-harvest stage** cannot be controlled by post-harvest treatments.

Infection is caused and/or enhanced during the sorting/packing/storage stage by contaminated water (usually used for hydrocooling or moving fruit during processing) or condensation in the packages. Therefore, the water requires strict disinfection.

Alternatives to chlorine for this purpose include chemicals such as peracetic acid (PA). Depending on the formulation, the broad pathogen control described for PA sometimes conflicts with the phytotoxicity it induces on the fruit stalk.

In addition, film materials that reduce water loss in cold storage are risky under fluctuating temperatures when condensation forms rapidly. This is especially a problem when ventilation is poor. Macro and micro perforation of the films used can promote water vapor permeability of these materials in the packages.

Image 2. Damage caused by insufficient amount of water used in transits during processing.

Image 3. Internal browning in cv. Regina developed in 35 days at 0° C

The tissues of sweet cherries are very sensitive to mechanical damage from impact and compression. These soon lead to symptoms described as "surface pitting." These symptoms worsen the aesthetic appearance of the fruit and create access points for infection by pathogens.

This "pitting" usually appears in the first ten days of storage, and susceptibility to "pitting" is related to the strength and deformability of the tissue and is very much related to variety (Figures 1 and 2).

Fruit firmness is a useful measure of fruit resistance to mechanical damage, so good firmness is a desirable characteristic in new varieties of sweet cherries, since these types of fruit are generally more resistant to compression damage.

However, a balance is needed, as some degree of deformability also contributes to resistance to impact damage. A cultivar's susceptibility to physical damage is critical in dealing with the rigors of harvesting, postharvest handling, and packing.

Careful assessment of handling damage associated with pitting can indicate critical points in the postharvest chain where damage occurs, thus enabling particular mitigation actions, including efficiency improvements or specific changes in packaging line design.

Various pre-harvest chemical treatments, such as applications of gibberellic acid or calcium or other bioactive chemicals used to manage crop load or increase resistance to rain splitting, can have different results depending on the variety

Physiological disorders can be defined as alterations in the normal physiology of the fruit, induced by abiotic stresses. Thus, rainfall during fruit ripening induces preharvest fruit cracking and also increases the incidence of postharvest cracking in the moist environment of a fruit package.

There are various other post-harvest physiological disorders, such as "orange peel" (also called "pebbling" or "alligator skin") or "internal browning," which affect fruit quality and thus consumer acceptance and market value. The "orange peel" phenomenon develops on the surface of the fruit in the form of rough patches, but without affecting the flesh. The fruit has a dull appearance, similar to old tissue.

Image 4. Orange peel, a physiological disorder in postharvest.

Internal browning, on the other hand, is a physiological disorder that affects the appearance of the flesh and gives it a "dull flavor" that makes the fruit unmarketable. The development of internal browning is related to storage time, with storage periods in excess of 35 days becoming impossible in the most susceptible cultivars (e.g., Regina and Skeena). Several research projects are examining postharvest factors through which the development of internal browning can be mitigated. (Figures 3 and 4).

Post-harvest technologies currently in use to reduce fruit spoilage involve the rapid removal of heat in the field and the rapid initiation and maintenance of the cold chain. Grading takes place in a high-speed system with chilled water, and packing takes place in a water-saturated environment. Storage is aided by a CO_2-enriched atmosphere in the package, created passively by the fruit and plastic film.

New technologies will be introduced based on our understanding of the causes of postharvest fruit spoilage and how new cultivars respond to these causes. How current and new technologies can be used to extend the shelf life of sweet cherries will be discussed in future issues of "Cherry Times."

Juan Pablo Zoffoli - Pontificia Universidad Católica del Chile
Cherry Times Scientific and Technical Committee

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8. GREGORY LANG: CHERRY ORCHARD TRAINING SYSTEM INNOVATIONS

Sweet cherry growers around the world are increasingly adopting trellised training systems that create a narrow, contiguous, planar "fruiting wall" canopy architecture. The benefits of such a radically redesigned orchard are significant, including:

- High light interception efficiency and light distribution porosity, with minimal shaded areas. This promotes premium fruit quality and ripening uniformity.
- Optimized canopy photosynthesis at lower light levels, an advantage for orchards in cloudier growing regions or with protective covering systems.
- Greater labor efficiency for hand harvest and pruning, and the potential to utilize mechanized hedging for some pruning tasks.
- Better spray coverage for pesticides, nutrients, and growth regulators, with less off-target drift.
- The potential to integrate orchard covering systems with the trellis structure, creating synergisms in climate modification investments and engineering.
- The ability to utilize narrow row covers to protect from rain and hail while minimizing the trapping of excessive heat during fruit ripening.
- The stability of the canopy conferred by the trellis can reduce wind-bruising of fruit, particularly important for bi-colored cherries.
- Optimized adoption of new technologies for canopy sensing, imaging, and mapping to acquire more precise data for better decision-making in balancing crop loads with canopy leaf area.
- The potential to utilize canopy sensing data and images for technology-driven new equipment such as "smart" sprayers with arrays of individually-activated nozzles that only apply products when and where needed, or mechanisms that selectively thin dense flower clusters, etc.

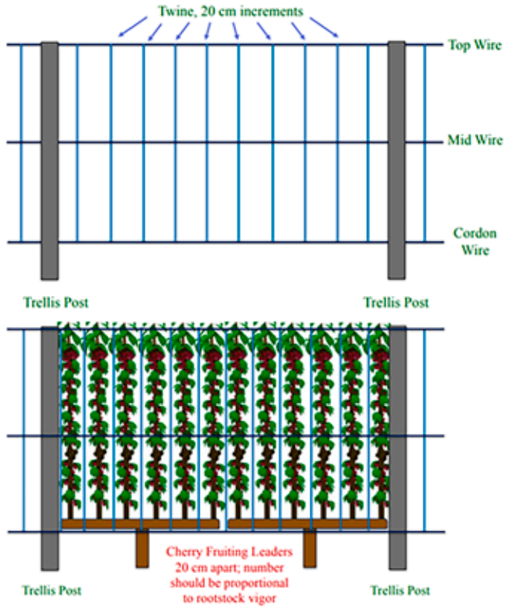
- The potential to utilize sprayer-applied pollen in springs when poor weather limits insect-pollination or compatible pollinizer bloom overlap.

Planar sweet cherry canopies can be trained as single vertical walls or dual angled ("V") walls, all requiring a multi-wire trellis for more precise canopy orientation.

Lightweight, high tensile plastic wire has been shown to reduce the potential for rubbing-induced bacterial canker infections in trellises compared to galvanized steel wire (as has rain-protective orchard covering systems). There are essentially four general methods to train sweet cherry trees to achieve the basic narrow canopy structure for single vertical or dual angled planar orchards:

1. **Super Slender Axe (SSA)**: must utilize trees on precocious dwarfing rootstocks and impose extensive severe annual pruning, with some potential for hedging. Single or dual leader trees are planted at very high to high densities with a 2- to 4-wire trellis, respectively, with the vertical leader(s) serving as permanent structure, and all horizontal-growing lateral fruiting branches are renewed annually. Fruiting is primarily from non-spur flower buds at the base of the previous season's lateral shoot growth.
2. **Trident (TRI)** or **Palmette (PLM)**: must utilize trees on semi-dwarfing to vigorous, preferably precocious, rootstocks, with some potential for hedging. Initial pruning creates a 3- to 5-leader (in proportion to rootstock vigor) candelabra-shaped tree with a 2- to 4-wire trellis, with fruiting on a mix of spurs and periodically-renewed lateral shoots arising from each leader.

3. **Upright Fruiting Offshoots** (**UFO**, also known as **Guyot** or **Planar Cordon**): can utilize trees on precocious rootstocks with a wide range of vigor, with good potential for hedging. Single or dual leader trees are planted at medium to high densities with a 3-wire trellis, with the leaders bent horizontally to create 1-2 permanent cordons on the bottom wire, from which upright fruiting offshoots grow vertically at a consistent 20 cm spacing. The fruiting offshoot number should vary in proportion to rootstock vigor and are renewed every 6-8 years. Fruiting is primarily from spur flower buds on each upright offshoot; any lateral branches are removed annually.
4. **Espalier** (**ESP**, also used to create a version of angled dual plane orchard known as **Tatura Trellis**): must utilize trees on semi-dwarfing to semi-vigorous rootstocks, with some potential for hedging. Single leader trees are planted at high to medium densities with a 5- to 7-wire trellis, and lateral shoots are promoted via scoring or growth regulator treatment to be trained permanently along each wire; the horizontal orientation promotes precocity. Fruiting is primarily from spur flower buds on each lateral branch, with most new shoot growth removed annually.



We developed and have been refining the UFO planar canopy for nearly 25 years now, utilizing sweet cherry's natural growth habit traits of apical dominance and acrotonic vigor to precisely fill vertical, narrow orchard space with light-efficient, renewable fruiting structures (see illustrations).

This technique can be adopted to rootstocks of any vigor, since it utilizes the concept of proportional diffusion of vigor by varying the number of upright fruiting offshoots, and these simplified fruiting units readily refill their vertical space upon renewal, maintaining youthful fruit-bearing structure borne on permanent cordons. This contrasts with the difficulty of filling or renewing horizontal fruiting structure in central (or dual) leader-based trees if "blind wood" or gaps occur in the canopy.

Gregory A. Lang - Department of Horticulture
Michigan State University (US)
Cherry Times technical-scientific committee

9. HIGH TEMPERATURES INHIBIT THE ACCUMULATION OF ANTHOCYANINS IN FRUITS

The colour of the sweet cherry fruit is a significant factor in determining the fruit's quality and market value. **Anthocyanin is responsible for the red colour**, and its presence has a direct impact on the colour of fruits.

Multiple biotic and abiotic factors, such as nutrition, temperature, light, and injury, have a direct influence on anthocyanin accumulation. Among them, **temperature serves a crucial role in regulating the accumulation of anthocyanin**. In fact, low temperature can induce anthocyanin biosynthesis and the expression of related genes, whereas high temperature accelerates anthocyanin degradation and is detrimental to anthocyanin biosynthesis.

During the development of plant tissue, **adaptations to variations in the external environment cause colour changes**. The weather during this period can have some strong and rapid fluctuations, which may have a significant impact on the colour of fruit. Under global warming, this phenomenon will be a prevalent problem in the production of sweet cherries, directly affecting the colour and quality of the fruit.

In this study, conducted by the researchers of the Shandong Institute of Pomology and the Shandong Agricultural University (China), **physiological and transcriptomic techniques were used to**

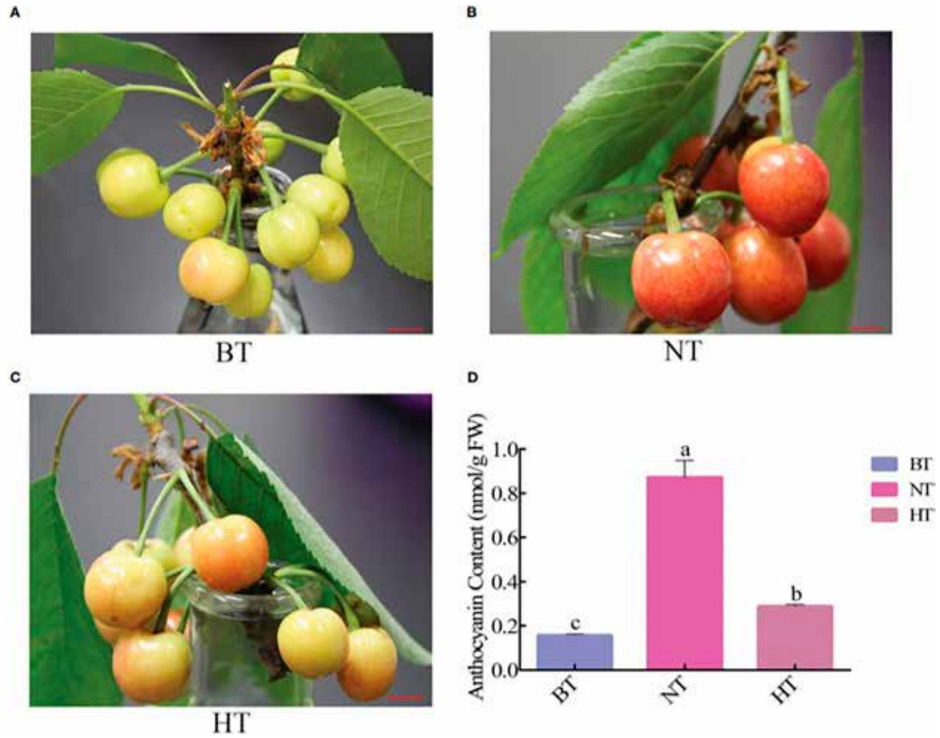


Figure 1. High temperature represses anthocyanin accumulation in sweet cherry peel. (A) Phenotype of sweet cherry before treatment (BT). (B) Phenotype of sweet chery treated at normal temperature [INT. 14°C (night)/24°C (day)]. (C) Phenotype of sweet cherry treated with high temperature [HT, 24°C (night)/34°C (day)]. (D) The anthocyanin content in different temperature treatment groups. The different letters indicate significant differences among different treatments according to Duncan's test ($p < 0.05$).

examine anthocyanin, sugar, plant hormones, and related gene expression in order to determine the effects of high temperature on fruit colouring and the underlying mechanism.

The trial had the aim to test two different temperature regimes on similar branches from 25 days after full blooming: normal temperature (NT: 24°C day/14°C night) and high temperature (HT: 34°C day/24°C night). **Results demonstrated that elevated temperature inhibited anthocyanin accumulation in fruit peel and slowed down the colouring process**. After 4 days of exposure to normal temperature and high temperature, the total anthocyanin content of fruit epidermis increased by 455% and 84%, respectively.

Likewise, the amount of eight anthocyanin monomers was significantly greater in NT than in HT. **High temperature also altered the concentrations of plant polysaccharides and hormones**. The total soluble sugar content of NT and HT increased by 29.49% and 16.88%, respectively, after four days of treatment. Auxins, gibberellic acid and abscisic acid (ABA) increased in both regimens, but at a slower rate in HT. In contrast, the levels of jasmonic acids and cis-zeatins decreased faster in HT than in NT.

The correlation analysis revealed a **significant relationship between the abscisic acid concentrations and the total anthocyanin concentrations, thus indicating that the presence of this hormone leads to the inhibition of anthocyanin biosynthesis**. HT also inhibited the activation of structural genes in anthocyanin biosynthesis as well as the repression of genes dominating the catabolism and inactivation of abscisic acid with a consequent slowing in fruit colouring.

These findings suggest that ABA may be a key regulator in the inhibition of sweet cherry fruit colouring by elevated temperatures.

Overall, our findings indicate that a **high temperature inhibits the colouring of sweet cherry significantly**. ABA, a key positive regulator of the maturation and colouring of non-climacteric fruits, likely plays a crucial role in this process.

An increase in temperature delays the downregulation of crucial genes expression during fruit colouring, resulting in increased ABA catabolism and ABA inactivation. **This reduces the amount of ABA in fruit skin and delays colouring**.

Source: Tan Y, Wen B, Xu L, Zong X, Sun Y, Wei G and Wei H (2023), *High temperature inhibited the accumulation of anthocyanin by promoting ABA catabolism in sweet cherry fruits*. Front. Plant Sci. 14:1079292. doi:10.3389/fpls.2023.1079292.

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10. APPLICATIONS OF METHYL JASMONATE (MEJA) TO REDUCE CRACKING

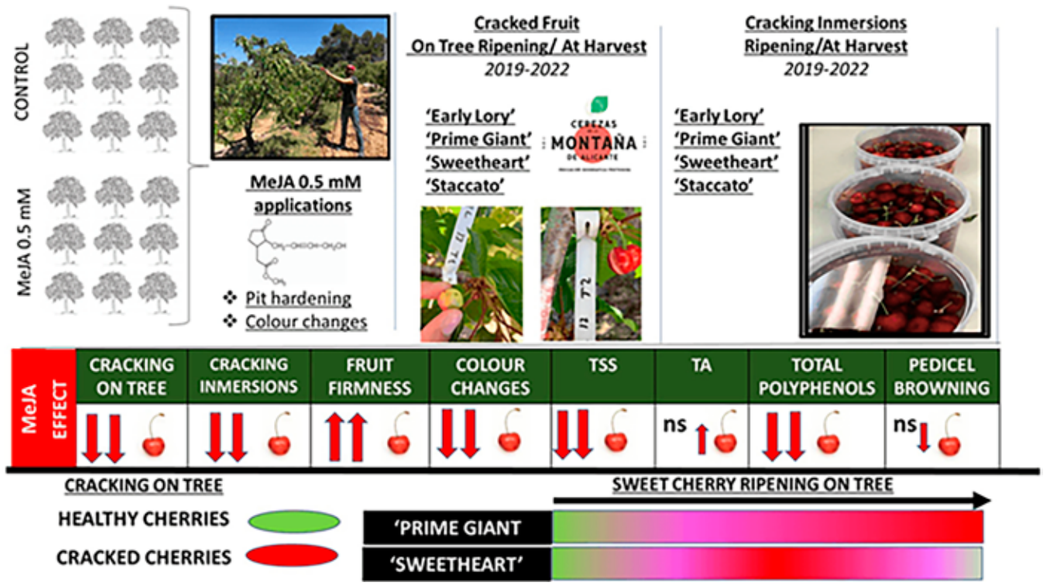
Each fruit species has different variables that contribute to cracking. Cherry fruits, which have a thinner epicarp, show greater susceptibility to cracking than other stone fruits characterized by fruits with thicker epicarp. In addition, **cracking of cherries is influenced by other variables** such as fruit size and shape, genetic variables and sugar content.

It is also known that **the ripening stage has significant importance on the occurrence of cracking**. It has been observed that cultivars with higher cracking tolerance have a more extensive cell division stage, leading to an increase in mesocarp size. However, the increasing frequency of extreme weather events related to climate change may exert a substantial influence on the occurrence of cracking on cherries.

Indeed, several environmental parameters are affected, including, but not limited to, increased rainfall, high humidity levels, and abrupt temperature fluctuations. In addition, the occurrence of **precipitation during the cherry development stages has the potential to cause substantial pre-harvest losses**, mostly attributed to cracking.

Some cultivars are more vulnerable to this problem, especially when there is a convergence of persistent rainfall with advanced phenological stages. In this context, **methyl jasmonate (MeJA), functioning as an intrinsic signaling molecule**, assumes a crucial function in the growth, development and physiological processes of plants, enabling them to successfully adapt to adverse environmental circumstances.

The primary objective of the study conducted by the researchers of the Postharvest Research Group of Fruit and Vegetables (Orihuela, Spain) was to **examine the effectiveness of preharvest methyl jasmonate (MeJA) treatments** in reducing sweet cherry cracking during tree ripening and at harvest.



Preharvest foliar treatments of 0.5 mM methyl jasmonate (MeJA) were **applied to 'Prime Giant', 'Early Lory', 'Sweetheart', and 'Staccato' over four growing seasons**. The results revealed that preharvest treatments with MeJA have a significant impact on reducing fruit cracking and improving tolerance to abiotic stress, both during the ripening stage and at harvest.

Furthermore, it has been observed that **these treatments result in a widespread postponement of fruit ripening on the tree among the varieties under investigation**. The observed phenomenon of delayed ripening is evident in various quality indicators such as fruit firmness, external color, total soluble solids content, and total acidity. The treatment with MeJA induced a delay in ripening in comparison to the control fruit.

However, the application of MeJA resulted in a postponement of total polyphenol accumulation, with only a marginal effect observed in terms of mitigating pedicel browning. The MeJA preharvest treatments have been found to contribute to an increased tolerance to cracking and delayed ripening, which could potentially be advantageous for plot management.

Therefore, these preharvest treatments utilising MeJA have the **potential to serve as effective strategies for adapting to climate change** and alleviating abiotic stress in sweet cherry cultivation.

Due to this rationale, it is plausible that MeJA, when administered as a preharvest intervention, may serve as an **effective mechanism for mitigating abiotic stress and retarding the ripening process in fruits while they are still on the tree**. Consequently, this intervention has the potential to improve field management and some quality parameters of harvested fruits.

Source: Ruiz-Aracil MC, Valverde JM, Lorente-Mento JM, Carrión-Antolí A, Castillo S, Martínez-Romero D, Guillén F. Sweet Cherry (*Prunus avium* L.) Cracking during Development on the Tree and at Harvest: The Impact of Methyl Jasmonate on Four Different Growing Seasons. *Agriculture*. 2023; 13(6):1244. *https://doi.org/10.3390/agriculture13061244*

11. FROM THE APENNINES TO THE ANDES: THE WORLDWIDE SUCCESS OF SWEET ARYANA®

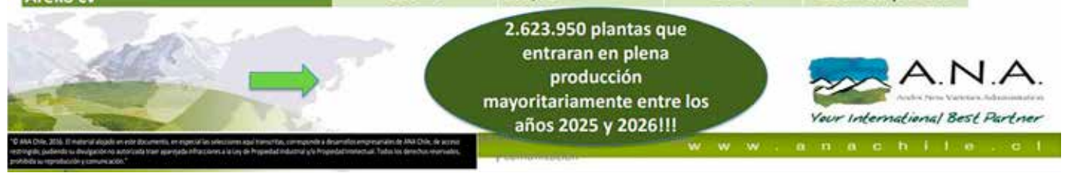
Nemo propheta in patria... Born and bred in Italy on the slopes of the Modenese Apennines (Vignola, Italy) **Sweet Aryana has found one of her earthly paradises on the other side of the Andes**. The Chilean experience is emblematic. There would be many more to tell and just as significant to demonstrate the international appeal of Sweet Aryana and her Sweet sisters.

With 2000 hectares invested and 2 million plants in the nursery (source: Ana) Sweet Aryana is generating strong interest in Chile. The development performance of Sweet Aryana registered in Chile is four times higher than in Italy and Europe.

THE 5 REASONS TO UNDERSTAND THE POPULARITY OF SWEET ARYANA

1. A **new cherry variety is more likely to emerge in developing countries** (e.g. Chile) than in areas where cherry cultivation is lagging behind (e.g. Italy and Europe). This applies to Sweet Aryana and equally to all other new varieties.
2. **The cultivation area can make a fundamental contribution to the development of a new cherry variety**. The results obtained in Chile on the quality of Sweet Aryana are superior to those recorded in Italy and Europe.
3. In spite of its earliness (-7 days Santina) **Sweet Aryana has a rather large harvest window** (up to 10 days and more) due to a very good ripening time of the fruit on the plant. This allows monovarietal plantings on large areas.

Variedad	Hectáreas Asignadas	Hectáreas Reservadas	Año primeras ventas	N° de Plantas Establecidas a Invierno 2022
Frisco cv	400 ha	342 ha	2017	344.745 plantas
Sweet Aryana® PA1UNIBO cv	2000 ha	1853,41 ha	2019	1.254.131 plantas
Sweet Lorenz®PA2UNIBO cv	400 ha	118,73 ha	2019	134.865 plantas
Sweet Gabriel®PA3UNIBO cv	180 ha	37,18 ha	2020	68.474 plantas
Nimba cv	600 ha	558,22 ha	2020	293.015 plantas
Pacific Red cv	600 ha	366,69 ha	2020	284.263 plantas
Polka cv	100 ha	65,9 ha	2020	8.751 plantas
Areko cv	350 ha	269,05	2019	235.706 plantas



1. New cherry varieties in Chile: current and future situation by ANA Chile.

	Acreage (000 ha)		Production (000 t)	
	2000	2020	2000	2020
Europe	188	172	1006	741
Italy	27	29	145	104
Chile	6	49	31	325

2. Cherry surfaces and productions in Europe, Italy and Chile – 2000 / 2022.

	ITALY	CHILE
Calibre - mm	28	28-30
Weight - g	10-12	12-14
Firmness – D25	65	85
Sugar - %	18-20	18-24
Colour - CTIFL	4-5	3-4

3. Fruit quality cv Sweet Aryana cherries in Italy and Chile.

4. Sweet Aryana has a large ripening window

5. Sweet Aryana produces well on both basal side buds and spurs.

	+ 22 days	+29 days	+37 days	+ 51 days
°Brix	23.5	25.0	27.0	25.7
Durofel	94	93	94	92
Acydity	0.72	0.74	0.67	0.69
Pitting	--	5%	--	5%

6. Results on post-harvest of Sweet Aryana. Source: ANA Chile.

4. In addition to fruit quality, **a good variety to be successful must be regularly productive** and **have a good plasticity of adaptation** to different planting systems: both medium-density ones with vigorous rootstocks (e.g. Colt and CAB) and high and very high-density ones made with dwarfing rootstocks (e.g. Gisela). **Sweet Aryana possesses these characteristics** due to its self-fertility, high vigour, expanded and well-branched vegetative habitus and intermediate productive habitus, being able to differentiate well on both lateral branches and darts.
5. A final characteristic that a new variety should have, probably the main one especially if grown in countries that produce cherries for export (e.g. Chile), concerns **post-harvest behaviour**.

From the experimental data released by ANA Chile, **the results obtained by Sweet Aryana are very positive and promising for a further development of the variety**, not only for the domestic markets, as is the case in Europe, but especially for the new world cerasic realities that are aiming at exports with quality out-of-season products.

Stefano Lugli - SL Fruit Service (IT)
Cherry Times technical-scientific committee

12. MULTIFUNCTIONAL COVERS ARE KEY TOOLS FOR CHERRY ORCHARD SUSTAINABILITY

The adoption of multi-functional covers in orchard systems is widely increasing due to their protective function against biotic and abiotic stressors.

In sweet cherry, nets and plastic covers are commonly used against hail, wind and, most of all, rain as one of the most effective tools to prevent cracking. Depending on their different features (mono-block or mono-row, material, color, shading level), multi-functional nets can affect a wide range of environmental, physiological, and productive factors. In fact, netting is known to alter the orchard microclimate in terms of temperature, relative humidity, wind speed and canopy light interception from both qualitative and quantitative points of view.

Multifunctional nets can be characterized by different shading levels. These levels vary depending on thread color, net weave, and material and reduce the amount of **radiation** reaching the orchard. Depending on the color of their material covers can increase diffuse light, thus improving light penetration and distribution within the canopy, with potential benefits on photosynthesis and fruit quality.

The effects on **temperatures** are highly variable and change depending on the material (threads, plastic covers etc). Thanks to their shading effect, covers usually reduce maximum temperatures during the day, even though in some cases an increase in the minimum nocturnal temperature has also been reported.

This effect can make covers a potential effective tool to protect orchards from the more and more frequent late frost occurring at blooming time. On the other hand, under non-shading plastic covers, maximum temperatures can significantly increase during the day as a consequence of the typical greenhouse effect, while decreasing during the night.

Usually, when the level of shading is higher than 30-40%, nets can easily affect **plant water status**. In fact, the lower temperatures recorded under shading covers reduce tree evapotranspiration with consequent benefits on water use efficiency. These results have been reported in apple, citrus and apricot with no negative consequences for fruit quality and yields. Therefore, shading covers can represent a useful tool to mitigate abiotic stresses such as heat waves, increased evapotranspiration requirements and drought, in addition to their "multi-function" against precipitations and pests.

Among the various crops, sweet cherry is one of the species having more benefits from the application of multifunctional covers, due to the many biotic and abiotic factors influencing its production (mainly, fruit "cracking" and Drosophila suzukii).

These premises suggest how dwarfing rootstocks might benefit from the reduced temperature deriving from nets deployment. Recent findings from the University of Bologna show how the effects on the tree physiological and productive performance, deriving from the use of mono-row multi-functional nets, can change depending on rootstock vigor.

In fact, when applied to intensive systems on dwarfing rootstocks, mono-row nets can play positive effects due to i) limited light reductions, thanks to the low canopy density, with no negative effect on stomatal conductance and leaf gas exchanges; ii) possible improvements in plant water status. On the contrary, when applied to systems on vigorous rootstocks, mono-row nets can play negative effects due to the typical high canopy densities of these systems which imply i) a reduction of the PAR radiation within the canopy, with possible decrease in stomatal conductance and thus in leaf carbon assimilation; ii) an increase in the fruit water potential which can lead to a reduction in fruit strength as sink, lower fruit growth rates and fruit quality at harvest.

In conclusion, multifunctional covers can play a wide range of effects on the orchard microclimate and physiological performance, depending on their type and features but also on the orchard characteristics (eg. vigor, density, variety etc.). Despite research is still needed to optimize the type of covers based on the different environments and the orchard features, multifunctional nets are currently one of the most effective and promising tools against biotic and abiotic stressors.

Brunella Morandi - Università di Bologna (IT)
Comitato tecnico-scientifico di Cherry Times

13. WITH BIODYNAMIC APOFRUIT HITS THE FORMULA BETWEEN TASTE AND SUSTAINABILITY

The Biodynamic segment is still a niche reality in Italy, even more so in the cherry sector. However, this type of approach to cultivation produces interesting results even for a delicate fruit like the cherry, as demonstrated by the project of the Simonetta farm in Lizzano di Cesena (IT).

The owner Enzo Trapani and his wife Simonetta have developed, together with Apofruit and Almaverde Bio, a cherry orchard entirely dedicated to biodynamic production, which covers 12 hectares and yields more than 50 tonnes per year.

"Our company is located in Cesena, with 17 hectares of cultivated land. Of these, 12 are dedicated entirely to cherry production, with production based entirely on the biodynamic approach. Obviously there were several evaluations and considerations when setting up the plant, first and foremost the need for water, which we were able to bring here to this area for irrigation years ago'.

"Added to this are all the critical issues and differences that concern Biodynamics in the strict sense, such as fertilisation and phytosanitary aspects".

Image 1 - Enzo e Simonetta Trapani.

What choices have been made at the varietal level and what impact have these choices had on a Biodynamic approach?

"As far as the variety question is concerned, we have relied entirely on Sweet varieties. From Sweet Aryana, to Sweet Lorenz or Saretta, these are all varieties that lend themselves very well to this type of cultivation. Last year we evaluated an investment of 1400 plants of Sweet Dave, which was repeated this year with 800 plants of the same variety".

"From a biodynamic point of view, I cannot say that these are the only varieties suitable for the type of cultivation, but it was not strictly an agronomic decision. It is really a decision related to the fruit. We are talking about a high grade, valuable and sought-after product: high calibre, crisp flesh, with excellent properties not only from an organoleptic point of view but also aesthetically'.

What type of planting system is used?

"All varieties are grafted onto dwarfing Gisela 6 rootstocks, with a density of 1,250 trees per hectare. To ensure a good harvest we of course use rain covers, single-row, to which we have also added insect-proof covers that enclose the plants all the way down to the ground once opened. This measure is also necessary to overcome the all common problem: Drosophila suzukii: without total enclosure very little can be done".

Speaking of yield, what is the output of such a planting system?

"We start from the assumption that, compared to a standard segment, with biodynamic we cannot expect a similar amount of production. However, there is a lot of satisfaction, also in terms of numbers. Last year, for example, the harvest forecast was over 50 tonnes. Unfortunately due to

some complications, especially the non-uniformity of the harvest, we were just over 30 tonnes'.

"This year, unfortunately, due to poor weather conditions we did not get more than 12 tonnes of harvest. The rain really ruined a season with great potential. Without the covers, we wouldn't have even got our hands on the plants".

What critical issues have been addressed and what are expected in the future?

"I think it is well known by now that the biodynamic approach places a high importance on the soil rather than on the phytosanitary aspect. The aim is not to use any chemicals, but to base all work on completely natural products. For example, we only use natural products for fertilising, such as cow manure or leaf fertilisers, mainly nettle fertiliser. Nettle is also used as an anti-aphid".

"This of course makes it possible to cultivate according to a sustainable and environmentally friendly process, but on the other hand it also entails certain disadvantages towards the problems of modern cultivation. As far as we are concerned, however, even at the varietal level we have not encountered any major problems. The only note, perhaps, may be a higher percentage of cracking due to the crispness of the Sweet varieties,' he says.

"Again, I believe that another big modern problem, that of labour, can be totally avoided thanks to the new dwarfing rootstocks. Since we don't have very large plants, we don't even need to use special equipment. We harvest everything from the ground. This contributes to two very important factors: firstly, it attracts more people during the harvesting period, but above all, it is not even necessary to employ workers with special types of experience because you don't need to use ladders or special equipment to harvest in these conditions.

"On the other hand, the terrain and soils in these areas are also clay and sandy, so a possible problem could arise due to the flexibility of the fertilisers that can be used. But even then, we work very well on heap and fertiliser. Preparation starts already in October, fertilisation in the spring period. Having early and medium-early varieties, we have to be ready to harvest as early as the beginning of May. This year, we finished on June the 8th".

"Contrary to what one might think, however, the satisfaction we get from production like this is priceless. We harvest a unique product. In Italy, if I'm not mistaken, there are a total of 30 hectares of biodynamic cherry orchards and we represent 12 of these hectares."

"We are very happy to bring a truly admirable product to the table, both in terms of taste and aesthetic qualities, also supported by the total lack of plant protection products: we are talking about a healthy and at the same time sustainable product, a prerogative that we feel is really important nowadays".

14. MAJOR CHERRY TREE DISEASES AND THEIR SUSTAINABLE MANAGEMENT

The cherry trees are stone fruit whose fruits are known for their many health benefits. **The nutritive value of the fruits is directly related to their quality**, which can be compromised by numerous adversities both in the field and post-harvest. Various fungi and bacteria can cause disease on cherry trees.

Fungal diseases of particular importance include cylindersporiosis, corynaeum, brown rot, and root rots from Armillaria mellea and Rosellinia nectrix, while bacterial diseases include bacterial canker and bacterial root and collar canker.

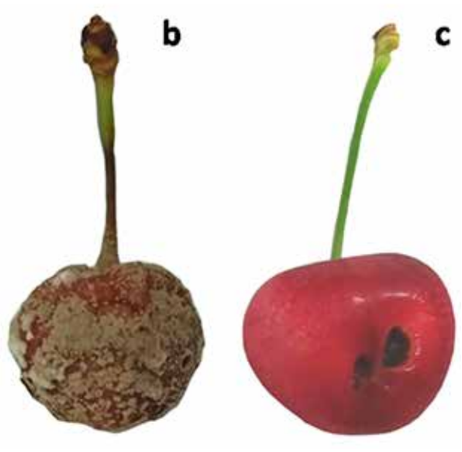
Cylindrosporiosis, caused by Blumeriella jaapii (an. Cylindrosporium padi), is one of the most damaging diseases for cherry trees because of the damage caused on the leaves, and if not effectively controlled, it leads to premature phylloptosis causing the plant›s photosynthetic capacity to be reduced (Figure 1a).

Coryneal, caused by Stigmina carpophila (syn. Coryneum beijerinckii), is another disease that typically affects leaves, where reddish-brownish indentations are observed sometimes surrounded by a yellowish halo a few millimeters in diameter that over time necrotize and fall off originating the classic symptom of balling.

Another important fungal disease of cherry is brown rot. Caused by several species of the genus Monilinia, and in particular Monilinia laxa and Monilinia fructicola, the disease owes its name to the brownish efflorescence that develops on the surface of infected fruit as a result of the evasion of these mycetes accompanied by the production of asexual spores (Figure 1b).

In addition to fruit, these pathogens can attack the cherry tree as early as flowering compromising much of the production and young branches on which the formation of cankers often accompanied by the presence of gummy exudates is observed. **Armillaria mellea and Dematophora (an. Rosellinia) necatrix are the main agents of root rot on cherry trees.**

At the level of the collar and roots, whitish mycelium can often be observed, and internally, the wood shows obvious necrotic areas and a breakdown of the cortical zone. **Symptoms observed on the crown of infected plants are nonspecific**, poor vegetative growth, chlorosis and necrosis of leaves followed by phylloptosis.



Similar symptoms are caused by Agrobarterium tumefaciens, an agent of bacterial tumor of the collar and roots, which is characterized by the presence of tumor outgrowths on said organs that allow identification of the pathogen. Two bacterial species belonging to the Pseudomonas syringae species complex, such as P. syringae pv. morsprunorum and P. syringae pv. syringae are the main causative agents of bacterial cancer on cherry trees.

In addition to the presence of cankers on young branches and buds, these species can cause symptoms on leaves and fruits that consist of slightly sunken necrotic indentations surrounded by a chlorotic halo (Figure 1c).

On a profitable crop such as cherry, whose harvest is concentrated in a fairly short period of time, **protection from these diseases requires adequate knowledge of the biology of the causal agents as well as the available means of protection that must be applied considering the sustainability of cherry production**. Removal and burning of infected material (e.g., mummified fruit, branches with cankers) are useful practices to limit potential sources of inoculum for infections in the following year mainly from brown rot and bacterial canker.

Appropriate management of vegetative vigor with green pruning, which promotes the entry of light and air circulation helps to contain coryneous and cylindersporiosis. **The use of healthy propagation material is essential to avoid problems from root rot and bacterial blight from the early years after planting**, which once present in the cherry orchard can only be slowed down by timely removal of infected plants. However, for root rot, cylindersporiosis, brown rot and bacterial cancer, it is possible to choose less susceptible rootstocks or varieties.

Protection by chemical means, to be implemented in full synergy with available agronomic practices, involves applications with cupric compounds (considering the maximum limits provided by the reference regulations) and synthetic fungicides (e.g., dodine and captan) at the leaf fall stage and at vegetative resumption toward coryneus, cylindersporiosis and bacterial canker.

Also important is the protection of first the inflorescences and then the fruits from brown rot through the use of available fungicides (captan, fludioxonil+cyprodinil, boscalid+pyraclostrobin, and triazoles), which can be minimized by the use of microbial antagonists such as Bacillus amyloliquefaciens sbsp. plantarum D747, B. subtilis QST 713, and Metschnikowia fructicola NRRL Y-27328.

Donato Gerin - Università di Bari (IT)
Cherry Times technical-scientific committee

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15. THE HEALTH OF PROPAGATION MATERIALS STARTS WITH THE BREEDERS

Some considerations on how to better qualify varietal innovation through breeding certification programs for a new sustainable and competitive cherry crop.

Always considered a minor species among stone fruits, cherry cultivation has been undergoing a major technical revolution in recent years involving canopy management and breeding systems with a wide range of new rootstocks and varieties proposed.

Higher planting densities, 2D hedge training systems, plant cover, weak rootstocks and a range of new varieties covering an 8-week harvest calendar characterize innovation in cherry cultivation.

The nursery industry has not been unprepared to meet this challenge. There are now specialized nurseries offering a wide range of rootstocks and holding propagation rights to the new varieties, all of which are protected by plant breeding rights.

Among the stone fruit species regulated by EU legislation on the multiplication, marketing and certification of nursery production, the cherry tree is the one that guarantees the absence of the greatest number of harmful organisms: 22 viruses, 2 phytoplasmas, 4 bacteria, 4 fungi, as well as nematodes and insects.

For nurseries that want to qualify their production more by joining the voluntary genetic-health certification scheme, the availability of starting propagation materials (Pre-basics) of new varieties, which meet the required phytosanitary requirements, is reduced.

Many nurseries, after purchasing the concession for a protected variety, initiate the procedures for its inclusion in the voluntary certification scheme.

Increasingly, the diagnostic techniques used to constitute the primary sources of new varieties to be enrolled in the certification scheme, whether woody indexing or more advanced and sensitive biomolecular techniques (PCR, RT-PCR, HTS - High-troughput sequencing, etc.), show the presence of viral entities - not only those provided for in the technical standards - already in the original materials received from the breeder or publisher in charge of managing the protected variety.

In some cases, harmful organisms-whose danger to the crop is yet to be ascertained and demonstrated-regulated organisms are also present, of which the nurseryman must guarantee the absence in the plants sold to fruit growers, assuming full responsibility.

It should be remembered that EU regulations also require breeders to produce new genotypes, which then become varieties, free of regulated pests. Therefore, greater consideration of phytosanitary aspects is needed right from the selection of parents for crosses and in the subsequent selection stages.

Before filling out the list of harmful organisms, it would be the case that these r

CHERRY TREE – HARMFUL ORGANISMS RECOGNIZED BY VOLUNTARY CERTIFICATION SCHEME QVI – QUALITY NURSERY ITALY

HARMFUL ORGANISM/PATHOLOGY	SIGAL	CODICE EPPO
VIRUS		
American plum line pattern virus	APLPV	APLPV0
Peach mosaic virus	PcMV	PCMV00
Little cherry virus 1	LChV1	LCHV10
Little cherry virus 2	LChV2	LCHV20
Tomato ringspot virus	ToRSV	TORSV0
Cherry rasp leaf virus	CRLV	CRLV00
Plum pox virus	PPV	PPV000
Prune dwarf virus	PDV	PDV000
Prunus necrotic ringspot virus	PNRSV	PNRSV0
Apple mosaic virus	ApMV	APMV00
Apple chlorotic leaf spot virus	ACLSV	ACLSV0
Cherry leaf roll virus	CLRV	CLRV00
Cherry necrotic rusty mottle virus	CNRMV	CRNRM0
Cherry mottle leaf virus	CMLV	CMLV00
Arabis mosaic virus	ArMV	ARMV00
Raspberry ringspot virus	RpRSV	RPRSV0
Strawberry latent ringspot virus	SLRSV	SLRSV0
Tomato black ring virus	TBRV	TBRV00
Cherry green ring mottle virus	CGRMV	CGRMV0
Cherry twisted leaf associated virus	CTLaV	CTLAV0
Plum bark necrosis stem pitting-associated virus	PBNSPaV	PBNSPaV
PHYTOPLASMA		
'Ca. Phytoplasma prunorum'		PHYPPR
'Ca. Phytoplasma pruni'		PHYPPN
BACTERIA		
Xanthomonas arboricola pv. pruni		XANTPR
Xylella fastidiosa		XYLEFA
Agrobacterium tumefaciens		AGRBTU
Pseudomonas syringae pv. morsprunorum		PSDMMP
NEMATODES		
Pratylenchus vulnus		PRATVU
Pratylenchus penetrans		PRATPE
Meloidogyne javanica		MELGJA
Meloidogyne arenaria		MELGAR
Meloidogyne incognita		MELGIN
Xiphinema rivesi		XIPHRI
Meloidogyne hapla		MELGHA
FUNGI		
Phytophthora cactorum		PHYTCC
Rosellinia necatrix		ROSLNE
Chondrostereum purpureum		STERPU
Armillariella mellea		ARMIME
INSECT & MITES		
Quadraspidiotus perniciosus		QUADPE

Luigi Catalano - Agrimeca / Civi Italia (IT)
Cherry Times Scientific and Technical Committee

16. CRACKING: WHEN IT RAINS, IT POURS

Rain cracking is a serious physiopathy found in many fruits, such as citrus fruits, apples, pomegranates, plums, table grapes and, above all, cherries. Cracking is the cause of enormous economic damage, both direct and indirect, and is destined to become an increasingly significant problem due to ongoing climate changes: increasingly intense rainfall events concentrated near the final stages of development and ripening of the drupes, as happened recently in the Vignola cherry production area, but not only, with more than 100 mm of rain falling in just two days just a few days before the start of the first harvests.

GENESIS OF CRACKING

From a physiological point of view, cracking is described as a series of chain reactions that lead to the rupture of the fruit's epidermis cells. Initially, it results from localised water absorption at the epidermal level, which causes the rupture of individual cuticle cells (microcracking).

These cell lesions cause a release of malic acid into the intracellular spaces, a swelling and weakening of the epidermis and underlying hypodermal cells. This generates the evident cracks on the fruit (macrocracking). Absorption of water by the fruit basically occurs in two ways: by osmosis through the cuticle and through the vascular system of the plant by absorption of water from the roots.

PREDISPOSING FACTORS

Atmospheric variables occupy the first place among the causes responsible for this phenomenon: rainfall and high air humidity increase fruit cracking; high temperatures also play a decisive role in that they increase transpirative processes and the absorption of water by the roots, water that then reaches the foliage and fruit; soil humidity and water availability also play a decisive role in the genesis and harmfulness of cracking.

Figura 1. Cracking su ciliegio

Other concauses may indirectly derive from **agronomic practices** aimed at obtaining a larger fruit size: for example, reducing fruit load with short pruning or fruit thinning, excessive inputs of fertilisers or growth regulators, or the use of vigorous versus dwarfing rootstocks, etc.

The **genetic component** also plays a not insignificant role. It is well known that larger fruits with firmer flesh are more susceptible to cracking, as are those with a high sugar content. Unfortunately, or fortunately, depending on one›s point of view, the new cherry varieties have been selected to meet the demands of the market and consumers, who want them beautiful, large and tasty.

At the varietal level, resistance to cracking is related to the conformation and elasticity of the fruit epidermis, as well as the duration of the initial stages of fruit development and the final stages of drupe ripening. There is evidence that varieties with a higher tolerance to cracking are those with a longer cell division period (phase 1). In fact, the protective cuticle of the fruit stops growing in the phase prior to veraison, while the pulp continues to increase its volume in the final stages of ripening.

It is no coincidence that **treatments with calcium or silicon salts**, which strengthen the membranes, are recommended precisely in the early stages of fruit development.

At the same time, there is evidence that **early-ripening varieties**, with a peridium development time between flowering and ripening of only 35 to 40 days, are considerably more susceptible to cracking than later-ripening varieties, which have a much lower growth rate (mm/day) and are better able to cope with the increases in volume and internal pressure that the fruit undergoes as a result of direct and indirect absorption of water from rainfall.

CONTROL STRATEGIES

Along with **preventive treatments** based on mineral salts, phytoregulators, biostimulants, antiperspirants and so on, the most effective means of controlling splitting remains rain covers. These structures prevent rainwater from coming into contact with the plant and the fruit. They do not prevent, in some cases instead they accentuate, the absorption of water by the roots, which then reaches the fruit.

For these and other reasons, it can happen, as happened this year albeit under exceptional conditions, that **even undercover cherries suffer severe cracking**. There could be several reasons for this and they are all related to the factors predisposing cracking.

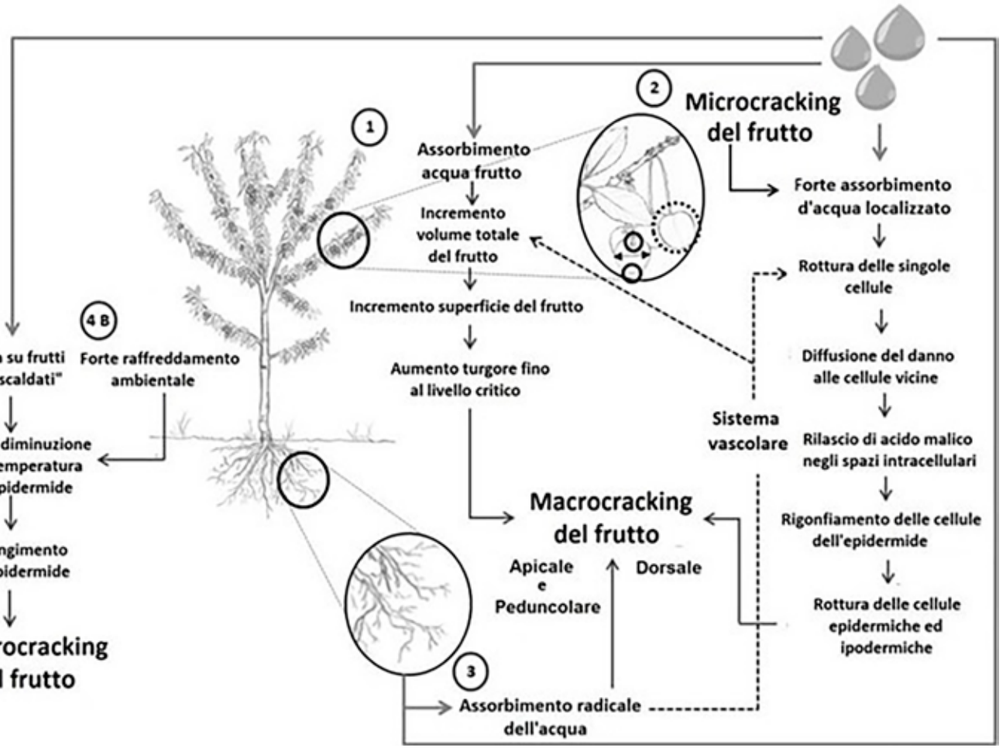

Fig. 2. Schematisation of the genesis of cherry fruit cracking following rainfall. Source: Correia et al., 2019.

Image 3. Cracking damage recorded on some cherry varieties in the Vignola area in plants equipped with rain covers. Cracking percentages vary according to variety from a minimum of 30% to a maximum of 70%. Photo by S. Lugli, 09 May 2023.

Fig. 4 – Burlat row with Solution system rain cover. This year Burlat, together with Sweet Early, were the early varieties with the least cracking, even under cover. Photo by S. Lugli, 09 May 2023.

For example, **higher under-cover temperatures may have accentuated the transpiration** of the tree and thus the absorption of water towards the fruit; a dry leaf certainly transpires more than a wet leaf of a tree in natural conditions without an umbrella; the higher relative humidity of the air in covered systems compared to uncovered systems may have facilitated the formation of micro-wounds which then evolved into macro-cracking; single-row systems involving all rainwater towards the root systems are certainly more risky for cracking than single-row or canopy systems.

Despite the many integrated management strategies implemented at various levels, **the problem of cracking remains far from being completely solved**. Further research is needed to learn both the root causes of cracking as well as new approaches in strategies to try to mitigate its damage.

The genetic route, through the study of molecular markers associated with cracking tolerance, remains perhaps the only way out in order to finally obtain cherry varieties resistant to rain cracking.

Stefano Lugli – SL Fruit Service
Cherry Times – Chair of technical-scientific committee

Figure 5a and 5b. Early Bigi row under Tramprain system canopy cover (5a) and Nimba row under Keep in Touch system cover. In both cases the cracking percentage exceeded 40%. Photo by S. Lugli, 09 May 2023.

17. THE IMPACT OF DEFICIT IRRIGATION ON CHERRIES GROWTH

Cherry cultivation is recently expanding in many European regions, including several Mediterranean regions where water availability is limited and water demands from evapotranspiration are rising due to climate change. **However, specific information on the optimal irrigation supply for this crop is lacking**, and cherry growers lack rational approaches to manage preharvest and postharvest irrigation.

Previous studies discovered that a postharvest reduction in water supply of about 50 percent is a promising strategy to reduce cherry water use, with no effects on the following year's production. **These findings suggest how reduced deficit irrigation protocols can be successfully applied in this species**. It is well-known that water supply during the fruit-growing season is directly correlated with fruit growth and yield, thereby allowing fruit to reach the appropriate size at harvest. Conversely, excessive preharvest water supplies may negatively impact the fruit storabilty.

However, it must be remembered that excessive irrigation can facilitate the occurrence of cracking. The work we present today analyzes the **effects of reduced irrigation supply on tree water status, foliar gas exchange and fruit vascular flows in two cultivars** with different susceptibility to cracking, providing insights into the potential application of deficit irrigation strategies in cherry.

The irrigation regimes applied to ‹Black Star› and ‹Vera› were: commercial control and 30% reduced irrigation. In both cultivars, pre-veraison

fruit growth was characterised by high xylem and transpiration flows, with phloem contributing approximately 20% of the total daily inflows. At this stage, reduced water supply had no effect on any of the monitored parameters, with the exception of stem water potential, which was reduced in 'Black Star' trees but not in 'Vera' trees.

At veraison, trees of both cultivars showed an increase in daily fruit growth rates and phloem contribution, reaching up to 80% of fruit total inflows. However, 'Vera' had 40% greater fruit phloem inflows and daily growth rates than 'Black Star. Also, at this stage, trees of both cultivars responded differently to decreased irrigation: 'Black Star' trees exhibited decreased stem water potentials but no difference in fruit vascular flows and fruit growth, whereas 'Vera' trees maintained similar physiological performances but fruit phloem inflow and growth rates decreased.

This study suggests that **in sweet cherry, cultivar and phenological stages characterised by high fruit growth rates may create the conditions for an increased susceptibility to water deficiency** due to the high requirements for water and carbon resources to sustain fruit growth. In contrast, phenological stages characterised by low fruit growth, such as pit hardening, or with no fruit postharvest may be suitable for implementing deficit irrigation within the context of deficit irrigation strategies.

In addition, **results indicate that the susceptibility of 'Vera' cherries to cracking is likely related to their higher fruit growth rates at veraison**. At this stage, fruit growth is primarily sustained by water and carbon imported via phloem, indicating a possible relationship between phloem inflow and cracking.

18. EXPERIMENTATION ON NEW CHERRY PLANTING SYSTEMS AT FEM

Experimentation at the Mach Foundation's holdings on cherry orchards began in 2010 with the first plot planted at Maso delle Part thanks to the collaboration with Nicola Dallabetta. In 2010, the idea was to do a more intensive planting compared to the spacing commonly used in those years, when the spacing used was 4 x 2.

Based on the work carried out on the biaxis for apple trees, this form of training was tested and, thanks to contacts with American researchers, a wall form, called UFO, was added, similar in some respects to the guyot form also proposed for apple trees, a system that is relatively widespread in Chile and the United States. **To evaluate the response, Gisela 5, and a somewhat more vigorous rootstock, Piku 1, were tested**.

Interesting indications emerged from this first experimental plot, in particular on pruning management in the first few years, and experimentation was therefore continued with new forms of training, planting an experimental plot on the Vigalzano di Pergine farm in 2013, with **two varieties, Kordia and Regina, grown with four different forms of training**, at the distances deemed suitable, according to this chart:

Plants were set up according to the chosen breeding form, as opposed to the traditional spindle, starting from one-year old rods, except for the biaxis form, for which pre-formed biaxis plants found on the market were used.

Over the years, **the main vegetative-productive data were collected from the plants**, three fruit samples were weighed for each test plant and the quality characteristics of one fruit sample per randomised block were analysed.

Kordia / columnar axis.

Analysis of the data collected revealed some **interesting indications** for vegetative and productive aspects.

For both varieties, the final growth of the trunk section was the smallest for the superspindle bred plants, due to the greater competition between the plants that are bred at a smaller distance, followed by the spindle and KGB forms. The largest trunk section was measured on the biaxis, which is the sum of the section of the two axes measured individually.

As far as production aspects are concerned, **the results of production per unit area are reported,** as for this test it is considered a more suitable parameter to represent the result of the combination of planting shape and density.

Until 2022, **the most productive forms of farming for Kordia were biaxis and superspindle**, with 138 and 125 tonnes/ha respectively over nine years of production, compared to 91 for spindle and 83 for KGB.

BREEDING FORM	SPINDLE	SUPERSPINDLE	BIBAUM	KGB/VASO	VARIETY	ROOTSTOCK
DISTANCE	1,4 m x 3,7 m	0,7 m x 3,7 m	1,4 m x 3,7 m	1,4 m x 3,7 m	KORDIA	GISELA 5
PLANTS/HA (9000M2)	1750 plants	3500 plants	1750 plants	1750 plants	REGINA	GISELA 5

Kordia / KGB pot.

Regina / Bibaum.

For Regina, the most productive breeding form was biase with 159 ton/ha, not statistically different from superspindle with 150 ton/ha. Slightly lower was spindle with 134 ton/ha, followed by KGB with 105 ton/ha.

With regard to fruit size, no drop in size was observed in the most productive forms, with Kordia's weight fluctuating between 12.3 and 12.9 g/fruit on average, while Regina's weight fluctuated between 11.1 and 11.9 grams.

The average grading performed at the delivery co-operative also did not result in major differences with 28+ fruit percentages averaging between 55% spindle and 62% biaxis for Kordia. **For Regina, somewhat wider differences in sizing were observed, ranging from 30% obtained with spindle to 42% with biase and KGB**.

From an internal fruit quality perspective, the differences observed were greater between the different seasons, although the **level of soluble solids (sugars) tended to be slightly higher for Regina**.

Tommaso Pantezzi - E. Mach Foundation (IT)
Cherry Times - Technical-scientific committee

Regina / Spindle.

Kordia / Spindle.

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Areko (PBR)

Regina

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19. SWEET CHERRY BREEDING: DIFFICULT BUT EXCITING CHALLENGES AHEAD

Sweet cherry breeding is nowadays a very active field, both in public institutions or in private companies. **In the last decades, a large number of new cultivars have been released**, despite the fact that worldwide sweet cherry cultivated area and production are significantly lower as compared to other major fruit species.

The implementation of new breeding programs was fueled by the advent of **modern and intensive sweet cherry orchards**, which required cultivars adapted to new training systems but also that could meet high-standard consumer requirements. For instance, the export sector of sweet cherry has tremendously progressed, both between countries from the same regions or from Southern to Northern hemisphere countries at counter-season.

In this respect, the case of **Chile is paradigmatic**, since it has become in less than 20 years the third largest sweet cherry producing country, behind Turkey and the USA, with over 90% of its production being shipped to distant Asian markets.

Breeding objectives will obviously be different depending on the targeted sweet cherry production area. Nevertheless, several criteria are mandatory for all breeders: **fruit productivity, fruit size and firmness, as well as tolerance to major abiotic and biotic stresses**. However, the complexification of sweet cherry cultivation, with the utilization of dwarfing rootstocks, higher planting densities and protective structures against rain or insects (such as *Drosophila suzukii*), have significantly increased growers' costs.

Hence, **new cultivars require specific attributes for rapid return on investment**. Two of the most critical features are precocity and regularity of production and one of the solutions offered to growers was the adoption of highly cropping self-fertile cultivars.

The second aspect that is increasingly considered by breeders is the **adaptation to climate change**. Indeed, sweet cherry is particularly vulnerable to global warming and there is an urgent need to create new cultivars with low chilling requirements for flowering but with relatively high heat requirements for spring budbreak, so that flowering does not occur too early, thus reducing the risk of frost damage.

It is also crucial to develop cultivars that can **cope with extremely high temperatures** since these can have deleterious consequences during the growing season, such as the sunburn of fruits and branches or during the following season, such as the formation of abnormal flowers and/or double pistils/fruits. Extreme and erratic rain events during harvest may lead to massive cracking of fruit, even under protective structures, and for this reason the search for fruit cracking tolerance remains a major breeding goal.

Finally, traits related to **tolerance or resistance to biotic stresses** will progressively become high-priority due to the increasing consumer demand for healthy and environment-friendly fruit. For this reason, breeding programs develop innovative approaches to target diseases such as bacterial canker, brown rot (monilia) or leaf spot, or pests such as black aphids. Besides traditional quality attributes such as taste (based on a good sugar/acid balance) and crunchiness, a new promising area of development for sweet cherry breeders is the search for health-related compounds.

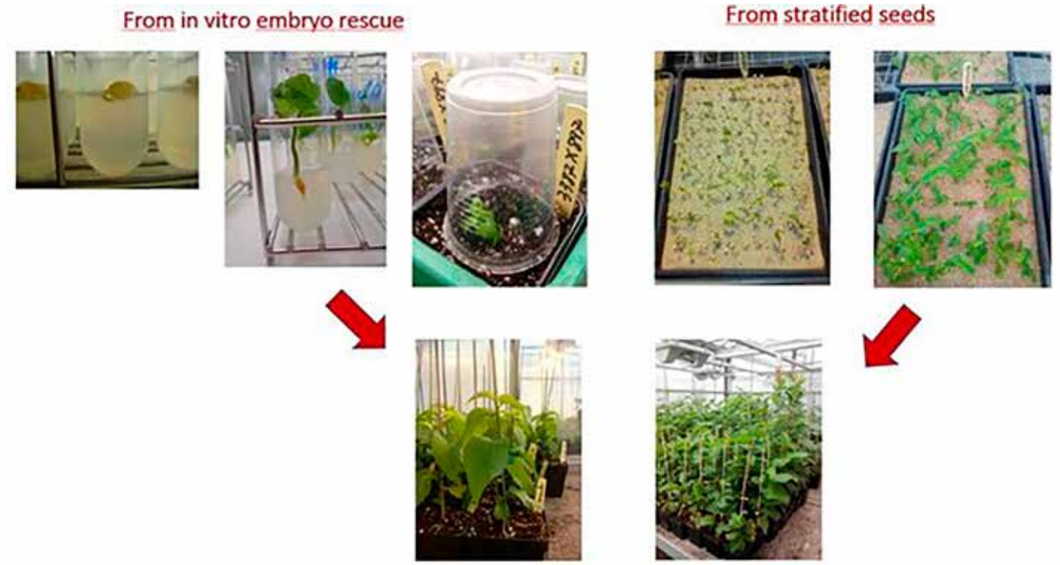

Fig. 1 - Germination and plantlet growth of sweet cherry hybrids

Fig. 2 - Sweet cherry hybrids 'on field' evaluation

Given the need to work simultaneously with such a large range of traits, sweet cherry breeders must optimize their operational procedures since the traditional period required between the cross of two parental lines and **the release of a new hybrid often exceeds twenty years**. One of the most promising approaches to accelerate the global breeding process is to use the information contained in each living cell, that is, the DNA.

Indeed, important research efforts have recently allowed the **discovery of many regions of the genome that control the traits of interest in sweet cherry**, such as fruit weight and firmness, bloom and maturity dates, tolerance to rain-induced fruit cracking, and so on. Breeders can use this information to better plan their crosses by selecting the parents that harbor the most favorable alleles and by selecting the best hybrids at the plantlet stage, during their first year of growth within the greenhouse. These methodologies are currently being deployed by several public institutions in Europe and North America but private programs are increasingly showing interest as well.

In summary, **sweet cherry breeders will face difficult but exciting challenges during the coming years** and multilateral cooperation between them and with scientists from University and research centers appears as crucial.

Main sweet cherry breeding programs (from Cherry book, 2017)

Country	Institution	Start date	Nb of cultivars
Bulgaria	FGI-Kyustendil	1951	10
Bulgaria	FGI-Plovdiv	1987	4
Canada	Agriculture and Agri-Food Canada (Summerland)	1936	35
Chile	Politécnica Universidad Católica de Valparaiso (PUCV)	2007	-
Chile	INIA-Biofrutales	2010	-
Chile	Consorcio Tecnológico de la Fruita and Pontificia Universidad Católica de Chile (PUC)	2010	-
China	Institute of Pomology, Dalian Academy of Agricultural Sciences (DAAS)	1963	8
China	Zhengzhou Fruit Research Institue, Chinese Academy of Agricultural Sciencees (CAAS)	1980	5
China	Institute of Pomology and Forestry, Beijing Academy of Agriculture and Forestry Science (BAAFS)	1997	5
Czech Republic	Research and Breeding Institute of Pomology Holovousy Ltd (RBIPH)	1960	25
France	INRA-CEP Innovation	1978	16
Germany	Obsbauversuchsanstalt Jork (OVA)	1953-1980	8
Germany	Julius Kühn-Institut (Dresden)	1958	8
Hungary	NARIC Fruitculture Research Institute (FRI)	1950	20
Italy	Bologna University, Department of Agricultural Sciences	1983	14
Japan	Horticultural Experiment Station, Yamagata Integrated Agricultural Research Center	1957	5
Romania	Research Station for Fruit Growing (Bristita and Iasi) and Research Institute for Fruit Growing (Pitesti)	1951	51
Spain	Centro de Investigaciones Científicas y Tecnológicas de Extremadura (CICYTEX-La Orden)	2006	-
Spain	Murcia Institute of Agri-Food Research and Development (IMIDA)	2006	-
Turkey	Atatürk Horticultural Central Research Institute	2001	2
United Kingdom	John Innes Center and East Malling Research	1920	25
Ukraine	Institute of Horticulture of National Academy of Agrarian Sciences of Ukraine (IH NAAS)	1928	23
United States	Washington State University (WSU)	1950	11
United States	Cornell University	1900	18
		TOTAL	293

Country	Main cultivars
Bulgaria	Danelia, Stefania
Bulgaria	Kossara, Rosalina
Canada	Lapins, Sandra Rose, Santina, Skeena, SPC103 (Sentennial), 13S2101 (Sovereign), SPC 136 (Suite Note), 13S2009S (Staccato), Stella, Sumele (Satin), Sumgita (Canada Giant), Summit, Sumnue (Cristalina), Sumpaca (Celeste), Sumste (Samba), Sumtare (Sweetheart), Sunburst, Sylvia (4 C-17-31), Van
China	Hongdeng, Jiahong, Wanhongzhu
China	Chunxiu, Longguan
China	Xiangquan 1
Czech Republic	Early Korvik, Kordia, Tamara, Techlovan, Vanda
France	Folfer, Ferdouce, Fertille, Fermina, Ferdiva, Fertard
Germany	Oktavia, Regina
Germany	Areko, Narana, Namare, Namati, Naprumi
Hungary	Axel, Carmen, Katalin, Linda, Paulus, Rita, Sandor, Vera
Italy	Black Star, Grace Star, PA1UNIBO (Sweet Aryana), PA2UNIBO (Sweet Lorenz), PA3UNIBO (Sweet Gabriel)
Japan	Benisayaka, Benishuhou
Romania	Rubin, Alex, Andrei, Ludovic, Maria, Severin
United Kingdom	Merchant, Summer Sun, Penny
Ukraine	Krupnoplidna, Melitopolska Chorna, Valerij Chkalov
United States	Benton, Chelan, Rainier, PC 7144.6 (Tieton)
United States	Ulster

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José Quero Garcia - INRA (F)
Cherry Times technical-scientific committee

CULTIVATING SUCCESS: INSIGHTS FROM SPINELLI NURSERY, THE ITALIAN FRUIT TREE SPECIALIST

You are a nursery specialising in the production of fruit trees. In the cherry tree you have invested a lot in recent years, both in updating the variety offer and in the choice of rootstocks other than Megaleppo. Which cultivar/ rootstock proposals have you invested in?

Since we are a nursery company that was historically born in a southern environment, such as that of Apulia, we started with historical varieties and rootstocks rooted in this territory. Over the years we have had an expansion of customers, from the north to the south of Italy. Precisely for this reason we had to readjust our offer, proposing a product dedicated to the needs and characteristics of different customers and territories.

As far as rootstocks are concerned, if we are talking about traditional planting patterns, we have focused on Prunus Mahaleb 'Magaleppo'. If, on the other hand, we must ensure more intensive systems, we have favoured dwarfing rootstocks such as Colt and Gisela 6. On our side, we are also working and counting on partnerships with other nurseries to propose new rootstocks that can favour high intensity.

We as Spinelli Nursery company have followed the Sweet series and the idea of innovation undertaken by the University of Bologna from the very beginning. We feel we can say that it is a winning project and is destined to remain so, and we could mention all the varieties because they fully meet the market standards. Not to mention that these are varieties with high productivity. For other contexts, however, we could mention Royal Tioga for southern territories, favoured by the earliness of the markets. If we then focus on the late varieties, we can talk about Regina and Kordia.

The Ferrovia cultivar, undoubtedly among the best and tastiest on the market, is still highly sought after. Today, however, we need a cherry that is good but attractive due to the large calibre that cannot be guaranteed with Ferrovia.

New areas of cherry production are moving from traditional areas (e.g., Italy, Spain) to new areas (e.g., Uzbekistan, Azerbaijan etc.). How important do you think it is to think in a global context?

As far as we are concerned, we operate to a large extent, around 85-90%, on the Italian market. The slice of the foreign market that we cover is often linked to programming and specific requests. We strive to produce dedicated plants for specific areas. Remembering how outside the European context we must cope with the directives related to breeder's rights, thus making our product clearly more attractive for the Italian and EU market.

The production costs of nursery plants in Italy are rather high. Many nursery companies (e.g. in Greece or Turkey) manage to produce at lower costs. Very often also illegally, by offering patent-protected varieties and rootstocks without any licence to do so. How could this piracy be curbed?

We must try to engage in a more general discourse, starting with all nurserymen in the sector. We nurseries that produce large volumes should work to discourage this kind of unfairness, which often comes from foreign countries, not just Italy. However, if we invest time and resources, we must be aware, and above all coordinated with other figures in the sector, such as breeders. By working in this way, I believe it is possible to discourage this phenomenon.

Genetic and health guarantees are essential to offer the fruit grower a high-quality product with full traceability. In Italy, with the QVI certification mark, we are leaders in Europe. Does your nursery adhere to this project?

Our company adheres to the QVI. In Apulia we are still part of COVIP, the Apulian nursery consortium. We must also say, however, that doing voluntary certification today compared to years ago has a cost. And this cost is not always passed on to the producer.

We are therefore talking about a fixed cost that we as individual companies must spread over the work we do daily. We strive to produce plants that are within these standards. Having varieties at our disposal, working with breeders, we start from a source that is always certain, it is a must for us.

20. AN ITALY-WIDE ANALYSIS OF THE COSTS AND PROBLEMS OF MODERN CERASICULTURE

As is well known, Italian cherry cultivation is undergoing a phase of profound evolution, although to date limited mainly to northern areas. Once based on densities of a few hundred plants per hectare, **today cherry cultivation involves densities of up to a few thousand plants/ha**.

Intensification tends to result in earlier entry into production and improved fruit quality, but this is counterbalanced by **higher planting costs and a shorter productive life of the plants**.

Another aspect of **absolute importance in modern cerasiculture is that of cover crops**, due to the now well known unpredictability of the climate and the spread of Drosophila suzukii, whose control is difficult and costly.

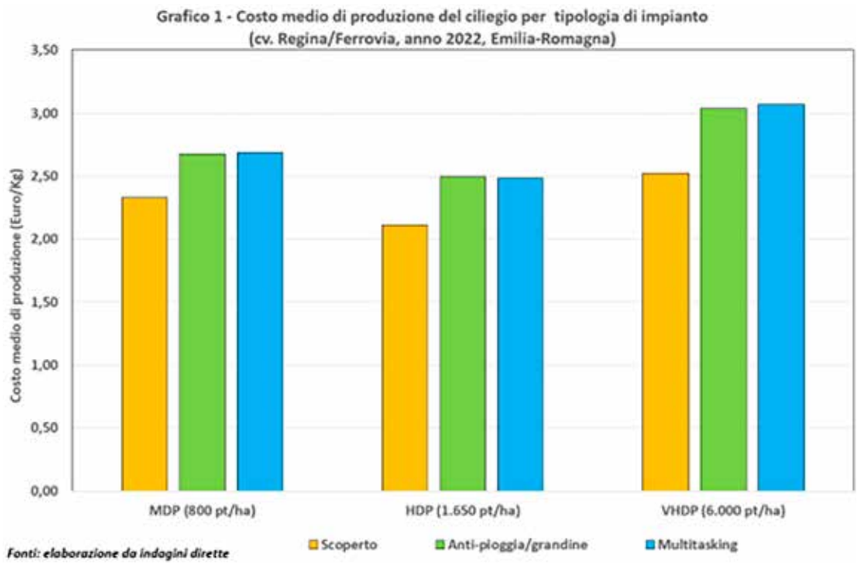
The question that arises, therefore, is whether or not to cover the plant and, if so, whether to do so with simple covers that include hail and rain protection, or multitask covers that also include insect netting.

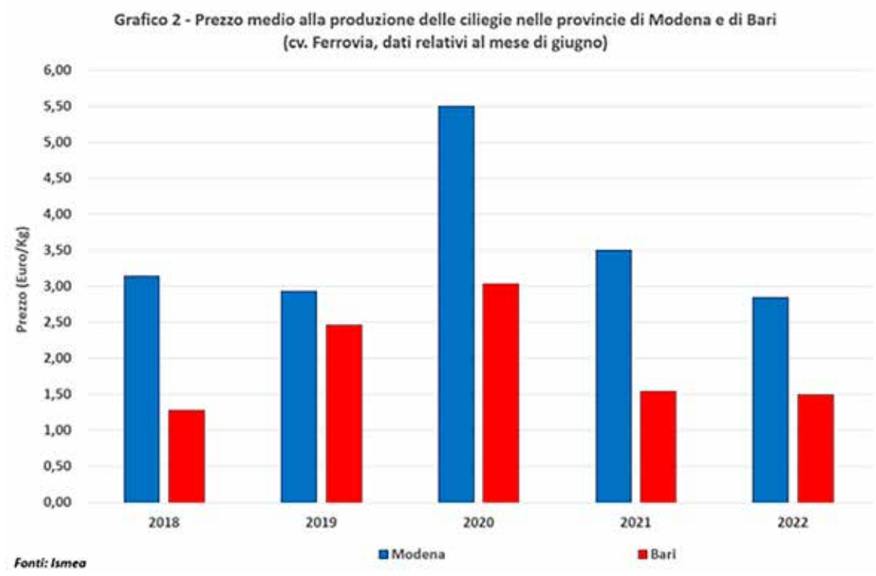
The parameters at stake in the economic calculations are, in this case, the **high initial cost of the covers and the management time** (opening and closing), as opposed to the greater protection against adverse events and, in the case of anti-insect nets, the savings in the use of pesticides.

One aspect not to be neglected is the **efficiency of the harvest yard**, which is greatly undermined by the presence of rain-damaged or Drosophila-damaged fruit, leading to sudden cost increases due to longer harvesting and sorting times.

From an economic point of view, given the time lag of production times, the financial aspect, linked to the cost of money, becomes crucial when calculating costs.

Graph 1 shows, therefore, a brief **comparison between 3 types of planting, medium density (MDP), high density (HDP) and very high density (VHDP)**, considered both in the absence of cover and in the presence of anti-hail netting and rain or complete anti-insect. The reference area is Emilia-Romagna, while the production data refer to an average between the Ferrovia and Regina cultivars.





The highlighted costs represent the threshold values for the recovery of invested capital, calculated on the basis of the economic life cycle of the plants and therefore also consider the financial impact (on the basis of a 4% discount rate) due to the differences in production cycles.

As can be seen, **in terms of density, it is the HDP plantations that record the lowest costs**, thanks to a more balanced mix of entry into production, yields, harvest times and overall plant life. Medium-density cherry orchards, on the other hand, suffer from lower yields and slower entry into production, while very high-density cherry orchards, superior in yield and speed of entry into production, however, suffer from a more limited production life, as well as very high planting costs.

With regard to covers, calculations show an **average cost increase of around 0.35 €/Kg on MDP and HDP plants compared to uncovered versions (+15%)**, but it must be considered that calculations were made with the same yields, while in practice one has to deal with climatic and biotic adversities.

In view of what has already been pointed out (production losses and increased harvesting costs), it only takes a few bad years in the life of plants to cause a sharp jump in the real costs of uncovered plants.

In conclusion, attention must be paid to the question of prices. Graph 2 shows the average prices for railways in June on the markets of Modena and Bari and, as can be seen, the values are well diversified.

In the Modena area, **with the exception of the loss-making 2020 campaign, prices in the five-year period 2018-2022 remained around 3 euro/kg**, while in the Bari area in 3 out of 5 years they did not go beyond 1.5 euro/kg. Quotations in the Modena area, therefore, made it possible to generate a positive income margin, although clearly only for those companies that maintained a production level in line with the average values considered.

For the economic sustainability of cerasiculture, however, it is essential to maintain strong actions to enhance the value of the product, which avoid its massification and thus limit its exposure to mere market dynamics.

Alessandro Palmieri - University of Bologna (IT)
Cherry Times technical-scientific committee

21. NEW HIGH-QUALITY EARLY VARIETIES: THE MEDA® SERIES

The Meda® series cherry varieties are owned by International Varieties Unlimited (IVU), a company established in 2010 from a joint venture between an American cherry breeding company, the Proprietary Fruit Varieties (CA USA) of the late Marvin Nies, one of the largest cherry breeders, and a group of Chilean cherry nurserymen and exporters.

"The intent of this agreement," Alejandro Navarro, president of IVU, tells Cherry Times®, "was to **select, develop and market new cherry varieties of high quality** (high size, hardness and sweetness) and **with good post-harvest performance** (processing, storage, shelf life). After a selective process lasting more than 10 years and conducted on a variety potential of 80 Californian cherry genotypes, IVU licensed, patented and marketed six new varieties under the Meda® trademark: Meda Rex® IVU-115*, Meda Fox® IVU-548*, Meda Tiger® IVU-524*, Meda Bull® IVU-104*, Meda Wolf® IVU-105* and Meda Taurus® IVU-533*.»

The cultivation of the varieties of the Meda Cherry® line internationally is managed and controlled by IVU through cultivation contracts with minimum planting rights. The varieties of Grupo Meda have been **authorised by eight Chilean exporters who have accepted a minimum planting right of 600 hectares** in total: Garces Fruit, Copefrut, Frusan, Cerasus, Ranco Cherry, Childresh, LQ Fruits and Polar Fruit. In addition, IVU has agreements with McDougall & Son (250 ha) in the US, Manuel Raventós (100 ha) in Spain and a contract is in the process of being closed in South Africa (100 ha) and Italy.

MEDA REX® IVU-115*

- Ripening: 12-14 days before Santina (2-4 days before Burlat).
- Flowering: early; self-incompatible (S1S4).
- Pollinators: IVU 533* and IVU 548*.
- Fruit: large size (28-30 mm), mahogany red colour, high firmness (D 88) and sweetness (22°brix).
- Very good firmness after harvest (35-40 days).
- Tree: high productivity, mainly on spurs.
- Chill requirement: 400-500 HF.

MEDA FOX® IVU-548*

- Ripening: 9 before Santina (1 day after Burlat).
- Flowering: early; self-incompatible (S4S9).
- Pollinators: IVU 533* and IVU 115*.
- Fruit: large size (28-30 mm), mahogany red colour, high firmness (D 80) and sweetness (21°brix).
- Very good post-harvest shelf-life (40-45 days).
- Tree: high productivity.
- Chill requirement: 600 HF.

MEDA TIGER® IVU-524*

- Ripening: 7 before Santina (3 days after Burlat).
- Flowering: early; self-incompatible (S1S4).
- Pollinators: Lapins and IVU 533*.
- Fruit: very high calibre (30-34 mm), mahogany red colour, high firmness (D 85) and sweetness (20°brix).
- Very good post-harvest shelf-life (35-40 days).
- Tree: high productivity, both on spurs and one-year branches.
- Chill requirement: 600 HF.

MEDA BULL® IVU-104*

- Ripening: 5 days before Santina (5 days after Burlat).
- Flowering: early; self-incompatible (S1S3).
- Pollinators: Lapins.
- Fruit: large size (28-30 mm), mahogany red colour, excellent firmness (D 90) and sweetness (24°brix).
- Very good post-harvest retention (35-40 days).
- Tree: high productivity, both on spurs and one-year branches.
- Chill requirement: 400-500 HF.

MEDA WOLF® IVU-105*

- Ripening: 3 before Santina (7 days after Burlat).
- Flowering: early; self-incompatible (S1S3).
- Pollinators: Lapins.
- Fruit: very high calibre (30-34 mm), mahogany red colour, high firmness (D 85) and sweetness (23°brix).
- Excellent postharvest shelf-life (40-45 days).
- Tree: high productivity, both on spurs and one-year branches.
- Chill requirement 600 HF.

TOMRA FOOD AND ICOEL S.R.L.

In November 2022, **TOMRA Food and ICOEL S.r.l. reached an agreement** that defines ICOEL as TOMRA Food›s integrated business partner for Europe and preferred partner for cherry technologies in Latin America. This agreement exploits the **synergies between the two companies** to strengthen the sales, services and support provided to ICOEL's customers and those of TOMRA Fresh Food (a division of TOMRA Food).

TOMRA Food designs and manufactures **sensor-based grading and peeling solutions**. ICOEL designs and manufactures solutions for **processing, sorting, packaging and traceability** of fruit and vegetables. TOMRA Food and ICOEL›s machines are often used in the same processing and packaging plants, especially in Europe.

In this double interview, **Benedetta Ricci Iamino**, Global Cherry Category Director Tomra and **Bruno Stravato**, General Manager, ICOEL, talk about the importance of this partnership for cherry packers.

Ricci Iamino: TOMRA Food works in more than 80 countries with over 12,000 processing plants for all types of fruit and vegetables. As far as cherries are concerned, TOMRA Food has always focused on providing its grading and packaging solutions in the countries of major production and export, such as Turkey, Italy, Spain, North and Latin America and Oceania. In these countries, thanks to partnerships such as the one with ICOEL, Tomra has already installed both grading and automatic packaging systems in over 500 fruit and vegetable plants.

The focus in the coming years will be on implementing an increasingly strong service and after-sales service in countries where we are already present and, at the same time, implementing a widespread sales network in new cherry producing and exporting countries such as Uzbekistan, South Africa and Asian countries.

Stravato: The starting point for this partnership was South America, in particular Chile, the first among cherry producers. But also, Italy as we explained before, Turkey and Greece are countries we are already focusing on.

The cherry market is an ever-expanding market with an increasing presence in countries such as South Africa and Europe in general.

Can you explain TOMRA and ICOEL's approach to the cherry industry?

Ricci Iamino: Every year, during each cherry season, whether in the northern or southern hemisphere, TOMRA sends a team of experts to the world's major cherry production areas, working closely with customers to understand how to help them improve yields, minimise waste, lower labour costs and find answers to ongoing challenges, future market needs and increased quality requirements.

What is the comparative difference between TOMRA, ICOEL and its competitors?

Ricci Iamino: TOMRA invests around 8% of its annual turnover in research and development. We believe that one of our main advantages is that our technology is able to classify the product better, with more accurate calibrationAt the same time, we have a very customised system that allows us to select different qualities and different categories of gauges for different customers and markets.

Finally, we have invested heavily in helping customers reduce labour costs by maximising line efficiency, increasing kilos per hour and using the same number of people, if not fewer.

Stravato: The substantial difference lies in the ability to work together to achieve more ambitious goals. A relationship such as the one established between ICOEL and TOMRA brings together the skills and knowledge of both in the study and implementation of solutions that fully meet customers' requirements.

Working in synergy allows us to achieve higher quality standards than our competitors.

The high degree of specialisation of both parties gives us the opportunity to pay more attention to the customer at every stage; design in particular benefits from this collaboration, the complexity inherent in this first step is reduced.

The combination of both in the subsequent phases of realisation, testing and processing, emphasises the advantages that can be summarised as a reduction in development time, an increase in product quality and certainly a reduction in the inefficiencies typical of longer and more complex processes, resulting in an increase in customer satisfaction.

22. CRACKSENSE IS THE NEW PROJECT THAT HOPES TO SOLVE THE CRACKING PROBLEM

CrackSense: 'High throughput real-time monitoring and prediction of fruit cracking by utilizing and upscaling sensing and digital data technologies' (*https://cracksense.eu/*), was initiated in 2023.

This project, coordinated by the research institute Volcani Center (Israel), deals with **Citrus**, **sweet cherry**, **pomegranate** and **table grape**. Its ambition is to better understand and predict the complex phenomenon of **fruit cracking**, a major agronomic problem, at the fruit, tree and plot level.

CrackSense project relies on **proximal** and **remote sensing technologies** including 3D temperature point cloud data processed on edge unit, as well as on the production of « proxies » for ecophysiological variables (water stress, nutritional status, etc.) from UAV (drone) images.

By combining these data with satellite data and other agri-environmental variables linked to the physiological status of trees, the project will produce real-time risk evaluations of fruit cracking at the plot and regional level, in order to improve orchard management and minimize economical losses.

CrackSense consortium includes numerous **public** and **private** partners from seven countries (Belgium, France, Germany, Greece, Israel, Lithuania and Serbia). This highly multi-disciplinary initiative is based on two levels of **upscaling**, one at the **area** unit level, since it deals with experimental plots, pilot plots and commercial orchards at the regional level, and another one that the **agronomic** unit level, with technologies applied on fruits, trees, plots or regions.

CrackSense is organized in 6 different workpackages (WP), as illustrated in the following figure:

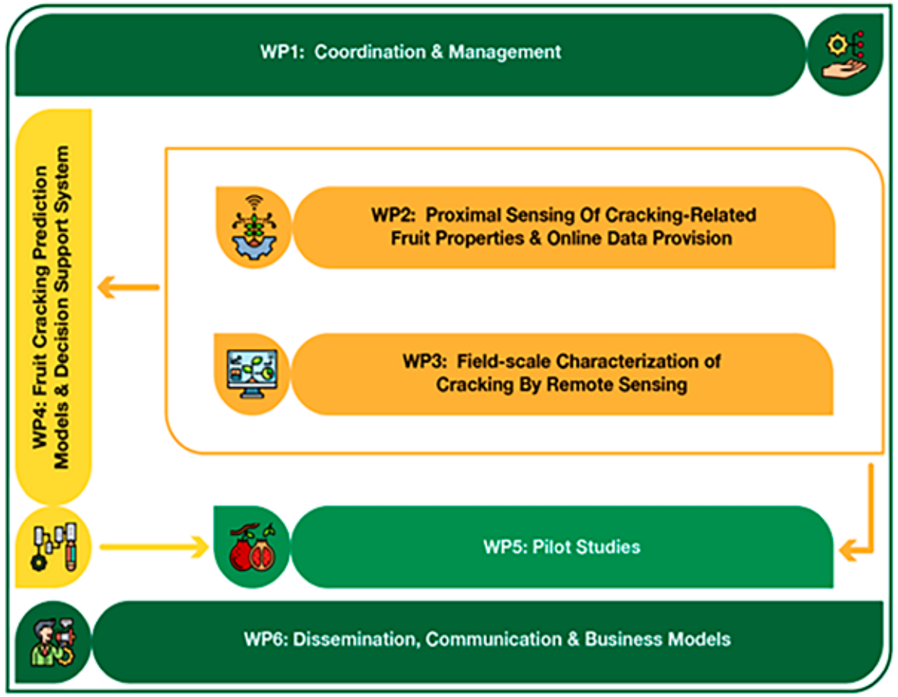


Image 1: Workflow of Working Packages (WPs) within CrackSense project.

Image 2: Fog chamber to simulate rain.

Concerning **sweet cherries**, the partners where experimental plots will be studied are located in France (INRAE) and Germany (LVGA).

At INRAE, the plant materials are a **population** derived from the cross between cultivars 'Regina' and 'Garnet', which has been characterized for fruit cracking for many years and within which there are hybrids both tolerant and sensitive to cracking (see *https://doi.org/10.1038/s41438-021-00571-6*).

At LVGA, plant materials are **cultivars** with different cracking susceptibility levels that are planted in pots (about 150 trees from cultivars 'Sam', 'Sweetheart' and 'SBC232') or field grown.

A **fog chamber** allows the simulation of rain and the variation of fruit surface wetness (see *https://doi.org/10.1016/j.scienta.2020.109400*).

Within WP2, **fruit temperature** and **wetness** will be estimated by using different **proximal** sensors, such as LIDAR and thermal camera, which will be installed in a conveyor named **terrestrial multi-sensor platform** (TOMMY). Simultaneously, fruit cracking will be visually evaluated on the studied trees

Within WP3, we will conduct, on the same plots, ground-based measurements to estimate the spatial and temporal environmental variables effect on cracking intensity. Moreover, **remote sensing**, including active and passive sensing-based UAV, will be used to assess tree health and estimate cracking-associated yield loss.

All the generated data will be processed and analyzed within WP4 in order to develop fruit cracking **prediction models** and **decision support systems.**

Image 3: Fog-induced cracking of fruits.

Pilot plots will be studied in a second phase of the project both in France (Ctifl) and in Lithuania (ART21) within WP5, with two objectives: implement successful treatments for **cracking mitigation** and upscale previously described sending tools for **monitoring cracking intensity** at the plot level in relation to spatiotemporal variability and tree health.

José Quero-Garcia – INRAE (FR)
Cherry Times technical-scientific committee

Image 4: First measurements with TOMMY at the site of Toulenne (INRAE- Bordeaux).

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23. EXPERIMENTAL PROGRAMME FOR THE INTEGRATED MANAGEMENT OF CHERRY TREES AGAINST DROSOPHILA SUZUKII AND PHYSIOPATHOLOGIES

Experiences with the application of multifunctional insect nets, territorial biological control and the attract & kill technique in Vignola

The study project on the integrated management of the cherry tree is entering the **third year of the work programme**. As with other fruit crops, control through the integration of low-impact techniques is a priority for the cherry tree.

In particular, the small fruit fly (**Drosophila suzukii)** is an adversity that requires and justifies additional attention due to the advanced phenological stage in which the insect becomes harmful.

It is in this context that the third season of experimental activities aimed at evaluating an integrated D. suzukii containment system that aims to **combine active, passive and agro-ecological rebalancing techniques** is beginning. A certainly ambitious but strategic programme for the full valorisation of this fruit production that sees the Modena Provincial Phytosanitary Consortium, the Regional Phytosanitary and Production Defence Sector, the Plum Cherry and Typical Fruit Consortium of Vignola, the Municipal Administration of Vignola with the full financial support of the Emilia Romagna Region at the forefront.

The work programme undertaken in 2021 has seen the realisation of **covers with multifunctional nets of several types applied in different configurations**, with the aim of assessing the contribution in the reduction of deleterious physiopathologies such as fruit cracking and at the same time protection against D. suzukii infestations. The experience of the first two seasons was realised in the varietal collection fields, becoming further preparatory to the evaluation of the adaptability of the new cultivars to cultivation under nets. To this end, the plants were equipped with a sophisticated

data collection network that allows comparison with outdoor conditions.

Reference is made to an **integrated management system** in that the project combines the protection offered by multifunctional nets with the integration of low-impact insecticide solutions based on the attract & kill technique, flanked by territorial management through a specific biological control intervention authorised by the Ministry of the Environment, which aims at biodiversity and the achievement of balance in the agro-ecosystem.

The original project did not envisage a territorial biological control programme, but depending on the behaviour of Drosophila, which, like the **Brown marmorated stink bug**, can be considered a territorial species, it was deemed strategic to aim for the introduction of a parasitoid that would reinforce the action of the indigenous species. To this end, a collaboration was established with the Edmund Mach Foundation and UniBO, which led to the request and subsequent obtainment of authorisations for the release of Ganaspis brasiliensis in the natural environments surrounding the cherry growing area, where the species can multiply undisturbed, parasitising the populations of D. suzukii that insist on native essences such as Blackberry, Elderberry, Ivy, etc.

The first few seasons have made it possible to **collect interesting and prospective data**, both from the point of view of the environmental conditions within the canopies and the consequent adaptability of the plants to the protected environment, as well as in relation to the concrete possibility of a reduction in defence interventions.

The activities will continue with the aim of **optimising this integrated management and at the same time gathering confirmatio**n of what has already been observed in previous years.

As planned, an extension of **the experimental demonstration area will be carried out in 2023** through the construction and evaluation of other plants covered with innovative materials and net closure systems, the verification of the complementarity of the attract & kill strategy and the continuation of the territorial biological control programme.

In short, a concrete example of the concept of integrating complementary techniques from which significant feedback is being gathered on the possibility of guaranteeing efficient and at the same time sustainable protection.

Luca Casoli
Provincial Plant Protection Consortium of Modena

24. THE CORETTE® SERIES: THE NEW EARLY AND DWARFING ROOTSTOCKS FROM MSU

From the cherry breeding conducted by Amy Iezzoni, professor emeritus at Michigan State University, five new dwarfing and early rootstocks have recently been commercially released: the Corette® series. All five rootstocks significantly reduce the size of the tree compared to standard rootstocks and entry into production occurs within the third year, two years earlier than traditional planting systems. These rootstocks have completed the experimentation phase in the USA both for sweet cherry, in very high density wall planting systems, and for sour cherries, using a high density production system and mechanized harvesting above the row.

The main characteristics of the Corette® series rootstocks are reported below (Iezzoni, 2022).

CASS (CORETTE® 1)

Dwarfing, precocity-inducing, clonal rootstock for cherry.

Origin: Michigan State University, East Lansing, by A. Iezzoni. Hybrid of unknown complexity involving *Prunus avium*, *P. cerasus*, and *P. fruticosa*. USPP 30,553; 4 June 2019.

Plant: vigor weak; branching habit spreading.

Rootstock performance: induces reduced vigor and increased precocity compared to trees budded on mazzard seedling rootstocks; vigor lower than Gisela® 5; grafted plants tend to produce root suckers; exhibits moderate sensitivity to high soil pH.

CLARE (CORETTE® 2)

Dwarfing, precocity-inducing, clonal rootstock for cherry.

Origin: Michigan State University, East Lansing, by A. Iezzoni. Hybrid of unknown complexity involving *P. avium*, *P. cerasus*, and *P. fruticosa*. USPP 32,852; 2 Mar. 2021.

Plant: vigor weak; branching habit spreading.

Rootstock performance: induces reduced vigor and increased precocity compared to trees budded on mazzard seedling rootstocks; vigor lower than Gisela® 5; grafted plants tend to produce root suckers.

CLINTON (CORETTE® 3)

Dwarfing, precocity-inducing, clonal rootstock for cherry.

Origin: Michigan State University, East Lansing, by A. Iezzoni. (*P. cerasus* × *P. canescens*) O.P. USPP 30,538; 28 May 2019.

Plant: vigor weak; branching habit spreading.

Rootstock performance: induces reduced vigor and increased precocity compared to trees budded on mazzard seedling rootstocks; vigor similar to Gisela® 5; grafted plants produce no root suckers.

CRAWFORD (CORETTE® 4)

Dwarfing, precocity-inducing, clonal rootstock for cherry.

Origin: Michigan State University, East Lansing, by A. Iezzoni. *P. cerasus* × (*P. cerasus* × *P. canescens*). USPP 30,473; 7 May 2019.

Plant: vigor weak; branching habit spreading.

Rootstock performance: induces reduced vigor and increased precocity compared to trees budded on mazzard seedling rootstocks; vigor similar to Gisela® 5; grafted plants produce no root suckers.

LAKE (CORETTE® 5)

Clonal rootstock for cherry.

Origin: Michigan State University, East Lansing, by A. Iezzoni. Hybrid of unknown complexity including *P. avium* and *P. fruticosa*. USPP 32,813; 16 Feb. 2021.

Plant: vigor weak; branching habit spreading.

Rootstock performance: induces reduced vigor and increased precocity compared to trees budded on mazzard seedling rootstocks; vigor lower than Gisela® 5; grafted plants tend to produce root suckers; exhibits tolerance to water stress compared to Gisela® 5.

Corette® rootstock series: attribute & planting parameters

	CASS	CLARE	CLINTON	CRAWFORD	LAKE	G5	G6
Tree size % - Colt = 100	40-50	40-50	40-50	40-50	50	50-60	80-85
Precocious	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Advance bloom/harvest - days	4	4	0-1	0-1	No	2-4	0-1
Compatibility	?	?	?	?	?	Good	Good
Root suckers	Low	Moderate	No	No	No	No	No
Anchorage	Good	Good	Fair	Good	Moderate	Fair/Good	Fair
Best for VHDP	Yes	Yes	Yes	Yes	Yes	Yes	No
Best for HDP	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Best for LDP	No	No	No	No	No	No	No
Best for shallow or pour soil	HD	HD	HD	HD	HD	No	HD
Best white low-productivity cv	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Best whit high-productivity cv	No	No	No	No	No	No	No/Yes

Source: reworked by Long et al., 2020

25. WP2: INNOVATIVE TECHNOLOGIES FOR SOUR CHERRY STORAGE

Within the framework of the multidisciplinary FAR Mission Oriented project 'Process and product innovations in the sour cherry chain: an integrated approach for the valorisation of a typical Modenese production', financed by the Fondazione Cassa di Risparmio di Modena, at the laboratories of the Department of Life Sciences of UNIMORE, **research was carried out with the aim of assessing the effectiveness of a treatment with high hydrostatic pressure (HPP, high pressure processing) for the quality preservation of fresh sour cherries.**

The HPP process involves pressurising the product, already packed in flexible packaging, to between 300 and 600 MPa, for a time ranging from a few seconds to a few minutes. The effectiveness of HPP treatments depends on various factors, such as product acidity, applied pressure, holding time, temperature, food matrix characteristics and target microorganism. Similar treatments have been shown to inactivate moulds, yeasts and vegetative cells, while they are not sufficient to destroy bacterial spores, which are highly baro-resistant.

Due to the very short spoilage time, 'amarena brusche di Modena' cherries have a reduced shelf life and limited availability on the market as a fresh product. Conventional processing technologies, while on the one hand guaranteeing food safety and a long shelf life, on the other hand modify the sensory and nutritional characteristics, leading in particular to the loss of thermolabile constituents and alteration of colour, flavour and aroma.

Samples of stoned Amarena del Rio, supplied by the company Piombini (Casinalbo di Formigine), packed in flexible packaging, were subjected to an HPP cycle at 600 MPa for 3 minutes (at HPP Italia, Traversetolo, PR). The efficacy of the HPP treatment was evaluated through the study of microbiological stability, colour monitoring, pH, antioxidant activity and content in bioactive constituents (polyphenols, flavonoids and anthocyanins) during 5 months of refrigerated storage.

Image 1. Sample of HPP sour cherries.

The results obtained confirmed the effectiveness of the HPP treatment in reducing the total aerobic mesophilic load and the load of yeasts and moulds below the detection threshold of the plate count method. In addition, the treated samples remained microbiologically stable throughout the storage period (5 months). The colorimetric evaluation, using a^* and b^* values with the evaluation of hue and saturation, showed substantial colour stability up to 3 months of cold storage, after which a colour change towards yellow shades was observed, with a change in colour intensity. No change was recorded in the pH value (3.2), which, in addition to acting in synergy with the high hydrostatic pressures in microbial inactivation, determines an unfavourable environment for the growth of any cells that may have survived the treatment.

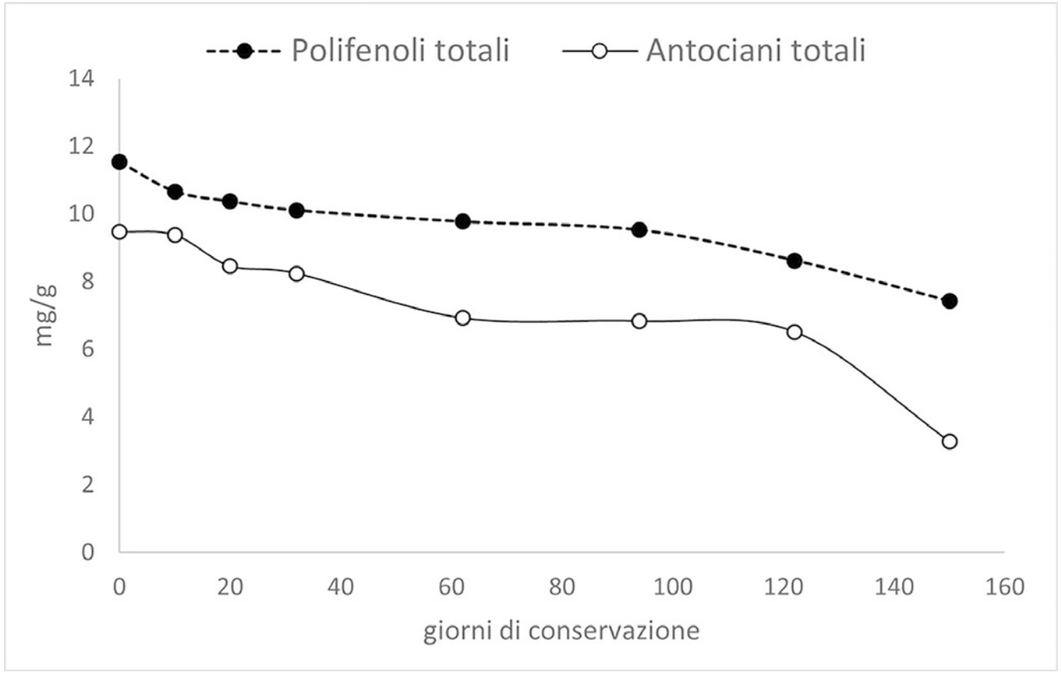


Image 2. Development of total polyphenol and total anthocyanin levels in cold-pasteurised sour cherries using HPP technology.

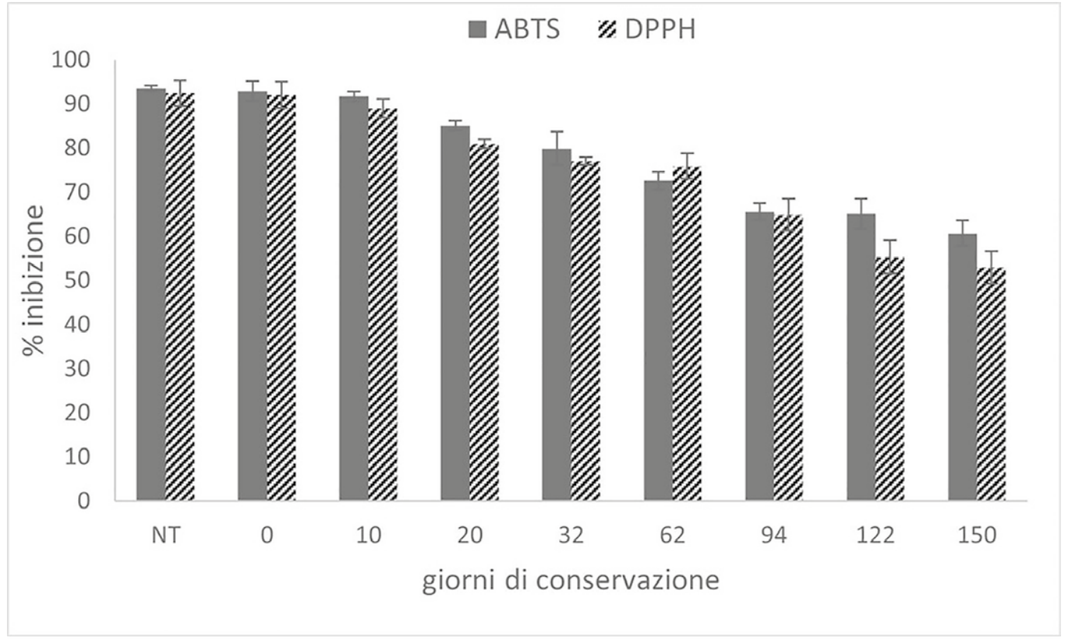


Image 3. Antioxidant capacity, measured by ABTS and DPPH tests, in cold pasteurised sour cherries using HPP technology.

The biological activity of fruit and vegetables depends on the content of bioactive compounds. Polyphenols represent the largest group of plant secondary metabolites, with proven action in the prevention of oxidative stress-related diseases. The quantification of phytochemicals in plant products is of fundamental importance for understanding their contribution in promoting health through diet. The content of bioactive components was found to be unaffected by processing, but variations during storage were observed in particular for total anthocyanins, which can be correlated with the changes in colour parameters recorded. A similar trend was found for the total antioxidant capacity: indeed, the HPP treatment did not significantly influence the antioxidant activity, which remained at high levels during storage.

Overall, results allow us to state that **the HPP treatment is able to preserve the quality characteristics of fresh stoned black cherries for at least 3 months under refrigerated conditions**. After this period, the product may present variations in instrumental colour parameters and a decrease in anthocyanin content, without however compromising the hygienic safety of the product.

The HPP treatment therefore represents an interesting strategy for the valorisation of the fresh sour cherry fruit, with potential for the development of fresh-like ready-to-eat products and semi-finished products (for sectors such as confectionery, ice-cream parlours, etc.) able to compete on the markets for superior sensory and health qualities

Source: Tenuta, M.C.; Artoni, E.; Fava, P.; Bignami, C.; Licciardello, F. (2023). Shelf Life Extension and Nutritional Quality Preservation of Sour Cherries through High Pressure Processing. Foods, 12, 342. *https://doi.org/10.3390/foods12020342*

Fabio Licciardello
University of Modena and Reggio Emilia (IT)

DANESE, AD-HOC REFRIGERATION AND ENERGY EFFICIENCY

Danese Group has been active in the refrigeration systems sector for over 30 years. In this interview, Matteo Danese, President of Danese Group, analyses with Cherry Times the solutions developed for companies in the cherry sector.

What distinguishes Danese in the panorama of industrial refrigeration systems?

Our company differentiates itself in the market thanks to its ability to realise ad-hoc projects, i.e. systems custom-designed for the customer. In fact, our company does not have a list of standard supplies, but I can guarantee that every system I have designed over the years differs from the other.

To what kind of companies do you address your services and product?

Our projects are tailored to everyone, from the local producer to the growers' consortium.

Looking to the future, which aspects do you think will be of greatest development?

Our in-house technical department is always looking for ways to optimise and make our refrigeration and hydrocooling systems more efficient. Today, our main focus is on new refrigeration technologies to bring new energy-efficient systems.

What are the advantages and peculiarities of your products?

For fruit and vegetables, and for cherries in particular, post-harvest temperature management is of fundamental importance. In fact, our company is able to offer energy-efficient cooling and sanitisation services both inside the cell and in our Hydrocooling systems.

What is the contribution that a service/ product such as yours can make within the cherry industry, even in terms of your area of expertise?

Our cooling systems, either through refrigeration cells or hydrocooling systems, guarantee a rapid reduction in product temperatures, which is extremely vital to the extension of shelf-life. Our customers confirm to us that, as a result of the rapid chilling achieved with our systems, they are able to expand their market to countries much further afield than before.

26. INNOVATIVE PLANT MODELS FOR SOUR CHERRY PRODUCTION

The traditional production of sour cherries in the Modena (Italy) area has strong and recognised identity and territorial characteristics and a local market that is already very receptive, with good prospects for expansion.

In particular, "Amarene Brusche di Modena" PGI cherries are still a niche product, but the health and nutritional properties of sour cherries that research has now confirmed and the many transformations to which sour cherries lend themselves offer opportunities for growing commercial success and open up paths of innovation in both process and product.

Cultivation, today mainly conducted according to extensive processes, can benefit from an evolution towards more efficient and sustainable innovative systems that allow high productivity, reduced production costs and the maintenance or enhancement of fruit quality.

With this aim in mind, the University of Modena and Reggio Emilia has evaluated the effects of innovative cultivation models in terms of varieties, planting distances, pruning management and defence against biotic and abiotic adversities in the Work Package 'New genotypes and planting models for an integrated and sustainable production' of the FAR Mission Oriented multidisciplinary research project 'Process and product innovations in the

Image 2 – Del Rio sour cherries.

Photo 1 – Overview of the experimental cherry orchard in full bloom.

black cherry sector: an integrated approach for the valorisation of a typical Modenese production', financed by the Fondazione Cassa di Risparmio di Modena and coordinated by Prof. F. Licciardello. F. Licciardello of Unimore.

THE "PEDESTRIAN" ORCHARD

The trials were conducted in an experimental 'pedestrian' cherry orchard with plots at different densities of plants per hectare (1250 – medium-high density- MHD; 1666 – high density- HD; 2500 – very high density- VHD) set up in 2015 at the Piombini company, in Casinalbo di Formigine (Modena, Italy).

During the two-year period 2021-2022, vegetative growth, fruit productivity and quality, harvesting and pruning times for manual and mechanical production of Amarena del Rio were analysed. This is a new variety that, due to the size and quality characteristics of the fruit, can be considered dual-purpose, for fresh consumption as well as for processing.

RESULTS

The two-year surveys showed that, with the same distance between rows (4 m), the reduction in the distance between plants on the row from 2 m to 1 m, and the consequent increase in the density of plants per hectare, resulted in lower vegetative growth, due to competition between root systems and canopy lighting conditions. In both years, production per tree decreased as plant density increased, with averages over the two years of 10 kg/plant for MHD, 7.8 for HD and 5.6 for VHD, respectively, and production yield per hectare increased from 12 t to 14 t from a density of 1250 to 2500 plants per hectare.

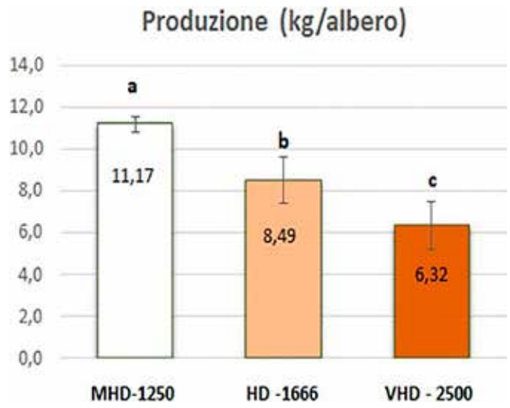


Image 3 – Production per plant in 2022 at the three planting densities.

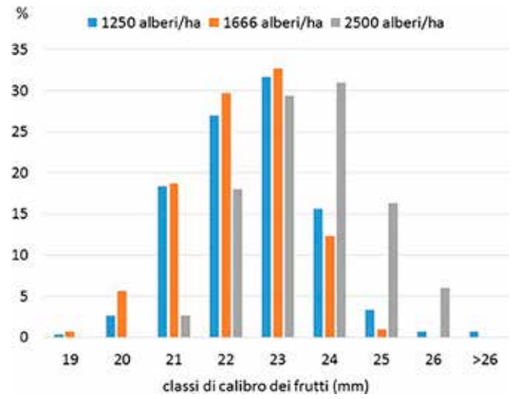


Image 4 – Distribution in the different size classes of the fruit obtained at the three different planting densities.

The vegetative growth and production trends over the two-year period show that the cherry orchard can maintain good productive efficiency and stability over the years and a condition of vegetative-productive balance even at the highest density.

The quality characteristics of the fruit (size, sugar content, acidity, firmness) were also satisfactory at all the planting densities and pruning forms applied. In particular, in both years the trees at a density of 2,500 plants/hectare produced more drupes of high size, with calibre greater than or equal to 22-24 mm. This positive result is largely attributable to the cultivar used, which combines good productivity characteristics with a compact vegetative habitus and average vigour.

Mechanical pruning with manual trimming carried out in the winter of 2021 reduced labour time compared to entirely manual pruning, but the growth response of the foliage made it necessary to intervene with manual pruning in 2022, making it necessary to adopt dynamic pruning systems in high-density plantations, with alternating manual and mechanical pruning over the years.

The Keep in Touch® multifunctional netting cover set up in the very high density planting resulted in a production, as an average over the two-year period, not significantly different from that of the open-air planting and made it possible to avoid Drosophila suzukii defence interventions and to improve some quality aspects of the sour cherries.

Cristina Bignami
DSV – UNIMORE

Figure 5 – Mechanised winter pruning of sour cherries.

27. REDUCTION OF LIGHT INTERCEPTED BY PLANTS AFFECTS FRUIT QUALITY

Fruit quality plays a crucial role in determining commercial value. Although at the moment the majority of the indices that contribute to price formation are based on external quality, **the idea of remunerating the fruit grower based on the internal quality of the fruit is beginning to spread**.

This is because the nutritional quality of the fruit is directly related to field management. In fact, **cherry trees need light for growth and production**. Continued apex growth, season after season, leads to canopy closure, resulting in an inability to use space and light energy efficiently.

Low light can therefore be considered one of the possible limiting factors for high-quality cherry production. Thanks to recent research, we are beginning to understand how changes in plant physiological responses to unfavorable conditions are ultimately attributable to molecular changes.

In recent years, in fact, research on the physiological response of plants to adversity is increasingly shifting toward the **study of microscopic mechanisms of plant physiological adaptation**. Transcriptomic techniques are currently being used to study adaptive regulatory mechanisms in plants when subjected to different types of stresses, especially abiotic stresses (high temperatures, drought, etc...).

It has been shown in other crops how differentially expressed **genes are typically involved in assimilation processes such as photosynthesis**, indicating complex mechanisms of regulation and interaction between weather conditions and physiological responses.

The scientific research we present today was conducted in Sichuan Province (China). **'Hongdeng' cherry plants were subjected to 30% shading**, while other plants were kept in full light and used as controls. Photosynthetic characteristics, physiology and biochemistry of the fruits were analyzed, as well as fruit transcriptome.

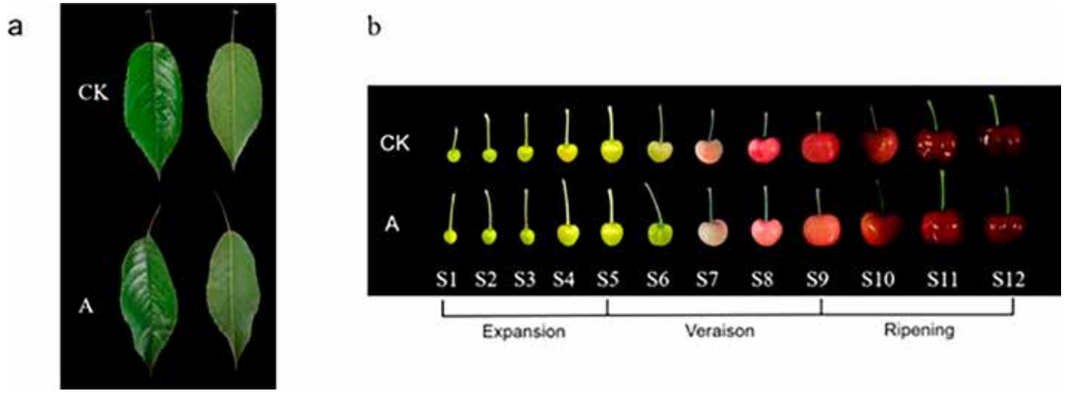


Figure 1. (a) Leaf phenotype map. (b) Phenotypic diagram of sweet cherry fruits during development. (CK indicates no shading (Control) and A indicates 30% Shading, as below). S1: means 5 days after flowering, S2: 9, S3: 13, S4: 17, S5: 21, S6: 25, S7: 29, S8: 33, S9: 37, S10: 41, S11: 45, S12: 49. Source: Tang et al., 2023.

The results showed that light reduction significantly reduces the light-capturing capacity of leaves, damages photosystems, reduces carbon assimilation capacity and converts most of the captured light energy into photochemical energy, thus limiting leaf growth and development and nutrient accumulation in fruits.

By directly affecting leaf growth and development, **shading thus significantly decreased the quality of cherry fruits** and the accumulation of nutrients within them.

At maturity, reduced fruit weight, sugar and vitamin C content were found, while a substantial increase in organic acid content was evaluated.

Transcriptomic data revealed that **low light stress induces a large number of differential genes involved in carbon metabolism**, organic acid metabolism, and stress resistance, indicating that shade stress can affect the expression of these genes and the presence of the corresponding molecules in the fruit.

This study showed that the **physiological quality of fruit is altered when 30% shading is applied**. For this reason, researchers from the Sichuan College of Horticulture recommend moderate shading (less than 30 percent shade rate) for the production of higher quality cherries.

Source: Tang et al, "Effect of Low-Light Stress on Sugar and Acid Accumulation during Fruit Development and Ripening of Sweet Cherry", *Horticulturae*, *9*(6), 654, 2023.

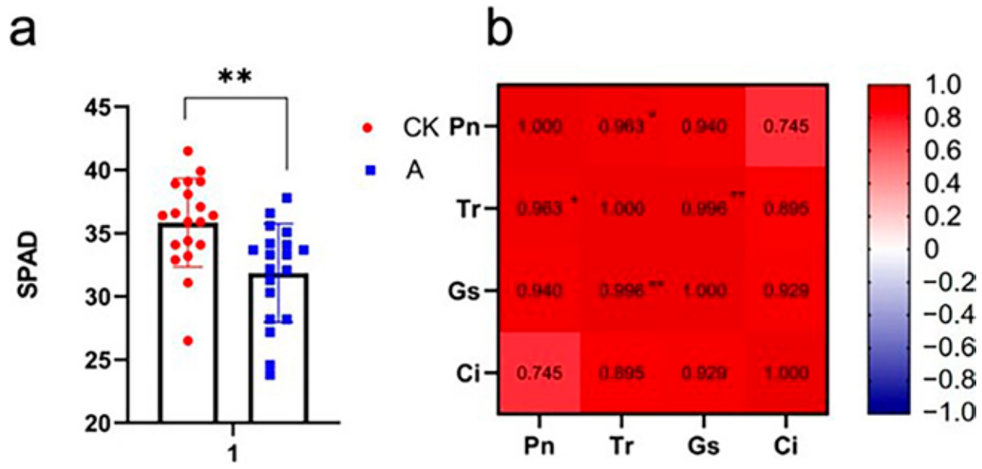


Figure 2. (a) Leaf SPAD values. (b) Correlation coefficients between gas exchange parameters. * indicates significant correlation at the 0.05 level and ** indicates highly significant correlation at the 0.01 level. Vertical bars indicate the standard deviation of the mean. Source: Tang et al., 2023.

GIACOVELLI: NEW VARIETIES AND ZERO RESIDUE CHERRIES

With a turnover of over 60 million euro, Giacovelli srl is one of the leading producers and marketers of fruit and vegetables in Apulia (Italy). Its passion and specialisation make Giacovelli one of Italy's leading producers of cherries.

Your company has been present on international markets for over 60 years and cherries are one of your specialities. What are the main demands made on you by the retail trade?

The demands of the Italian and foreign retail trade vary according to consumer preferences in the individual countries. Starting from the technical and standard parameters of the individual cultivars, retailers pay a lot of attention to colour, size and taste: while Belgians and Swiss prefer, for example, a colouring tending towards dark red, Germans tend to choose ruby red cherries depending on the region and different consumption habits.

What is missing to build a more effective supply chain?

We need a more proactive approach from the large-scale retail trade (buyers and category managers): visits to the field, learning about the various stages of production, and even educating those who work in the shops on the storage, branding and shelf positioning of the cherries.

Precisely in this regard, last January we held two meetings in the core areas of cherry production, in Turi and Conversano: the resonance was so great that some partners have already grafted new cultivars.

Zero residue and organic: what is the future?

Zero residue is very interesting: it will be the future and will bypass the organic sector, because it makes it possible to monitor and guarantee from the very beginning a correct and healthy product management, benefiting not only consumers (hence, less use of pesticides and harmful substances), but also producers. The latter for the strict organic protocols lose product nor is the market really attentive and recognises the economic value of this type of production as well. We are already working in this direction on table grapes and figs, and we would like to start conducting zero residue also some cherry varieties together with our partners.

As mentioned before, we need to find ways to add value to the cherry. In your opinion, is the PGI a valid path?

The path of the Vignola cherry on this issue and on branding is a striking example that should be emulated... For a long time now, attempts have been made in our area to create the IGP supply chain, with little success. Surely the Ciliegia d'Italia supply chain project can give a turning point to sales, consumption and above all the perception of this premium product abroad and in Italy. We must aspire to create a brand as strong and recognized as that of the Chilean cherry with ASOEX, investing in new varieties, sustainable farming methods and a lot of communication internally (between all the technical links in the chain, crossing the whole nation) and externally towards the consumer.

In conclusion, what are the prospects for Apulia cherries?

Apulia cherries have enormous potential, because the different soil and climate zones in the region make it possible to have the same product with slight differences in time and thus extend the seasonality. The foreign demand exists, but we need to invest in the field and in communication, because, especially on the late harvest, Greece and Turkey are still leading the way.

28. GERMANY IS THE THIRD LARGEST IMPORTER OF CHERRIES

Germany is the third-largest importer of cherries in the world after China/Hong Kong and Russia. From 2010 to 2021, between 52 and 77 percent of the cherries consumed in Germany were imported, with the majority of imports originating in other EU member states. The largest non-EU cherry suppliers are Turkey for sweet cherries and Serbia for sour cherries.

German cherry **production for MY 2022/23 is estimated at 54,700 MT**. This is a 43-percent increase compared to the preceding year and 19 percent above the ten-year (2012-2021) average. The increase is largely a rebound from the unusually low production of 2021.

AREA

The harvested area for sweet and sour cherries is expected to amount to approximately 6,000 and 1,800 ha, respectively. **Germany is more competitive for sweet cherries than for sour**. Most of the sweet cherry production is for fresh consumption and consumers are willing to pay a premium for locally produced cherries.

In contrast, **most of the sour cherries are destined for processing**. When farmers plant new sweet cherry orchards, the trend is towards shielded production. It requires a higher investment but offers protection against rain and enables the farmer to use predators as a pest management tool.

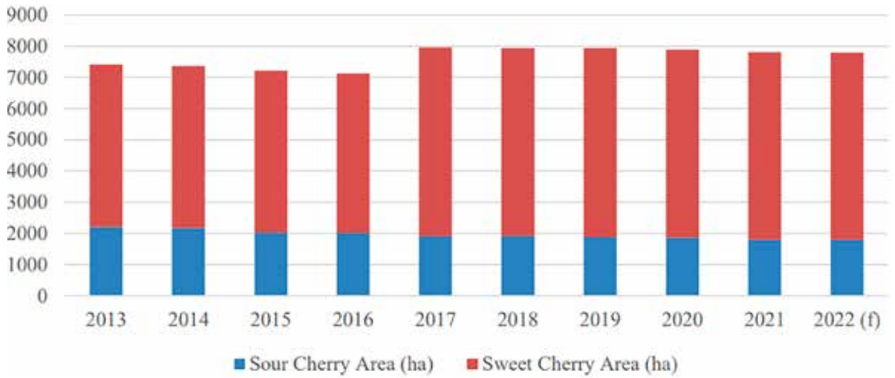
According to a newspaper article **investment costs amount to approximately 100,000 Euro per ha** (roughly USD240,400 per acre.) Popular varieties include Bellise, Burlat, Kordia, and Regina for sweet cherries and Schattenmorelle and Morellenfeuer for sour cherries.

PRODUCTION

German cherry production for MY4 2022/23 is estimated at 54,700 MT. This is a 43-percent increase compared to the preceding year and 19 percent above the ten-year (2012-2021) average. The increase is largely a rebound from the **unusually low production of 2021** when German cherry production was hit by late spring frosts, drought, and heavy rains during harvest.

Sweet cherry production is estimated at 40,600 MT and sour cherries at 14,100 MT. In 2021, production amounted to 38,370 MT – thereof 27,340 MT of sweet cherries and 11,030 MT of sour cherries.

Sweet and Sour Cherry Area in Germany by Year (in ha)



Source: FAS Berlin; Data from German Federal Office of Statistics (destatis)3 , (f) = FAS Berlin forecast.

TRADE

Germany is the third largest importer of cherries in the world after China/Hong Kong and Russia. From 2010 to 2021, between 52 and 77 percent of the cherries consumed in Germany were imported, with imports varying between 47,000 and 75,000 MT of cherries annually.

The **majority originates from other EU member states**—mainly Austria and Greece for sweet cherries and Hungary and Poland for sour cherries. The largest non-EU suppliers are Turkey for sweet cherries and Serbia for sour cherries.

Opportunities for U.S. sweet cherries are best at either end of the German domestic production cycle, i.e., the end of May/beginning of June and August/September. Of the two periods, the latter is more promising as there is less competition from cheaper Turkish cherries.

In recent years, U.S. cherry exports to Germany mostly occurred **via other EU member states,** mainly the Netherlands. Direct imports from the United States are rare. They last occurred in MY 2018/19. Germany is the third largest importer of cherries in the world after China/Hong Kong and Russia.

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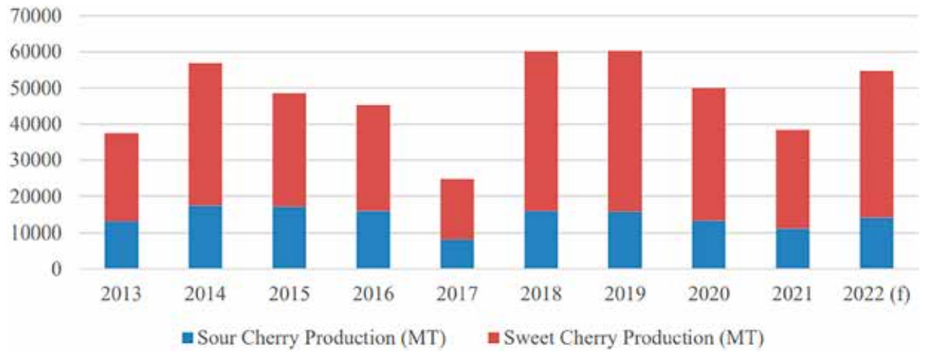
Germany exports less than 10 percent of its total cherry supply, between 4,000 to 7,800 MT in recent years. Main destinations are other EU member states, such as the Netherlands, Austria, Denmark, and Sweden. The largest and almost exclusive extra-EU destination for German cherries is Switzerland. For MY 2022/23, exports are expected to increase because of the larger German production.

Sweet and Sour Cherry Production in Germany by Year (in MT)



Source: FAS Berlin; Data from German Federal Office of Statistics (destatis), (f) = FAS Berlin forecast.

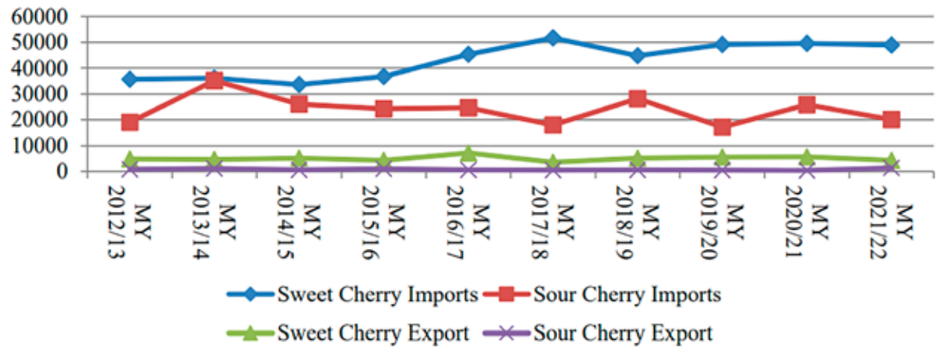
German Cherry Imports (Sweet & Sour) by Origin and Marketing Year (MT)					
	2017/18	2018/19	2019/20	2020/21	2021/22
World	69741	72999	66361	75365	69031
Intra EU-27	58655	60637	53460	65474	63276
Extra EU-27	11086	12362	12902	9890	5756
Austria	15418	14244	14434	14402	14306
Greece	3815	3915	5484	10130	9276
Hungary	13035	13294	10291	9736	8599
Netherlands	5740	4985	6909	7318	7529
Poland	430	7754	2685	13212	7251
Spain	6110	4614	5027	3585	6310
Italy	10057	5052	1883	2537	4671
Turkey	7858	8529	10846	8027	4162
Czech Rep.	2271	4421	2878	2730	3503
Serbia	2794	3376	1804	1540	1069
France	423	632	700	703	715
U.S.A.	0	30	0	0	0
Other	1790	2153	3420	1445	1640

Marketing year April/March – Source: Trade Data Monitor, LLC. (TDM), MY2021/22 = April 2021- March 2022.

German Sweet Cherry Imports by Origin and Marketing Year (MT)					
	2017/18	2018/19	2019/20	2020/21	2021/22
World	51721	44780	49167	49542	48899
Intra EU-27	43706	35987	38120	41390	44631
Extra EU-27	8015	8793	11047	8151	4268
Austria	14889	13550	13407	14341	14178
Greece	3702	3840	5453	10112	9251
Netherlands	5277	4643	6642	7036	7233
Spain	6088	4518	5015	3448	6158
Italy	9486	4608	1870	2519	4655
Turkey	7858	8529	10846	8027	4162
Hungary	3308	3065	3520	2861	1625
Poland	25	614	95	44	669
France	315	511	633	521	383
U.S.A.	0	10	0	0	0
Other	773	892	1,686	633	585

Marketing year April/March – Source: Trade Data Monitor, LLC. (TDM), MY2021/22 = April 2021- March 2022.

German Cherry Trade by Year (in MT)



Source: FAS Berlin; Data from Trade Data Monitor, LLC. (TDM).

CONSUMPTION

In Germany, **fresh cherries are considered a seasonal product** and stocked in supermarkets mainly during the German marketing season (June/July). According to the German market information company Agrarmarkt Informations-Gesellschaft mbH (AMI) in 2020, 92 percent of private household purchases of sweet cherries occurred in June and July, and six percent in August .

In contrast, purchases of peaches, which are hardly grown in Germany, are more evenly distributed between May and October. This seasonal availability explains the lower per capita consumption of cherries (2.7 kg) compared to peaches (3.4 kg). Nonetheless, **per capita consumption of cherries is more than twice as high as for plums (1.1 kg).**

In recent years, **sweet cherries have become a trend item** that benefitted from increased health consciousness and the growing popularity of snacking. In contrast, plums are mostly used for baking and cooking. For sweet cherries, consumer preferences clearly trend toward larger sizes (>26 mm/1.024 inches).

Smaller cherries sell at a large discount. For example, in the week of June 27, 2022, the average wholesale price for domestic sweet cherries amounted to 5.18 Euro (USD 5.208) per kg for larger cherries but only 3.12 Euro (USD 3.13) per kg for cherries smaller than 26 mm.

The use of sour cherries for processing is relatively stable and roughly amounts to 70-90 percent of German domestic production. The majority of sour cherries are used for canning (over 70 percent), while the remainder is used in juice production.

The percentage of **sweet cherries used for processing** fluctuates between 30 and 50 percent depending on the weather during harvest, as rain damage increases the percentage that goes into canning or distilling into spirits.

Processing of cherries into dried fruit is not common in Germany. The s**mall but growing demand for dried cherries** is met with imports. Due to lack of a product specific HS code, data on dried cherry trade is not available.

Source: Overview on the German Cherry Sector 2022 (USDA, September 2022).

29. IN ITS OWN SMALL WAY... IN CHERRY ORCHARDS, PIEDMONT INVESTS BIG!

Piedmont is one of the few Italian regions showing signs of vitality in the cherry sector.

In fact, while Puglia, Campania, Veneto and Emilia Romagna have been struggling for years to maintain their positions as leading regions in the national production of cherries – some of which, according to the latest ISTAT 2023 data, are continuing to retreat both in terms of new areas planted with cherry trees and in terms of annual harvests – from Piedmont, on the other hand, there is renewed interest in the red fruit of paradise. But why?

There are several reasons for this:

- The cultivation of cherry in Piedmont has found fertile ground for expansion, especially in the plain and hill areas of the Cuneo region, territories traditionally dedicated to the cultivation of apple, nectarine and kiwi trees. The new interest towards cherry cultivation probably stems from the crisis that affected kiwi cultivation a decade ago, due to dieback and other health problems.
- At that time, large corporate groups operating in fruit growing (e.g. Rivoira and Sanifrutta) planned ambitious investment projects on the cherry tree, using and exploiting the best of the world's knowledge in terms of product and process innovations to create a highly specialised cherry sector.
- For example, the Rivoira group a few years ago planned a multi-year project that will result in 200 new hectares of cherry trees. Sanifrutta and Joinfruit have planned a similar one for 80 new hectares.

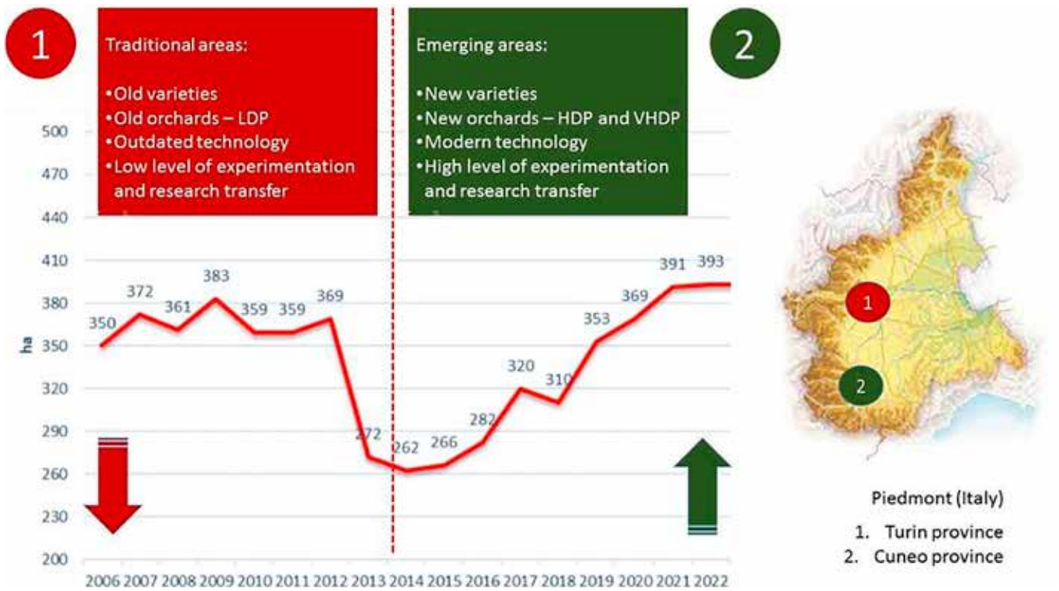


Image 1: Evolution in cherry tree cultivation in Piedmont.

Image 2: New cherry tree plantings at the 4th leaf at Sanifrutta (Cuneo, Italy).

Image 3: Variety Sweet, one of the main innovations introduced by the Rivoira group.

- In the new projects, process innovation includes the planting of high or very high density cherry orchards with dwarfing rootstocks, narrow-walled forms of cultivation such as the bibaum or columnar axis, multitasking covering and defence systems, modern technologies for selecting, processing and packaging cherries.
- In the varietal sector, the new Piedmontese companies initially invested in the Trentino / Alto Adige model by focusing on two late varieties of undoubted value: Kordia and Regina. Subsequently, in order to broaden the calendar of cherry supply and seek to improve the varietal standard and make it more responsive to the needs of domestic and foreign markets, product innovation also proved to be a decisive lever for the development of the cherry sector.

Image 4: The late varieties of the Final series are exclusive to Sanifrutta in North-West Italy.

- Many companies invested in early varieties (e.g. Sweet series, Nimba, Red Pacific and Frisco), others, exclusively, in some extra-late varieties (e. Final series).
- The introduction of a new variety should only take place after qualified experimentation. Luckily for the fruit growers in Piedmont, they have a very efficient, well-established and super partes varietal evaluation system that can guarantee certain and timely answers.
- In this context, the research carried out by Agrion Foundation researchers at the experimental farm in Manta (Cuneo) offers producers an excellent guiding tool for a correct varietal choice for new plantings.

Below are the latest results on Agrion's cherry varietal innovation presented in Manta (Cuneo) last July on the following varieties:

- Early Star® Panaro 2
- Glen Blush*
- Folfer*
- Cerasina® Prim 3.1
- Arvin Glen*
- Poisdel*
- Sweet Lorenz® PA2UniBo*
- Mariant* Giant Red®
- Marysa*
- Grace Star*
- El Capitan*
- Cambrina*
- Sweet Gabriel® PA3UniBo*
- Kordia Attika®
- Sweet Valina® PA4UniBo*
- Starland*
- Royal Helen*
- Henriette*
- Klara*
- Emma*
- Betti*
- Kir Vulcano®
- Babelle*
- Sweet Stephany® PA7UniBo*
- Fertard*
- Feroni*
- Regina
- Balrine*
- Cerasina® Final 11.3
- Kir Lamour®
- Cerasina® Final 12.1
- Cerasina® Final 13.1
- Kir Rosso®
- M2058

Cherry Times would like to thank the director and staff of Agrion for sharing the results of their research on the cherry tree with us.

Stefano Lugli – SL Fruit Service
Chair of Cherry Times technical-scientific committee

30. READ MORE ONLINE

Scan the QR codes below to unlock a world of cherry content. Each code will guide you directly to categories on our website, giving you instant access to in-depth articles, specialised knowledge and thorough information about the global cherry industry!

VARIETIES

TECH MANAGEMENT

ROOTSTOCK

CROP PROTECTION

MARKETS

POST-HARVEST