

# ipóma

Tomorrow's Harvest Impressions — Rise and Fall Red Delicious  
Precision and Prediction Interview — Quo Vadis, USA? Market Report  
Flavor and Variety Portrait — Love and Craftsmanship Japan



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# Welcome

## Dear Readers,

Interpoma is back! And it's packed to the rafters with new themes, new insights, and new ideas. This time at the world's only trade fair dedicated exclusively to the apple we shine the spotlight on resource use, new technologies – and the USA as an apple nation. We take a look at the dynamics in the country, which, as we know from the past, often pioneers global developments. **ipoma**, the official Interpoma magazine, provides a fascinating deep dive into the issues that matter, not just to trade fair participants, but to the entire apple industry. The articles on the following pages are brimming with insights into the future, the past, and the hot topics of today.

Besides the main themes of the fair, in this issue we also look at the rise and fall of an erstwhile icon: the Red Delicious. Precision agriculture experts Luigi Manfrini and Luca Corelli Grappadelli discuss artificial intelligence in fruit orchards in a double interview. Walter Guerra, coordinator of the Interpoma Congress 2022, tells us about his eventful career path into research. And we check out the traditions surrounding apple cultivation in Japan and visit Normandy, where apples that are no good to eat become a sparkling surprise when transformed into cider and calvados. Join us on our exciting journey through the world of apples!

**Interpoma 2022 takes place from November 17 to 19, 2022.**

**We hope you enjoy reading our magazine!**

**The ipoma team**



**100% apple**

**This magazine is printed entirely on apple paper – paper made out of waste from apple juice production. That's how versatile the apple is.**

**Do you have any suggestions, ideas or feedback?**

**Get in touch at**

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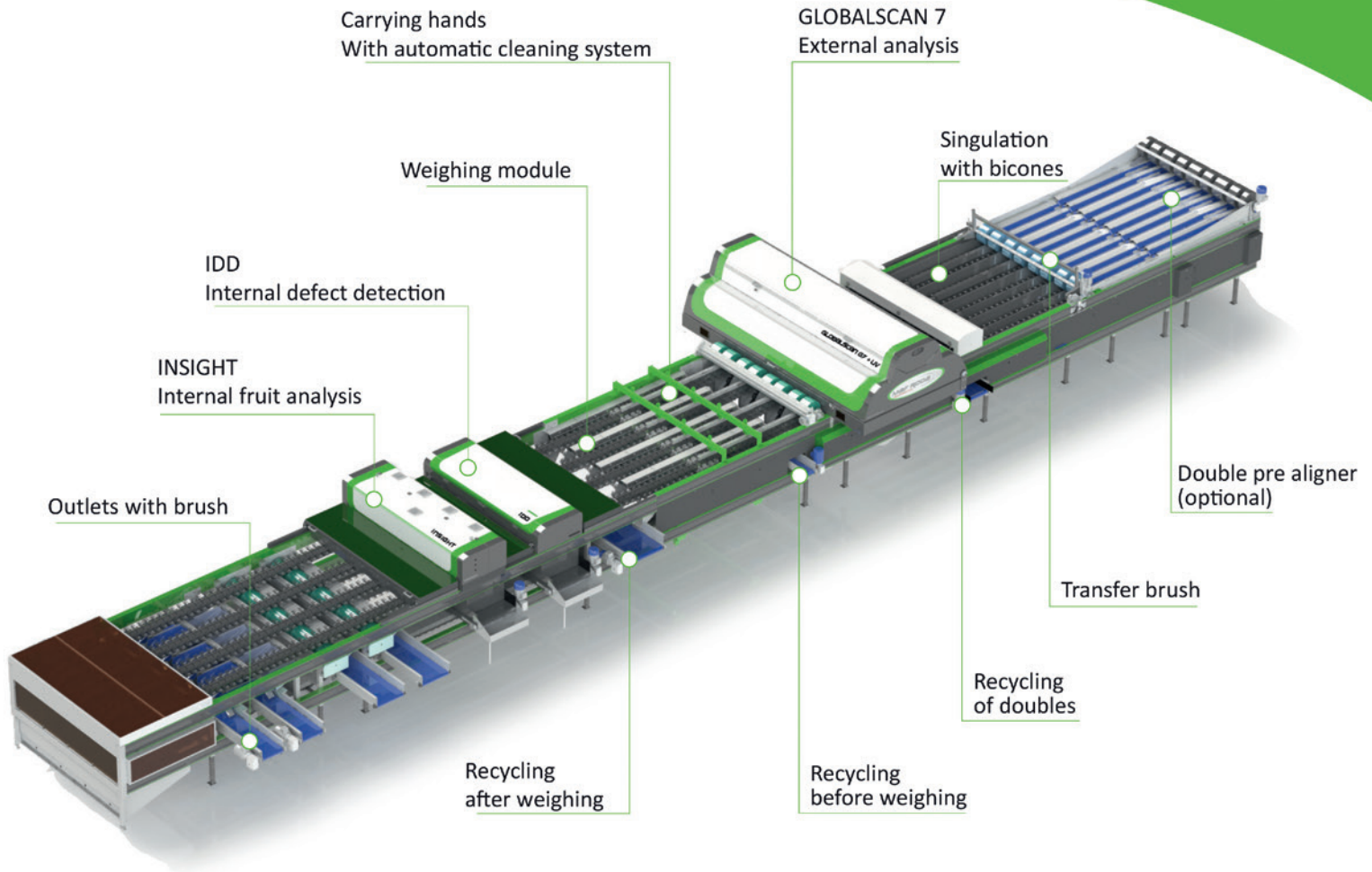
— The number of apple-themed images the editors sorted through during their research. 82 made it into the magazine.



— The number of apple varieties the editorial team got to sample during production.



— The number of times the word "tree" appears in this issue: 31 times in the singular, 26 times in the plural.



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# Features



## Tomorrow's Harvest

From manual labor to full automation. A journey in pictures. [\\_\\_\\_ 06](#)



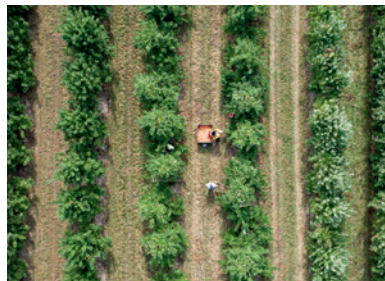
## Rise and Fall

End of the line for a superstar: why the Red Delicious has gone downhill. [\\_\\_\\_ 18](#)



## Precision and Prediction

We talked to two precision agriculture experts about automation and the future of apple farming. [\\_\\_\\_ 24](#)



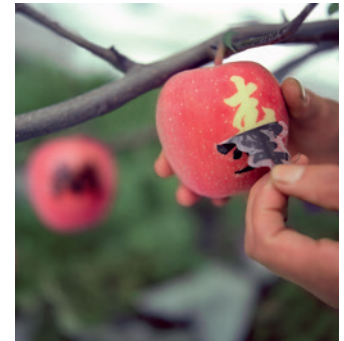
## Quo Vadis, USA?

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## The Visionary

Testing, tasting, selecting: Pomologist Walter Guerra talks about his life as a researcher. [\\_\\_\\_ 46](#)



## Love and Craft

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# Yesterday, Today, Tomorrow

Despite a succession of new technologies and mechanical aids, *apple picking* has always been a largely manual task. Now we are on the brink of a revolution: fully automated harvesting.

## 01

The most sophisticated harvesting system in evolution: the human hand. The complex interaction of eye, hand, and brain – recognizing fruit, assessing ripeness, gently picking, collecting – has been the subject of many simulation attempts with automated systems in recent years. Italian start-up Aigrtec's picking robot (pictured, see also p. 63) works by combining artificial intelligence (AI) and robotics.



## 02

Created in around 1624-1650, the copper engraving “Autumnus” (Autumn) by the Dutch artist Pieter Stevens shows how apple harvesting was done for centuries. Entire families picked apples in an orchard together, collecting them in baskets and wooden barrels which they then took away on their backs or on horse-drawn carts.

## 03



Tall, home-made picking ladders with wooden rungs and picking sacks made of cloth were the only tools available to many generations of harvesters in the apple-growing region of South Tyrol. Harvested apples were taken away on horse-drawn carts and, from 1867, by the newly-built railway. The first fruit cooperative was established in 1893.

Technology finds its way into the apple orchard: hydraulic picking machines pulled by tractors made lighter work of harvesting in higher treetops, as seen here: a model from around 1989 in action in South Tyrol.



## 04



05



Innovations are sometimes about very small steps – and, at first glance, very simple ones. For centuries, apples were collected in simple baskets and bags, until inventive minds took this one step further. The 1970s saw the introduction of picking buckets that could be opened on the underside for gentle emptying. With shoulder pads, back straps and thigh protectors, they also made the manual work a little easier.

07



“MARS” in action: Professor Chao Chen developed the Monash Apple Retrieving System with his team at Monash University in Australia. “The system is able to pick apples in complex canopies – not just in heavily modified 2-D fruit walls,” says Chen. This cuts the cost of adapting the orchard systems for automation. “We want to create orchard-friendly robots, not robot-friendly orchards.”

ipoma

06

Picking is still done by hand, with machines providing a helping hand: innovative systems are already used for harvesting in many growing areas. Knecht, well known for its harvesting systems and self-drive lifting platforms, also makes complex machines such as the prototype V300, of which only two examples have so far been produced.



08

Ripe Robotics from Australia named their harvesting robot after the biblical apple picker. “Eve” gently sucks apples from the tree with minimal pressure damage compared with picking by hand. The system is currently undergoing testing for commercial use.





## 09

Flying high: Israeli startup Tevel uses agile, relatively low-cost drones that use suction cups to reach all the fruits on the tree. A TV documentary inspired Tevel founder Yaniv Maor to develop a high-tech solution to the extreme labor shortage: in the TV program, young people tried their hand at harvesting work – but all of them gave up after only half a day.

**75 percent** of all apples in India grow in Kashmir. Yields are only around **11.5 tons** per hectare, with climate change and cheap Iranian imports threatening the sector and its **3.5 million** jobs. The region is therefore currently trialing fast-ripening varieties, drip irrigation, and high-density orchards.

Sources  
Younis Dar/The Probe/  
Outlook India

# Did You Know...

## HISTORY



## ... that hail was once fought with rockets and cannons?

**Shooting skyward:** Before hail nets and insurance against crop failure came onto the scene, for centuries hailstorms deprived people of their income from months of hard work in a matter of minutes. Therefore, the history of hail suppression – from ritual weather bell ringing to the controversial process of cloud seeding by aircraft with silver iodide – is also one of powerlessness. The curious phenomenon of anti-hail rockets originated in France and Italy in the 20th century. Between 1950 and 1980, 123,000 rockets were fired into the sky in South Tyrol alone, using 230 tons of explosives. On August 17, 1967, it actually felt as if war had broken out when farmers between the towns of Lana and Caldarò fired 2,272 rockets in the space of just a few minutes to ward off hail – but without success.

## POMOLOGY

## ... that one apple variety in Campania goes back to Roman times?

**Heritage variety:** The area around Naples is where the small, white-fleshed Annurca apple grows, a variety described by Pliny the Elder and discovered on wall paintings in Pompeii. The apple is harvested unripe, and its post-harvest treatment dates back to Roman times: the apples are placed on the ground in small reddening plots known as “melai”, traditionally on straw or hemp but nowadays on fleece and woodchips. In the mild, dry late autumn, the farmers regularly turn the fruits by hand until they develop their red coloration. Sought after by fans and connoisseurs, the Annurca has PGI status (Protected Geographical Indication) and is marketed in the high-priced segment.



# Innovations

## START-UP 1 XFARM

### Digital Agriculture

**XFarm Technologies** raised an additional €17 million in growth capital from major technology investment funds in a series B financing round in 2022. The Italian start-up headed by CEO Matteo Vanotti develops digital solutions for farms and currently has 110,000 customers in 100 countries. Their latest tool, xldro, opens and closes irrigation valves remotely. [xfarm.ag](http://xfarm.ag)



## START-UP 2 PIXOFARM

### Export Champions

**Pixofarm** won the Born Global Champion Award in 2022 for its export achievements. Farmers in around 20 countries use the young Viennese tech company's smartphone app. The Pixofarm system uses Artificial Intelligence to accurately calibrate parameters such as fertilization and irrigation. The app also has functions for estimating harvest yields more accurately and counting harvest quantities quickly on-field by scanning the crates. [pixofarm.com](http://pixofarm.com)

## INTERPOMA AWARD SMART WATER MANAGEMENT

### Precious resource

**“More crop per drop”**: This is the motto of the Interpoma Award 2022. This year's award aims to reward technologies, machines, or systems that optimize water management in apple orchards in a particularly innovative way. True to the motto, the aim is not only to save water but also to improve yields and fruit quality at the same time. A jury of six Italian and international experts selected and judged the projects from submissions by companies, individuals, and start-ups.

**THE WINNING PROJECTS** — For details of the jury's decision and the winners of the Interpoma Award 2022, head to [interpoma.it](http://interpoma.it)



## PROCESSING DRIED FRUIT



Innovative process: With the DIC technology, the entire edible part of the fruit including the skin and core is used.

## Crunchy!

**Crunchy, not rubbery:** Dried fruit takes on a whole new texture with Controlled Immediate Decompression (DIC). This innovative technology is being researched by Laimburg Research Centre's Fruit and Vegetable Processing working group, headed by Elena Venir, with a DIC pilot plant at the NOI Techpark in South Tyrol. In other drying processes the structure of the apple collapses, turning it rubbery. But with DIC, a sudden drop in pressure induces immediate evaporation, causing the tissue to expand. Only then is it completely dehydrated. The result: a porous, crunchy consistency, and an attractive color. "What's more, the nutritious skin and core don't need to be removed: thanks to DIC they don't taste woody," Venir says. "This cuts production waste down to as little as 25%, opening the door to new products with a high nutritional value and exciting textures."

## SUSTAINABILITY PROJECTS

## Green future

### A more sustainable apple economy

is possible: so says the mantra behind numerous projects setting new standards in the industry. Environmental concepts, research projects and new technologies will make the apple sector more climate-friendly one step at a time.

1. The ecological **footprint of the apple** is the focus of a new project by the Italian apple producers' association Assomela and the Free University of Bolzano. The aim is to calculate the CO<sub>2</sub> emissions of apple production from orchard to supermarket and to find solutions to reduce their CO<sub>2</sub> balance that will progressively take the industry towards the EU objective of climate neutrality by 2050. [unibz.it](http://unibz.it)
2. The APOT apple producers' association in Trentino is drawing up a **sustainability balance sheet** in accordance with Global Reporting Initiative (GRI) standards for the purpose of comparing and measuring the results of its sustainability measures. One of these measures is the appointment of a dedicated Sustainability Manager. [trentinofrutticolosostenibile.it](http://trentinofrutticolosostenibile.it)
3. **Sustainapple**, the sustainability strategy of the South Tyrolean fruit industry, comprises ten packages of measures covering plant health and climate-positive fruit growing; economic sustainability with a regional circular economy and family-run businesses; and healthy, high-quality food. [sustainapple.it](http://sustainapple.it)

# High-tech Jobs & Robot Arms

Ines Hanrahan, director of the Washington Tree Fruit Research Commission, sees harvest automation as a major opportunity for farmers – as well as a recipe against labor shortages and high costs.

*Ines Hanrahan heads the Washington Tree Fruit Research Commission (WTFRC), funded by the growers themselves (1+3). She herself has experienced the labor shortage (2) on the commercial fruit orchard she runs with her family.*

## 01 Will robotic harvesting herald the future of the apple industry over the next few years?

Yes – in fact, this route has already been mapped out for some time. Fruit growers here in Washington State were pushing for research programs on automation as much as fifty years ago. For years, breeders have only been developing varieties that are suitable for robotic harvesting, with uniformly ripening fruits that only need one picking, are not prone to bruising, and are easily recognizable on the tree due to their coloring. All new plantings have been converted to higher-yielding V systems or 2-D fruit walls. Robotic arms cope best with the latter.

## 02 Are robots a solution to the global labor shortage in agriculture?

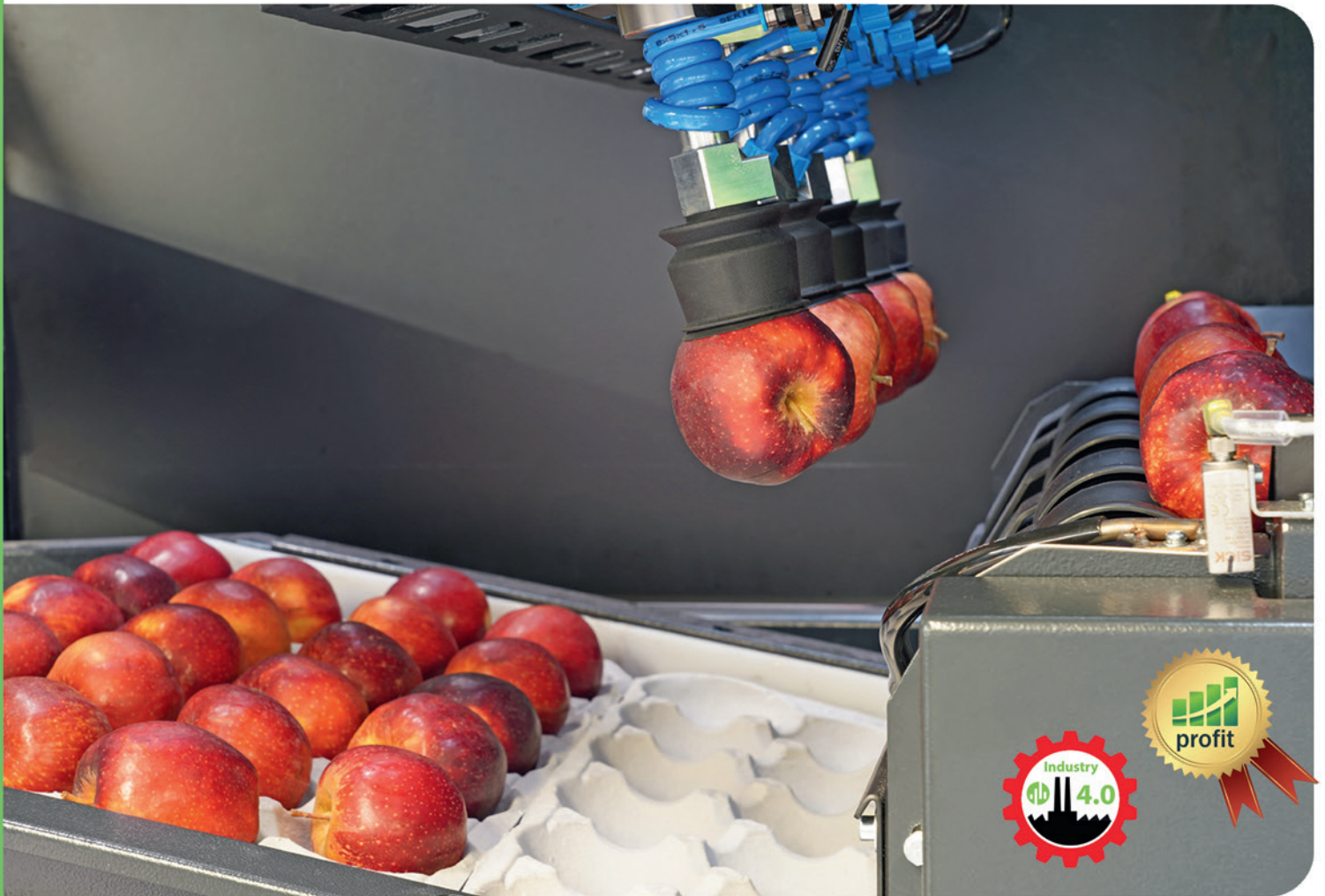
Yes, if you consider that harvesting accounts for up to 60 percent of the cost of an orchard operation. Migrant workers are a bigger financial burden for small farms these days, and robots can absorb workload peaks during the harvest period. Plus, today's young people aren't interested in jobs in the agricultural sector but in technology and sustainability. In the future, fruit growing can be a high-tech job: data-driven and environmentally sound.

## 03 Which of the robotic systems currently being tested as prototypes is the most promising?

The cameras that recognize the fruits all work equally well. The problem is the robotic arms, which are complicated and expensive. Luckily, there are several competing approaches: competition is good for innovation. The system most likely to prevail will be the one that offers farmers the best local service, works reliably for days on end – and gets the apples into the crate without squashing them.







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The *Red Delicious*, mother-in-law's favorite. Why has an apple that looks so appetizing with its deep red coloration and conical shape fallen out of favor?

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# The Fall of an Icon

For 70 years, the Red Delicious dominated the apple market in the USA. But now the iconic fruit has become little more than a decorative object. Delicious by name... but for most people, no longer by nature. *Why is that?*

By Bettina Gartner

Photography by Alexandr Kokan/iStock; Sam Armstrong/Getty

Red Delicious is my mother-in-law's favorite, an internet user shares with a forum's readers. His mother-in-law also eats only well-done meat and doesn't like chicken or eggs. In other words, this woman has a questionable palate. But she is old enough to remember the times when the Red Delicious was the number one apple on offer. In fact, it was US consumers' apple of choice for decades. Competitors didn't stand a chance. That there are internet forums today on which people get wor-

ked up over the question of why anyone would still buy a Red Delicious at all shows what a massive fall from grace the former market leader is undergoing.

Why have customers lost their appetite for an apple that, with its deep red color and elongated shape, literally looks good enough to eat? Have they had their fill of them over the years, or do new varieties simply taste better?

## “The Red Delicious has become a victim of its own success.”

Markus Bradlwarter, *Managing Director of the South Tyrol Variety Innovation Consortium*

“Red Delicious has become a victim of its own success,” says Markus Bradlwarter, Managing Director of the South Tyrol Variety Innovation Consortium. “The focus has increasingly been on cosmetic appeal, and people forget that the quality on the inside also counts.”

In its early years, the Red Delicious delivered on inner qualities such as tasty flesh. Back in the 1880s, the “father” of this apple, Jesse Hiatt, even dubbed it the “best apple in the world”. Walking through his orchard one day in 1872, the lowan fruit farmer had discovered a chance seedling among his trees which he didn’t want and chopped it down. But the interloper – which was thought to be an offshoot of the Yellow Bellflower variety – just wouldn’t go away. Hiatt gave in, and the tree went from strength to strength. After a few years, it produced a new apple variety, which Hiatt named “Hawkeye” after the nickname of his home state.

This ancestor of the Red Delicious looked nowhere near as promising as today’s specimens, either in shape or in color: it was strangely elongated and heavily striped. But it tasted good. When in 1893 the Stark Brothers Fruit Company of Louisiana ran a nationwide competition to find the “apple of the future”, the Hawkeye won over the judges at first bite. “Delicious!” Clarence M. Stark, the company’s president, reportedly proclaimed after tasting it. And that is how Hiatt’s apple, the rights to which were later bought up by the Stark Company, got its name. However, the high-flyer’s career was almost nipped in the bud when the data sheet containing Hiatt’s name and submission details disappeared. If Hiatt – who was as resolute as his tree – hadn’t tried his luck again

the following year, the apple’s story would have been very different.

The Stark Company spared no expense or effort to popularize the “Stark Delicious”, as it was known at the time. The new variety proved to be wonderfully uncomplicated, as it was resistant to fire blight and not prone to cedar apple rust. It wasn’t long before orders started flooding in. When the Stark Company added the Golden Delicious to its assortment in 1914, Hiatt’s apple was given the attribute “Red”, even though the two varieties bore no resemblance to each other bar the name.

Red Delicious: the name said it all. The ideal apple had to be red because red represents ripeness – and ripeness represents flavor. In 1923, a fruit farmer in New Jersey who had planted Red Delicious in his orchard noticed a branch on one of his trees with fruits that turned red earlier than the others and produced a deeper, more uniform color. These mutant branches, known as sports, which grow from spontaneously mutated buds and can be propagated by breeding, are not uncommon on Red Delicious trees. The Stark Company bought the New Jersey fruit farmer’s special branch for \$6,000.

This news struck a chord with breeders, who began working tirelessly to make the red of the Red Delicious even redder and the shape even more attractive. Elongated, conical fruits borne on spurs promised commercial success. In South Tyrol, these apples thrive particularly well at an altitude of 400 to 800 meters, where the days are still warm in the fall, but the nights are already noticeably cool. “The temperature differences are crucial for the formation of sufficient gibberellins in the trees – plant hormones that make the shape taller,” Bradlwarter explains.

The original Stark Delicious was followed by the Ruby Red, Royal Red, Top Red, Starkrimson and numerous other spontaneous mutations. Everyone was happy: the producers had their mature, high-yielding trees in plantations the production costs of which had long since been recouped. Consumers had their affordable apple, which looked phenomenal. The fact that the growers focused on the appearance of the Red Delicious also benefited the trade, since its visual charms had the added bonus of increasing the apple’s shelf life: since the fruits of new variants turn red before they are ready to eat, they can be harvested earlier and stored for longer. Once harvested in mid-September, they will keep for a good three

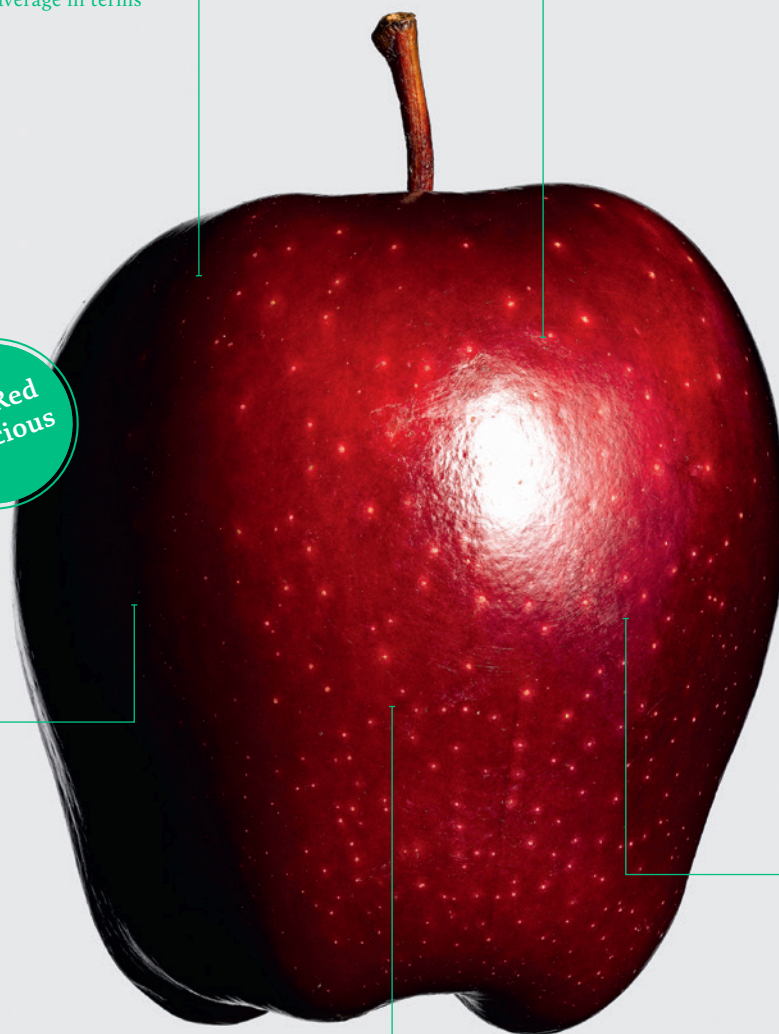
01

Balanced: The *sugar content* of Red Delicious (including skin) is between 11,3 and 12,5 °Brix. This puts the variety well within the apple average in terms of sweetness.

02

Off the mark: The Red Delicious is said to have lost its flavor because the *red coloration* was intensified. Experts disagree with this notion.

The Red  
Delicious



03

Healthy: Compared to other apples, the Red Delicious is particularly rich in *polyphenols*. These substances, which are found in or directly below the skin, reduce the risk of certain types of cancer, support the immune system, and have an antioxidant effect.

04

Double-edged: Apple seeds contain vitamins and minerals, but also *amygdalin*, a substance that can release toxic hydrogen cyanide into the body when consumed. But like all apples, the Red Delicious contains very low levels of amygdalin, so the seeds can still be eaten.

05

Not well tolerated: Red Delicious apples are not recommended for people with an *apple allergy*. Better suited are varieties such as Belle de Boskoop, King of the Pippins (Reine des Reinettes) and Glockenapfel.

## “The goal of improving storage by slowing down ripening has had a particularly negative impact on quality in Red Delicious.”

Fabrizio Costa, *Professor of Agricultural Genetics at the University of Trento*

months at refrigerator temperature. Other varieties go soft after just a week. But the Red Delicious stays looking fresh for so long that the New York Apple Association recommends it as a decorative object in wreaths and holiday table centerpieces. Like a Coca-Cola bottle, the Red Delicious stands firm on its five bumps, encased in its comparatively thick skin. “When it comes to shipping and handling, the skin can’t be thick enough, as it protects the fruit against bruising,” Bradlwarter says. “Although it can be tough to eat.”

That sounds as if the inside of the Red Delicious doesn’t keep what its exterior promises anymore. What about that first bite – the “crispness” the experts refer to? The “crunch” that describes the sensation you get when you chew? Like other old varieties, the Red Delicious tends to turn mealy quite quickly. We describe an apple as “mealy” when the middle lamellae – the thin, glue-like layers that bind the cells together – separate under pressure when we chew, instead of the cells rupturing and creating that typical crunch. Fragments of these middle lamellae remaining in the mouth leave unpleasant residues behind.

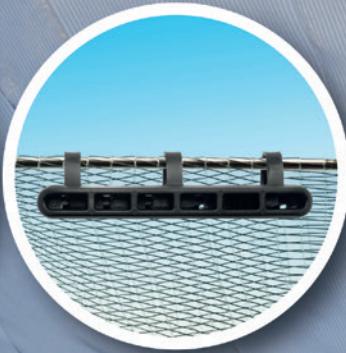
The disintegration of the cell structures is stimulated by the hormone ethylene, which causes the fruits to ripen in the fall. As scientists led by Fabrizio Costa, Professor of Agricultural Genetics at the University of Trento, have discovered,

ethylene also plays an important role in the taste of apples with a mealy texture: it promotes the production of flavor carriers such as alcohol and esters. If ethylene is not present, the aroma disappears. Modern storage methods, in which the oxygen content of the air is lowered and the carbon dioxide content is increased, reduce the formation of ethylene. This enables Red Delicious apples to be stored for a good eight months – albeit at the expense of flavor. “The goal of improving storage by slowing down ripening has had a particularly negative impact on quality in Red Delicious,” says agricultural geneticist Costa.

A mouthful of mealy apple with no particular flavor is something that appeals to fewer and fewer consumers. In the US state of Washington, where two-thirds of all American apples are produced, the proportion of Red Delicious in the apple harvest has dropped from its peak of 75% in the 1980s to just 16% in 2021, and most of those are not eaten at home but exported. The Chinese love red apples as a symbol of happiness; in the Middle East, the Red Delicious with its five bumps still embodies the ideal image of the apple. “India, Greece, Mexico, Turkey, and Argentina are also tradition-bound markets,” says Walter Guerra, head of the Institute for Fruit and Viticulture at South Tyrol’s Laimburg Research Centre.

In the USA and Europe, other varieties have for some time now been elbowing their way onto the retail shelves once dominated by the Red Delicious, such as the Gala, market leader in the USA in 2021 with a 21% share, the Fuji, and the Honeycrisp. The logo of the Washington Apple Commission reflects the current diversity: a new, fantasy red, yellow and green apple has taken the place of the former Red Delicious. The apple of today should have a crisp, juicy texture and a complex aroma. “No-one is interested in a bog standard product any more,” Bradlwarter says. “It won’t be long before the Red Delicious disappears from the market altogether.”

But it still has a period of grace, as the world of the apple turns slowly. It can take anything between five and seven years for new trees to produce the same yields as old ones. And besides, clearing one hectare of apple plantation can cost around €15,000, and the bill for planting a new variety – including the irrigation system and hail nets – can be as much as €80,000 per hectare, Bradlwarter reckons. So all that buys the Red Delicious a little extra time. And the forum user’s mother-in-law on the internet will get to savor her number 1 apple for a few years yet. **BG**



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# Precision

# and

We talked to University of Bologna precision agriculture experts *Luca Corelli Grappadelli* and *Luigi Manfrini* about the technical future of apple growing, artificial intelligence and developments in China.

**Interview by** Barbara Bachmann

**Photography by** Andrea Pugiotto

# Predictions



**1** Precision optimizes prediction, says *Luca Corelli Grappadelli*. It enables you to anticipate future scenarios and steer them in the right direction.

**2** According to *Luigi Manfrini*, there is intensive work going on to mechanize the harvesting of fruit for the fresh market. Many universities and research centers already have robotics laboratories.

**You both work in the field of precision farming – a concept of farm management that uses digital technologies to monitor and optimize production. This method is well advanced in arable crops such as grains but is still in its infancy in three-dimensional crops such as apples. Why is that?**

Luigi Manfrini: There are several reasons for this. The first is the way the fruits are harvested. Unlike grapes, it is not easy to harvest fruit crops like apples by machine. Producers want to avoid damage to the fruits at all costs, as it impacts on sales. But that is not to say that we are not working intensively on mechanizing the harvesting of fruit for the fresh market. Many universities and research centers already have robotics laboratories that can identify the fruits on the plant for mechanical picking. The second factor is the structure of the tree. Fruit trees are three-dimensional, so the fruits are not only produced parallel to the ground, as in arable crops. The work going into precision farming in this sector is all about creating automation-friendly forms of cultivation. Another thing that makes the precision approach harder is a plant's accumulated experience.



## Climate change is making it more difficult to predict the seasons.

### Experience in the sense of memory?

Manfrini: Yes, exactly. Arable crops stay in the field for one season, but fruit trees can last for anything up to 25 years. They remember what happened in the past, and that makes things more complicated. For example, if a plant does not get what it needs to form flower buds the following year, the inflorescences can develop differently, which can be a problem.

### Can you give us one or two examples of technology that farmers are already using?

Manfrini: Systems that support decision-making are common in irrigation. They collect information in or near the orchard that gives an indication of the plants' irrigation needs. This is currently only available on an orchard-wide basis; we cannot yet respond to the needs of individual plants. But we can estimate how much water the orchard will need, thereby limiting the use of this resource, which in turn makes us more sustainable. These systems work with relatively simple sensors that evaluate variables such as temperature, relative humidity, or leaf surface wetness. Some companies have machine setups with much more advanced systems – video cameras or laser scanners – that can indicate the plant's productivity.

### How does precision benefit agriculture?

Luca Corelli Grappadelli: Precision optimizes predictions. Having an abundance of information from the fruit orchard enables us to anticipate future scenarios and steer the plants in the right direction. The aim is to optimize results: maximum quality and maximum quantity with minimum energy input. This includes minimal use of pesticides, fertilizers,

and irrigation, which in turn has a positive impact on the environment. Today's expert systems take the weather forecast for the next four days into account in their calculations of water demand. So if rain is predicted in four days' time, which will replenish the water supply used up yesterday, the system can stay dry for two days.

Manfrini: In the past, temperatures, frost, and rainfall used to be more uniform throughout the season. But in recent years we have noticed that the stable structures needed to produce the calculations for fruit orchards are no longer there because the variables in the environment are changing. Climate change is making it more difficult to predict the seasons: very heavy rainfall and prolonged periods of heat are no longer an exception. The fruit farmers of today often don't know how to deal with these events as they lack the value of experience and the intuition they need to do so. So precision engineering is the perfect complement to their knowledge.

### How can technology support people in apple growing – without replacing them entirely?

Corelli Grappadelli: The apple is a grateful species because we can harvest it over many days with no adverse impact on quality. A number of processes around the apple tree are already mechanized, and yet we are finding fewer and fewer people willing to work in an orchard. This work needs an image boost, otherwise we won't be able to get anyone to do it. I am convinced that the new role of system operator will make apple growing more attractive and will help ensure its viability going forward: a specialist working remotely will be able to control a certain number of robots in a certain number of orchards.

### What knowledge will employees with a technical background need for this?

Manfrini: People who work in cooperatives in the decades ahead will need to have different skills than orchard technicians of the past. They will need to be able to interpret the information obtained from the sensors in the orchard correctly and relate it to the practical and technical information coming from the fruit growers. The aim of precision fruit farming is to provide objective clues as to what is happening in the orchard. Based on this information, we can make fruit production more sustainable, lower costs, and reduce the use of inputs, chemicals, and fertilizers.

### What developments already exist in the field in terms of innovations in apple harvesting and apple harvest predictions?

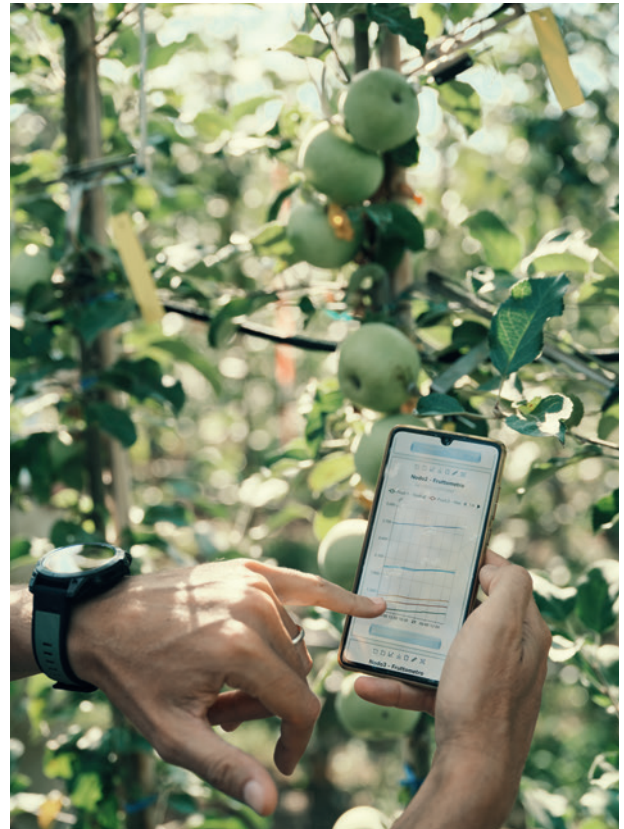
**Manfrini:** Some companies are developing prototypes that harvest apples using drones or some kind of mini vacuum cleaner, for example. But as far as I know, these systems are not yet on the market. When it comes to identifying the quantity of fruits on a plant, there are already several commercial offerings available based on artificial intelligence. Here at the University of Bologna we also offer a service that provides an indication of a plant's productivity, although not with the help of innovative systems but with simpler approaches that do not involve the fruit grower investing large sums of money. In fact, the benefit-cost ratio is often a reason why many farmers are reluctant to use the precision approach. And yet objective information from the orchard is extremely important even for small farms, because a minor mistake can sometimes mean a substantial loss at the end of the season.

**What role does artificial intelligence play in precision agriculture?**

**Manfrini:** It is an essential component of it. We have seen

how complex the orchard system is because we capture the information it contains at different times and in different places, analyze the data as accurately as we can, and feed it back again. The systems used for this need to adapt to the increasing variability of the environment, which I touched on earlier. Artificial intelligence and artificial neural networks are the most important approach for analyzing data from an orchard.

Prototypes are being developed that harvest fruit using *drones*. Artificial intelligence is key to *analyzing data* from an orchard.



## “Technology brings a number of benefits. But I believe that we need to promote dialog in society.”

Luca Corelli Grappadelli, *Professor of Agricultural Science*

### Now let's move on to what Big Data means for the apple industry.

**Manfrini:** Fruit orchards generate huge information flows. This information can provide insight into future developments in productivity which is then communicated to the markets in advance. All this information can also serve as a recommendation for the fruit grower on the best techniques and approaches to use. So managing this big data gives an indication of how to move forward both at the market level and at the technical level. As in many other areas, the value of data is steadily increasing in the apple sector.

**Corelli Grappadelli:** We are collecting and will continue to collect large volumes of data that we will use to train and test neural networks over the next ten years. Once these networks have reached the level of accuracy we want, it is very likely that they will also tell us which data they no longer need. This will make our work much easier.

**Manfrini:** We will probably get to the point where we no longer even need sensors in the field because the existing baseline information can already predict what could happen based on experience from previous data streams.

### Could there be counter-developments to this?

#### And if so, what kind?

**Corelli Grappadelli:** I suspect there will be, as some people reject the concept of technology and the advances associated with it by definition. Sadly, we have already seen integrated farming being unfairly denigrated. I therefore believe that we need to promote dialog in society. Technology brings a number of benefits, including reducing carbon emissions. We are trying to minimize the price, for example



*Luca Corelli Grappadelli (l.), full professor at the University of Bologna, conducts research in the light and water physiology of plants, from which algorithms for precision fruit growing are derived. In the context of EU projects he also studies the relationships between the environment, technical management, and fruit quality. He is vice-president of the International Society for Horticultural Science's Temperate Tree Fruits division and chairman of its Environmental Physiology and Developmental Biology workgroup.*



Fruit orchards generate enormous *information flows*. They help inform future developments in productivity.

## “China has been heavily subsidizing precision research. But there is a shortage of experts.”

Luigi Manfrini, *researcher in Pomology and Nursery Management*

by using plastic to reduce consumption of fossil fuels. Plastic can at least be recycled. We are researchers and do not advocate a single solution a priori. We assess the situation and try to understand how we can act in the most environmentally friendly way. Science knows that there are no certainties; it is always looking for new evidence. In my opinion, it gets dangerous when its findings are completely ignored in some circles.

### What developments are you currently observing in other parts of the world, in China, for example?

Manfrini: China has been heavily subsidizing precision research for a long time. But in my opinion, there is a shortage of experts with scientific expertise there. Some years ago, I attended a conference in Xinjiang as a speaker. What struck me most was the level of demand for specialists from abroad – both from companies and from research centers. Specialization in certain subjects is probably very high in China, but at the same time I think they have trouble combining knowledge from different sectors. They are unable to apply the expertise in the practical setting and still need information from elsewhere to boost their competitiveness.

### What is your vision for the future?

Manfrini: I believe the future lies in plant-based farming systems, in other words managing each individual tree in a plantation of thousands of trees with an individually tailored strategy. And I would go even further, because I believe that precision will take us right down to the level of just a few centimeters, meaning that we can focus on a single branch with all its fruits and shoots. **BB**



*Luigi Manfrini*, chairman of the “Robotic Harvest” session at Interpoma Congress 2022, is a lecturer and researcher in Pomology and Nursery Management at the University of Bologna. He focuses on application of new technologies and precision management coupled with the effects of the environment on fruit tree physiology with the aim of developing new strategies to improve orchard sustainability whilst maintaining high quality and yields. He is involved in several international projects addressing issues relating to precision management, sustainable fruit production, and efficient resource use.



# SMART ORCHARD MONITORING

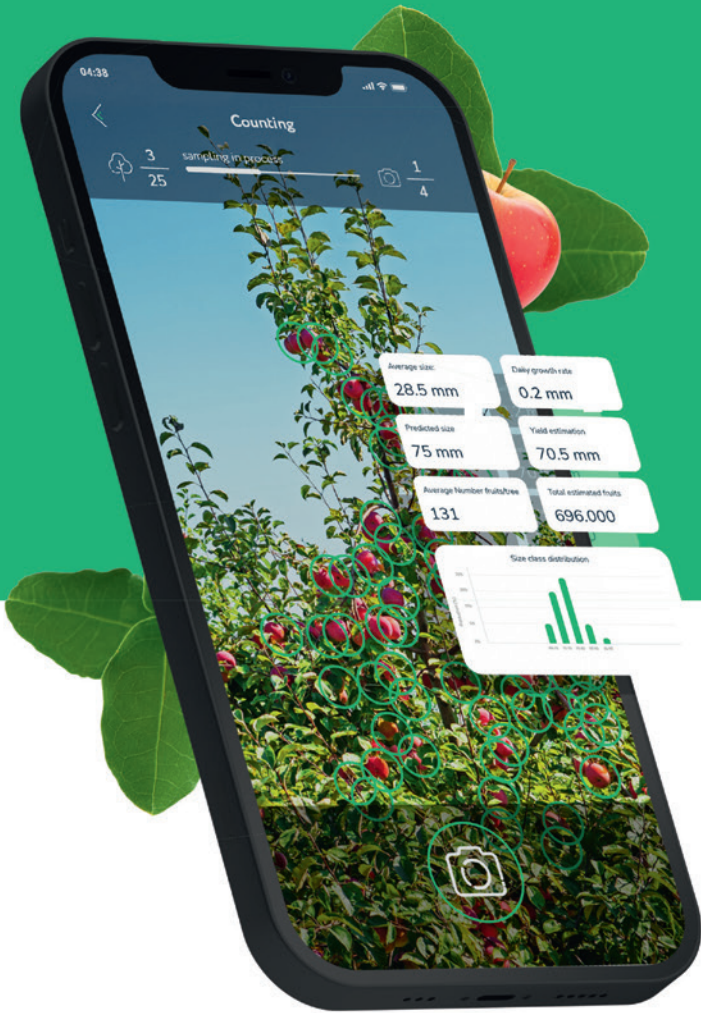
Make informed decisions before & after harvest.

YIELD ESTIMATION

COUNTING

SIZING

BIN SCAN



## RECEIVE INFORMATION ABOUT ...

- ✓ number of fruits per tree and orchard
- ✓ average fruit size
- ✓ size class distribution
- ✓ growth rate
- ✓ yield estimation
- ✓ information about number of fruits, size class distribution and fruit color for each bin
- ✓ weather data

## NO EXPENSIVE HARDWARE NEEDED

Easily count your fruits, get the size classes and monitor your yield, using just your phone.

## SAVE TIME & RESOURCES

## BETTER DECISIONS ACROSS THE ENTIRE VALUE CHAIN

By getting the right information at the right time you can make smarter choices about on-field operations, logistics, sales and marketing.

“Before and after the harvest - Pixofarm gives you the ideal basis for decisions”

- Martin Anhof, fruit grower & agronomist

With Pixofarm Martin keeps track of the growth and state of his apples. He can easily control and steer his manual thinning efforts, knows his yield weeks before harvest and can start with logistical measures early on. After the harvest, Pixofarm provides him with great information about the harvested apples in the bins months before the apples are sorted.



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# Quo Vadis, USA?

Since the 2000s, the USA has risen to the top in the apple world. It got there by using the latest technology and investing vast sums of money in research, diversity, and development. But this rapid rise also carries risks. *We take a wrap-around view.*

By Susanne Pitro

Photography by Bloomberg, Alamy, EyeEm, AP, Washington State University





Gala harvest in the US state of Michigan. With *private and state capital* in plentiful supply, the US shows the direction the global apple industry's technological journey will take in the future.

# “For the past few years, we have increasingly been struggling with climatic anomalies.”

Tim Welsh, General Manager of Columbia Orchard Management (COM)

A dry climate with low humidity, little rainfall, and big temperature differences between cold nights and warm days – coupled with fertile, often volcanic soils and no end of water from rivers and lakes. This makes places like Wenatchee Valley, Yakima Valley, Columbia Basin, Lake Chelan, and Okanogan perfect apple growing country. An estimated 3.1 million-plus tons of apples were grown here across more than 70,000 hectares in the 2021/22 harvest year. Two out of every three fruits picked in the USA come from these areas in Washington State, the epicenter of the US apple industry.

Since the turn of the century, the USA has become one of the big players in the global apple business alongside China. Reason enough to take a closer look at the market giant – perhaps even helping to predict developments in other countries. Most things run smoothly in North America, but as elsewhere there are challenges that can only be resolved with vision and a united approach. “For the past few years, we have increasingly been struggling with climatic anomalies,” says Tim Welsh. The General Manager of Columbia Orchard Management (COM) has worked in the apple industry for 42 years. In summer 2022 he has just come through the coldest spring of his entire career. Slap bang in the middle of the apple blossom season, 30 centimeters of snow fell in Wenatchee and the temperature didn’t rise above 15 °C (or 60 °F) until June. “In 2021, on the other hand, we had had the other extreme: a record heat wave and 44 °C, or 111 °F, in June, which put trees and fruits under extreme stress,” says Welsh.

COM is the operating arm of Columbia Fruit Packers, one of the largest marketing organizations for apples and cherries in the USA. And it’s not only weather extremes that are causing stress there: labor shortages are another major

headache. The phenomenon of the Great Resignation – record numbers of people leaving their jobs since the Covid-19 pandemic – had already been looming in US apple orchards for some years. Government policies and the pandemic restricted the numbers of immigrant workers entering the country, while “we are losing domestic workers faster than we can replace them,” according to the Industry Outlook 2021 by USApple. The interest group representing the 26,000 US apple growers and 3,700 companies in the apple sector estimates that employment in apple orchards fell by an annual average of 20 percent between 2014 and 2020, while labor costs rose. This

**1 + 4** Alongside China, the USA is one of the *big players* in the apple business.

**2** Wenatchee is a *stronghold of US apple production*. Two out of every three fruits picked in the USA come from Washington State.

**3** *Tim Welsh* is General Manager of Columbia Orchard Management (COM), the operating arm of the largest American apple marketing organization.





**1** Technologies from all over the world can be trialed at the large, vertically integrated orchards in the US. Currently, researchers are working flat out on harvesting robots.

**2** Italian pomologist *Stefano Musacchi* is Endowed Chair at Washington State University.

**3** To combat heat damage in increasingly hot summers, fine water mists and nets are being tested in Washington's orchards.

is a huge problem to which – like the challenges of climate change – there is only one answer: technology. Or in other words, research into new technologies and varieties.

“It would be presumptuous to say that Washington State leads the world in developing new technologies,” Welsh says. “But one thing is certain: no-one involved in developing technology can afford to ignore Washington.” Yet for a long time there was very little interest worldwide – including from South Tyrol’s apple experts – in what was happening on the other side of the Atlantic. “Fifteen years ago we would not have chosen to spotlight the US apple market at Interpoma,” says Walter Guerra, head of the Institute for Fruit Growing and Viticulture at the Laimburg Research Centre. From product range to cultivation technology to marketing, everything in the USA felt old-fashioned in those days. But a lot has happened since then. First and foremost, many small businesses have evolved into large, vertically integrated companies. Technologies from all over the world can be tested on a large scale

there. The apple giants also have their own research and development departments.

“Around 80 percent of US apple production is in the hands of eight to ten companies in Washington. And we are talking about groups with plantations in the order of around 2,400 to 4,000 hectares,” says Stefano Musacchi. The Italian pomologist is Endowed Chair of Tree Fruit Physiology and Management at Washington State University in Wenatchee. Musacchi began his career at the University of Bologna and dived deeper into the apple business during a stint at the Free University of Bozen-Bolzano in South Tyrol. His reasons for accepting the Chair at Wenatchee in 2013 were mainly due to funding opportunities in the US system. “In just nine years in the USA, I have raised 5.7 million euros in research funding for my program,” the pomologist says.

In Washington, one major source of funding for his research comes from the producers themselves. Since the late



**“In just nine years in the USA, I have raised 5.7 million euros in research funding for my program.”**

*Stefano Musacchi, pomologist and researcher in Washington State*

1960s, the Washington Tree Fruit Research Commission has received a very small share of all sales from fruit growing to finance research projects benefiting fruit farms. A ten-member commission, made up of representatives of fruit producers, regularly issues guidelines on what specific research the three to five million dollar budget should be spent on. “As a researcher, it’s then a matter of designing your projects to align as closely as possible with the commission’s goals so that they can be approved,” Musacchi explains. But the funds are also intended as a form of seed capital for larger-scale ideas. “If you look for partners for your subject in other US states, you can put together a more wide-ranging project – as happens with EU projects – and get much more lavishly endowed research funds from the federal government,” the professor says. He has already carried out four such federal research projects himself. “That has a lot of advantages, because in a sense I am multiplying the dollars that are available for my stakeholders’ research.”

With plenty of private and state capital, the US apple industry – and not only in Washington – is demonstrating in many areas where the technological journey will head in the future. Technologies are already available that allow all relevant orchard indicators to be recorded automatically, from tree growth and crop load density to the stress the trees are under. Cornell University’s Geneva rootstock series has been setting new standards for decades, for example in resistance to diseases such as fire blight and in quality traits such as fruit size and hanging density. To combat the increasingly hot summers and associated consequences such as sunburn, many US growers have already gained a lot of experience with nets, but also with fogging systems that envelop the tree canopies in a fine mist of water on hot days to prevent the fruit from overheating.



## “A recent survey revealed that there are currently 80 varieties on the market.”

Tom Barnes, *CEO of Category Partners LLC*

But the hottest topic by far is technology that can be used to automate orchard work. “Almost everything I am doing in apple orchards at the moment is geared towards preparing the orchards for automated harvesting,” says Musacchi. All trees must be aligned uniformly so that the fruit can be reached by a robotic arm. “And that arm only has one horizontal movement,” he adds. In other words, while agritech companies are working feverishly on robots equipped with interacting computer eyes, software, and robotic arms that can identify and pick ripe apples without damaging them, the cultivation systems must also be adapted to these new digital harvest assistants.

The motto in Washington’s apple orchards is: 2-D, not 3-D. Narrow, see-through “fruit walls” with short branches are ideal for robotic harvesting. The distribution of the fruits on the tree is also becoming more and more important. Cultivation systems are therefore being adapted accordingly. “We need to facilitate mechanical access while at the same time increasing yields from the new systems,” says COM’s Tim Welsh. “We are achieving 80 to 100 tons per hectare in some cases, but the average is still well below that.” While more and more apple orchards are being irrigated or protected from frost automatically and activities such as spraying, mowing, and tree maintenance are increasingly being done by machines, the big breakthrough in automated harvesting has yet to come. What is more, the bankruptcy of one of the most promising robot producers has also put a major damper on Stefano Musacchi’s hopes of the technology being ready in just a few years from now. “There are a number of question marks at the moment. But there’s absolutely no question that automated harvesting is the future,” he says.



**1** The arrival of new *digital harvest assistants* means changes to cultivation systems.

**2 + 3** The enormous array of varieties is beginning to overwhelm US consumers, says market research expert *Tom Barnes*.

# The US Market in Figures

**#1** **5,034,875 t**

CONSUMED FRUIT IN THE USA

AMOUNT OF APPLES GROWN ANNUALLY IN THE USA  
(= 11.1 BILLION POUNDS)

**67%** **154,590 ha**

OF CROP IS GROWN FOR FRESH CONSUMPTION.  
30% IS USED FOR JUICE AND OTHER PRODUCTS

TOTAL ACREAGE OF LAND FOR GROWING  
APPLES IN THE USA

**7,000+** **1 of 4** **6.1 %**

DIFFERENT VARIETIES  
GROWN IN THE USA

FRESH US APPLES ARE  
PRODUCED FOR EXPORT

GROWTH FORECAST IN US APPLE  
PRODUCTION BY 2025

**26,000+** **616.9 M \$**

APPLE PRODUCERS IN THE USA. APPLES ARE  
GROWN IN ALL 50 US STATES

TURNOVER IN ORGANIC APPLES IN THE USA  
IN 2020 (15.5% OF TOTAL TURNOVER)



**1** W38 Cosmic Crisp® is the first variety to be bred in Washington State. The gray layer of kaolin clay protects the fruit from sunburn.

**2 + 3** Kate Evans, researcher at Washington State University, co-developed the Cosmic Crisp. The mother tree still stands on the university's Wenatchee site.

**4 + 5** The cross between Honeycrisp and Enterprise is the most successful *apple newcomer* of all time: just one year after its launch, Cosmic Crisp is the #7 best-selling variety.

**6** Since 2017, 14 million of the new trees have been planted in Washington.





6

## The Cosmic Crisp® is an apple that gets everything just right: color, texture, flavor – and storage properties.

What is already a reality, however, is that almost every harvest brings the US consumer an even greater choice of apples. But for Tom Barnes' liking, the range of apple varieties on offer has actually begun to overshoot the mark: "A recent survey revealed that there are currently 80 varieties on the consumer market," says the CEO of data analysis and market research specialists Category Partners LLC. "Consumers are often faced with shelves containing up to 30 different types of apples." And this is in a country where the apple has long been synonymous with Red Delicious. A marketeer like Barnes sees this as a problem: how to communicate the unique selling points of an ever expanding number of premium brands and club varieties? Especially against a backdrop where:

1. with the exception of 2020, annual apple consumption has declined slightly over the past five years;
2. the share of online trade is increasing, with new products more difficult to accommodate; and
3. the rise in inflation as a result of the war in Ukraine has drastically reduced consumers' willingness to buy more expensive apples.

"Influencer marketing still offers some opportunities, but often all you can do now is work along the lines of 'display and pray,'" Barnes says. In other words, put the apples on the shelves and hope they will sell. Nevertheless, he also points out that over at least the past decade, the flavor and quality of apples in the USA have progressed in leaps and bounds.

This is mainly thanks to people like Susan Brown, head of Cornell AgriTech in Geneva, New York; Bruce Barritt and Kate Evans of the Washington State University Tree Fruit Research and Extension Center; and David Bedford of the University of Minnesota's apple breeding program. The latter landed the first real apple hit with the Honeycrisp variety launched in the 1990s. "Super juicy, super crunchy, super tasty: a hot, fantastic apple, but a nightmare for the grower," is how the fruit is often described. Number three in the US market in terms of volume after Gala and Red Delicious, it was the catalyst for a veritable boom in variety development and a constant stream of new flavor highlights with better agronomic behavior. Cornell AgriTech's Susan Brown alone has achieved a number of successes over the past decade, including NY1 SnapDragon™ and NY2 RubyFrost™, as well as Pink Luster (NY 73), Firecracker (NY 109), and the scab-resistant Cordera (NY 56).

But the biggest new release sensation in recent years is undoubtedly W38 Cosmic Crisp®. Bred by Bruce Barritt and Kate Evans of Washington State University, this Honeycrisp/Enterprise cross is an apple that gets everything just right – from color, texture, and flavor to excellent storage properties. Since 2017, 14 million trees have been planted in Washington State, where – alongside South Tyrol – Cosmic Crisp is grown exclusively. Never before in the history of apple growing has a variety spread so rapidly in such a short space of time or has so much marketing effort been expended on an apple. Such hype is clearly not risk-free, but so far, at least, the rising star of the US apple firmament has kept its promises: a year after its market launch, in spring 2022 it already ranked in surveys as the seventh best-selling apple in the USA, with a market share of 2.2 percent. Its price per pound of \$2.51 was almost twice as high as that of Red Delicious (\$1.34), although it was still below Honeycrisp (\$2.63).

One thing is already certain: even though Tom Barnes may be keen to see producers consolidate brands and reduce confusion, Cosmic Crisp won't be the last word in apples on the US market for long. With the country's top breeders having amassed so much knowledge, further innovations will not be long in coming, and not just in terms of flavor. We will also be seeing plenty more on plant diseases and, importantly, greater plant resilience to the effects of climate change, for example. "There are many things we can optimize to make crops more resilient to weather extremes, but the first solution must surely lie in genetics," says Stefano Musacchi. So, *quo vadis*, USA? Towards a future awash with challenges. But the country's apple industry is well prepared for them. **SP**

# “Great Potential“

Three experts from the international apple industry on water management in fruit growing as the challenge of the future – and possible solutions.

**Massimo Tagliavini, full professor at the Free University of Bozen-Bolzano and President of the Italian Society of Horticultural Science; Interpoma Award 2022 jury chairman**

“The past summer has shown just how urgent this topic is. The goal must be to ensure that almost all the water supplied is absorbed by the tree and does not evaporate or seep away. Sensors that measure the supply of water to the soil and trees are promising. But technologies that serve other purposes also have a positive impact on water demand: anti-hail nets, for example, reduce solar radiation, wind pressure, and thus evaporation, which can lead to water savings of 15-20 percent. Allocating water based on consumption rather than acreage could also be a solution.”



**Martin Thalheimer, head of the “Soil, Fertilization, and Irrigation” working group, Laimburg Research Centre, Italy; Interpoma Award 2022 jury member**

“In the future it will be necessary to adapt irrigation to the plants’ needs and to control it technically. The ‘Smartland’ project, which we created in collaboration with Alperia, makes this possible using soil moisture sensors with automatic data transmission. Findings so far show that the system has great potential to significantly increase the efficiency of water use. But even the most innovative and effective solution will only be successful if it is user-friendly, easy to understand, and affordable.”

**Yongbing Yuan, Professor of Agricultural Sciences, Qingdao Agricultural University, China**

“Limited water resources are currently a major challenge for Chinese apple production. At present we use three methods of saving water. Technical methods such as drip irrigation, pipe systems, or underground irrigation are designed to reduce water losses from evaporation, leaks, and runoff. Agronomic methods include using organic matter or non-woven fabric mulches under the trees that slow down evaporation, rootstocks whose roots can absorb water deeper down in the soil, and pit irrigation in drought zones. At the management level, the focus is on optimizing irrigation time based on tree development.”



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The Non valley is recognised worldwide for its production of the Golden Delicious apple, and it's here where REVO was born; created by the children of generations of apple farmers who understand the particularities of growing and harvesting.

The technical challenges of this land is the driving force in our search for innovative solutions. Our goals have always been to increase fruit quality and reduce labour costs; close daily contact with farmers is an integral part of our process to create machines that meet their needs.

Our flagship product is our fruit harvesting conveyor, which has obtained the European patent for its unique construction, and is now favoured by farmers all over the world.



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Born and bred in the city of Bolzano/  
Bozen, *Walter Guerra* climbed his first  
apple tree at his grandfather's farm in the  
Ahrntal valley. His early tentative steps, if  
you will, in an impressive career.

# The Visionary

As a young boy, *Walter Guerra* climbed his grandfather's only apple tree. Today he is deputy director of the Laimburg Research Centre in South Tyrol and is one of the world's most renowned pomologists. A conversation with the coordinator of Interpoma Congress 2022

Interview by Lenz Koppelstätter

Photography by Patrick Schwienbacher

**Mr. Guerra, close your eyes for a moment and think back to your first apple memory. What do you see?**

I come from Bolzano, a city child from a mixed-language marriage: a German-speaking mother and an Italian-speaking father. There were no apple orchards near where we lived. I used to play *Settebello* and *Scopa*, two typically Italian card games, with my *nonno*. And I often visited my maternal grandfather in the Ahrntal valley. Only two hours away, but a whole different world. My second home. When I was there, I used to go climbing on a huge apple tree he had on his mountain farm. It was difficult to get to the apples – it gave me a big sense of achievement when I did. So I ate them, even though they were barely edible. Grandpa would put the apples in straw, where they ripened and tasted a bit better, but they were still sour.

**What variety were they?**

I have no idea! The tree isn't there any more. Later, long after I joined the Laimburg Research Centre, we started a campaign asking South Tyroleans to report old apple trees still growing in the wild. We mainly heard from people in the side valleys of Pustertal valley, including from grandpa's Ahrntal. Today we have a collection of 120 old South Tyrolean varieties. At first glance we may not be getting anything out of this financially, but it does enrich us nonetheless: it shows us how diverse the apple culture around us is. The apple is everywhere, in all shapes and sizes, and it thrives in so many different conditions. It still inspires me today, just as it fascinated me as a little boy, 1300 meters above sea level on my grandpa's farm.



ipoma

## “In the season, I taste up to 80 apples a day. Take a bite, taste, spit out.”

### **The apple’s genome was decoded ten years ago. Doesn’t that destroy part of the fascination?**

Quite the opposite! Far from putting an end to the research, this decryption by colleagues at the Fondazione Edmund Mach Institute in San Michele all’Adige marked a new beginning. Sure, we know the sequence of the apple’s 750 million base pairs today, but we have actually barely scratched the surface so far. We now understand a few sentences, we can start reading a few chapters, we can speak the language of this fruit a bit now, and we are beginning to understand its instruction manual. The apple has 40,000 genes. So far, we have deciphered maybe a few hundred. It is a very complex process, and we still have a long way to go. I’d say that at least we now know that we know almost nothing yet. What we need to do next is some interdisciplinary research, with closer collaboration between physiologists, pomologists, and molecular biologists. There is still plenty of work for generations of scientists to do.

### **Can you still enjoy an apple without the reference manual popping into your head and your scientist’s brain kicking into gear?**

Nope! Just now, I was over at our research storage facility and grabbed a couple of apples that were lying there. I bit into one – and it started straight away. Hmm, it’s been in storage a bit too long. Why? How could that have been avoided? Even when I eat a slice of apple strudel, I’m wondering what variety it’s made with. I can’t help it. It’s like a bet with myself. There are 30,000 varieties in the world, so I can’t possibly know every single one. But I can recognize almost all of the new varieties, as we deal with them daily.

### **Was your childhood, living in two worlds, in two realities – German and Italian – an advantage in the international world of the apple and interdisciplinary science?**

Very much so, yes. The eclectic nature of it helped me as a

child. And it still does today. I got the interesting bits from both cultures and languages. My parents mixed two cultures through their love, and I do the same in my breeding work. We cross as many different varieties as possible at the Laimburg Research Centre, often producing exciting results. I spent ten years traveling the world looking at a huge diversity of apples, wild varieties, and specimens from a wide range of growing areas. I have built up and maintained a network of contacts. That is one of the most important things in the field of research, and we have really institutionalized that at Laimburg. If I discover a pest here today that I once saw in South Africa, I immediately send a WhatsApp to the bottom end of the globe, get a quick reply, and can react immediately. There are so many countries in the world where apples grow...

### **How many?**

Wait, let me turn that around: there are very few countries where apples don’t grow. In parts of Southeast Asia, but that’s about it. There are even apples growing in central Brazil. They don’t taste very good, but they fruit twice a year. The apple has made it all the way from the mountains of Kazakhstan to the equator. What a success story! I spend a lot of time in Val Gardena in the Dolomites. Along the old, abandoned railway line there you get impromptu apple trees from all countries and centuries, established by apple-munching tourists throwing their cores out of the window.

### **You were born into two cultures. So cross-breeding must come as second nature to you...**

And to think I almost became an engineer.

### **Tell us more!**

I was all set to enroll at the University of Padua for a degree in Engineering. The day before, I partied a bit too long at the legendary South Tyrolean nightclub Juwel. My father woke me up early the next morning and drove me down in the car, but I was one document short and the guy in the enrollment office wouldn’t budge. Nothing I can do, he said. My father was furious. I had to go down again a few days later, this time by train, armed with all the right documents. But just before I went back into the guy’s office, I crossed out “Engineering” and wrote “Agricultural Sciences” over the top. It was a spur-of-the-moment thing – completely intuitive. Then I called home from a phone booth. I said: It’s all done. I’m studying *Scienze agrarie*. Deathly silence at the other end of the line. My father was lost for words. But I went through with it. I had always been interested in plants and nature. I had to go with my gut feeling – I knew it was the right thing to do.



While I was at university, I worked here at Laimburg as a picker. And the rest is history.

#### **What happened next?**

I came back as an intern and eventually wrote my master thesis here as well. Then I went to the University of California – a temple of fruit science – where I spent a year researching tomatoes. Apples and tomatoes, both of which are flowering and seed-bearing plants, have a lot in common. After that I actually wanted to go and work on a kibbutz in Israel, and I had a PhD offer from California in my pocket, but when I heard the Laimburg Research Centre was looking for a breeder, it was the obvious choice to go back.

#### **What does a typical working day look like for you?**

Besides all the desk work that piles up, almost every day from July to November my team and I walk through the experimental orchard with our 8,000 fruit-bearing seedlings. Our task is always to select some to observe closely, nurture, and taste. Over and over again.

#### **Do you taste apples every day?**

In the season, yes – anything up to 80 apples a day. Take a bite, taste, spit out.

#### **Do you enjoy eating an apple in the evening, after work, on the patio? Occasionally, at least?**

No, that's when I've had enough of apples for the day. When I visit my mother and she has baked apple strudel, I give her a scathing look. Really, mom!? I often get my two daughters to join in the tastings, though. They are perfect for that: unbiased and honest.

From June to November, Walter Guerra takes a daily walk through Laimburg Research Centre's experimental orchard and selects apples to try.



## “What I cross today will only come to fruition in twenty years’ time. So you have to be a visionary. A futurologist.”

### What are the hot apple topics across the globe right now?

A lot of work is being done to back up the adage “an apple a day keeps the doctor away” with facts. To acknowledge how special the apple is. Moving away from the mass product! Showing it in all its diversity. It’s all about natural, sustainable production. In breeding we are also trying to go along with this, smoothing the way. We are looking for varieties that are robust and resilient against diseases and changing conditions. But as a pomologist, you should always bear in mind that everything you cross today will only come to fruition in twenty years’ time. So you have to be a visionary. A futurologist. The apples I crossed here at the Laimburg Research Centre in 2003 when I was just starting out will be coming onto the market soon. With any luck, at least!

### Because there is still factor X, nature, climate change...

Absolutely. But also changing consumer behavior. Five years ago, no-one would have put money on today’s consumers demanding small snack apples – portable fruits. People no longer share an apple in the family like they used to. Those days are over. Big apples are out in many places.

### What role do club or managed varieties play?

I have always followed this development with fascination and interest – from the Pink Lady Club to the wealth of variations we have today. We will be exhibiting more than 50 worldwide managed varieties at this year’s Interpoma. That’s quite impressive. Basically, managed varieties aim to counteract mediocre and even poor quality. And to package apples with good marketing and branding. Sure, you can add value that way, but it is no guarantee of better quality. Just because it says “managed variety” somewhere doesn’t mean it tastes

great. We supply data in the breeders’ carousel of varieties, and we help the growers decide which variety warrants a closer look and which is worth taking further. It remains to be seen which managed varieties will still be there in twenty years’ time. I’m looking forward to finding out!

### Let’s gaze into the crystal ball for a moment.

#### What will we like in twenty years’ time?

Trends in taste are heading toward sweet. These days, nobody bites into the sour apples I remember from my childhood. Not even the boy who scrambles to the top of the tree to pick them. But regular niche and secondary markets for millions of consumers are opening up: sweet-tasting apples with low sugar for diabetics. Apples for people with fructose intolerance. Apples with low allergy potential. Just as the “selenium potato” has done, the “selenium apple” will also find its place. Consumers will want even higher levels of vitamin C. There will be the diet apple, the lifestyle apple, red fleshed, yellow fleshed, the seedless apple, the apple on the chocolate shelves, the apple in the pharmacy, the apple for Michelin-starred restaurants... There will be an apple matrix. The palette will become wider and wider, I am in no doubt. **LK**

*Walter Guerra*, born in 1974, coordinator of Interpoma Congress 2022, completed his PhD in Bologna after studying agricultural sciences at the University of Padua and following a stint at the University of California, Davis (USA). Today he is head of the Institute for Fruit Growing and Viticulture and deputy director of the Laimburg Research Centre. There, new apple varieties originating from hundreds of breeding programs around the world are tested for their agronomic properties, storage qualities, and susceptibility to disease. Each of the more than 300 experimental varieties is compared with fruit with a successful market track record.



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# Interpoma Variety Garden

For the first time, the Interpoma trade fair will feature a unique collection of more than 50 managed varieties. These exclusively grown and distributed apple varieties range from the club pioneers that made their debut 30 years ago to the newcomers on the fruit shelves.

For the first time in its history, the Interpoma apple trade fair will host an international exhibition of managed varieties – branded apple varieties – from all over the world: the Interpoma Variety Garden.

Created specially for the show, this garden will feature more than 50 varieties from all the world's major apple-growing countries, from New Zealand to the United States and from France to Italy, including the main Italian production areas of Interpoma host South Tyrol and the neighboring province of Trentino.

If there's one thing the Interpoma Variety Garden will be above all else, it's colorful. That's partly down to the huge diversity of apple skin colors – the bright yellow of the varieties marketed

under the yello® and opal® brands; the fresh, bright green of a GreenStar®; the intense dark red of a Crimson Snow®; the various red-blushed varieties in their hundreds of different shades; and the attractive new red-fleshed varieties branded Red Moon®, Kissabel® or Lucy™ Glo.

But what makes the exhibition even more colorful are the many different brand identities with their exclusive branding and unique packaging. The Interpoma Variety Garden is therefore also a journey through the history of variety management – a global success story that began some 30 years ago with pioneers such as the KIKU®-branded Fuji in Italy and Cripps Pink, marketed under the Pink Lady® label. Today, the managed varieties system opens up opportunities for growers

such as price advantages and planning security, while offering consumers a huge diversity of varieties and brands: a veritable panorama of colors, flavors – and narratives. After all, the storytelling of the brands is key. Each brand is aimed at specific target audiences and communicates the strengths of the different varieties at a glance: there are small snack sizes just right for children's hands, exotics for discerning and adventurous shoppers, and super nutritious or sustainable apples for the health-conscious or environmentally aware consumer.

**The Interpoma Variety Garden is open throughout Interpoma (November 17-19, 2022) in the new H1 Event Space at the Bolzano Exhibition Center. Admission is free.**





More information:  
[fieramessa.com/en/interpoma/event/interpoma-variety-garden](http://fieramessa.com/en/interpoma/event/interpoma-variety-garden)

 Interpoma

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Japan is a country steeped in *tradition*. If it is customary to do things in a certain way, then that has a particular importance.

# With Love and Craftsmanship

In *Japan*, apples are not eaten as a snack but as a delicacy – and are often sold as individual specimens. This peculiarity of Japanese culture has had a significant impact on the cultivation of apples in the island nation and has raised them to the status of a cultural asset.

By Christian Heinrich

Photography by Jane Alden Stevens ©2010

Apple growing is like music. It always needs a rhythm – and if a melody is added in, it can turn into art. The rhythm of apple growing is set by nature, the seasons, and the weather; that's no different in Italy than in northern Germany, Japan, or America. But in Japan, apple growers add their own melody to this rhythm. And the instruments that create the melody are craftsmanship and love.

In the northern prefecture of Aomori, for example, on many apple plantations the fruits are double-bagged in early July, about 50 to 60 days after full bloom. In this area, the main reason behind this is to improve the shelf life of the fruit, while in the Nagano prefecture further south, it's all about the fruit color.

The outer bag is removed 35 days before harvest, and the inner one, which is coated with fungicides, one week before. To protect the apples from sunburn in the final few days, large nets are spread out over the trees to reduce the intensity of the sun's rays. It's all just as elaborate and painstaking as it sounds: on average, a worker can bag between 100 and about 400 apples per hour, which even on a medium-sized plantation amounts to more than 1,000 labor hours. But Japan is a country tied to tradition. If it is customary to do things in a certain way, then that has a particular significance, and it is usually done patiently and without grumbling.

**After the Satsuma mandarin (770,000 tons produced and consumed annually), the apple (750,000 tons) is the most popular fruit of the Japanese.**

The structure of Japanese apple growing also reflects this: the main practitioners of this labor-intensive, hands-on cultivation process with the focus on the highest possible fruit quality tend to be small family farms.

The fact that apple growers in Japan lavish so much time and attention on their fruit also has to do with the high status afforded to the apple. “For us, an apple is something precious. Apples are treasured gifts for the harvest and year-end festivals, we gift them to friends and acquaintances on special occasions, and we give them as get well soon gifts for the sick in hospital,” says Professor Hiroo Koike, who has run a research station for apple growing in the Nagano prefecture for several decades and is considered one of Japan’s foremost apple-growing experts.

Because of their status, apples are often also bought and sold as individual specimens in Japan. Weighing in at around 300 grams on average, they are usually larger than European apples and will ideally have a deep, uniform color. So rather than being munched on as a snack between meals or as part of a cafeteria lunch, apples tend to be eaten on special occasions and at home. And that’s why growers give each individual apple the kid glove treatment in their attempts to get the very best out of their crop.

**On average, a hand-cultivated apple orchard in Japan is less than one hectare in size.**

Before the apples are bagged, the fruits are thinned out on the tree. Selectively removing apples from clusters of several fruits is emblematic of the fact that in Japan, tradition and care are valued over mass production and high yields.

Each apple is cherished and nurtured to achieve the best possible shape and color. Around 20 to 30 days before harvest, red varieties are de-leafed by hand around the fruits to allow the color to develop better, with around one in ten leaves closest to the fruits being removed. “This step of the harvest cycle takes up roughly 20% of the labor time,” Koike says.

The fruits are also rotated to expose the shady side to the sunlight in order to ensure uniform fruit coloring –

**Malus sieversii, the Asian wild apple, originally came to Japan from Central Asia, albeit the long way round via Europe and the USA: in 1879, the Japanese government imported many different varieties from North America, giving rise to the birth of apple growing in Japan.**

another important factor for customers and buyers down the line. According to Koike, this practice accounts for another 18% of the labor time. Reflective foils are often used to further optimize the color.

Attention is paid to factors such as size, color, and natural flavor – Japanese consumers have a preference for sweet apples – right from the breeding stage. Apples are grown in around a dozen of Japan’s 45 prefectures, with most found in the north of the main island where it is slightly cooler, meaning that rice is harder to grow there – another factor

that spoke in favor of establishing apple growing back in the day. Almost every prefecture in which apples are grown has its own breeding program. More than half of the 750,000 tons of apples produced annually in Japan are grown in Aomori, followed by Nagano. But other prefectures such as Iwate and Akita are also well-known apple growing areas.

Some Japanese-bred varieties are now found all over the world. The best known Japanese apple is the Fuji, which accounts for 60% of apple production in Japan. This variety was first introduced in 1939, but several events intervened

**“For us, an apple is something precious: a treasured gift on special occasions or for hospital visits.”**

Hiroo Koike, *professor and apple growing expert from Nagano*





In Japan's small *apple orchards*, like this one in Aomori Prefecture, most of the work is done manually following traditional methods such as pruning and burning branches in the spring.



1+4 *Apple blossoms* are still partly pollinated by hand the traditional way. Apples are luxury items for special occasions in Japan, so farmers go to great lengths to optimize their crops.

1



before the Fuji became a firm favorite the world over: World War II brought apple growing as a whole to a standstill; in 1941, early frosts destroyed a large part of the crop; in 1944, a typhoon destroyed stocks; and the price of apples plummeted in 1948. However, the 1950s saw a revival in apple growing in Japan, and by 1962, Fuji apples – named not only for the famous mountain but also for the city of Fujisaki, where the variety was developed at an apple cultivation research station – had become a worldwide hit.

In addition to the Fuji, other varieties have also been licensed in growing regions around the world. Shinano Gold, a Nagano-bred variety – Shinano is the old name for Nagano – is now also grown in South Tyrol, for example. The best fruits of this variety grow to 350-400 g in weight.

Thinning, bagging, leaf removal, rotating towards the sun, netting – a melody of craftsmanship and love that many Japanese apples clearly exude. And that attention to detail can ultimately pay off: in luxury fruit emporia and auctions, completely flawless specimens can go for as much as several hundred euros.

**In the Nagano area in particular, newer orchards are being densely planted, inspired especially by the orchards in South Tyrol.**

temples are stuck on the apples on the tree. When the sun shines on the apples, they turn a beautiful, uniform red – except under the stencils, where the skin stays yellow, leaving the images clearly visible and immortalizing the melody of Japanese apple farmers in the apple skin.

These practices can, of course, elicit much astonishment and shaking of heads. Why lavish so much time and

**Red Fuji varieties are best grown in apple plantations in which the fruits are not bagged. Their uniform red color can also be achieved without this labor-intensive step, and the higher Brix level this produces makes them more popular with Japan's consumers, whose preference is for sweet apples.**

effort on something that is only going to be eaten? That's true, on the one hand, but this practice ties in completely with Japanese culture, which regards transience as part of the cycle of life and sees no reason to be less circumspect because of it – a form of “consciousness of existence”, perhaps. And this not only applies to the apple itself – it's also about the apple grower who nurtures the fruit with so much craftsmanship and love. **CHH**

Stencils are used to create characters for “health” or “happiness” on the skin. In luxury emporia or at *auctions*, completely flawless apples can sell for as much as several hundred euros – each.



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# Sunny Prospects

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Agriphotovoltaics uses fruit orchards to generate energy – and can also protect against hail, frost, or drought.

**Research.** The need for alternative energy is growing, but solar systems often founder due to a lack of space. Agriphotovoltaics could provide an answer. A project launched in Germany in 2022 by the Fraunhofer Institute for Solar Energy Systems ISE is trialing photovoltaics in apple orchards (pictured is a pilot plant in Rhineland-Palatinate). The systems can also offer protection against hail, frost, and drought, as well as generate synergies in water management. [ise.fraunhofer.de](https://www.ise.fraunhofer.de)

# The Future Makers

Automated precision spraying, thinning, and harvesting: with their start-up Aigritec, Elia Bruni and Daniele Facchin want to revolutionize the apple industry using artificial intelligence and robotics.



**Company:**

Aigritec Srl

**Industry:**

Precision agriculture

**Established in:**

2019

**Headquartered in:**

Bolzano, South Tyrol

**Founders:**

*Elia Bruni* (41, r.), CEO and AI researcher;

*Daniele Facchin* (41), CTO and electromechanical engineer

**Our job in brief:** We develop solutions for precision agriculture and harvest automation by combining advanced robotics components and artificial intelligence. Elia takes care of the business side of things and is our resident AI expert, and Daniele is the expert in robotics. Together we lead a team of five at the NOI Techpark in South Tyrol.

**Why we do what we do:** Because robotics – in conjunction with artificial intelligence – can unlock a future in which everyone can choose their job according to their passions.

**What we're proud of:** Aigritec – it's our baby! We are building an autonomous machine that will revolutionize fruit crop management with deep learning and robotics – and will make agriculture a more efficient, more precise, and more sustainable process. So we are developing the technologies of tomorrow.

**Our next project:** We are currently working on adapting our robot to other types of fruit and vegetables besides the apple. Once we have trained it, our computer vision model recognizes individual apples in real time. This system can now be transferred to other types of fruit and different environments.

**In 30 years' time the world will be...** We have to be optimistic: thanks to AI and robotics, our world will be greener and more sustainable and people will be healthier and happier!

**How we became what we are today:** Hard work, curiosity, and a bit of luck! Elia is a researcher in the field of artificial intelligence (AI), with experience at the universities of Trento, Bolzano, Amsterdam, Barcelona, and Osnabrück, as director of the Computer Vision Lab at German startup ExB, and as a visiting researcher at the Facebook AI Research Lab in Paris. Currently he is a professor at the Institute of Cognitive Science at the University of Osnabrück. Daniele is an electromechanical engineer with extensive experience in the development of electric motors and in rapid prototyping. He is currently head of the R&D team for automation and control systems at TechnoAlpin, the world market leader in technical snowmaking.



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A

# Is for Aroma

Sensory technologist *Christine Brugger* has mapped out the 300 aromas in apples and made it her mission to introduce people to the diversity of flavors in this fruit.

By Christian Heinrich  
Photography by Sylvan Müller

There are a million different *aromatic compounds*; it's the combination of these that creates the aroma. We perceive the aroma via the nose or palate.

Some journeys change you for the rest of your life. This is exactly what Christine Brugger offers as she opens the door to a world that has hitherto been largely unknown – even though everyone comes into contact with it several times a day. This world is all about the flavors, textures, and aromas you perceive when you eat with all the senses.

Brugger is a sensory technologist, distiller, and, more recently, organic fruit farmer. She runs her parents' organic farm, advises food businesses, lectures and researches in sensory science, trains sommeliers – and runs apple tasting courses. Participants on her courses learn to experience and describe the flavors with all five senses. "This is something that is very close to my heart: people are amazed and excited when they find out just how much they can perceive," Brugger says. At her tastings she has heard phrases like: "That reminds me of an apple we used to grow in the garden," or "That conjures up images of my childhood." The cascade of impressions, emotions, and memories sometimes starts even before the first bite, when the surface of the peel or the initial scents and smells are discussed. A whole new world opens up.

"People are usually quite good at recognizing taste, in the narrower sense, right from the start," Brugger says. The word "taste" is also used to describe the whole sensory experience that unfolds when you eat, although in technical terms the definition of taste is a little more precise: it's what we can perceive with the minuscule taste buds on the tongue. Five taste qualities have been confirmed to date: sweet, sour, salty, bitter, and umami.

But taste is just the very simple beginning. "There are only around five to seven types of taste but a million different volatile organic compounds," Brugger says. The combination of the different compounds forms the aroma, or the "decisive element that informs the character of a fruit," as she puts it. We perceive the aroma with the olfactory mucosa via the nose or palate. Added to this is texture: the mouthfeel and the surface of the food, both of which often change noticeably in the mouth when the food is crushed and mixed with saliva as we eat.

According to Brugger, apples have a particularly wide aromatic and textural diversity. A few years ago, she developed the first aroma wheel for apples, which brings together the most important characteristics: a map of the flavor of apples. "Apples have around 300 aromatic compounds, of which ten to twelve are main aromas. So the variety of flavors is practically endless!" And then there are also 3,000 to 4,000 apple varieties in Europe alone, she adds.

Curiosity sparked? Christine Brugger has a very simple exercise that everyone can do at home: "Place four apples side by side on the table. Then taste one at a time and think carefully about how each one tastes different." Specifically setting out to find differences usually makes you pay more attention. Sure, one apple tastes sweeter than the other. But is it juicier? And how firm is it? Doesn't the third apple taste slightly more floral than the others? "All of a sudden, people often discover vocabulary that has been unused for years or is just waiting to be learnt," Brugger says. That sets something in motion for many people.

And that's how it all started for Brugger. She grew up in the 1970s on a farm on Lake Constance that her parents ran. Already way ahead of their time, they decided to convert to biodynamic farming following the Demeter method. There were 20 to 30 different varieties of apples on the farm. Sorting out and deciding which ones were suitable for organic farming and which to prioritize was an ongoing process. The main question was which flavor and aroma would be the biggest hit with their customers. The decision usually went like this, Brugger explains: "We all sat in the kitchen together for a blind tasting. My father put various apples on the table with just their breeding numbers, so we didn't know what variety they were. Then he cut each apple in half, always across the middle so that the star-shaped core was showing. We tried them all and decided which had the most appeal."

Brugger's parents soon discovered that their daughter had the keenest sense for this. "My father was good at recognizing the flavor. But that was just the start. When it came to the individual aromas and their potential, everyone deferred to me," Brugger laughs. It wasn't long before she realized that this was what she wanted to do for a living.

To start with, she studied nutritional sciences in Gießen and Munich. Some of her fellow students went on to become nutritionists. "But in my last two semesters I realized I had no desire to dictate to people what they should or shouldn't eat," Brugger says. The job was too far distanced from flavor, texture, and aroma. So in 2000, she interned in Nestlé's sensory technology department, where her on-the-job training taught her more about sensory perception and how it could be captured.



*Christine Brugger, 49, is a sensory technologist and distiller. She grew up on her family's fruit farm on the shores of Lake Constance, studied nutritional science at university, and since 2001 has been working as an author, university lecturer, food sensory technology researcher, and consultant in the international food industry. In 2014 she founded the Organic Distillery on her parents' farm, where fruit spirits have been distilled over four generations. There she combines her scientific expertise with the traditional craft of distilling, specializing in the gentle production of organic gin and essences. Christine Brugger lives in Friedrichshafen and Zurich. She regularly runs sensory seminars. [aromareich.ch](http://aromareich.ch)*

# “I want to teach people how to be more consciously perceptive.”

Christine Brugger, *sensory technologist and organic fruit farmer*

Her next move was to Givaudan, the world's largest flavor and fragrance manufacturer, where she worked on a global aroma project, the subject of which has stayed with her to this day. “It was all about communicating aroma characteristics in different cultures. We soon discovered that there are huge differences between languages when it comes to ways of expressing the characteristics of aromas in precise words and phrases,” Brugger says. As part of this worldwide project, she worked with flavorists and sensory panels to develop references and set standards for classifying, naming, and summarizing different aromas. Brugger taught this vocabulary to Givaudan's development teams around the world in a series of week-long training courses. Armed with the new language and associated references, the teams were able to capture the sensory essence of their entire aroma portfolio. Now it became clear that they had countless strawberry aromas on offer, ranging from fruity green and grassy green to spicy cinnamon. Based on Brugger's work, the 2,000 strawberry flavors alone that Givaudan had in its portfolio at the time were structured better and grouped together where there were substantial overlaps.

This fascination for the language of food has stayed with Brugger to this day. “There are also big differences between the various ways of describing texture. In Europe we just use the term ‘slimy’ for lots of things that are viscous and have a damp surface with little profile. A much finer distinction is made in other cultures, especially in Asia: in Vietnam there are dozens of terms for foods with a similar consistency, and in Japan there are many more,” Brugger says.

After her stint in the food industry, Brugger went into academia as a researcher and lecturer in 2006, following which

she headed the sensory analysis department for plant products at the state research institution Agroscope in Wädenswil. Brugger recently went back to her roots to manage her parents' farm, which the family now runs together.

This leaves her room to continue working in research, science, and sommelier training. To meet the high demand, she not only offers her apple-tasting courses on her own farm but also throughout southern Europe. “I want to teach people how to be more consciously perceptive,” Brugger says. If you eat more mindfully, you can even discover a kind of aromatic melody in some foods that slowly unfolds as you eat: “First we chew, which enlarges or reduces certain surfaces, and the interaction with saliva then releases new aromas, so when we eat a meal mindfully a real tension can arise between the sensory impressions we get,” she explains.

This spring, Christine Brugger and her colleagues in South Tyrol carried out a test run for an apple sommelier course she plans to offer regularly as a 14-day event. Sensory analysis takes up four whole days of the course. “It starts off with the background to how flavor is created and how smell works. But then it's mainly about training the individual aromatic characteristics. Participants are given lots of tastings at which they learn subtleties in perception and ways to describe them. For example, ‘crispy’ describes a different texture than ‘crunchy,’” Brugger says. It is basically about learning to perceive more and more subtle nuances.

The beauty of it for everyone is that more perception – at least as long as the perception is pleasant – usually also leads to greater enjoyment. **CHH**

# “Every Drop Is Precious”

VOG Products processes around 350,000 tons of apples per year into juice, puree, and concentrate. A vital part of this process is water, which is used for cooling and as a means of transport. The company uses this natural resource carefully – and not just once.

Producing apple juice is a water-intensive process. At VOG Products, water is the main means of transporting the millions of apples processed in Laives, as well as being used as a coolant in the production process. “We use it with great care and reduce our consumption wherever possible, as water is one of the key elements of our sustainability strategy,” says Christian Thaler, who, as technical manager, knows the company’s water usage cycles better than anyone. “We are constantly improving our performance in water management.”

One major improvement the company has embarked on this year involves using water twice. All the water used in one of the central buildings for cooling (use #1) will in future be collected in a collection pipe, returned to a tank, and distributed from there to the “liquids” production area, where the water will then be recycled primarily for use in the transport system (use #2). “This will save us about 700,000 cubic meters of water per year – roughly equivalent to the amount 15,000 people use in a year,” Thaler says.

The water from water vapor is recycled as well. This occurs during the production of fruit concentrate: when the juice is heated, the water in it evaporates and the water vapor is continuously drawn off. The vapor is then recondensed, and the resulting water is reused – a process that VOG Products has been using for many years. It has also



Water is the main means of transport for the apples processed at VOG Products.

optimized its pipeline rinsing process: “The water we rinse our product pipes with is collected and used for the next prerinse. So we recycle water on many levels,” Thaler says.

For Thaler, constant monitoring of the water flows is just as important as water recycling: “By monitoring the data coming from the flow meters, we can detect leaks at an early stage and keep water losses to a minimum.” Additionally, VOG Products is focusing on reducing water-intensive processes. At the new apple receiving station, the fruits are briefly rinsed and cleaned with water jets before being gently moved on to the automatic grading facility on a “dry” conveyor, without using water for transport.

Water consumption will also be taken into consideration in future investments, because “every drop is valuable,” Christian Thaler says. Whether the water is used for transport, cleaning, or other purposes, it ultimately flows on to the wastewater pretreatment system, passing through self-cleaning screen filters that separate solids from the industrial wastewater. The water is then piped to the Eco Center wastewater treatment plant in the nearby village of Bronzolo, where biogas is produced and used to generate electricity and heat in a combined heat and power plant.

**1** The apples are briefly cleaned with water jets, after which they are gently moved on to the next stage on a dry conveyor.

**2** *Christian Thaler* heads the technical department at VOG Products. He is fully committed to sustainable water use.



### Water balance sheet.

In the spring of 2022, VOG Products was keen to obtain an accurate overview of its water usage and the origin of the water, so it produced a “water balance sheet”. The technical office analyzed the internal water usage circuits and audited three aspects:

1. the various water types,
2. the pipe network,
3. and the mechanical and electronic flowmeters.

The result was an overview of its consumption data, showing exactly where action needs to be taken and where there is potential to further reduce its water usage in the future.

### VOG Products.

Based in Laives south of Bolzano, VOG Products is owned by **18** South Tyrolean fruit cooperatives and three producer organizations in South Tyrol and Trentino. The **230**-strong workforce processes around **350,000** tons of fruit from integrated and organic cultivation annually into apple juice, concentrate, purees and finished products. It has an export quota of around **90** percent and counts **nine of the world's ten** largest food companies among its customers.

# Products



## PRODUCT INNOVATION

### Award-winning Cider

**Refined.** The fact that apple growers have a bad image because they use pesticides bothered Martin Torggler. “Vineyards are sprayed as well, but winegrowers are seen as sophisticated philosophers because they produce a much more refined product,” says the young farmer from South Tyrol. To refine the modest apple in the same way, Torggler developed Ander Dog, a cider made from Granny Smith and Braeburn. But while in many places cider is as respectable a social drink as wine, in Italy it’s never caught on. “And yet, South Tyrol is perfect for it. Countries such as the UK, where they drink a lot of cider but don’t grow that many apples, import juice concentrate. Whereas our cider is made from pure juice from locally harvested fruit.” The result: Ander Dog was crowned “World’s Best Cider” in 2019 and 2020. 330 ml bottle, EUR 2.50. [shop.torgglerhof.it](http://shop.torgglerhof.it)

## TEXTILES

### Piste-ready Apple Leather

**Sporty.** Elegant skiwear made from recycled pet bottles and sturdy apple leather: The AppleSkin collection from South Tyrolean fashion brand OneMore is designed for environmentally conscious skiers. The brand was created in collaboration with Frumat, the developer of the multiple award-winning apple leather. The leather is made from fibers and peel left over from apple processing in South Tyrol, which are ground into powder and then transformed into textiles. OneMore therefore follows the cradle-to-cradle principle and aims to demonstrate sustainable production models. Women’s ski jacket, EUR 1,201. [one-more.info](http://one-more.info)





HIGH-END

## A Good Drop

**Single origin.** The Winter Calville, or *Calville d'hiver*, is a capricious variety: sensitive to weather conditions, susceptible to pests. But this apple tastes so good that in around 1900 it was sent from South Tyrol to the Tsar's court, individually wrapped in paper. Thomas Kohl makes it into Grand Cru juice, which, with its peach and honey notes, goes well with lamb or goat's cheese. 1.5 l, EUR 25. [kohl.bz.it](http://kohl.bz.it)



PACKAGING

## Always to Hand

**Practical.** Fruit processor VOG Products has developed a new squeeze pack for its Leni's brand of consumer products. The lightweight 200 ml apple juice stand-up pack preserves the freshness and quality of the juice and is a handy companion for anyone who spends lots of time away from home – whether on mountain hikes or at the playground with the kids. [lenismele.it](http://lenismele.it)

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# The Secrets of Cider

Normandy in the north-west of France is home to around ten million apple trees. The apples are not good to eat – but they come into their own when turned into cider and calvados.

*A success story with a sparkle.*

By Bettina Gartner

Photography by Normandie Tourisme/M.-A. Thierry, C. Bazin, Coraline et Leo, T. Le Floc



## Cider-making was a popular pastime in Normandy for many centuries.

For some, Normandy is the place where the Allies landed in 1944 to bring World War II to an end. For others, the area's half-timbered houses and white chalk cliffs are reminiscent of England. But you can also sum up this region in the north-west of France in just three words: cider, calvados, and Camembert.

The cuisine of Normandy is all about apples and cheese. Soft, slightly tangy Camembert with its white, bloomy rind is just as much part of a typical Normandy meal as a glass of sparkling, mildly alcoholic cider and its stronger brother calvados, a hearty apple brandy. In Normandy, cider and calvados are traditionally drunk to quench your thirst and lift your spirits. But times have changed: they now regularly appear on the menus of Michelin-starred restaurants, at state receptions in the Elysée Palace, and in clubs and bars as a hip alternative to beer and wine. Particularly fine ciders such as Blizzard by Antoine Marois can cost as much as 53 euros per liter.

So how does the humble apple turn into a drink that can even give wine a run for its money? Normandy cider and calvados start their lives in the region's traditional meadow orchards, where apple trees grow far enough apart for animals to graze in between. The mild, humid climate coupled with the clay and calcareous soils create the ideal environment for the trees to flourish. But the small, tannin-rich cider apples are not good to eat. Bite into one and you'll find out why: the flesh is too bitter, too sour, and too firm. It's only in liquid form that these little fruits come into their own – but it's all in the process.

According to the Greek historian Herodotus, a people in Asia Minor were making a drink from pressed apples as early as the 4th century BC. In fact, the word “cider” originates

from the ancient town of Side in present-day Turkey, the home of the first producers. In Normandy, medieval writings from the 13th century recorded recipes describing the proper way to prepare the sparkling apple wine following steps that are not unlike the way it is made today. To make cider, apples are harvested, grated, and pressed. The extracted “must” is poured into vats and left to ferment – the process in which the sugars in the apples are converted into alcohol and carbon dioxide.

Cider-making was a popular pastime in Normandy for many centuries. Almost every farmer had their own cider house in the yard, while people in towns bought cider in vats and bottled it by hand. Everyone knew that the sparkling apple wine was best served well chilled and in earthenware bowls. “We Normans all have a little cider in our veins,” wrote Gustave Flaubert, author of *Madame Bovary*.

Although cider is produced in other regions of France – not least in Brittany – it is only in Flaubert's homeland of Normandy where quality is prized above all. The same exacting standards also apply to calvados, an apple brandy produced

**1** *The apple trees* are spaced far enough apart for cattle to graze between them. Modern orchards are often more densely planted, with machines used to shake the apples from the tree.

**2** Cider and calvados were *traditionally* drunk to quench thirst and lift the spirits. *Today* they are also served in high-end restaurants and hip bars as an alternative to beer and wine.

**3** *The mild, humid climate* and the *clay and calcareous soils* are ideal for growing the small, bitter, sour cider apples with their firm flesh.



## Nature still sets the pace when it comes to processing the apples: the fruits are not collected until they have fallen from the tree.

by distilling cider. The cider is heated until the liquid evaporates, and the alcohol steam and aromas are collected, cooled down, and condensed back to liquid form. The first person to document success with this process was Gilles de Gouberville, a 16th century diarist and member of the Norman gentry. On March 28, 1553, he reported that he had finally succeeded in distilling a reasonable *eau-de-vie* from apples. Today, only apple brandy that has been produced entirely from orchard to bottle in certain regions of Normandy can be called calvados. The designation AOC (*Appellation d'Origine Contrôlée*) refers to the exact area in which the apples (or pears, as calvados may also contain a small percentage of pears) are grown and processed: AOC Calvados, AOC Calvados Domfrontais, AOC Calvados Pays d'Auge. The designation AOP (*Appellation d'Origine Protégée*), with its rules governing origin and production method, is used for cider.

In the historic Pays d'Auge in the heart of Normandy, 48 different apple varieties can be used to make cider and calvados. The make-up of cider is paramount: bitter varieties such as Bedan, Bisquet, and Domaines together with sweet varieties such as Coquerelle and Germaine should make up more than 70% of the cider; sharp varieties such as Rambault must not exceed 15%. The actual varieties and percentages are closely-guarded trade secrets.

No producer is satisfied with just one variety. "Instead, they use mixtures of apples with different characteristics – they can choose between sweet, sour, bitter, bittersweet, sharp, and bittersharp – in order to obtain a balanced end product," says food technologist Lorenza Conterno of the Laimburg Research Centre, who is researching which apples are suitable for the production of a true cider in South Tyrol,

where dessert apples such as Coop38 GoldRush® and Topaz are popular choices.

In Normandy, nature still sets the pace when it comes to processing the apples: the fruits are not collected until they have fallen from the tree. They are then sorted by variety and left to ripen in wooden crates.

In modern apple orchards, the trees are not spaced out in meadows, but planted close together in serried ranks, as is done here in South Tyrol. Machines shake the fruit from the trees and gather them up. "The decision whether to harvest by hand is all down to the question of effort and yield, ripeness and undamaged fruits," Conterno says.

Finally, with leaves and twigs removed, the apples are crushed and pressed. One hundred kilograms of apple pulp can produce up to 80 liters of must. Cider farmers who work with presses that are also used to produce champagne will get slightly lower yields. In this case, they must go about their work slowly and gently to ensure as many aromas as possible end up in the must.

**1 + 4** The *fallen apples* are harvested, coarsely grated, and then pressed. The extracted must is put in barrels and left to ferment.

**2 + 3** In the heart of Normandy, 48 different apple varieties can be used to make cider and calvados. Each producer combines sweet, bitter, and sour varieties – although exactly which ones is something of a trade secret.



## After distillation, calvados is matured from two to six years in oak or chestnut casks.

Stored in stainless steel or oak vats and cooled down to eight degrees, the apple juice finally begins the process that transforms it into cider: fermentation. This can be sped up by adding cultured yeast, or the juice can be left alone to allow the yeasts occurring naturally in apples to get to work, a process that requires several weeks of patience. The length of the fermentation process determines how fruity, or dry, the end product will be: the higher the fructose content (and therefore sweetness) remaining in the must, the fruitier the cider and therefore the lower the alcohol content. Normandy's fruity but mild *cidre doux* has an alcohol content of 2-3%, while the other cider typical of the region, the dry *cidre brut*, contains more than 4% alcohol. In the 19th century, the author Gustave Flaubert described cider as "a bitter drink which sometimes bursts the bung."

These days, fine, elegant ciders are in demand, to accompany sushi and oysters, as well as lobster, chicken, and lamb dishes. A glass of calvados – in its pure form, or as an apple or pear and calvados granita – is often served as a palate cleanser between courses of a long meal. With an alcohol content of up to 45%, this ritual drink is said to create a *trou normand*, literally a "Norman gap", in the drinker's stomach. After distillation, calvados is matured in oak or chestnut casks from two to six years before being diluted to drinking strength, blended, and bottled. During this time, the aroma, strength, mildness, and color develop, turning the transparent distillate into a rich, amber-colored spirit with vanilla, almond, or walnut notes. It takes around 27 kilograms of apples to produce one liter of calvados. With 4.8 million bottles sold in 2021, every single one of the ten million or so apple trees said to grow in Normandy certainly earns its keep. **BG**



While it *ages in the cask*, calvados distilled from cider develops its aroma, strength, mildness, and color. With an alcohol content of up to 45%, this apple brandy is said to create a *trou normand*, literally a "Norman gap", in the drinker's stomach.

It takes around 27 kilograms of apples to produce one liter of calvados. Only distillates from certain regions of Normandy can be called calvados.





# “Trust the Systems”

Brunella Morandi, an expert in tree physiology and water management in fruit growing, on targeted measures for more precise and more efficient water use.



## 01 Are apple orchards irrigated efficiently these days?

Our research has revealed that the tendency is to apply too much water. In our environments, fruit tree orchards could be irrigated 30 percent less without impacting on tree physiology, productivity, or fruit quality. In fact, irrigating less can actually lead to improved physiological reactions in the plant.

### 02 How come?

Several studies show that targeted water management with controlled deficits at the right point in time leads to higher dry matter content. This improves the flavor, the shelf life, and the nutrient content of the fruit – which in turn increases consumer acceptance.

## 03 So another thumbs up for automatic systems that measure demand and irrigate accordingly?

Even the latest systems can sometimes go too far and recommend excessive amounts of water. It's different in drier countries like Israel or some regions of Spain, where much more thought is given to water usage and farmers and the systems developed there irrigate more efficiently.

## 04 What does this mean for the apple industry in a future shaped by global warming?

There are multiple challenges. Firstly, fruit producers will need to be put in a position to irrigate with greater precision. To do so they will need monitoring tools, technologies such as sensors, and even more accurate decision support systems. Secondly, farmers must also trust these systems. Neither of these are a given.

## 05 Are there other potential solutions?

Research is currently being done into alternative water sources such as purified wastewater from households and industry. Another strategy is to use anti-hail shading nets, which slow down evaporation without affecting photosynthesis and productivity. We have discovered that the light in fruit tree orchards is often too strong. In our conditions, reducing it up to 40% increases the performance of the plants and reduces abiotic stress factors such as drought, photo-inhibition and sunburn.

*Brunella Morandi* is a professor of tree ecophysiology at the University of Bologna. She leads the EUFRIN Working Group on Water Relations and Irrigation and researches plant/environment relationships to develop new strategies for efficient water use in the face of climate change. She is a jury member of the Interpoma Award 2022 for innovative water management.

Watch the video



# Home of apples

The Origin of our apples, Expertise that has ripened over years of working together, a focus on Sustainability: this is where our wide variety of Products and Brands comes from. These are the building blocks of our company, where the best apples can always be found.





## sustainapple: The ABCs of sustainability

Unveiled in 2020, **sustainapple** is the South Tyrolean Apple Sector's strategy to consistently pursue sustainability in the long term. Treating nature as a partner has been deeply rooted in the actions of the South Tyroleans for decades. By providing a roadmap for the future, **sustainapple** is the next logical step in the development of an increasingly sustainable apple sector.



[www.sustainapple.it](http://www.sustainapple.it)