

# Production of summer lemons in Sicily, Italy

Citrus growers in Sicily are known for producing a larger than normal volume of lemon fruit during summer (June to September) – a period in which lemons in Europe are scarcest. The growers make use of an ancient technique called *Forzatura*, meaning the forcing of trees to flower with water stress.



JAKKIE STANDERS

Although a few old conference proceedings on the *Forzatura* technique are available, not much information is available on how to successfully apply the *Forzatura* technique under different conditions, or all the factors that could influence the practice under commercial conditions in South Africa. To find out more about the *Forzatura* technique, I visited citriculturists who work on this field at the university of Bologna and university of Catania in Sicily, and growers in the region of Catania on the East coast of Sicily in Italy during winter of 2018.

The first grower visited was a retired Professor from the university of Catania and a 6th generation lemon grower, Professor Giovanni Continella. His orchards are located on the foothills of Mount Etna, where his family still produces lemons and recently also planted soft citrus varieties, such as 'Nova' and 'Mandalate'. His family is known for selecting the 'Feminello Continella' lemon variety. The second and third lemon farms visited were those of growers Antoninio Leonardi and Nino Barbagallo in Timpo, a village surrounded by a crater on one side, and the ocean on the other, and reminiscent of Ventura county, California.

## Citrus production in Catania, Sicily

Lemons are grown using 'Sour orange' rootstock and trees are planted in shallow, nutrient-poor volcanic ash with a low water holding capacity (Fig. 1). Most citrus farms consists of no more than 3 to 5 ha orchards and are located at sea-level, with some trees planted higher on the lower foothills of Mount Etna on ancient terraces, or so-called "muro a secco". The production practices are mostly primitive and at very low intensity. Since no foliar sprays are applied, most orchards are not planted in rows and no vehicles can access the orchards. Many growers still supply water with flood irrigation, and very little fertilizer is applied, if any.

Sicily is known for its typical Mediterranean-type climate – cold and wet winters and warm and dry summers, ideal conditions for the successful application of the *Forzatura* technique. During the last few years, the climate of the region has changed considerably. Winters, which used to be very cold and wet, are now warmer and winter rain occurs less frequent. Summers are warmer and short spells of 50 to 100 mm rain in June occur frequently. Rainfall during summer impacts negatively on the *Forzatura* technique since rainfall stops the flower induction process and results in floral inhibition. It is also bad for the prevention of the spread of Mal Secco disease, a disease endemic to the Mediterranean basin and specifically common in the 'Feminello' lemon variety that is widely planted in Sicily. Mal Secco infection normally starts in the upper canopy and spores are carried by wind or water from one tree to another. Most orchards visited were severely affected by the disease (Fig. 2a). Limbs from infected trees are removed throughout the season and burned, since the disease spreads rapidly through the xylem and phloem to the rest of the tree (Fig. 2b). Severely infected trees are cut back to below the bud union and top-worked during summer.



**Fig. 1.** Trees grown for production of summer lemons are planted in shallow, nutrient-poor volcanic ash with a low water holding capacity.

### Lemon varieties

Most of all the older lemon orchards visited consisted of a large number of 'Monachello' (Fig. 3a) and 'Interdonato' (Fig. 3b) lemon trees; older lemon varieties that are grown only in Sicily and that are resistant to Mal Secco disease. The trees have low vegetative vigour, and characteristics of the foliage and fruit resembles that of the citron. The fruit have thick, rough and pebbly rinds and low juice content.

Between 75% and 80% of the Italian lemon crop consists of production of selections of the 'Femminello' lemon variety. The 'Femminello' varieties are more vigorous than the 'Monachello' and 'Interdonato' and responds better to the *Forzatura* technique. The trees generally flower throughout the year and produce fruit of better quality compared to the 'Monachello' and 'Interdonato'. Unfortunately, the 'Femminello' selections are all susceptible to Mal Secco disease and most orchards are cut back annually, which impacts badly on production. The most prominent 'Femminello' selections seen were the 'St. Teresa', 'Continella', and the 'Zagara Bianca' and 'Zagara Rosa' selections.

The 'St. Teresa' is perhaps the most popular 'Femminello' variety in Sicily at the moment due to it being more tolerant to Mal Secco disease and the fruit having higher juice content. The 'Continella' variety was selected by the father of Professo



**Fig. 2.** Most orchards visited were severely affected by Mal Secco disease. Mal Secco infection starts typically in the upper canopy and spores are carried by wind or water from one tree to another (a). Limbs from infected trees are removed throughout the season (b), since the disease spreads rapidly to the rest of the tree through the xylem and phloem.



**Fig. 3.** Most old lemon orchards consist of 'Monachello' (a) and 'Interdonato' (b) lemon trees. The fruit have thick, rough and pebbly rinds and low juice content.

Continella near Mount Etna, and is perhaps one of the 'Femminello' selections with the highest potential for commercial production in South Africa. The 'Continella' variety flowers more regularly and is more everbearing than the other 'Femminello' selections. The tree is less vigorous, which, to a certain degree, slows down the spread of Mal Secco. The fruit has a more elongated shape compared to other selections, especially the lemons from the summer crop,



**Fig. 4.** The fruit of the 'Feminello continella' variety have a more elongated shape compared to other selections, especially the lemons from the summer crop, and a smooth, thin rind and high juice content. The fruit are low-seeded to seedless.



and a smooth, thin rind and high juice content (Fig. 4). Usually, the winter fruit are more elongated and maintain a larger part of the fruit style, because the weather conditions during spring are very mild, but this is not the case with the 'Continella' selection. The fruit are low-seeded to seedless and the quality much better than other 'Feminello' selections (Fig. 4). From a horticultural perspective, the unique characteristics of the 'Zagara Bianca' (meaning white flower) and 'Zagara Rosa' (meaning red flower) 'Feminello' selections were of particular interest. The flower petals of most lemon varieties have a violet colour, but the petals of the 'Zagara Bianca' are white (Fig. 5), and that of the 'Zagara Rosa', red. The trees have compact, upright growth habits and are less vigorous than the other 'Feminello' selections. In both selections the summer fruit are of better quality than fruit produced from the winter crop, and the fruit are virtually seedless with high juice content. Both selections, however, are highly susceptible to Mal Secco.

### The Forzatura technique

The *Forzatura* technique consists of the withholding of irrigation to lemon trees during summer, until the



leaves wilt and do not recover during the night. It is an ancient technique with the primary objective to increase late summer and autumn flowering, to produce lemons in the following summer. In Italy, these lemons are called *Verdelli* lemons and can have up to ten times the market value of the winter crop, and a higher value than imported lemons from the Southern Hemisphere (Fig. 6).

In Sicily, the *Verdelli* crop remains on the tree for up to 12 months, and is picked while the fruit are still light-green. The fruit have a thicker rind and rounder fruit shape than winter fruit, and usually have a few seeds which are almost all aborted. The *Verdelli* crop is mostly sold as fresh, light green summer lemons. Under normal conditions, without *Forzatura*, the *Verdelli* crop is set in August (Northern Hemisphere) and consists of approximately 10% of annual production. When the *Forzatura* technique is applied in mid-summer, however, heavy flowering can be attained and a larger *Verdelli* crop can be set, if the wilting period is followed by sufficient irrigation and fertilisation and the suitable lemon variety is used.

The time at which irrigation is ceased vary depending on climatic conditions and soil water status. Growers in Sicily start applying the *Forzatura* technique after the physiological fruit drop period of the



Fig. 5. The flower petals of most lemon varieties have a violet colour, but the petals of the 'Zagara Bianca' are white.

spring flowering response, to avoid fruit drop of the winter crop. Irrigation is withheld for six to eight weeks, starting in early June (December in South Africa) and resuming in late July (late January). Upon re-irrigation, a larger amount of water is supplied compared to normal irrigation, and 2.5 kg ammonium sulphate is applied per tree to support fruit set of the flowers that usually emerge three to five weeks after re-irrigation. If no extra fertilizer is applied upon re-irrigation, or too little water, most of the flowers drop. A spell of rain during the forcing period is usually detrimental to the flower induction process, and result in no to very little flowering as was the case in June 2018.

The summer crop induced by *Forzatura* in the previous summer are usually harvested before initiation of *Forzatura* of the following season, and under Sicilian conditions, has no negative impacts on the winter crop that flowered 10 weeks earlier. According to Sicilian growers, the only significant impact the *Forzatura* technique has on the winter crop, is that the time of harvest is delayed by six to eight weeks.



Fig. 6. The summer lemon crop produced through the *Forzatura* technique is called the Verdelli crop in Italy, and can have up to ten times the market value of the winter crop, and a higher value than imported lemons from the Southern Hemisphere (such as those from Argentina in the photograph on the right).

## Conclusions

A large proportion of South African lemon orchards are young and not yet in production, leading to fears of oversupply in the global lemon market in the near future when these plantings reach full productivity. These fears need to be addressed; either new markets are to be sought or the lemon supply peak to be shifted. The use of the *Forzatura* technique has such potential.

The *Forzatura* technique has been used for many years in the Sicilian lemon industry and manipulates the tendency of a lemon tree to flower repetitively throughout the year, to accentuate the summer flowering response and to produce lemon fruit in the summer when market supply is limited. It could be an alternative for South African citrus growers to solve a possible oversupply problem of winter fruit, but thorough research is needed before the practice can be tested under South African conditions.

A three-year research project by CRI is currently underway, in which the possibility to commercialise the *Forzatura* practice in South Africa is being evaluated.