INTERNATIONAL SOCIETY FOR HORTICULURAL SCIENCE

Section Tropical and Subtropical Fruits

Newsletter No 18 January 2018



Dear Colleagues,

Wish you and your family a Happy, Healthy and Prosperous New Year

In 2017, the Section has successfully organized International Symposium on Flowering, Fruit Set and Alternate Bearing from 19-13 June at Palermo, Italy; XII International Mango Symposium from 10-16 July at Guangxi, China; IX International Pineapple Symposium from 15-19 October at Havana, Cuba and V International Symposium on Papaya from 24-27 October at Merida Yucatan, Mexico.

The Section is organizing II International Symposium on Jackfruit and other Moraceae, II International Symposium on Date Palm, VII International Symposium on Tropical and Subtropical Fruits, I International Symposium on Avocado and X International Symposium on Temperate Fruits in the Tropics and Subtropics during XXX International Horticultural Congress to be held at Istanbul, Turkey from 12-16, August 2018.

In 2017, the Section has published four Acta Horticulturae: First International Symposium on Moringa (Acta 1158); International Symposium on GA3 Tropical Fruits (Guava, Wax Apple, Pineapple and Sugar Apple) (Acta 1166); International Symposium on Tropical Fruits (Acta 1178) and International Symposium on Durian and other Humid Tropical Fruits (Acta 1186).

This e-Newsletter is yours and you are welcome to use it as a vehicle to disseminate information to other colleagues. We will be happy to receive your comments, suggestions and will look forward for your inputs for the next issue.

With regards,

H.Jaenicke
Vice-Chair

S.K. Mitra
Chair



Mango and Litchi in Mediterranean Climate of Sicily, Italy

Mango, litchi and papaya are now form part of the Sicilian coastal landscape and their fruits are regularly available in the local markets. In Sicily, these crops are increasingly expanding because of decline in citrus cultivation which is no longer a profitable crop particularly along the Tyrrhenian coastal areas (Fig. 1-2).



Fig. 1. Mango orchard in Sicily (Cupitur Farm, Furiano, Messina).

The climatic conditions prevailing in these areas of Sicily, particularly during the cold seasons, differ greatly from those of most mango-growing regions. In these areas, the temperatures average17–18 °C and the average rainfalls are close to 650-700 mm along 70-80 rainy days. Under the bioclimatic aspect, the station is referred to the upper thermos-Mediterranean lower sub humid bioclimatic belt. The possibility to cultivate mango in this areas is mainly subjected to the effect of temperature. Vegetational limits, especially in terms of seasonal temperature during the fall, have caused, in recent years, the failure of many new orchards based on the introduction of new cultivars from tropical Countries. In order to avoid the occurrence of such situations, it is therefore necessary to carefully evaluate the vegetative and reproductive behavior of the new cultivars. In a recent study (Farina *et al.,* 2016),we have evaluated the adaptation of 10 mango cultivars in Sicily by analyzing phenological stages with seasonal thermal trends using the BBCH scale (Biologische Bundesantalt, Bundessortenamt und Chemische Industrie) and measuring the physical-chemical and sensory quality of the fruits. We have observed that in the coastal areas, the climate is characterized by temperatures that do not inhibit the phenological evolution of plants, allowing a good adaptation to the examined area with the exception of some critical winter days. Nevertheless, mango cultivated in Mediterranean climate needs protection against low temperature. In addition to collective wind deflector, the adoption of Individual plant protection from adverse temperature has always been a necessity for young trees. For this purpose, it lends the non-woven fabric, a synthetic material used in agriculture which can be placed directly over the canopy to protect the tree from cold winds. Hence, we analyzed the behavior of young mango trees during the winter in Mediterranean climate focusing our attention on traditional individual protective canopy protection systems in comparison with innovative typologies designed for this experiment (Farina *et al.,* 2017)**.** We studied the evolution of temperature inside the canopy and evaluated the threshold of damage on leaves and shoots. We also monitored soil temperature under the trees. Non-woven sheets preserved intact the shoots as the canopies were completely covered by a closed space because the leaves and shoots were isolated from outside (Fig.3).Since temperature is the limiting factor for mango cultivation in our environments, we started some trials cultivating mango trees in greenhouse and monitoring their phenological stages during the growing and production season (Fig.4).



Fig. 2. Mango and litchi fruit cultivated in Sicily (Cupitur Farm, Furiano, Messina).





Fig.3. Different kind of canopy protection (on the first line, from left to right) and the relative effect of cold season on the canopy (on the second line): trees with windbreak protection using a shading net (SN); trees with windbreak protection using non-woven sheets (WB); fully covered trees withnon-woven sheets and the addition of a 'heat exchanger' device (FC+). On the second line the effect of cold temperature after protection removal. a) Heat exchanger dispositive; b) Self-built dataloggers based on a TI (Texas Instruments) MSP-430 microcontroller and equipped with TI TMP112 temperature sensors.

A further experimentation focused on the study of the fruits aimed at defining the most important pomological, taste and aromatic parameters that contribute to obtaining a fruit of excellent quality. The results have shown the interesting chemical-physical traits (such as SSC) of the observed cultivars in our conditions (Fig. 5).
These cultivars contribute to enlarge the commercial offer able to satisfy the market requirements (Farina *et al.,*2013).Considering that the final judgement on the quality of the fruit is performed by the consumer, we have carried out panel tests and consumer tests able to guide the cultivation choices, anticipating the preferences of the end users (Mazzaglia *et al.,* 2012).Sensory analysis (Fig. 6) always shows high scores for valuable descriptors, while descriptors associated with a negative perception have recorded very low values for all cultivars under examination (Farina *et al.,* 2016).In addition to the sensory analysis carried out by expert panelists, we also aimed to identify consumer preferences by carrying out a hedonistic-affective test at large organized retail market, preceded by a Focus Group that allowed us to have an initial general approach between consumers and mango (Columba *et al.,* 2012).



Fig. 4. Young mango trees cultivated in greenhouse in Sicily (Palermo).

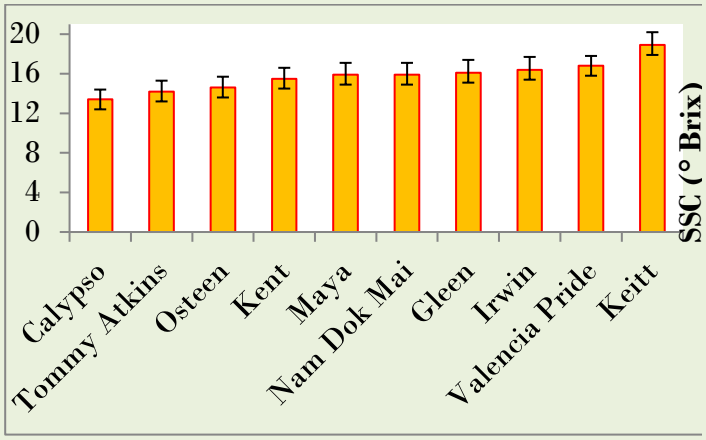


Fig.5.Solid soluble content (Brix°) of mango fruit harvested at mature ripe stage in Sicily.

The result is a positive scenario where the consumer, despite not being very familiar with this fruit unfamiliar with our food traditions, is getting to know it and is more inclined to buy a fruit not imported but grown locally. Today, in addition to the few cultivars from the first studies, there are many others cultivars interesting qualitative characteristics**.** Sicilian fruits are generally ripened on the tree and picked at 'mature' stage. These fruits are clearly destined to a short supply chain not necessarily related to national markets as they can reach in a few days the most important European markets (Fig. 7).

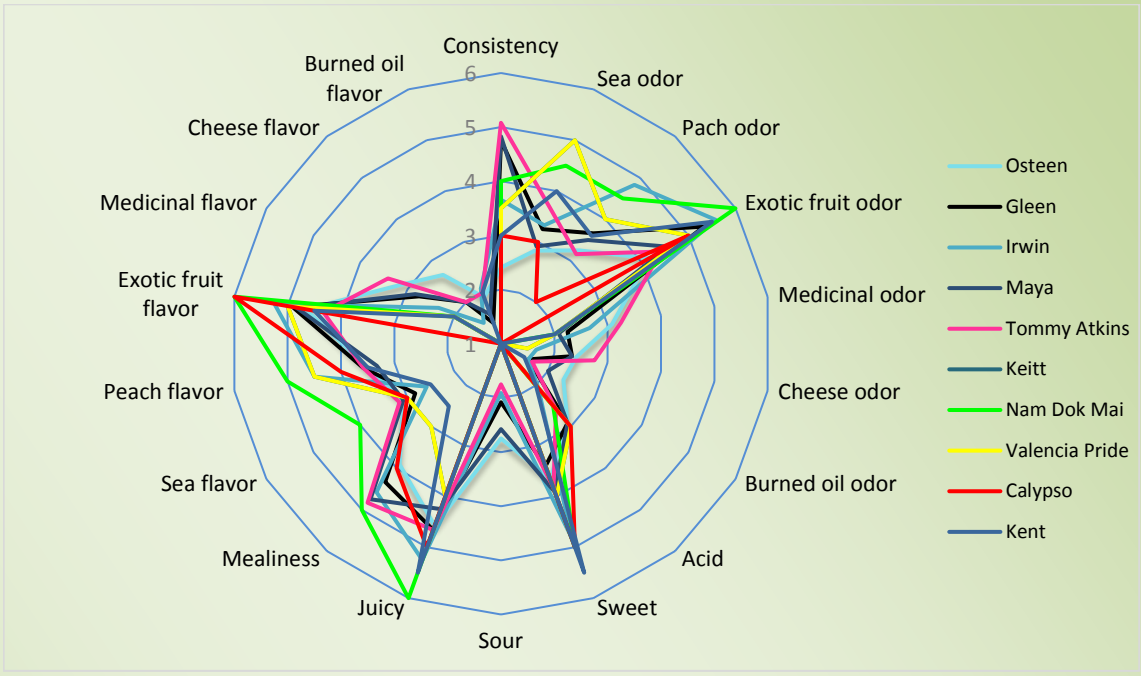


Fig. 6. Sensory profiles of mango cultivars harvested in Sicily and evaluated by a trained panel.



Fig. 7. Mango *tree ripe* fruit harvested in Sicily (Cupitur Farm, Furiano, ME).



Fig. 8. Fresh cut tropical mix (mango, orange and pineapple) in active MAP.

To extend postharvest life, in a recent study we investigate the effects of 1-MCP treatment on the pomological and sensory traits, antioxidant capacity and ascorbic acid content in late ripening mature-ripe mango fruits submitted to a simulated shelf life at 20 °C. The response of the mango fruits grown in Mediterranean conditions to a 1-MCP postharvest treatment at 20 °C was positive in terms of organoleptic fruit quality, sensory profile, antioxidant capacity, and ascorbic acid content. Treatments that extend postharvest life at room temperature should give new market opportunities to small scale production units where the cold chain infrastructure is often lacking. The commercialization of mango fruits in Italian market may also be extended to the formulation of fresh-cut products. We have used MAP (Modifying Atmosphere Packaging) at a temperature of 10° C to extend the shelf-life of a tropical mix of pineapple, mango and orange fruits (Sortino *et al.,* 2017). The packaging/temperature combination (Fig. 8) has allowed the fruit to be kept for 9 days while maintaining excellent quality characteristics.

Another tropical fruit whose cultivation is gradually spreading in Sicily is the litchi. Litchi supplies in Europe were particularly small and it is mainly based on fruit importation from tropical countries. Indeed, from the second half of July to the end of October the export season from tropical countries generally ends and fruit is absent from the European markets.

In this period, the only offer comes from the Mediterranean countries (Spain, Israel and Italy) with no market saturation. The climatic conditions prevailing in Sicily differ greatly from those of most litchi growing regions: the winter is mild and wet , blooming is delayed to April-early May and the fruit is harvested from July until September. The qualitative response of litchi fruit was largely studied in tropical area whereas it was not yet analyzed in Mediterranean climate. In a recent trial we have studied the agronomic performances and fruit quality of 4 litchi cultivars grown in the coastal areas of Sicily by physico-chemical and sensory analyses during two productive seasons (Farina *et al.,* 2017).The obtained results indicated that fresh fruit of litchi could be cultivated and commercialized in Mediterranean areas, limiting the long-distance fruit export season from tropical countries.



Litchi is a subtropical fruit characterized by a rapid pericarp browning and dehydration during postharvest, resulting in an accelerated shelf life and in a loss of consumer appreciation and consequently of its market value. In a recent trial we have assessed litchi fruit chemical-physical and sensory quality changes during postharvest and shelf life using rapid refrigeration (RR) (Fig. 9) and active modified atmosphere packaging (MAP) (Fig. 10). Fig 10. RRF of litchi fruit

Generally, the fruit submitted to RRF treatment presents a more intense red color in particular referring to L parameter and the best chemical-physical characteristics. Moreover, RRF fruit revealed having more consistency, juicy flesh, fruity flavor and exotic flavor after 4 days and of fruity odor and exotic odor after 8 days of cold storage. MAP and MAP+ showed a sensory decay only after 12 days.

Based on the yield and on the fruit qualitative characteristics of mango and litchi, considering that the researchers have confirmed the great potentiality of these species in the suitable areas of our island, the expansion of this species in Sicily offers wide opportunities. Moreover, papaya, anona and loquat are also spreading in the same suitable areas of the island.



Fig. 8. Litchi fruit harvested in Sicily and submitted to active MAP

Please refer to the enclosed bibliography for details of the data mentioned in the article.

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Fruit Growth and Development of Copoazú- A Wild Fruit of Brazilian Amazonia

The copoazú [*Theobroma grandiflorum* Wild ex Spreng (Schum)] is an arboreal fruit species of *Sterculiaceae* family. The tree found wild in the eastern subregion of Brazilian Amazonia, but has also been introduced into the humid tropics of Colombia, Costa Rica, Ecuador, Peru and Venezuela.
The fruit is a drupe with strong and pleasant smell and creamy exotic taste. It is smooth on the outside, ellipsoidal, 25 cm long and 12 cm wide and attained a fresh weight of 1.5 kg or less. The endocarp is white, soft and sour-tasting, containing 25–50 seeds in five rows. The pulp occupies approximately one-third of the fruit and is usually used to make fresh juice, ice cream, jam and tarts (Balee, 1994; Giacometti, 1994; Moraes, *et al.*, 1994; Franco and Shibamoto, 2000).

Fruit growth

Copoazú fruit growth follows a sigmoidal curve according to morphological traits and fresh weight (Fig 1). The logistic regression provided the most satisfactory fit for the tree growth traits studied and the lowest residual mean square (R^2=0.935 for longitudinal diameter and 0.975 for equatorial diameter, P<0.001; Table 1). Three different growth stages can be outlined (S1, S2 and S3). The slow growth pattern (S1) lasted 33 d. Fruit show an exponential growth during the stage S2 from the 33th to 96th day. The fruit attain their final size in S3 stage after 140±2 days after full bloom. Copoazú fresh weight fit a sigmoidal curve with high correlation coefficients (R^2>0.963) (Table 1; Fig. 1 A) fitted with a significance of P<0.001, similarly to arazá fruit (Hernández *et al*., 2007). The percentage of pulp in copoazú at harvest is around 33% w/w at the end of development, while epicarp and seeds are the rest.

Table 1. Logistic models fitted for different traits against growing time (D, in days from full bloom) of copoazú fruit selected according to mean square. Coefficients of determination R^2 were above 0.95 except for dry weight and fruit components (R^2=0.83). The terms significance was P< 0.001.

Dependent variable Y	Logistic model	Residual mean square
Equatorial diameter (cm)	$Y = 10{,}5 / (1 + e^{2.65 - 0.05 \cdot D})$	0.14
Longitudinal diameter (cm)	$Y = 19 / (1 + e^{5.74 - 0.08 \cdot D})$	0,24

Fruit quality

Copoazú exhibited brown epicarp color during its growth. By the end of S3, fruit keep the dark brown as fruit senescence advance. Color indices (ligthness, hue angle and chroma) slightly change after maximum enlargement of fruit. On the contrary, pulp color varies from white to creamy H*=95º; C*=80 units and L*=20 units during ripening. Color and juiciness were classified as two indices of fruit maturity (data not shown). The respiration rate (RR) in mg kg^{-1} h^{-1} of CO_2 is high (400±18) in S1. Although the beginning of S2 showed an apparent and transient climacteric, peak and the RR decreased to 97±3 mg kg^{-1} h^{-1} of CO_2. Finally, during S3 a climacteric peak appears (156.24±42.5 mg) at day 124. The increase in the climacteric peak was significant (P≤0.05), but the fruit is not showing detectable ethylene production levels before natural fruit abscission.

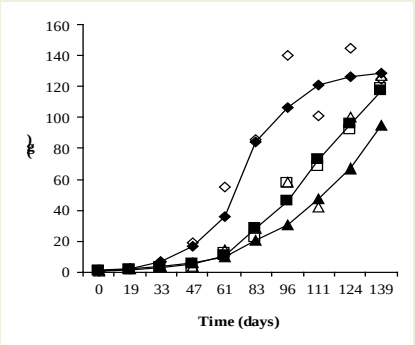


Figure 1 Fresh weight of epicarp (◆◇), pulp (▲△) and seeds (■,□) during copoazú fruit growth. Solid line indicates the fitted line of the logistic model. (n=20 fruit).

During the climacteric peak (124 Days after set (DAS)), total titratable acidity decreased to 2.0±0.2% citric acid, while the pH shows the opposite behavior with a slight increase during the climacteric peak. Maturity ratio (MR) decreased between 98 and 110 DAS, from 3.5 to 2.1, which then increased to 3.1 at the end of S3. The TSS showed a significant increase (P≤0.05) from 132 to 139 DAS (6.5±1.3 up to 10.5±0.6°Brix. After natural abscission, TSS and MR increased (from 10.5±0.6 to 13.7±0.1°Brix and 3.3 to 4.9 (TSS/citric acid (%)), respectively) over 2 d, and then decreased.





Fruit processing

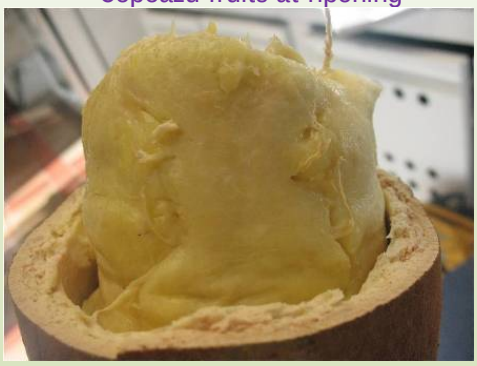
Copoazú fruit has a very strong flavor, which influenced the perception of the consumers as well as it gave consistency in mixes with others fruits. Pulp is used in juices, fruit bars and subjected to spry drying. Copoazú pulp enzymatic treatment enhanced pulp-seed separation and filtration reduced the total solids as the remaining starch and insoluble fiber fraction retained. A significant increase in levels of sucrose, fructose and glucose sugars was observed in Copoazú pulp because reducing sugars increase due to pectic enzymatic activity in enzymatic treatments. Regarding the organic acid content, only the citric acid content increased significantly during processing. Organic acid and sugar increases explain the higher soluble solids for treated Copoazú pulp and, as the sugar-acid relation changes, there is an expected improvement in flavor acceptance (Díaz *et al.*, 2014). Chocolate from seeds is produced recently in local Amazonian industries with high sensorial quality and acceptance.

Conclusion

Copooazú fruit show a sigmoid growth with a climacteric respiration pattern and it exhibits interesting properties for fruit processing and new food development. Amazonian people in Colombia take advantage from the pulp and the chocolate production from seeds of this fruit.



Copoazu fruits at ripening



Copoazu ripen fruits in the southwest Amazonian Colombian region

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Crop Regulation for Round-the-year Harvest of Guava

Guava (*Psidium guajava* L.), the poor man's apple, is one of the most common fruit grown widely in tropical and subtropical regions of the world. Guava has well established markets in more than 60 countries. The top ten guava producers in the world are India, China, Thailand, Pakistan, Mexico, Indonesia, Brazil, Bangladesh, Philippines and Nigeria. Guava bear fruits at different times of the year. However, harvesting all the crops in small amount is not profitable, In India, maximum fruiting is found in the rainy season which are poor in quality due to high water content and severely attacked by fruit fly while the winter harvested fruits are superior in quality having good market demand. Cycling of crop to avoid rainy season crop and increasing winter crop is possible. Cycling of crop by using different methods of flower regulation, it is possible to harvest guava round-the-year. The method/s to be followed for crop regulation depends on climatic factors, cropping pattern, market and industry demand, cultivar etc.

The principal of crop cycling in guava was developed by Shigeura *et al.* (1979) at Hawaii to harness the natural flowering and fruiting tendencies of guava and contribute to increased yield and profitability. The concept is based on the fact that the guava flowers are borne only on new, succulent, vigorously emerging vegetative growths. These new growth flushes can be either new emergence of lateral buds on older stems within the crown, or extension of already established terminals of various size and vigor.



Training (bending) of shoots to regulate cropping

This method of crop cycling is effective when the plants are between 2 and 5 years of age. The plants are trained in such a manner that only four shoots will grow in all the four directions at 30-45 cm trunk. Certain varieties (Allahabad Safeda, Bengal Safeda) were found more responsive with the treatment. The shoot bending should be made before 15-30 days of flowering. Leaves, small developing shoots and flowers (if any) should be removed before training (bending) of shoots.

The bended shoots are tied with ropes in pegs which should be removed after emergence of new shoots. Trees should be fertilized (based on leaf nutrient status) before 15 days of treatment (bending of shoot), followed by irrigation. During summer (April-June), the new shoots emerge within 8-10 days of treatment while in autumn (September-October) the new shoots emerged after 20-25 days. Flowering occurs in the new emerging shoots at 4-5 pair leaf stage, after 45-50 days of summer and 60-65 days of autumn treatment. A second dose of fertilization is required at the pea stage of fruit growth.

Crop regulation by shoot bending increased winter harvest and improved fruit quality in terms of fruit size, total soluble solids and vitamin-C content of fruit (Sarkar *et al.,* 2005). Bending of shoots increased the total free amino acid contents in leaf and bark compared with control (Bagchi et al., 2008). This may be on account of the inefficient utilization of amino acids in protein synthesis or due to proteolysis. Higher lipids in bark at the initial stage and in leaves at the later stage signify the tendency of plants to overcome the shock effects of bending and pruning. In leaves and bark, total soluble sugars and reducing sugars were also higher in the bending/ pruning treatments; for starch, however, it followed reverse trend. As proline biosynthesis is stimulated under stress profuse flower bud initiation occurs in stressed plant (by bending). A positive relationship between proline concentration in the leaves and yield was observed by Bagchi *et al.* (2008). Definite biochemical changes in guava shoots under an episode of stress may produce off-season flowering in guava leading to higher fruit production.

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FORTHCOMING EVENTS, 2018-2020

