VARIETAL ASPECTS IN THE CHOICE OF TABLE OLIVES CULTIVAR FOR QUALITY PRODUCTION

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ABSTRACT

The improvement of the quality of the horticultural productions has recently become one of the main objective of national agriculture politics in the E.U. Countries. The lowering of production costs, together with quality, are recognised to be crucial in order to enhance the competition power of the domestic European horticultural products in the international market.
Although the contribution of the research has grown in the years on the issue of the quality, however, it should be recognised that in the field of the table olives production still remain many areas of problems to be faced. Some of these aspects concerning the qualitative improvement of the productions are, obviously, at least in part common to those of the oil olive industry in general (Crescimanno, 1993).
Table olive production represents, indeed, only a small part of the entire olive industry (Crescimanno, 1989), while peculiarities and points of contact are found with the topics of fruit tree production. In other words table olive industry has in part already assumed, and for the future necessarily it will have to assume, more and more the characteristics of the modern and intensive fruit growing.
It should be mentioned, moreover, than even under the point of view of quantities of production the EU Countries, particularly Italy, have still to exploit their potentialities.
Our Country, even with an annual average production that is around 60-70.000 tons, i.e. approximately 9% of the total world production, is annually forced to import various tens of thousands of tons of table olives, mainly from Spain and Greece (> 80%), in order to satisfy the domestic requirements that amount to approximately 120,000 tons, with a consumption *per capita* of about 2.5 Kg. Italy is, therefore, the second Country after U.S. for table consumption and for the imports.
Great part of our production of table olives comes from few regions: Sicily, Apulia and Calabria alone concur to supply approximately 80% of the total of the Italian offer, indicating the strong southern character of this type of fruit growing (Di Marco and Barone, 1998).
It is clear therefore that there is space for an increment of the productions as well as for the elevation of the qualitative level of our productions above all if it is considered that large amounts of table olives are still obtained from not specialised orchard systems normally destined to the oil production.
Under this point of view the extreme heterogeneity of the production, coming from an extremely high number of cultivars (a group of forty), known from the consumer only locally and transformed from a myriad of artisan enterprises must be stressed and is far from being solved.
In Spain, like in Greece, there are prevailing, standardised, productions from a narrow number of appreciated cultivars able to totally satisfying the requirements of the transformation industry and of the market. The Spanish table olive industry in particular is characterised for the spread of only three cultivars, the 'Manzanilla de Sevilla' (southern zone of the Guadalquivir and province of Badajoz), the 'Gordal Sevillana' (province of Seville) processed as green olives and the 'Hojiblanca' (Cordoba and Malaga) also as black olives with which, as a whole, a quarter of the entire world-wide production and 50% of the world-wide export volumes is obtained (Rejano, 1998). It's easy therefore to comprise as reasonable perspectives of market are possible for Italy only if a severe process of restructuring of our table olive industry is faced. Such a process will have to regard the aspect of the extreme heterogeneity of the productions, but it must necessarily take care of the other factors that concur in elevating qualitative profiles: optimal pedoclimatic environment, adequate cultural techniques, appropriated conservation and processing technologies.
Cultivar selection, when attempting to enhance table olive quality, is a tool of extraordinary value. This is why this problem will be mainly discussed hereafter.
Varietal aspects - The choice of the cultivar largely depends on the type of olives we want to produce. The International Olive Oil Council standard includes three types of olives, according to the degree of ripening at the time of harvesting: green olives, black olives and olives turning colour.
Depending on the various destinations that can have the drupes, table cultivars properly said can be distinguished from others considered to be 'twofold attitude' i.e. for oil and for direct consumption. Such a distinction, however not always clear and easy, tries to separate the specialised table cultivars from those that are generally used for oil extraction but in some cases are also used for the direct consumption thanks to a medium-large dimension of their fruit. Several cultivars and, in Italy, above all many of the South (Intosso, Itrana, Passulunara, Tonda Iblea, Moresca, Pizz'e Carroga, Carolea and Grossa di Cassano), belong to this group that to world-wide level concurs to the offer of fruits for the direct consumption for approximately 50%.

Cultivar selection should take into account some characteristics of the tree such as (Crescimanno, 1993):

climatic adaptation
earliness of fruiting
regular bearing habit
good vigour
degree of adaptation to cultural intensification
resistance to pest and disease
absence of virosis

These characteristics generically define one good cultivar of olive tree.
Table olive cultivars will have moreover to possess other valuable specific characteristics and essentially:

an uniform model of maturation
a constant and uniform average size of the drupes from year to year

Other characteristics that concur to the definition of the concept of quality of a table olive cultivar can be identified in:

shape and dimensions of the drupe
homogeneity of the size
yield in flesh (flesh to pit ratio)
facility of separation of the flesh from the pit
aspect and colour
flesh texture and firmness
taste
attitude to olive processing
shelf life
oil content

Other varietal characters, the qualitative-quantitative composition of organic acids and the glucidic fraction of the flesh, can affect the natural fermentation process and may, therefore, assume relevance in determining the suitability of the cultivar for green pickling.

More in detail, as far as the characteristics of the drupes are concerned, it must be specified as these must present percentages of flesh greater than 75%, i.e. a F/P ratio of about 3. Good appreciation receives drupe with F/P equal to 4 (80%) while "much good" and "optimal " can be considered olives with F/P equal to 5 and greater than 6, respectively (i.e. 84-85% and > 86% of flesh) (Brighigna, 1989).
From the point of view of drupe size, olives whose size is less than 14-15 millimetres are considered not marketable. Thus, cultivars offering large amount of production with drupes of this size have consequently to be considered not suitable for table olive production. On the contrary, cultivars that are able to supply high percentages (> 60%) of homogenous olives altogether with diameters comprised in a range of medium-high diameters (e.g. 17-20) must be preferred (Brighigna, 1984).
Generally medium-sized cultivars (200-250 drupes per litre), but sometimes also cultivar with a larger fruit (> 6 g) with hardly 90-100 drupes per litre (Ascolana, Bella di Spagna, Giarraffa, Gordal) are appreciated by the market.
The character “flesh firmness”, besides the dimensions, assumes primary importance in the processing of green olives. This method of processing requires, in fact, the flesh to be crisp, compact but not too much turgid or 'swollen' for effect of excessive irrigation in proximity of the harvest time (Brighigna, 1984).
To the aims of the resistance of the drupe to the lesions caused by the manipulations, the transports or the mechanical harvest the firmness of the flesh turns out to be determining.
From trials of mechanical harvest carried out in Calabria it is emerged that the percentage of damaged drupe is raised between 3 and 4.5 times for the S.Agostino and the Nocellara Etnea, respectively, in comparison to manual harvest (10%) (Lombardo, 1978).
As far as fruit shape is concerned it results that particularly roundish shape (Manzanilla type) is preferred in the international market, even if other various shapes can equally be appreciated on a smaller scale.
Discordant opinions are found in the literature concerning the preference to reserve to cultivar with poor content in fat matter. For good results of the processing elevate oil contents would be detrimental (Cimato, 1989). In any case, in favour of the selection of cultivars with an appreciable oil content it is worth

considering that, in this case, the drupes can assure a greater economic return if it is impossible to use them for processing as table olives. However, in Israel a low (3-4%) fat content cultivar (Kadesh) has been licensed and is currently sold as a dietary product (Lavee, 1978).

Limiting the analysis of the perspectives of quality improvement for table olives to the agronomic thematic, the essential role of the corrected application of the most recent cultural technique guidelines must be emphasized.
It is necessary to remember the role carried out by the irrigation in the expression of specific qualitative-quantitative aspects of the productions, specially if we consider that table olive trees are diffusely grown in Mediterranean regions, where the period of water deficit during the course of the year can be particularly extended.
Dettori (1987) estimates a water consumption, in adult olive groves, of 560 millimetres of water per year and 370 millimetres during the course of the irrigation season (May-September).
The restoration, even if only partial, of more favourable conditions of humidity of the soil concurs to influence positively the development of the drupes with appreciable effects on drupe size, flesh-pit ratio, and on the reduction of alternate bearing (Baratta et al., 1985; Milella and Dettori, 1986).
Goldhamer and co-workers (1993) have found, for the Californian conditions, a positive linear correlation between yields of cv. the Manzanilla and applied irrigation volumes, in the range of 200 - 950 millimetres, leading to a doubling of the yields.
The effects of fertilisation onto fruit quality can not be easily determined. However, a correct and balanced mineral nutrition constitutes the base for a favourable vegetative-productive status of the plants, above all in conditions where water availability is not limiting. In particular, flesh/pit ratio seems to be improved by foliar application of urea (Cimato et al., 1990).
A rich nitrogen fertilisation, as demonstrated by Hartmann (1958), can delay the maturation.
The time of harvest influences fruit quality and is crucial above all for the green olives processing.
When harvest is performed too much early, in fact, olives are not allowed to reach full size and they may have poorer yield in flesh that result excessively fibrous and hardly separable from the pit, as reported for the Grossa di Spagna in Apulia (Ferrara et al., 1988).

A correct execution of pruning, and above all, a correct timing of fruit thinning in relation to the effect that is obtained balancing fruit load to the potentialities of the tree, concurs to influence positively the fruit size and improve flesh-pit ratio with benefits in alleviating alternate bearing (Baratta et al., 1990).
Another technique, successfully experienced by Lavee in Israel, that is able to affect the production and the quality of the fruit is girdling of the productive branches. Lopez-Rivares and Suarez (1990) found positive effects of girdling on fruit size only if done 30 days before full bloom under irrigated conditions.
This technique provokes, however, some perplexity for the high cost of execution that, as it is obvious, is exclusively manual and for the early ageing of the branches.

Fruit size is a genetic character and, therefore, may vary considerably from one cultivar to one other. Besides cultivar, it depends considerably on crop load. The heavy crop of one year, due to competitions for nutrients and for water, is therefore often associated with strong reduction of the size of the fruit, much of which is of little commercial value. Such phenomena of competitions are nonetheless the reason of the intense fruit drop phenomena that occur already after 35-40 days after full bloom.
Moreover, when trees carry a large crop load, also F/P ratio decreases with further reduction in fruit quality (Di Marco al., 1988). This is the reason why a less alternating cultivar will also show a less variable fruit size from year to year. Encouraging perspectives for the reduction of the phenomenon of alternate bearing are therefore expected by means of the crop load regulation through the use of thinning agents of chemical nature in blooming (urea) or post blooming (NAA) applications. In Spain and in Israel with treatments with this last thinning agent (120-130 mg/l) sprayed two weeks after full bloom a good improvement of fruit size associated to a contained yield reduction is obtained.
In the United States chemical thinning is the most common method adopted to regulate olive crop size effectively improving fruit quality and return bloom for the next year. It is successfully carried out with NAA between 12 and 18 days after full bloom with concentrations raising by 10 ppm per day after full bloom (Sibbett and Krueger, 1998). However, chemical thinning of water stressed trees could be detrimental and thus should be avoided.

There is after all enough evidence that in order to improve the qualitative profile of the productions more attention has to be paid to correct and timely application of each management practice able to regulate fructification. Fertilisation, pruning, irrigation should be practiced in a regular and balanced manner to this

aim. Particularly irrigation, ensuring a better vegetative development that predisposes favourably the plant for the production of the successive year, would be also able to influencing the ripening period. This will result anticipated when the crop load on the trees is low but it is prolonged and the colouring of the fruit is delayed by irrigation. Irrigation can also delay blooming time, increase the frequency of perfect flowers and reduce the density of the inflorescence for centimetre of branch, as recently has been shown on "Manzanillo" (Ferguson et al., 1993). When the frequency of irrigation increases a period of continuous and homogenous fruit growth is guaranteed with a positive effect on the uniformity of fruit size and on the yield in flesh.
Improvements of the size of the fruits in dry farming conditions have been traditionally obtained through severe pruning consisting in the thinning of 2-3 year-old branches (Andalusia, Sicily). In Spain as a consequence of this practice damages derived from excessive insolation, premature aging of the plants and yield decrements have been reported. Above all it has to be stressed that pruning is not as effective as thinning because it removes both fruit and leaves and does not raise leaf-to-fruit ratio which is essential in order to improve fruit size.
Positive effects on the uniformity of the productions and on other important characteristics like as vigour, the adaptation to the pedologic substrate can be expected in the future as a result of the use of specific selections of clonal rootstocks coming out from ongoing rootstock breeding programmes (Fontanazza et al., 1992).
Substantial qualitative and quantitative improvement of the productions can derive from the correct application of the available agronomic techniques.
As a whole these factors can offer, in suitable environments, powerful tools to allow an optimal expression of specific genetic valuable characteristics, that are typical of every cultivar, but in no case they can render valid a product with no intrinsic value.
It appears, therefore, extremely clear that the pursuit of quality passes primarily through a cautious cultivar selection, first of all within the local available germplasm, accordingly with the pedological and climatic environment of cultivation and supported by an appropriate experimentation.
Secondarily the adopted techniques of industrial processing must be able to concur to the maintenance of the qualitative characteristics of the cultivar in the end product, enhancing the potentialities of each type of table olive preparation.

The diverse varietal attitude to the various processing techniques becomes another aspect of primary importance to be taken into account.
From the technological point of view, in fact, the various cultivars can present a different degree of adaptation to the diverse processing methods.
Processing, for example, generally induces a loss of flesh firmness that can affect end quality depending upon the raw material. With the Sevillan style system losses of firmness of 112% with the Picholine (hard textured) and of 156% with the tender Ascolana have been obtained.
Trials carried out by the Istituto Sperimentale per l'Elaiotecnica have determined that cultivars with firm flesh (e.g. Intosso) have a greater total content of pectin compounds of that one of the cultivars with a more tender flesh (e.g. Carolea) and that such content however diminishes with progressing of the maturation. Among these compounds, the protopectins are the main responsible substances of the hardness of the fruits.

Fruit colour is another character that should be considered for quality production. Optimal colour is defined by IOOC standards in relation to cultivar and to method of processing. Fruit colour changes during maturation from green to yellow-white (straw) and finally to purple or black. The compounds responsible for this last change in colour are the anthocyanins, particularly cyanidin-3-glucoside and cyanidin-3-rutinoside. These follow an evolution in the course of fruit maturation that can be different from cultivar to cultivar. In order to estimate the different varietal attitude for black olives preparation the study of the behaviour of these compounds, as affected by cultivar and management, can represent an useful additional information.

It has been shown that pursuing the objective of quality various criteria can be utilised for varietal selection. However, when introducing cultivars from other areas attention should be primarily paid to their degree of adaptation to local environmental conditions in order to choose the most suitable ones. The effective value of new varieties should be therefore necessarily compared with that of traditional ones and should be studied case by case.

In any case the extreme usefulness of the clonal selection among local accessions seems unquestionable. In Italy different researches carried out in Tuscany, Sardinia, Apulia, Calabria and in Sicily have confirmed the potentiality of valorisation of the native genetic material.

Comparative trials carried out in Sicily to estimate the bio-agronomic behaviour of various table olives cultivars have confirmed the value of Nocellara del Belice, one of the best Italian cultivars for the production of green olives. The Spanish cv Manzanilla emerged, among the others for the precocity of maturation, for the reduction of tree size and the good quality of fruit (Barone et al., 1986). Giarraffa emerged for its potentialities for the production of black olives. According to intensive olive growing criteria adopted Picholine resulted one of the most interesting variety for productivity, even if the size of the drupe very rarely met the standards (Caruso et al., 1990; Barone et al., 1993). Positive qualitative results have been obtained with Gordal, Conservolia and Bella di Spagna.

Many other minor cultivars of the Sicilian germplasm with good perspectives for oil production are locally used for table olives and sometimes can provide fruit with interesting characteristics even if relevant problems such as excessive alternate bearing, sensitiveness to diseases, or irregularity of the ripening pattern limit at the present time their use for commercial table olives.

Further research in the area of breeding, specially by the means of clonal selection, can deserve for the future interesting perspectives for the enlargement of the varietal platform and the enhancement of table olive quality.

In this report, after a brief description of the main table olive cultivars diffused world-wide the current state of the art of the scientific progress in the field of varietal aspects related to fruit quality will be reviewed.

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