

Reintroduction of old local scab-resistant/tolerant varieties in organic orchards in Italy

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Abstract

In Italy there is a rich heritage of apple varieties mainly of Roman origin that is fortunately saved in germoplasm collections and by some local growers. Monitoring for many years 380 Italian old accessions (192 genotypes) showed in most of them substantial or medium susceptibility to scab (*Venturia Inaequalis*). But some were resistant or at least very tolerant. In field trials without any chemical sprays, these landraces had from 3% to 8% of fruits with scabby spots while Red Delicious had 100%. In Durello, the gene of scab resistance was identified as giving resistance to race 6, while many new varieties with Vf genes are susceptible. For others, probably, polygenic resistance is the basis of very low scab symptoms in the leaves and fruits. In orchards where these genotypes are prevalent, very few copper sprays are required. After that, they have been reintroduced into the original areas, achieving new holistic orchard design for organic farms. Most are used together including also recent Vf varieties. Many examples of biodiversity are present in this way in the orchards, helping pollination and bee circulation, so that different resistant gene sources should allow good control of new strain breakdown. These landraces are also included in breeding programs with the aim to obtain alternative Vf polygenic genes.

Keywords: germoplasm, old apple variety, scab resistance, organic orchard

Introduction

Fruit cultivation was already well-known in Roman times. Many apple, pear and peach varieties have been cited by Pliny and other writers. But it seems barely credible that many of these apples and pears were still growing in Italian farms up to the beginning of the last century after 2 thousand years (Buscaroli 2019), together with Middle Ages and Renaissance varieties. The introduction about one hundred years ago of USA varieties and new agricultural techniques, such as the use of chemistry for disease protection, changed everything and caused the loss of many very ancient genotypes. Only a recent awareness in the scientific community is preventing consistent genetic erosion. During the 1990's a large CNR (National Research Center) program and investment involved many Italian Universities and Institutes working on fruit trees research. A national network was created to change fruit scion wood but, above all, every old fruit tree still living in grower farms was recovered and included in living trees germoplasm collections. At least 3 trees/collection of every accession had to be present in 2 different places. The University of Bologna, Fruit Science Department, was the coordinator for apple species and had to preserve each accession coming from other Institutions taking part in the program. At the end of the 90's national funds ran out, but many trials have been possible in these ten years to improve the understanding of traits of old varieties compared with new ones leading to their use in breeding programs. After that, the Institutions have looked for new ways of funding fruit collections whenever possible, but many accessions are at risk of being lost. New regional and national laws were recently created to safeguard biodiversity and to contain erosion. Sometimes funds have been found through Eu Rural Development Programs. Guard

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growers and the reintroduction of old varieties in their farms could be other ways to save them.

Materials and Methods

In March 1985 a germoplasm collection of about 350 accessions was established at the University of Bologna, in the plain at 30 m. above sea level. Every accession had been grafted on M9 in a nursery 2 years before. 3 trees were planted for each accession at a distance of 4 x 1,5. The training system chosen was free spindle so it was possible to see in a few years the typical natural habit of each of them. Most accessions were Italian varieties recovered by other scientific institutions or local growers of each region from the north to the south. Some well-known varieties from other countries were included in the collection as a comparison. An annual common fertilization plan was used as well as some sprays against main diseases: scab, powdery mildew, rose aphid, codling moth. After the 2nd year the first data were taken about the vegetal bearing of the trees. At the 3rd year pomology data started being taken. In spring, scab and powdery mildew data were collected on leaves and fruits from 1995 to 1999. In 1997 a second orchard was established with accession that had showed some symptoms on fruits and leaves. Scion wood was always grafted on M9. In the new collection sprays were never used. Golden Delicious and Red Delicious were included in the collection as sensitive testers, while Florina, Prima, Primera Priam as scab resistant cultivars with Vf gene. Furthermore some cultivars with different SR genes were included: Murray (Vm), Freedom (Vf + Va), Realka (Vr), Reglindis (Va). Later, old genotypes, which had demonstrated less scab susceptible or putative resistance, were propagated and given to local growers of the original region of each variety. Some of them were analyzed to understand better the molecular bases of the resistances (Tartarini et al. 2004). About ten years ago the collection was completely characterized by SSR markers (Wei et al. 2014).

Results

As a consequence of limited fungicide sprays in the germoplasm collection, scab infection was very high and accessions showed large reaction variability. Many of the most damaged ones were accessions coming from southern Italy, where generally hot and dry springs stop infection, 2-3% of accessions showed almost absent symptoms, more in fruit than in leaves. 10-15% showed very low symptoms (Fig. 1). In the second step, a new collection with only very tolerant scab accessions were planted with tester and managed without any spray.

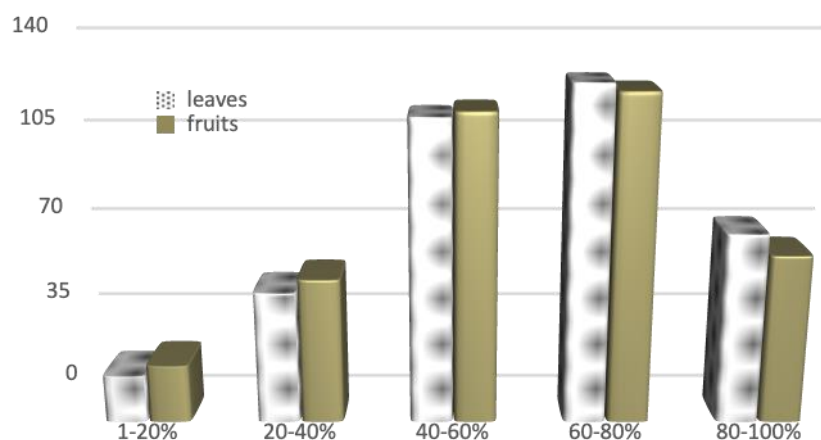


Fig.1 – Symptoms of scab in leaves and fruits of 380 germoplasm accessions

Some of them have confirmed the previous trend bringing a good fruit production with very few scab spots on fruits (Tab.1). Golden and Red Delicious lost their leaves early in spring, only 2-3 fruits/trees did not fall before harvest and had many scab spots per fruit. In few years they stopped growing, but never died.

Table.1 - Scab symptoms on fruits of old Italian varieties and testers in germoplasm collections without chemical sprays (Buscaroli et al. 1996).

Variety	% fruit damaged	n.spot/fruit	Size/spot Cm
Renetta grigia di Torriana	3	1,6	3,4
Durello di Forlì	4	2,2	2,9
Decio	8	2,2	3,4
Gelata	100	12,1	4,6
Florina (Vf)	-	-	-
Red Chief	100	12,1	3,6

Apart from local varieties, also some genotypes of other origin, have shown good scab resistance: Renetta Ananas, old Belgium genotype, Clivia from Germany, Boskoop from the Netherlands. These are now included in new organic orchards together with local and Vf types.

Table.2 - Scab symptoms on fruits of local and international old varieties and testers with different resistance sources in germoplasm collections without chemical sprays.

Variety	% fruit damaged	n.spot/fruit	Size/spot cm
Lavina	5	2,1	3,2
Campanino	7	1,8	2,8
Durello di Ferrara	8	2,5	3,2
Renetta Ananas	4	1,8	2,2
Rambour Franc	6	2,4	2,5
Renetta dorata (Blenheim Reinette)	6	2,8	3,3
Clivia	7	2,3	3,0
Boskoop	8	2,6	2,8
Primiera (Vf)	-	-	-
Murray (Vm)	-	-	-
Freedom (Vf+ Va)	-	-	-
Realka (Vr)	-	-	-
Reglindis (Va)	4	1,4	1,8
Golden Del.	95	10,2	3,4

Rambour Franc known as susceptible genotypes in the past, showed few symptoms in this trial. Later, scab resistance of Durello di Forlì was studied by molecular analysis (Tartarini et al. 2004) and a gene was identified (Vd) as having specific resistance to race 6 to which Vf is considered susceptible. SSR marker characterization (Wei l.c.) confirms that 66% of accessions are different and unique genotypes, many with very ancient origin, some probably over 1 or 2 thousand years.

Discussion

In the last ten years, most landraces have shown, in the trials carried out during 1-2 decades, a good scab polygenic resistance/tolerance. They have been reintroduced in organic farms together with Vf recent varieties to strengthen monogenic resistance and limiting risk of breakdown. Market-based interest in local varieties is increasing very much. Experience shows that fruits of old varieties are not beautiful, they are irregular, but fascinating, not as crispy as new ones but much more scented and aromatic. Most of them can be stored for a long time even outside the fridge by putting them in a cellar or in an attic, inside a wooden box during all the winter with no chemicals. Orchard design should be studied very well, both for pollination and according to each variety: Renetta Ananas are fruits with a very good taste but with a very short period of storage, so not too many trees should be put in the orchard, differently from Lavina, Durello e Campanino. A lot of landraces history, linked to the local tradition, has been rediscovered and told to consumers. Campanino is well-rooted in its original area of cultivation (Modena), where it is possible to find farmers that have been growing this variety for many centuries with very sustainable management. Now they have found a new market for organic production. Durello is still cultivated in some areas. There are more genotypes which are very similar but with some differences: D. Forlì is a dwarf type. D. Ferrara has got a very upper habit. D. Faenza grows more open branches and shoots, so it seems less susceptible even to Rosy apple aphid. Lavina is a green-yellow fruit variety of the Appennines, abandoned after the introduction of Golden Delicious. Now it has been reintroduced in organic orchards because of its good scab resistance, good taste and long storage. Renette grigia di Torriana is a “rusty” skin type of Piedmont origin where a Slow Food Presidium was born managed by a farmers’ consortium. Decio was probably introduced in E.Romagna and Veneto by Valentiniano III around 450 B.C. and cultivated until the 30’s of the last century for very rustic traits. Decio is now a Slow Presidium apple. At present, these landraces are also being used as parents in breeding programs to introduce polygenic sources in new resistant varieties.

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