

Needs and knowledge gaps in organic fruit breeding and variety testing across Europe: A survey study

Introduction

Having adapted varieties is a pillar for a successful and more sustainable organic fruit production. To better understand the current organic fruit breeding needs, future challenges and lack of knowledge across Europe a survey was carried out in the framework of the Horizon Europe project 'InnOBreed' with a focus on pip and stone fruits.

Methods

A survey with specific questionnaires for breeders and variety testers, including multiple choice questions and open questions, was conducted. The survey was completed by 46 breeders and 60 variety testers from 11 European countries.

Results

- Focus traits: fruit quality & yield > disease susceptibility (Fig. 1).
- Selection and testing performed only for few major pests and diseases (Fig. 2).
- Most breeders and variety testers work under high input conditions (Fig. 3).
- The maintenance, access, and sharing of genetic material, and the integration of traits fitting with climate change are the main challenges of pre-breeding (Fig. 4).

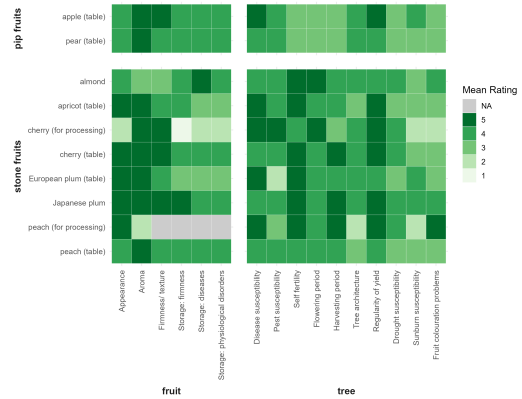


Fig. 1: Rating of the importance of the breeding criteria (1 = not important at all; 5 = very important).

Crop	Disease / Pest	Name of the disease/ pest	Markers	Breeders	Variety testers
Apples	Diseases	Apple scab (<i>Venturia inaequalis</i>)	X	19	36
		Powdery mildew (<i>Podosphaera leucotricha</i>)	X	12	30
		Nectria canker/European canker (<i>Neoneotria ditissima</i>)	X	8	15
		Fireblight (<i>Erwinia amylovora</i>)	X	1	10
		Storage diseases		0	9
		Marronnier apple blotch (<i>Diplocarpon coronariae</i>)		1	4
		Sooty blotch		0	4
		Aschtrachose (<i>Elsinoe pipi</i>)		0	3
		Aphids (in total)		3	32
		- Rosy apple aphid (<i>Dysaphis plantaginea</i>)		3	12
Apples	Pests	- Woolly apple aphid (<i>Eriosoma lanigerum</i>)	X	0	7
		Codling moth (<i>Cydia pomonella</i>)		0	11
		Apple sawfly (<i>Hopllocampa testudinea</i>)		0	5
		Brown marmorated stink bug (<i>Halyomorpha halys</i>)		0	4
		Apple blossom weevil (<i>Amblyopron pomorum</i>)		0	3
		Mites (European red mite (<i>Panonychus ulmi</i>), Two-spotted spider mite (<i>Tetranychus urticae</i>))		0	2
		Leafrollers/ortrix moths		0	2
		Pear scab (<i>Venturia pyrina</i>)		0	2
		Fireblight (<i>Erwinia amylovora</i>)	X	2	2
		Stemphylium leaf blight (<i>Stemphylium vesicarium</i>)		0	2
Pears	Diseases	Monilia fruit rot (<i>Monilia spp.</i>)		0	1
		Pear scab (<i>Venturia pyrina</i>)		0	2
		Pear bedstraw aphid (<i>Dysaphis pyri</i>)		0	2
		Lace bug (<i>Corythosoma pyri</i>)		0	1
Pears	Pests	Sinuate pear-tree borer (<i>Agilus sinuatus</i>)		0	1
		Codling moth (<i>Cydia pomonella</i>)		0	1
		Monilia twig blight (<i>Monilia laxa</i>)		2	4
		Plum rust (<i>Tranzschelia spp.</i>)		0	3
Apricots	Diseases	Bacterial canker (<i>Pseudomonas syringae</i>)		2	2
		Powdery mildew (<i>Podosphaera tridactyla</i>)		0	2
		Sharka / Plum pox virus (PPV)	X	3	1
		Aphids (Green peach aphid (<i>Myzus persicae</i>), Mealy plum aphid (<i>Hyalopezus pruni</i>), ...)		0	2
Peaches	Pests	Leafhoppers		0	2
		Earwig (<i>Falcata avaricaria</i>)		0	1
		Monilia twig blight (<i>Monilia laxa</i>)		5	2
		Leafrollers/ortrix moths		0	1
Peaches	Diseases	Monilia brown rot (<i>Monilia spp.</i>)		5	2
		Powdery mildew (<i>Sphaerotheca pannosa</i>)	X	2	2
		Peach leaf curl (<i>Taphrina deformans</i>)	X	4	2
		Bacterial leaf spot (<i>Xanthomonas spp.</i>)	X	1	1
		Plum rust (<i>Tranzschelia spp.</i>)		0	1
		Green peach aphid (<i>Myzus persicae</i>)	X	2	1
Peaches	Pests	Brown marmorated stink bug (<i>Halyomorpha halys</i>)		0	1
		Earwig (<i>Falcata avaricaria</i>)		0	1
		Green leafhopper (<i>Eumecurus decedens</i>)		0	1
		Leafrollers/ortrix moths		0	1
		Monilia blossom blight (<i>Monilia laxa</i>)		1	3
		Monilia brown rot (<i>Monilia spp.</i>)		1	3
Cherries	Diseases	Bacterial canker (<i>Pseudomonas syringae</i>)		1	1
		Cherry leaf spot (<i>Blumeriella jappa</i>)		0	1
		Black cherry aphid (<i>Myzus cerasi</i>)		0	2
		Cherry fruit fly (<i>Rhagoletis cerasi</i>)		0	2
Cherries	Pests	Spotted wing drosophila (<i>Drosophila suzukii</i>)		0	2

Fig. 2: Pests and diseases assessed by breeders and variety testers by fruit crop.

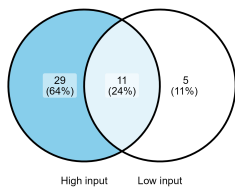
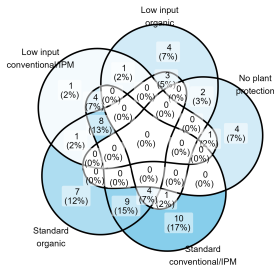


Fig. 3: Systems under which breeders (left) and variety testers (right) test the candidate lines/ varieties.



Conclusion

- To date, most fruit breeding efforts have been conducted under conventional management, with a strong focus on yield and fruit quality and less on robustness.
- To develop varieties that are more tailored to the specific needs of organic farming systems, dedicated organic plant breeding programmes are required, which integrate new specific traits (greater resilience, disease and pest tolerance, and input-use efficiency), while maintaining fruit quality and productivity.

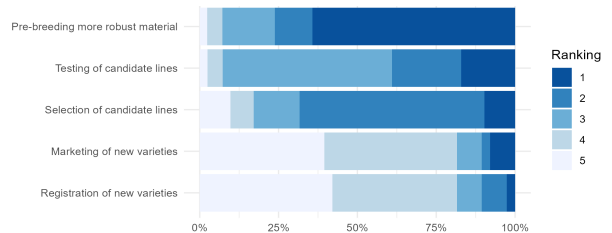


Fig. 4: The breeding process has been divided into five main steps: pre-breeding, selection, testing of candidate lines, registration, and marketing of a new cultivar. The breeders were asked to rank them according to their area of needs (1= most important, 5= least important).