Participation, utilization and development of genetic resources in the Organic Outdoor Tomato Project

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Tomato, participation, organic breeding, ex situ, on farm

Introduction

In Germany tomato is the most important vegetable. Like in many other regions of the world (Foolad et al. 2008) late blight caused by the fungus *Phytophthora infestans* severely impairs organic outdoor cropping as the most resource efficient production method. Since 2003 we have developed a participatory screening and breeding method on a national scale to improve the cooperation between safeguard, selection, and dissemination (Fig. 1). Market gardeners, seed savers, advisors, and scientists work together to ensure that the best use of genetic resources is made in a well targeted program to meet the demand in horticulture. Future genetic resources need to be developed.

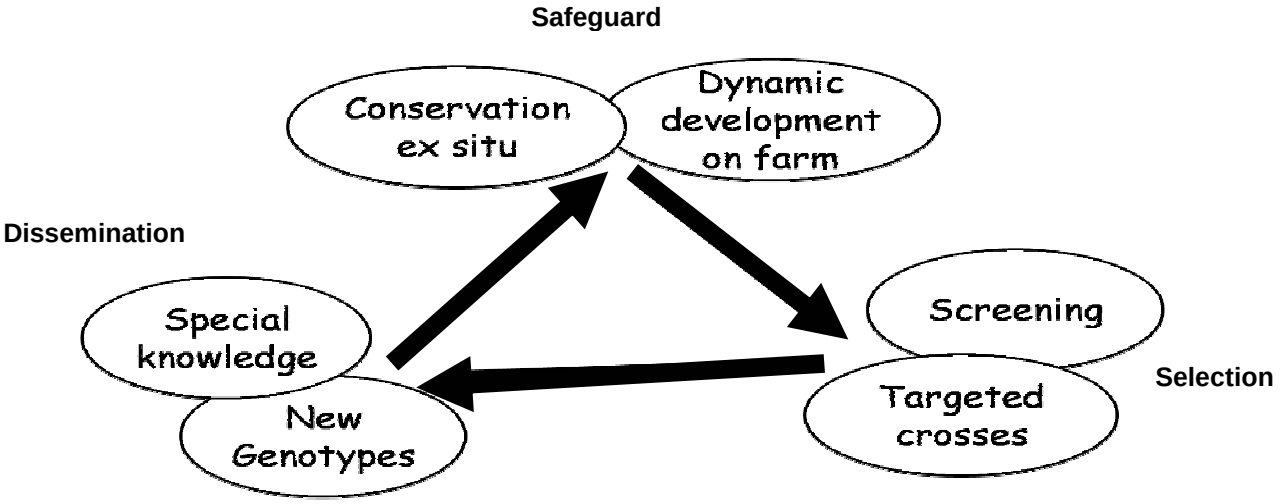

Figure 1: Cooperation between safeguard, selection, and dissemination

Results and discussion

Interesting genotypes were donated from complementary sources ex situ (genebanks) and on farm / in garden. NGO and private seed savers contributed to the latter approach. Dynamic development in practical horticulture has the potential to select recombinant and adapted genotypes. The outcrossing rate in garden was determined (Fig. 2, Fischer 2008); depending on year and genotype the range covered 0 to more than 4%. Tomato production in Germany is based on app. 10 mio plants in commercial cropping and app. 30 mio plants in amateur gardening (Siebold 2006). An average outcrossing rate of 1% would lead to 400,000 recombinant plants p.a. if exclusively garden saved seeds were used. To avoid undesired genotypes, however, isolation distances or roguing need to be used.

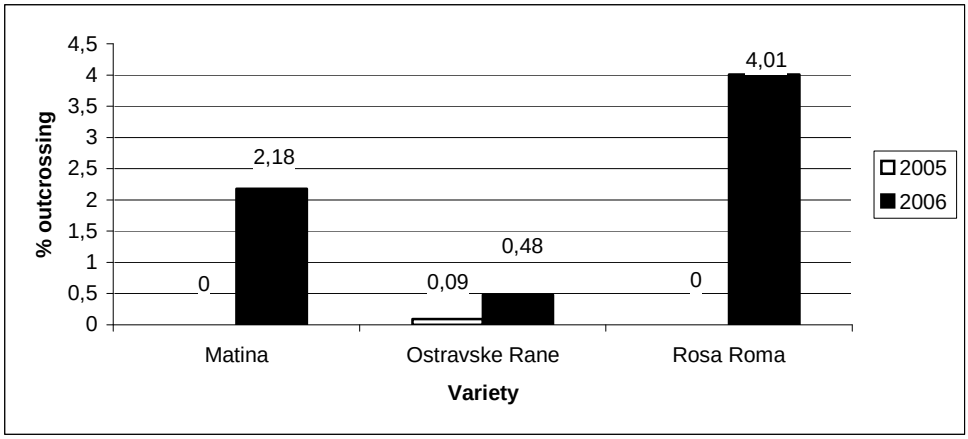

Figure 2: Outcrossing in outdoor tomatoes in Schönhagen 2005 and 2006

Screening and breeding program were carried out at three major locations in organic market gardens. Additionally a smaller number of genotypes was tested at up to 34 locations per year in amateur-, market-, and botanical gardens as well as in research institutions. After three years of evaluation, 88% of the best performing 33 varieties had been provided by non-commercial sources, i.e. genebanks, NGO and private seed savers. More than 60% were originally maintained and recommended by seed savers and NGO within organic horticulture (Fig. 3, Horneburg and Becker 2008). The best open pollinated varieties were made availale to amateur gardeners.

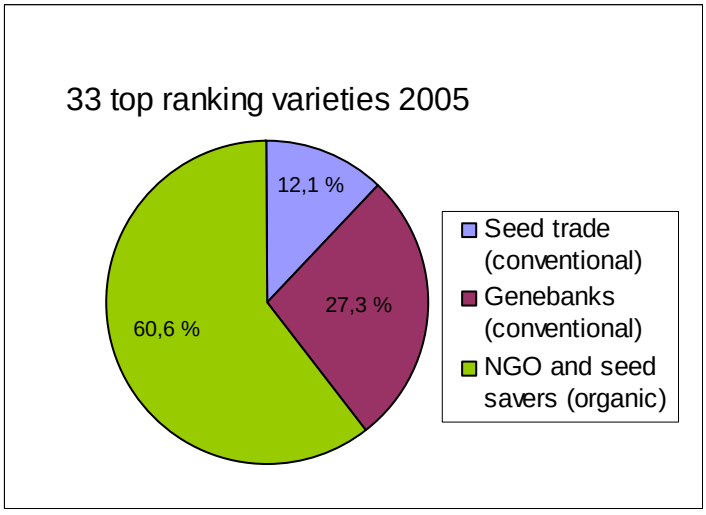

Figure 3 : Origin of the best performing genotypes based on 3,500 accessions after 3 years of screening at 3 locations

In the breeding program we could demonstrate the potential of regional selection. Site specific adaptation for yield was observed for one cross selected for two generations at three locations (Tab. 1, Horneburg and Becker 2008). The selections Schönhagen and Ellingerode yielded best at their site of selection. Relative performance of the selection Rhauderfehn was improved at Rhauderfehn, but was outyielded by the selection Ellingerode.

Selection in the breeding program was a collaboration of market gardeners selling tomato fruits, professionals producing young plants, advisors, seed traders, and plant breeders. Important traits and their weighting was discussed. Traits include field resistance, earlyness,

positive sensory attributes, easy pruning, compact young plants, and other special customers demands. Selection of advanced breeding lines was carried out together. The results have been promising. Presently the first three open pollinated breeding lines are tested for registration and will probably be released in 2011.

Table 1: Influence of the selection site on the yield (g) of Golden Currant x Matina in three market gardens in the F_5 generation

	Selection site			
Test site 2006	Schönhagen	Ellingerode	Rhauderfehn	Mean
Schönhagen	1697	1571	1225	1498
Ellingerode	2475	2920	1884	2426
Rhauderfehn	1019	1095	1037	1050
Mean	1730	1862	1382	

Selected varieties of so called wild tomatoes, genotypes with very small fruits and many side shoots, combine a high level of field resistance with good fruit quality. Special production methods with multiple shoots were developed to increase yield. Compared to plants pruned to one shoot the content of soluble solids, mainly sugars, was increased, too (Fig. 4).

Dissemination of special knowledge for production and marketing, heritage varieties identified in the screening, and new varieties deriving from the breeding program is granted by the persons and organizations involved.

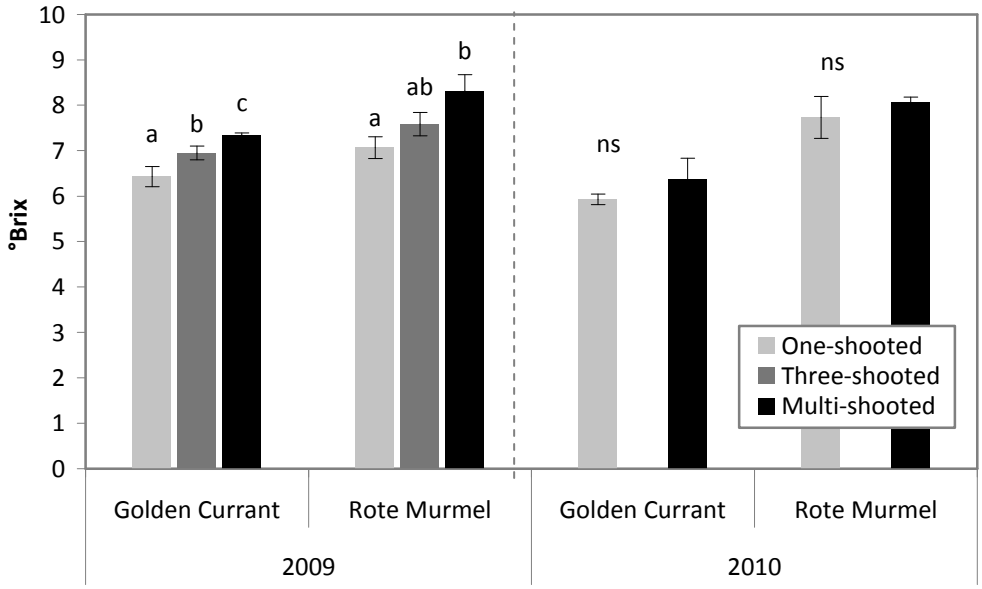

Figure 4: Influence of the production system on total soluble solids content (°Brix) of two varieties of “wild” tomatoes 2009 and 2010 at Göttingen.

Up to this point it has been demonstrated how genetic resources that were donated to the Organic Outdoor Tomato Project could benefit organic and low input horticulture. To serve future needs the continuous conservation and dynamic development of genetic resources needs to be fostered. Ideally advances in breeding are kept available by i) the *ex situ* conservation of varieties removed from the common catalog of registered varieties and ii) dynamic management on farm / in garden. Both processes are severely impaired today. With the advent of hybrid breeding the draining of the genepool was accellerated. F_1-varieties are

only in exceptional cases stored in genebanks or taken into dynamic development on farm, because of the segregation in the F_2-generation. The agreement Bundessortenamt – Genebank of the IPK Gatersleben states: “Once a year the Bundessortenamt passes the seed samples of varieties deleted from the national list on to the genebank. (...) This agreement covers all field crops and vegetables **except** potatoes, **hybrid varieties**, and **inbred lines**.” (Translation BH). The genebank of the Centre for Genetic Resources, the Netherlands, does not hold hybrid varieties. In the Netherlands all fruit vegetables produced by the breeding companies since the early eighties are hybrids. As a result we have to face a situation that in crops like tomato for two to three decades the publicly available genepool has not been replenished. Advances in breeding are increasingly privatized and inbred lines are behind lock and key in breeding companies. Patenting further reduces the use of important traits in the long run.

The relevance of genetic resources from non-commercial sources has been demonstrated above. To further illustrate the potential of garden saved seeds figure 5 gives the results of an inquiry among customers of a small organic seed trader in Germany who exclusively offers open pollinated varieties (Allmendinger 2001). 64,3% of the responding gardeners (758 out of 1179) did save seeds of one or more varieties of cultivated plants in their garden. Numbers were much higher than expected despite the fact that the target group was more committed than the average gardener.

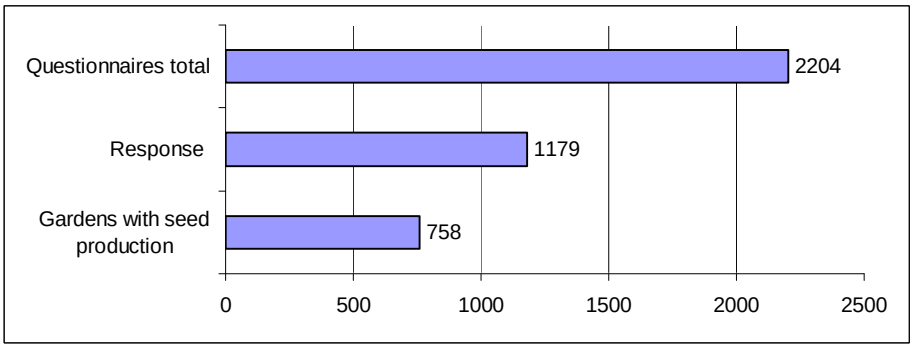

Figure 5: Inquiry among customers of a small organic seed trader

Thanks

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