Financing Open-Source Organic Plant Breeding

Subjects: Biodiversity Conservation

Contributor: Johannes Kotschi, Berthold Schrimpf, Ann Waters-Bayer, Bernd Horneburg

Organic seed is vital for organic agriculture. However, lack of financial resources constrains organic plant breeding. Using an open-source approach that recognises seed as a common good offers new funding strategies.

Keywords: seed commons ; open source ; organic plant breeding ; organic seed

1. Introduction

For many consumers today, organic food is commonplace. In the European Union (EU), organic food can be obtained from specialist retailers, discounters, and the fast-growing movement of community-supported agriculture (CSA). The organic food market is expanding rapidly. With the growth of organic farming, the demand for suitable organic seed and vegetative propagation material is also growing. A wide range of locally adapted crop species and cultivars is needed to use the potential of organic farming in diverse areas fully. Genetic diversity is key for adaptation to changing environmental conditions. Thus far, much of the seed and vegetative propagation material used in organic farming are grown organically but not bred organically. Thus, they may lack specific traits relevant to organic cultivars.

A shortage of funds for organic plant breeding appears to be the main constraint to increasing organic breeders' efforts to satisfy the demand for organically bred cultivars. Plant breeders, farmers and other actors in the organic food supply chain are increasingly asking why funding is insufficient and how this problem can be solved.

2. Plant Breeding in Transition

Our crops are the result of selection over thousands of years, an evolution directed by humans [1]—both men and women [2]. Scientific plant breeding emerged only in the second half of the 19th century [3]. At that time, farmers, for instance, in Germany, were interested in new cultivars that would allow them to make better use of their investments in soil fertility through an improved three-year crop rotation. The first scientific-oriented breeding approaches emerged in many places and over a relatively short period. Soon afterwards, the foundations were laid to regulate the seed market [4]. Seed quality control centres were established, a procedure for cultivar recognition and protection was developed, and a cultivar registry was put in place. These regulatory processes had an enormous impact on plant breeding and agriculture. With the new cultivars, the yield of many crops was increased. Resistance to diseases that had sometimes led to crop failure was greatly improved. Plant breeding has been the greatest contributor to the intensification of agriculture, clearly ahead of the contribution of mineral fertilisers and chemical plant protection [5].

The regulation of seed markets triggered a process of privatising seed. Privatisation contributed greatly to the disappearance of economically less important or only locally important crops and cultivars, thus a major loss of agrobiodiversity. Privatisation led to market consolidation of the seed sector [6]. In the beginning, the farmers—either individually or cooperatively—started to breed and sell improved cultivars. Soon, these entities became specialised plant-breeding companies. A new economic sector of mainly small and medium-sized enterprises (SMEs) developed. In the 1970s, international chemical companies discovered plant breeding as a highly profitable business. This led them to acquire seed companies, setting in motion a process of market concentration [7]. Today, only three international chemical companies control more than 60% of the global commercial seed market, reaching monopoly-like proportions [8].

Essentially, the financing of private plant breeding is based on royalties from intellectual property rights (IPRs) such as plant variety protection (PVP) and patents [9][10]. In the IPRs-based financing system, cultivars are most profitable when grown on a large scale. Consequently, this business model promotes standardised and uniform agricultural production and contributes to reducing crop diversity. The formation of monopolies also creates growing dependence of seed users and society as a whole on only a few companies. All this has reduced agrobiodiversity tremendously and puts the sustainability of agriculture and food at risk.

There is a mismatch between supply and demand. The conventional seed market offers an impressive number of cultivars for our main crops, but many of them are similar, differing little from one another. Genetic uniformity prevails due to the one-sided focus in breeding on a limited number of traits such as high yield, uniform time of maturity or short straw in cereals [11]. Furthermore, uniformity is legally required to register and protect a cultivar as being private and exclusive, as demanded by the EU's Plant Variety Property Rights (CVPR). Therefore, IPRs-based plant breeding is not sufficient to provide the plant genetic diversity that our planet needs. It can be assumed that only a few agricultural crops are subjected to intensive breeding efforts, resulting in fairly homogeneous high-performing cultivars for large-scale distribution.

However, uniformity in crop production is the opposite of what is needed to meet the main challenges in today's agriculture [6][12]. Adapting cropping systems to climate change, generating food security for an expected 11 billion people [13] and transforming production systems from chemical-based to organic farming are huge tasks in which plant breeding plays a vital role. Rich biodiversity is the basis for the resilience and adaptability of cropping systems [14]. Diverse crop rotations, the cultivation of many different crops and the use of productive and sufficiently heterogeneous cultivars are the main elements to optimise cropping systems ecologically. It is also necessary to preserve cultural landscapes and their ecosystem services. Therefore, suitable cultivars need to be generated by plant breeding [15]. However, the private seed sector is structured and financed in a way that will not be sufficient to provide this crucial diversity. Alternatives to complement conventional plant breeding must be further developed.

3. Organic Plant Breeding—A Novelty

As an alternative to conventional plant breeding, organic plant breeding has emerged as a novelty in the seed market [16]. Organic plant breeding is defined mainly by the breeding technologies used [17]. The genome is respected in a way that physical insertion, deletions or rearrangements of the genome are not allowed, the plant cell is respected as an indivisible functional entity, and methods of genetic engineering are excluded [18][19]. Furthermore, a key objective is to sustain and increase agricultural biodiversity. Based on these definitions, a private standard and certification system for organic plant breeding has recently been established.

Organic plant breeding was founded by pioneers mainly from the biodynamic agricultural movement. Most of these breeding initiatives are in Germany, Switzerland, Austria and the Netherlands. Within the past 25 years, the organic sector recorded considerable growth. Still, the development of organic plant breeding and seed production has not kept up with the increase in area under organic crop management—currently about 10% of the total cultivated area in the EU [20]. Therefore, most cultivars used in organic agriculture are still derived from conventional plant breeders, even if the seed is produced organically. Today, organic plant breeding is an established niche in the seed market. Its contribution to seed supply is still small, and the lack of financial resources is a key constraint to expanding organic breeding [21][22]. Available funds have been growing continuously by about 10% per year, and a total volume of 4–5 million Euros was recently estimated for the four countries mentioned above [23]. But current needs for organic breeding are estimated to be at least 100 million Euros per year [24].

4. Seed as a Commons for an Alternative Economy

For some years now, a renaissance of commoning–social cooperation in the use of commons–can be observed, shaping social discourses and practice. Commons research has been established as a new scientific discipline. Particularly ground-breaking was the work of Elinor Ostrom. In numerous case studies, she and her team investigated how social groups worldwide manage their natural resources–land, forests, pastures, and fishing grounds–collaboratively and as a common good. Ostrom refuted Hardin's thesis of the "tragedy of the commons" [25], based on the assumption of inevitable overuse and destruction of a common good by individuals. She provided evidence that an economy based on commons can be very sustainable as long as clear rules have been agreed. In essence, she postulated seven design principles for the successful management of commons [26]. For this achievement, she was awarded the Nobel Prize in Economic Sciences.

In plant breeding, the concept of the commons is gaining importance: organic plant breeders work in the framework of non-profit organisations that also function as cultivar owners [27]. The vegetable breeders of the German association Kultursaat e.V. go one step further. They completely forego PVP [28] and release their new cultivars freely available for everybody–but with no protection against the renewed private appropriation of derivatives such as new populations, breeding lines and cultivars.

There are two key principles in managing commons. Commons need to be protected if they are to be maintained. There can be no commons without commoning: rules and regulations must be made and applied by the people concerned [29]. The open source principle was developed on this basis. Computer scientists in the 1980s created the software open-source licence, which led to various Creative Commons Licenses for manifold products under copyright law [30].

With respect to open source seed, there are basically three rules [31]:

- Seed may be used for any purpose and by anyone;
- No one may apply IPRs such as patents or PVP to the seed and its derivatives;
- All recipients of open source seed transfer the same rights and obligations to future users of the seed and its derivatives. This obligation, referred to as “copyleft,” secures that the seed and all its derivatives through subsequent plant breeding remain open source and thus a commons.

Following these rules, there are two approaches to support breeders and seed producers to manage seed as a commons. The Open Source Seed Initiative (OSSI) in the USA pursues an ethical approach using a pledge [32]. OpenSourceSeeds, hosted by Agrecol Association for AgriCulture & Ecology in Germany, and Bioleft in Argentina use open source seed licences that can be legally enforced [33][34]. Other initiatives are underway [35]. Open source seed closes a gap in the current practice of organic plant breeding. Thus far, most new cultivars have been released without any protection, a practice that can be referred to as “open-access” and carries the risk of future appropriation by the private sector.

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