Bioleft: open-source seeds for low-input farming systems

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Abstract

This article describes Bioleft, an 'open source', highly collaborative seed breeding initiative, in order to encourage reflection on potential synergies with fair trade ideas and practices. Bioleft aims to develop and redistribute collective agency over seed breeding, as a response to the emergence of an oligopolistic seed industry. It is experimenting with novel approaches to seed innovation that increase the diversity of crop varieties, in order to support agricultural practices that are ignored by mainstream seed firms, particularly small-scale family farming and more ecologically and socially sustainable agricultural practices. More generally it is experimenting with new forms of social and productive organization based on norms of sharing and solidarity.

Keywords: Bioleft; Open-source seeds; Collaborative innovation

Introduction

Experimentation with radically *open* and highly *collaborative* ways of producing new knowledge and material objects can be found everywhere; from farm machinery to open scientific hardware to community based 'maker-spaces' (Quilley et al, 2016; Baden et al, 2015). What is distinctive about such initiatives is that they support a way of working based on a combination of the free circulation of knowledge, unencumbered by property rights and other restrictions, and extensive collaboration on a shared activity or on a shared conception of a problem, especially by including people that fall outside the boundaries of organisations or of established communities of practitioners (van Zwanenberg et al, 2017). This approach to production has been spurred on by the availability of networked digital infrastructure, and especially by the idea, first developed by the free/libre software movement, of 'hacking' existing intellectual property law to provide a legal basis for creating protected 'knowledge commons' (Weber, 2004).

Many motivations underpin such initiatives, but the most prominent are aspirations to support more democratic forms of production; to address problems that are ill-served by conventional markets and state institutions; to widen access to socially useful technology; to demonstrate that there are viable, alternative ways of organising production, relative to those prevalent within incumbent market structures; and, more generally, to promote norms of solidarity and sharing (Benkler, 2006). There is much in common here with the underlying values and aims of the fair trade movement, but rather intriguingly, there has so far been little in the way of interaction between these two movements.

In what follows we outline one example of the surge of recent experimentation with open and collaborative forms of production, called *Bioleft*, which we have been closely involved with developing in Argentina. Bioleft is an initiative to create an 'open-source', networked approach to seed breeding that supports the particular production needs of small farmers, and those working within other low-input agricultural systems at various scales, such as agroecological farmers.

The Conventional Framework for Producing and Selling Seeds

Mainstream seed firms and markets focus overwhelmingly on developing seed varieties for, and selling them to, farmers working in intensive, high-input agricultural production systems (Fess et al, 2011). Those markets do not adequately cater for most of the world's farmers. This situation has been exacerbated by a collapse in the diversity of seed breeders over the last four decades, as hundreds of national and regional seed firms that used to either develop their own seed varieties, or that commercialised varieties produced by the public sector, have been bought up by a handful of global agrochemical firms (Howard, 2015). At the same time, public sector seed provision has declined everywhere (Tripp and Louwaars, 1997). This rapid, unprecedented restructuring of the seed sector has been driven by the emergence of new genomics technologies, and especially by the worldwide imposition and diffusion of strict intellectual property rights (IPRs) over seed material (Schenkelaars et al, 2011). Just three giant firms now dominate global seed R&D and commercial seed markets.

The business models adopted by the global chemical/seed firms, which strict IPRs enable, mean that breeding efforts become focused on a limited range of crop species and seed varieties for very large commercial markets and commercially significant production constraints (Fulton and Giannakas, 2001). Other less commercially important production constraints, minor corps, marginal agroecological environments, 'niche' markets, such as for agroecological production, and the needs of small farmers everywhere are increasingly neglected (Falcon and Fowler, 2002). This is likely to result in an acceleration in the decline of crop diversity, unsuitable seed varieties (for many farmers), a much narrower variety of agricultural systems and practices that the seed sector is able to support, and the loss of domestic technological capabilities in many countries, as domestic firms are purchased. Strict IPRs also allow large firms to 'lock up' good quality germplasm, preventing smaller firms, public sector breeders or farmers from using protected seed varieties as a basis for further breeding and adaptation. By using patents or patent-like restrictions, such as private material transfer agreements, a firm can exclusively appropriate the efforts of generations of plant breeders and farmers with the addition of just one incremental change to a seed variety, a possibility seen as both unfair and ominous for the future of seed innovation (Piesse and Thirtle, 2010). Many commentators, as well as people involved in agricultural production, are deeply concerned about the long-term impact of these developments, and how they ultimately impede the emergence of more sustainable and just food systems (IPBES-Food, 2016).

Bioleft

In Argentina, in response to these trends, a group of plant breeders, farming organisations and researchers have created an open-source, collaborative seed breeding initiative called *Bioleft*, which addresses some of the challenges posed by an oligopolistic seed sector. Bioleft supports the diffusion and development of knowledge and seed varieties, free from restrictive intellectual property, that are suitable for diverse agricultural practices, particularly small-scale farming and other *low-input* forms of agriculture at various scales.

The initiative involves both institutional and technical tools. The former are legal clauses for exchanging seed material, based on open-source principles, much like the Creative Commons licenses used by writers and artists. The clauses grant a recipient of seed material the right to use that material for most or any purposes, in particular for breeding and the development of new plant varieties. Importantly, a condition of the clause is that any further transfers of that material, including any new seeds bred using, and therefore containing, the original material, must contain the same clause. This is critical. It means that all progeny of material released or transferred with a Bioleft license will become part of the same 'protected commons', available to all on the condition that they agree to always share.

The second tool is a web-based platform for enabling and recording transfers of Bioleft seed material, and for supporting a process of collaborative seed improvement between plant breeders and farmers. In Argentina, public sector breeders often develop potentially useful new varieties, but they have no way to deliver those

varieties to small producers in the many instances in which markets are too small to be viable for private seed firms. The platform is, therefore, intended to support the diffusion of new open-source seeds. It also supports a process whereby farmers test new seed varieties on their farms, providing information to breeders about seed performance in different agroecological settings and, in collaboration with breeders and other farmers, to select seeds from the best performing plants for further distributed replanting and selection. In effect, the platform enables multiple trials without the seed breeder needing to possess an extensive field-testing infrastructure – a resource that only very large seed companies possess.

We are currently trialling Bioleft within three different farmer–breeder networks, beginning the process of collaborative selection of: a) novel, open-pollinated maize varieties with organic producers; b) new, salt-tolerant fodder crops with agroecological producers and small subsistence family farmers; and c) 'recovered' tomato varieties with small, peri-urban farmers and with producers belonging to a biodynamic farming organisation.

Commercial seed firms largely ignore the needs of these kinds of producers. Small family farmers usually have no choice if they need to purchase seeds but to buy varieties that have been bred for large commercial production, and that only work well with a package of external inputs and irrigation. Likewise, producers in 'niche' markets, such as agroecological farming, cannot find suitable seeds and so have to try and breed them informally within their own networks. By linking producers who are marginal to mainstream seed innovation processes with the high-level scientific capabilities of plant breeders, we seek to link existing dispersed breeding capabilities, create new ones and help meet the very substantial unmet demand for appropriate germplasm.

Groups of plant breeders and farmers in a number of other countries are also exploring how 'open-source' principles can be used to create a protected commons in germplasm, for example in the USA, Germany, Austria and India (Kotschi and Horneburg, 2018; Luby et al, 2015). We are part of that emerging network, although our initiative is a-typical in that it is also supporting collaborative breeding of such germplasm. Another difference is that most other initiatives that have developed open-source seed initiatives envisage no restrictions at all on what recipients can do with open-source seed material. By contrast, one of our licenses allows restrictions on who is allowed to multiply seed (i.e. the reproduction of that seed for resale). This is because we are keen to encourage small seed firms to participate in the initiative, and to encourage the formation of new small seed firms. Small firms sometimes want the exclusive right to multiply seed, even where they accept that no restrictions should be placed on the circulation of germplasm as a basis for further breeding, and that farmers can save and reuse their own seed, and/or share it with other farmers on a non-commercial basis.

'Recovered' Tomatoes

An illustration of what open-source seed material looks like can be found within the 'recovered' tomatoes project run by the Faculty of Agronomy at the University of Buenos Aires (FAUBA), of which Bioleft is a partner. Tomatoes originated in the Andean region but there are now only a small handful of varieties of commercially available tomatoes in Argentina. They are all hybrid, which means that the seeds cannot be saved and replanted, and they are sold as germinated seedlings, which are expensive. They are also relatively tasteless because varieties that are high-yielding and do not bruise easily in transport and storage have been commercialised, over and above other traits.

FAUBA collected over 160 'forgotten' varieties of tomato that used to be grown in Argentina in the first two-thirds of the twentieth century but that have now disappeared from use. In most cases, the researchers could only obtain specimens from seed banks located abroad. FAUBA multiplied the recovered varieties and then organised public tasting sessions at its monthly agroecological farmers market, held on the faculty's campus in the middle of Buenos Aires. These were used to select the most popular varieties in terms of taste, texture and smell. FAUBA is now offering packets of seeds from those selected varieties to anyone, and these will be transferred with a contract containing a Bioleft clause.

The contract asks growers to return double the quantity of seeds that they have been given to plant. This will enable university agronomists to maintain populations of the tomato varieties, ensuring that they can be distributed, for free or at marginal cost, to anyone who wants to grow them in the future. The Bioleft clause will also mean that all those tomato varieties (and any new, improved varieties based on the recovered seed material) become part of a 'protected commons', thus assuring the future, unhindered circulation of that material for further adaptation and breeding. Some producers will also be recording information about the performance of the new seeds on Bioleft's digital platform, and later selecting fruit from the best performing plants for a process of collaborative seed improvement.

With this particular initiative, there has been substantial demand for tomato seeds from a range of small-scale producers, agricultural co-ops, farmers' movements and public sector experimental stations, as well as from several hundred home/urban gardeners. The reasons why people might want those seeds no doubt vary but might include their negligible cost, the fact that they are traditional, more flavoursome varieties, and the 'open-source' ideology and practice underpinning their production and future reproduction. If improved varieties are eventually developed through Bioleft that are adapted for low input agriculture (e.g. with good pest/disease resistance and/or with yields approaching the commercial hybrid versions), we might expect increased demand. This is key because the longer-term ambition with this kind of collaborative breeding initiative is not just to provide a product that is well adapted for, and accessible to, small-scale farmers and for other producers who work in low-input agricultural systems, but rather to increase the viability and profitability of those sectors, and enable them to expand and become more competitive with mainstream agricultural practices.

Challenges and Synergies

Putting Bioleft into working practice and expanding and replicating it involves many challenges. We need to demonstrate that the process of networked collaboration in seed breeding works and is advantageous, relative to what a university department, for instance, might do on its own. In the domain of free/open-source software, networked collaboration in the absence of property rights has famously produced superior, more diverse and more reliable software then conventional software firms are able to achieve. Companies like Amazon choose to run their servers on open-source software because it is more reliable than proprietary alternatives, not because it is free. The implications of adapting this model to other domains of production are intriguing, but open-source software is a virtual product, which means that it is only contributors' knowledge and labour time that needs to be gifted, and it is co-produced by communities who are very comfortable with networked digital infrastructure. The more material domain of seeds, where capital and land, as well as labour time, are needed to produce and distribute seeds, and the different social and cultural settings of, say, farmers, mean that the success of open-source software is unlikely to be straightforward to replicate.

We have, so far, been able to establish the kernel of an alternative seed innovation system, in part by taking advantage of gaps in existing infrastructure (e.g. public sector breeders with sufficient autonomy to allocate time and resources to a collaborative breeding initiative) and on the basis of small grant income, but it would be desirable to put Bioleft on a self-financing basis and to establish it as a social enterprise. This is one issue where we might learn from the fair trade movement.

Finally, in terms of synergies with the fair trade movement, open and collaborative production initiatives, such as Bioleft, are ultimately seeking to develop new capabilities, on the part of individuals, firms and organisations that are politically and economically marginal to mainstream innovation processes – a redistribution of power and agency in innovation – as well as new forms of social and productive organisation based on ideas of sharing and solidarity. There would appear to be considerable overlap with the values and aims of the fair trade movement, and so potential for collaboration and mutual learning. One way to start might be with the products that open-source seed creates. There is no reason why the marketing of produce developed on the basis of 'open-source' seeds should not be labeled and marketed as such, and linked with other forms of certification and labeling that seek to promote more socially just and environmentally sustainable forms of agricultural production.

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