Unleashing the potential of genetic diversity for organic plant breeding

COBRA

Organic farming, despite its past successes, faces major challenges. A key problem is the lack of suitable plant varieties adapted to the specific conditions of organic systems. This issue can only be resolved if organic plant breeding efforts are better coordinated and if the potential of plant genetic diversity is unlocked.

Over the past decades, mainstream plant breeding has focused on developing varieties for high-input (non-organic) systems. There is therefore currently not enough choice of varieties for organic producers.

Despite the known demand for varieties bred for organic systems, however, organic plant breeding enterprises are still struggling. Meanwhile agriculture is experiencing the continued loss of genetic diversity of cultivated plant species as landraces are being replaced by modern cultivars. However, agricultural productivity strongly depends on high genetic diversity of cultivated plants and on the availability and maintenance of suitable germplasm. For two reasons, this is particularly relevant for organic agriculture. First, the loss of plant genetic diversity mainly affects germplasm that would be especially suitable for organic conditions, because it stems from agriculture that did not use synthetic inputs for plant protection or plant nutrition. Second, the comparatively large environmental variability in organic systems needs to be buffered with higher levels of in-field diversity.

Besides the need to breed specifically adapted pure line varieties for organic production, there is a complementary strategy, the use of plant material with High genetic Diversity (Hi-D) e.g. as in Composite Cross populations (CCPs) (see picture). Apart from buffering against environmental fluctuations and providing insurance in stressful environments, Hi-D-based approaches allow for evolutionary adaptation to organic farming conditions. But although Hi-D-based systems have shown promising results under organic management, their benefits can at present not be exploited, due to agronomic, technical, and regulatory hurdles. These constraints of Hi-D breeding approaches are shared with and linked to organic plant breeding in general.

Specifically, there are five problem areas that need to be addressed:
(1) issues of seed health;
(2) response to multiple stresses, acting simultaneously on the crops;
(3) improvements inbreeding efficiency;
(4) structural issues such as funding for breeding and the regulatory framework; and
(5) networking and coordination.
These five issues are going to be tackled in a new European research project called COBRA (Coordinating Organic plant Breeding Activities for Diversity), which is led by the Organic Research Centre (UK). Starting in March 2013, the € 3 million project brings together 41 partner organizations from 18 countries and focuses on four major arable crops: wheat, barley, pea and faba bean.

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