

*Communication*

## A New Generation of Plant Breeders Discovers Fertile Ground in Organic Agriculture

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**Abstract:** Plant breeding for organic systems is a growing field that is attracting a new cohort of graduate students in land-grant plant breeding programs. In 2012, the first Student Organic Seed Symposium (SOSS) was organized by and for graduate students and held in Greensboro, VT. This three-day symposium brought together graduate students and plant breeding professionals in the public, private, and non-profit sectors. Organic plant breeding offers an exciting new niche for public breeding programs, with the potential to develop unique opportunities and partnerships. Participation in the symposium demonstrated that graduate students are enthusiastic about engaging in organic plant breeding and building a community of support for their work. This new cadre of researchers represents one opportunity to collectively move towards a more sustainable agricultural future, and underscores the necessity of building and maintaining strong public plant breeding programs that can facilitate this work.

**Keywords:** plant breeding; organic agriculture; graduate education

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## 1. The Student Organic Seed Symposium

The first Student Organic Seed Symposium (SOSS) was held in Greensboro, VT in August 2012. At the symposium, graduate students from public universities across the United States gathered for three days to learn from leaders in organic seed systems and organic plant breeding. Organized by graduate students from the University of Wisconsin-Madison and hosted by High Mowing Organic Seeds, the symposium aimed to build community among the next generation of professionals in this field. The symposium brought together twenty graduate students from diverse academic disciplines and twelve speakers from the private, public, and non-profit plant breeding sectors. In addition to presentations, field talks, and panel discussions, SOSS participants traveled to local organic farms and businesses. These tours further emphasized the impact that breeding for organic systems can make for diverse operations—from vegetable farms and dairies to food processing centers—and the important role of farmer participation in breeding for the varied growing environments that characterize organic farms [1]. Over-enrollment for the symposium and engagement of the attendees demonstrated that a cadre of graduate students is enthusiastic about plant breeding for organic systems and that well-funded public university programs are needed to educate and train this next generation of plant breeders. In this article, we present insights about this emerging community of researchers based on our experience as the student organizers of the first Student Organic Seed Symposium.

## 2. Trends in Plant Breeding and Organic Agriculture

Organic plant breeding, defined by Lammerts van Bueren and Myers [2] as plant breeding for organic systems or plant breeding under organic conditions, sits at the intersection of two opposing trends in agriculture today. One trend is the unprecedented growth of organic agriculture in the past decade. Between 2000 and 2008, certified organic farmland in the United States more than doubled, from 700,000 hectares to 1.9 million hectares [3]. In 2010, organic food sales totaled \$26.7 billion, a 7.7% increase from 2009 [4]. In contrast, plant breeding in the public sector has seen a steady decline despite its historic importance to United States agriculture. A survey conducted in 1994 found that commercial breeders outnumbered public breeders by more than two to one, a ratio that is presumably more extreme today [5]. Analysis by Fuglie and Walker [6] has shown that private investment in breeding is highly correlated with the economic value of the crop, with scant attention given to the development of cultivars for minor crops. With funding for public breeding programs declining sharply over the past twenty years, many have sounded an alarm about the shrinking capacity of these programs to develop needed cultivars, as well as to educate and train the future generation of plant breeders [7–10].

Although organic agriculture has expanded tremendously since its introduction, advocates argue that it will not reach its full potential until farmers can easily access regionally adapted and organically-bred cultivars [11]. Research indicates that cultivars that perform well in conventional systems are not necessarily high performers in organic systems [12,13]. It follows that the release of cultivars specifically adapted to organic systems will improve the quantity and quality of crops that can tolerate minimal external inputs like fertilizers, herbicides, and pesticides. The need for organic plant breeding offers an exciting new niche for public breeding, with the potential to mitigate the decline in

public programs through new opportunities and partnerships. For example, breeders interested in pursuing organic plant breeding can garner financial support from a wide array of stakeholders such as the USDA, farmer groups, organic food companies, private foundations, and seed companies serving the organic market. Already, the USDA's competitive grants program for organic research (Organic Agriculture Research and Extension Initiative—OREI) offers new funding streams for public breeders. The USDA—OREI was the largest funder of the 57 publicly funded organic seed or organic breeding projects identified by the State of the Organic Seed Report [11] from 1996 through 2014. In addition, Seed Matters, an initiative spearheaded by the Clif Bar Family Foundation, is funding graduate student fellowships in organic plant breeding at Land Grant Universities. Such opportunities can potentially enable public breeders to train graduate students interested in breeding for organic systems, while developing useful cultivars for an underserved but growing market.

### **3. Lessons from the Student Organic Seed Symposium**

The experiences of SOSS participants highlighted lessons that can be informative to the growth of the new field of organic plant breeding. The event clearly demonstrated the strong enthusiasm that this cohort of graduate students has for participating in organic plant breeding. As one student commented afterwards, "I am more informed as a student, and energized to pursue this work long term." In order to be successful, however, graduate students need access to research projects and resources that address questions related to organic plant breeding, and faculty that can mentor them in the process. In addition, reactions to activities like the field tour of a participatory wheat breeding program at Butterworks Farm demonstrated the interest these students have in working collaboratively outside of the university to truly address farmers' needs. Education that incorporates all these elements requires strong public breeding programs with a commitment to educating and mentoring the next generation, led by breeders who are actively releasing cultivars from field-based programs. A recent survey of plant breeders supports these conclusions, identifying practical field experience and opportunities to learn from experienced breeders as critical components of a plant breeding education [14].

In addition to displaying strong student interest, SOSS revealed the unique demographic composition of this student cohort, which was quite diverse both in terms of previous careers and current fields of research. For many decades, the sustainable agriculture movement has called for collaboration between agriculturalists, environmentalists, sociologists, economists, and ethicists, among others [15,16]. The backgrounds of attendees, which included various agricultural sciences, agroecology, and rural sociology, is perhaps a testament to the success of the movement in building these connections between disciplines. For students that do not come from a farming background, the contribution of a specialized field such as plant breeding to a more sustainable agriculture may not be initially obvious, but attendance at SOSS suggests that it is becoming more apparent. As these students are drawn to explore plant breeding, the organic seed sector stands to benefit from their varied perspectives when students have access to strong education programs and opportunities to engage. Because it is a nascent field, students pursuing organic plant breeding can feel isolated in graduate programs that focus on commodity agriculture. The community-building aspect of gatherings such as SOSS enable students to share ideas, address pressing questions unique to this field, and reaffirm the relevance of their work.

As one participant stated, “I was inspired and invigorated by...the people who attended and the importance of our work.”

Some students voiced understandable concerns about the scarcity of careers in organic plant breeding. While this issue remains unresolved, perhaps some hope can be found in another key lesson from SOSS: the value of collaboration between public sector, private industry, and non-profit organizations. Indeed, the inspiration for SOSS came from a conversation with Tom Stearns, president of High Mowing Organic Seeds, during the Vegetable Breeding Institute (VBI), an annual meeting that brings together public and private vegetable breeders. A field visit to a farmer-led wheat breeding project at Butterworks Farm also highlighted the importance of grounding organic plant breeding in farmer participation and support. Further coordination and mutual support between these stakeholders seems crucial to the continued capacity of organic plant breeding to take advantage of the groundswell of student interest in this field.

#### **4. Conclusion**

The Student Organic Seed Symposium was organized by and for graduate students and rooted in the Land Grant system. The opinions presented here are based on our observations as student organizers of the event, as we sought to connect with other students interested in this field and build a community of support for our work. Our experiences in organizing SOSS emphasize that graduate students should be added to the growing list of stakeholders that are invested in the growth and success of organic plant breeding and seed systems. There is an increasing need for plant breeding in organic farming systems, and graduate students are eager to address it. As future professionals in these fields, we have an important voice to contribute to the organic seed movement. To the extent that development of strong organic systems helps further the broader goal of sustainable agriculture, graduate student interest in organic plant breeding represents one important opportunity to collectively move towards that goal, and underscores the necessity of building and maintaining strong public plant breeding programs that can facilitate this work.

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#### **Conflict of Interest**

The authors declare no conflict of interest.

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