

Globally Collaborative Agriculture – A Plant Breeding White Paper

Introduction:

Recent developments in world food supplies and grain prices emphasize the interconnectedness of global agricultural economies and the effect that relatively disparate crops can have on the price and availability of others. This paper discusses the ways that plant breeding can impact agricultural production, and help stabilize and economize food, feed, fiber and bio-fuel supplies for a growing world population. Global collaboration, particularly in plant breeding, is in the best interest of all nations because of the increasing interaction of agricultural economies, and the international nature of modern agricultural research. We illustrate the ways that plant breeders can contribute to a robust agricultural future, and point out the need to educate a new generation of American plant breeders.

The Challenge:

Rising food prices are raising social concerns in developed countries and causing public unrest in some developing countries. The recent sharp price increases of several commodities (maize, wheat, rice, and soybeans) have been identified as the trigger for these concerns. Real or not, there is also a perception by some that this price increase is driven by the diversion of corn and soybeans to the production of bio-fuel, primarily in the United States.

The reality is a worldwide demand for food supplies that is beginning to surpass production and distribution capabilities. This is both a problem and an opportunity, as the nations who can meet this growing demand stand to profit both economically and in terms of international good will. The United States is uniquely positioned to meet this challenge, but it is becoming obvious to both the public and private sector that the recent emphasis on biotechnology has resulted in a shift in funds and attention away from classical plant breeding. This shift has made keeping classical plant breeding programs funded and attracting new scientists into this research field progressively more difficult. Our concern is a lack of funding and scientists will become a weakness that will hinder future agricultural development in the U.S.

How and why are plant breeders relevant:

The world demand for food, fuel, fiber and bio-based materials is on the rise. Nations with “emerging economies” are competing for these essentials, while agricultural land is being diverted to other purposes, and input costs for production are rising. The result is that all nations will need to become increasingly efficient in their crop production practices. The “Green Revolution” met a similar challenge not so long ago through the creation and dissemination of improved crop varieties, inputs, and scientific techniques. Future advancements in agricultural production and opportunities for fostering better educated growers will depend on new scientific breakthroughs. However, the breeder’s ability to develop varieties adapted to new cultural and environmental conditions will remain the key to success in the new biotechnology-based green revolution. Biotechnology alone will not meet this need, as we are currently unable

to “create” new crop varieties. Classical plant breeding serves as the foundation upon which biotechnology can build.

The climate changes we are experiencing may result in future disruptions of our food supply due to temperature change and altered rainfall patterns. Although plants have the ability to adapt to climate change, it is only through plant breeding that we can guide and enhance this adaptability. As our climate changes, it is essential that we have trained breeding professionals to direct the process of plant evolution to our advantage, enabling us to maintain a stable national food supply. It is vital that we start now to keep pace with the changing environment.

The current and projected energy demand is forcing our nation to search for bio-based alternatives to fossil fuels. Ongoing efforts to breed and test new plants for biomass/bio-fuel production will contribute to our energy independence. These efforts should be intensified in order to develop plants that can efficiently generate bio-energy or bio-based products. Alternatively we may need to develop new plant varieties that can produce economically with minimum energy inputs. To meet these future challenges, we need to have trained people in place working on the solutions today.

Due to the globalization of agriculture and rapid transportation of large quantities of live agricultural products, plant pests are moving faster than ever around the world. In their new habitats, they have no natural enemies and can have devastating effects. It is essential that plant breeders work closely with entomologists and pathologists to quickly adapt important crops to resist these new challenges as they arise, or even better, through proper and careful screening, to anticipate and neutralize these threats before they become huge economic and environmental disasters. One striking example of such a devastating pest is a race of wheat stem rust, UG99, that moved from Eastern Africa across West and Central Asia in less than a decade. Our wheat industry in the U.S. could easily be affected by this pathogen as we do not yet have a stable resistance gene to combat its devastating effect. As the climate changes, pests and pathogens will move even more rapidly, and plant breeders will provide the first line of defense against these biological agents.

As hungry, acquisitive, people develop their communities, they radically change their environment for comfort and safety. In the pursuit of these goals, people often replace plant biodiversity (wild and weedy relatives, old crop varieties and landraces) with a relatively small number of high-yielding crop varieties. These important germplasm sources that at one time may have seemed unimportant could harbor genes with the potential to combat a variety of pests and adverse climatic conditions. While we are just beginning to explore in depth the various plant genomes and gain expertise to rapidly and effectively moving and stacking desired traits, it is already apparent that protecting genetic diversity is of undeniable value. The people best trained to catalog and maintain these presently under appreciated genetic entities are trained and dedicated plant breeders. In addition to maintaining this diversity, we need to have fair and equitable means of sharing genetic resources between the originating community, and other communities which can make best use of them.

In a similar vein, as we have developed our societies we have not always been kind to the water, earth and air around us. We have mined, paved, diverted, unbalanced and polluted our environment, often in a spirit of competition. As we learn to survive on an increasingly crowded planet, we will need to clean up messes we have made and learn to refrain from doing

the same in the future. We believe that plants, fungi and bacteria can be adapted to reclaim land and water that have been damaged by man. Similarly, plants are the major entities that scrub the air of carbon dioxide and generate life giving oxygen. Therefore, keeping our planet filled with the proper balance of life-giving vegetation is another essential role of plant breeders. Plant breeders also increase the quality of life by developing new flowers, shrubs, berries, fruits and trees and improved grasses for lawns, golf courses, stadiums and playgrounds. We are a community with varied interests, but a common central theme. Thus, we as plant breeders hope to work more actively in a spirit of collaboration rather than competition with colleagues from around the world, sharing the goal of a better life on our planet. We believe that by learning from each other's experiences, we can create a whole that is greater than the individual pieces. These lofty ideals are often lost in the reality of politics, but we as a small subset of society share not only a vocation, but an avocation. We breed plants because it is our passion, and we are naturally compelled to exchange information, experiences and insights with those having similar interests. Hopefully, we can translate this into collaborations that rise above past hatreds and rivalries.

The Future of Plant Breeding: Moving Forward in a Spirit of Collaboration

U.S. agriculture was built on a solid foundation of science, technology, and art. We are among the most technologically advanced agricultural nations in the world, in areas ranging from basic crop production to advanced biotechnology. We as plant breeders are proud of the part we have played in building this industry, and hope that this paper has highlighted some these contributions. We look to the future optimistic that as new challenges arise, we will have the ability to develop plants that are suited to the new reality, which will meet or exceed the needs of our society. The advances made by American plant breeders have been made possible in large part due to public support. However, in recent years this support has been diverted to other newer areas of scientific interest, such as biotechnology, leaving a noticeable gap in that support for plant breeding. While we still have many active professionals in classical plant breeding, the number of graduate students and the number of University programs in plant breeding that are available to them has dwindled dramatically. There is concern both in industry and the public sector that we will, in the not too distant future, find ourselves deficient in trained people in an area providing critical support to American agriculture and industry. Because of the time and experience required to properly train a new plant breeder, this challenge will not be remedied quickly. We hope this paper will inform interested parties of the contributions plant breeding makes to society, and to the potential shortfalls if plant breeding does not continue to be a national priority. This is in the hope that fair and balanced resource allocations will be made to keep the supply of plant breeding professionals available to maintain and protect our vital agricultural needs.