Marker-Assisted Selection

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Marker-assisted selection (MAS) is a sophisticated new technique that makes use of expanding knowledge of plants at the genetic level to assist plant breeders in developing new crops with desirable traits. With MAS, scientists locate the chromosomal regions (markers) in plants that are associated with desirable traits, and use this information to speed up traditional plant breeding. The Center for Food Safety believes that MAS, while no panacea, has the potential to fulfill at least some of the unmet promises of genetic modification. This briefing paper sets out our assessment of MAS in the context of other techniques to assist farmers in providing a healthy and abundant food supply.

Strengths of Marker-Assisted Selection

* **Safety:** Unlike genetic modification (GM), MAS does not involve the random and disruptive splicing of genes from bacteria, viruses and other unrelated species into plants, with all the uncertainties and risks this entails. Unlike GM, MAS does not introduce novel proteins from these unrelated species into plants – proteins that in some cases could be toxic, cause allergies, or have other harmful effects.

* **Exploiting the crop's hidden potential:** All plants have a rich genetic repertoire, much of which remains hidden. MAS holds the potential to find and unlock valuable traits like increased yield, disease-resistance, and drought-tolerance that lie undiscovered in the plant's own genes

* **From isolated genes to interaction:** Most important traits arise from extremely complex interactions between genes, RNA, proteins and environmental signals. Genetic modification, which moves single genes, has succeeded only in those few cases where a single gene harbors the desired trait. MAS represents an advance because it can move sets of interacting genes that contribute to more complex traits.

* **Speed:** MAS offers the potential to reduce the time to develop new plant varieties by 50% over classical breeding

* **Accessibility:** Though at present expensive, some hope that MAS will eventually become more accessible through lower costs and free access to genetic information.

Weaknesses of Marker-Assisted Selection:

* **Limitations of gene-centered paradigm:** While MAS is an advance on simplistic genetic modification, it is still based on a gene-centered paradigm that by its very nature downplays the importance of the plant's overall genetic makeup and its complex interactions with the environment, such as plant-soil relationships. Thus, the effective use of MAS requires extensive real-world testing to determine whether desired traits are properly expressed in different crop varieties grown under a wide range of environmental conditions.

* **Expense versus classical breeding:** Effective use of MAS depends on extremely detailed knowledge of crop genetics, information that at present is very expensive to obtain. Many plant

breeders have expressed frustration that public research funds flow disproportionately to high-tech "genomics" (e.g. MAS) or transgenic programs rather than sophisticated classical breeding programs, which are cheaper and often more effective.

* **Minor crops neglected:** Detailed genetic information is lacking for all but a few major crops (e.g. corn, rice, wheat). Breeding efforts with many plants of great importance to developing countries will not be assisted by MAS, unless or until major resources are committed to constructing their genetic maps. Resources devoted to MAS cannot be used in other, possibly more effective, ways.

* **Corporate control and patents:** The major biotechnology companies, with their growing monopoly over crop germplasm, all have major MAS programs. Some have begun to patent MAS techniques and crops bred with those techniques.

* **Confusion and synergy with genetic modification:** Biotechnology companies are already blurring the lines between GM and MAS by offering brand-name lines containing GM crops as well as those bred with MAS (e.g. Monsanto's VISTIVE line of soybeans), and by describing the products of both MAS and GM as "biotech crops." MAS is also being used in conjunction with genetic modification, for instance to more quickly breed GM traits into various conventional corn hybrids.

Plant Breeding in Relation to Agroecology:

* **Breeding versus cultivation:** Too often, plants are bred in an attempt to overcome problems fostered by essentially unhealthy agricultural systems. For instance, monocultures and fields planted to the same crop year after year are more susceptible to devastation by disease and insect pests. In these cases, changing cultivation practices (e.g. intercropping, crop rotation) is often simpler, cheaper and offers more benefits than changing the plant's genetic makeup, whether by transgenics, MAS or traditional breeding. It should be noted, however, that traditional breeding and MAS can be (though seldom are) used to develop varieties that work best in healthy, agroecological systems.

* **Agroecology** is an approach that emphasizes optimization of farming methods based on close observation and holistic consideration of plants and farm animals in their interactions with the environment. Agroecology promotes the health and productivity of farms through building healthy soils, intercropping with beneficial companion plants, conserving soil moisture, attracting predators of insect pests, recycling animal waste for use as fertilizer, employing biodiversity to improve resilience and productivity, and similar practices.

* **Keep the culture in agriculture:** As a general rule, agroecological methods, which utilize farmers' deep knowledge of their local conditions and historical experience, should be considered before highly centralized genetic improvement programs removed from local or regional conditions in tackling important agricultural problems.

* **Farmers first:** Small farmers throughout the world are threatened by powerful agribusinesses and government agriculture and trade policies that favor the rich. Decisions about how to address agricultural problems should prioritize the welfare of small farmers.