COMMENTARY

# Role of plant breeding in organic agriculture

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**Madloo M. Role of plant breeding in organic agriculture. J Plant Biol Agri Sci. 2021;3(1):1.**

## DESCRIPTION

Critics of organic agriculture claim it's too low-yielding to be a viable alternative to standard agriculture. However, a part of that poor performance could also be the results of growing poorly adapted varieties. It is estimated that over 95% of organic agriculture is predicated on conventionally adapted varieties, albeit the assembly environments found in organic vs. conventional farming systems are vastly different thanks to their distinctive management practices. Most notably, organic farmers have less number of inputs available than conventional growers to regulate their production environments. Some breeding varieties which have been specifically adapted to the unique conditions of organic agriculture is hard for this sector to understand its complete potential.

This requires selection for traits such as:

- Water use efficiency
- Efficiency of nutrient use (especially nitrogen and phosphorus)
- Weed competitiveness
- Tolerance of mechanical weed control
- Pest/disease resistance
- Early maturity (serves as a mechanism to avoid particular stresses)
- Abiotic stress tolerance (i.e. drought, salinity, etc...)

Currently, few breeding programs are directed at organic agriculture and until recently people that did address this sector have generally relied on indirect selection (i.e. selection in conventional environments for traits considered important for organic agriculture).

However, because the difference between organic and traditional environments is large, a given genotype may perform very differently in each environment, interaction between genes and therefore the environment. If this interaction is severe enough, a crucial trait required for the organic environment might not be revealed within the conventional environment, which may end in the choice of poorly adapted individuals. To ensure the foremost adapted varieties are identified, advocates of organic breeding now promote the utilization of direct selection (i.e. selection within the target environment) for several agronomic traits.

Organic plant breeding is restricted to specific conventional breeding practices, generally to crossing methods that don't break the reproductive barriers between species, and to selection methods supported the evaluation and selection of whole plant performance i.e.,

(1) Intraspecific crossing,

(2) Backcrossing,

(3) Mass and individual selection,

(4) Selection *via* DNA markers,

(5) Hybrid cultivars-as long as next generation is fertile and therefore the hybrid production doesn't chemically induce sterility, and

(6) Meristem culture.

Apart from that, the technologies or the methods that engineer plants at the DNA level are considered to be incompatible with organic plant breeding

Examples:

(1) Genetically modified organisms and

(2) The appliance of synthetic hormones and colchicine treatments.

There are many modern breeding techniques which will be utilized for crop improvement in organic agriculture despite the ban on genetically modified organisms. For instance, controlled crosses between individuals allow required genetic variation to be recombined and transferred to seed progeny *via* natural processes. Marker assisted selection also can be used as a diagnostics tool to facilitate selection of progeny who possess the specified traits, greatly speeding up the breeding process. This technique has proven particularly useful for the introgression of resistance genes into new backgrounds, also because the efficient selection of the many resistance genes pyramided into one individual. Unfortunately, currently molecular markers aren't available for several important traits, especially complex ones controlled by multiple genes.

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**Received date:** *August 27, 2021*; **Accepted date:** *September 10, 2021*; **Published date:** *September 17, 2021*