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THE BALANCE IN RESEARCH BETWEEN BIOTECHNOLOGY AND TRADITIONAL CROP IMPROVEMENT

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ABSTRACT

The balance between biotechnology and traditional crop improvement is discussed. Both are complimentary, and require good infrastructure and a sound financial resource.

Key Words: **Biotechnology, crop improvement**

RÉSUMÉ

L'équilibre entre la biotechnologie et l'amélioration conventionelle des plantes est discutée. Les deux sont complémentaires et nécessitent une bonne infrastructures et ressources financières solides.

Mots Clés: **Biotechnologie, l'amélioration des plantes**

TRADITIONAL CROP IMPROVEMENT

The traditional approach to improving crop performance usually involves a breeder focused on crop modification and an agronomist concerned with crop management. A crop improvement team might include, in addition to the above, an entomologist, a pathologist, a physiologist, a food technologist and possibly an economist. The concern in this discussion is with modification of the crop.

The major thrust of a crop improvement team is to increase grain and/or forage yield, with good quality and resistance to biotic and abiotic stresses. It is necessary to prioritise yield-limiting problems in the environment where the crop is important, and to consider quality traits relevant to food and feed uses. The approach is to generate genetic variability by introduction and crossing. The variability generated is exploited through selection. Selection for specific traits is generally undertaken in nurseries and environments where it is possible either naturally or by artificial inoculation and control of environmental parameters (for example moisture availability), to reliably and uniformly gain good expression of the trait for purposes of selection.

A number of traits are simply inherited and relatively easy to manipulate by breeding. However, most traits of economic concern are polygenic and the gain, say in resistance, may vary from poor to relatively good. In such studies, the breeder frequently only has a general idea of the mode of inheritance and seldom, almost never, in the case of polygenic traits, any idea of a specific gene product. Complex traits can frequently be subdivided into component traits, and test procedures developed. But seldom do breeders select for these component traits or pyramid their effects. Rather, the breeder integrates the expression of interest with other traits in the selection process - the art of plant breeding.

The effective application of a crop improvement programme, as with any endeavor, depends on the availability of qualified manpower, physical facilities in which they can function effectively, and a satisfactory financial support base. This is generally not adequately realised, thus providing some limitation to the rate and effectiveness of accomplishment. It becomes important then not only to focus on biological problems but to prioritise within the support framework.

Research is undertaken to support farmers and users of the crop. A rising concern is that research accomplishments do not reach the farmer-user. The scientist, or their institution, considers the job finished with the completion of research. The development component, however, requires follow through by the developing scientist if it is going to make its potential impact on a timely basis in the user community. This is also a concern that needs recognition, prioritisation, and the appropriate support base. With a limited resource base in many countries, this vital activity needs to be balanced with the impact of research. It can logically be argued that the development aspect should receive greater priority before spreading to other research areas. Accomplishments with the end user should be considered as a priority, particularly where there are inadequately exploited existing research contributions.

BIOTECHNOLOGY

While biotechnology is a general term, today it usually refers to understanding the gene at the molecular level, linkage mapping, and the transfer of genes within or across species by asexual means. It is a rapidly expanding science and has made a significant contribution, but frequently techniques exist that are still too expensive and complicated for routine application. The potential gains from biotechnology are a better understanding of the genetic control of traits, the use of molecular markers, and gene transformation. These hold significant promise in making crop improvement more precise, requiring less time and hopefully becoming less expensive.

Accomplishments from biotechnology include fingerprinting to identify similarities and differences relevant to patent protection, identification of duplicates in germplasm collections, and a better understanding of evolution. High density molecular maps have also contributed to a better understanding of the similarities in gene and gene sequences. For example, among the grasses it made it possible to use probes from maize to study the genome of sorghum. The potential to use closely linked molecular markers to track genes of economic importance through generations of breeding could increase reliability of selection, especially for traits with poor expression or high environment interaction. Markers are also important to identifying genes that can be isolated for transformation. While these techniques have been demonstrated, there is generally still a need to make their use routine.

As with the traditional approach, it is necessary to prioritise traits, being sure that they are relevant to the user community. It is important to select projects where success is likely; for example, to attempt studies on drought tolerance may be too difficult at this time. The availability of scientific capability, infrastructure and financial resource are important considerations.

CONCLUSION

Logically, traditional crop improvement scientist and biotechnologist should work together. The traditional scientist has much of their usual role in identifying priority problems and environments where they are important, looking for component aspects of polygenic traits, increasing gene frequencies by selection, setting up screening capabilities and following accomplishments to the end users. These aspects of improvement are also relevant to the biotechnologist, who can contribute to a better understanding of gene action, the range of benefits of molecular markers and gene transfer, thus increasingly making the crop improvement process more efficient.