CONCLUDING OVERVIEW

DEVELOPMENTS IN *BRASSICA* OILSEED BREEDING GENETICS AND BIOTECHNOLOGY

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Introduction

As is evident from the 103 papers presented on the breeding, genetics and biotechnology of *Brassica* oilseed crops, research and development in these crop species is moving forward rapidly and on a broad front. This is as it should be since the *Brassica* oilseeds continue to be the fastest growing world source of edible oilseeds and are one of the few crop species with the potential to meet the growing edible oil needs of many countries in Asia, Africa and the Indian subcontinent.

In reviewing the progress since our last Congress in Paris there have been some disappointments. Certain important objectives have not yet been achieved. The low glucosinolate level in *B. juncea*, prematurely reported from California in 1983, has yet to be fixed despite strong programs in several countries. Even though *B. juncea* has many advantages including high seed yield, drought tolerance and resistance to shattering and many important diseases, the species will not attain its full potential until the canola qualities of low glucosinolate and low erucic acid are incorporated into agronomically acceptable material. However, I feel confident that this goal can and will be accomplished before our next Congress in 1991. From the information presented, it also appears that no one has yet produced a stable, bright yellow seed coat color in an agronomically acceptable *B. napus* strain, although there is evidence of some progress. If the report that many yellow seeded *B. napus* lines have been identified within Chinese germ plasm proves correct, then we may celebrate this breakthrough at our next Congress as well.

It was also somewhat disappointing to see the amount of time and effort still being expended to identify the most important yield components when past experience has shown that the relative importance of the main components of yield will vary markedly with the environment.

Hybrids

As predicted at the Paris Congress, hybrids have become a major focus of many public and private breeding programs.

Although restorer genes for the radish (Ogura) CMS cytoplasm have been introgressed into B. napus and the chlorophyll problem overcome, this system is apparently still not completely functional due to the reported adverse effects of the introgressed genes on female fertility. Some studies are still progressing with the Siga-Thompson-Bronowski system; however, the most commercially functional CMS genetic restorer system, presently available in B. napus, appears to be the polima CMS cytoplasm combined with the dominant restorer gene from "Italy". Both of these components were discovered by Chinese scientists in B. napus material originating in Europe. However, even this well functioning system does not appear to permit the heterotic potential of a cross to be fully expressed when compared to hand crossed F_1 hybrids with the same parental background. It seems clear from the papers presented that the mitochondria play a key role in establishing many of the essential characteristics needed for the success of a commercial hybrid, including the degree and stability of cytoplasmic sterility as well as the amount of nectar secreted. It was also indicated that protoplast fusion and regeneration of the cybrids could result in mitochondria genome rearrangement. The application of this technique may result in a more effective CMS genetic restorer system than is presently available. The discovery by French scientists of a maintainer for the Diplotoxis system in Korean B. napus may provide a second effective CMS restorer system. As an alternative to such CMS restorer systems Chinese scientists reported on the effectiveness of a simple gametocide as well as the successful application of the three line genic male sterile system. Data was also presented indicating that the highest levels of heterosis in B. napus could be expected from crosses between Asian and European parents, although at present such crosses would not yield hybrids with the needed canola quality and disease resistance.

Little new information was presented on progress towards hybrids in B. juncea or B. campestris. Although restorer genes have been reported for the Anand system in B. juncea, it appears their inheritance would make them difficult to utilize in a commercial hybrid system.

Only minimal data was presented or is available on the proportion of parental seed that can be tolerated in hybrid sowing seed without adversely affecting the farm field performance of the hybrid. Such information is essential for the regulation and sale of hybrid seed. The reported use of genetic probes and electrophoresis to identify the parental and cultivar genotypes could be a useful tool in seed regulation as well as for genetic mapping and detection of somatic hybrids.

Although there was evidence that herbicide resistance may be induced in microspore and protoplast cultures, research reports on the transfer of genes for herbicide and pest resistance were conspicuous by their absence. It is anticipated that the next Congress will feature information on the performance of transformed or induced herbicide resistant material.

Conventional Resistance Breeding

The report of a shattering resistant mutant in Brink winter rape is of interest, as is the finding that Junius black mustard is immune to Phoma or blackleg disease and that Oro is resistant to leaf minor attack.

Biotechnology

The Brassica oilseeds continue to respond to the application of nearly all the biotechnology techniques. However, their application as a major component of most plant breeding programs has not been as rapid as many predicted. The development of the microspore culture technique, which is much more efficient in producing haploids in some B. napus genotypes than anther culture, has overcome one of the major constraints of the doubled haploid technique. However, further modifications are required so that the microspore technique can be applied with equal success to other genotypes and species. The high cost and low yield of superior genotypes which have characterized doubled haploid Brassica programs to date dictates that greater efficiency and some means of immediately screening for superior gametes is required. The microspore-doubled haploid system reported by the University of Guelph and Keller's Agriculture Canada laboratory in Ottawa appears to be a major step towards this goal. However, the main application of the doubled haploid technique is likely to be in the rapid transfer or combining of specific characteristics rather than the immediate identification of cultivars for direct release.

In the quest for ever-improved quality, glucosinolate content and composition continues to be the object of much research. Although all the environmental factors which influence glucosinolate levels in rapeseed have not been identified, experience to date suggests that cultivars bred with less than 15-18 umoles of aliphatic glucosinolates will reliably produce crops within the canola standard of 30 umoles. The report that cell suspensions of B. juncea produce indole glucosinolates and only indoles suggests that these compounds may play an essential metabolic role in growth and development. It is also of interest that the indoles as well as the aliphatic glucosinolates in Brassica leaves have antifungal activity against Phoma (Leptospheria maculans). However, the fact

that low glucosinolate cultivars and strains with high resistance to this disease have been developed in Australia and elsewhere indicates that other effective plant mechanisms for resistance are also present. New and broader ranges in fatty acid compositions continue to be reported and incorporated into agronomically acceptable backgrounds. The improved quality and versatility, which these modifications impart, are important for improved competitiveness and versatility of the Brassica oilseeds. It is now evident that levels of at least 40% linoleic combined with less than 3% linolenic are quite feasible and could be combined with a 10 to 12% palmitic in agronomically acceptable lines. It was also suggested that a high oleic oil with 72% or perhaps as high as 79% could also be developed. It seems ironic that just as the long-sought high linoleic, high palmitic, low linolenic composition is about to become a commercial reality, North American nutritionists and the canola industry are now telling us that from a health point of view the present canola composition of about 4% palmitic, 20% linoleic and 10-12% linolenic is almost ideal. This assessment is based on the premise that low saturate levels are highly desirable, as are moderate levels of linoleic and linolenic. No doubt opinions will differ on this question in different parts of the world but breeders should continue to explore and extend fatty acid ranges and combinations and be ready to exploit the options in the market as they appear.

It is clear from the research reported to this seventh International Rapeseed Congress that the future holds as much challenge and opportunity for the Brassica oil crops as at any time in the past. There is every reason to look to the future with excitement and confidence. I look forward to seeing you and your research results in Canada in 1991.