BREEDING QUALITY IMPROVEMENTS INTO CANADIAN BRASSICA OILSEED CROPS

R. K. Downey, A. J. Klassen and S. H. Pawlowski

Rapeseed production in Canada has undergone change and challenge since the last International Congress at Ste. Adèle in 1970. We have experienced a dramatic upsurge and subsequent decline in production; a challenge from both insects and diseases; an almost complete conversion of varieties and the type of oil they produce, and initiated a second varietal conversion for improved meal. These events have had some disruptive effects on the short-term outlook for rapeseed in Canada but there is little doubt that the total experience of the past three years has been to the long-term benefit of rapeseed production and utilization in Canada.

Although production and the area seeded to rapeseed in 1974 are expected to be lower than in recent years (Fig. 1), it would appear that a new plateau of minimum production has been achieved. Never before have we been able to maintain production at the present level in the face of very favorable prices and market opportunities for flax and cereal grains which compete for the same land resources. Continued average yield increases (Table 1) have been important in maintaining grower interest despite the disruptive influence of pest problems and varietal changes.

Table 1:

Average Canadian rapeseed yields by 5-year intervals 1943-73

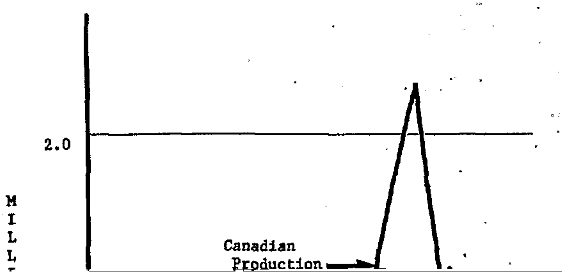
Years averaged	Yield kg/ha
1943-47	639
1948-52	801
1953-57	822
1958-62	844
1963-67	919
1968-73	982

Table 2:

Percent of Canadian rapeseed production sown to B. campestris varieties by provinces, 1970-73

Province	1970	1971	1972	1973	Av.
Alberta	96	95	94	95	95
Saskatchewan	68	60	47	60	59
Manitoba	33	35	35	33	34
Canada	75	70	64	71	70

Average Canadian yields, compared to those from European winter rape (2,000 + kg/ha), appear rather low; however, it should be realized that all of the Canadian production is of summer rape (B. napus) and summer turnip rape (B. campestris), and that the potentially lower yielding turnip rape varieties continue to make up the largest percentage of the plantings (Table 2). In the future the trend toward greater use of the B. napus species, evident in 1972, is likely to intensify to where the acreage will be divided 60-40 and perhaps even 50-50 as a result of development of earlier maturing B. napus varieties and the replacement of delayed seeding practices as a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addition, growers have experienced the most intense population cycle that the bertha armyworm (Mamestra configurata Wlk.) is probably capable of producing, and learned how to combat the insect and still produce profitable crops. As a result of this experience moth collection stations have been established in production areas so that some advance warning of possible larval outbreaks of M. configurata, Loxostege sticticalis L. (beet webworm), and Plutella xylostella L. (diamondback moth) can be given, and some additional 6 man years of research is now devoted to chemical and biological control of rapeseed insects.

Diseases of rapeseed have also become more prevalent with yield losses increasing each year for the past four years in which surveys have been conducted. Of greatest grower concern is the white rust disease (Albugo candida). Although only the turnip rape (B. campestris) varieties are susceptible, it causes widespread losses which are clearly visible to producers. Yield losses of 3, 6 and 9 % were attributed to white rust infection in 1970, 1971, and 1972, respectively. Techniques have been devised at Saskatoon to screen for resistance in the seedling stage and for the first time a method has been developed which permits germination of oospores at will (PETRIE and VERMA, 1974). As a result of these efforts, disease-resistant plants have been identified in strains from Mexico, Chile, and Costa Rica. Unfortunately these resistant plants have high erucic and high glucosinolate levels. An extensive and time-consuming breeding program is required to combine the disease resistance with the desired quality characteristics in adapted strains. Provided the inheritance pattern of the disease resistance is relatively simple, white rust resistant strains low in erucic and glucosinolate should be available by 1979. Thus, more research effort is now being centered on more efficient techniques of identifying resistance to two other potentially serious diseases, Alternaria brassicae and Mycosphaerella brassicicola.

Canadian conversion to low erucic varieties, initiated in 1971, was 84 and 86 % complete in 1972 and 1973 respectively. It is anticipated that over 90 % of the 1974 crop will be sown to low erucic varieties and that complete conversion will be attained in 1975. The conversion has been accomplished without regulations, penalties or premiums and was brought about by industry-wide cooperation. Initially there was some grower reluctance to accept the first low erucic varieties Oro and Zephyr due to their late maturity, extra height and lower oil content. The new low erucic variety Midas, which is superior in most agronomic and quality charateristics to any previous high or low erucic B. napus varieties, has reversed this trend (Table 3). Similarly the first low erucic B. campestris variety, Span, is now being replaced by the higher seed and oil-yielding variety Torch.

In some production areas difficulties were also experienced in obtaining commercial seed for processing which would yield oils with erucic acid levels of 5 % or less. This level has become critical for Canadian processors since December 1, 1973, when the domestic industry adopted the voluntary guideline that erucic acid would constitute no more than 5 % of the total fatty acids contained in a manufactured fatty food. Failure to attain a

Table 3: Yield and agronomic performance of rapeseed varieties in Western Canada, 1971-73

Species & Variety	Yield kg/ha 1971	1972	1973	3-yr av.	Days to mature	% oil	Ht. cm	% protein
B. napus								
Midas *	-	2500	2030	2320	103	42.9	108	40.5
Zephyr	2085	2375	1895	2120	105	39.7	119	41,0
Oro	2120	2340	2005	2150	105	39.6	117	40.5
Tower	-	-	1940	-	103	41.7	107	45.2
Target	2250	2310	1905	2150	104	42.5	108	42.8
B. campestris								
Torch *	-	2005	1715	1885	90	39.9	95	41.2
Span	1895	2015	1660	1860	89	39.4	95	40.9
Echo	2005	2150	1715	1960	90	40.5	102	41.7
R-500	1715	1870	1590	1725	97	43.3	93	44.6

* Only two years' data are available from all locations for Midas and Torch, thus weighted averages are given.

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low erucic level at a farm delivery point has been largely due to admixtures with old high erucic varieties and their volunteers in producers' fields. These difficulties have been most pronounced where production of B. campestris varieties predominates. This results from the very small tolerance for error between the 3.8 % erucic acid content which may be contained in Certified seed of Span and Torch and the desired 5 % erucic level in the commercial seed (DOWNEY, 1974; CRAIG et al., 1974). This problem should be eliminated in the 1975 crop when Certified seed of reselected Span and Torch, with less than 1 % erucic acid in their seed oil, will be available for commercial plantings. In B. napus producing areas there has been little difficulty in meeting the 5 % level since the B. napus varieties Oro, Zephyr, Midas and Tower rarely exceed the 1 % erucic acid level even in commercial seed.

The conversion to low erucic acid varieties on an international scale has caused concern in those industries which have relied on rapeseed oil as a source of erucic acid for special industrial applications (MOLNAR, 1974). In Canada this need will probably be met through contract production of either a B. campestris strain of Yellow Sarson, such as R-500 (Table 3), or Saskatoon selections of yellow or white mustard (B. hirta L.) which contain over 50 % erucic acid in their seed oil.

As important as these developments have been to the industry, the greatest impact on the value and marketability of the crop will likely occur with the introduction of varieties with low glucosinolate contents. The first Canadian commercial processing of low glucosinolate seed from 800 ha of production was completed in 1973. Evaluation of the oil and meal is now underway. As a result of these and other comparative tests the low erucic, low glucosinolate B. napus variety Tower was licensed in February 1974. This variety, bred by Dr. STEFANSSON of the University of Manitoba, is expected to rapidly replace the Canadian B. napus varieties now grown. However, a complete conversion of the Canadian crop must await the introduction of low erucic, low glucosinolate B. campestris varieties. Several such lines have been developed by the Agriculture Canada Research Station at Saskatoon, from interspecific crosses among plants of B. campestris, B. napus and B. juncea, followed by backcrosses to low erucic, yellow-seeded B. campestris lines. The strains now under test have good fertility and are indistinguishable from other B. campestris strains except that they are predominantly yellow seeded and have an erucic acid level of less than 2 % and a glucosinolate level of less than 2 mg/g when expressed as 3-butenyl isothiocyanate. Satisfactory performance of these lines in 1974 would permit commercial evaluation as early as 1975.

This short review of recent Canadian rapeseed developments highlights the rapidity of the changes that are taking place. Many are developing faster than we could forecast as recently as three years ago. The speed and facility with which the changes are being introduced is in large measure the result of total grower-industry involvement.

Our research and that of others indicates that further changes and improvements are possible in the 1980's. Time and space limit speculation but the accomplishments of the world rapeseed research workers to date augurs well for the future.

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