

SELECTION FOR OIL AND PROTEIN IN RAPESEED

By B.R. STEFANSSON, University of Manitoba, Winnipeg, Canada.

The high **negative** correlations between protein and oil expressed as percent of seed as well as between protein content and yield of seed are well known. These negative associations can be interpreted as impediments to the achievement of useful recombinants but may actually offer opportunities for progress.

At Winnipeg we have been selecting for both oil and protein as a percentage of the seed for more than a decade. Tower, a variety developed from this program, and Midas, selected primarily for oil content, were included in yield trials grown at 17 locations in Western Canada in 1976. Data from these trials (Table 1) indicates that the sum of oil and protein for Tower was 2.4% higher than the sum for Midas. Thus selection for both oil and protein has resulted in an increase in the two most valuable components of the seed and leads to an increase in the intrinsic value of the seed.

Table 1. Data from 17 locations in Western Canada, 1976.

Variety	Seed Yield kg/ha	Oil % of seed	Protein * %	Sum of Oil and Protein % of seed
Midas	2120	42.6	28.1	70.7
Tower	2140	42.1	31.3	73.4

\* dry basis

A series of investigations designed to elucidate the nature of the difference in the protein content for Midas and Tower were undertaken and the results were published in the Canadian Journal of Plant Science, Vol.57, 1977.

The higher protein content of the seed from Tower could be due to greater uptake of nitrogen or greater translocation of nitrogen to the seed. Analysis of plant parts (roots, stems, leaves, pods and seed) for nitrogen at anthesis and at maturity did not provide decisive evidence for either alternative. Apparently, both uptake and translocation of nitrogen are involved in the difference in protein content of Midas and Tower.

The protein and oil contents were determined for cross and self-pollinated seed from the same plant on a number of plants from reciprocal crosses between Midas and Tower. The results indicated that protein content of the seed was determined by the maternal parent, while oil content was largely determined by the maternal parent with some slight effect from the pollen parent. The results from reciprocal crosses were essentially similar; thus, the differences in oil and protein content observed in the seed were controlled by nuclear genes and not by extranuclear determinants. The absence of cytoplasmic effects on oil or protein content in the progeny from these crosses was further confirmed by backcrosses to both parents.

Quantitative methods of analysis for the parents,  $F_1$  and  $F_2$  generations indicated that oil, protein and the sum of oil and protein expressed as a percent of the seed were conditioned by additive gene action. Dominance was nonsignificant and epistasis appeared to be absent.

The average broad sense heritabilities for protein, oil and the sum of the two expressed as percent of the seed were 24.5, 26.0 and 33.2 percent respectively. The low narrow sense heritability for protein (-3.5%) was somewhat unexpected and may be due to one of a number of factors which may have led to an overestimation of dominance variation and an underestimation of additive variation in the data from these crosses.

The minimum number of genes which condition the differences between Midas and Tower in protein, oil and the sum of the two were estimated as seven, one and two.

The average phenotypic and genotypic correlations between oil and protein content were -.81 and -.71 respectively. These high negative correlations indicate that the variance for the sum of the oil and protein should be lower than the variance for either one taken alone. Actual results confirm this expectation and the higher heritability for sum indicates that selection for the sum of oil and protein is more effective than selection for either component without consideration of the other.