

INTERRELATIONSHIPS BETWEEN QUALITY FACTORS AND YIELD IN
CANADIAN CANOLA FROM HARVEST SURVEYS, 1956 TO 1994.

Daun, James K., DeClercq, Douglas R.

Canadian Grain Commission, Grain Research Laboratory, 1404-303 Main St., Winnipeg,
MB R3C 3G8 Canada.

ABSTRACT

Long-term harvest surveys show an increase in oil and yield but a decrease in protein in rapeseed and canola grown Canada. There was also a significant correlation between oil and yield. Recent surveys show that the inverse correlation between oil and protein is strong and consistent over different environmental influences. A significant positive correlation between oil and chlorophyll was noted for both *B. napus* and *B. rapa* samples.

INTRODUCTION

The Canadian Grain Commission has surveyed the quality on newly harvested Canadian rapeseed and canola annually since 1956. Changes in methodology, as described in Daun and DeClercq (1994a) adopted to improve accuracy and precision and to allow processing of larger numbers of samples, have made it difficult, however, to simply use data from survey reports to establish accurate long term trends in quality factors.

From 1956 to 1976 oil content was determined on a simple 18 hour extraction of ground seed using petroleum ether. NMR technology was introduced in 1977 but the instrument continued to be calibrated against a single stage extraction method until 1986 when the F.O.S.F.A. method was adopted. Adoption of this multiple regrind method resulted in an increase of about 0.6% oil (on average). Protein content was determined using the Kjeldahl method using mercury based catalysts until 1972 and Titanium Oxide in more recent years. The shift to titanium oxide catalyst resulted in a decrease in protein content by about 0.6%, while in 1992, total nitrogen determination by combustion was introduced resulting in a return to values similar to those determined by Kjeldahl with mercury catalyst (Daun and DeClercq, 1994b). Similarly changes in methodology occurred in determination of fatty acid composition, chlorophyll and glucosinolates in order to keep up with technological advances in these analytical methods. An evaluation of NIR spectroscopy as a tool for measuring oil, protein, chlorophyll and glucosinolates began in 1991.

This study presents oil and protein values for No. 1 Canada canola from harvest surveys 1956 to 1994 which have been corrected to correspond to analytical techniques currently being used. The long term trends and interrelationships between these quality factors and yield are discussed and the relationship between oil and protein is further examined on a species and varietal basis based on data from recent harvest surveys.

During the period of study, oil content increased significantly while protein content showed a significant decrease (Figure 1). The sum of oil and protein remained constant at $69.3\% \pm 0.9\%$. The increase in oil content came as a result of plant breeding efforts but the high correlation between oil and protein ($r = -0.755$ for the long term data) presents a definite breeding challenge if the goal is to increase protein along with oil and yield. Yield

of rapeseed and canola in Western Canada has increased from an average of less than 1 tonne per hectare to 1.3 tonnes per hectare, as a result of plant breeding and improved agronomic practices. Yield was positively correlated with oil content ($r=0.691$) which suggests that the combination of breeding, agronomy and environmental characteristics which resulted in an increase in yield, also result in an increase in oil content.

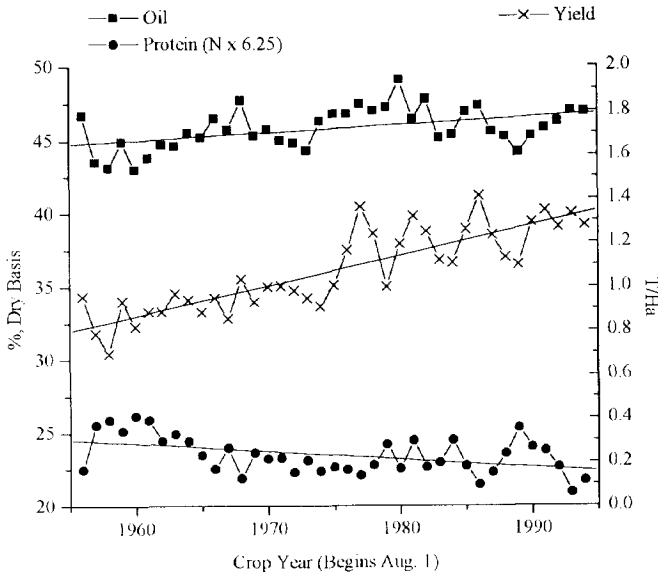


Figure 1. Yield, oil and protein contents of top grade Canadian canola and rapeseed from harvest surveys. Data for oil and protein corrected to correspond to most recent methodology. Yield data from Statistics Canada's Crop Reporting Series.

In recent years the use of NIR spectroscopy has enabled the study of the quality of individual varieties grown in true production situations. While the variety identification in these surveys is based on the affidavit on the sample, overall relationships suggest that the results are reasonably accurate. Of the years studied, 1992 was characterized by an extremely early frost, 1993 by a cold, wet summer while 1994 had more average growing conditions. This resulted in oil contents ranging from 36% to 54% (dry basis) and protein contents ranging from 15% to 32% on a dry basis (N x 6.25). For samples collected overall from the 1992 to 1994 harvests, there was a high negative correlation between oil and protein for both species (*B. napus* 2228 samples, $r=-0.939$, *B. rapa* 2174 samples, $r=-0.891$). It is notable that for both species, there was also significant positive correlation between oil and chlorophyll ($r=0.568$). This suggests that the cool wet weather which leads to higher chlorophyll levels through late maturity, also leads to the highest potential level of oil content. It is interesting and somewhat paradoxical that this positive correlation exists since studies of grade averages have shown that low quality seed (with high chlorophyll content) has a lower oil content.

All varieties occurring in all three years of the survey showed strong negative correlations between oil and protein content (Table 1). Although Grami and Steffanson (1977) had suggested that prediction for the sum of oil and protein would provide improved oil and protein in the seed, there is no evidence that this has been successful since the sum of oil and protein for the varieties in this study were the same as the sum reported by Grami and Steffansson (68-70%).

Table 1. Correlation between oil and protein content for varieties occurring in all three years of harvest surveys, 1992 to 1994.

Species	Variety	1992		1993		1994	
		N	R	N	R	N	R
<i>B. rapa</i>	Colt	35	-0.875	81	-0.837	86	-0.882
	Horizon	77	-0.858	186	-0.822	117	-0.880
	AC Parkland	139	-0.878	287	-0.782	139	-0.844
	Tobin	96	-0.871	144	-0.823	121	-0.817
	Goldrush	59	-0.819	197	-0.797	162	-0.838
	Mean		-0.860		-0.812		-0.852
<i>B. napus</i>	Bounty	28	-0.940	73	-0.912	40	-0.900
	Delta	47	-0.922	75	-0.905	40	-0.920
	AC Excel	76	-0.856	204	-0.909	187	-0.887
	Legend	151	-0.862	242	-0.898	103	-0.861
	Profit	22	-0.929	35	-0.913	9	-0.949
	Vanguard	37	-0.924	68	-0.845	36	-0.901
	Westar	52	-0.784	52	-0.913	11	-0.941
	Mean		-0.888		-0.899		-0.908

The correlations between oil and protein were higher for *B. napus* varieties than for *B. rapa* varieties. Recent varietal introductions have claimed to have broken the restriction on the sum of oil and protein. It will be interesting to see what effect this has on the individual and overall in vers correlations between oil and protein.

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