INFLUENCE OF ENVIRONMENT AND GENOTYPE ON RAPESEED/CANOLA SEED CHLOROPHYLL CONTENT

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INTRODUCTION

At harvest, seed of canola may retain variable amounts of chlorophyll which can effect seed grade. As little as 3% distinctly green seed (Daun 1982) will reduce the value of the crop because chlorophyll is extracted with the oil and is then difficult to remove by conventional bleaching processes (Yuen and Kelly 1980). The presence of chlorophyll not only gives the oil an undesirable color, but contributes to oxidative instability resulting in rancidity (Dahlen 1973), and inhibits the hydrogenation catalyst used for hardening in the manufacture of margarine (Abraham and De Man 1986). In studies conducted at the Agriculture Canada Research Station, Saskatoon seed chlorophyll content of rapeseed/canola strains and cultivars grown in five seasons was examined using near-infrared reflectance (NIR) spectroscopy.

MATERIALS AND METHODS

Strains and cultivars of *Brassica campestris* L. and *B. napus* L. were grown at the Agriculture Canada Research Station, Saskatoon in 1981, 1983, 1984, 1985 and 1986 in 1.8 x 6.1 m plots replicated four to six times depending on the year. *B. campestris* consisted of the strain Polish and the cultivars Arlo, Candle, Echo, Polar, R-500, Span, Tobin and Torch. The *B. napus* species was represented by the strains Argentine, DI-820, DJ-63 and ZN6-2836 and the cultivars Andor, Bronowski, Golden, Midas, Nugget, Oro, Reston, Target, Tribute, Triton, Westar and Zephyr. The experimental design was a split block with species constituting the main plots and strains and cultivars the subplots. Maturity was recorded and the seed harvested, air-dried and stored in a coldroom at -17 C until analyzed for chlorophyll content.

Chlorophyll content was determined by NIR analysis using a Technicon InfraAlyzer model 500 spectrophotometer equipped with a Hewlett-Packard Micro 26 computer and Technicon software version 8.0. NIR was chosen because it is a simple and fast technique (Tkachuk et al. 1988). Two 15±0.1 g samples of seed were ground in a water-cooled Tekmar model A-10 analytical mill for two 15 second intervals followed by mixing with a spatula. Clumps were dispersed by a short 1/2 second grind, and the samples loaded into open cups. Chlorophyll content was measured using a previously determined calibration (McGregor 1990) bias adjusted by 4 ppm to eliminate negative values.

RESULTS AND DISCUSSION

Chlorophyll analysis showed that in each of the years studied strains and cultivars of B. campestris had lower seed chlorophyll contents than those of B. napus (Fig. 1). Further, the mean seed chlorophyll content of B. campestris strains and cultivars remained more or less constant over the years studied while the mean seed chlorophyll content of the B. napus strains and cultivars varied, down slightly in 1984 compared to 1981 and 1983, and up substantially in 1985 and 1986. In 1985 and 1986 the range of seed chlorophyll content of the B. napus strains and cultivars was also larger. Individual strains and cultivars within species were observed to have different seed chlorophyll contents but no trend to higher or lower chlorophyll content was evident in newly registered cultivars (Table 1).

Of particular interest was the relationship observed between seed chlorophyll content and days to maturity (Fig. 2). When strains and cultivars of both species were considered together, a positive correlation of 0.69 was observed. However, when the species were considered separately the correlation for B. campestris was 0.50 and the correlation for B. napus 0.02. Taken in conjunction with the fact that there was no appreciable species overlap in seed chlorophyll content, the results leave open the question as to whether there is an inherent genetic difference in chlorophyll content between the species.

In Sweden it has been observed that winter rape (B. napus) normally has a higher chlorophyll content than winter turnip rape (B. campestris), and spring rape (B. napus) a higher chlorophyll content than spring turnip rape (B. campestris), but these differences have been attributed to variation in maturity and differences in stand establishment under various environmental conditions in diverse parts of Sweden (Larsson and Gottfridsson 1974). Larsson and Gottfridsson (1974) have implicated agronomic practices, time of seeding, seeding rate, row spacing, nitrogen fertilization and harvest time, as factors that could affecting chlorophyll content. These practices would be expected to affect plant maturity. The impact of genotype on chlorophyll content, beyond its effect on maturity, is not clear.

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Table 1. Mean seed chlorophyll content of strains and cultivars of Brassica campestris L. and B. napus L. grown at Agriculture Canada, Saskatoon in 1981, 1983, 1984, 1985 and 1986.

Strain or Cultivar	Number of samples	Chlorophyll (ppm)	
B. napus			
Triton	12	18.50	a[1]
Target	15	16.67	b
Midas	27	16.40	b
Golden	27	16.13	bc
Zephyr	16	15.50	c
Argentine	26	14.06	d
Westar	22	13.53	de
Tower	28	13.40	def
Oro	27	13.34	def
Bronowski	28	13.05	ef
Andor	28	12.92	ef
Regent	26	12.90	ef
Altex	26	12.72	ef
Tribute	12	12.60	f
Nugget	26	11.12	g
Reston	16	11.05	g
ZN-2836	15	9.85	h
DJ-63	4	7.84	i
DI-820	13	7.37	i
B. campestris			
R-500	22	7.02	i
Candle	20	5.30	j
Tobin	21	4.99	j
Polar	15	4.04	k
Polish	27	4.35	k
Torch	19	4.44	k
Echo	26	4.49	k
Arlo	26	4.49	k
Span	22	4.79	k

(1) According to the Duncan-Waller test. Values followed by the same letter are not significantly different ($P \leq 0.05$).

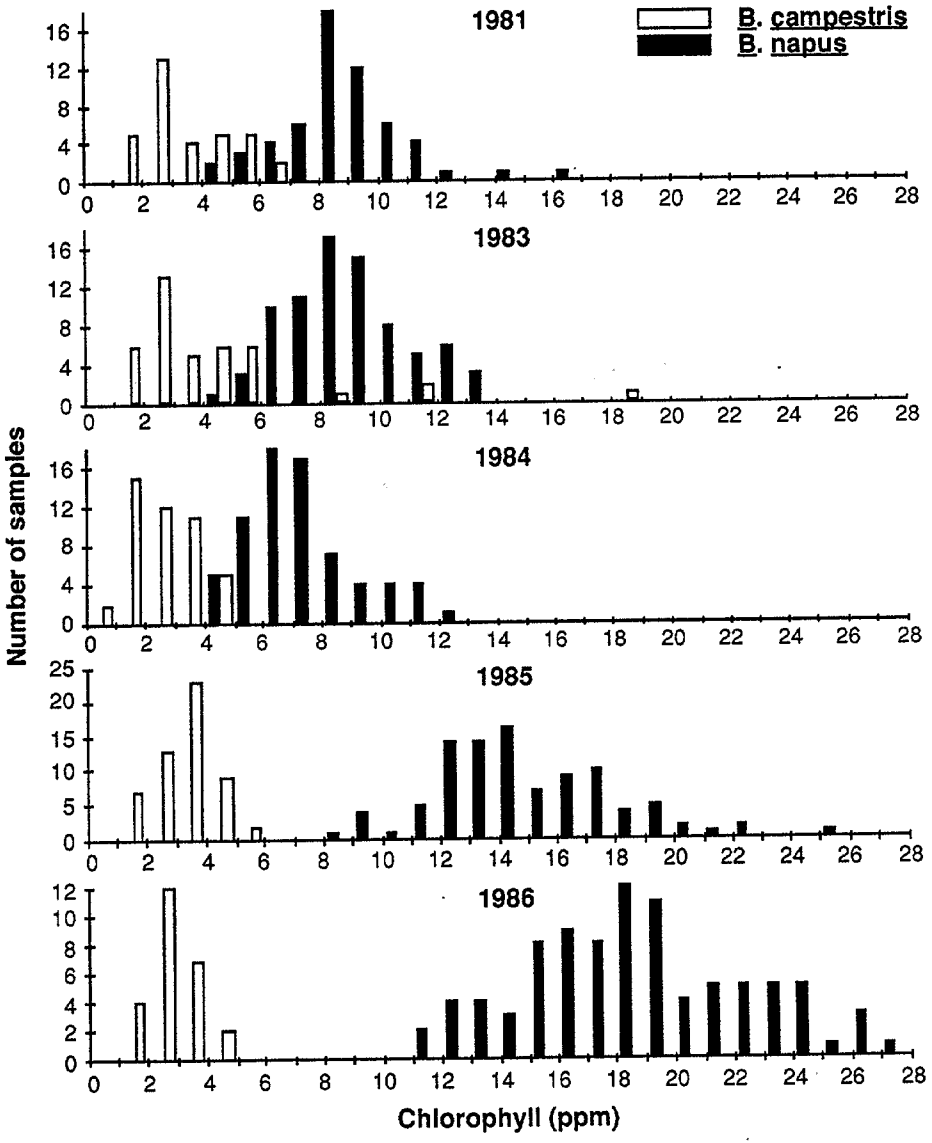

Fig. 1. Distribution of seed chlorophyll in Brassica campestris and B. napus strains and cultivars grown at Agriculture Canada, Saskatoon in 1981, 1983, 1984, 1985, and 1986.

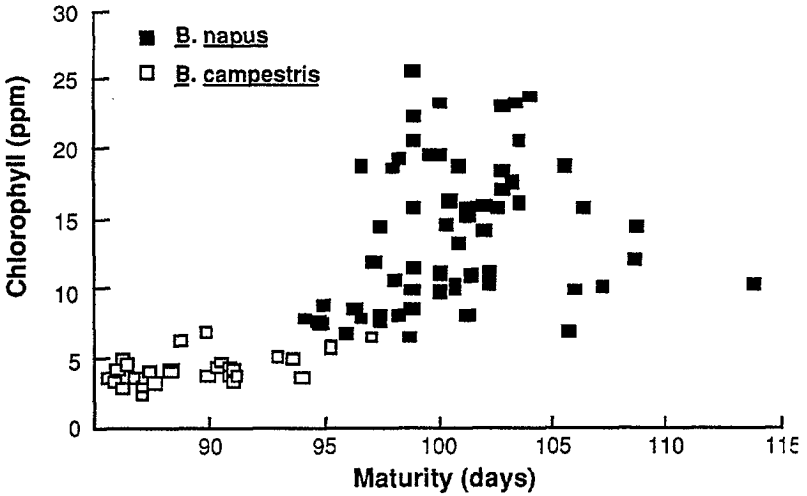

Fig. 2. Relationship between mean seed chlorophyll content for each strain and cultivar in each year and maturity of Brassica campestris and B. napus strains and cultivars grown at Agriculture Canada, Saskatoon in 1981, 1983, 1984, 1985, and 1986.