BREEDING FOR EARLY MATURITY IN SUMMER TYPE BRASSICA NAPUS

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Approximately 50 % of the rapeseed acreage in Canada is planted to summer type B.napus. The remainder of the acreage is planted to summer type B.campestris which has a lower seed yield and lower oil and protein content. The large proportion of B.campestris production is due to its early maturity. This is required because many production areas have average frost-free periods of 110 days or less. These areas also have a lower heat unit accumulation than areas with a longer frost-free period. The lower heat unit accumulation results in a maturity requirement for current B.napus cultivars of 115-120 days compared to 95-100 days for B.campestris cultivars. The maturity requirements in higher heat unit areas are 105 days and 90 days for B.napus and B.campestris respectively. Reducing the time to maturity for B.napus so that it could be grown in areas now producing B.campestris would result in an increase in average seed yield and an increased oil and protein content of the commercial crop.

The development and evaluation of early maturing B.napus types has been undertaken in two programs. One program was the selection on a single plant basis and a line basis to develop early flowering and early maturing lines. The other program was the detailed study of the growth pattern of licenced cultivars and a subsequent study of licenced cultivars and early maturing lines. The growth pattern characteristics were analysed in relationship to yield and yield components to determine what traits were associated with high yield of B.napus under low heat conditions.

The first study used the cultivars Target, Nugget and Oro. These cultivars were chosen because they represented a range of maturity types that were grown in Western Canada. Target is early maturing, Nugget intermediate and Oro is late maturing. Single plants of each cultivar were observed in solid stands. The plants were observed for emergence of leaves, initiation of elongation, first flower on the main raceme, first flower on each of the secondary racemes, last flower of main raceme and maturity. The whole plants, including roots were harvested at maturity for analysis. Also recorded were the total number of leaves on the main stem, number of secondary racemes, number of tertiary racemes, number of pods on the main racemes, 1000 seed weight, total plant weight and seed yield. Vegetative yield was calculated as total plant weight minus seed yield. Flowering rate was expressed as number of racemes flowering per day. The seed filling period was the period from first flower to maturity of first pod.

This study indicated that time to first flower is a major factor in determining the time to maturity. Target exhibited many characteristics which would tend to make it a late cultivar, such as lower developmental rate during the rosette stage. However, it was significantly earlier in days to first flower and maturity (Table 1).

The correlation of first flower with maturity was significant for all three cultivars, indicating that selection for early first flower could result in early maturity. First flower is more readily determined than maturity. The heritabilities for first flower ranged from 21 % to 61 % in crosses between the three cultivars and for maturity they ranged from 16 % to 36 %. This indicates that selection for first flower could result in better genetic gains.

TABLE 1

POPULATION MEANS

	Oro	Nugget	Target
Days to first flower	56	55	50
Days to maturity	116	115	113
Correlation of first flower vs. maturity	.50**	.65**	.61**
Seed filling period (days)	61	60	63

A study of the yield components indicated that vegetative yield was the major contributor to yield. The number of secondary racemes, tertiary racemes and harvest index were also important contributors. The significant partial correlations with seed yield (holding vegetative yield constant) for number of secondary racemes and number of tertiary racemes indicates they contribute to seed yield independently of their association with high vegetative yield (Table 2).

TABLE 2

CORRELATIONS WITH SINGLE PLANT SEED YIELD

	Oro	Nugget	Target
No. of secondary racemes	.56**	.72**	.41**
(Partial correlation)	(.19*)	(.04)	(.23**)
No. of tertiary racemes	.85**	.71**	.74**
(Partial correlation)	(.53**)	(.33**)	(.47**)
Harvest index	.31**	.52**	.21*
Vegetative yeild	.96**	.95**	.95**
Days to first flower	-.08	-.45**	-.08
Days to maturity	.06	-.37**	-.07
Flowering rate of racemes	.44**	.51**	.22*
Seed filling period	.12	-.12	-.02

The correlations of days to first flower and maturity with yield were negative, indicating that earliness is associated with higher yield. The positive correlations of flowering rate of racemes with yield indicates that a rapid rate of flowering is associated with high yield. The seed filling period was not correlated with yield, indicating that it is not a limiting factor.

The second study included the cultivars, Oro, Turret, Midas, Altex and early flowering line 74G-1382. This study was performed on a plot basis. The number of growth stages observed was concentrated on the time from first flower onward. This study involved location, seeding dates and seeding rates.

Days to first flower was found to be a factor in determining the days to maturity in the later maturing cultivars, Oro, Turret and Midas, but not a significant factor in the early maturing Altex and 74G-1382 as indicated by the correlation of first flower with maturity (Table 3).

A study of the yield components indicated that only harvest index had a consistently high correlation with yield (Table 4).

TABLE 3

POPULATION MEANS

	Oro	Turret	Midas	Altex	74G-1382
Days to first flower	56	51	52	49	45
Days to maturity	113	108	107	103	100
Correlation of first flower vs. maturity	.19	.10	.24*	-.05	-.03
Seed filling period (days)	57	57	55	54	55
Seed yield plot (grams)	400	480	472	479	485

TABLE 4

CORRELATIONS WITH PLOT SEED YIELD

	Oro	Turret	Midas	Altex	74G-1382
No. of racemes	.19	.07	-.06	.09	-.03
Harvest index	.83**	.72**	.69**	.64**	.68**
Days to first flower	.21*	.14	.22*	.18	.23*
Days to maturity	-.27**	.12	.14	.03	.21*
Seed filling period	-.37**	-.01	-.05	.09	-.03

The yield correlation with days to first flower were largely positive but ranged from negative to positive for maturity. The yield correlation with seed filling period was largely non-significant.

The two studies indicate that early maturity is not necessarily associated with a reduction in yield. This is particularly obvious in that the earliest flowering and earliest maturing line 74G-1382 was the highest yielder. The studies also indicate that it is possible to alter the growth characteristics to produce increased yield.

Since maturity is not a limiting factor it would appear that growth rate, flowering rate, and rate of dry matter accumulation during seed formation under cool growing conditions may be major factors in yield determination. This is indicated by the performance of the cultivar Altex. Altex was selected for early first flower under cool growing conditions. The specific adaptation is demonstrated in the comparison of performance in Western Canada versus Central Alberta (Table 5).

Detailed studies of growth rate, flowering rate and dry matter accumulation may result in further modification of the growth habit of B.napus to further improve maturity and yield.

TABLE 5

PERFORMANCE OF CULTIVARS IN WESTERN CANADA
(AVERAGE 1976 & 1977)

	Yield 100 kg/ha	% Yield	% Oil	% Protein	Days to Mature
Midas	22.9	100	43.5	40.8	108
Tower	22.3	97	43.0	45.3	107
Regent	22.3	97	43.6	45.2	108
Altex	23.4	102	43.8	43.6	105

PERFORMANCE OF CULTIVARS IN CENTRAL ALBERTA
(AVERAGE 1976 & 1977)

	Yield 100 kg/ha	% Yield	% Oil	% Protein	Days to Mature
Midas	21.7	100	43.1	40.2	113
Tower	22.1	102	42.4	45.1	113
Regent	20.8	96	42.7	44.5	113
Altex	24.4	112	43.4	43.7	111