VERNALIZATION RESPONSE OF SPRING CANOLA (BRASSICA NAPUS L.)

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INTRODUCTION

Spring and winter habit of growth has been delineated by the response of the plant to vernalization (Jedel et al, 1986). Winter crops generally require cold treatment in order to respond to light and temperature conditions that result in flowering, while spring crops are generally unresponsive. This distinction, however, is not absolute.

Vernalization response is not desirable in spring planted *B. napus* cultivars in Western Canada, as exposure to vernalizing conditions in the field is not consistent. The failure of vernalization could result in unacceptably late maturity in responsive cultivars.

Studies of vernalization response in *Brassica* have been conducted with *B. napus* in Australia (Thurling and Vijendra Das, 1977 and Myers et al, 1982); *B. oleracea* (Gauss and Taylor, 1969; Crisp and Walkey, 1974 and Atherton et al, 1987) and *B. campestris* (VanderMeer and Vandam, 1984). To date, no information is available on the significance of the vernalization response of spring seeded *B. napus* cultivars grown in Western Canada.

The objective of this investigation was to screen a range of *B. napus* cultivars for response to vernalization.

MATERIALS AND METHODS

The criteria for selection of the cultivars used in the study included the predominance of use in Western Canada, use in the University of Manitoba hybrid canola breeding program and geographic distribution (Table 1).

Petri plates were filled with 30 ml coarse acid silica sand and mixed with 9 ml distilled water. The seeds of each cultivar were placed in the moist sand, covered and held at 22 C for 24 hours. Petri plates were then moved to 4 C vernalization room for 2 to 6 weeks. Seeds of the 0 week control treatment were held at 22 C for 48 hours, in order to attain a similar stage to the cold-treated seeds.

Germinated seeds were planted in peat flats containing MetroMix soilless mix. Cold treatments and controls were started so that all the plantings for the experiment could take place a the same time. The flats were transferred to growth cabinets and grown under 22/16 C day/night temperature and 20 hour photoperiod.

Once plants had reached the 2.1 stage of the Harper-Berkenkamp (1975) scale, 3 plants from each treatment were transplanted into peat pots filled with MetroMix. The pots were arranged in the growth cabinet in a randomized complete block design. The light bank was maintained at 0.5 m above the canopy. Pots were randomized within blocks on a weekly basis.

Measurements of days to first open flower (FF) and final leaf number (LN) were determined on the main raceme at 2 day intervals. To facilitate leaf counts, each leaf was punched once with a single hole punch near the leaf margin. The resulting 0.5 cm hole was visible throughout the experiment.

RESULTS

The spring canola cultivars examined exhibited a cumulative or quantitative response to vernalization for FF and LN (Figure 1). The length of the vegetative period decreased with increased exposure to 4 C.

While the average performance of cultivars indicates a quantitative response, there were differences between cultivars. Of particular interest are the cultivar responses to 0 vs. 2 weeks at 4 C (Table 2). Global and Marnoo are considered to be responsive to vernalization, as there is a significant difference between the control and the treatment mean. Karat is considered to be non-responsive, as there is no significant difference between the treatments. Westar and Regent showed an intermediate response, as the differences between treatments, while significant, were not as large as those for Global and Marnoo.

The response category index (RCI) of non-responsive, intermediate and responsive resulted from the difference for each parameter for the control vs. 2 weeks at 4 C. The standard error of the mean is the basis of the index and the RCI will be used in the future to screen breeding material.

DISCUSSION

The quantitative response to vernalization exhibited by the _B. napus_ cultivars in this study is similar to the results obtained in _B. oleracea_ (Gauss and Taylor, 1969 and Atherton et al, 1987), but differed from the results of Thurling and Vijendra Das (1977), who found that the Canadian cultivar Target had no response to vernalization under long day conditions in Australia. Myers et al (1982) indicated that variable response to the environmental cues of photoperiod and vernalization existed between two samples of the same cultivar from different sources, which could be the reason for the difference in results of this experiment from those of Thurling and Vijendra Das.

The identification of responsive cultivars was considered to be of practical importance, as it is to be expected that these cultivars could result in the most erratic response to environmental conditions from year to year. Cultivars Global and Marnoo were clearly responsive to as little as 2 weeks at 4 C and thus will require further assessment. The focus of our study was on the 0 vs 2 week experiment, as this was considered to be the most likely exposure to cold under Western Canadian growing conditions.

Vernalization response studies are of particular interest to the University of Manitoba hybrid canola breeding program. Erratic maturity of experimental lines makes it difficult to assess potential hybrid line combinations. The inclusion of cultivars such as Marnoo in the hybrid program in an attempt to maximize heterosis, may be introducing a requirement for vernalization that may or may not be met each spring.

Temperature conditions at seeding may or may not be conducive to satisfying the vernalization requirement. This may be contributing to the erratic maturity that we have seen. For example, if the spring was cool and moist, conditions conducive to vernalization, the decreased vegetative development time could result in lower yields. Lack of vernalizing conditions, on the other hand, could contribute to unacceptably late maturity.

CONCLUSION

A quantitative response to vernalization at 4 C exists for spring B. napus cultivars grown in Western Canada. This response would not appear to be of any direct adaptive value in spring-seeded material. In Western Canada, where the greatest limitation to crop production is the length of the growing season, any factor which may impact upon crop maturity and hence productive capacity, must be fully understood.

REFERENCES

ATHERTON, J.G.; HAND, D.J. and WILLIAMS, C.A. 1987. Curd initiation in the cauliflower (Brassica oleracea var. Botrytis L.). In: Manipulation of Flowering. J.G. Atherton (ed.). Butterworths, London. pp. 133-145.

CRISP, P. and WALKEY, D.G.A. 1974. The use of asceptic meristem culture in cauliflower breeding. Euphytica 23: 305-313.

GAUSS, J.F. and TAYLOR, G.A. 1969. Environmental factors influencing reproductive differentiation and the subsequent formation of the inflorescence of Brassica oleracea L. var italica, Plenck, cv. 'Coastal'. J. Amer. Soc. Hort. Sci. 94: 275-280.

HARPER, F.R. and BERKENKAMP, B. 1975. Revised growth stage key for Brassica campestris and B. napus. Can. J. Plant Sci. 55: 657-658.

JEDEL, P.E.; EVANS, L.E. and SCARTH, R. 1986. Vernalization responses of a selected group of spring wheat (Triticum aestivum L.) cultivars. Can. J. Plant Sci. 66: 1-9.

MYERS, L.F.; CHRISTIAN, K.R. and KIRCHNER, R.J. 1982. Flowering responses of 48 lines of oilseed rape (Brassica spp) to vernalization and daylength. Aust. J. Agric. Res. 33: 927-936.

THURLING, N. AND VIJENDRA DAS, L.D. 1977. Variation in the pre-anthesis development of spring rape (Brassica napus L.). Aust. J. Agric. Res. 28: 597-607.

VANDERMEER, Q.P. and VANDAM, R. 1984. Determination of the genetic variation in the effect of temperature and daylength on bolting of Brassica campestris L. Euphytica 33: 591-595.

Table 1. *B. napus* cultivar descriptions, country of origin and relative maturity.

CULTIVAR	COUNTRY OF ORIGIN	YEAR RELEASED	RELATIVE* MATURITY
Global	Denmark	1985	+7 - +14
Karat	Sweden	1980	+8
Marnoo	Australia	1980	+5
Regent	Canada	1977	+3
Westar	Canada	1982	0 (99 days)

* Relative maturity determined from 1988 field performance in Manitoba, Canada.

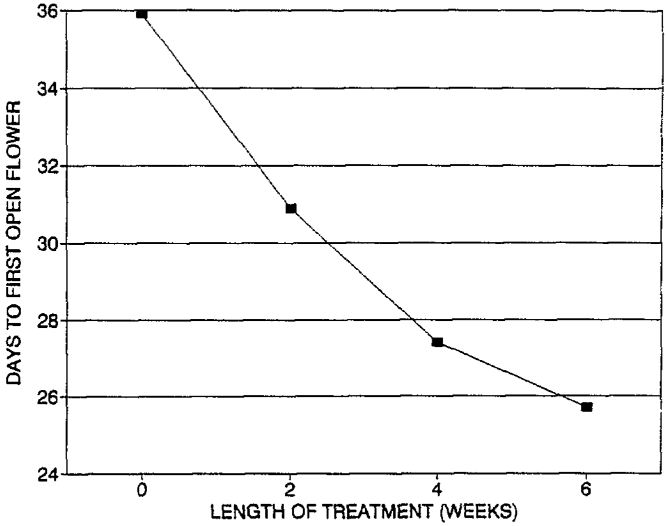
Table 2. *B. napus* cultivar response to 0 vs. 2 weeks at 4 C for days to first open flower (FF) and final leaf number (LN).

CULTIVAR	TREATMENT (WEEKS)	FF (DAYS)	LN
Global	0	41.6 (1.3)*	18.8 (1.3)
	2	33.0 (0.9)	9.3 (0.4)
Karat	0	33.6 (0.6)	11.1 (0.6)
	2	33.9 (0.6)	10.1 (0.8)
Marnoo	0	36.6 (1.1)	14.2 (1.8)
	2	29.3 (0.6)	10.0 (0.3)
Regent	0	33.8 (0.8)	9.9 (0.6)
	2	30.0 (0.4)	8.0 (0.6)
Westar	0	32.8 (0.5)	9.9 (0.2)
	2	28.3 (0.5)	9.1 (0.5)

*value in brackets represents the standard error of the mean

Figure 1. Mean of the 5 cultivar responses to vernalization at 4 C for 0-6 weeks for a) days to first open flower (FF) and b) final leaf number (LN).

a)



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