THE EFFECT OF TEMPERATURE ON THE FATTY ACID COMPOSITION OF HIGH-AND-LOW-ERUCIC-ACID RAPE CULTIVARS

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INTRODUCTION

Brassica napus is cultivated in Israel under climatic conditions different from those in the main countries of cultivation (Western Europe, northern U.S.A. and Canada). As a result, a different fatty acid composition was observed in the oilseed (Yaniv and Elber, unpublished data.).

It has long been know that the temperature prevailing during seed maturation has an influence on the fatty acid composition (Canvin, 1965); Yaniv et al. 1989). Not much is known about the changes of fatty acid composition in high-erucic-acid rape during maturation (Appelqvist, 1975) and, in particular, the effect of temperature on this process.

In order to ascertain the effect of different temperatures on the fatty acid composition of commercial rape seeds, an experiment was initiated to test two rape varieties under controlled temperature conditions: high erucic acid (Brassica napus var Norin) and low-erucic high-oleic acid (B. napus var Westar).

MATERIALS AND METHODS

Seeds of B. napus var. Norin 16 and B. napus var. Westar germinated in Speedling containers on Nov. 15, 1989. Once they reached the four-leaf stage, four plants were transferred to 10 liter containers filled with a mixture of light soil, sand and peat (1:1:1). At the onset of bolting, plants were transferred to a Phytotron and grown under four different temperature (night/day) regimes: 12/17°C, 17/22°C, 22/27°C, 27/32°C, the daily photoperiod was kept constant L:D 16:8. Sixteen plants were used for each temperature regime. Flowers were tagged at anthesis and developing pods were taken for analysis at the times indicated in Figures 1-3. Seeds were dried overnight at 50°C and then analysed for oil content and fatty acid composition by common methods (Yaniv et al. 1989).

RESULTS AND DISCUSSION

The effect of temperature on the fatty acid composition of high (Norin 16) and low-(Westar) erucic-acid B. napus seeds is shown in Table 1. The content of erucic acid was lower in seeds of high-erucic-acid rape grown at high temperatures than in seeds maturing at cooler temperatures and was accompanied by an increase in oleic acid. A similar observation was reported by Marqvard (1985) in high-erucic-acid cultivars.

Low-erucic-acid B. napus var. Westar reacted to increasing temperatures with a decrease of oleic acid accompanied by an increase in linoleic acid. This latter observation is in contrast to common knowledge that, at high temperatures, the content of unsaturated acid is reduced (Canvin, 1965; Tremolieres et al. 1978; Yaniv et al., 1989).

The effect of temperatures on seed yield parameters is shown in

Table 2. Following an increase in temperature there was a decline in most seed yield components of both varieties. The oil content of both varieties decreased by approximately 10%. Variety Westar reacted within a short time to the temperature increase than did var. Norin 16.

The rate of synthesis of the major fatty acids in developing seeds of the two varieties is shown in Figures 1-3. Erucic acid in var. Norin was synthesized faster under high temperatures (Fig. 1), but the maximum level was reached within 37 days and was much lower than the maximal level at lower temperatures. Under a low-temperature regime, the rate of erucic acid synthesis was slower (52-57 days), but its final content was significantly higher.

A similar pattern was observed in the synthesis of oleic acid in low-erucic-acid var. Westar (Fig. 2). At higher temperatures, oleic acid was synthesized faster. However, a higher content of this acid was measured at maturity under lower temperatures.

Figure 3 demonstrates the rate of linoleic acid synthesis in the same variety as in Fig. 2. The trend was found to be the opposite of oleic acid (Fig. 2).

CONCLUSIONS

The oil content and fatty-acid composition of rape seed soils were studied under three different controlled temperature regimes: low 12°/17°C; medium 17°/22°C; and high 22°/27°C. No fruit set was obtained beyound 27°C.

Under low temperatures, seeds of high-erucic acid Brassica napus var. Norin developed higher (54%) erucic and lower oleic acid levels, while seeds of low-erucic high-oleic acid B. napus var. Westar maintained a high (>60%) level of oleic acid up to 22°C. Under high temperatures seeds of high-erucic cultivars showed a decrease in erucic (to 41%) accompanied by an increase in oleic and linoleic acids.

However, a slight decrease in oleic acid was observed after maturation of low-erucic acid cv. Westar followed by an increase in linolenic acid. In both cultivars oil content decreased with the increase in temperatures. In addition, higher temperatures accelerated the time of seed maturity. The rate of synthesis of the different fatty acids during seed development was found to be affected by the different temperature regimes.

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Table 1. Effect of temperature on the fatty acid content of high and low-erucic-acid rape seeds.

Variety	Temperature night/day °C	C16:0	C18:1	C18:2	C18:3	C22:1
Norin 16	12/17	2.8	8.2	14.3	11.9	54.5
	17/22	3.2	10.6	14.3	13.6	49.3
	22/27	4.4	13.6	18.4	11.8	41.4
Westar	12/17	3.7	65.2	17.4	9.2	0.0
	17/22	4.0	62.9	18.6	9.6	0.0
	22/27	5.2	57.2	25.0	6.8	0.0

Data expressed as percent of total.

Table 2. Effect of temperature on seed yield parameters of high and low-erucic-acid rape seeds.

Variety	Westar			Norin 16		
Temperature (°C) Night/day	12/17	17/22	22/27	12/17	17/22	22/27
No. of seeds/pod	26.0	23.0	16.0	22.0	22.3	16.4
Length of ripe pod (cm)	6.4	5.4	4.6	7.0	6.7	5.2
Seed wt./pod (mg)	195	137	50	175	157	53
Days to maturity	60	55	45	57	52	37
Wt. of 10^3 seeds	7.5	6.0	3.1	8.0	7.0	3.2
Oil percentage	45	41	nt	42	37	nt

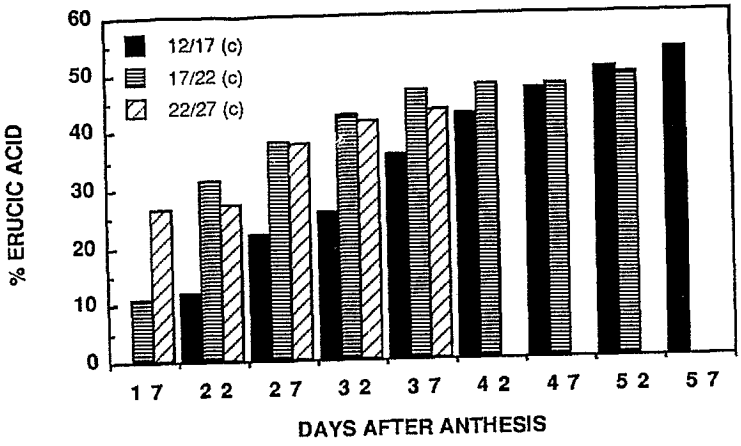

Fig. 1. Effect of temperature on erucic acid in maturing var. Norin 16 rape seeds.

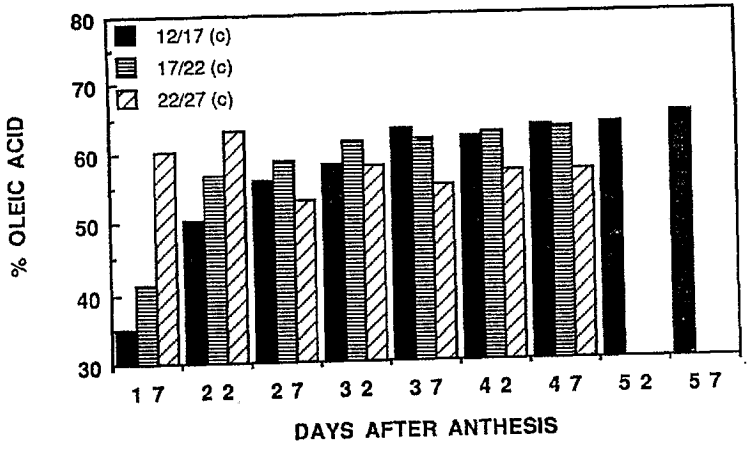

Fig. 2. Effect of temperature on oleic acid in maturing var. Westar rape seeds.

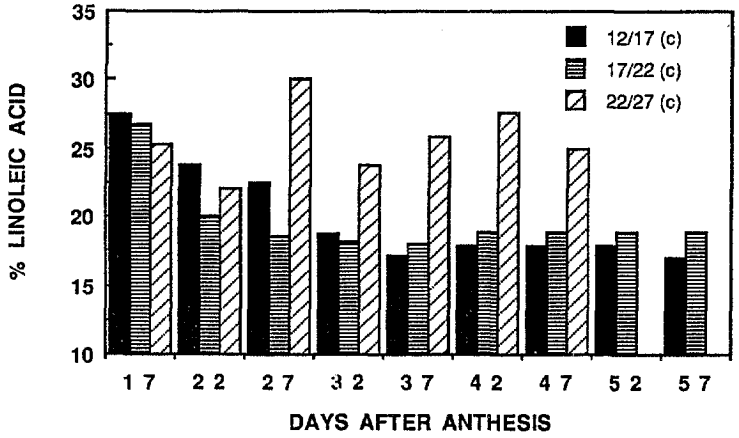

Fig. 3. Effect of temperature on linoleic acid in maturing var. Westar rape seeds.