ERUCIC ACID LEVELS IN SINAPIS ARVENSIS L. FROM DIFFERENT PARTS OF THE WORLD.

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ABSTRACT

S. arvensis L. is a common weed species in areas of rapeseed production. The seed, although somewhat smaller than *B. napus*, is difficult to separate and tolerances for admixture as high as 5% have been established. The seed contains about 27% oil and 30% protein and about 160 μM/g glucosinolates, mainly sinalbin. A survey of samples of *S. arvensis* seed showed the existence two different subtypes based on the content of erucic acid in the oil. A study of 34 single plant accessions from Israel showed a mean erucic acid level of 35.6% with a standard deviation of 3.5%. Samples from Yugoslavia, Germany, Italy, Denmark and Japan showed levels of erucic acid similar to those from Israel. Nine samples collected from different parts of Australia, including Tasmania, had a mean of 36.1% erucic acid and a standard deviation of 3.3%. Twenty-four samples collected from different parts of Western Canada over the period of 1972 to 2001 (including one sample from the northern USA) had a mean erucic acid level of 6.4% with a standard deviation of 2.8%. This suggests that *S. arvensis* growing in N. America has evolved differently from *S. arvensis* growing in other parts of the world. *S. arvensis* also showed significant amounts of *cis* (n-7) fatty acids, similar to *B. napus*.

Key Words charlock – wild mustard – erucic – FAME – n-7 fatty acids

INTRODUCTION

Sinapis arvensis L. is also known as *Brassica kaber* (DC.) L. C. Wheeler var. Pinnatifida (Stokes) L.C. Wheeler in North America. The annual weed is commonly referred to as wild mustard (especially in North America) and charlock (in other parts of the world). The seeds have sufficient similarity to rapeseed (*B. napus* L. and *B. rapa* L.) that it is difficult to quickly and accurately distinguish and quantify admixtures. Admixture of wild mustard with commercial canola or rapeseed results in decreased oil and meal quality due to the lower oil content and higher levels of glucosinolates and erucic acid in the contaminating weed (Daun, DeClercq, and Mazur 1983) (Davis et al. 1999). In Canada, where the seed is relatively a relatively common weed in Brassica crops, a tolerance of 5% admixture has been set for canola (Canadian Grain Commission 2002). The level of 5% was found to be adequate to protect canola oil from excess levels of erucic acid because of the unusually low level of erucic acid found in *S. arvensis* seeds grown in North America (Daun, DeClercq, and Mazur 1983). The large intraspecies variability in fatty acid composition in *S. arvensis* was first observed by Appelqvist (Appelqvist L.-Å. 1971).
While the earlier studies had indicated that S. arvensis growing in N. America contained relatively low levels of erucic acid, the increased international scope of plant breeding programs, coupled with the move to lower the maximum level of erucic acid in canola oil to 1%, suggested that a review of the erucic acid levels in *S. arvensis* grown in N. America was in order. At the same time, it would be appropriate to compare the fatty acid composition of seed originating in N. America with the fatty acid composition of seed from other parts of the world including Europe and Australia, major rapeseed growing areas and the middle east, the presumptive point or origin for the species.

MATERIALS AND METHODS

Seed samples were collected from various fields in western Canada with the assistance of Svalov Weibell and AAFC. Single plant accessions from Israel and Japan were obtained from the USDA North Central Regional Plant Introduction Station. Samples of seed from Australia were obtained from the Australian Temperate Field Crops Collection, the University of Tasmania and the Australian Wheat Board. Samples collected in Europe were obtained from the Nordic

Gene Bank, BAGKF, NPZ, Kiel, Universidad Politechnica, Madrid and USDA Peoria. *S. arvensis* L. identification in all samples was provided by Canadian Grain Commission seed analysts.

Oil was extracted from the crushed seed samples with hexane. Fatty acid methyl esters were prepared by base catalyzed transmethylation (Hougen and Bodo 1973) and methyl esters were separated and quantified by gas liquid chromatography with samples injected (split 30:1) into a 15m by 0.32mm column with a 0.25µm Supelcowax 10 coating; carrier gas H_2 at linear flow 35 cm/sec; injector and detector temperatures were 280 and 300°C respectively; the temperature program started at 125°C for two min followed by two temperature gradients; 125 to 175°C at 25°C/min then 175 to 220°C at 4°C/min and held at 220°C for 4 min giving a total run time of 15.5 min.

RESULTS AND DISCUSSION

The erucic acid level in seed from 34 single plant selections from Israel, presumed to be near the geographic origin of the species, ranged from 28.4% to 40.6% with a mean value of 35.6% and a standard deviation of 3.5% (Table 1). Eight samples from Australia, and single samples from several countries in Europe as well as Japan had erucic acid contents not different from the samples found in Israel. Samples collected in Canada, both in 1983 and 2001 had significantly lower levels of erucic acid (2.7% to 10.9%). The highest level of erucic acid reported in North American samples is 21.1% reported in a field in Idaho {Davis, Brown, et al. 1999 #14050}. There did not appear to be any difference between the erucic acid content determined in the Canadian samples in 1983 and the samples collected in 2001. This suggests that there has not been a significant degree of crossing between plants from Canada and plants from other parts of the world brought in as adventitious seed in plant breeding programs.

This appears to be the first report of the fatty acid composition of S. arvensis from Australia. The results suggest that *S. arvensis* in Australia shares the same genetic ancestry as *S. arvensis* from Europe, the middle-east and Asia but not North America. It would be surprising not to find some seed from North America in Australia given the large impact of the Canadian plant breeding program on the Australian plant breeding program.

Table 1. Erucic acid in samples of *S. arvensis* L. from different origins.

		Erucic Acid (% of total fatty acids)			
Origin	Samples	Mean	Std. Dev.	Min	Max.
Yugoslavia	1	33.4			
Germany	1	32.4			
Italy	1	41.8			
Denmark	1	31.2			
Japan	1	40.1			
Israel	34	35.6	3.5	28.4	40.6
Australia	8	36.1	3.3	31.0	39.5
Canada (1983)	12	5.4	2.4	2.7	10.8
Canada (2001)	12	4.5	3.0	2.5	10.9

The detailed fatty acid composition from *S. arvensis* (Figure 1) showed the presence of both n-9 and n-7 fatty acids for the C18, C20, and C22 fatty acids (Figure 1). This is similar to the fatty acid profile for *B. napus* (Hu, Daun, and Scarth 1994) but not for *B. rapa.* For samples from outside of N. America, the C18:1(n-7) isomer was present at 1.26% of the fatty acids while for samples from within N. America it was present at 2.35%. N-7 isomers of C20:1 and C22:1 were also noted.

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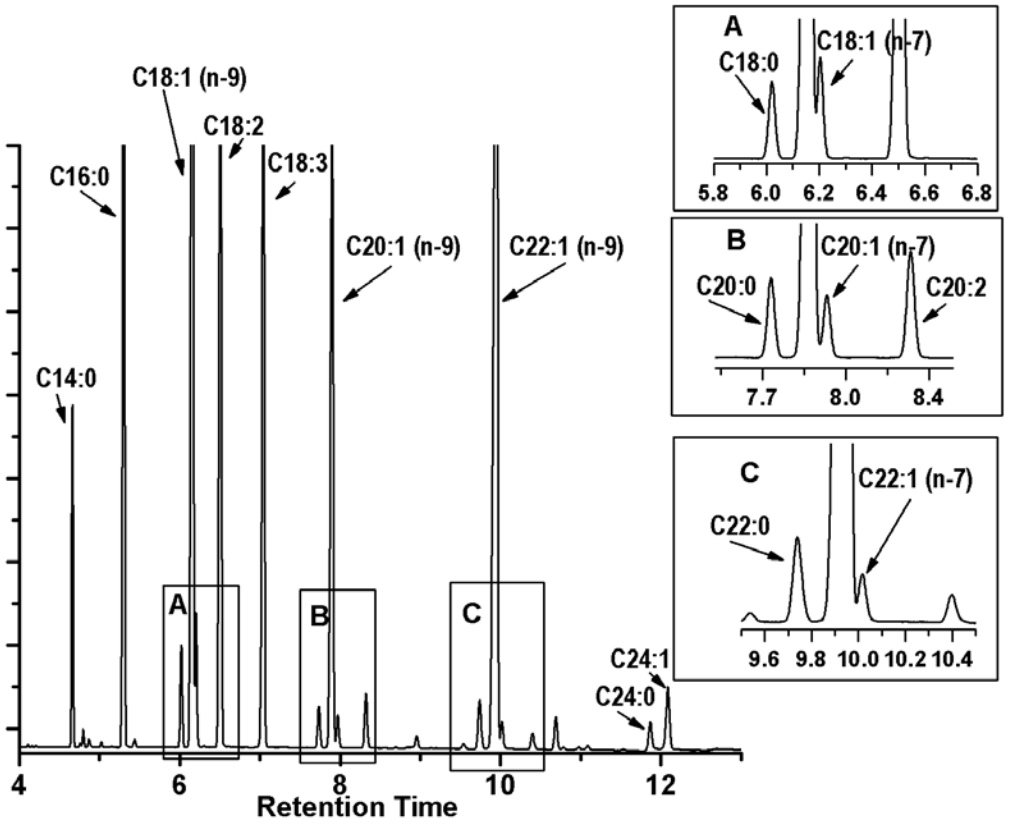

C16:0	C16:1	C18:0	C18:1 (n-9)	C18:1 (n-7)r	C18:2	C18:3	C20:0	C20:1 (n-9)	C20:1 (n-7)	C20:2	C22:0	C22:1 (n-9)	C22:1 (n-7)	C22:2	C24:0	C24:1
3.09	0.14	1.20	11.09	1.26	13.39	11.79	0.71	11.23	0.53	1.18	1.37	35.60	0.93	0.52	0.75	1.65

Figure 1. Gas chromatogram of fatty acid methyl esters from *S, arvensis* L. seed originating from Europe showing the presence of both n-9 and n-7 fatty acids. Table shows average percentage of each fatty acid for samples from other than North America.