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VARIABILITY IN FATTY ACID COMPOSITION OF THE SEED OIL OF HELIANTHUS SPECIES

The development of sunflowers with higher levels of monounsaturation or higher drying quality of the oil would provide broader markets for the oil. Great changes have already been made in the oil of safflower (Carthamus tinctorius) (P. Knowles, 1968) and rapeseed (Brassica campestris and B. napus) (B. Stefansson, F. Hougen, R. Downey, 1961). Fatty acid content of sunflower oil was stated by Kinman and Earle (1964) to be under genetic control insofar as flowering date is genetically controlled. Putt et al (1969) concluded that genetic control of fatty acid percentage was independent of dates of flowering and maturity. Knowles et al (1970) found similar results for seed of wild species from different locations.

The objective of our work was to examine a wide range of collections of wild sunflowers from different origins, and to attempt to identify genes modifying fatty acid composition in selections with unusually high levels of oleic or linoleic acids when grown under uniform conditions.

Seeds were collected from wild populations of *Helianthus annuus* L., *H. bolanderi* Gray, and *H. exilis* Gray, mainly from locations in California but also from Arizona, Nevada, Washington, and Idaho.

Oil from bulk samples of 10 to 20 seeds from different populations and within populations, and also from half seeds (permitting sowing of the remaining half seed), was analysed in a Varian-Aerograph gas chromatograph coupled to a recorder and a digital integrator. Remaining portions of seeds with extreme deviations from mean levels of oleic and linoleic acid were sown in a

greenhouse maintained at a minimum of 18° by night and maximum 27°C by day.

Results of oil analyses of bulk samples are given in Table 1. High oleic types were infrequent. There was high negative correlation between linoleic and oleic acids ($r = -0.988$), but no consistent relation among the other acids. Oleic acid content is higher at high temperatures, linoleic at lower temperatures. The positive association was found between high temperature during the month before seed collection, and high oleic acid content. One conspicuous exception was the Idaho sample in whose seeds the oleic acid content was high at a low-temperature.

Variability was much higher in samples of single seeds than in bulk samples (Table 2). Seven selections with oleic acid content above 65% and nine with linoleic acid above 70% were grown. Because of self-incompatibility crosses were made within both types. Data for the original selections and for their progenies are given in Table 3. One selection from Idaho, a cool area, showed transgressive segregation, giving progenies with oleic content over 60%, and a maximum of 85.1%. It appears to be the most promising source of genes for high oleic. No transgressive segregation for linoleic content was observed. Some progenies of *H. exilis* had very high linoleic acid; they could be a good source of genes for this character.

Environment appears to be partly responsible for high oleic and linoleic acid content in most of the original collections; heritability is low, except for the high oleic selection of *H. annuus* from Idaho and the high linoleic selections of *H. exilis*.

Some variability (maximum 22%) was observed within individual heads. This could be explained in part by environmental differences (slight in the greenhouse) during blooming. If control of fatty acid content is gametophytic (P. Knowles et al, 1970) such variation could occur if high oleic and high linoleic content were assumed to

Table 1

Range and Means in Proportions of Fatty Acids of Oil from Bulk Samples of Seed from Several Plants and Bulk Samples of Single Plants of Wild H. annuus, H. Bolanderi and H. exilis from Different Locations

Species and number of samples	Fatty acid composition, %							
	Palmitic		Stearic		Oleic		Linoleic	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
<u>Bulk of several plants</u>								
<u>H. annuus</u> 47	4.6-8.0	6.2	1.1-7.1	3.3	14.3-50.1	29.4	41.8-75.5	60.9
<u>Single plants</u>								
<u>H. annuus</u> 128	4.9-19.0	6.5	1.9-6.4	3.3	10.1-55.1	27.0	37.1-80.5	63.0
<u>H. bolanderi</u> 63	6.8-16.9	8.1	3.4-9.6	5.2	13.0-37.2	21.0	48.2-72.8	65.5
<u>H. exilis</u> 61	6.2-21.7	8.2	1.7-7.7	4.8	3.6-21.2	13.7	57.6-86.9	73.0

Table 2

Range and Means in Proportions of Fatty Acids of Oil of Single Seeds from Selected Samples Deviating in Oleic and Linoleic Acid Content of Wild H. annuus, H. Bolanderi and H. Exilis

Species and number of samples	Fatty acid composition, %							
	Palmitic		Stearic		Oleic		Linoleic	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
<u>H. annuus</u> 82	3.9-4.9	7.7	1.0-8.3	2.8	11.2-74.6	42.5	18.4-78.6	46.5
<u>H. bolanderi</u> 15	4.6-11.3	6.9	2.2-6.1	4.1	9.0-20.9	13.5	62.8-82.5	75.2
<u>H. exilis</u> 18	4.6-11.3	6.2	1.2-5.9	2.8	3.3-15.2	7.6	75.2-88.3	83.1

Table 3

Range and Means in Proportion of Fatty Acid in Oil of Selected Single Seeds with High Levels of Oleic and Linoleic Acid Planted in the Greenhouse and in Progenies Obtained by Crossing with these Types.

Species and number of samples	Fatty acid composition, %								
	Palmitic		Stearic		Oleic		Linoleic		
	Range	Mean	Range	Mean	Range	Mean	Range	Mean	
<u>High oleic types</u>									
<u>H. annuus</u>									
A. Original seeds	4.6-	6.1	1.0-	1.6	68.0-	69.1	18.5-	23.3	
7	7.6		2.0		74.6		26.0		
B. Progenies									
1. Variation from head to head									
24	2.7-5.7	3.9	0.9-3.0	1.9	35.4-74.7	52.6	18.9-	41.4	
2. Variation from seed to seed							59.0		
98	2.8-8.0	-	0.5-3.6	-	29.5-85.1	-	8.1-64.8	-	
			<u>High linoleic types</u>						
<u>A. annuus</u>									
A. Original seeds	6.8-	8.0	1.0-5.0	3.1	11.2-17.8	14.2	72.3-	74.5	
9	10.0						78.6		

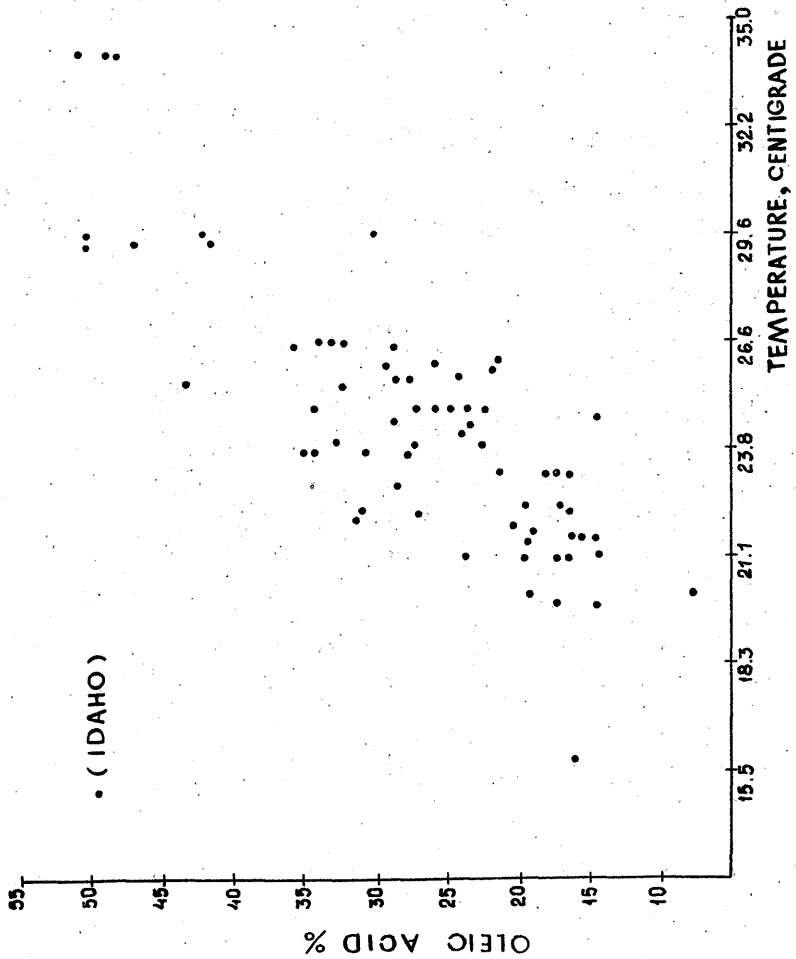


Fig 1. Association between mean temperature for the month before collection and the oleic acid composition of seed oil of sunflower

be governed by several genes. If the original genotypes were heterozygous, new genotypes in the crosses would account for transgressive segregation.

Selection for both extremes is being continued in our material. After both types are fixed, the patterns of inheritance will be worked out.

References

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