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SOME ASPECTS OF BIOCHEMICAL STUDIES IN SUNFLOWER

Progress in sunflower breeding has radically changed its chemical composition (N.F. Dublyanskaya, 1975). It is impossible to predict which initial material will be necessary for breeding purposes in the future, but at present there is a need of conservation and detailed study of sunflower samples collected by the All-Union Vavilov Institute of Plant Growing.

The biochemical laboratory of the Kuban VIR experimental station has since 1943 been determining the oil content of a sunflower collection amounting to 1,200 entries. A total of 1,196 entries have been analyzed, but only for 585 of them there are data for at least three years, i.e. the oil content has been authentically studied in 49% of the entries. There are much less data concerning protein and its quality and on the fatty acid content of the oil.

Previously some biochemical aspects of sunflower were studied using the collection material, e.g. 113 inbred lines (A.N. Fragina, 1966) and 100 Soviet and foreign varieties (E.V. Popova, 1972). These authors concentrated on Soviet commercial varieties and hybrids, i.e. high oil samples while the bulk of the collection forms belongs to a group with a low oil and high protein content.

The following methods were used in the chemical studies of seed samples: oil content was determined by stay method of Ya.S. Dyachkin (1953); fatty acids were determined by gas-liquid chromatography using chromatograph Chrom-2; methanolysis was carried out in the Kharchenko modification (1973); total nitrogen was determined by Kjeldahl half-micro-method using coefficient for crude protein 6.33

(L.V. Suprunova, 1969).

Weight of 1,000 seeds and husk percentage were obtained at the Station's Laboratory of Industrial Crops (V.T. Rozhkova).

Six collection entries showed oil percentage almost equal to that of the check variety Peredovik (Table 1).

Five of the afore-mentioned entries and Soviet commercialized varieties and one Romanian (Rekord). Two varieties bred at the All-Union Research Institute for Oil Crops are not included into the Table: VNIIMK 1646 (Cat. 1650) and Smena (Cat. 2052). The latter has rather large seeds (weight of 1000 seeds 80.8 g) and relatively low huskness (22.8%).

Oil content is under considerable influence of environmental conditions, particularly meteorological ones. There are 8 entries in the collection which are very stable in oil percentage (Cat. 136, 1536, 1879, 1901, 1930, 2127, 2213, 2269), their variability from year to year being less than 1%.

Since 1971 we have been studying the fatty acid content of sunflower oil. So far we have studied 127 entries, but we have chiefly obtained one-year data.

Sunflower oil of modern highly productive varieties is classified as an edible oil with a high percentage of linoleic and oleic acids and with the predominance of the former over the latter. For thermal processing in the food industry it is desirable to have oils with high oleic acid percentage (V.P. Rzhekhin, 1969), while linoleic acid should not exceed 40% of the sum of fatty acids (A.I. Yermakov, O.M. Megorskaya, 1972).

In collection entries which we have studied the oleic acid percentage ranges from 21.2 to 45.4%. The following entries showed high levels of this acid: SM-83, Cat. 2295, (45.4%), and SM-144 (42.1%) from Canade; L-2600 from Odessa, Cat. 2318; and Bulgarian entry, Cat. 1385 (45.0%). Linoleic acid content in the above entries was 43.5%, 47.5%, 45.2%,

Table 1

High Oil Sunflower Collection Entries
(Average for 1966, 1969, 1974)

Varieties	Catalogue	Oil,% in abs. dry seed	Weight of 1,000 seeds, g	Husk, %
Peredovik	2051	59.1±3.9	82.8±7.0	25.6±2.9
Mayak	2120	62.5±2.9	78.5±10.8	22.4±4.4
Chernyanka	2097	62.4±1.8	70.4±11.5	24.8±1.4
Rekord	2171	62.1±2.3	77.3±10.2	23.9±1.8
Armavirsky 3497	1960	62.0±2.1	78.4±11.9	22.4±6.4

and 44.9%, respectively.

The dye stuff industry needs sunflower oil with the iodine number of 140-160, that is with higher levels of linoleic acid (up to 80%) and reduced levels of other acids, especially the oleic one.

Linoleic acid content in the studied entries of the collection ranged from 43.5 to 70.8%. The highest levels of linoleic acid were observed in the Bulgarian entry, Cat. 2259 (70.8%) and Canadian entries 2306 (68.9%), 2301 (67.9%) and 2305 (67.5%).

Since 1969 we have been studying protein content in the kernel of the seed, having analysed 832 entries, but data for many years are only available for 70 samples. High protein levels were observed in 35 samples (2% and more than in checks). The highest protein level was observed in the sample from Aravia, Cat. 820 (41.3%) (Table 2).

The Persian sample, Cat. 551, is somewhat lower in protein than samples from Hakassia (Cat. 1899) and Transcaucasus (Cat. 417). These are all forms with rather large seeds, except the Persian one, and are in this respect close to checks, but rather husky.

It is known that oil content and protein in the kernel are in reverse proportion; this can be established with a sufficient quantity of samples. It is interesting to note, however, that the sum of protein and oil increases as the oil percentage increases. This conclusion can be drawn from our data and from the work of N.F. Dublyanskaya (Table 3).

We may conclude that thorough biochemical studies of sunflower collection are necessary to obtain valuable theoretical and practical data.

Table 2

High Protein Sunflower Samples
(Average for 1970, 1971, 1974)

Variety, origin	Cat. #	Protein,% in abs. dry seed	1,000 seed weight	Huskness, %
Peredovik VNIIMK	2051	31.9±6.1	76.9±11.8	29.7±2.8
Aravia, Yemen	820	41.3±6.9	76.6±13.2	45.0±1.8
Persia	551	40.8±5.4	61.8±2.4	40.7±1.9
Hakassia	1899	40.6±3.1	76.2±9.0	42.6±4.0
Transcaucasus	417	40.4±7.7	76.7±8.9	42.6±1.9

Table 3

Protein and Oil Relationship in Sunflower Seed
(data for 1974)

Variety, origin	Cat. #	Oil, % in abs. dry seed	Protein, % in abs. dry matter	Sum of protein and oil, %
Krasnodarsky	593	42.2	36.8	76.1
R-27, Saratov region	1875	42.5	37.7	80.2
Austria	2349	46.6	36.3	82.9
Peredovik, VNIIMK	2051	61.3	24.4	85.7
Voskhod, Voronezh region	2180	65.4	22.8	88.2