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# BREEDING OF SELF-POLLINATED SUNFLOWER LINES AND ASSESSMENT OF THEIR COMBINING ABILITY ACCORDING TO PRODUCTIVITY AND OIL CONTENT

Prior to the use of the heterosis effect vast prospects have opened for sunflower owing to the fact that CMS sources have recently been discovered in some countries; these make it possible to obtain the 100% cross-breeding of parental forms under free flowering. Therefore, signal importance attaches to the elaboration of methods of creation and selection of components (self-pollinated lines) for hybrids.

Breeding of self-pollinated lines began in the V. Yuriev Ukrainian Institute for Plant Growing, Breeding and Genetics in 1958-1959 using the then regionalized and perspective Soviet varieties as initial material. A long (5-7 years) inbreeding helped create a number of lines with genetic male sterility possessing morphobiological evenness. However inbreeding was not accompanied by a sufficient control over the seed huskness and oil content. As a result, the bulk of lines bred at that time failed to meet the requirements of plant breeding, largely due to a low oil content of the first generation seeds grown on the basis of interlinear and variety-line hybrids. The involvement of high oil forms as a parental component did not substantially improve the hybrids quality. As the same time it was proved that the male form greatly influences the seeds huskness and oil content (Table 1).

In recent years diverse initial material has been used for breeding self-pollinated lines including the collection of the N. Vavilov Research Institute for Plant Growing. But the use

Table 1

Yield and Oil Content of Interline Sunflower Hybrids

| Hybrid | Seed yield, c/ha | Huskness, % | Fat, % | | Fat yield, kg/ha |
|---|---|---|---|---|---|
| | | | in nucleus | in achenes | |
| 5/2-2x659 | 31.6 | 26.9 | 60.0 | 43.8 | 1218 |
| 5/2-2x714 | 31.9 | 24.0 | 62.4 | 47.5 | 1334 |
| 714x5/2-2 | 32.2 | 26.2 | 61.0 | 45.0 | 1273 |
| 4/6-8x29/1-2 | 31.3 | 23.2 | 63.8 | 49.1 | 1349 |
| 29/1-2x231 | 31.6 | 25.3 | 61.0 | 45.6 | 1267 |
| 714x170/3 | 31.8 | 30.4 | 59.4 | 41.4 | 1158 |
| VNIIMK 6540 | 29.9 | 20.3 | 62.8 | 50.0 | 1315 |

of collection samples to directly breed self-pollinated lines did not as a rule give the expected results; the lines received from them had some negative features, namely rough hush, low oil content, late maturing and others, though certain self-pollinated lines from this material contained a rather high general combining ability in terms of seed yield.

We have obtained the best results in breeding self-pollinated lines when we inbred first generation plants from crossing our lines with collection samples coming from Romania, Bulgaria, Hungary, the GDR, Morocco, Canada, etc. In this case a number of 4-5 generation lines have a complex of economically valuable traits we found in ascertaining their combining ability by the test cross-breeding method.

We also obtained good (in terms of breeding) self-pollinated lines from inbreeding most high oil varieties of Soviet selection, such as Sputnik, Kharkovsky 100 and others. Some generalized data relating to the efficiency of using diverse unitial material to breed valuable self-pollinated lineages are cited in Table 2, and characteristics of best first generation hybrids bred on their basis - in Table 3.

To breed self-pollinated lines we annually perform 2.5-3.000 self-pollinations. Lines $1_2$-$1_3$ are checked for disease and pest resistance in natural conditions as well as for general combining ability by the topcrossing method. All lines checked are crossed with 2 testers (with our line 4/6-8 and variety Zelenka 368 improved). Besides, 30-40% of lines are cross-bred with 3-4 more testers, self-pollinated lineages and varieties. To evaluate general combining ability (GCA), one-year field topcross trial is made on the 5 $m^2$ plots by the simple double sieve method, a repeated trial being only made for the best hybrids. Consequently, inbred lines are sorted at the first stages of breeding according to their GCA.

Table 2

Hybrid Heterosis Effect Depending on the Origin of Parental Lines

| Origin of self-pollinated lines | Hybrid quantity exceeding the standard by 15% and more (% of the total number studied) | | | | |
|---|---|---|---|---|---|
| | according to seed yield | according to seed & fat yield | according to fat content | | according to huskness |
| | | | in kernel | | in achenes |
| From foreign varieties | 11.1 | - | 7.4 | | 3.7 |
| From Soviet bred varieties | 13.6 | 5.9 | 17.7 | 7.5 | 6.8 |
| From hybrids received by crossing own self-pollinated lines with collection samples | 16.3 | 10.3 | 10.6 | 3.5 | 3.5 |
| With other lines of own selection | 27.5 | 17.0 | 12.5 | 5.0 | 12.5 |

Table 3

High Heterosis Sunflower Hybrids

| Origin ♀ | Origin ♂ | Vegetation period, days | Seed yields, c/ha | Huskness, % | Fat content, % in kernel | Fat content, % in achenes | Fat yield, c/ha |
|---|---|---|---|---|---|---|---|
| Chernyanka 66 | Odesskaya 231 | 91 | 41.7 | 20.5 | 66.46 | 52.84 | 19.39 |
| Armavir | Zelenka 368 | 91 | 40.6 | 17.1 | 67.62 | 56.06 | 20.01 |
| L-1639 Bulgaria | Chernyanka 66 | 93 | 39.8 | 18.7 | 65.86 | 53.54 | 18.74 |
| X-50 | Zelenka 368 | 91 | 37.8 | 17.3 | 67.57 | 55.88 | 18.61 |
| X-100 | Zelenka 368 | 92 | 37.4 | 10.3 | 65.15 | 53.23 | 17.51 |
| L-2154 Bulgaria | 4/6-8 | 91 | 37.0 | 19.9 | 66.29 | 53.10 | 17.31 |
| Chernyanka 66 | Zelenka 368 | 91 | 36.2 | 19.9 | 66.95 | 53.63 | 17.09 |
| (16/1-2x214)x x2140 | 4/6-8 | 93 | 36.0 | 17.9 | 66.13 | 54.29 | 17.20 |
| Kharkovsky 100 | (Standard) | 93 | 32.0 | 19.2 | 65.77 | 53.37 | 15.03 |

Table 4

Average Productivity of Interlinear Hybrids Depending on a Paternal Component

| Pollinators | Seed yield, c/ha | Seed huskness, % | Fat, % | | Fat yield, c/ha |
|---|---|---|---|---|---|
| | | | in kernel | in achenes | |
| 4/6-8 | 28.7 | 22.4 | 64.73 | 50.23 | 12.73 |
| K-659 | 32.1 | 28.7 | 61.75 | 44.69 | 12.67 |

Experiments to study the self-pollinated lines GCA by the topcross method showed a rather complex mutual-influence of genotypes of the female and male crossing components. In the majority of cases the use of diverse testers (in terms of their economico-biological properties) gives coincident GCA estimates, but hybrids with different analysers often differ considerably in many economically important properties.

Compare, for example, the lines received from crossing the same maternal forms with two testers, namely line 4/6-8 of our breeding and line K-659 of the UPI Kuban Experimental Station (Table 4).

These data show that testers give an unequivocal estimate of checked lines in terms of fat yield per hectare, but due to different components.

Beginning with $F_3$ seeds of the best (in terms of GCA) lines are analyzed for the husk and oil content in kernel.

In recent years the Institute has bred several lines with the 18-20% huskness, 63-68% and more kernel oil content, and with a high CA. These lines are used to bred experimental interlinear and variety-line hybrids.