

Attempts of Heterosis Use to Improve Winter Rape Yield in Poland

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The main target of breeding works and researches is to obtain new varieties of double low winter rape. The most difficult task is now to restore the yielding ability and the winterhardiness of rape which were lost in the course of modifying of its chemical composition. Efforts to make use of heterosis effect are one of the methods applied in our works.

Significant increase in efficiency of rape selection for improved quality was obtained when inbreeding was applied. Rape has quite considerable ability to self-pollination however longer application of inbreeding causes decrease in viability and inbred depression. Researches on heterosis effect in low erucic and double low winter rape (tables 1 and 2) showed that it occurs by inter-varietal, inter-strain and first of all, inter-line crossings. The degree of yield increase ranges from 1 % to 109 % depending on cross combination and environmental conditions in which hybrids are grown. The worse conditions of plant growing the stronger is heterosis effect. The mean value of this effect for all experiments amounts to 32 %.

The use of hybrid varieties of winter rape in production is impossible now because of lack of good male sterility system. Heterosis effect can be utilized now only in synthetic varieties. These synthetic varieties may be produced on two ways - by full

intercrossing made by hand or by growing the mixture of lines for spontaneous intercrossing.

The result obtained in first experiment with two line synthetics obtained by full intercrossing are given in table 2.

Mean heterosis effect for F_1 was 36 % and ranged from 22 % to 125 % for different combinations but it dropped down to 6 % in F_2 and ranged from 2 % to 88 %.

Four line synthetics were examined in next experiments. Mixtures of lines before (MP) and after spontaneous intercrossing (MF_1) were grown in field trials. Results obtained are shown in table 3. Mean heterosis effect is 27 % for low erucic lines and only 6 % for double low lines but some combinations are giving much better results.

Figures in table 4 represent a comparison of seed yields for parental lines (P) for mixtures of parental lines (MP) and for their progeny (MF_1) and for four line hybrids (F_1) of double low winter rape.

All obtained result show that it is possible to increase the seed yield of winter rape by application of synthetic varieties but the lines used for this purposes should have the best combination ability and should be high yielding.

Table 1 : Summary of Polish researches on heterosis effect in winter rape

| Genotype | n | Seed yield t/ha heterosis effect % | | | | Year |
|----------|-----|------------------------------------|----------------|-----------|------|------|
| | | P | F ₁ | \bar{x} | max. | |
| 0 | 30 | 2,19 | 2,57 | 17 | 40 | 1976 |
| 0 | 36 | 1,52 | 2,46 | 62 | 182 | 1976 |
| 00 | 36 | 2,45 | 3,00 | 22 | 62 | 1976 |
| 00 | 36 | 0,64 | 1,34 | 109 | 293 | 1976 |
| 0 | 92 | 2,18 | 2,21 | 01 | 29 | 1977 |
| 0 | 36 | 3,07 | 4,12 | 34 | 72 | 1977 |
| 00 | 42 | 2,61 | 3,28 | 26 | 43 | 1978 |
| 00 | 107 | 2,90 | 3,13 | 8 | 94 | 1981 |
| 00 | 35 | 1,54 | 1,73 | 12 | 50 | 1982 |

0 : low erucic
00 : double low

Table 2 : Heterosis effects for different genotype of winter rape
Seed yield t/ha - Borowo 1976/1977

| Genotype | n | P | F ₁ | F ₂ | $100 \frac{F_1 - P}{P}$ | $100 \frac{F_2 - P}{P}$ |
|----------|----|------|----------------|----------------|-------------------------|-------------------------|
| 0 x 0 | 16 | 3,29 | 4,05 | 3,26 | 23 | - 1 |
| 0 x 00 | 4 | 3,06 | 4,51 | 3,02 | 47 | - 1 |
| 0 x 00 | 4 | 2,94 | 3,92 | 3,00 | 33 | 2 |
| 00 x 0 | 4 | 3,03 | 4,46 | 3,40 | 47 | 12 |
| 00 x 00 | 1 | 2,84 | 3,49 | 3,23 | 23 | 14 |
| 00 x 00 | 1 | 2,74 | 4,41 | 2,64 | 61 | - 4 |
| 00 x 0 | 4 | 2,94 | 4,22 | 3,32 | 44 | 13 |
| 00 x 00 | 1 | 2,74 | 3,35 | 3,13 | 22 | 14 |
| 00 x 00 | 1 | 1,65 | 3,71 | 3,10 | 125 | 88 |
| Mean | | 3,07 | 4,12 | 3,20 | 35,7 | 5,6 |

0 : low erucic
00 : double low

Table 3 : Yielding ability of synthetic winter rape varieties (MF₁) obtained by spontaneous intercrossing four lines mixtures (MP).
Results of investigations carried out in Poland

| Genotype | n | Seed yield t/ha | | Heterosis effect % | | Year |
|----------|----|-----------------|-----------------|--------------------|------|------|
| | | MP | MF ₁ | x | max. | |
| 0 | 45 | 2,16 | 2,74 | 27 | 63 | 1979 |
| 00* | 35 | 1,54 | 1,64 | 6 | 30 | 1982 |

* : only 35 % of plants passed through winter

Table 4 : Comparaison of parental lines with four lines mixture (MP) their progeny (MF₁) and four lines hybrids (F₁) of double low winter rape Seed yield t/ha - Borowo 1981/1982

| Combination | Yield | % |
|---------------------------------------|-------|-----|
| P - ACDG | 1,57 | 100 |
| MP - ACDG | 1,76 | 112 |
| MF1 - ACDG | 1,90 | 121 |
| F1 - ACDG | 1,94 | 124 |
| P - ADEF | 1,56 | 100 |
| MP - ADEF | 1,65 | 106 |
| MF1 - ADEF | 1,84 | 118 |
| F1 - ADEF | 2,38 | 153 |
| P - BCDG | 1,59 | 100 |
| MP - BCDG | 1,70 | 107 |
| MF1 - BCDG | 1,79 | 113 |
| F1 - BCDG | 2,00 | 126 |
| Mean of all 35 combinations - P | 1,57 | 100 |
| MP | 1,52 | 97 |
| MF1 | 1,64 | 104 |
| F1 | 1,73 | 110 |