# RAPE AND MUSTARD BREEDING FOR OIL QUALITY.

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## INTRODUCTION

In solving the problem of increasing the USSR edible vegetable oil production and consumption great importance is being attached to the oilseed crops of the genus Brassica.

Until 1981 of all cruciferous crops Indian mustard (B.juncea Czern.) was most commonly grown in our country while in recent years rape (B.napus oleifera Metzg.) and turnip rape (B. campestris L.) have acquired the leading position. According to the targets of the Food Project by 1990 rape commercial seed production is to be brought up to 1.5 m tons.

In this connection during the recent ten to fifteen years VNIIMK scientists have been developing erucic-free low-glucosinolate varieties of winter and spring rape and turnip rape alongside with intensive research on further improvement of rape, turnip rape and mustard oil quality.

## MATERIALS AND METHODS

The method of interspecific hybridization of Indian mustard (B.juncea Czern.(2n=36) and rape (B.napus oleifera Metzg. (2n=38) has been applied in this work. High-erucic Indian

mustard variety Yubileinaya, low-erucic lines isolated from this variety and erucic-free spring rape Oro of Canadian breeding have been used in crossings.

Low-linolenic erucic-free spring rape variety Kubanskii developed on the base of these hybrids has been crossed with low-erucic mustard-rape hybrids of mustard type and the resulting hybrids have been further crossed with low-erucic lines isolated from mustard variety-populations.

Oil fatty acid composition of the material under study has been determined by gas-liquid chromatography [2]. Hybrid evaluation and study for major valued traits have been carried out according to the procedure currently accepted at VNIIMK for oilseed crops of the genus Brassica [1].

## RESULTS

Indian mustard is found to be taken as a maternal component for the development of mustard-rape hybrids. When crossed otherwise seeds , generally, fail to set (table 1).

Table 1. Crossing ability of Indian mustard with erucic-free rape (Brassica juncea Czern.X Brassica napus oleifera Metzg.)

1982 data

| Combinations | Number of plants pollinated | Percentage of seeds and siliques set | |
|---|---|---|---|
| | | siliques | seeds |
| Variety Yubileinaya X variety Oro | 500 | 58,2 | 16,4 |
| Variety Oro X variety Yubileinaya | 500 | 0,0 | 0,0 |
| Variety Yubileinaya X variety Zefir | 500 | 31,9 | 8,0 |
| Variety Zefir X variety Yubileinaya | 500 | 0,0 | 0,0 |

When crossing high-erucic mustard with erucic-free rape erucic acid content in oil from hybrid seeds is intermediate, being the lower, the poorer its content is in the maternal component (mustard).

The first hybrid generation is slightly fertile and uniform for morphological traits which are intermediatly inherited. Plants are vigorous , branched, long-flowering types that produce few seeds and have root swellings.

Mustard-rape hybrids in the second generation are segregating greatly for morhpological characters and oil fatty acid composition. The largest number of hybrids with erucic and linolenic acid content less than 10% and 5%, respectively, are found among plants of the second generation, grown from seeds which we obtain from open pollination of $F_1$ plants surrouded by erucic-free rape plants.

Hybrids of rape type inherit well fatty acid composition of oil in $F_3$. Low-linolenic hybrid oil contains 3.0 to 4.5 % of linolenic acid and 65,9 to 72,5 % of oleic acid (table 2).

Table 2. Oil fatty acid composition of mustard-rape hybrids of rape type in $F_3$, 1975 data.

| Entries | Oil fatty acid content, % | | | | | | |
|---|---|---|---|---|---|---|---|
| | $C_{16:1}$ | $C_{18:0}$ | $C_{18:1}$ | $C_{18:2}$ | $C_{18:3}$ | $C_{20:1}$ | $C_{22:1}$ |
| 30231 | 3,2 | 0,8 | 72,5 | 18,8 | 3,0 | 1,5 | 0,0 |
| 30235 | 3,7 | 1,7 | 69,5 | 20,0 | 4,0 | 1,3 | 0,0 |
| 30226 | 3,3 | 1,4 | 70,7 | 18,1 | 4,2 | 1,1 | 0,0 |
| 30236 | 3,5 | 1,4 | 65,9 | 22,9 | 4,5 | 1,5 | 0,0 |
| Rape, variety Oro | 2,9 | 1,5 | 65,2 | 22,6 | 6,1 | 1,0 | 0,5 |
| Mustard, variety Yubileinaya | 2,1 | 1,2 | 20,6 | 21,3 | 10,0 | 10,2 | 34,5 |

Basing on these low-linolenic hybrids a new erucic-free spring rape variety Kubanskii with good productivity and oil quality was developed in the Soviet Union. Average data on three-year competition trials of this variety showed its superiority for major agronomic traits not only to such variety as Oro, but even to more productive variety Zefir. Oil linolenic acid content in variety Kubanskii amounted tc 3.9 %, that was for certain, lower than in variety Zefir (table 3).

Table 3.Performance of low-linolenic spring rape variety Kubanskii (average data for a period from 1977 to 1979).

| Variety | Vegetation period (days) | Seed yield q/ha | Seed oil content % | Oil yield q/ha | 1,000 seed weight g | Oil major fatty acid content, % | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | $C_{18:1}$ | $C_{18:2}$ | $C_{18:3}$ | $C_{22:1}$ |
| Kubanskii | 87 | 17.8 | 41.9 | 6.6 | 3.6 | 70.5 | 17.5 | 3.9 | 0.0 |
| Zefir | 90 | 15.8 | 41.5 | 5.8 | 2.9 | 67.0 | 18.9 | 6.1 | 0.0 |
| LSD 0.05 | - | 1.5 | - | 0.5 | 0.1 | - | - | 1.6 | - |

Method of multiple individual selection with progeny evaluation allowed to single out entries of rape type with 1.4 to 2.3% linolenic acid content from mustard-rape hybrids (table 4).

Table 4.Low-linolenic mustard-rape hybrids of rape type, 1982 data.

| Entries | Major fatty acid content in oil, % | | | | | | |
|---|---|---|---|---|---|---|---|
| | $C_{16:1}$ | $C_{18:0}$ | $C_{18:1}$ | $C_{18:2}$ | $C_{18:3}$ | $C_{20:1}$ | $C_{22:1}$ |
| 9239 | 1.4 | 0.1 | 79.2 | 17.2 | 1.4 | 0.7 | 0.0 |
| 9261 | 3.7 | 0.6 | 73.8 | 19.1 | 1.9 | 0.9 | 0.0 |
| 9279 | 3.1 | 0.1 | 73.4 | 19.9 | 2.3 | 1.2 | 0.0 |
| Rape, variety Kubanskii | 3.4 | 1.9 | 71.4 | 18.5 | 3.2 | 1.6 | 0.0 |

In breeding Indian mustard for oil quality with the method of multiple individual selection we failed to develop varieties

with erucic acid content less than 9 to 13 %. Mustard-rape hybrids proved to be good initial material for the development of erucic-free forms of mustard type.

In 1980 among hybrids produced from crossing low-erucic mustard variety (erucic acid content of 10.9 %) with erucic-free low-linolenic spring rape variety Kubanskii we obtained erucic-free yellow-seeded mustard with linolenic acid content in oil ranging from 5 to 10 % but with seed oil content reduced to 40 to 41 %. Subsequent crossings of these hybrids with high-oil low-erucic line developed from mustard variety-populations made it possible to single out erucic-free mustard forms with seed oil content amounting to 43 to 45 % and linolenic acid content being equal to 2.3 to 4.2 % at various ratio of oleic and linoleic acid content (table 5).

Table 5. Fatty acid composition of oil from low-linolenic mustard-rape hybrids of mustard type, 1986 data.

| Entries | Seed oil content % | Fatty acid content in oil, % | | | | | |
|---|---|---|---|---|---|---|---|
| | | $C_{16:1}$ + $C_{18:0}$ | $C_{18:1}$ | $C_{18:2}$ | $C_{18:3}$ | $C_{20:1}$ | $C_{22:1}$ |
| 8556 | 43.1 | 5.8 | 50.3 | 39.6 | 2.3 | 2.0 | 0.0 |
| 8576 | 43.0 | 3.7 | 66.4 | 25.7 | 2.7 | 1.5 | 0.0 |
| 8561 | 44.6 | 4.1 | 50.2 | 40.8 | 3.2 | 1.7 | 0.0 |
| 8547 | 45.2 | 5.1 | 48.2 | 39.5 | 4.1 | 3.1 | 0.0 |
| 8569 | 45.1 | 3.9 | 42.8 | 45.4 | 4.2 | 3.7 | 0.0 |
| Mustard, variety VNIIMK 11 | 46.3 | 2.6 | 28.8 | 25.9 | 13.0 | 10.3 | 19.4 |

DISCUSSION

Further oil quality improvement in erucic-free oilseed varieties of the genus Brassica is possible through raising the ratio of linoleic acid to linolenic acid content as well as to

oleic acid content.

Interspecific mustard-rape hybrids allow to develop rape and mustard forms with improved fatty acid composition of oil.

Linoleic-linolenic acid content ratio in variety Kubanskii is raised up to 4.5 to 1 as compared to 2 to 1 in most varieties. In hybrids developed at VNIIMK this ratio is increased up to 8 to 1 and even up to 12 to 1.

Erucic-free mustard forms have been developed with linoleic-linolenic acid content ratio ranging from 10 to 1 to 17 to 1 and linoleic-oleic acid content ratio ranging from 0.4 to 1 to 1 to 1.

## CONCLUSIONS

Mustard-rape hybrids proved to be good initial material in breeding for further oil quality improvement of erucic-free rape and mustard varieties.

## REFERENCES

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