STUDIES IN F_1 AND F_2 OF CROSSES BETWEEN WINTER AND SUMMER TURNIP RAPE

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The seed yield of summer turnip rape has in many cases been small or insufficient, which seems to be largely due to the rather small specific yield of this turnip rape type. One of the reasons for the interest in and for the initiation of crosses between summer and winter forms of turnip rape was the hope of obtaining types giving higher yield. An other reason for the interest in these crosses was the possibility of developing leafy turnip rape types which could be used for green fodder production. Further, the author was interested to see the influence of different winter turnip rape varieties used as parents, on crosses with one common summer turnip rape.

Material and methods

The present investigation was carried out at the Plant Breeding Institute Gullåker, Hammenhög, Sweden. The study was undertaken in connection with the practical plant breeding work at the institute.

The crosses were carried out by the author in 1951. The hybrid seeds and the seeds of parents were sown in planting-boxes in the early spring of 1952. The plants were planted in the field at the beginning of May. The planting was successful with the exception of the Mette plants, which had begun to shoot before planting and consequently had reached a developmental stage where the plants would not survive planting. In order to have some possibilities for comparison Mette was at the same time sown. These Mette plants were then used for comparisons with F_1 of the crosses, and the winter turnip rape varieties used as parents in the crosses.

The plants were planted at distances of 45 × 45 centimetres. The numbers of investigated plants are given in Table 1. The developmental stage and the plant height of the F_1 plants were determined on August 1st.

Seed yield per plant, seed weight per silique, length of silique and number of seeds per silique were investigated.

The F_2 plants of the investigated crosses were grown in the summer of 1953 and were partly compared with Mette and partly with the winter turnip rape varieties used as parents in the actual crosses. The plants were grown in sown stands.

The χ^2 tests were undertaken in conformity with FINNEY (2) and determined with the help of FISHER and YATES (3).

The development of F_1

The developmental stage of the F_1 plants in comparison with parents on August lst, 1952 is given in Table 1. At this date all the plants of the summer turnip rape variety Mette had reached the ripening stage. The varieties of winter turnip rape used as mothers did not shoot with the exception of two plants of Rapido. All hybrid plants were later than Mette and earlier in development than the corresponding mother. In some cases, however, plants were classed in the same group as Mette and the mother variety plants, respectively. The slowest rate of development was shown by the hybrids between Storrybs and Mette.

In all four cases the height of the hybrids was on an average larger than that of Mette and the corresponding mother variety of winter turnip rape. The tallest hybrids on August 1st were on an average those of the cross Rapido × Mette, which were on an average twice as high as the father and mother varieties (Tabel 1).

Of the whole number of plants about half of the hybrids Gruber × Mette and Sprengel × Mette gave seed yields, whereas about threefourths of the plants of Rapido × Mette gave seed yields. The smallest number of the hybrids giving rise to seed-bearing plants was found in Storrybs × Mette, which indicates that the smallest part of the plant number gave seed for the hybrids with the latest flowering

Table 1. The development and height of F_1 in comparison with the parents.

Variety or cross	Number of investigated plants	Develomental stage August lst							Plant height August lst		
		Not shooting	Shooting	Flowering	Finishing flowering	Stopped flowering	Beginning of ripening	Ripening	Mean cm.	Min. cm.	Max. cm.
Mette	30	—	—	—	—	—	—	30	45.0	—	—
Rapido × Mette, F_1	120	—	1	53	21	19	4	22	94.4	35	140
Rapido	8	6	2	—	—	—	—	—	25.0	5	65
Gruber × Mette, F_1	98	—	6	43	14	15	8	12	70.7	2	130
Gruber	4	4	—	—	—	—	—	—	16.3	10	30
Storrybs × Mette, F_1	24	1	3	16	4	—	—	—	73.5	40	125
Storrybs	16	16	—	—	—	—	—	—	13.1	10	20
Sprengel × Mette, F_1	103	8	3	56	23	8	3	2	66.7	2	115
Sprengel	8	8	—	—	—	—	—	—	40.0	40	40

Table 2. Plants giving seed yields 1952.

Parents	Mother	Father	Hybrids
Rabido × Mette	non	all	93 out of 120
Gruber × Mette	non	all	42 » » 98
Storrybs × Mette	non	all	4 » » 24
Sprengel × Mette	non	all	49 » » 103

Table 3. Beginning of flowering and the plant height of the winter turnip varieties used in the crosses as parents.

Variety	Beginning of flowering days ± Rapido	Plant height cm + Rapido
Rapido	May 9th	80
Gruber	+ 2	+ 50
Storrybs	+ 4	+ 60
Sprengel	+ 2	+ 20

and ripening parents and with the highest plants, whereas the Rapido-hybrids gave the largest number of seed-bearing plants, Rapido having been the earliest and lowest of the mother varieties at maturity. This indicates a relationship between the characteristics of the parents (Table 3) and the characteristics of the hybrids (Table 2). A corresponding difference between different hybrids is also found in Table 1 as regards the developmental stage of the F_1 hybrids on August 1st, 1952.

The differences between the different groups of hybrids in the number of F_1-plants giving seed yields (Table 2) are in most cases significant, namely: Rapido × Mette — Sprengel × Mette $\chi^2 = 22.14^{xxx}$, Gruber × Mette — Storrybs × Mette $\chi^2 = 4.87^{x}$, Rapido × Mette — Gruber × Mette $\chi^2 = 27.87^{xxx}$, Rapido × Mette — Storrybs × Mette $\chi^2 = 18.76^{xxx}$ and Storrybs × Mette — Sprengel × Mette $\chi^2 = 7.61^{xx}$.

The seed yield and seed-setting characters of F_1 of the crosses

In all the investigated crosses the seed yield per plant was on an average considerably higher per seed-bearing plant than in Mette summer turnip rape. The same was applied to the seed weights per plant, if all the plants were taken into consideration. The only exception was F_1 of the cross Storrybs × Mette (Table 4).

The highest seed weights per silique, the largest length of silique and the highest number of seeds per silique were found in F_1 of the cross Gruber × Mette. The smallest average seed weights and numbers of seeds per silique were found in F_1 of the cross Storrybs × Mette (Table 5), but these hybrids were very late in development.

Table 4. Seed yields in F_1 of the crosses.

Variety and cross	Number of investigated plants	Milligrams of seeds per investigated plant	Milligrams of seeds per plant if all plants are included
Mette	30	193	193
Rapido × Mette, F_1	93	2327	1803
Gruber × Mette, F_1	42	1118	509
Storrybs × Mette, F_1	4	775	129
Sprengel × Mette, F_1	49	1102	524

Table 5. Seed-setting characteristics in F_1 of the crosses.

Variety and cross	Number of investigated plants	Seed weight milligrams per silique	Lenght of silique in millimetres	Number of seeds per silique
Rapido × Mette, F_1	75	17.3	37.9	13.7
Gruber × Mette, F_1	35	26.7	48.8	15.7
Storrybs × Mette, F_1	4	13.0	45.0	9.8
Sprengel × Mette, F_1	44	15.3	43.7	13.0

Development of F_2 of the hybrids

F_2 of the crosses began to flower 3—5 days later than Mette. The varieties of winter turnip rape used as mothers did not reach the flowering stage in the summer of 1953 in any sigle case. In comparison with the flowering of Mette that of the hybrids was much later and slower. Further, the flowering of the hybrids was much delayed through the large size of the plants and their leafiness. Owing to this the seed yield of the hybrids was uneven and not of the same high quality as that of Mette.

The plant height of the hybrids was on an average smallest for Sprengel × Mette and largest for Storrybs × Mette, whereas the plant height of varieties used as mothers was the reverse according to the information given in Table 6, when sown the same spring.

The seed yield and seed-setting characteristics of F_2 of the crosses

The mean length of the siliques was about the same for Mette and the hybrids. The same is also largely valid for the number of seeds per silique, though a small tendency to higher mean numbers is to be found in the hybrids (Table 6).

Table 6. Development of characteristics in F_2 of the crosses.

Variety and cross	Number	Beginning of flowering	Plant height			Mean				Largest		
			About May 20th	June 8th	Aug. 5th	Length of silique, millimetres	Number of seeds per silique	Seed weight per silique, milligrams	Seed weight, milligrams	Length of silique, millimetres	Number of seeds per silique	Seed weight per silique milligrams
Mette	8	8.6	40	54	56	37.8	13.4	30.1	2.25	46.3	20.0	47.5
Rapido × Mette	55	11.6	8	56	106	34.4	14.2	36.5	2.56	42.3	21.3	55.6
Rapido				5	22							
Gruber × Mette	25	11.6	8	53	105	38.1	13.7	36.7	2.67	47.2	20.5	59.9
Gruber				5	58							
Storrybs × Mette	2	13.6	5	38	108	36.1	13.6	44.0	3.25	46.1	17.5	55.0
Storrybs				6	12							
Sprengel × Mette	22	12.6	8	51	98	38.3	14.6	39.6	2.71	46.9	19.9	58.2
Sprengel				5	80							

All the mean values as well as all the largest values as to seed weight per silique were considerably larger than the corresponding values in Mette. The higher seed weight per silique was in the main due to higher mean seed weights. The difference was in all cases larger than ten per cent, which must be considered exceptionally large (Table 6).

Dicussion

Earlier investigators (cf. BAUR, 1) have stated that the hybrids are fertile. This has in the main been confirmed in the present investigation.

It was very interesting to observe the difference in the developmental rhythm between hybrids with the same summer turnip rape, Mette, as father, and different winter turnip rape varieties as mother. These differences were especially pronounced as regards the percentage of plants giving seed yields. The differences in the seed yields the seed-setting characteristics were in some cases very small.

The very large differences in the seed yields between Mette and the hybrids in F_1 (Table 4) are largely due to the considerable distance between the plants and to the ensuing very large vegetative development of the hybrid plants, whereas Mette had a clearly limited vegetative development.

Judging by the results of the present study the hybrids seem to be correspondingly larger and slower in development the larger and slower the winter turnip rape used in the cross.

Summary

In the present study four hybrids between winter and summer turnip rape are compared with each other and with their parents. In all crosses the father was the same summer turnip rape, namely Mette.

F_1 and F_2 of the hybrids were intermediate as regards their development in comparison with the parents.

About three-fourths of the F_1 plants of the cross Rapido × Mette, one half of F_1 of the crosses Gruber × Mette and Sprengel × Mette, and only a small part of the crosses Storrybs × Mette gave seed yields.

The seed yield per plant of the F_1-hybrids was larger than that of the summer turnip rape Mette.

The seed weight per silique and the mean seed weight were considerably higher in F_2 of all the hybrids than in the summer turnip rape Mette.

The green fodder production of the hybrids can be expected to be large.

The hybrids seem to be usable in plant breeding work.

REFERENCES

(1) BAUR, G. 1944: Der Rübsen. — Handbuch der Pflanzenzüchtung. IV. Band, 238—242. Berlin

(2) FINNEY, D. J. 1953: An introduction to statistical science in agriculture. 179 pp. Copenhagen

(3) FISHER, R. A. and YATES, F. 1953: Statistical tables for biological, agricultural and medical research. 126 pp. Edinburgh.

SELOSTUS:

SYYS- JA KEVÄTRYPSIN VÄLISTÄ RISTEYTYSPOPULAATIOITA KOSKEVIA TUTKIMUKSIA

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Tutkimuksessa todetaan, että keväällä kylvetyt F_1- ja F_2-sukupolvet kasvavat ensimmäisenä vuonna vanhempiaan paljon korkeammiksi. Näin ollen on syytä tutkia lähemmin risteytyspopulaatioiden arvoa vihantarehukasvina. Kehitysnopeudeltaan F_1- ja F_2-sukupolvet ovat vanhempiensa välimuotoja. Risteytyssekakasvustojen siemensato yksilöä ja litua kohti oli suurempi kuin kevätrypsillä.

Mette oli kaikissa risteytyskombinaatioissa hedekasvina. Emikasvina on käytetty Rapidoa Gruberiä, Sprengeliä ja Suurrypsiä (Storrybs). Emikasvikannasta riippuen oli eri risteytyspopulaatioiden kehitysnopeudessa todettavissa selviä eroja. Tämä merkitsee sitä että syys- ja kevätrypsiä risteytettäessä on syytä valita vanhemmat huolellisesti, koska mm. risteyssekakasvustojen kehitysnopeus näyttää olevan positiivisessa vuorosuhteessa risteytysvanhempien kehitysnopeuteen.