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ROW SPACE IN OILSEED CROPS

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a) ROW SPACE IN WINTER OILSEED CROPS

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The common method of growing winter rape seed and winter turnip rape-seed in Sweden has been sowing at a wide row space (45-50 cm) and with tractor hoeing. However, in 1963 investigations were started with the aim of studying the influence of both wider and narrower row spaces. Wider row spaces than the common row space were studied because hilling often had a profitable effect on the overwintering, especially on the winter rape-seed. In order to carry out satisfactory hilling wider row spaces than the common ones may be required. Narrow row spaces were studied because trials with green fodder crops had given favourable results for these row spaces.

The average seed yield of all trials is given in Table 1.

Table 1: Seed yield of winter rape and winter turnip rape. 1963-1973

Row space cm	Relative yield	
	winter rape	winter turnip rape
12	98	114
24	99	110
45-48	100	100
54	96	94
67	88	83

The yield of the wide row spaces was rather low and during the last years of the investigation only the three narrowest row spaces were used. Generally, the row spaces were combined with different seed rates, sowing times or nitrogen dressings.

Winter rape

It is clear from Table 1 that there were no differences in the average seed yield of row spaces from 12 to 45 cm. However, there were great differences in different areas. This is shown in Table 2.

Table 2: Winter rape. Seed yield in different areas, 1969-1973

Area	Number of trials	Row space, cm		
		12	24	48
A. Southernmost Sweden	16	92	96	100
B. South Sweden without A.	19	96	98	100
C. South part of central Sweden	13	106	102	100
D. North part of central Sweden	3	118	113	100

Sowing at a narrow row space gave a poor result in south Sweden but an excellent result in central Sweden. The results are more and more in favour of the narrowest row space with increasing latitude (Table 2). We know that the climate during the winter is most favourable in the south part of Sweden. Thus, during the ten-year period from 1964 to 1973, 9 per cent of the sown area of winter rape died during the winter in the southernmost area but 20-40 per cent in central Sweden. It thus seems as if there is a reliable connection between the yield of the different row spaces and the climate during the winter. Sowing at a narrow row space is most favourable when there are severe overwintering conditions.

The influence of the sowing time on the yield of different row spaces was investigated in south Sweden. The trials showed (Table 3) that the narrowest row space, in comparison with the widest row space, gave the best result at the latest sowing time, e.g. under the most favourable conditions.

Table 3: Winter rape. Seed yield at different sowing times. 7 trials in 1972-1973

Date of sowing	Row space, cm					
	12	24	48	12	24	48
	kg/ha			rel.		
4.08	2 640	2 890	2 910	91	99	100
18.08	2 690	2 770	2 870	94	96	100
1.09	1 940	2 180	1 990	97	109	100

In Sweden, winter rape may be sown after different preceding crops, e.g. bare fallow, ley and barley. The latter crop is a more unfavourable preceding crop than the other two. The trials seem to show that sowing with a narrow row space gives a better result after barley than after bare fallow and ley. Thus, it was again found that sowing at a narrow row space gave the best results when the overwintering conditions were unfavourable.

It is thought that the vigorous leaf canopy obtained when sowing with narrow row spaces may protect the terminal buds from being killed during the winter in spite of the fact that the plants are taller in the narrowly sown stand than in the widely sown stand.

The influence of seed rate was studied in 1969-1973. The trials showed that there was an interaction between seed rate and row space (Table 4).

It is clear from the table that a seed rate of 5 kg/ha is best when sowing at a row space of 48 cm. When sowing at a row space of 12 cm the seed rate ought to be higher, about 12 kg/ha.

A fairly high plant population is necessary when sowing at a narrow row space. All hoeing is impossible in the thick stand and therefore in the autumn the rape plants must cover all the ground with their leaves and in that way kill the weeds. May-weed (Matricaria inodora) is easily killed in this

Table 4: Winter rape. Seed yield at different seed rates. 27 trials in 1969-1973

Seed rate, kg/ha	Row space, cm					
	12	24	48	12	24	48
	kg/ha			rel.		
5	2 290	2 310	2 310	99	100	100
10	2 380	2 350	2 300	103	102	100
20	2 300	2 370	2 260	100	103	98

way. Therefore, rather early sowing and an even stand are necessary in order to get a weed-free stand.

Winter turnip rape

With winter turnip rape sowing at narrow row spaces gave better results in all areas than sowing at a wide row space (Table 5).

Table 5: Winter turnip rape. Seed yield in different areas, 1969-1973

Area	Number of trials	Row space, cm		
		12	24	48
South Sweden	11	108	105	100
South part of central Sweden	12	109	103	100
North part of central Sweden	34	119	115	100

The best result of sowing with a narrow row space was obtained in the northernmost area.

In all years the sowing with a narrow row space gave a higher yield than sowing with a wide row space (Table 6).

The relations were somewhat different from year to year. Sowing at narrow row spaces gave the best result in 1970 and 1971 and the worst in 1972 and 1973. The last two years were characterized by mild winters and very good overwintering of all autumn sown oilseed crops. On the other hand, the winters of 1970 and 1971 were severe and a large part of the autumn sown oilseed crops were lost. Thus, it was again demonstrated that sowing at a narrow row space is most favourable under severe conditions.

As in the winter rape trials, trials with seed rates showed that a narrowly sown turnip rape crop ought to have a higher seed rate than a widely sown crop (Table 7). At a row space of 12 cm a seed rate of about 10 kg/ha is needed.

Table 6: Winter turnip rape. Seed yield during different years

Years	Number of trials	Row space, cm					
		12	24	48	12	24	48
		kg/ha			rel.		
1969	8	2 220	2 190	1 900	117	115	100
1970	8	1 840	1 770	1 520	121	116	100
1971	14	1 950	1 830	1 540	127	118	100
1972	23	2 090	1 990	1 860	112	107	100
1973	18	1 990	1 980	1 870	106	106	100

Table 7: Winter turnip rape. Seed yield at different seed rates. 45 trials in 1969-1973

Seed rate kg/ha	Row space, cm					
	12	24	48	12	24	48
	kg/ha			rel.		
5	1 970	1 890	1 730	114	109	100
10	1 970	1 890	1 680	114	109	97
20	1 910	1 810	1 630	110	105	94

The number of plants was determined in the seed rate trials. The narrow row space always gave a higher winter survival than the widest row space independent of the seed rate (Table 8). It was also found that many newly emerged plants died already in the autumn, especially at the widest row space.

Table 8: Winter turnip rape. Number of plants and winter survival. 42 trials in 1969-1973

Characteristic	Row space, cm		
	12	24	48
Number of plants per m^2, autumn	240	227	200
spring	150	134	97
Winter survival, %	62	59	48

Not only the seed yield but also the time of ripeness and the seed quality were influenced by the row space. The crop matured a little earlier when sown in narrow rows instead of wide rows. The oil content was higher and the chlorophyll content was lower, e.g. the quality of the crop at row spaces of 12 cm was better than the quality at 48 cm (Table 9).

Table 9: Winter turnip rape. The quality of the seed. 45 trials in 1969-1973

Characteristic	Row space, cm		
	12	24	48
Oil content, % of d.m.	44.4	44.4	43.8
Chlorophyll, p.p.m.	14	15	17
Nitrogen, % of d.m.	3.84	3.83	3.91

The farmers in central Sweden have quickly adopted the new method of growing the oilseed crops, especially the winter turnip rape.

b) ROW SPACE IN SPRING-SOWN OILSEED CROPS

I. Ohlsson

In Sweden the acreage of spring rape (Brassica napus L.) and spring turnip rape (Brassica campestris L.) has increased rapidly in recent years. In the intensive cereal system in central Sweden spring rape and spring turnip rape are being increasingly used as break crops. In the last two years these two crops together have been grown on ca. 85 000 hectares.

The present investigation was designed to study the influence on seed yield and seed quality of sowing spring oilseed crops at different row spaces.

Materials and methods

Spring rape and spring turnip rape were sown in rows spaced 12, 24 and 48 cm apart. Only the widest spacing was hoed, the given control of weeds by inter-row cultivation, while the rest received no measures of weed control. The effects of the various spacings were studied in combination with various seed rates and nitrogen applications.

During the period from 1969 to 1973 the experiments with spring rape (118 trials) and spring turnip rape (45 trials) were carried out in various provinces in central Sweden.

The total number of trials were distributed as follows:

Year	Number of trials	
	spring rape	spring turnip rape
1969	9	7
1970	22	10
1971	28	10
1972	30	9
1973	29	10

Each trial was arranged in a split plot design with three replications. All fertilizers used were applied at the time of sowing. The size of the plot was 40 m^2. Border effects were eliminated by removing the outer rows of each plot some weeks before harvest. The trials were directly combined at harvest.

Results and discussion

The means for the row space reatments of spring rape and spring turnip rape concerning the various yield parameters are presented in Tables 1 and 2. The results are presented as means for each row space over all other treatments.

Table 1: Influence of row space on yield and quality of spring rape. 118 trials in 1969-1973

Analysis	Row space, cm		
	48	24	12
Seed yield, kg/ha	2 020	2 160	2 260
Crude fat, % of d.m.	44.7	45.3	45.4
Crude fat, kg/ha	773	835	874
Crude fat, rel. values	100	108	113
Chlorophyll, ppm	45	37	37
Thousand kernel weight, g	4.3	4.2	4.2
Crude protein, % of d.m.	24.6	23.9	23.8
Moisture content at harvest, %	20.8	19.5	19.3
Maturity [1]	--	-1	-2

1) - = days earlier than the 48 cm row space

Table 2: Influence of row space on yield and quality of spring turnip rape. 45 trials in 1969-1973

Analysis	Row space, cm		
	48	24	12
Seed yield, kg/ha	1 450	1 600	1 700
Crude fat, % of d.m.	42.1	42.7	43.7
Crude fat, kg/ha	518	582	620
Crude fat, rel. values	100	112	120
Chlorophyll, ppm	40	33	32
Thousand kernel weight, g	2.5	2.5	2.5
Crude protein, % of d.m.	24.7	23.9	23.9
Moisture content at harvest, %	17.4	16.3	16.0
Maturity [1]	--	-1	-2

1) - = days earlier than the 48 cm row space

Decreasing row space in the two crops studied showed the same effect. Seed yield increased by 250 kg per hectare when decreasing row space from 48 to 12 cm and the amount of crude fat per hectare increased by 100 kg, corresponding to increases of 13 and 20 % in spring rape and spring turnip rape, respectively. The lowest contents of chlorophyll, crude protein and moisture were obtained when sowing at narrow rows, 12 cm. This method of sowing resulted in maturity being two days earlier and more uniform than when using the widest row space, 48 cm. The seed weight was found to be uninfluenced by the row space. Highly significant differences in yield of seed and crude fat (kg/ha), contents of crude fat (% of d.m.) and chlorophyll were found as a result of different row spacing.

In each year the highest yield of crude fat was obtained with the 12 cm row space, Tables 3 and 4. Compared with the widest row space, the difference

Table 3: Spring rape. Influence of row space on yield of crude fat in five different years, rel. values

Year	Row space, cm		
	48	24	12
1969	100 (= 401 kg/ha)	124	127
1970	100 (= 878 kg/ha)	107	109
1971	100 (= 984 kg/ha)	103	107
1972	100 (= 769 kg/ha)	105	111
1973	100 (= 771 kg/ha)	116	123

Table 4: Spring turnip rape. Influence of row space on yield of crude fat in five different years, rel. values

Year	Row space, cm		
	48	24	12
1969	100 (= 448 kg/ha)	111	113
1970	100 (= 547 kg/ha)	118	126
1971	100 (= 549 kg/ha)	111	117
1972	100 (= 619 kg/ha)	106	115
1973	100 (= 420 kg/ha)	116	127

ranged from 7 to 27 %. The results from spring rape indicated that the least effect of the narrowest row space occurred in years with a high yield level (e. g. in 1971).

The chlorophyll content of the seeds is a measure of maturity and in Sweden this is a quality factor upon which price regulation is based. The following two tables (Tables 5 and 6) give the levels of chlorophyll obtained in different years. The chlorophyll content of seeds of spring rape and spring turnip rape showed, however, in all years the highest values at the widest row space (48 cm). The total difference in chlorophyll content between 12 and 48 cm row space varied year by year. In 1970, a year with a high chlorophyll level, differences of 29 and 19 ppm were found in the seed and

Table 5: Spring rape. Influence of row space on content of chlorophyll in five different years, ppm

Year	Row space, cm		
	48	24	12
1969	20	18	17
1970	91	61	62
1971	37	34	33
1972	33	31	31
1973	40	33	33

Table 6: Spring turnip rape. Influence of row space on content of chlorophyll in five different years, ppm

Year	Row space, cm		
	48	24	12
1969	9	8	6
1970	64	47	45
1971	54	43	41
1972	28	28	27
1973	41	33	31

in 1972 a year with a low chlorophyll level, the differences were 2 and 1 ppm in spring rape and spring turnip rape, respectively.

If different row spaces are tested in combination with different seed rates the results are plants of different appearance. For example, a high seed rate and a wide row space results in very small, feeble plants with weak straw, generally without branches and with the small pods concentrated to the top of the plant.

Three seed rates, 5, 10 and 20 kg/ha in spring rape and 4, 8 and 16 kg/ha in spring turnip rape, were tested at all row spaces. The results are given in Tables 7 and 8. These data show interactive effects between row spaces and seed rate. Optimum yield of crude fat from different row spaces was obtained at different seed rates. Thus the treatment with a 12 cm row space must be sown at a higher seed rate than the two wider row spaces. When sowing at a 12 cm row space a seed rate of 16 and 11 kg/ha can be recommended for spring rape and spring turnip rape, respectively.

Table 7: Spring rape. Effects of row space and seed rate on the yield of crude fat, rel. values. 45 trials in 1969-1973

Seed rate, kg/ha	Row space, cm		
	48	24	12
5	100[a)]	107	109
10	103	112	118
20	98	112	117

a) 728 kg/ha

Table 8: Spring turnip rape. Effects of row space and seed rate on the yield of crude fat, rel. values, 45 trials in 1969-1973

Seed rate, kg/ha	Row space, cm		
	48	24	12
4	100[b)]	110	116
8	101	113	122
16	97	111	119

b) 522 kg/ha

In spite of very good effects on the yield and quality of sowing the crops at a narrow row space, this method of sowing cannot be recommended on land where high weed populations can be expected.