https://doi.org/10.29321/MAJ.10.A03194

Madras agric. J. 64 (5) : 317—320, May, 1977

Studies on Crossability of Wheat with Rye

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The crossability of eight wheat varieties (four each of hexaploid and tetraploid wheats) with six diploid rye varieties of diverse geographic origin, was studied. Among the eight wheat parents, Sharbati Sonora and H-132-4 among hexaploids and 3-2 and S_2 C among tetraploids were found to have high crossability with rye varieties. In general, the seed set in hexaploid wheat x rye crosses was low but the germination percentages were higher. The reverse was the case in tetraploid wheat x rye crosses. Wherever Russian rye was involved as a male parent, the seed set was high in tetraploid wheat combinations. The differential behaviour of the varieties with regard to seed setting and germinatian could be attributed to the differential genetic back-grounds.

Zillinsky and Borlaug (1971) stressedt he importance of bringing diverse genotypes of both dwarf wheat and dwarf rye varieties in the triticale improvement programme which in turn would result in the broadening of the genetic base of triticales. The present day triticales suffer from some primary limitations such as endosperm shrivelling, reduced fertility etc. To overcome these, it is essential to broaden the genetic base in order to facilitate effective selections.

The present study was undertaken to assess the extent of crossability of wheat (both hexaploid and tetraploid) and rye genomic components which, in turn, provides ways for breeding better populations of triticales and also get some useful information on the comparative performance of hexaploid and tetraploid wheats in crosses with different diploid rye varieties.

MATERIALS AND METHODS

Four hexaploid wheat varieties viz., Sharbati Sonora, K-1-67-1, H-132-4 and $S_{2:2}$; four tetraploid wheats viz., S_2C S_4WA, 3-2 and 44-1 and six diploid rye varieties viz., Assam rye, Australian rye, Russian rye, E. C. 1951, E. C. 1952 and E. C. 7950 were used. Wheat (female parent) and rye (male parent) varieties were grown in the field in rows spaced at 120 cms. apart. The seeds were dibbled 15cms apart within the row. Emasculations and hand pollinations were done at different intervals depending upon the time of flowering of a variety.

Observations were recorded on the number of florets emasculated and number pollinated, of seeds formed, and number of seeds germinated.

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RESULTS AND DISCUSSION

Data on the percentage seed set and germination are presented inTables I and II.

TABLE I. Data on seed set and germination in crosses of 6 x wheats with rye.

Crosses		No. of florets pollinated	No. of seeds set	Seed set %	No. of seeds germinated	Germination %
Sharbati Sonora	x 1	128	26	20.3	4	15.3
,, ,,	x 2	116	18	15.5	2	11.1
,, ,,	x 3	120	23	23.3	6	21.4
,, ,,	x 4	114	20	17.5	3	15.0
,, ,,	x 5	122	16	13.1	1	6.1
,, ,,	x 6	130	28	21.5	3	10.7
K-1-67-1	x 1	118	20	16.9	2	10.0
,,	x 2	120	21	17.5	4	19.0
,,	x 3	132	24	18.1	3	12.5
,,	x 4	124	22	17.7	4	18.1
,,	x 5	122	19	15.5	1	5.2
,,	x 6	116	22	18.9	2	9.2
H-132-4	x 1	120	20	16.6	6	30.0
,,	x 2	116	16	13.7	3	18.7
,,	x 3	118	19	16.1	4	21.0
,,	x 4	122	20	16.3	2	10.0
,,	x 5	108	24	22.2	5	20.8
,,	x 6	104	26	25.0	3	11.5
S.227	x 1	118	19	16.1	3	15.7
,,	x 2	122	14	11.4	2	14.2
,,	x 3	116	17	14.6	4	23.5
,,	x 4	124	18	14.5	1	5.5
,,	x 5	102	16	15.6	0	0.0
,,	x 6	116	22	18.9	4	18.1

1=Assam rye 2=Australian rye 3=Russian rye
4=E. C. 1951 5=E. C. 1952 6=E. C. 7950

Among the crosses between hexaploid wheat and rye, it was observed that the cross H-132-4 x E. C. 7950 gave the highest seed set among the hexaploid wheat varieties. Other useful crosses for better seed set were Sharbati Sonora x Russian rye, H-132-4 x E. C. 1952, Sharbati Sonora x E. C. 7950 and Sharbati Sonora x Assam rye. Sharbati Sonora possessed good crossability with different diploid rye varieties compared to the remaining hexaploid wheat varieties. The male sterile line K-1-67-1 crossed uniformly well with all the rye varieties as shown by the almost constant values of seed setting percentages. S_{227} (from which cultivar, Kalyansona has been derived) did not cross well with rye varieties.

The germination percentages were high in all the crosses when we consider that this is an inter-generic cross. The highest germination percentage was observed in the cross H-132-4 x Assam rye. Generally, the seeds from these crosses were shrivelled. Seeds from the cross S_{227} x E. C. 1952 did not germinate. The seedlings were very vigorous in the early stages of growth.

Among the tetraploid wheat and rye crosses, the highest seed set was noticed in 3-2 x Russiam rye followed by S_2C x Russian rye, 44-1 x Russian rye, 3-2 x E. C. 1951, S_4WA x Russian rye and S_2C x Assam rye. It was interesting to note that the seed set was high wherever Russian rye was involved in tetraploid wheat combinations. Among the tetraploid wheat varieties, 3-2 and S_2C appeared to be promising. The germination percentages were low in most of the cross combinations. In certain crosses like S_2C x E. C. 1952, S_4WA x Australian rye, S_4WA x E. C.

1952, 3-2 x Assam rye and 3-2 x E. C. 1952 there was abolutely no germination.

TABLE II. Data on seed set and germination in crosses of 4 x wheats with rye

Crosses	Florets pollinated	Characters Seeds set	Seed set %	Seeds germinated	Germination %
S_2C x 1	120	38	31.6	3	7.8
,, x 2	116	33	28.4	4	12.1
,, x 3	124	46	37.0	4	8.6
,, x 4	108	30	27.7	2	6.6
,, x 5	120	24	20.0	0	0.0
,, x 6	120	21	17.5	1	4.7
S_4WA x 1	118	29	24.5	1	3.4
,, x 2	122	31	25.4	0	0.0
,, x 3	120	38	31.6	2	5.2
,, x 4	116	28	24.1	2	7.1
,, x 5	120	20	16.6	0	0.0
,, x 6	114	26	22.8	1	3.8
3-2 x 1	120	33	27.5	0	0.0
,, x 2	124	28	22.5	1	3.5
,, x 3	116	44	37.9	3	6.8
,, x 4	108	36	33.3	2	5.5
,, x 5	120	21	17.5	0	0.0
,, x 6	114	28	24.5	2	7.1
44-1 x 1	120	27	22.5	1	3.7
,, x 2	118	32	27.1	1	3.1
,, x 3	106	37	34.9	2	5.4
,, x 4	122	39	23.7	2	6.8
,, x 5	114	28	24.5	3	10.7
,, x 6	118	22	18.6	1	4.5

1=Assam rye 2=Australian rye 3=Russian rye
4=E. C. 1951 5=E. C. 1952 6=E. C. 7950.

A combined picture of the data would suggest that tetraploid wheats set seeds readily when pollinated with rye but these seeds germinated poorly as evidenced by low germination percentages in most of the cross combinations. In contrast to this, the hexaploid wheats gave low seed set percentages but higher germination percentages as reported by Riley and Chapman (1967). Gupta *et al*. (1970) had observed that the percentage of crossed seed between tetraploid wheat and diploid rye was 5-10% and the seeds were subnormal in size, poorly developed and wrinkled. They were of the opinion that the application of embryo culture technique is important and could be explored for the synthesis of a large number of triticales with diverse A, B and R genomes.

Sulyndin and Naumova (1960) observed that though *Triticum durum* formed three times as many hybrids as *Triticum aestivum* in crosses with *Secale cereale*, the proportion of viable grains was appreciably lower, the results varying with seed parent's ecotype. According to Rigin (1966) the better combining ability with rye was observed in species from the 28 chromosome group of wheat than in those from the 42 chromosome group. The differential response of both hexaploid and tetraploid wheats in cross combinations with diploid rye varieties in regard to seed setting and germination could be attributed to the differential genetic backgrounds. With diverse A, B and R genomes, the genetic base of triticale in respect of yield and it's components can be considerably enlarged. This will go a long way in overcoming the primary limitations, the present day triticales suffer and in selecting desired genotypes with superior and consistent performance.

The authors are highly indebted to Drs. V. Arunachalam, Biometrical Geneticist and M. G. Joshi, Geneticist, for their valuable suggestions in this study. The senior author is thankful to the Indian Council of Agricultural Research for awarding a fellowship during the course of this investigation.

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