The use of Secale vavilovii in rye breeding

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Index words

Secale vavilovii, wild rye, tetraploid stocks, evaluation.

Summary

The use of the wild rye species, *Secale vavilovii* has been discussed.

The annual wild species *Secale vavilovii* Grossh. is distinguished by a number of interesting characteristics. Some of them are detrimental, i.e. the fragile rachis, the tiny seeds, the very weak straw and the high susceptibility to all *Puccinia* pathotypes and to powdery mildew. On the other hand, *S. vavilovii* has some very useful characters, of which its high self-fertility is most important. The genome of *S. vavilovii* is different from that of the cultivated rye (*S. cereale*) with regard to at least two structural rearrangements (Kranz 1973) as well as to the amount and distribution of heterochromatin (Bennett et al. 1977).

Two samples of *S. vavilovii* had been collected by Kuckuck (1973) in Iran. He succeeded in crossing this *S. vavilovii* material as male parent to *S. cereale* cv. 'Heines Hellkorn' and was able to select self-fertile 'cultivated' stocks after seven inbreeding generations. The material shows almost no detectable inbreeding depression. Therefore, at the Eucarpia Conference in Poland, Kuckuck (1974) concluded, that *S. cereale* × *S. vavilovii (c/v)* crosses can efficiently be used in broadening the genetic variation of rye and facilitating the differentiation and fixation of genetic stocks.

This paper reports on the progress made in the breeding of fertile tetraploid stocks of rye. From diploid *c/v*-stocks tetraploid progenies have been derived which have been backcrossed to cultivated tetraploid varieties/-stocks (Kuckuck und Peters 1977). In the progenies, types with improved seed setting have been selected. In many cases not only the percentage seed set but also the number of seeds per head is higher than in the control variety Tero. A comparison of the frequency distributions for seed set of the best family (F IV) with 'Tero' reveals that their seed set is not different after open pollination (Fig. 1). After bagging, however,

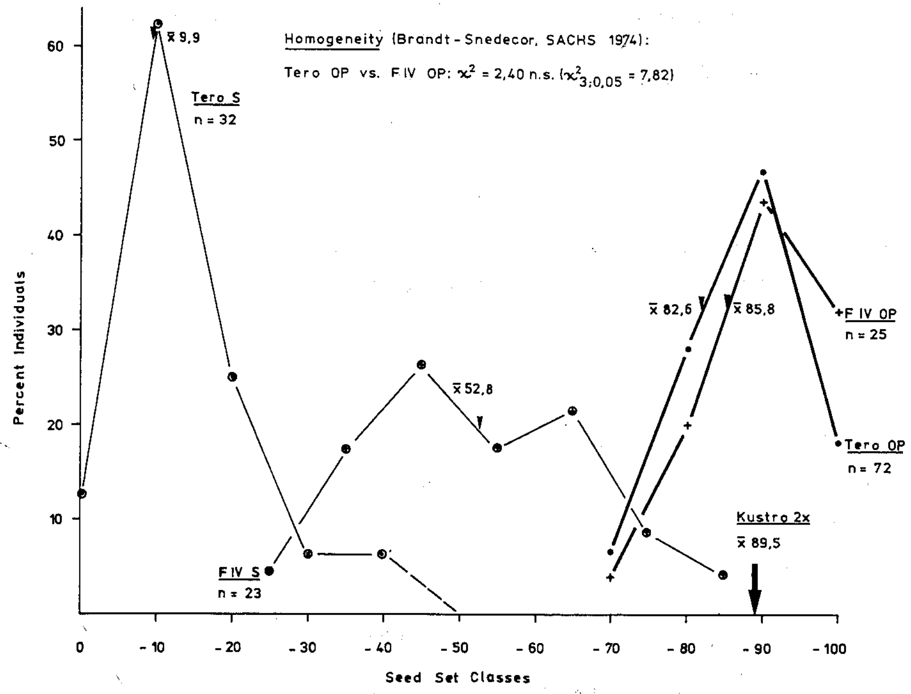

Figure 1. , Fertility of the tetraploid 'Family IV' (F IV) derived from a cross ((*S. cereale* X *S. vavilovii*) X *S. cereale*) as compared to the tetraploid cultivar 'Tero' after open pollination (OP) and selfing (S) at Grünbach, FRG, in 1977.

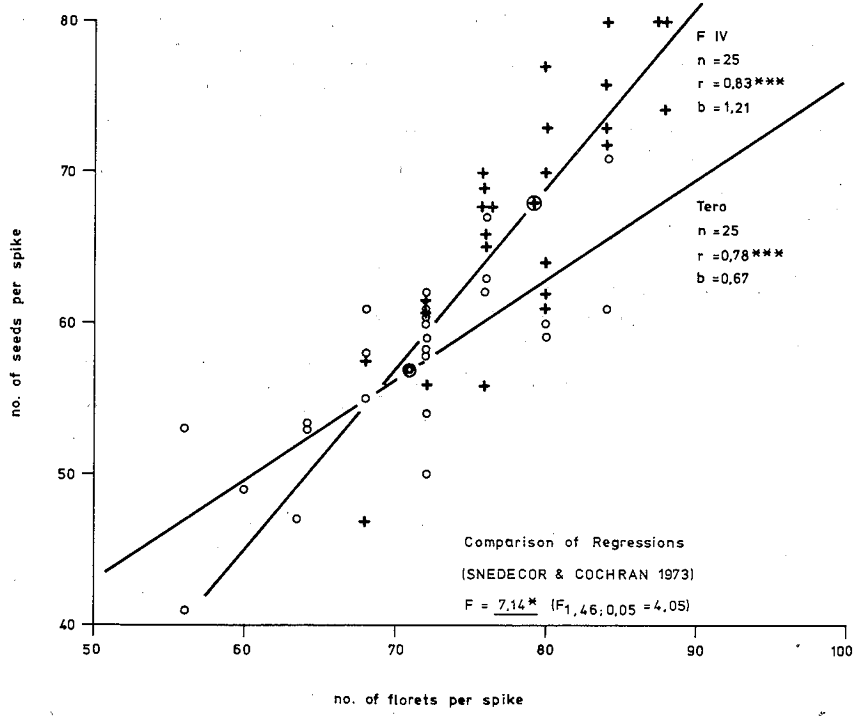

Figure 2. Relationship between the number of florets per spike (vigour) and the number of seeds per spike (fertility) of 'Family IV' (F IV) and 'Tero' after open pollination at Grünbach, FRG, in 1977.

'Tero' is highly sterile, whereas 'F IV' is self-fertile (Fig. 1), so that in the latter the differentiation and fixation of genotypes can easily be acquired.

What are the reasons for the higher seed set of 'Family IV'? From Fig. 2 is evident that the increase of the number of kernels per spike (fertility) with increasing number of florets per spike (criterion of plant vigour) is stronger in 'F IV' than in 'Tero' as revealed by the respective regression lines, which are significantly different. As a consequence the percentage seed set of 'Tero' is negatively related to its plant vigour (no. florets), whereas the seed set of 'F IV' increases with increasing number of florets. Since the seed set of 'Family IV' depends directly on its plant vigour it is obviously less influenced by other factors like cytological anomalies and is therefore more stable than the fertility of 'Tero'. This is also supported by cytological data.

From Fig. 2 it is also evident that the number of florets per spike as well as the number of seeds per spike are generally higher in 'F IV' than in 'Tero', which means that the former has a higher yield potential per spike. The total kernel yield of some of our stocks is comparable to that of 'Tero', others are significantly poorer in yield (Table 1). This is obviously due to other yield components like tillering ability etc. which need further improvement.

Another positive result is the successful reduction of plant height as indicated

Table 1. Plant height and yield performance of four tetraploid stocks of rye as compared to the commercial tetraploid cultivar 'Tero' in two years, 1976 and 1977, at Grünbach/Bavaria. Plant height of the diploid cv. 'Kustro' (1977) = 127,7 ± 1,2 cm.

Material	Plant height		Kernel yield rel. 'Tero'	
[(*S. cereale* x *S. vavilovii*) x *S. cereale*]	1976 $\bar{x} \pm SE$[1]	1977 $\bar{x} \pm SE$	1976 (%)	1977 (%)
F IV	140.7 ± 2.3	135.2 ± 1.4	71.8**	83.9*
F VIII	139.1 ± 2.1	128.0 ± 1.7	99.0	103.5
B III	151.9 ± 1.9	125.9 ± 1.8	100.0	94.3
S I	128.3 ± 1.7	124.2 ± 1.5	67.0**	83.3*
cv. 'Tero'	161.1 ± 1.7	143.0 ± 1.6	100.0	100.0

1. $\bar{x} \pm SE$ = mean value ± standard error
*, ** significantly lower than 'Tero' at P = 0,05 and P = 0,01, respectively

in Table 1, where all of the stocks are clearly shorter than 'Tero'. Plant height (lodging resistance) is a main objective in rye breeding. We have in progress some *c/v*-material which is satisfactorily short and also fertile and vigorous. However, improving lodging resistance and kernel yield at the tetraploid as well as the diploid level needs intensive future efforts.

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