THE NUMBER OF LOCI CONTROLLING VERNALIZATION IN SEVERAL WINTER WHEAT CULTIVARS DIFFERING IN LEVELS OF WINTERHARDINESS

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ABSTRACT

Two spring wheat cultivars were crossed to four winter wheat cultivars with differing levels of winterhardiness. Analysis of the F2 generations showed all eight populations segregating at two loci for winter versus spring growth habit. The spring habit was dominant.

INTRODUCTION

Pugsley (1972) reported up to four recessive genes controlling winter-type growth habit, vernalization requirement, in segregating populations from crossing spring and winter wheat types. The number of loci conditioning vernalization habit does not greatly affect days to anthesis in winter wheat (Berry et al., 1980), but has been linked with reaction to powdery mildew (Wells, 1966). The objective of this study was to determine if the number of loci controlling vernalization was associated with level of winterhardiness in several hard red winter wheat cultivars.

MATERIALS AND METHOD

Two unrelated spring wheat cultivars, 'Centa' and 'WS1809', were crossed to four winter wheat cultivars with differing levels of winterhardiness in 1983. The winter cultivars listed in order of increasing levels of winterhardiness were: 'Newton,' 'TAM105', 'Brule', and 'Winoka'. Relative winterhardiness levels were estimated from unpublished cultivar yield trial observations. The winter wheats are genetically dissimilar with an average coefficient of parentage of .1, except for TAM105 and Newton with a value of .28 (Cox et al., 1985). The F2 seed obtained from selfed F1 plants of a cross was bulked to establish eight F2 populations.

The segregating F2 populations were tested in the greenhouse in 1985 and 1986. For both years, nonvernalized seed of the eight populations was planted in soilbeds in early October and evaluated for growth habit the following February. Six and eight rows of each population were planted in a completely randomized fashion in 1985 and 1986, respectively. Approximately 15 seeds were planted per row. Two sets of parents were included as checks.

Data were collected on the number of winter type plants, i.e., no spike elongation, and spring type plants, i.e., mature spike formation, in the populations. Chi square goodness of fit tests were used to determine if the data fit 3:1 or 15:1 genetic models. The 1985 and 1986 data were then combined by population and a homogeneity test performed (Redei, 1982).

RESULTS AND DISCUSSION

The patterns of segregation for the eight populations are given in Table 1. All populations fit a 15:1 genetic ratio at a probability level above .05. No relationship, then, is apparent between level of winterhardiness and number of loci segregating for vernalization requirement in these eight wheat crosses. For all crosses, two loci are segregating for spring/winter growth habit. In Table 2 the combined analysis and results of the test for homogeneity are presented. For all populations the yearly data could be pooled.

To find if Centa and WS1809 possessed dominant alleles at different loci for spring habit, 177 F2 plants of the cross Centa/WS1809 were tested in 1985 for spring/winter growth habit. No winter type was observed. The probability that the two spring wheat cultivars have three dominant loci for spring growth habit

TABLE 1

The Number of Plants of Winter and Spring Growth Habit in the F2 Populations of Spring by Winter Wheat Crosses

	Fall 1985			Fall 1986		
Cross	winter	spring	p[a]	winter	spring	p[a]
Centa by:						
Newton	9	113	.5-.75	8	116	.9-.99
TAM105	11	92	.05-.1	4	71	.9-.99
Brule	11	99	.1-.25	6	124	.5-.75
Winoka	8	96	.5-.75	9	167	.5-.75
WS1809 by:						
Newton	6	108	.75-.9	12	99	.05-.1
TAM105	6	101	.9-.99	13	125	.1-.25
Brule	5	109	.5-.75	10	120	.5-.75
Winoka	7	93	.9-.99	6	111	.75-.9

[a]Probability of fit from Chi square test for a 15:1 ratio.

TABLE 2

The Combined Number of Plants of Winter and Spring Growth Habit in the F2 Populations of Spring by Winter Wheat Crosses

Cross	winter	spring	p[a]	homogeneity	p[b]
Centa by:					
Newton	17	229	.5-.75	.1	.75
TAM105	15	163	.1-.25	1.3	.25-.5
Brule	17	223	.5-.75	2.1	.25-.5
Winoka	17	263	.9-.99	.4	.5-.75
WS1809 by:					
Newton	18	207	.25-.5	2.1	.1-.25
TAM105	19	226	.25-.5	.2	.5-.75
Brule	15	229	.9-.99	.6	.25-.5
Winoka	13	204	.9-.99	.1	.75

[a]Probability of fit from Chi square test for a 15:1 ratio.

[b]Probability of homogeneity test for combined data.

with one locus in common is less than .01. A genetic system of four loci with the spring type cultivars having two different, dominant loci, however, cannot be excluded.

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