University of Kentucky College of Agriculture
New Crop Opportunities Center

Development of White Wheat Cultivars from a Red Wheat Breeding Program

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Introduction

Wheat cultivars are placed into two color classes, red and white, based upon the seed coat color. White wheat has several advantages over red wheat such as a higher flour extraction rate, greater aesthetic appeal of whole wheat products and a more valuable bran (3). Seed color is controlled by three genes; red genes are dominant to white genes. Wheat breeding programs that choose to develop white wheat lines must identify and utilize effective methods for differentiating between red- and white-seeded wheat.

The main disadvantage of white wheat is its susceptibility to preharvest sprouting. Preharvest sprouting occurs when the seed germinates in the wheat spike before it is harvested from the field. Preharvest sprouting generally occurs when there is frequent precipitation at harvest time (4) and renders the seed undesirable due to increased enzyme activity, sugars, and total protein, changes in amino acid composition, and decreases of starch (2). Therefore, the major issues to address when developing white wheat are differentiation of red and white seed and establishing tolerance to preharvest sprouting.

Materials and Methods

Seed Color Differentiation

Six white-seeded wheat lines and five red-seeded cultivars were evaluated using a modified NaOH method (1) (Table 1). Thirty-five seeds of each line were placed into 100 x 15 mm petri dishes. Five percent NaOH solution was poured over the seed and the seed were allowed to soak in the solution for five minutes. After five minutes, the seeds were rinsed with water and placed into plastic bags. The seeds remained at room temperature for 24 hours and then were placed into a 4°C cold room. Germination was recorded each day from days one to seven.

Preharvest Sprouting Evaluation

Thirty physiologically mature spikes were collected from 20 experimental lines, dried for three days at 29.4°C, and then placed in a freezer for preservation until evaluation can occur. The spikes are placed into a mist chamber for four days in a greenhouse. They are allowed to dry and then rated for preharvest sprouting.

Results and Discussion

The modified NaOH method for evaluating seed color was very effective. The data were analyzed to determine differences between the red and white seed classes and also by line. When treated with NaOH, the germination rate of white seeds was significantly higher than that of red seeds (Tables 2 and 3). However, when analyzed by line, 25W33, Cardinal, and 25W60 germinated at a significantly higher rate and GA 871339W and VA 96W-403WS germinated at a significantly lower rate than the rest of

the lines (Tables 4 and 5). Cardinal's significantly higher germination rate could be explained by its susceptibility to preharvest sprouting. Therefore, GA 871339W and VA 96W-403WS may possess more resistance to preharvest sprouting than the other white lines. This hypothesis will be tested using the preharvest sprouting protocol explained above. The most striking results of the experiment were that the white seed changed color very rapidly when treated with NaOH, allowing for a simple method of visual inspection and preservation of seed viability.

The samples for the preharvest sprouting evaluation have been collected and placed in the freezer; however, evaluation will not occur until fall 2003.

Literature Cited

1. Chmelar, F. and K. Mostovoj. 1938. On the application of some old and on the introduction of new methods for testing genuineness of variety in the laboratory. Proc. Int. Seed Testing Assoc. 10:68.

2. Morad, M.M. and G.L. Rubenthaler. 1983. Germination of soft white wheat and its effect on flour fractions, breadbaking, and crumb firmness. Cereal Chm. 60(6): 413-417.

3. Paulsen, G.M. and E.G. Heyne. 1981. Development of hard white winter wheats for the Great Plains. Wheat Grower 4:26-28.

4. Sorrells, M.E., A.H. Paterson, and P.L. Finney. 1989. Milling and baking quality of soft white wheat genotypes subjected to preharvest sprouting. Cereal Chm. 66(5):407-410.

Table 1: Cultivars Evaluated Using a Modified NaOH Method

Line	Seed Color	Source
25W33	White	Pioneer Hi-Bred International
GA 871339W	White	University of Georgia
VA 96W-403WS	White	Virginia Tech
VA 97W-375WS	White	Virginia Tech
VA 98W-170WS	White	Virginia Tech
25W60	White	Pioneer Hi-Bred International
Cardinal	Red	Ohio State University
Allegiance	Red	University of Kentucky
25R37	Red	Pioneer Hi-Bred International
Foster	Red	University of Kentucky
Roane	Red	Virginia Tech

Table 2: Analysis of Variance for the Germination Rate of the Two Color Classes when Treated with NaOH		
Source	df	P-value
Color	1	0.0013
Error	414	

Table 3: Mean Germination Rate of the Red and White Wheat Seed when Treated with NaOH	
Class	Mean
White	0.3975 a
Red	0.31957 b

Table 4: Analysis of Variance for the Germination Rate of the Lines when Treated with NaOH		
Source	df	P-value
Line	10	<.0001
Error	1040	

Table 5: Means for the Germination Rate of the Lines when Treated with NaOH	
Line	Mean
25W33	0.8425 a
Cardinal	0.7782 ab
25W60	0.7431 b
VA 97W-375WS	0.7153 bc
VA 98W-170WS	0.6615 cd
Roane	0.6336 d
Foster	0.6227 d
25R37	0.5955 d
Allegiance	0.4987 e
GA 871339W	0.3597 f
VA 96W-403WS	0.1664 g