Effects of Awns on Yield, Test Weight and Kernel Weight of Soft Red Winter Wheats

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The effects of awns on productivity and quality of wheat and barley has interested agronomists for some decades. Aamodt and Torrie (1) reviewed the contradictory results presented in the earlier literature.

More recent comparisons between awned and awnletted or awnless wheat types, represented by selected spikes from bulk hybrids (9), selected composites derived from bulk hybrids (3), and nearly isogenic lines (2, 15), have generally shown an advantage in the awned type for test weight and kernel weight. A yield advantage for the awned types has been shown for some but not all materials tested.

Lamb (9) found that the influence of awns on yield of soft red winter wheats was slight and nearly negligible in Ohio. Bayles and Suneson (3) found that the awned composite from a spring wheat hybrid outyielded the awnless but that similar composites from a winter wheat hybrid were not significantly different in yield in tests in western United States. Suneson et al. (15) reported a 5% increase in yield from the transfer of awns to Onas wheat from United States. Atkins and Norris (2) found that awned types of wheat were superior in yield to comparable awnless types in years of drought stress in Texas.

MacKay (10) found spontaneous bearded mutants in winter wheats with pronounced adaptation to wet years in Sweden. Awned wheats have traditionally predominated in many of the drier winter wheat regions, whereas awnletted wheats have been most widely grown in the more humid regions of eastern United States.

The reported superiority in certain respects of awned types could arise from functioning of the awns or from beneficial genetic factors linked with those conditioning awn expression. Miller et al. (12) reported a comprehensive study and literature review on physiological functions of wheat awns. Awns have been shown to have an important role in transpiration. De-awning was found to reduce kernel weight, test weight, and weight of grain per spike (12). Awns have been found to function in drying of ripe, standing grains (13), to serve as a reservoir for ash (12) and to function in photosynthesis especially at lower soil moisture levels (11).

Everson and Schaller (5) reported that the association of semismoothness of awns and higher yield in barley was due to linkage rather than to pleiotropic action of the gene (r) for semismoothness, even though retained through 9 backcrosses. Hanson (6) postulated that linkage groups are broken only to a limited extent during breeding procedures used for self-pollinated crops, often leaving intact fairly large blocks of genes.

The genetics of awnedness of wheat has been studied extensively. Much of the literature has been recently reviewed (4, 7, 8). Factors influencing awns have been located on 11 chromosomes involving all 7 homologous groups defined by Sears (14): 1. XVII; 2. II, XX; 3. III, XII, XVI; 4. IV, VIII; 5. IX; 6. X; and 7. XXI. The occurrence of so many genes influencing awn expression in wheat would allow for a number of different genetic associations to occur with awnedness or awnlessness in different experimental materials.

Comparisons, using nearly isogenic selections of soft red winter wheats in the eastern soft wheat area, have not previously been made.

MATERIALS AND METHODS

Twelve pairs of lines of soft red winter wheat nearly isogenic except for awns versus awnletted were compared for yields and test weights of grain in nursery trials at Lafayette, Indiana, during 3 years. Weights per 1000 kernels were determined in 1 year. A split-plot design was used with the 12 pairs treated as a randomized block and with the awned and awnletted lines of each pair as subplots. Each subplot consisted of four 8-foot rows 1 foot apart with the center 2 rows harvested for yield and test weight.

Four replications were used in 1953 and 5 in 1957 and 1958.

Two pairs of lines were derived from the cross Purdue 9245 and 5 pairs each from crosses Purdue 9345 and Purdue 4127. The lines were carried heterozygous for awnedness for 3, 3, and 9 segregating generations, respectively, in each of the crosses. The source of awns in each of the 3 crosses was a different parent. These were not closely related. The awned parents were generally of the Fulze type. The crosses were: (a) Purdue 9245 = Malakof-P44-3 (awned) × Purdue 3241-6-2 (awnletted), (b) Purdue 9345 = Fairfield C.I. 12013 (awned) × Blackhawk C.I. 12218 (awned), and (c) Purdue 4127 = Kawvale C.I. 8180 (awned) — Purdue B3612A13-12-1 (awnletted) — Fairfield (awnletted) × Purdue B9392A2-2 (awnletted).

The awned and awnletted members of each pair were similar for height, straw strength, date of heading, reaction to leaf rust, and general appearance except for awnedness. In segregating families from which these stocks were derived, awns were determined by a single genetic factor difference with the fully awned type recessive.

Test weight was determined by a test weight apparatus utilizing a pint container. Weight per 1000 kernels was calculated from the weight of 500 kernels from each replication.

RESULTS

Yield of grain—The 12 pairs of nearly isogenic lines were adapted to Indiana conditions and averaged 52.2, 45.3 and 59.8 bushels per acre for 1953, 1957, and 1958, respectively.

Differences in grain yield between awned and awnletted types within pairs approached significance in 1953 and 1957 and were highly significant in 1958 (Table 1). The average yield advantage for awns was significant in 1953 and 1957 and highly significant in 1958, averaging 1.0, 1.5, and 3.7 bushels per acre, respectively, for the 3 years. The awned member was superior to the awnletted member of the pair in 8 of 12 comparisons in 1953, and 9 of 12 in 1957, and in all comparisons in 1958.

The greatest yield differences in favor of awns occurred in 1958, a season cooler and wetter than normal, when highest average yields were produced. Precision of the measurements of yield differences was high in 1958, as