Utilizing Grain Yield Data from Wheat Demonstration Plots

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ABSTRACT

Wheat (Triticum aestivum L.) cultivar demonstration plots are used widely in Kansas to promote early adoption of high yielding cultivars. These single-replicate plots are often harvested, however, and yields are reported in local newspapers. The objectives of this study were to compare the relative yields of wheat cultivars in demonstration plots and in official winter wheat performance tests and determine the usefulness of demonstration plots as yield indicators. Using cultivar \times environment mean square as an error term, significant cultivar differences could be detected in five of 10 cropping districts, and correlations between demonstration plots and variety performance tests were significant in seven of 10 districts. The five districts with significant cultivar differences and correlations tended to be ones with relatively homogenous soil types. Hybrid wheat cultivars dominated demonstration plots, but hybrids have not been widely accepted by farmers. Mean yields of demonstration plots over locations can be used as yield indicators, when they represent homogenous environments.

RESULT DEMONSTRATIONS have been a mainstay of the Cooperative Extension Service for educating producers about new farming techniques (Kittrell, 1974). In Kansas, demonstration plots have long been used as a method of introducing farmers to better-adapted cultivars of hard red winter wheat (Triticum aestivum L.). In fact, one county has had wheat demonstration plots on the same farm for 75 yr (R. Seyfert, 1989, personal communication). Demonstration plots can be given credit for the rapid adoption and wide usage of high-yielding cultivars, such as 'Newton' and 'Arkan'. Each year, approximately 75 of 105 Kansas counties have wheat demonstration plots with field days in the spring.

Nafziger (1984) indicated that many counties report yields of unreplicated plots, which may reflect differences in field variability rather than cultivar differences. He suggested that one way to avoid this problem is to explain field variability to farmers and agricultural agents and not to harvest demonstration plots. Unfortunately, considerable pressure is placed on agents by local farmers, seed dealers, and administrative boards not only to harvest the plots but also to report the yields in local newspapers. Also, with the introduction of wheat cultivars for specific areas of adaptation, there is concern that not enough testing locations are available to evaluate yield performance across environments adequately. Because demonstration plots are numerous and widely dispersed, the temptation exists to use the yield results.

The objectives of this study were to evaluate the usefulness of demonstration plots as yield indicators and to compare the ranks of wheat cultivars in county demonstration plots with those in replicated winter wheat performance tests.

MATERIALS AND METHODS

Data were derived from two sources: county demonstration plots and Kansas Winter Wheat Variety Performance Tests (VPT). Ten publicly released, hard red winter wheat cultivars were furnished to cooperating county agents for use in demonstration trials (Fig. 1) during 1983-1986. Agents were encouraged to include commercially released cultivars (pure lines and hybrids both public and private) in demonstration plots. Sites were identified by county agricultural agents. Plots were planted and harvested with farm equipment. Plot size varied, but typically was one drill-width wide (3-4.8 m; 10-16 feet) by at least 90 m (100 yards) long. Seeding rates and dates were those typically used by cooperating farmers and varied across the state. Grain yields were reported to the authors in bushels per acre. Yields were averaged within counties each year, so that the basic data unit was for a cultivar-county-year combination. Cultural practices used in the VPT at 16 locations (Fig. 1) were reported by Walter (1986).

Two-way analyses of variance for grain yield from dryland demonstration plots and VPT were performed within each of Kansas' nine crop reporting districts (Fig. 1), utilizing the cultivar \times environment mean square for the error term, as recommended by Nafziger (1984). A tenth "district" was defined as comprising all irrigated locations for each data set (VPT and demonstration plots). An environment was a county-year combination for demonstration plots and a location-year combination for VPT. All irrigated demonstration plots were grouped separately for the analyses of variance. Because the data were highly unbalanced, Type III sums of squares from SAS PROC GLM (SAS Inst., Inc., 1985) were used in the analyses of variance. Least-square means for varieties over all years within districts were computed by PROC GLM. Within-district correlation coefficients between least-square means from demonstration plots and least-square means from VPT (over all years in which demonstration plot yields were available) were computed over all cultivars common to both data sets.


RESULTS

In five of the 10 districts, significant differences among cultivars were observed (Table 1). Error (cultivar × environment) mean squares were heterogeneous among districts, with the largest occurring in South Central. As a consequence, significant differences were not detected among cultivars in that wheat-growing district. There were significant correlations between cultivar yields in demonstration plots and VPT in seven of the 10 districts (Table 2), including all five districts in which there were significant cultivar differences.

The five top-yielding cultivars in demonstration plots and their ranks in the VPT are shown in Table 3 for the five districts in which cultivar mean squares were significant. Hybrid wheat cultivars dominated demonstration plots. In the Northwest district, the top five entries were hybrids, whereas in West Central and North Central districts four of the top five were hybrids. Among pure-line cultivars, the top five within each district were generally considered to be adapted to those areas (Table 3). For example, later-maturing cultivars such as ‘Siouxland’, ‘Thunderbird’, ‘Centurk’, ‘Ram’, and ‘Sandy’ ranked high in northern areas, whereas earlier-maturing cultivars such as ‘Sta-

DISCUSSION

When we look at the general soil map of Kansas, it is not surprising that significant cultivar differences in demonstration plots occurred in only five of 10 districts. In general, where differences were significant, soils were homogeneous (e.g., Northwest and West

Table 2. Correlations between wheat cultivar least-square means from demonstration plots and variety performance tests (VPT).

Table 1. Analyses of variance for wheat cultivars in demonstration plots by cropping district.
Central), or there were a small number of demonstration plots on similar soils (e.g., Southeast). Soil heterogeneity undoubtedly reduced correlations between demonstration plots and VPT. Another important factor was soil-borne mosaic virus (SBMV). Only one of three VPT locations in the South Central district is noteworthy. Unit price and the farmers' inability to save grain to use as seed wheat for planting have greatly reduced acceptance of hybrids.

A third factor causing cultivar × environment interaction among demonstration plots and reducing their correlation with VPT results was variability in quantity and timing of rainfall. Springtime rains in Kansas often occur as thunderstorms; therefore, water stress may vary greatly even within small geographical areas. Finally, demonstration plots often, but not always, are sown by the farmer after most or all other sowing is finished. Significant cultivar × planting date interaction would reduce predictive value of demonstration plots.

In summary, we agree with Kittrell (1974) and Nafziger (1984) that the primary purpose of demonstration plots should be for visual observation by the public and that single-location demonstration plot yields are not useful. But we realize that such data often will be compiled. Our results show that cultivar means over several demonstration plots in several years within a region relatively homogenous for soil type and soilborne pathogens may be meaningful. Degree of similarity between testing and farm environments should be considered by all growers when using either VPT or demonstration plot means in cultivar selection.

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REFERENCES


