Wheat Demonstration Plots: Establishing, Conducting, and Reporting Data

K-STATE Research and Extension

Department of Agronomy

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Importance of Wheat Demonstration Plots

County and district wheat demonstration plots are educational tools that help producers identify wheat varieties well-suited to their farms. Historically, three to five wheat demonstration plots were installed per agricultural district and one to three per county in the state.

Selecting a Cooperator and Site

It is crucial to select a good cooperator to work with when establishing wheat demonstration plots. New agents who have not fully developed a network of producers to work with can work with Program Development Committees to select possible collaborators for the program. Also, coworkers and agents in neighboring counties might be a source of potential producers to work with.

Establishing plot sites within a farm may be challenging, as many producers prioritize their planting operation over a demonstration plot. If it is possible to select a location within a field, select a location close to a well-traveled road so it will be seen by travelers and easily accessible. Also, it is important that the location can accommodate the expected attendance at a plot tour. Finally, selecting a location within a field with homogeneous soils and little-to-no slope, or uniform slope, allows for fewer effects of soil variability on different wheat varieties. A yield map from previous crop years can help find homogeneous areas in the field. If the field slopes in one direction, align varieties with the slope so all varieties are subjected to the same slope gradient.

Plot Size, Replications, Randomization, and Check Strips

In wheat demonstration plots, plot size is generally determined by field length and the machinery available for fieldwork. Width of equipment used to apply treatments (drill, sprayer, combine, etc.) is a factor in determining plot width. Field length or seed availability generally determine plot length.

Replication is necessary to identify differences among varieties with some degree of confidence. Randomization within each replication prevents one treatment from being favored over the others due to individual plot location. If you are able to install the wheat demonstration plots as replicated, randomized trials, this is preferred when compared to unreplicated strips. In this case, at least three replications should be used and the area agronomist or wheat specialist can assist in blocking and randomizing the wheat varieties as well as in performing the statistical analysis. Replication and randomization require planning and an increased amount of fieldwork when compared to unreplicated strips.

Wheat demonstration plots established directly with producers may not be replicated due to space, machinery, time, or labor constraints. In this case, unreplicated strips are installed, where each strip represents one variety. One alternative to estimate field variability in these situations is to have check strips of one standard variety across the whole plot area. For check strips to be of value, it is important to have one check strip at no more than every three varieties, which may result in a large use of land and resources. Although results from these check strips can be used to adjust yields of other varieties for productivity gradients across the field, these do not eliminate the need for replications. Additional discussion about the use of check strips can be found in *Establishing On-farm Demonstration and Research Plots,* MF966.

Another alternative is to reduce the number of varieties evaluated and replicate fewer, more representative varieties. For example, instead of planting 30 different varieties, select 10 representative varieties and replicate these three times. This approach reduces the number of varieties to be discussed in plot tours, but it gives more confidence in the data being collected.

In some cases, nearby demonstration plots can be used as replications for each treatment. To use nearby locations as replications, farms must be close enough to be representative of a certain region and a common set of varieties should be planted. If there is local interest, additional varieties can be planted in individual locations, but pooled results will only be attainable for varieties planted at all locations. Randomization, including planting order, should occur at each farm. Preferably, fungicide or insecticide treatments applied to the crop should be consistent across all farms. Previous research performed in Kansas

comparing yield results from nearby wheat demonstration plots used as replications to those from variety performance tests has shown that both approaches can result in similar variety ranking within a given geographical region. When the different demonstration plots are installed in homogeneous soils, the replications of plots show the differences in means (averages) between varieties. For instance, when a factor such as a low soil pH is present at a site, results will be skewed favorably towards aluminum-tolerant varieties. The area agronomist and the state wheat specialist can help with variety selection and randomization for nearby locations.

Selecting Wheat Varieties

When selecting a variety, county and district agents are given a wide array of public and private varieties to choose from; however, space to establish the demonstration plots is generally limited and 15 to 25 varieties need to be selected. When selecting varieties to be included in the wheat demonstration plots, consider:

1. the most widely used varieties in the region;
2. varieties that historically performed well in regional variety performance tests;
3. new, promising varieties that farmers are asking about; and
4. varieties that the farmer cooperator is interested in.

If space is limited, avoid varieties released for different regions than those in your county or district. Wheat blends appropriate for the region also can be added. If using nearby sites as replications, the final pooled analysis will only include varieties occurring at all locations. It is important to have a set of recurring varieties across locations, although more varieties can be added at a given location if there is local interest. If space is limited and you are unsure how to choose varieties or how to randomize varieties in nearby locations, contact the area agronomist or the state wheat specialist for further discussion.

Information to be Collected from Wheat Demonstration Plots

Information collected from the field where the variety demonstration plots are established enriches plot tour discussions and yield reports. It also provides valuable information when comparing sites. Table 1 highlights information that can be collected for this purpose. Collect "Priority information" at every wheat plot. This includes seeding date and rate, soil fertility levels, previous crop, fertilizer and pesticide (fungicide, herbicide, and insecticide) programs, and harvest date. "Desirable information" also enriches discussions and reports and should be collected if possible, including soil type, row spacing, weather and pest concerns, harvest conditions, and tillage practices.

To facilitate data collection, agents will be provided with Table 2 at time of seed distribution. Please submit a completed copy of Table 2 with yield results to the state wheat specialist and the area agronomist at the end of the growing season.

Conducting Plot Tours

Generally, plot tours are conducted by the state wheat specialist, area agronomist, state plant pathologist, wheat breeder, or a combination. Some extension agents, however, prefer to conduct the tours on their own. Because of the high demand, submit requests for desired tour dates and specialists as early as possible within the growing season. When conducting a plot tour, it is important to provide producers with information from Table 1. Informing producers about the basic management practices sets the stage for the variety discussion. Additionally, it helps producers when comparing the test plots to management practices used in their own operation. After providing basic management practices used across the area, each variety's characteristics should be discussed.

Each wheat variety has a different pedigree and distinct strengths, weaknesses, and area of adaptation. Discussing the strengths and weaknesses of each variety has been the historical approach to plot tours, although it can quickly become cumbersome. You could initiate the discussion with characteristics that generally make a variety successful for that given region. Certain characteristics make varieties more successful than others, and those successful characteristics are different for different areas of the state. For example, acid soil tolerance is important in south central Kansas but is not significant in western Kansas. Starting the discussion by providing information about which characteristics are more important for the region and later focusing the discussion of each variety around those characteristics, is a way to provide a short, straightforward, and focused plot tour discussion.

Reporting Harvested Yield

Yield results from unreplicated plots should not be reported as official K-State information. Replications are needed to assess whether differences between varieties actually existed or were due to differences in soil properties, sampling error, or other factors that may have benefited one variety over another. However, producers that are providing land and labor and allow the wheat demonstration plot program to exist usually push toward release of this information not only for their own decision making but also to the community. Agents may find themselves in the situation where they need to report yields, test weight, or protein from unreplicated wheat demonstration plots.

Reported yields from unreplicated strips should not be used alone for variety selection. The county or district report should make this statement explicit and should direct producers to the K-State variety performance test results for complete variety comparison data when selecting varieties for their operation.

Additionally, private companies may have restrictions on reporting unreplicated data, and varieties that fall in this category should not be taken to final yield unless there are replications and randomization of the trial.

Another alternative is to use nearby locations as replications as previously described. In this case, a statistical analysis can be conducted and varieties can be ranked according to a valid, statistical approach. The area agronomist and state wheat specialist can help set up varieties and randomization for nearby locations, as well as conduct the statistical analysis. When replications in the same site are not possible, this approach should be adopted if possible.

When reporting results from demonstration plots, it is crucial to report typical management practices. By completing Table 2 during the growing season, most of the information needed should be compiled. Important information to report includes whether the field was dryland or irrigated, total irrigation applied (if irrigated), planting date, seeding rate, row spacing, seed treatment (if used), previous crop, tillage after previous crop, any non-starter fertilizer applied after previous crop (rate and timing), starter fertilizer, lime or manure, pre- or post-emergence herbicide program, whether the crop was grazed, in-season foliar fungicide and insecticide, as well as any significant yield loss due to insects, diseases, weeds, frost, hail, flood, or lodging.

County and district agents are welcome to develop wheat variety demonstration plot reports using their own style; however, an electronic template to report results from wheat demonstration plots will be provided during the growing season. This template increases the uniformity of the demonstration plots reports.

Table 1. Priority (left panels) and desirable (right panel) information to be collected from areas where wheat demonstration plots are installed. Efforts should be put into collecting "Priority information" at every location where wheat plots are established. "Desirable information" should be collected if possible.

Priority information	
Information	**Procedure**
Seeding date and rate	Record the date and rate the wheat demonstration plots were planted.
Basic soil nutrition[2]	Take a composite sample (~15 soil cores) 0-6" from the plot area at time of planting and send to K-State soil testing lab to measure soil pH, P, K and OM. If soil test results are used from a lab other than K-State's, specify method: Bray 1P, Mehlich III, Olsen.
Previous crop	Record the previous crop planted in the area (soybean, sorghum, corn, continuous wheat, fallow, etc.)
Fertilizer program	Record the fertilizer program adopted: amount, type, and date of fertilizer application (pre-plant, at sowing, and as topdress).
Herbicide, insecticide, and fungicide programs	Record the products used, the rates applied, and date.
Harvest date	Record the date the plots were harvested.

Desirable information	
Information	**Procedure**
Soil type[1]	Record the soil type. This can be performed with the Web Soil Survey.
Row spacing	Record the row spacing (inch) used when plots were planted.
Weather concerns[3]	Record freeze or heat events during reproductive stages, severe drought conditions, etc.
Pests and diseases[3]	Record occurrence of stripe rust, leaf rust, tan spot, soilborne mosaic, wheat streak mosaic, Hessian fly, barley yellow dwarf virus, etc.
Harvest conditions[3]	Record factors that might decrease wheat quality: precipitation events after physiological maturity, occurrence of head scab, etc.
Tillage practices	Record the tillage practice adopted: no-till, reduced-till, or conventional till.

[1] Web soil survey can be accessed at: websoilsurvey.sc.egov.usda.gov/App/HomePage.htm. Using the plot location address to create an area of interest allows you to retrieve the major soil type in the study area.

[2] This step requires collecting a composite soil sample from the plot area and submitting to a soil testing laboratory. Despite the additional work, it can provide valuable information to the producer and for field tours and reports.

[3] In years when extreme weather events or heavy disease incidence occur, please consider collecting this information as "Priority Information."

Table 2. Template for information collection from the field where the wheat demonstration plot is installed. One field example where demonstration plots were no-tilled after soybeans is shown.

Crop/harvest year	Wheat/2016	
County or district	Saline	
Number of varieties on demo	22	
Field location: Section: Township: Range *or* GPS coordinates of field *or* County and field location relative to road intersection	KS N1/2 Sec. 27 T13S R4W *or* 38.89735°, -97.75150° *or* 1½ miles north of I-70 on Hedville Rd.	
Dryland or irrigated? If irrigated, total irrigated applied (in)	Dryland	
Soil fertility for the top 6" and 24" if available (pH, NO_3-N, P, K and OM)	6" - 5.2, 12 lbs N/a, 125 ppm, 325 ppm, and 1.8%. 24" – 30 lbs N/a	
Soil test (K-State or private, Haney or traditional, Bray 1P, Mehlich III, or Olsen)	K-State, traditional	
Planting date	10/29/15	
Seeding rate (lbs/a)	85	
Row spacing (in)	7.5	
Seed treated (Yes/No)? What brand name product(s)?	Yes (Gaucho)	
Prior crop in this field? Residue harvested or grazed?	Soybean, residue left on field	
Tillage after prior crop? No-till; ridge; strip; disk; chisel; vertical. If vertical, indicate timing	No-till —	
Any (non-starter) fertilizer after prior crop?	No	
Specify rate (pounds nutrient/a) and timing	N/A	
Lime (L) or Manure (M)? If yes, specify rate and timing	M, 2 ton/a, 10/15	
Any starter fertilizer (Yes/No)? If yes, specify product	Yes, 60 lbs/a DAP	
Was the wheat grazed?	No	
Herbicide program: pre-, post-, or both? If post-, specify timing (M/Y)	Post, 02/16	
Any in-season insecticide applied? If yes, specify product and time	No	
Any in-season foliar fungicide? If yes, specify product, rate, and time	Yes, Twinline, 9 oz/a, 05/16	
N fertilization: rate (lbs N/a), source, and time	70 lbs N/a, urea, 03/16	
N practice (N sensor, soil based, or blanket application)	Blanket application	
Any significant yield loss due to insects, diseases, weeds, frost, hail, flood, lodging? Specify problem	Freeze on 04/15/16, no major damage	
Harvest date	6/27/16	
Average, maximum, and minimum plot yields (bu/a)	45, 23, 62	

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