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FROM THE GROUND UP
agronomy news

2000 Colorado Winter Wheat Variety Performance Trials

Trial results provide information for making good variety decisions.


Wheat variety trial harvest at Cheyenne Wells

INSIDE THIS ISSUE:

Colorado State University conducts variety performance trials to obtain unbiased and reliable information for Colorado wheat producers to make better variety decisions. Good variety decisions can save Colorado wheat producers millions of dollars each year.

Adequate soil moisture conditions in the fall and mild winter temperatures led to good plant stands. Mild but dry winter conditions prevailed throughout much of the state. Favorable winter conditions led to large insect populations and losses were suffered from viral diseases transmitted by insects. Russian wheat aphid, Bird cherry-oat aphid, and Greenbug infestations were severe in SE Colorado; Greenbug and wheat curl mites were severe along the I-70 corridor;

(continued on page 2)

Trial results

(Continued from page 1)

and Adams county had severe infestations of brown wheat mites. Barley yellow dwarf virus, transmitted by the Bird cherry-oat aphid and Greenbugs, were widespread from Baca to Kit Carson counties. Wheat streak mosaic virus and/or high plains disease was present in counties along the Kansas border. Very little leaf rust infection was observed in eastern Colorado although stripe rust (also known as yellow rust) infection was severe at the Genoa location and influenced yields. Following good rains in April, drought conditions dominated most of eastern Colorado in late spring through grain filling. Several late spring freeze events occurred but the worst, on May 13, reduced yields on large parts of eastern Colorado as well as compromising two of our variety trials.

Our dryland winter wheat variety trial was restructured in 1999 so that the low moisture (LMVT) and higher moisture trials (HMVT) of previous years were combined into a single uniform variety performance trial conducted at ten locations. There were 60 entries in the dryland trial, approximately half named varieties and half experimental lines. Six hybrids were entered by HybriTech-Monsanto, and Cargill-Goertzen entered five varieties. Two experimental lines from Kansas State University, and one new Nebraska variety were entered alongside common check varieties and experimental lines from the CSU breeding program. The CSU entries included two new white wheat lines, six herbicide-tolerant wheat lines, and experimental lines in their first, second, and third year of testing. Two irrigated variety trials were conducted at Rocky Ford and Haxtun. A randomized complete block field design with three replicates is used in all trials. Four or six, 12 inch-spaced rows, 46 feet long, are harvested from each plot. All dryland trials are seeded at 600,000 seeds/acre and the irrigated trials are planted at 900,000 seeds/acre.

The trial at Orchard was lost due to drought, disease, and freeze damage. The results of the Bennett trial were strongly influenced by the freeze and non-experimental errors led us to discard the results from the Sheridan Lake trial. This year's yields were lower than in the recent past - closer to long-term average yields - and several varieties that ranked high in the trial in the past (and risen to prominence in state acreage) did not rank as high this year. There were only modest total differences in average yield from the top-ranking variety to the lowest-ranking variety due to the multitude of different stresses experienced this year. Consequently, variety rank in 2000 is less reliable than average performance over multiple years as an indicator of expected future performance. Alliance and Trego were high yielding in both the high yielding environments of last year and the low yielding environments this year. The herbicide tolerant wheat lines (in TAM 110 background) were similar in yield to TAM 107 and Prairie Red.

This year's trials, under strong drought, heat, insect, and disease pressure were very valuable to the CSU wheat-breeding program to screen tough, new varieties for the future. The unified trial included 32 experimental lines (not included in the enclosed table), eight of which ranked among the top ten entries for highest average yield over locations, with the best yielding 114% of TAM107. The irrigated trial results illustrate how some public varieties are able to compete favorably with hybrids at high yield levels.

Variety planting suggestions, based on these trial results, are found in the

(continued on page 3)

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Web Site: http://www.colostate.edu/Depts/SoilCrop/extension/Newsletters/news.html

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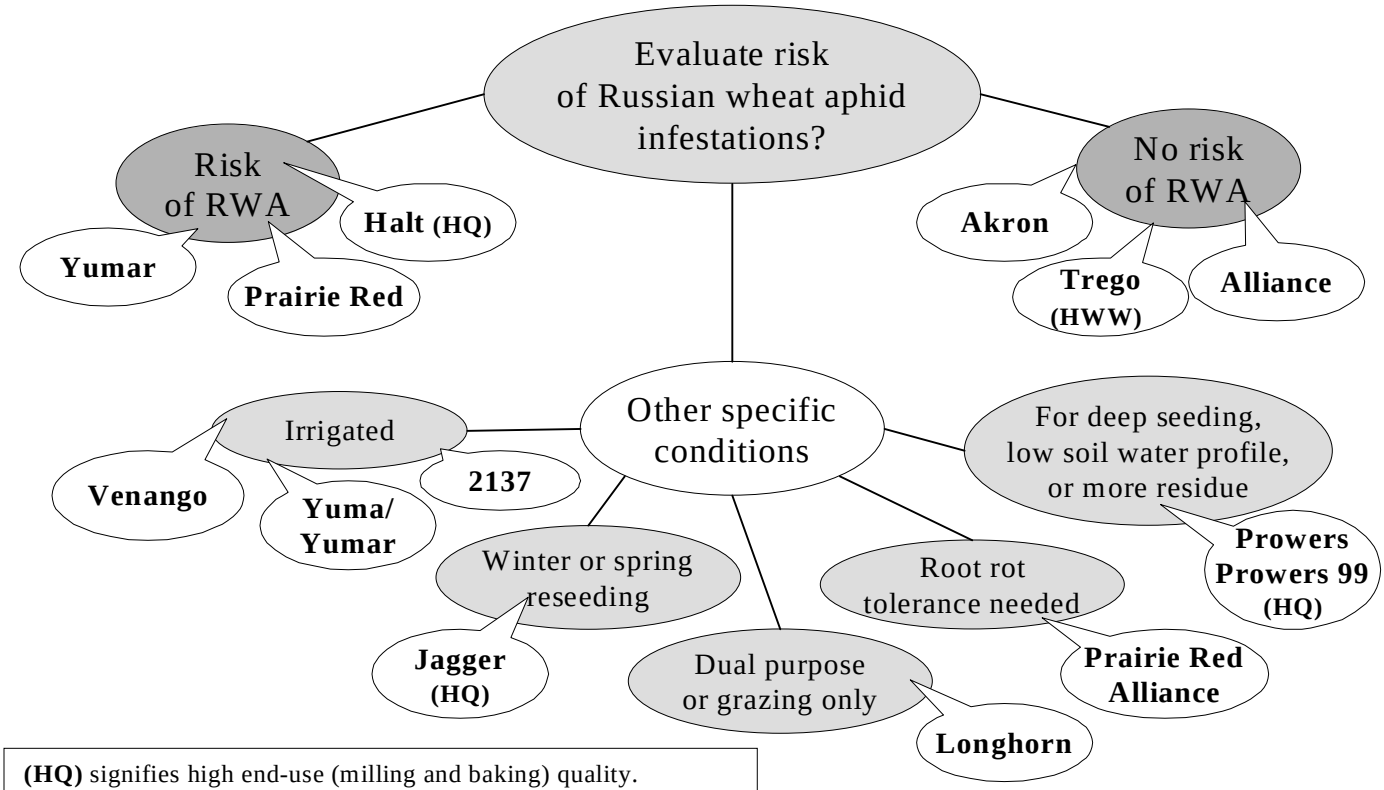
Decision Tree for Winter Wheat Variety Selection in Colorado

Jerry Johnson and Scott Haley (July 2000)



(HQ) signifies high end-use (milling and baking) quality.

(HWW) signifies Hard White Winter wheat variety.

The best choice of a winter wheat variety in Colorado depends upon variable production conditions. The decision tree combines our knowledge of wheat varieties with their performance in CSU variety trials. Varieties listed in the decision tree are varieties that we think growers should consider for the production conditions specified in the tree. Production risks may be reduced by planting more than one variety and it should be remembered that avoiding poor variety decisions may be as important as choosing the winner among winners.

Trial results

(Continued from page 2)

revised "Decision Tree for Winter Wheat Variety Selection in Colorado." We encourage producers to spread the variety decision risk by planting more than one variety. The average performance over two or three years is a proven tool for yield performance evaluation but producers should be mindful of other varietal characteristics, like maturity, height, disease and insect resistances, quality parameters, and winterhardiness, that influence variety adaptation and performance. The full complement of trial results can be viewed on the web at: http://www.colostate.edu/Depts/SoilCrop/extension/CropVar/wheat1.html starting July 19, 2000.

Jerry Johnson and Scott Haley

Winter Wheat Breeding Update from CSU

Russian wheat aphid resistance, followed by winter annual grass control, and the market-driven development of white winter wheat guides CSU wheat breeding program.

Scott Haley speaks with producers at Haxtun Wheat Field Days on June 14, 2000.

Over the past several years, research conducted at Colorado State University (CSU) has resulted in successful development and release of improved winter wheat cultivars for producers in Colorado. A large component of the overall breeding effort has been directed toward rapid deployment of genetic resistance to the Russian wheat aphid (RWA), an introduced insect pest against which resistance was previously unavailable in adapted cultivars.

Since 1994, five improved cultivars carrying resistance to the RWA have been released by CSU through the partnership with the Colorado Wheat Administrative Committee (CWAC) and Colorado Wheat Research Foundation (CWRF). These cultivars ('Halt', 'Yumar', 'Prowers', 'Prairie Red', and 'Prowers 99') each carry a single resistance gene called "Dn4", a gene proven in both greenhouse and field studies to be highly effective in minimizing the adverse effects of the RWA in infested wheat. Within our current germplasm base (often called "the breeding pipeline"), the vast majority of RWA-resistant breeding lines carry the Dn4 resistance gene. Because there exists concern (albeit slight) over development or introduction of RWA biotypes against which Dn4 is ineffective, we continue to work with several other resistance genes. Experimental lines carrying some of these other resistance genes have reached advanced stages of testing and one of these lines is currently under consideration for potential release.

In addition to advanced experimental lines with "new" sources of RWA-resistance, we have also been working to develop a RWA-resistant version of 'Akron', a cultivar released by CSU in 1994. Akron is susceptible to the RWA yet has shown exceptional field performance in variety trials and farmer's fields throughout Colorado and the west central Great Plains. In development of the RWA-resistant version of Akron, 85 experimental lines were tested at three locations during the 2000 field season. From these 85 lines, a group of five has been identified and will be entered in the 2001 Uniform Variety Performance Trial (UVPT). With statewide and regional yield trials during the 2001 and 2002 field seasons, and simultaneous increase and purification for RWA resistance, we hope to be able to release a RWA-resistant version of Akron in fall 2002. While the release

(continued on page 5)

Breeding

(Continued from page 4)

date for one of these lines is a couple of years away, we have already brought this material into our crossing program to broaden our efforts in combining RWA resistance with the adaptive features that have made Akron so popular in Colorado.

While RWA resistance will continue to be a primary focus of wheat breeding efforts at CSU, other objectives have recently received increased attention. The first of these is the development of *Clearfield*™ (imidazolinone-resistant) winter wheat cultivars adapted for production in Colorado and the west central Great Plains. The *Clearfield*™ trait, developed by BASF (formerly American Cyanamid) without the use of recombinant DNA technologies (e.g., is "non-GMO"), would allow selective control of several winter annual grass weeds (e.g., jointed goatgrass, downy brome, cheatgrass, Japanese brome and feral rye) that are problematic in Colorado. Through a partnership between CSU, the CWAC, and BASF, an ambitious inter-disciplinary research program was initiated in 1997 to develop adapted *Clearfield*™ wheat cultivars and appropriate management strategies for deployment of this technology. Six promising experimental lines were entered for statewide testing in the 2000 UVPT. Two of these (coded CO980894 and CO980889) performed exceptionally well and have been retained for further yield testing and foundation seed increase to enable potential release in fall 2001. A large number of experimental lines developed through parallel, accelerated breeding schemes are also currently under field evaluation and are positioned to provide potential cultivar releases in 2002 and 2003. In addition to carrying the *Clearfield*™ trait, many of these lines also carry the Dn4 RWA resistance gene.

Development of hard white winter wheat (HWW) cultivars has also received significant attention at CSU over the last few years. From the standpoint of end-use markets, the growing interest in HWW can be attributed to the following factors: slightly greater milling yield; product development for a more health-conscious and ethnically-diverse society (e.g., whole wheat white bread, flat tortillas, and noodles); and rapidly-increasing demand in overseas markets, most notably in Southeast Asia (for a multitude of different types of noodle products). While HWW breeding research began in the Great Plains many years ago, it hasn't been until the last couple of years that HWW cultivars yield-competitive with the best hard red winter wheat (HRW) cultivars were made available. Since 1997, we've seen the release of several new cultivars (e.g., 'Betty', 'Heyne', 'Nuplains', and 'Trego') that promise to capture a significant portion of the acreage in their primary areas of adaptation. Within each of the programs that have released new HWW cultivars, a steady stream of improved HWW cultivars is expected for years to come.

Within the CSU wheat breeding program, we currently have one experimental HWW line under foundation seed increase for potential release in 2001. This experimental line (coded CO940611) originated from a germplasm exchange with the

(continued on page 5)

Breeding

(Continued from page 5)

Kansas State University breeding program in western Kansas (Hays) in 1995. While this line lacks RWA resistance, it has shown exceptional performance in Colorado Variety Performance tests since 1997, yielding slightly less than Alliance but superior to other cultivars commonly grown in Colorado. This experimental line has shown great promise, but development of HWW cultivars with RWA resistance is a major priority. To this end, roughly 50% of the experimental lines that were in their first year of field testing in 2000 are HWW originating from crosses with RWA-resistant parents. Selection for RWA resistance and continued statewide yield testing will hopefully provide a RWA-resistant HWW cultivar release by 2004.

Without a doubt, the most daunting challenges for HWW breeding are those that arise from the fact that we are most likely in a transition period between large-scale HRW production and large-scale HWW production in the west central Great Plains. Until a breeding program is capable of making adapted HWW x HWW crosses (which yield 100% HWW segregates), efforts necessarily revolve around isolating HWW lines from mixed samples of HRW x HWW crosses. While this is relatively straightforward in the absence of rain-induced weathering, the genetics of bran color are such that white segregates from HRW x HWW crosses are quite rare – often only 6% at best.

Of greater importance, however, is the fact that HWW cultivar development requires additional evaluation efforts for traits that are generally less important within the HRW market class. The first of these, that of the tendency of HWW to sprout in the head under wet conditions at harvest (known as "preharvest sprouting"), is a problem that presents a definite concern to the industry. Fortunately, sprout-tolerant germplasm is available and manageable screening techniques may be readily implemented within the framework of existing programs. Furthermore, preharvest sprouting is expected to be of lesser concern for HWW production in Colorado and the west central Great Plains where environmental conditions that promote sprouting in the head prior to harvest are much less prevalent.

End-use quality evaluation also presents a unique and significant set of challenges. Because the Asian noodle market represents an attractive export market opportunity for Colorado-produced HWW, our quality evaluation in the breeding program must be geared toward providing wheat cultivars that are desirable for both bread and noodle production. While we have a much greater understanding today of both domestic and export quality requirements, time and patience will likely be required to successfully integrate "dual-purpose" quality performance criteria into germplasm adapted for production in Colorado and the west central Great Plains.

Scott Haley

NEW WEB SITE!

Transgenic Crops: An Introduction and Resource Guide

http://www.colostate.edu/programs/lifesciences/Transgenic Crops/

by
Pat Byrne -- Sarah Ward -- Ann Fenwick -- Lacy Fuller

Topics:
History of Plant Breeding -- What are Transgenic Plants?
How to make Transgenic Plants: Animation Deni
Evaluation & Regulations -- Current Transgenic Products
Future Transgenic Products -- Risks & Concerns -- News Updates

Weed Control In Winter Wheat

Maverick, Clearfield, and jointed goatgrass research are the good news for 1999-2000.

Weed control developments for winter wheat include the labelling of Maverick, and new methods of tracking jointed goatgrass accessions.

Maverick

Maverick was available for purchase in the fall of 1999; results were variable for downy brome control due to dry weather conditions

CSU/Monsanto collaborated on a wheat/corn plantback study assessing dryland corn growth following use of Maverick in wheat. Maverick is currently labeled for use in wheat only in wheat/fallow/wheat rotations. Maverick was applied on 60 foot wide strips at a 1X and 2X rate in the fall of 1999 across wheat fields at over 20 locations in Colorado, Western Nebraska, and Western Kansas. Field sites were chosen that had varied topography, high pH, and coarse textured soils. Corn will be planted spring 2001 and visual evaluations and yield measurements will determine the corn response following Maverick use in wheat.

The Bayer Chemical Co. herbicide MKH-6561, a sulfonylurea herbicide similar to Maverick, now has the trade name Olympus. This product should be labeled for annual brome control in winter wheat by fall 2001.

Research continues on the development and use of Clearfield winter wheat with resistance to imazamox. Imazamox has good activity on jointed goatgrass, bromes, and cereal rye. Use of Clearfield wheat shows good promise for control of jointed goatgrass in badly infested wheat fields.

Jointed goatgrass on the left, wheat on the right.

Jointed goatgrass

The objective of this study was to determine the genetic diversity of jointed goatgrass accessions using DNA fingerprinting techniques. Eight jointed goatgrass accessions were selected that represented a range of geographic locations, from a collection of 53 accessions currently being maintained at CSU. RAPD (Random Amplification of Polymorphic DNA) techniques were used for DNA-based genetic fingerprinting. DNA was extracted and amplified with 30 different 10-base random primers. Using agarose gels, many distinct bands were produced in each run but only two polymorphisms were detected, indicating very little genetic diversity among these eight accessions. This result is consistent with the loss of allelic variation after long distance colonization events and the limited amount of time in the new environment to increase genetic diversity by outcrossing. Fifty additional jointed goatgrass accessions from 13 different Eurasian countries were obtained from the National Small Grains Collection in Aberdeen, ID. The same 30 primers were used on the Eurasian accessions and again, few polymorphisms were detected.

These results suggest either a very limited amount of genetic diversity in

(continued on page 8)

Preventing Insects In Farm-Stored Grain

Good grain storage strategies can mean two to three years pest-free storage.

Colorado has low to moderate risk for stored grain insect problems. Following a few simple guidelines can result in 2-3 years of pest-free storage. Growers may be planning on holding grain longer than usual in today's farm economy so careful attention to good grain storage practices is important.
There are three basic strategies for preventing stored grain insect problems:
1. Eliminate existing infestations.
2. Prevent the establishment of new infestations.
3. Discourage the growth of infestations.

Eliminate infestations.
Thoroughly clean all debris and remaining grain from in and around the bins, including behind partitions, under floors, etc. Clean all transport and handling equipment. Even small amounts of infested grain can lead to problems. For example, 30 weevils held at ideal temperatures can become more than 10,000 weevils within five months.

Treat the bin with an approved bin treatment to kill any insects that survived the cleanup. Treat all interior surfaces, exterior surfaces around bin openings and a six foot band of soil around each bin. Fumigating inaccessible areas (such as under false floors) may be necessary.

Feed or destroy the first few bushels through handling equipment. This is sort of like rinsing the equipment out before use. Never store new grain on old grain, which is very likely to have some insects in it already.

Prevent infestations.
Treat grain going into long-term storage with an approved protectant. Monitor grain for insect activity and fumigate if problems are detected.

Discourage growth of infestations.
Store clean, dry grain. Dockage greatly improves the survival of stored grain insects, especially the "bran bug" types. Adjust the combine to minimize damaged kernels. Consider screening the grain before storage. Grain moisture content of 12% or less makes it very difficult for insects to grow and reproduce.

Frank Peairs

Weed control

(Continued from page 7)

jointed goatgrass or the inability of RAPD techniques to detect the diversity in this species. To improve DNA fragment resolution, polyacrylamide gel electrophoresis (PAGE) and silver staining techniques were employed on 16 selected accessions; thirteen Eurasian accessions, one from each country in our collection; and three U.S. accessions, one each from Colorado, Oklahoma, and Washington. The PAGE and silver staining techniques resolved several more DNA bands of various fragment size; however, very few polymorphisms were still detected.

AFLP (Amplified Fragment Length Polymorphism) fingerprinting techniques were subsequently employed. AFLPs are currently one of the most powerful methods to determine genetic sequence differences among closely related accessions within and among species. Ten primer combinations were used on a subset of 16 jointed goatgrass accessions (one from each of 13 Eurasian countries, and one each from CO, OK, and WA). These techniques generated 560 scoreable bands of which 28 were polymorphic (~5%). Apparently, jointed goatgrass is quite uniform genetically. The relatively large genome of jointed goatgrass may provide a substantial amount of plasticity, and a significant amount of genetic mutation may not have been required for its invasion and establishment in U.S. winter wheat producing regions.

Phil Westra

Wheat Fertilization Practices Surveyed

Low wheat prices and bad weather reduce fertilizer rates.

During the 1999 and 2000 wheat field days, farmers were surveyed about their fertilization practices. Different scenarios were presented to the farmers to determine how wheat price, fertilizer price, and weather influence fertilizer decisions at planting and in the spring. The 209 farmers responding to the survey represented 16 Colorado counties and three other states. Average wheat acreage per farmer was 1334 acres. Sixty-five percent of wheat farmers said that they soil test to help them make good fertilizer decisions.

Nitrogen fertilizer rates were much lower in the spring than in the fall (Table 1). In addition, only about one-fourth of farmers would apply fertilizer in the spring, as opposed to 80% in the fall.

Of those farmers questioned about a pre-plant scenario, about one-half said they would apply fertilizer pre-plant or at planting, 9% said they would wait until spring, and one-fifth said they would apply fertilizer at both times (Table 2).

Table 2. When would you apply fertilizer (scenario posed pre-plant)?

Fertilizer Timing	Pre-planting or Planting
Neither Fall nor Spring	20 %
Fall Only	51 %
Spring Only	9 %
Both Fall and Spring	20 %

Farmers planning to apply fertilizer at planting or pre-plant would choose anhydrous ammonia most often, with 11-52-0 as a distant second choice (Table 3).

Spring fertilizer applications favored urea ammonium nitrate (UAN) and urea.

In the spring, most farmers would not apply any other fertilizer besides nitrogen (Table 4). But at pre-plant or planting time, nearly three-quarters of farmers would apply other fertilizer in addition to N. After N, phosphorus (P) would be applied most often at pre-plant or planting, and in the spring.

Lastly, when wheat prices were high, N fertilizer

Table 1. How much N fertilizer would you apply?

Time of Fertilization	Pre-planting or Planting	Spring
Farmers that Would Fertilize	80 %	25 %
Nitrogen Fertilizer Rate	51 lbs N/acre	33 lbs N/acre

Survey

(Continued from page 9)

application rates would go up by 5 lbs N/acre. Weather also impacted N rates, but this effect was greatest in the spring. Pre-plant and planting applications would only be reduced by 1 lb N/acre due to bad weather. But spring applications would be reduced by 11 lbs N/acre when weather conditions were limiting wheat yields.

Jessica Davis

Table 3. What type of N fertilizer would you use?

Nitrogen Fertilizer Type	Pre-planting or Planting	Spring
anhydrous ammonia	63 %	14 %
11-52-0	17 %	7 %
urea ammonium nitrate	10%	32 %
urea	5 %	21 %
ammonium nitrate	3 %	18 %
other	2 %	7 %

Table 4. Would you apply any other fertilizer besides N?

Response	Pre-planting or Planting	Spring
No	26 %	56 %
Yes--no specific type named	4 %	2 %
P	56 %	30 %
S	2 %	2 %
P and S	6 %	0 %
P and S and Zn	4 %	0 %
P and Zn	--	2 %
Other	2 %	

web sites

http://www.colostate.edu/Depts/SoilCrop/extension/CropVar/index.html
CSU's Crops Testing page of 1999 Wheat Variety Performance

http://www.colostate.edu/Depts/CoopExt/PUBS/CROPS/pubcrop.htm
CSU's Cooperative Extension publications relevant to crops and soils.

http://www.ksu.edu/kscpt/
Kansas State University's Crop Performance page with Variety Trial Results.

http://www.usask.ca/agriculture/plantsci/winter_wheat/contents/htm
Winter Wheat Production Manual from Canada (University of Saskatchewan.

http://www.hpj.com
High Plains Journal on the net.

http://www.nal.usda.gov/
The National Agricultural Library (NAL), part of the Agricultural Research Service ofthe U.S. Department of Agriculture, is one of four national Libraries in the United States.

http://www.uidaho.edu/aberdeen/cereals/index.html
University of Idaho, Aberdeen Extension Cereals Program: "The Cereals Information Source."

http://www.ianr.unl.edu/ianr/agronomy/whttst/1999/whttst.htm
University of Nebraska Wheat Variety Testing results.

http://www.ianr.unl.edu/pubs/FieldCrops/
University of Nebraska's famous Nebsheets for Crop Production. Excellent information.

http://www.colostate.edu/programs/lifesciences/TransgenicCrops/
Information about transgenic crops including history, explanations of the process, figures on crops in use, and a quiz to test your knowledge about the issue of transgenic crops.

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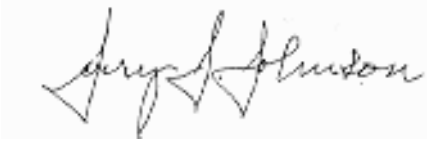

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