NATIONAL TEST-20 WHEAT PRODUCTION GUIDE

# STATE RECOMMENDATIONS FOR MAXIMUM ECONOMIC WHEAT YIELDS

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# WHEAT MANAGEMENT FOR OPTIMIZING YIELDS IN COLORADO

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## Introduction

Today's farm economic situation, low grain prices and relatively high input prices, necessitates the need to reduce unit cost of production. The 1986 Colorado Ag Statistics show that the average wheat yield in Colorado was about 35.8 bu/acre (1983-85). Variety trials conducted by CSU throughout Colorado show yields of 60 to 90 bu/acre for the higher yielding varieties indicating a great potential for increasing average wheat yields in Colorado. **Intensive crop management systems** have shown that increased wheat yields often reduce the unit cost of production. Intensive crop management systems usually require more inputs, resulting in greater input costs. However, the increase in yield and gross income generally offsets the increased production costs resulting in greater net profits.

General principles of intensive management applicable to Colorado will be emphasized in this discussion. Intensive crop management requires **flexibility of thought and action** in order to combine the appropriate production practices for each field situation. Intensive crop management begins with consideration of all crop production aspects prior to initiation of field work. A grower must have a clear perception of the production system that will maximize his efficiency, and then organize his resources to accomplish the necessary work in a precise and timely fashion. Wheat production aspects that must be considered include the following:

1) **soil and climate;**
2) **tillage method and water conservation practices (residue management); 3) setting a yield goal;**
3) **soil testing and soil fertility;**
4) **variety selection;**
5) **crop rotation;**
6) **plant populations and row spacing;**
7) **seeding date;**
8) **weed, insect, and disease control; and**
9) **harvesting and marketing.**

All factors must be integrated into the optimum production package. Even though many aspects may require no action in most years, the grower must know when inaction is an appropriate part of his production system to maximize profits. The successful grower will not only react to change in the crop but will anticipate problems and conditions that warrant action.

Outlined here are general procedures for implementing intensive wheat management systems in Colorado. These procedures will simply be guidelines to be followed by Colorado wheat producers for the purpose of optimizing wheat yields and economic returns (See also: reference #2).

Soil and climatic resources, particularly precipitation and soil water holding capacity, are significant constraints to the response of wheat to intensive management in Colorado. Most wheat production aspects are affected by water availability in the soil or plant canopy; hence, management of water resources is very important. Management for the next wheat crop therefore begins before the current crop is harvested by controlling preharvest weeds to conserve water. At harvest, provisions need to be made for spreading the chaff and straw behind the combine over the width of the header cut. This will facilitate seeding operations under reduced tillage conditions, improve the performance of many of the herbicides, and prevent phyto-toxic effects of the chaff on the next wheat crop. Wheat seeded into large amounts of chaff will often have reduced yields.

## Tillage and Water Conservation Practices

The dryland wheat producing areas of Colorado are dependent on stored soil water and growing season precipitation to provide sufficient water to satisfy the needs of the wheat crop. Therefore, consideration for water conservation practices should start at harvest time. Sufficient stubble should be left standing to provide good snow-trapping abilities during the winter months. Reduced and no-till farming practices conserve more water for crop production than conventional tillage methods which nearly eliminate surface crop residues by planting time. A combination of chemicals for weed control during the fallow period plus one or two tillage operations that leave more than 30% surface cover and much of the stubble erect may be the most economical. Need for tillage will vary with weed species and chemical costs to control the weeds. Remember, each tillage operation will result in the loss of about one-half inch of plant-available water or about 2 to 3 bu/acre in wheat yield. No-till methods of wheat production have averaged 7 bu/acre more than conventional till methods at Akron, CO (D.E. Smika, USDA-ARS).

## Setting Yield Goal

A challenging, but reasonable yield goal should be set. A yield goal of that achieved by the highest yielding varieties in the CSU Variety Trials located nearest your farm may be a reasonable challenge or **30 to 50% higher** than the county average. The yield goal is primarily a reflection of available water, financial resources, and a positive attitude to improve economic returns. As the level of plant-available water (soil plus growing season precipitation) increases, the yield potential also increases. A yield goal will be needed for determining soil fertility inputs, variety choice (lodging and disease resistance characteristics), and for making other management decisions that will affect both yield and profits.

## Soil Fertility

A soil test prior to planting is essential in any intensive crop management program. Soil samples from the surface 0 to 6 inch soil depth (tillage depth) should be collected from numerous locations (15 to 20 samples per 40 acres), composited, and then subsampled for routine soil test analyses. The routine soil test at the CSU Soil Testing Laboratory includes: soil pH, soluble salts, organic matter content, nitrate-N, phosphorus, potassium, zinc, iron, manganese, copper, lime (estimate), and texture (see: reference #4) for a cost of $12.00 per sample. In addition, the CSU Soil Testing Laboratory offers subsoil nitrate-N and sulfate-S analyses for $2.00 per sample. The CSU Soil Testing Laboratory uses an ammonium bicarbonate-DTPA extracting solution for the cation and anion analyses. For phosphorus, the ammonium bicarbonate-DTPA extract used by CSU or a sodium bicarbonate extract used by many other laboratories is recommended for Colorado soils and should be requested when having a soil analyzed for phosphorus. In addition to the 0 to 6 inch soil depth, the 6 to 12 and 12 to 24 inch soil depths should be analyzed for sulfate-S and nitrate-N. In addition, the 24 to 48 inch soil depth could be analyzed to evaluate the presence of any accumulation of deeper subsoil nitrate-N which can contribute N for crop growth and improved quality. A soil test is essential for determining the amount of fertilizer nutrients needed to achieve the desired yield goal. The soil pH, organic matter content, and texture information are important for determining which herbicides can be utilized for weed control without residual carry-over problems for the next wheat crop.

**Nitrogen:** Winter wheat requires approximately 2 to 2.5 lb N/bu to optimize yields and to maintain protein content of the grain. A value of 2.5 lb N/bu will be recommended for use in intensive wheat management systems in Colorado. The quantity of fertilizer N needed can be estimated as follows:

**a) Total N Requirement (lb/a) = Yield Goal(bu/a) x 2.5 lb N/bu**

**b) Fertilizer N (lb/a) = Total N - (Soil $NO_3$-N) - (O.M.-N)**

where soil $NO_3$-N equals the residual level of nitrate-N (lb/a) in the 0 to 2 ft or deeper soil depth and O.M.-N equals the amount of nitrogen (lb N/a) expected to be mineralized from the soil organic matter. The CSU Soil Testing Laboratory estimates that each 1% of soil organic matter will contribute 20 lb N/a. Therefore, the organic matter N contribution in equation "b" can be estimated from this relationship.

Fertilizer N should be applied in a manner to reduce volatilization losses and to achieve its most efficient use. Preferably, some N and P should be applied directly with the seed or near the seed at planting as a starter fertilizer. Do not exceed 10 lb N/acre directly with the seed on sandy soils and 15 lb N/acre on heavier textured soils. At least 50 to 75% of the needed fertilizer N should be applied at or prior to planting. In early spring, the remaining N should be applied with the fertilizer N rate adjusted for stand, moisture conditions, and other factors that appear to be influencing yield potential. Liquid N sources could be used as carriers for herbicides and applied at the appropriate time to achieve weed control. Some burning of the plant leaves may occur; however, at rates of 10 to 15 lb N/acre, yield reductions are generally not observed.

Method of application and source of N used may vary with the type of tillage system being used. For conventional tillage systems, the fertilizer applied during the fallow period should be incorporated immediately after

application. For no-till systems, the fertilizer N should be banded below the soil surface or in concentrated bands on the soil surface to reduce microbial tie-up and volatilization loss. When managed properly, source of N will generally have no affect on yield potential. Use the cheapest source of N that is compatible with your operation.

**Phosphorus:** Sufficient fertilizer phosphorus needs to be applied, using the cheapest source compatible with your equipment, to eliminate phosphorus as a yield limiting factor in intensive wheat management systems in Colorado. The CSU Soil Testing Laboratory recommends a soil test P level (ammonium bicarbonate extractable) of 8 ppm P as being adequate for optimum wheat yields in Colorado. This is equivalent to about a 16 ppm sodium bicarbonate extractable soil test P level. Multiplying ammonium bicarbonate extractable P levels by 2 will approximate the sodium bicarbonate extractable P equivalent. The current CSU Soil Testing Laboratory recommendation is 40 and 20 lb $P_2O_5$/acre broadcast incorporated for low and medium soil test levels, respectively.

At "low" soil test P levels, banding of the P fertilizer is more cost efficient in the short term because lower rates of fertilizer P can be used to achieve the same yield potential. At "low" soil test levels, broadcast P rates could be reduced by 50% and at "low to medium" soil test levels by 20% if the P fertilizer is to be banded with or near the seed. Placing both the N and P fertilizer in the same band has been a very effective fertilizer application method. Except for N, the entire quantity of all other fertilizer nutrients should be applied just prior to or at planting.

**Other Nutrients:** Potassium, sulfur, and micronutrients are generally not limiting nutrients for wheat grown on most Colorado soils. A soil test should be used to determine their needs. Application of K fertilizer (KCl form) has been shown in other states to help wheat plants resist some diseases, such as Take-All root rot, because of the beneficial effects of the chloride ion. Therefore, application of KCl may be beneficial if root rot is a problem. Straw strength may also be improved by K fertilization on K deficient soils. However, don't place more than 15 lb N + $K_2O$/acre directly with the seed.

Small responses (3 to 4 bu/acre) of wheat to S fertilization have been noted on some soils in Colorado in recent experiments, particularly sandy soils. If the soil test indicates a potential S deficiency, apply the recommended amount of S fertilizer. Do not apply ammonium thiosulfate directly with the seed.

**Variety Selection**

Selecting a high yielding, high protein variety adapted to your cropping district is of prime importance for optimizing economic returns. Good quality certified seed should be used. Following is a list of several high yielding winter wheat varieties for two cropping districts in eastern Colorado.

Hybrid winter wheats have been extensively tested in Colorado during 1983 to 1986. The average advantage of the best hybrids compared to the best pure line varieties has been about **6%** at the highest yielding dryland sites and/or under irrigation.

**Varieties For Cropping Districts/Situations**

| Dryland Northeast | Dryland Southeast | Irrigation |
|---|---|---|
| Vona | Vona | Vona |
| Tam 107 | Tam 107 | Tam 107 |
| Hawk | Hawk | Hawk |
| Siouxland | Sandy | |
| Carson | Carson | |

## Crop Rotation

Rotating winter wheat with other crops is important for breaking weed, insect, and disease cycles as well as reducing the detrimental effects of monoculture crop residues on the following crop. Observations made in eastern Colorado indicate that winter wheat yields tend to be higher where the previous crop grown before the fallow period was not winter wheat.

## Planting Date, Row Spacing, Plant Population

The best time to plant winter wheat in Colorado for optimum yield potential is between September 10th to September 25th. Soil temperatures in the seed zone should be less than 60 degrees F at the time of planting. Early winter wheat plantings generally have lower yield potentials because they are more susceptible to root rot diseases and insect damage and tend to use excessive stored soil water for unnecessary fall growth.

A row spacing of **7 to 12 inches** is generally associated with optimum wheat yield potential in Colorado. Row spacings greater than 12 inches have generally resulted in lower grain yields. A plant population of **500,000 plants** per acre is needed for optimum wheat yields in Colorado. Therefore, drills should be calibrated to deliver enough seed to achieve this plant population. The number of kernels in a pound of seed will need to be determined in order to calculate seeding rates. Kernel weight data can be used to make this determination. Since seed size varies, kernels per bushel vary considerably among varieties. Therefore, it is very important to determine the number of viable kernels being planted per acre.

Depth of seed placement is also critical for many of the semidwarf wheat varieties. The semidwarf wheats tend to have a very short coleoptile which can result in reduced emergence and plant stands if planted more than 2 inches deep. If one must plant deeper than 2 inches to place the seed in moist soil, then a high yielding standard straw length variety should be planted. No-till and reduced tillage cropping systems will generally reduce the need for deep planting because of better soil water conditions near the soil surface. A good drill is needed to place the seed accurately and evenly at planting. If using a no-till or reduced tillage system, the drill must also be able to handle large quantities of crop residue.

**List of Professional Expertise in Colorado**

| Professional | Agency | Phone | Area of Expertise |
|---|---|---|---|
| Dr. Ardell Halvorson | USDA-ARS | 345-2259 | Soil Fertility |
| Dr. Jim Quick | CSU | 491-6483 | Wheat Breeding, Varieties |
| Dr. John Shanahan | CSU | 491-1920 | Plant Stress |
| Mr. Steve Workman | CSU | 491-5061 | Soil Testing Laboratory |
| Dr. Hunter Follett | CSU | 491-6201 | Soil Fertility |
| Dr. Dwayne Westfall | CSU | 491-6149 | Soil Fertility |
| Mr. Jim Echols | CSU | 491-6201 | Variety Testing |
| Dr. Darryl Smika | USDA-ARS | 345-2259 | Tillage, Weed Control |
| Dr. Randy Anderson | USDA-ARS | 345-2259 | Weed Control |

## Weed Control

Optimizing wheat yields requires that weeds in the growing crop be controlled. Fields must be monitored closely to detect weed emergence. Proper identification of weed species present and selection of the most cost effective herbicides to control the weeds present in the growing crop is critical. Herbicides should be applied at the proper time (both weed and crop growth stages) to attain good weed control without damage to the crop. **Remember to read and follow the herbicide labels (see: reference #3).**

Herbicides used to control weeds during the fallow period prior to planting wheat should be carefully selected to avoid carry-over problems and to achieve the weed control needed at the least cost (see: reference #1).

## Insect Pest and Plant Diseases

Fields must be monitored several times weekly during the growing season to detect infestations of insects and diseases that may reduce crop yields. Wheat production can be reduced by planting too early because the wheat curl mite may transmit wheat streak mosaic from live corn, sorghum, millet, or volunteer wheat plants. Also, the Hessian fly threat is increased by early planting. Root rot diseases are significantly increased by planting early in warmer soils due to increased infection and/or increased water stress. Leaf diseases usually do not reduce yield potential or require fungicides in Colorado due to the very low canopy humidity and higher temperatures. Scouting at regular intervals is needed to ensure that fungicides are not needed.

## Growth Regulators

Recent growth regulator research in Colorado has not shown any great yield increases due to their application, particularly on the semidwarf wheat varieties. Benefits of growth regulators have been greatest for the taller standard wheat varieties to reduce lodging under high yield conditions.

## Tram Lines

Tram lines as used in Europe and discussed elsewhere in this handbook may be useful for intensive wheat management systems in Colorado for precision application of additional N fertilizer, herbicides, insecticides, and fungicides to the growing wheat crop. Use of tram lines will concentrate any soil compaction in specific areas and reduce the potential for sprayer skips in the field.