EASTERN U.S.

High Yield Wheat in the Eastern U.S.

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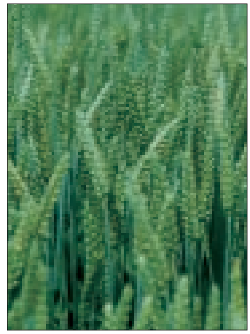

Record wheat grain yields in many Southeastern states are two and sometimes three times higher than state averages. Many come from research, others from farmers competing and learning how to harvest more of wheat's genetic yield potential. Such yield differences become a challenge to educators and a timely opportunity for wheat farmers. If yields can be increased, farmers stand to realize the economic benefits from lowering the unit cost of producing wheat.

> High yields begin with understanding wheat plant development and needs from the time of seed germination until physiological maturity. Any stress or shortage of a vital raw material will take its toll on grain development. Equally important is the timeliness of delivery of plant input needs including plant nutrition. This article evaluates those management practices that produce top wheat yields.

Today's Record Yields: Tomorrow's Production Goals

Very high wheat yields have been documented by researchers for more than 20 years. The highest verified wheat yield in North America of 205 bu/A was obtained in British Columbia research in 1988. Split nitrogen (N) applications, fungicides, and use of a lodging resistant variety were critical production factors in this high rainfall coastal region. Details on how the record yield was produced are available in *Better Crops with Plant Food*, Fall 1989 p.7.

TABLE 1. Components of wheat grain yield, increase with yield level.

Component	50-bushel	100-bushel
Heads per square foot	42	55
Grains per head	28	35
Seed size	32 grams/ 1,000 seed	40 grams/ 1,000 seed
Seeds per pound	14,188	11,350

During this same period of time, researchers were measuring yields of nearly 120 bu/A in states such as Maryland, Virginia and Georgia. In 1997, a University of Maryland scientist produced 151 bushels of wheat per acre by applying a system of high yield management practices to a fertile Coastal Plain soil.

Research Know-How Helps Farmers to Harvest Record Yields

Success in achieving high yields in research comes with the responsibility of transferring new production technology to farmers. One approach has been the development of yield contests organized and supervised by university Extension and industry wheat specialists. The initial success of this effort has been above expectations. High yields have been measured by farmers, and state average wheat yields have been improved. Some farmers have approached and even exceeded a yield level of 100 bu/A. At the same time, the educational efforts helped other farmers to improve their wheat yields. For example, the Virginia state average wheat yield improved at a rate of about 1.5 bu/A per year.

Scientists Focus on Three Major Components of Wheat Yield

Researchers have identified three management components that are critical to the development of wheat yield.

Plant population (heads per acre).

The initial seedling population must be uniformly distributed over the field. Tillering will then fulfill this requirement for high yield by establishing the potential for number of wheat heads per unit area.

Seed number per head. The number of seeds that can develop in a wheat head is established during the early weeks of rapid spring growth.

Seed formation (test weight). Many conditions influence the rate and/or amount of photosynthates produced and deposited in the developing wheat seed. Adequate nutrition and minimal plant stress due to drought, temperature, diseases, etc. serve to establish wheat seed size or test weight.

Each farmer's high yield system will be slightly different. Each field site will need specific attention due to differences in soil characteristics, yield potential, or even the timeliness of getting a job done. Success will come from producing more and larger seed per acre. **Table 1** provides an indication of how the yield components might change as the grain yield increases from 50 to 100 bu/A.

High Yields Require a System of Best Management Practices (BMPs)

Today's record wheat yields represent only a part of the crop's full genetic potential. Selecting a realistic yield goal is a first step. Five bushels over the highest previous field yield is often attainable. The next step involves an in-depth review and possibly overhaul of each and every production practice. Some practices build yield while others serve to protect that yield from being lost to weeds, insects, diseases, or other unfavorable growth conditions.

Nutritional needs of high yield wheat can seldom be met by soil reserves alone. Soil tests can provide a good measure of aglime requirements and nutrients available in the soil reservoir. Fertilizer nutrients must be selected and applied to make up any shortage in plant needs. The nutrition package must also be woven into the production system so as to best interact with practices such as seeding rate, row width, date of planting, variety selection, or tillage practices. It will also need to be adjusted for yield goal, basic soil fertility level, plant stress, or even adjusted within season due to unpredictable climatic conditions.

High Yield Management Practices To Consider

Certain management practices are universally important for attaining high wheat grain yields. Each can be adjusted to fit site-specific needs and sometimes readjusted within the season to compensate for uncontrolled climatic or plant stress conditions. The following practices are considered to be building blocks to higher yields and are in continual need of fine tuning.

Site selection. The investment in high yield management begins with the selection of fields with soils that are fertile and capable of achieving high yields.

Tillage and seedbed preparation. Reduced tillage saves trips over the field and helps to improve soil/water relations. A firm seedbed is needed for good soil-seed contact.

Liming and adjusting soil fertility. Soil test and where possible apply needed aglime at least three months before seeding. Consider adjusting soil test levels for phosphorus (P) and potassium (K) to the high range except on soils with very low cation exchange capacity.

Variety selection and seeding. Select performance tested varieties. Plant within the

TABLE 2. Nutrient requirements for high yield wheat production (Georgia).

	Wheat yield, bu/A						Straw removal
	40		70		100		
Nutrient	Uptake	Removal	Uptake	Removal	Uptake	Removal	3 tons
Nitrogen	75	46	130	89	188	115	35
Phosphorus (P_2O_5)	27	22	47	38	68	55	14
Potassium (K_2O)	81	14	142	24	203	34	80
Magnesium	12	3	21	5	30	8	5
Sulfur	10	2	18	4	25	7	3

ideal high yield window. Consider a 4-inch row width with fewer seeds per foot of row.

Nutrition management. Each of the three grain yield components are nutrition driven. Nitrogen can do its best when balanced with K, sulfur (S), P, and other needed nutrients. Multiple applications help to deliver nutrients prior to critical growth stages. The following example might help to illustrate timing fertility to crop need for low cation exchange capacity, Coastal Plain soils that are subject to intense periods of rainfall.

- Preplant: Consider about one-third of N, all the P, and half of the K, S, and boron (B) needs. This promotes seedling growth and tiller development and helps to establish the high yield requirement for heads per acre.
- Sidedress prior to early spring growth flush (Feekes 3.0): Consider half of the remaining N and the other half of the K, S and B needs. This minimizes the risk of nutrient loss by leaching and helps to insure optimum nutrition during the second critical yield development period.
- Sidedress prior to early boot stage (Feekes 4.5): Adjustments at this time can compensate for adverse weather, crop stress, or unexpected situations detected during field scouting.

Weed, insect, and disease management. Prevention or early detection and control of stress inducing factors are essential. Each can be very site specific. Rely on area specialists for appropriate diagnosis and control.

Field scouting. In-field inspections allow in-season adjustments to unexpected problems. Global positioning, yield monitoring, stress area mapping, plant nutrient analysis, etc. are additional tools to chart the course to improved yields.

Higher Yields Increase Wheat Needs for Certain Inputs

As wheat yield increases, the demand for a balanced menu of essential nutrients will also increase. Researchers found that wheat produces most of its dry matter between the boot and milk stages of growth. They reported that a crop producing 108 bu/A accumulated 224 lb dry matter per acre per day during this 20-day period. This is also a period of high nutrient need.

Plant nutrient requirements increase as grain yields increase (**Table 2**). Nutrient removal from the field depends on the amount of grain harvested and whether straw is burned or removed from the field. Thus, nutrient removal is a factor to consider when fertilizing the following crop.

Higher Wheat Yields Can Improve Profitability

Farmers, agribusiness and consumers have all benefited from research-based high yield wheat production systems. For example, Virginia Tech and the University of Maryland scientists evaluated the economic benefits of high yield production in 1997 (**Table 3**). The cost per bushel for many wheat farmers was about $3.50. This value was lowered to $2.55 with research yields of 125 bu/A and down to $2.15 in the top research management study.

Wheat growers understand that higher yields allow for increased profit per acre. How to do it and keep doing it is the challenge. The "systems approach" for improving wheat yield continues to be a proven way for more and more farmers and for university and industry wheat specialists in the East and Southeast. BC

TABLE 3. Estimated production costs of high yield wheat systems in Maryland (1997).

Yield level, bu/A	State average 60	Top wheat farmer 85	Past intensive research 125	Top 1997 research 151
Variable costs	141	176	209	215
Fixed costs	85	100	110	110
Total costs	$226	$276	$319	$325
Cost per bushel	$3.76	$3.25	$2.55	$2.15

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