MARYLAND

Intensive Wheat Research Provides Positive Yield, Profit Potential, and Nitrogen Efficiency Benefits

By F. Ronald Mulford

Maryland's intensive wheat management research began in the early 1980s. The goals at that time were to grow consistently 100 bu/A in research and to provide farmers with a wheat production system to double the 35 to 40 bu/A state average yields. By the late 1980s, research yields were consistently in the range of 110 to 120 bu/A, and educational programs were underway to introduce the system to farmers. Today, state average wheat yields are in the 60 to 65 bu/A range and increasing since the early 1980s at a trend of 1.5 bu/A per year as more and more farmers adopt an intensive wheat production system tailored to fit their site-specific conditions. Many farmers using intensive wheat production practices set and achieve yield goals of 80 to 110 bu/A.

The top yield in the 1997 Maryland intensive wheat research program was 151 bu/A. This is one of the highest yields recorded for wheat research in the state. These high yields were obtained in a systems management study where the goal is to increase yield levels, input efficiency and profit potential.

The current emphasis is on: (1) rate, timing, source, and efficiency of nitrogen (N) use; (2) source and timing of fungicides; (3) variety evaluation; and (4) no-till wheat production.

Systems Research and Yield

The top yield in 1997 was obtained by incorporating the following three practices into the intensive wheat production study.

(1) The first spring N application was made in mid-February. Many soil types on the Eastern Shore of Maryland have a sandy texture. Throughout typical winter periods there are many days when soil temperatures exceed 32° F. Each time this occurs, root growth is stimulated and N uptake occurs. After several of these occurrences residual N could be depleted and yield potential lost even though no top growth would be observed. It is environmentally responsible to apply only the amount of N wheat can utilize at any given time throughout the growing season.

(2) Ammonium sulfate [$(NH_4)_2SO_4$] was utilized to increase the ammonium (NH_4) portion of the total N applied and to provide sulfur (S), an essential and often limiting nutrient on coarse-textured soils of the area. Previous research has shown that using a higher proportion of NH_4-N compared to nitrate-N (NO_3-N) in both corn and wheat production has given significantly higher yields.

(3) Tilt® fungicide was applied as a post-heading treatment during flowering at Feekes growth stage 10.3. (This application timing is not supported by the current Tilt® label.) Tilt® is registered for use until the ligule of the flag leaf emerges (Feekes growth stage 8.) No endorsement of Tilt® being applied on the head is suggested.

The treatment described was a comparison to the recommended timing for Tilt®. Novartis is in the process of finalizing the data necessary to support postheading treatments which will add flexibility in managing late season foliar and heading diseases.

The intensive wheat production study was established at two locations, on Mattapex silt loam and Galestown sandy loam soils. Systems-type research allowed us to investigate the role of new technologies in a previously developed intensive production system to improve the total package. A high yield potential variety (Quantum 706) was planted on October 14, 1996. Soil test levels for phosphorus (P) and potassium (K) were at University of Maryland recommended high levels. The fungicide was applied at a 4 oz/A rate on the head at flowering.

A total of 141 lb/A N, 50 lb/A P_2O_5, 50 lb/A K_2O, and 48 lb/A S were applied as follows:

- Preplant incorporated: 100 lb/A of 21-0-0-24...$(NH_4)_2SO_4$
- February (at green-up): 60-50-50-24 applied as 39 lb of N from 34-0-0 (ammonium nitrate, NH_4NO_3) and 21 lb of N and 24 lb of S from $(NH_4)_2SO_4$ (21-0-0-24); P_2O_5 from 0-46-0 (triple superphosphate, TSP); K_2O from 0-0-60 (potassium chloride, KCl)
- Feekes GS 6: 60 lb N as urea ammonium nitrate solution (UAN) streamed in 10-inch spacing.

Intensive wheat production offers increased profit potential and N use efficiency.

Table 1 shows the results from two locations where these three practices were compared with a currently popular intensive wheat production system that is the same except for the timing of the fungicide application and addition of $(NH_4)_2SO_4$. A total of 141 lb/A N was used in both systems. Yields were increased 16 and 39 bu/A at the Mattapex and Galestown locations, respectively.

TABLE 1. Effect of N source and fungicide timing on wheat yields grown on the Eastern Shore of Maryland.

System	Mattapex silt loam	Galestown sandy loam
	yield, bu/A	
Current popular wheat production system	135	82
Potential new wheat production system	151	121
Yield increase	16	39

TABLE 2. Effect of N source, S and fungicide timing on wheat yield and N efficiency.

Nitrogen source for Feb. application	Fungicide	Yield, bu/A	N efficiency, bu/lb N
NH_4NO_3	none	86	0.61
$(NH_4)_2SO_4$	none	94	0.67
$(NH_4)_2SO_4$	Tilt® at Feekes GS8	102	0.72
$(NH_4)_2SO_4$	Tilt® at flowering	112	0.79

All plots received 21-30-30-24 in the fall; 60 lb N as 30 percent UAN at Feekes GS6; 60 lb N as either NH_4NO_3 or $(NH_4)_2SO_4$ in February.

Nitrogen Efficiency

There is a concern by some that research designed to increase crop yields will have a negative impact on N

TABLE 3. Historic yields, estimated N use, and N use efficiency on wheat in Maryland.

Year	Wheat yield, bu/A	Estimated N applied, lb/A	N efficiency, bu/lb N
1990	75 (intensive management)	100	0.75
1997	85 (intensive management)	110	0.77
1997	151 (top research)	141	1.07

use efficiency. Systems-type research, where all interacting controllable production practices are managed at optimum levels, has been successful in increasing yields and improving input efficiency. The 1997 results provide a good example. Nitrogen efficiency was increased from 0.96 to 1.07 bu/lb N used on the Mattapex soil and from 0.58 to 0.86 on the Galestown soil (data not shown). A second study on a Galestown soil provides another example (**Table 2**). Ammonium sulfate increased yields 8 bu/A over the NH_4NO_3 treatment with the same rate of N. Tilt® used at flowering increased yields 10 bu/A. Nitrogen efficiency increased as yields increased.

Historic yields, fertilizer recommendations, and Extension farm management records can give us some idea of the N use efficiency trends on wheat in Maryland (**Table 3**). These estimates indicate that while the use of N on wheat has steadily increased, a proportional increase in yields has maintained the level of N efficiency for wheat production. An estimate of the yields and amount of N used by those growers that have adopted intensive wheat production practices would indicate they have had no negative impact on N use efficiency. In addition, growers using intensive wheat production practices have a more vigorous growing crop with greater root systems, more crop residues, quicker ground cover, and improved water use efficiency. All these factors are associated with improved environmental quality. Our latest research would indicate there is a potential to increase N efficiency and the other factors associated with environmental quality when intensively managing wheat.

Profit Potential

Table 4 shows the cost per unit of wheat produced for various yield categories as estimated from Extension farm management production cost guidelines in the region. Profit potential as measured by the unit cost of production increases as yields increase. There is a need to put emphasis on educational programs that encourage farmers to implement the intensive wheat production system and to help them keep abreast of adjustments to the system as they are developed in research. BC

TABLE 4. Estimated total production costs for wheat and costs per unit of production in Maryland.

Item	1977 state ave.	Intensive wheat farmer	Past intensive research	1997 top research
Yield, bu/A	60	85	125	151
Variable costs:				
preharvest (except N)	105	125	140	140
N costs	22	31	39	39
harvest costs	14	20	30	36
Total variable costs	141	176	209	215
Total 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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