COLORADO

Irrigated Corn: 300 bu/A in Colorado

By W.M. Stewart

Greater profits come from higher yields since costs are spread over more units (bushels, bales, pounds, etc.), resulting in lower cost per unit of production. Efficient and profitable production involves lowering unit cost by increasing yield to a point of maximum net return. Several factors can limit crop yield. Variables such as fertility, light, hybrid, population, row spacing, and temperature can prevent the achievement of high yields, and thus greater profit.

Research conducted in Colorado in the late 1970s and the 1980s on irrigated corn investigated some of the barriers to achieving high yields. Corn yields in excess of 300 bu/A were recorded on the western slope during the studies. This discussion focuses on some of the available details of that research.

The principle investigator in the Colorado research, Dr. Sterling Olsen, in one publication observed: "We don't know the limit to yield. High yields result from a combination of many growth factors which may limit or increase growth in a dynamic way. And we are working to find out what these factors are."

The effects of nitrogen (N) rate, plant population, and variety on corn yield were reported (**Table 1**). Interesting interactions among these three factors were observed. **Figure 1** illustrates these interactions in terms of percent yield increase. Yields were enhanced by increasing plant population with all varieties except for one at the lowest N rate. With all but one variety there was a positive interaction between N fertilizer rate and population. In other words, the higher plant populations had the potential to produce substantially higher yields with higher levels of fertility.

Another aspect of the study involved the investigation of corn response to enhanced ammonium (NH_4) supply. The hypothesis tested in these field experiments was that a combined supply of NH_4 and nitrate (NO_3) forms of N would increase N use efficiency and yield compared to either form alone. Research fields were furrow irrigated. Initial soil test phosphorus (P)...sodium bicarbonate ($NaHCO_3$) extraction...was high...14 parts per million (ppm)...and soil test potassium (K) was 110 ppm (medium). Phosphorus and K fertilizers were broadcast and incorporated preplant at the rates of 100 lb P_2O_5/A and 200 lb K_2O/A. Where N fertilizer application was split, the mid-season applications were

TABLE 1. Effect of population, variety, and N fertilizer on irrigated corn yield.

Variety	N rate, lb/A	Population, plants/A 26,596 Yield, bu/A	37,985 Yield, bu/A
Variety A	150	192	195
	225	194	214
	320	205	229
Variety B	150	204	212
	225	226	241
	320	221	239
		Population, plants/A 38,826 Yield, bu/A	**46,429**
Variety C	150	216	222
	225	214	219
Variety D	150	232	226
	225	244	261

made through irrigation water. A nitrification inhibitor (nitrapyrin) was applied with the N fertilizer in some treatments to retard the conversion of NH_4 to NO_3.

Corn yields were increased with treatments that increased the proportion of available N in the NH_4 form by applying the nitrification inhibitor with NH_4 forms of N fertilizer.

Table 2 shows the effect of N application timing, nitrification inhibitor, and plant population on corn yield. The use of the nitrification inhibitor with split N applications increased yield by approximately 35 bu/A. Where no nitrapyrin was used, neither higher population nor additional N fertilizer increased yield. This suggests that delaying nitrification of NH_4-N resulted in a more favorable N balance.

Another trial involved the comparison of several N fertilizer sources in split applications (**Table 3**). Where nitrapyrin was applied with urea-ammonium nitrate (UAN) solution, corn yield was substantially higher than where none was applied with UAN or the other N sources. These data indicate that balancing N nutrition is important in maximizing N use efficiency and optimizing corn yield.

Dr. Olsen and other authors emphasized that an adequate supply of K enhances NH_4 utilization and improves yield. Potassium counteracts the possible toxic effects of NH_4 nutrition by activating enzymes that function in NH_4 assimilation. This prevents accumulation of toxic concentrations of NH_4 in plant tissue. Furthermore, the presence of adequate amounts of K are necessary for synthesis of organic acids and translocation of amino acids and carbohydrates in plants. Other scientists have observed that when corn absorbed N as NH_4 there were significant yield increases at higher K rates, while no yield increase was observed at higher K rates with NO_3-N.

This brief review clearly demonstrates the effects of a few of the variables and their interactions affecting crop yield. As fundamental barriers to the achievement of higher yields and profit are overcome, other barriers surface. For example, improved hybrids may have the potential for significantly higher yield, but that yield will not be expressed without sufficient inputs such as adequate and balanced fertility. BC

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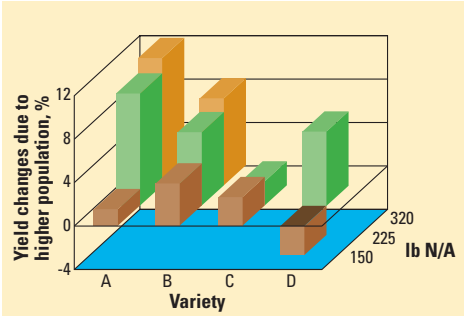

Figure 1. Influence of N fertilizer rate on yield response to higher plant population of four corn hybrids.

TABLE 2. Effects of N application timing, nitrapyrin, and plant population on irrigated corn yield.

N source	Application date[1]	Nitrapyrin	Population, plants/A	Yield, bu/A
Ammonium nitrate	5/5	no	30,165	209
Anhydrous ammonia	6/23	no	38,441	200
	7/25	no		
Ammonium nitrate	5/5	no	28,314	222
Anhydrous ammonia	6/23	yes	37,679	235
	7/25	yes		

[1]100 lb N/A/application

TABLE 3. Effect of N fertilizer source and nitrapyrin on irrigated corn yield.

N source	N rate, lb/A	Application date	Nitrapyrin	Yield, bu/A
UAN	100	4/19	no	
	200	7/9	no	261
UAN	100	4/19	no	
	200	7/9	yes	270
Urea	100	4/16	no	
	200	7/9	no	249
Ammonium nitrate	100	4/16	no	
	200	7/9	no	252