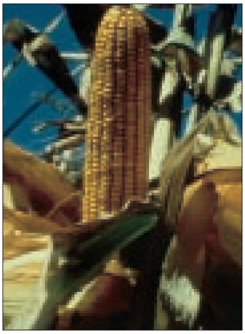
MIDWEST

Producing High Corn Yields – Herman Warsaw's Challenging Legacy



By H.F. Reetz, Jr.

Herman and Evelyn Warsaw bought their Illinois farm in 1941. It had a USDA-established corn yield of 38 bu/A. Herman knew he needed to build the yield potential if his operation was to survive. By 1960, he had reached a good average production level, but decided to try to find the limits of the fields he was farming. He started building fertility levels, increasing plant population, and looking for other limiting factors. Fifteeen years later, in 1975, he set a new world corn yield record of 338 bu/A and gave a challenge to university and industry researchers. As a new crop production systems researcher at Purdue University, I had produced my first 200 bu/A corn yield that year, yet it didn't sound very impressive compared to this Illinois farmer's achievement.

> Herman Warsaw developed a corn production system that got the attention of other farmers and agribusiness when he set a new world corn yield record in 1975. His deliberate approach to removing yield-limiting factors and gathering and acting on information challenged the thinking of all those who knew him. His accomplishments left a legacy for all of us to build on.

Fortunately, PPI took some leadership in getting a group of us together to visit the Warsaw farm and then for some brainstorming on what we could do to achieve higher yields on our research plots.

Herman continued to refine his production system, constantly looking for the next limiting factor to be eliminated. From 1975 to 1989, he produced five yields over 300 bu/A, with a 15-year average of 274 bu/A. In 1985, he eclipsed his own earlier record with a new world-record yield of 370 bu/A from a measured 1-acre area in his field. I rode the combine with Herman as he harvested the crop and watched the machine creep along at 1.2 mph while the electronic monitor flashed "ROCKS" due to the heavy volume of ears coming into the machine.

The keys to Herman Warsaw's success in corn production are found in his diligence in observing the soil and the crop, gathering information, revising the plan, and carefully implementing the details. Deep tillage, working in the residue from a 200 bu/A crop and still leaving the residue from another 100 bu/A crop on the surface, helped increase soil tilth, support a healthy earthworm and micro-organism population, and incorporate applied nutrients into the root zone. High populations helped build the crop canopy early to capture all of the available sunlight, to support development of large, well-filled ears, and to produce massive amounts of crop residue that contributed to further improvement in soil tilth.

Herman's field had very high phosphorus (P) and potassium (K) levels, not just in the surface layer, but throughout the root zone. So the plants were assured of an adequate supply throughout the season, regardless of rainfall and soil moisture distribution. He used maintenance applications of P and K from commercial fertilizer and periodic heavy applications of manure. **Table 1** shows the results of incremental soil tests taken in 1978 from different areas of his fields. Note that the high yield areas are significantly higher than the fence-row samples (representing unfertilized, native prairie soil).

Soil test levels from a 10-inch sample

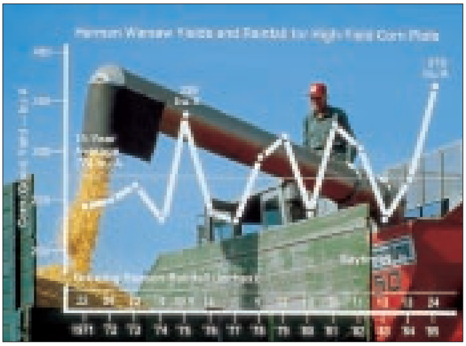
depth collected on August 6, 1985, in the field that produced 370 bu/A of #2 corn, are shown in **Table 2**.

The corn hybrid, FS 854, was planted at 37,000 seeds per acre on April 25. Harvest was on October 17, with a final stand of nearly 36,000 plants per acre. Harvest moisture was 22.2 percent.

Was it profitable? Most decisions ultimately come to dollars and cents. Analysis of Warsaw's production system costs for 370 bu/A corn is shown in **Table 3**.

Based on the 370 bu/A yield, Herman's out-of-pocket costs were $1.25 per bushel, and total costs were $1.60 per bushel. He sold the crop that year for $3.09 per bushel. High yield management paid a good return...more than $550/A. This return more than covered the costs of building the high yield system. But the real payoff came in what he learned from the plot that could be applied on the rest of his 400 acres of corn production. The intensive, high population management had too many risks (mostly of lodging) to be used on the whole farm, but he was able to produce a farm-average of 200 bu/A in 1985...considerably above the average for the area...by implementing much of what he learned from his "research" plots.

Herman Warsaw was a student of corn... and of the soil and water resources that he managed in producing it. He loved to talk about his passion for increasing corn yields and at the same time protecting those resources which he had carefully improved over the years. While his explanations didn't always match the "science", there was no question that this man knew more about growing corn than most farmers or researchers.



Herman Warsaw of Saybrook, Illinois, produced outstanding corn yields and encouraged others to question and study the factors limiting production.

Over the last three or four years Herman was farming, he annually hosted an average of about 1,000 visitors to his farm...by busloads or as individuals. They came to see first-hand what a 300 bu/A corn production system looked like. Farmers, researchers, government officials...a wide range of interests from around the world...walked the fields, looked at the implements, and listened to the expert tell his story under the old maple tree.

A videotape was produced by the University of Illinois in 1983-1985, to docu-

TABLE 1. Soil test results collected from Herman Warsaw's farm in March 1978.

		Sample depth, inches					
		0-3"	3-6"	6-9"	9-12"	12-18"	18-24"
P-1, lb/A	Normal production area	202	134	76	38	28	20
	High yield-lighter subsoil	234	192	58	20	12	8
	High yield-darker subsoil	252	204	108	42	44	36
	Fence row sample	44	26	8	6	6	4
K, lb/A	Normal production area	914	470	346	348	366	400
	High yield-lighter subsoil	740	404	270	232	300	382
	High yield-darker subsoil	1,400	556	412	332	328	320
	Fence row sample	652	452	320	338	284	262
O.M., %	Normal production area	6.6	5.4	5.5	5.4	4.1	3.6
	High yield-lighter subsoil	5.9	5.7	4.9	4.9	3.2	1.4
	High yield-darker subsoil	4.7	4.3	4.0	3.7	4.3	4.3
	Fence row sample	5.8	4.5	4.0	3.3	2.7	2.3
pH	Normal production area	5.5	5.7	5.7	5.6	5.8	5.9
	High yield-lighter subsoil	5.0	5.5	5.8	6.1	6.1	6.6
	High yield-darker subsoil	5.2	5.7	5.6	5.5	5.3	5.4
	Fence row sample	6.0	5.9	6.0	5.8	6.0	6.7

TABLE 2. Soil test levels from a field that produced 370 bu/A corn in 1985.

Phosphorus P-1	161 lb/A
Potassium	800 lb/A
Magnesium	871 lb/A
Calcium	4,850 lb/A
Cation exchange capacity	23 meq/100g
Sulfate-S	35 ppm
pH	6.0
Organic matter	5.3%
Zinc (Zn)	Good
Iron (Fe)	Good
Boron (B)	Good
Copper (Cu)	Good

ment Warsaw's high yield system. This tape has been used throughout the world to teach people about the approach this master farmer used to set a new standard in corn production. Of greater importance, however, it helps keep alive the legacy left by Herman Warsaw. That is, we can substantially increase yields and profits in crop production by paying attention to details and eliminating yield-limiting factors...while at the same time being responsible stewards of our soil and water resources.

Physiology of High-Yield Corn

The late Dr. Richard Johnson (Deere and Company) projected the theoretical maximum corn yield in the Midwest to be about 490 bu/A. (*Better Crops with Plant Food,* Winter 1981-82, p. 3-7). Using a 120- to 130-day growing season, with about 90 days of full crop canopy and a daily solar energy input of roughly 20 billion calories per acre, the corn crop could produce 625 lb/A of dry matter per day [allowing for about one-third of the fixed carbon dioxide (CO_2) to be re-released in respiration]. Assuming 25 percent of the dry matter production goes to root growth and 55 percent of the remaining above-ground dry weight goes to the grain, a corn crop producing dry matter at 625 lb/A/day for 90 days would yield 490 bu/A of #2 corn.

Areas of the western U.S. with higher solar energy rates per day could have increased potential. A corn yield potential estimate of 600 bu/A has been made by scientists in Ontario based on hydroponics (see page 9 of this issue).

Dr. Richard Hageman, University of Illinois plant nutrition specialist, studied the mineral nutrition and physiology of the FS 854 corn hybrid that Herman Warsaw used for his record yields and concluded that the high K level of the soil helped maintain plant growth regulator activity needed to keep nitrogen (N) uptake and utilization functioning at full capacity about two weeks longer at the end of the growing season. With lower K levels, the N uptake system in this hybrid started to break down, and the plant began breaking down photosynthetic enzymes in the lower leaves to meet the N requirement of the developing grain. This reduced the supply of sugars available to feed the roots, further decreasing the ability to absorb water and nutrients. By keeping the lower leaves healthy and functional for about two weeks longer in the season, the potential for building higher grain yields was realized.

TABLE 3. Production costs, $/A, that produced 370 bu/A corn in 1985.

Input category	**Cost per acre**
Fertilizer	$201.05
Lime	$10.42
Herbicide/insecticide	$39.10
Seed	$26.72
Field operations, harvesting, and drying	$186.50
Total out-of-pocket costs	**$463.79**
Estimated land cost	$130.00
Total production costs	**$593.79**

Renewing the High-Yield Challenge

Herman Warsaw didn't have tools such as computers or satellites, but his style was definitely site-specific. The impact of his challenge and the PPI/FAR program that helped get university and industry researchers to address it have been great. We must encourage the new generation of researchers and farmers to keep the high-yield challenge alive. Continued progress depends on their becoming infected with the Warsaw passion for eliminating that next limiting factor to produce higher yields and responsibly manage the production resources they have available. BC

Dr. Reetz is PPI Midwest Director, located at Monticello, Illinois. E-mail: hreetz@ppi-far.org. *We gratefully acknowledge the contribution of Darrell Smith,* Farm Journal, *for his assistance in recovering some of the information in this article.* *Herman Warsaw passed away in 1989.*