Dynamic cropping systems more productive over long term

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Don Tanaka

Don Tanaka, ARS, talks about dynamic Cropping systems at ARS-Mandan field tour.

MANDAN, N.D. - ARS researchers have found a "dynamic" cropping system provided the best yields over a decade when compared with other cropping systems.

Don Tanaka, ARS soil scientist, spoke to producers and others at the Area 4 SCD Cooperative Research Farm and Northern Great Plains Research Laboratory's forum recently in Mandan.

Tanaka has been conducting long-term research on a field scale since he arrived at the ARS center in Mandan in 1991, and continuing field-scale crop research begun at the center in the 1980s.

The dynamic cropping system was started 10 years ago and it is based on the crop sequencing calculator that researchers at the Mandan ARS developed.

"With the dynamic system, we never know what we are going to put in as a crop until after harvest when we check the calculator," Tanaka said.

For example, when the forecast called for a wet spring, they might put in sunflower or corn which would use a lot of water.

Scientists, including Tanaka, have developed several versions of the crop sequence calculator over the years.

Basically, it uses data from growing 100 combinations of 16 crops and evaluates the crops for both wet and dry years, as well as calculating returns.

A producer can see what is the best crop to put in after another crop based on what kind of growing season is expected, and other variables such as soil type, weeds, diseases, and amount of soil moisture.

Other cropping systems that were compared with the dynamic system included a cereal crop-fallow system began in 1984; a continuous spring wheat system that has some acreage in no-till for 26 years and other acreage in conventional till for 15 years; a spring cereal, winter wheat and sunflower system (three-year rotation) in place for 26 years; and a spring cereal, winter wheat, dry pea, corn, and soybean (five-year rotation).

Scientists wanted to know if crop diversity would improve crop yields.

On the average, the growing season from 2001 to 2010 received more than 9 inches of rain, which is about normal for the area, according to Tanaka.

He said there was a large range of yields over that 10-year period, indicating years of stress from drought and good growing seasons with good precipitation.

Examples of the range of yields in the systems was the cereal crop/fallow had 20.4 bushels per acre in 2006, but 53.8 bushels per acre in 2004.

The average over the decade for the cereal crop/fallow cropping system was 38.6 bushels per acre.

The continuous wheat system had a 16.8 bushel per acre yield in 2006 and averaged 52.5 bushels per acre in 2004.

The average over the decade for the continuous wheat cropping system was 34.4 bushels per acre.

The three-year rotation had a 6.7 bushel per acre yield in 2006 and a 53.5 bushel per acre yield in 2004.

The average over the decade for the three-year cropping system was 32 bushels per acre.

The five-year rotation had a 9.3 bushel per acre yield in 2006 and a 52.1 bushel per acre yield in 2004.

The average over the decade for the five-year cropping system was 32.9 bushels per acre.

The dynamic cropping system had a 20.4 yield in 2006 and a 52.2 bushel per acre yield in 2004.

The average over the decade for the dynamic cropping system was 38.3 bushels per acre.

"The dynamic cropping system does improve yields for wheat when we have stress for spring wheat," Tanaka said.

It might look as if the cereal crop/fallow system got better yields than the dynamic cropping system. After all, it was 38.6 bushels per acre compared to 38.3 for the dynamic system.

"But you have to remember, you are not getting a crop every year. You grow wheat one year and the land is in chemical fallow the next year," Tanaka said.

ARS scientists also discovered the dynamic system made the best use of precipitation.

Tanaka said the dynamic system had 162.5 pounds per acre of precipitation use efficiency (PUE) compared with 100 pounds per acre of PUE in the crop/fallow system.

"The dynamic system had a 62 percent better use of precipitation than the crop fallow system," he said.

They also found out that cropping systems need to be greater than three years to take advantage of crop diversity. Cover crops planted after harvest could help with this.

Another finding was that continuous wheat yielded as good as the dynamic system but the inputs were much greater.

"All it takes is one error and you can end up with a major problem," Tanaka said. He summed up by saying dynamic cropping systems provide the greatest opportunities for crop diversity, while at the same time making the best use of precipitation.