

NEWS & VIEWS

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High Fertility— Extremely Important with Weather Extremes

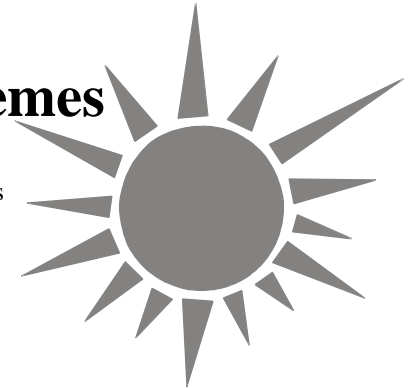
AS FINAL PLANS are made for the 2000 growing season, take another look at nutrient levels. Review soil tests and fertilizer plans to be sure nutrient needs of the planned crops will be adequately met. Many areas came through the 1999 season with a shortage of soil moisture, and winter precipitation has been below normal. While it is too early to predict seasonal weather patterns, dry areas are likely to occur again in 2000. Crop yields can best be protected by maintaining adequate nutrient levels.

South-central Ohio was an area of severe drought in 1999, with corn yields in the 40 to 70 bu/A range common. Yet farmers with high soil test levels were able to produce over 150 bu/A in that area. Similar results were reported in other areas.

Some key points to think about in reviewing plans for the 2000 season:

- Drought will have less impact on yield where nitrogen (N), phosphorus (P), and potassium (K) availability are high throughout the growing season.
- Yield increases in response to added fertilizer may actually be higher in a dry year than in a normal year.
- Good fertility stimulates earlier and deeper root growth, making more efficient use of available water and ensuring season-long nutrient uptake.
- Where drought-damaged crops were harvested for hay or silage last year, nutrient removal may have been greater than if a normal grain crop had been harvested. Be sure to adjust crop removal estimates.

- Soil compaction increases the impact of drought stress. Steps to eliminate compaction will help improve root growth and water use efficiency.
- Because root growth will be limited in a dry year, high soil tests and deep placement may be even more important to ensure adequate season-long supplies of nutrients.
- High P is important to early root growth.
- Adequate K is necessary for healthy plant water relations. Opening and closing of stomata, which regulate carbon dioxide (CO₂)...photosynthesis... and water vapor exchange (transpiration) between the leaves and the atmosphere, are controlled by K level in the leaves. If K is inadequate, transpiration water loss increases and photosynthesis decreases.
- Development and maturity are speeded up by high fertility levels, allowing the crop to get through critical flowering stages earlier, perhaps before drought stress occurs.
- Selecting varieties with deeper, more vigorous root growth patterns may be beneficial, so long as their yield under normal conditions is also good.
- Other management practices such as early planting, conservation tillage, and adequate weed, disease, and insect control measures also help keep the crop growing at peak performance and enhance water use efficiency.



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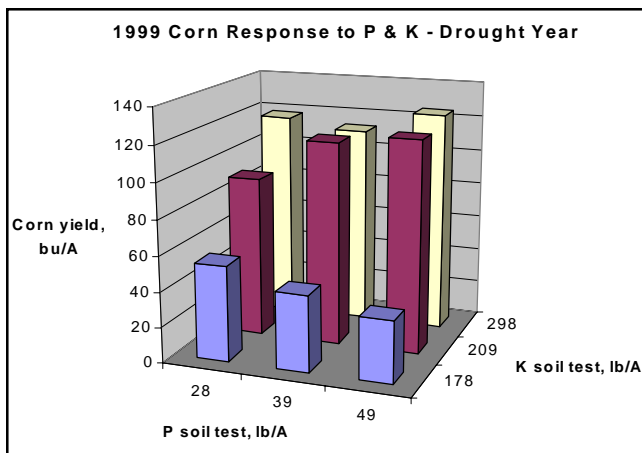


Figure 1. Corn response to different soil test levels in a corn-soybean rotation. Soil tests were taken after the 1998 soybean harvest.
Source: Dr. Jay Johnson, Ohio State University, 1999.

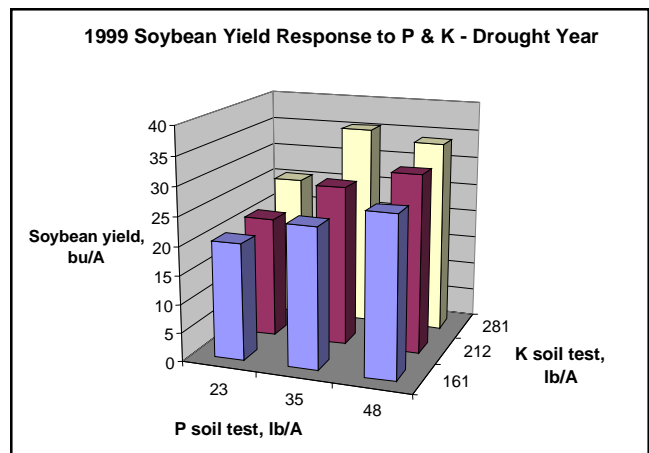


Figure 2. Soybean response to different soil test levels in a corn-soybean rotation. Soil tests were taken after the 1998 corn harvest.
Source: Dr. Jay Johnson, Ohio State University, 1999.

Long-term field studies with a range of soil test levels provide a unique opportunity to quantify the importance of soil test level in reducing the impact of drought stress. Results for 1999 from a long-term P and K rate study on a corn/soybean rotation conducted by Dr. Jay Johnson in Ohio showed a dramatic response to high fertility as a means of combating drought effects on yield (**Figures 1 and 2**).

This is one of many examples in 1999 supporting the need to maintain high soil tests to reduce the impact of drought stress. Drought makes it difficult for a plant's roots to supply adequate nutrients throughout the season. When water supplies are short, a higher soil test level supplies the plant with more nutrients in a limited root volume. Shortage of nutrients reduces physiological functions of the plant, making energy transfer and other growth processes less efficient.

Water use efficiency is perhaps the most seriously affected by moderate water stress. Stomata tend to lose their control of water loss from the leaves, further increasing the stress. Photosynthesis rate declines and respiration tends to increase, so that net accumulation of sugars is reduced. Since the main component of crop yield is converting light energy into chemical energy through the accumulation of sugars, there is a direct effect on yield potential.

All of these processes are better maintained under stress conditions if adequate supplies of nutrients are available throughout the growing season.

For the Ohio study, corn yields were severely depressed at low soil test levels, but impact of the drought was greatly reduced with high P and K soil test levels, highest yields being where P and K soil tests were highest (**Figure 1**).

The most dramatic effect was the response to higher K soil tests. There was a positive interaction between P and K soil test levels. Increasing P levels at low K levels resulted in decreased yield, possibly due to interaction with other nutrients. Increasing K soil test levels resulted in increased yield. At higher K soil test levels, there was also an increase in yield as P increased. Farmers, dealers and Extension advisers throughout the Midwest have reported that fields with high soil test levels were able to produce near-normal yields, while fields testing medium or below suffered major yield losses from the dry weather during the 1999 growing season. The benefits of high fertility are much more evident in a stress year than in a normal year.

Soybean yields for this study in 1999 also responded to higher P and K soil test levels (**Figure 2**). Having adequate nutrients appeared to be more important in a stress year than in a normal year. There is also a positive P and K interaction, so that highest yields were obtained where both P and K soil tests were at the highest level.

Generally it is not advisable to make decisions on the basis of one year's data, but this study has been in place for over 25 years, and the data series includes several examples where this same type of response is seen in dry years. The effect is masked when years are averaged together, so it is important to look at the individual year in this case. The 1999 response was nearly double the response that occurred under similar drought conditions in the mid-1970s, probably due to the increased yield potential of today's hybrids compared to those of 25 years ago.

If dry conditions are expected, one of the best defensive strategies is to be sure soil tests levels are high. If good conditions prevail, you have lost nothing, because the higher nutrient supply will help increase yields.

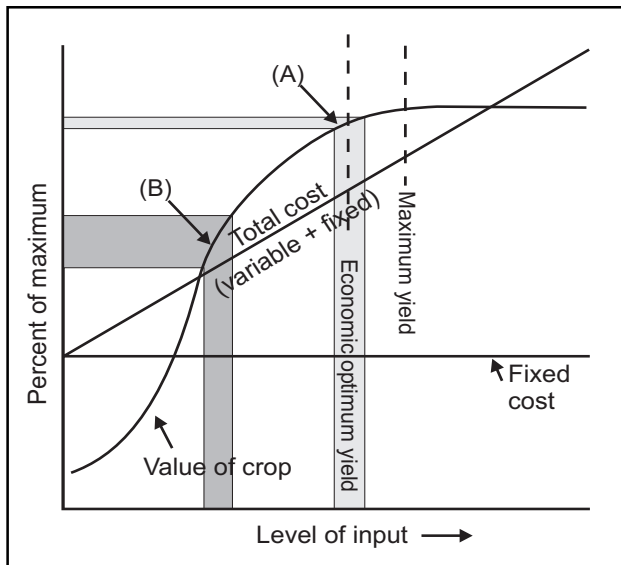


Figure 3. Typical response of crop to an input such as fertilizer and generalized relationship to costs and production.

Farmers faced with the double problem scenario of moisture shortage and low crop prices and desiring to cut input costs may be tempted to cut back on inputs such as potash. **Figure 3** illustrates why such cut-back decisions may be the wrong choice. Note the impact of reducing the application rates of a production input at different levels of management. The light gray band (A) represents the effect of reduction of input (such as potash fertilizer) when managing at a point near economic optimum...maximum economic yield (MEY). This is usually within the range where maintenance-only application rates are needed. The dark gray band (B) represents the effect of the same reduction of input when managing at a point where buildup applications are needed. Reduction of input in this zone in this example results in yield losses of several times the loss caused by the same input reduction when managing in the zone near economic optimum. Managing for high yields, near the MEY level, provides the greatest flexibility in management decisions.

Fortunately, the best strategy for dealing with an expected dry year is also the best strategy for a good year...that is, **plan for a good year**. Adequate nutrition is essential to take advantage of the good growing seasons, but it is also the best management approach to preparing for a drought. Adequate supplies of N, P, and especially K, must be readily available to keep the crop healthy and vigorously growing all season long.

Under dry conditions, an adequate nutrient supply will ensure early root development and deeper penetration. If a good root system can be established early, the plant will be better equipped to explore deeper in the soil profile for water and nutrients later in the season.

Review recent soil tests. Areas that are medium or below should be considered for additional fertilizer

application. If detailed sampling (grid- or management zone-based) has been done and variable-rate application equipment is available, this may be an opportunity to focus limited fertilizer dollars where they will do the most good. In any case, shortcutting P and K supplies will likely lead to shortcutting yield potential and profits. If field-average management is used, it is important to move to high soil test levels to be sure no areas of the field have limited nutrient supplies.

**Best strategy for a poor year:
Plan for a good year.**

**Plan for a bad year and
you are guaranteed to get one.**

Contact PPI/PPIC/FAR on the Internet

You can reach the Potash & Phosphate Institute (PPI), Potash & Phosphate Institute of Canada (PPIC), and Foundation for Agronomic Research (FAR) on-line. Use one of the following as a URL to reach the web site: www.ppi-far.org or www.ppi-ppic.org.

There is increasing variety and diversity of information now available in electronic form at PPI/PPIC/FAR, with more additions and changes to the web site coming soon. Current and back issues of *Better Crops with Plant Food*, *Better Crops International*, *News & Views*, and other publications are available as pdf files.

For further information, contact PPI headquarters by phone at (770) 447-0335 or fax (770) 448-0439.

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