Phosphorus Nutrition Improves Plant Disease Resistance

Phosphorus improves resistance and tolerance to diseases that can reduce crop yield and quality. The protection that P provides is often related to the role it plays in plant development. For example, P is important in early root development and plays a key role in promoting proper seed development. In addition, it provides the stored energy necessary for driving major plant functions.

Phosphorus (P) is an important element in a complete and balanced fertility program that can improve crop health and reduce the incidence and severity of many crop diseases.

Root System

One of the best defenses against root diseases is a vigorous and well developed plant root system. The role that P plays in promoting rapid root development in young plants is well established. Under adverse or stressful conditions early root development is especially important. The negative impact of root diseases in several crops may be reduced by the application of P fertilizer.

Application of 100 lb P_2O_5/A to a soil low in P in Canada reduced yield losses from common root rot from 15 percent to 9 percent with four varieties of barley. Applied P reduced disease infection of barley in other studies from 42 percent without P fertilization to 21 percent with P.

In Oregon, researchers recommend banded application of P where there is a high probability of take-all root rot infection. The scientists noted that response to banded P is likely when take-all is present in soils that would otherwise be non-responsive. In addition, the Oregon research demonstrated the importance of the interaction between banded P and chloride (Cl) fertilization and its effect on wheat yield in a soil with high risk of take-all infection (**Table 1**).

Stem and Leaf Diseases

The likelihood of stem and leaf disease problems increases with crop stress and nutrient shortages and imbalances. The results of a Virginia experiment, illustrated in **Figure 1**, show the effect of P and potassium (K) fertilization on reduced pod and stem blight infection of soybeans.

In a Kansas study, wheat yields were increased and leaf rust pressure was decreased by applying adequate P and K fertilizer. Yields were increased by as much as 30 bu/A, and leaf rust was reduced by an average of 27 percent by the improved nutrition provided by both P and K fertilization.

Foliar applications of P, K, and P+K to cucumbers in a greenhouse study provided up to 94 percent systemic protection from powdery mildew. The scientists conducting this study concluded that "The efficiency of induction of systemic protection and curative properties of phosphate and potassium fertilizers

TABLE 1. Influence of P and Cl fertilization and planting date on wheat yield.

	Planting date			
	October 4		October 27	
	Cl rate, lb/A			
P_2O_5 rate, lb/A	35	435	35	435
	Yield, bu/A			
0	41	50	61	74
60	40	73	65	82

High soil test P and high risk of take-all infection.

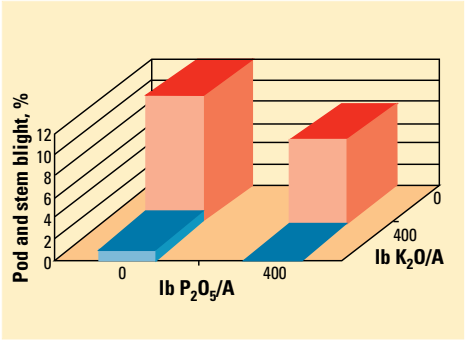

Figure 1. Effect of P and K fertilization on pod and stem blight infection of soybeans.

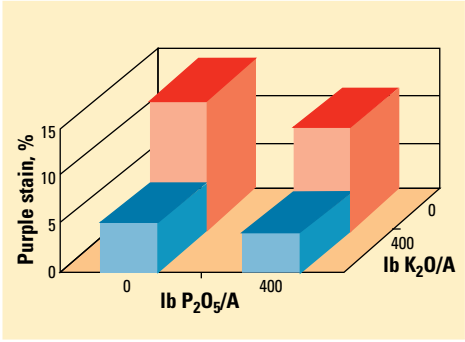

Figure 2. Effect of P and K fertilization on purple stain of soybean seed.

can be considered for disease control in the field".

Scientists concluded in a survey of Illinois field research that applied P reduced cob rot of corn on low P soils when the causal organism was Fusarium. Other studies have revealed that P can reduce the incidence of boil smut of corn.

Phosphorus and K helped reduce purple stain, Cercospora, in soybean seed in a Virginia study (**Figure 2**). Purple stain can lead to dockage and reduced profit. Other studies relate sound P nutrition to less shriveled seed and improved soybean seed germination.

Plants under nutrient stress are more susceptible to disease attack. Therefore, balancing P with other nutrient inputs is essential in reducing the risk of disease occurrence. For example, high levels of nitrogen (N) relative to P and other nutrients can lead to severe outbreaks of *Pythium*, *Rhizoctonia*, *Drechslera*, *Bipolaris*, *Typhula*, and other diseases in turfgrass.

Plant resistance to diseases can be reduced by any of several factors that result in stress. Some of these factors are drought, compaction, excess moisture, temperature extremes, physical plant injury, and nutrient imbalances. Phosphorus is a critical component of a balanced fertility program that results in crops that are better able to withstand stress and are consequently less susceptible to disease infection. BC

Water Use Efficiency... *(continued from page 15)*

yields and water use efficiency in periods of moisture stress and in saline conditions.

- Placement may be a factor in maximizing the moisture-related benefits of P. BC

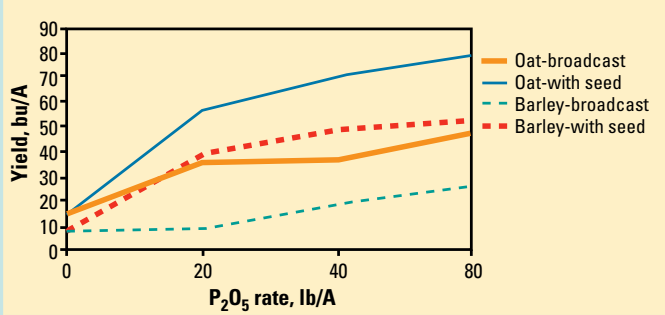

Figure 3. Effect of P fertilization rate and placement on yield of oats and barley under saline soil conditions.