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THE ROLE OF POTASSIUM IN REDUCING THE INCIDENCE OF CROP DISEASES

Potassium is essential for all plants. It is considered one of the macronutrients, along with N and P, because it is used in relatively large amounts compared to other nutrients. For example, an 80 bu/A barley crop will take up about 106 lb N, 43 lb P_2O_5 and 93 lb K_2O. Barley grain contains the majority of the N and P, with 74% and 79%, respectively. The majority of K, about 74%, is in the straw or residue of the crop. Although K is important to many vital plant functions such as plant enzyme activation, water regulation, energy capture from photosynthesis, N uptake and protein synthesis, starch synthesis, and root growth, K is not part of plant manufactured components such as proteins and oils. However, it also contributes to grain or fruit quality, helps prevent lodging, and increases crop disease resistance.

The simple explanation for increasing crop resistance to plant diseases is that by providing balanced plant nutrition, including adequate K, crop plants are healthier. A healthy plant is more able to resist invasion by disease organisms, and recover from a disease episode. However, besides just being healthier, there are other ways that K specifically helps plants resist disease.

Potassium helps crop plants resist disease organism invasion or penetration by strengthening cell wall structure. Plants having adequate K will have thicker cell walls compared to plants deficient in K. This makes it harder for disease organisms to penetrate plant cells and establish an infection. This applies to fungal, bacterial, nematode, insect, and viral disease organisms. Another indirect benefit from stronger cell walls is that plants are less prone to lodging, and stem and leaf architecture is more upright and spread out, thus improving airflow through the crop canopy. This can help slow down the spread of any disease organism through the crop canopy, and result in lower humidity levels that can reduce the growth of pests and diseases that prefer moist environments.

Potassium is also vital for water regulation in plant cells. There are two mechanisms of water regulation that help plants better resist disease establishment. Potassium is important for stomate cell regulation for pore openings on plant leaves. Adequate K nutrition will allow the plant to maintain smaller stomatal openings compared to a K-deficient plant, and also pores are opened and closed more easily and timely, which helps limit the successful invasion of disease organisms into plant leaves. The second water regulation mechanism that can help reduce disease organism penetration into plant cells is that adequate K nutrition helps the plant to maintain increased turgor, or water pressure in cells. A cell with optimum turgor pressure will tend to push organisms away from the cell membrane when the invading organism attempts to push through the cell membrane.

Adequate K in plant cells improves utilization of the building components required for synthesis of starches and proteins. This results in a lower concentration of low molecular weight carbohydrates such as sugars in plant cells. Many disease organism growth rates are increased if there is an ample supply of simple sugars or carbohydrates compared to larger structures such as starches. In a similar way, complex protein structures are more slowly utilized by many disease organisms, whereas higher concentrations of mineral N in the form of ammonium and nitrate, or N contained in basic amino acids, can facilitate more rapid disease organism growth.

Incidence of crop diseases can be reduced if attention is given to supplying crops with adequate supplies of K. There are two ways to assess whether or not a crop will have, or does have, adequate K. Soil testing for plant available K can show whether or not more K should be applied as fertilizer prior to planting. Plant sampling and tissue testing of crop plants during the growing season might show less than optimum levels of K in plant tissues, and increased K fertilizer rates should be considered for future short-season annual crops. In the case of long-season or perennial crops, there may be a benefit to topdressing K. Advice can be obtained from your local consulting agronomist or certified crop adviser, or from a soil and plant testing laboratory agronomist, to know whether or not K fertilizer might be beneficial.

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Abbreviations: N = nitrogen; P = phosphorus; K = potassium.

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