Potassium helps crops during

ENSURING an adequate supply of Potassium (K) improves the ability of crops to tolerate stress from soil moisture and hot dry weather. Because it regulates the water balance in plant tissue, potassium helps to prevent crops from drying out in times of drought. Where crop yields are limited by soil moisture, correcting K deficiencies can ensure the most efficient use of available water. High levels of K in the soil help crops withstand drought conditions that often occur in dryland farming.

HOW DOES POTASSIUM HELP THE CROP TO RESIST DROUGHT?

Water enters plants through the root system and travels upwards from the roots to the leaves. On the lower side of the leaves there are tiny holes called stomata, which allow the plant to breathe. When the water reaches the leaves, it evaporates and escapes through the stomata. This process is called transpiration.

Plants need to control the water loss from transpiration. They do this by opening and closing their stomata. Two guard cells surrounding each stoma can open and close it. The holes are opened to allow gaseous exchange (breathing) and are closed to reduce loss of water. Thus, if there is a water deficit, the plant needs to close the stomata to conserve water. The plant controls the opening and closing of the stomata by regulating the concentration of potassium in the guard cells. A large concentration of potassium ensures turgid cells and open stomata; by lowering the potassium in the guard cells they become limp and the stomata close.

Maize leaves excised from K deficient plants dehydrate more easily, curling up and wilting immediately. Leaves with adequate K nutrition retain water and maintain rigidity.

A shortage of K causes the stomata to open only partially and to be slower in closing. This increases stress from drought. For example, barley leaves exposed to hot windy conditions closed their stomata after 5 minutes in plants with adequate K, while it took 45 minutes to closure in plants with K deficiency. In the last case, loss of water was much higher and the plant suffered from water stress conditions.

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Another way that K helps drought-stressed plants is through the enhancement of water uptake by the roots. The more K inside the root cells, the more strongly roots attract water from the soil. Potassium also enhances deep root growth, allowing roots to penetrate deeper into the soil and make use of subsoil moisture.

In addition, the positive effect of potassium on the whole plant development results in a better water economy of plants. K has an osmotic effect in the plant sap, maintaining cell turgor and retaining more water in the plant. Potassium also enhances rapid seedling development: good early growth provides quick cover of the soil with plant leaves and will therefore reduce evaporative losses from the soil surface. Finally, K produces early maturity, ensuring that the crop will get through the critical pollination period earlier, before drought.

POTASH FERTILIZATION - AN ECONOMIC INSURANCE AGAINST DRY YEARS

While in good years response to potash may be modest, in adverse years its contribution will be

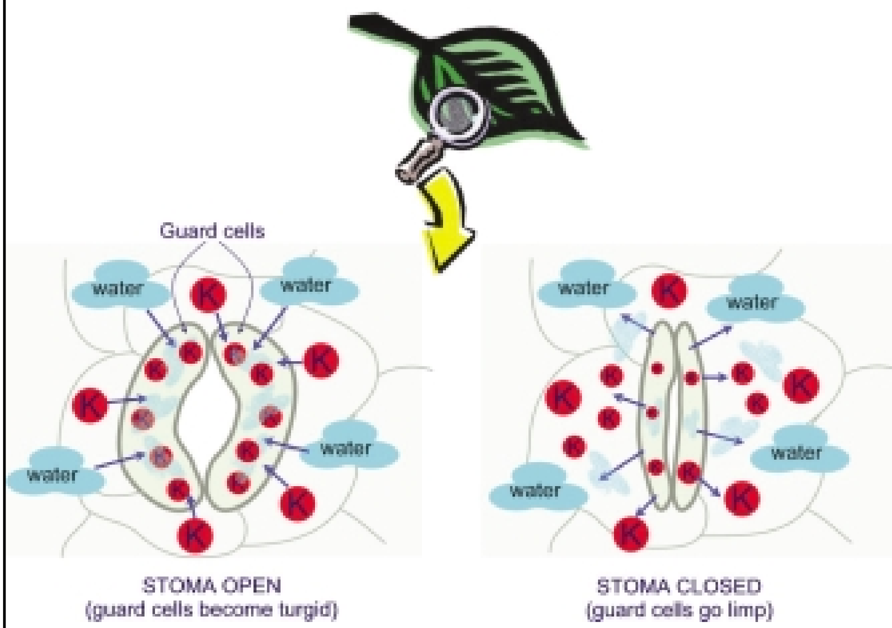
drought conditions

substantial. Potassium provides some insurance protection against difficult conditions.

The positive effects of K application on crop yields under drought conditions are illustrated in the following table, which presents the results of a groundnut experiment conducted in Junagadh, Gujarat (India) by the International Potash Institute (IPI) and the Gujarat Agricultural University.

Dry Spell	Yield (kg/ha) -K	+K	Yield increase (%)
Control	1,957	2,150	9.8
Single	1,486	1,613	8.5
Double	835	1,039	24
Triple	485	613	26

Groundnut yields were lower in dry years than in wet years but the yield increases due to potash application were higher in dry years. Potassium cannot protect against extreme droughts but helps to maintain yield levels in years of water stress. Good K management can help farmers to reduce risks related to drought.■



The potassium in the guard cells control plant transpiration, the stomata open and close regulating the water content and adjusting to the weather conditions.

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'based on the data available, hazardous constituents in fertilizers generally do not pose harm to human health or the environment.'

EPA did not recommend standards or limits for metals in fertilizers but has proposed to tighten up a RCRA hazardous waste rule that allows the use of zinc wastes as a recycled source of essential zinc nutrient in inorganic fertilizer. These wastes will be required to meet a technology-based metal limit in the future. CDFA's risk assessment, entitled Development of Risk-Based Concentrations for Arsenic, Cadmium and Lead in Inorganic Commercial Fertilizers, was issued in March 1998. Risk-based acceptable concentrations (RBC) are calculated maximum levels in parts per million (ppm) of a specific metal in a fertilizer product that do not pose an unacceptable health risk following its use and exposure over a sensitive person's lifetime.

Table 1: Elements Analyzed

Micronutrients	Trace Metals	Radionuclides	Other
Boron	Antimony	Radium	Aluminum
Cobalt	Arsenic	Uranium	Barium
Copper	Berylium	Thorium	Strontium
Iron	Bismuth		Titanium
Manganese	Cadmium		
Molybdenum	Chromium		
Selenium	Lead		
Zinc	Mercury		
	Nickel		
	Silver		
	Thallium		
	Vanadium		

TFI's risk assessment, entitled Health Risk Evaluation of Select Metals in Inorganic Fertilizers Post Application, was issued as a draft by The Weinberg Group in January 2000. RBCs were derived for 12 metals and compared to concentrations of these metals in NPK and micronutrient fertilizer products as reported by the U.S. EPA numerous states monitoring programs and fertilizer manufacturers. Based on the same peer review comments as those received on the CDFA risk assessment, the RBC values have undergone some modifications and were finalized in July 2001 under the title Scientific Basis for Risk-Based Acceptable Concentrations of Metals in Fertilizers and Their Applicability as Standards (see at www.tfi.org. or at www.aapfco.org).

CONCLUSION

There are many facets of a successful health and safety program, not the least of which is a strong public relations team. Assessing products, distribution, and exposure parameters alone are not enough to counter public challenges to the health and safety of an industry's products. A concerted approach that weaves the scientific evidence gained through extensive analytical study with a strong public relations thrust is The Fertilizer Institute's core strategy for demonstrating the safety of fertilizer products.■