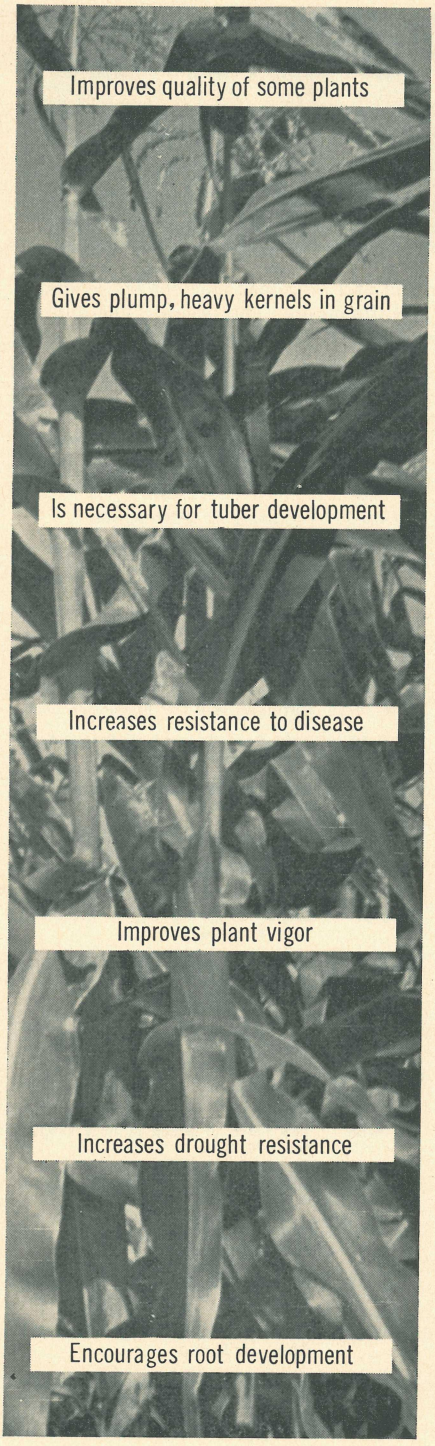

POTASSIUM

Its Functions And Availability As A Major Plant Food

Without food there would be no life. This applies to plants and animals, as well as to man. For plants to grow and produce normally, they must be well fed.

Potassium is one of the major plant-food elements, used in large quantities by most plants. Though a few soils are well supplied with available potassium, most soils have little or only a limited amount. Consequently, the functions and use of potash in plant growth are important to the fertilization of crops.

In its effects on plant growth, potassium tends to check, balance, support, and supplement the other essential plant-food elements. This relationship is very important in fertilizer practice since it influences the results that may be attained by applying fertilizers, influencing the economy and effectiveness of their utilization.

The potash added supplements the soil nutrients to make available to the plant the correct proportion of potassium to go along with nitrogen, phosphorus, and other plant-food elements. Whenever one of the plant elements is lacking, the effectiveness of the others is seriously handicapped.

Dr. W. J. Peevy, head of Soil Testing Laboratory for the Louisiana Agricultural Experiment Station, gave an excellent example of this improper

balance of plant food. Working very closely with a large dairy farmer near Hammond, he and the farmer used about 250 pounds nitrogen (equivalent to 750 pounds ammonium nitrate), from 80 to 120 pounds P_2O_5 (equivalent to 400 to 600 pounds superphosphate), and until the fall of 1954 120 pounds K_2O (equivalent to 200 pounds muriate of potash).

For an oat crop, the potash application was reduced to 60 pounds K_2O per acre. The oats came up, turned reddish in color, and made practically no growth. Peevy suggested that additional nitrogen be tried in strips across the field; that additional phosphorus be tried similarly, and also potash. No noticeable results were obtained from the extra application of either nitrogen or phosphorus. But when extra potash was added, the oats immediately began very rapid growth and lost the reddish color. The remainder of the oats were then top-dressed with potash, giving excellent results, according to Dr. Peevy.

He now recommends to this dairy farmer from 126 to 168 pounds K_2O annually, depending on the crops being grown. He says this amount of potash was necessary to give the proper balance with the large amount of nitrogen and phosphorus being used. And if this extra quantity of potash was not used, the yield would be reduced accordingly.

In other words, *plants can only grow and develop to the point at which some element becomes a limiting factor.* In this case, it was potash —a common occurrence on many of our soils.

Turning under large quantities of legumes may disturb the potassium-nitrogen relationship, causing decreased yields. This effect has been observed rather widely throughout the Corn Belt where sweet clover has been used as a cover crop. A typical example occurred in Missouri. In a two-year rotation of corn, wheat (sweet clover), the sweet clover plot yielded 23.5 bushels more corn per acre than the check plot the first year of the experiment. This differential decreased to 14.8 bushels for the second corn crop. After the third crop of sweet clover had been turned under, the yields were 21 bushels less than those on the check plot. *The plots showed signs of potash deficiencies with excessive lodging.*

Most mineral soils, except those of a sandy nature, are high in total potassium. Yet, the potash held in an easily exchangeable condition at the mineral interfaces is *usually small.* Thus, higher plants must depend, in part at least, on the ordinary processes of solution or effect on availability by direct contact with the undecomposed soil minerals and the colloidal complex.

By
Niven D. Morgan

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Shreveport
Louisiana

Drainage water from mineral soils will usually have large amounts of potash, at least enough annually to satisfy the needs of higher plants. *Yet, they may be suffering a potash deficiency.* They apparently must be in contact with a *comparatively concentrated solution* in order to obtain a satisfactory amount of this element, especially if other cations are relatively high in the soil solution.

Some of the very fertile Red River soils in Louisiana give good responses to the application of potash even

though the soils are high in potash. No doubt there are many other such cases.

Not only is potash essential for increasing yields, but it also plays an important role in determining *crop quality*. Experiments with cotton have shown that potassium increases the *strength of the fiber* and produces a *higher percentage of lint per seed.* Research has also shown it increases the protein content of the seed.

In the field of horticultural crops, nearly everyone knows the desired shape of good grades of sweet potatoes is obtained only in the presence of adequate potassium.

If water and a comparatively low percentage of ash are excepted, proteins, carbohydrates, and their derivatives make up the bulk of a plant. Potassium which is necessary for carbohydrate formation, plays an important role in regulating the nitrate reserves in many plants by accelerating the absorption of anions, such as nitrates.

Considerable evidence indicates that directly or indirectly potassium is essential for reducing nitrate and perhaps for later stages of protein synthesis. As new proteins are synthesized from nitrate, carbohydrates are utilized in the process and more potassium is needed for the synthesis of more carbohydrates. This being the case, potassium is very important to cell wall formation and stiffness of stems.

Structural elements of lignin or cellulose, which represent carbohydrates in the most condensed form, cannot become highly developed when there is a carbohydrate deficiency. If nitrate reserves are high in relation to carbohydrates, and if carbohydrates are not replenished through photosynthesis faster than they are used in respiration and protein manufacture, cell walls become thin and stems structurally weak.

Some Texas Agricultural Experiment Station research shows that lodging is *very bad* with corn plants where there is a potash deficiency. When potash is added, the lodging is reduced to a minimum.

Many rice farmers report that the extra ease of harvesting rice with adequate potash more than pays for the potash. Some of the rice millers are asking for rice that has been fertilized with potash because of the improved milling qualities.

Except for simple salts, it is not known whether potassium enters into any organic combination in the plant. It is freely translocated from mature to meristematic tissues when there is a deficiency of it.

Further, when developing fruits are present, potassium is often in large part transferred to them, with subsequent death of vegetative growing point. These facts have been brought out by many workers, who have consistently emphasized the importance of potassium in the cambium and in other actively growing tissues. *Therefore, the lack of potassium may drastically modify plant form.*

Potassium encourages root development in plants. As an example, corn plants well supplied with potash are very hard to pull up and if they are pulled up, a large clump of roots will be pulled from the ground. Corn plants with deficient potash are usually easily pulled up and only a small clump of roots is pulled from the ground.

The root system of the corn plant is very important in supplying moisture and nutrients to the plant. Therefore, the extent of the root system will greatly influence the growth and productivity of the plant. Drought resistance is increased.

In a Louisiana corn fertility experiment where soil moisture was depleted to a low level, only the plants on plots *which had high potash* were not wilted at the time of the observation. With continued drought, the plants on these plots would have eventually wilted.

The presence of adequate available

potash in the soil has much to do with the general tone and vigor of the plant. It increases resistance to disease. One of the common potash-deficiency diseases is *rust in cotton.*

With a soil low in potash, the margins of corn leaves, small grains, and grasses become scorched or brownish in color and finally die. In corn, the vascular system becomes disrupted, limiting the free movement of plant nutrients and moisture.

Potash-deficiency symptoms show up in practically all crops where the deficiency is severe. A person should never wait to use these deficiency symptoms as a guide in crop fertilization *because they only occur when the lack of potash is very severe.* Increased yields from the application of potash will occur long before deficiency symptoms show up.

Potassium tends to eliminate prematurity. It is important to the grain formation of cereals, giving plump, heavy kernels. It also seems especially valuable to all leguminous crops. It is absolutely necessary for root and tuber development, being very important in the growth of potatoes. *In fact, all root crops respond to liberal applications of potash.*

There is another feature of fertilization that is usually overlooked. Too little is known about it. *Commercial fertilizers, when added to a soil, influence the micro-organisms just as profoundly as they do higher plants.* In fact, the fertilization of the soil flora is an essential feature of successful soil management. Since the bacteria, fungi, and actinomyces are more successful than are higher plants in their competition for nutrients, their needs are satisfied first. Thus an amount of fertilizer fully adequate for crop needs may fail to give the desired results when added to a soil because of chemical and biochemical fixation.

The supply of potash for crop fertilization will be adequate for several generations. Potash is being mined in the United States in the Permian Basin near Carlsbad, New Mexico, and extracted from the brines of Searles Lake, California, and the salt flats of Utah. There are seven major producers in this country. Additional production is being considered.

In conclusion, the functions of potassium are as follows: It . . .

1. Is a major plant-food nutrient.
2. Is necessary for production of carbohydrates.
3. Plays an essential role in the absorption of anions, such as nitrates.
4. Is essential for reduction of nitrates.
5. Favors protein manufacture.
6. Has a balancing effect on excessive amounts of nitrogen and phosphorus.
7. Gives plump, heavy kernels in grain.
8. Encourages root development.
9. Is necessary for tuber development.
10. Increases resistance to disease.
11. Improves plant vigor.
12. Is necessary for the development of chlorophyll.
13. Tends to prevent pre-maturity.
14. Increases drought resistance.
15. Improves quality of some plants.

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POTASH PAYS

When nitrogen and phosphate levels are kept high the acre value of burley tobacco can be increased, even though yields are only slightly affected. For instance, on a soil well supplied with nitrogen and phosphate, but low in potash, an application of 150 pounds of potash increased the income $283 per acre even though the yield was increased only about 100 pounds. This was an increase in crop value of $23.58 for each dollar spent on potash.

Kentucky Bankers Association