Product Information Bulletin

State of Emergency is a powerful Phosphorus (P) - and Potassium (K) - based nutrient supplement formulated for use in reproductive production systems during the early generative stages of reproductive growth (early flowering) and during the final stages of ripening in flowers, buds and fruits.

The increased use of phosphorus and potassium during the early flowering and late maturation of reproductive crops is well founded based on their respective biochemical, metabolic and physiological contributions during these stages of crop development.

Reproductive plants experience a period of exclusive vegetative growth prior to the initiation of reproductive (flowering) activity. Some may question why the plant does not begin flowering concurrently with vegetative growth.

Researchers suggest that the timing of reproduction is a genetic trait that is triggered when the plant has grown and functions to the point where it has the capacity to acquire and store sufficient nutrient resources that are critical to reproductive growth.

At this time, plants will begin partitioning of resources (carbohydrates, proteins, metabolic intermediates) from vegetative structures (i.e., leaves and stems) and reassign their transport to other areas of the plant (sinks) to prepare for the reproductive stage of plant development.

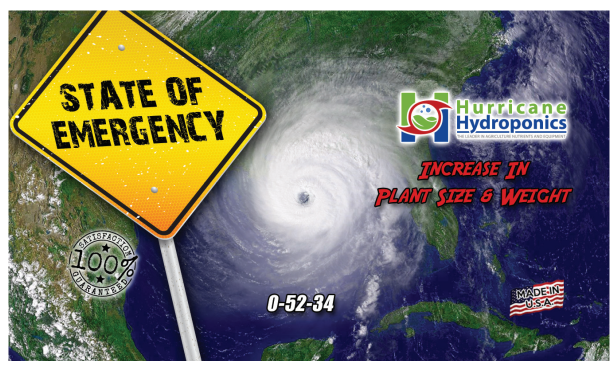
This concept of plant resource partitioning and allocation of resources (acquired or manufactured) is important since this genetically-based function drives the types and quantities of nutrients needed for all stages of plant development.

Phosphorus (P) and potassium (K) are recognized as two critical nutrient resources most often linked to this purposeful staging of plant development.

This is logical since low phosphorus availability has been shown to delay flowering and reduce yield. If potassium is deficient or not supplied in adequate amounts, growth is often stunted and yields (and quality) are reduced.

The importance of both of these elements to plant growth and development is fully realized by the scientific and grower community. However, their separate contributions as well as their integrated functions with each other during the reproductive stage of plant development is highly significant and without question, complementary -- requiring much higher levels than those adequate for the vegetative stage.

A good nutrient system for vegetative growth is proportionally higher in nitrogen, but the most successful systems during the flowering stages are proportionally higher in phosphorus and potassium. **And for good reason**.



State of Emergency

Hurricane Hydroponics State of Emergency is a soluble 0-52-34 NPK nutrient formulation designed to take full advantage of its phosphorus and potassium components to enhance plant function during the reproductive stage of development.

The phosphorus and potassium macronutrients in State of Emergency provide unique integrated modes-of-action that optimize nutritional response by reproductive plants when used after the vegetative growth period. **It should be noted that reproductive plants have uniquely different uses for these nutrients during this period of their development**.

State of Emergency used during the reproductive stage will encourage increased flower production, increased yields and crops with improved quality characteristics. Plants also demonstrate a greater level of tolerance to stress conditions.

We invite you to continue reading our Product Information Bulletin. It provides additional information as to the impact these two elements have on a wide range of critical functions during reproduction that are necessary in order to give your crops a chance to show what they can do.

PHOSPHORUS -- "The Energy Element"

The demand for energy is elevated during the reproductive stage of plant development. As plants transition from the vegetative stage, a great deal of energy is diverted to the production of flowers. Indeed, reproductive plants are often referred to as "nutrient hogs."

Mode of Action

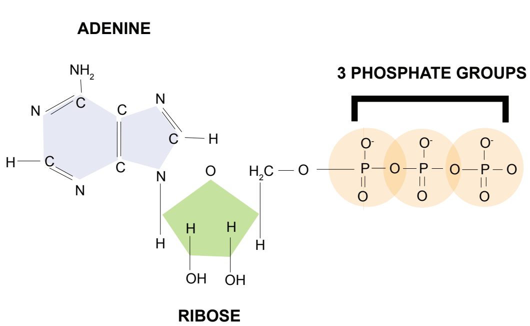
Phosphorus is commonly referred to as the "currency of energy" in both plants and animals. It is a principle constituent in the ATP (adenosine triphosphate) molecule that is responsible for the storage of energy needed to activate chemical reactions and conduct plant functions.

The relationship of energy transfer (acquisition and use of energy) in plant biochemical systems is complex. If we put the biochemical relationships and reactions in everyday things we use, it may be easier to grasp and appreciate the value of phosphorus.

If we look at a plant function like it is a flashlight, then ATP is the rechargeable battery that provides the energy to the light bulb. **Phosphorus can be associated with the electricity or "energy" that is put into the battery when it is put in the charger**. The battery (ATP) then stores the energy until it needed by the flashlight (plant function).

Just as the battery requires a charge to be useful, **the ATP molecule requires phosphorus to be useful to the plant. The "P" in ATP is our energy source – Phosphorus in the form of phosphate.** As indicated in the name, there are three phosphate groups in the adenosine **<u>tri</u>**phosphate molecule.

ADENOSINE TRIPHOSPHATE



When a plant needs energy to run its metabolic, photosynthetic and other functions, it is like turning on the flashlight. The result is you use up some of the charge in its battery to power the bulb (or LED for you high tech users).

As the plant function requires energy, part of the high-energy phosphate group of the ATP molecule is broken off (this is done in the mitochondria during respiration), creating energy. ATP then turns into ADP or adenosine diphosphate.

Adenosine Diphosphate (ADP) Formation

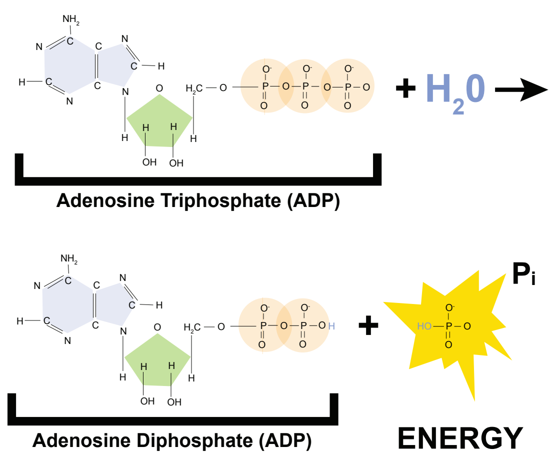


Illustration of energy formaton as triphosphate group in ATP loses a phosphate group. This results in the formation of ADP (adenosine diphosphate.

Energy from photosynthesis acts like the charger in a rechargeable battery system. It temporarily stores its energy in the high-energy phosphate bonds of ATP by adding phosphates back on ADP molecules – reforming ATP.

Fruiting and Flower Set

Phosphorus is required throughout the life of the plant. When plants are flowering and trying to set fruit, demand for phosphorus is at its highest level. It should be clear that plants can't grow without a reliable source of this nutrient.

Increased levels of phosphorus helps promote the development of additional flowering sites, especially during the early stages of flower production. During flower and fruit production, plants require much higher levels of phosphorus to provide energy for the developing reproductive organs. Phosphorus is also needed to provide energy for increased photosynthesis and subsequent carbohydrate metabolism. Delayed reproduction as well as reduced flowering and/or seed production are often key symptoms of plants deficient in phosphorus.

Phosphorus is a major structural component of DNA, RNA, proteins, enzymes and nucleic acids. Of particular importance here is that without DNA, plants cannot reproduce.

The importance of phosphorus cannot be understated. After nitrogen (N), it is the most frequently limiting macronutrient for plant growth. During flowering growers will want a high phosphorus and low nitrogen nutrient ratio.

POTASSIUM
Quality of Fruit and Flowers

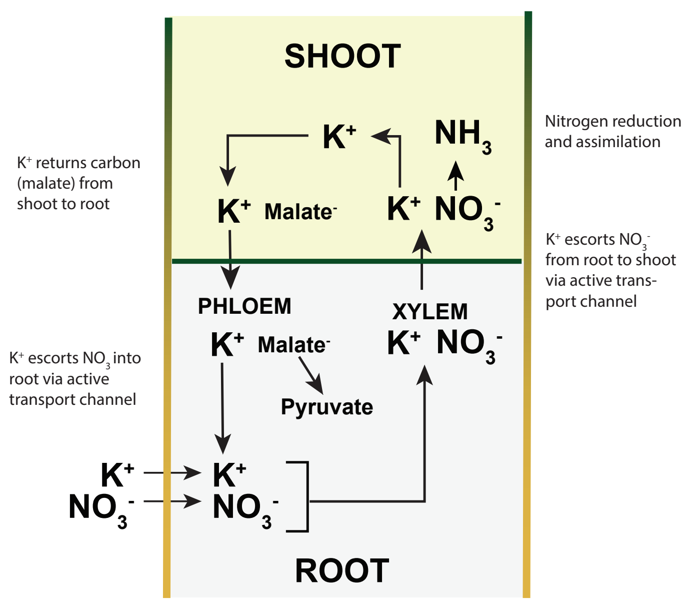
Potassium is highly unique as a nutrient element inasmuch as it remains in its ionic form (remains as K^+) inside plants rather than being incorporated into the structure of organic molecules. This characteristic makes potassium quite versatile as it does not get tied up within molecular reactions. Its mobility allows it to actively participate and become involved in numerous regulation mechanisms throughout the plant.

While phosphorus influences increased flower production and associated increased yields, **potassium is often referred to as the quality element for crop production**.

Involvement in Physiological Processes Relevant to Crop Quality

Nitrogen Metabolism

Much of the impact on quality from adequate nutrient levels of potassium is the result of a unique nitrogen-potassium interaction in plants. This interrelationship starts in the root where NO_3 (nitrate) accumulates and is escorted by potassium into the shoot to be reduced and ultimately assimilated to form amino acids, proteins, enzymes and other nitrogen-related molecules.



Graphic of potassium (K^+) escorting nitrate ion (NO_3^-) into root, through the xylem and into the shoot via K-assisted active transport mechanisms.

This "nitrate shuttle service" (active transport) performed by potassium is critical to optimum nitrogen assimilation because without potassium acting as the co-transport mechanism through specialized channels in cell membranes, NO_3 transport from the roots would be severely restricted and reduce N fertilizer use efficiency.

The plant cannot be forced to take up more N if potassium supplies are limited.

Energy Status

Potassium has an active role in the energy status of the plant. It has been proven to improve the transfer of radiation energy into primary chemical energy by maintaining the balance of electric charges in chloroplasts (which is required for ATP formation). This energy transfer is a fundamental process affecting many functions of the plant that affect the quality of crops.

If potassium levels are inadequate, production of ATP energy storage molecules will be reduced. This will ultimately result in the delay of reproductive functions (flowering and fruit development) or poor quality yields.

Photosynthesis

Plants require potassium ions for protein synthesis and for the opening and closing of stomata -- the pores through which leaves exchange carbon dioxide (CO_2), water vapor and oxygen (O_2). Proper functioning of stomata is essential for photosynthesis and functions related to transpiration of the plant. Potassium also influences water uptake, transport and utilization – all critical to the photosynthetic function of the plant.

Translocation of Photosynthates

Potassium plays a lead role in the transport of assimilates and nutrients in plants. This is particularly important during the reproductive period of the plants since photosynthetic products (photosynthates) must be transported from the leaves (sources) to the site of their intended use or storage (sinks).

This role of K is related to its contribution to the osmotic potential in the sieve tubes and to its function in ATP synthesis, which provide the energy for the phloem loading of photosynthates.

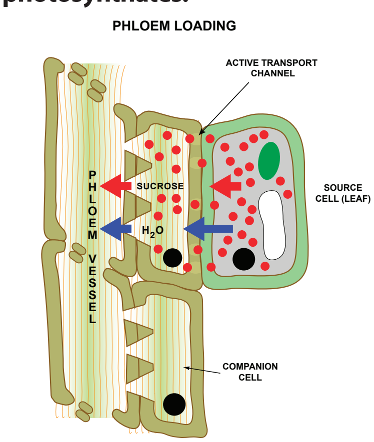


Illustration of sucrose molecules being loaded into phloem vessel against a gradient by potassium influenced active transport.

In plants well supplied with K, the concentration of potassium, the osmotic potential of the phloem sap and the volume flow rate, are all higher than in plants supplied with a lower K level. As a result, sucrose concentration in the phloem sap and the phloem unloading is increased.

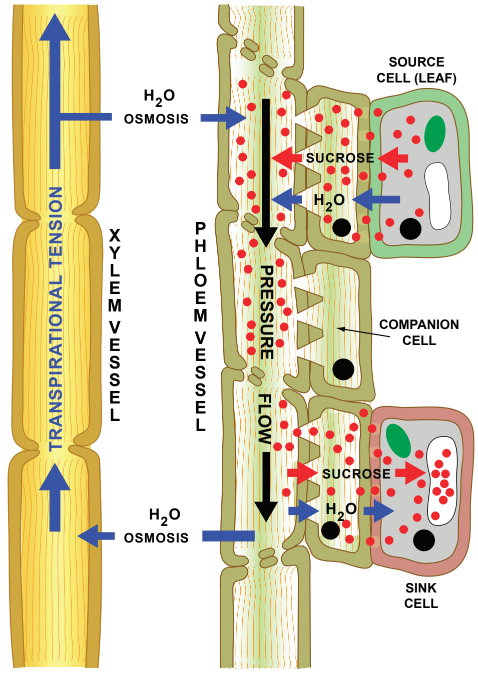


Illustration showing movement of sucrose from source leaf doward via pholem pressure flow and into cell sink.

The plant's transport system uses energy in the form of ATP. If potassium is inadequate, less ATP is available and the transport system breaks down.

Promoting synthesis of photosynthates and their transport to reproductive sinks is crucial to the quality of fruits, grains, and other storage organs. Should a supply shortage of potassium exist, the rate of photosynthesis and the rate of photosynthate translocation to sinks will be reduced. Enzyme systems that support plant function (including reproduction) will also affected. The overall result is a reduction in plant growth and crop quality.

Enzymes

Potassium is a necessary cofactor for many of the enzyme-catalyzed steps in metabolic pathways. Potassium has the appropriate properties and is present in cells in sufficient concentration to fulfill the univalent cation requirements of over 60 enzymes whose activities are dependent upon univalent cations.

Much of potassium's ability to activate certain enzyme-catalyzed reactions is associated with its ability to penetrate cell membranes, its affinity for active transport and its ability to reach concentration levels in plants without disturbing other processes and functions.

The impact of potassium on catalytic enzymatic reactions during the plant's reproduction stage is illustrated in its role in fruit formation and influence on fruit quality. The process by which glucose is converted into starch utilizes the enzyme, starch synthetase, which requires potassium for its activation.

Stress Resistance

Sufficient evidence has been generated to confirm that potassium is involved in numerous physiological functions related to plant health and tolerance to biotic and abiotic stress.

Much of plant stress resistance improvement under a potassium rich environment is associated with its ability to maintain CO_2 assimilation rates by regulating stomatal function, structural enhancements (thicker cell walls), balancing cell water relations and support of plant defense mechanisms.

High K levels are closely associated with the role of K in enhancing photosynthetic CO_2 fixation and transport of photosynthates into sink organs and inhibiting the transfer of photosynthetic electrons to O_2, thus reducing ROS production.

Potassium has also been linked to the production of antioxidative enzymes -- extremely important in combating abiotic stresses such as heat, drought, temperature extremes, metal toxicity, salinity and light.

Less pest damage in higher K plants can be attributed to a lack of pest preference under sufficient nutrient concentrations, as well as the synthesis of defensive compounds leading to higher pest mortality.