

## Uses

Bipyridyllums herbicides are nonselective, postemergence herbicides used to control unwanted vegetation. **Diquat**, in an aqueous salt solution, is used in aquatic situations while **paraquat** is used in no-till programs, vine desiccation, direct sprays, and for pre-plant vegetation control.

## Behavior in Plants

### *Absorption and translocation*

These herbicides are absorbed very rapidly by foliage. Neither are translocated to any great extent in plants due to damage in membrane integrity, therefore, thorough coverage is essential for greatest activity. Root uptake is minor because these herbicides are tightly bound to soil colloids and organic matter.

### *Selectivity*

The bipyridyllums are non-selective, injuring all green foliage they contact. Plant selectivity is achieved by applying the herbicides in a manner to avoid contact with desired plants (shields, row-middle treatments, etc.). **Diquat** is used for aquatic weed control in ponds while **paraquat** is used as a nonselective spot treatment much the same way as glyphosate. The main advantage is its quick response, killing weeds within hours of treatment. Symptoms include rapid plant wilting and desiccation, followed by necrosis. It is possible to have one-half of a leaf desiccated while the other half may still be green since little translocation of the chemical occurs within the plant. These herbicides provide top-kill of perennials but do not affect their underground structure and regrowth soon follows.

### *Mechanism of action*

Bipyridyllum herbicides disrupt plant membranes. They intercept electrons from photosynthesis and transfer the energy to form various free radicals that damage cell membranes and permit the cell contents to leak into the intercellular spaces. Sunlight is needed for its activity and plants treated on cloudy days or in the dark will not show symptoms until they are placed in the light.

## *Degradation*

Limited research indicates that bipyridyllums are not degraded by higher plants. Bipyridyllums undergo photodecomposition when exposed to light such as would be the case where they may be on leaf surfaces. **Paraquat** loss from UV radiation can be up to 50 percent in 24 hrs and 75 percent in 96 hrs. However, once absorbed by the leaf tissue these herbicides are protected from photodecomposition.

## Behavior in soils

### *Adsorption and leaching*

**Paraquat** and **diquat** are tightly adsorbed by ionic bonding to most soils and on the inner and outer surfaces of nonexpanding clays such as kaolinite (outer surfaces) and expanding clays such as montmorillonite (inner and outer surfaces). These herbicides carry positive charges (cationic) while clay minerals and certain fractions of soil organic matter are negatively charged (anionic). These herbicides have no preemergence activity in normal agricultural soils and there is no leaching because of the tight soil adsorption.

### *Persistence*

**Bipyridyllum** persistence is based on its biological availability in soils and is nonexistent due to its adsorption. However, persistence of the intact form (but unavailable) bound to clays may be quite extended (for example, **paraquat** can persist for up to 13 years.). Microbial, chemical, and photodecomposition is minor due to the tightly bound **paraquat** which is unavailable for exposure to these processes. In contrast, **diquat's** half-life in water is less than 48 hours.

## Distinguishing characteristics

- Cationic, high water solubility, and is nonvolatile
- Contact, rapid acting herbicide family with little or no mobility in plants;
- Not degraded in plants, but is slowly degraded in soils;
- Adsorbed by clay minerals in soils;
- Used as nonselective herbicides in directed sprays, aquatics, desiccation, etc;
- Corrosive to aluminum and should be flushed immediately after use;
- Nonionic surfactant is needed to enhance paraquat's herbicidal effectiveness.