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Improving the Efficacy of Ethephon Sprays by Adjusting Water Quality and Temperature

The PGR ethephon breaks down to release ethylene, reducing internode elongation, increasing branching, and aborting flower buds. However, ethephon efficacy is influenced by a variety of factors including air temperature at application and carrier water alkalinity.

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Plant growth regulators (PGRs) are commonly applied as foliar sprays, substrate drenches, liner dips, or bulb, tuber, and rhizome dips/soaks during production of greenhouse crops to produce uniform, compact plants that can be easily packaged, shipped, and marketed to consumers. The majority of the PGRs (ie. ancymidol, chlormequat chloride, daminozide, flurprimidol, paclobutrazol, or uniconazole) used by greenhouse grower suppress stem elongation by inhibiting the biosynthesis of gibberellins (GAs; plant hormones that regulate growth and stem elongation). In contrast, ethephon [(2-chloroethyl) phosphonic acid] is a PGR that has multiple uses as it releases ethylene (another plant hormone responsible for ripening and senescence) upon application. Therefore it is used to suppress stem elongation (extension growth) and increase stem diameter, reduce apical dominance causing an increase in branching and lateral growth, and induce abscission of flower buds (Figure 1) and leaves. For example it can be used during propagation to set the flowering

Figure 1 (right). Untreated gernanium (top) and greanium treated with ethephon (bottom). Photo: Roberto Lopez.

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clock of crops with sporadic or non-uniform flowering such as New Guinea impatiens to zero (Figure 2) by causing flower and flower bud abortion. Additionally, some growers use it to increase branching and reduce stem elongation of petunia (Figure 3). Ethephon (ie. Florel or Collate) sprays are typically applied

Figure 2. Premature and nonuniform flowering of New Guinea impatiens in propagation. Photo: Roberto Lopez.

to greenhouse crops 1 to 2 weeks after transplant and can be repeated 1 to 2 weeks later. Many factors influence its efficacy including the rate, volume, use of a surfactant, spray solution pH, and the substrate moisture and air temperature at application. In this e-GRO Alert, learn how to optimize your ethephon spray applications by monitoring and adjusting two often overlooked cultural and environmental factors.

Water Alkalinity and pH

Similar to most greenhouse chemicals, ethephon is applied as a liquid. As ethephon changes to ethylene, it changes to a gaseous form. When ethephon is applied to and absorbed by the plant, the pH increases, releasing ethylene. Therefore, we do not want

Figure 3. Increased branching, reduced internoted elongation, and flower bud abortion on petunia treated with ethephon. Photo: Roberto Lopez.

ethephon to break down until it is inside the plant. Ethephon breaks down into ethylene more quickly as the pH of the spray solution increases. The goal is to keep the pH of the spray solution after adding ethephon to your carrier water lower than 4.5. This is normally not a problem because ethephon is naturally acidic. However, if you have water with high alkalinity, the pH may not decrease enough to fall within the target range and you may need to add a buffering agent such acid or pHase5 to lower the pH. As you increase your ethephon concentration, the solution pH will also decrease. Also, as your carrier water alkalinity decreases, your solution pH decreases (Figure 4). The ultimate goal is to keep the spray solution pH below 4.5. However, growers with very pure water (low alkalinity) may need to add a different buffering agent that will keep the spray solution water pH from getting too low.

In a recent study at Michigan State University, we applied ethephon using three carrier water alkalinities (50, 150, and 300 ppm) and four ethephon (0, 250, 500, and 750 ppm) concentrations to ivy geranium, petunia, and verbena. Extension growth deceased as the carrier water alkalinity decreased and ethephon concentration increased (Figure 5). Therefore, we recommend that you can check the alkalinity of your

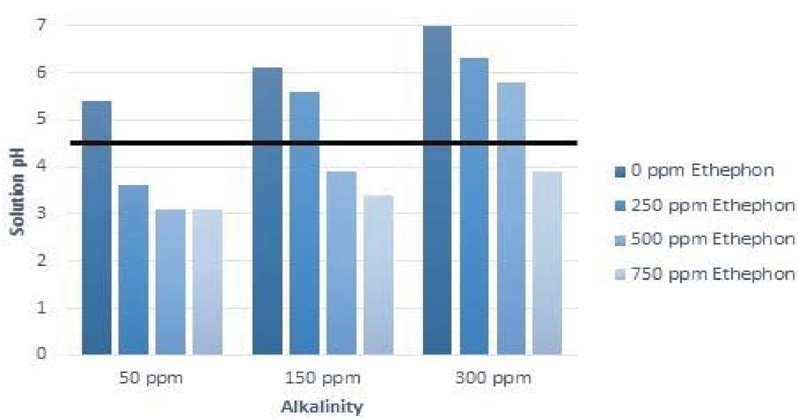

Figure 4. Influence of carrier water alkalinity and ethephon concentration on spray solution pH.

carrier water with a hand-held alkalinity meter (Figure 6) and make the necessary adjustments. Next, add ethephon and check the pH of your spray solution with a hand-held pH meter to ensure that it is lower than 4.5.

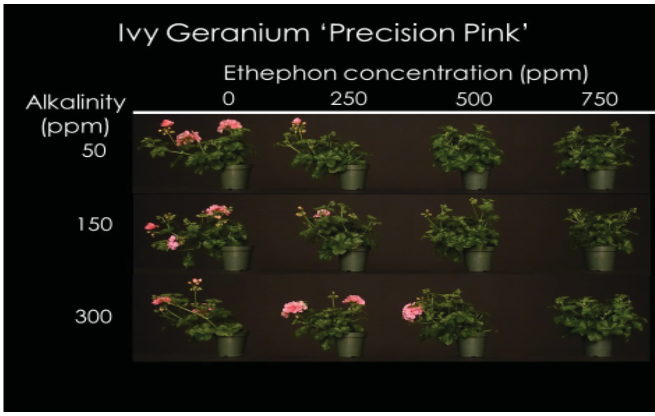

Figure 5. Influence of carrier water alkalinity and ethephon concentration on branching and flowering of Ivy geraniun. Photo: Kellie Walters.

Figure 6. Portable and hand-held alkalinity meter that can be used in the greenhouse to determine your carrier water alkalinity. Photo: Kellie Walters.

Air Temperature at Application

We have also determined that air temperature at the time of chemical application can also influence the efficacy of ethephon. As air temperature increases, the rate of ethylene release from ethephon increases, theoretically reducing efficacy. From our research, we have found adequate ethephon efficacy when the air temperature at application was between 57 to 73 °F. When temperatures increased to 79 °F, ethephon had little to no effect on extension growth, promoting branching or flower bud abortion (Figure 7).

Take Home Message

If you have a high water alkalinity, use a buffer to lower the alkalinity of your water before mixing your spray solution and ultimately the spray solution pH. Apply ethephon when greenhouse temperatures are below 79 °F.

Figure 7. Influence of air temperature at application on the efficacy of a 750 ppm ethephon spray on petunia. Photo: Kellie Walters.