Do Insecticides Affect Plant Growth And Development?

University research tests foliar insecticides to determine whether applications affect growth, development, physiology and overall gerbera quality.

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THE application of insecticides is often necessary in greenhouse crop production to prevent damage from insect pests that could render the plants unsalable. However, pesticide usage can lead to toxicity issues, which may adversely affect plant growth and development. It seems plausible that applications of foliar insecticides could adversely affect photosynthesis by clogging, or at least partially blocking, plant stomates – the microscopic pores in leaves through which gases (water vapor and CO_2) are exchanged.

Reduced photosynthetic rates can delay production times or reduce plant quality, in addition to any visible damage due to chemical toxicity. Subtle negative effects of insecticides on individual crops can add up and lead to economic loss when multiple crops are grown.

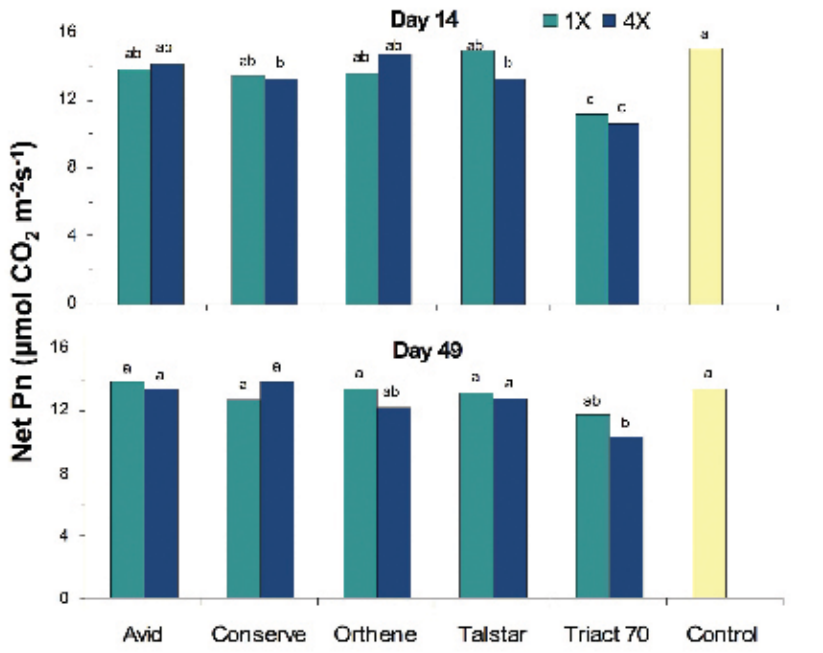
While visible phytotoxicity and the toxicity to humans and animals are tested prior to registration, subtle impacts such as effects on flower production, stunted growth or longer production times are not often tested. We tested various foliar insecticides (including spraying control plants with de-ionized water) on gerbera daisies to determine whether the insecticide applications affect growth, development, physiology and overall plant quality.

Gerberas make ideal feeding grounds for a variety of pests including aphids, broad mites, spider mites, whiteflies, leaf miners and likely their worst enemy – western flower thrips. Gerbera daisies are mighty tasty to western flower thrips, which feed on both the foliage and the flowers. It has even been suggested that gerberas could make an excellent trap crop for western flower thrips.

Due to this high susceptibility to insect pests, growers need to spray on a regular basis in commercial potted gerbera production. In our evaluations, we chose five insecticides that represented the diversity of chemicals used against gerbera pests, including western flower thrips (See Table 1). Plants were sprayed weekly at the recommended (1×) or at four times the recommended rate (4×) to determine the likelihood of plant damage under normal and overdose conditions.

Avid 0.15 EC, Talstar Nursery Flowable and Conserve SC did not reduce photosynthesis, and did not cause plant damage, even when applied at 4×

Figure 1. Effect of insecticide treatments on net photosynthesis (*Pn*) of physiologically mature leaves



the recommended rate (see Figure 1). In fact, the highest quality plants in terms of growth and aesthetics were the plants sprayed with Avid and Conserve (either 1× or 4×) (see Figures 2 and 3).

Orthene Turf, Tree & Ornamental Spray 97, when applied at 1×, did not adversely affect plant growth and development, or plant gas exchange (photosynthesis and stomatal conductance) on gerbera. However, Orthene applied at the 4× rate resulted in fewer flowers, yellow spotting and brown, dry leaf margins, although the flowers were nice (see Figure 4).

Triact 70 (clarified hydrophobic extract of neem oil) applications reduced photosynthesis (see Figure 1), plant growth and development and flower production, with greatest reductions occurring at the 4× rate. This is important, because a grower might not notice this damage if he or she did not have untreated plants for comparison.

Insect infestations on some of the control plants and Talstar-treated plants had the greatest negative impact on their commercially acceptable appearance, demonstrating the importance of insect pest management practices (see Figure 5). Although labeled for thrips control, weekly applications of Talstar were ineffective in our study. Thrips feeding damage became noticeable at approximately week seven, when flower buds were present.

It is possible that small populations of thrips were maintained on Talstar-treated plants because they were not contacted directly with insecticide applications. Talstar is a contact insecticide; i.e. thrips must be contacted directly to be affected. The thrips may have avoided contact with insecticide treatments by feeding within flower buds and flowers. Thrips are also capable of developing resistance to bifenthrin, the active ingredient in Talstar products. In fact, greenhouse populations of western flower thrips in coastal California have shown high levels of insecticide resistance to bifenthrin.

Triact, which is labeled as both a fungicide and an insecticide, had a growth retarding effect on gerberas in this study (see Figure 6). Plants treated with Triact showed reduced plant growth and delayed flower development compared to plants in other treatments. These effects were likely due to reduced net photosynthesis and stomatal conductance, as measured by our observations. Some open flowers treated with Triact had brownish spotting and "flagging" due to the weight of the oil in the product.

Non-toxic effects of Triact on plant growth and development were similar to those of a plant growth regulator (PGR). Typical PGRs control the crop's growth processes by influencing the balance between the plant's own hormones, usually by reducing production or responsiveness to gibberellic acid, which causes plant elongation. If used sparingly on gerbera vegetation, Triact may be useful as a PGR for management of leaf expansion, in addition to its normal use as a pesticide.

Triact applications also reduced leaf stomatal conductance of treated plants. This was likely due to the neem oil. Insecticides and surfactants with oil-based formulations are more likely to interfere with plant

Figure 2. Effect of insecticide treatments on overall plant quality of gerbera. Plants were rated on a scale of 1-5, with 5 being no visible damage.

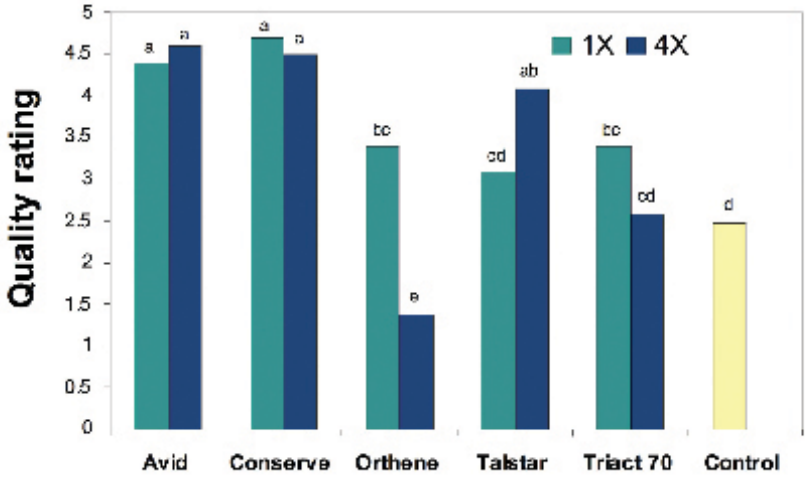


Table 1. The Classification And Recommended Concentration Of The Insecticides Used In The Study.

Trade Name	Common Name (a.i.)	Chemical Class	Mode Of Action Group	Recommended Concentration (per 100 gallons)
Avid II 0.15 EC	Abamectin	Macrocyclic lactone	Chloride channel activators	8 fluid ounces
Conserve SC	Spinosad	Microbial	Acetyl choline receptor modulators	22 fluid ounces
Orthene TT&O Spray 97	Acephate	Organophosphate	Acetyl choline esterase inhibitors	8 ounces
Talstar Flowable	Bifenthrin	Pyrethroid	Sodium channel modulators	44 fluid ounces
Triact 70	Clarified hydrophobic extract of neem oil	Botanical	Suffocant	1.0 percent

gas exchange, compared with other formulations. Oil may cover and mechanically block plant stomates, thus reducing photosynthesis. Insecticides that reduce plant gas exchange generally do so only transiently, lasting for a few days. Weekly applications of Triact caused a reduction in gas exchange for the duration of the study; however, the plants seemed to recover photosynthetic capacity toward the end of the study. Gas exchange was measured one day after insecticide application, and photosynthesis rates may have increased in succeeding days.

Many emulsifiable concentrate formulations are phytotoxic to plants. In our study, abamectin (Avid 0.15 EC) was applied as an emulsifiable concentrate, but the emulsifier was not phytotoxic to gerbera and did not affect photosynthesis. This may be due to the relatively low dose permitted for use in greenhouse production. The recommended concentration for thrips suppression is only 0.6 mL·L-1 for Avid compared to 10 mL·L-1 for Triact.

The insecticides used in our experiment represent different chemical classes and may differentially affect plant growth and development. This was true for acephate (Orthene), which was phytotoxic to gerbera at 4× the recommended label rate. However, most of the insecticides used in our experiments did not affect gas exchange or plant growth and development – even when applied at high, supra-optimal levels.

As demonstrated by this experiment, spray oils that have the potential to mechanically interfere with gas exchange are the most likely to reduce photosynthesis. When used according to label recommendations, none of the insecticides we tested, except for oil-based formulations, caused visible or subtle negative effects on gerbera daisies and are considered safe for use in greenhouse production. **GG**

Figure 3. Gerberas treated with Conserve or Avid at 1× or 4× the recommended concentration resulted in no plant damage.

Figure 4. Orthene was phytotoxic to gerbera when applied at 4× the recommended concentration. Plants were undamaged at recommended rates.

Figure 5. Control and Talstar-treated gerberas had distorted flowers and visible damage on leaves due to western flower thrips feeding.

Figure 6. Gerberas that received Triact 70 applications at 4× the recommended rate resulted in stunted growth. Gerberas treated with Triact 70 at recommended rate were marketable.

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