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**IR-4 Ornamental Horticulture Program  
Tebuconazole Crop Safety**

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**Acknowledgements**

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## **Abstract**

Tebuconazole was first registered in 1994 for peanut diseases. Since then its food use label has expanded to several other food crops. The first noncrop registration of Torque 3.6SC (tebuconazole) occurred in 2010 for ornamental horticulture growers, professional landscape managers and for golf course turf. Tebuconazole manages foliar ornamental horticulture diseases including powdery mildew and rusts. However, given that triazoles have a tendency to also exhibit impacts similar to growth regulators, the crop safety profile for Torque 3.6SC is not well known. From 2012 through 2014, the IR-4 Project completed 25 trials on 13 ornamental plant genera or species. In these trials, 8 species or genera exhibited minimal or no injury after foliar applications. Torque caused stunting in Pansy and Zinnia at the higher application rates. In one trial, Narcissus exhibited moderate injury after the third application; additional trials are warranted to determine whether number of applications or the crop cultivar might be the contributing factor for injury. For the remaining 2 crops, not sufficient information has been generated.

## **Introduction**

Tebuconazole was first registered in 1994 for peanut diseases. Since then its food use label has expanded to several other food crops. The first noncrop registration of Torque 3.6SC (tebuconazole) occurred in 2010 for ornamental horticulture growers, professional landscape managers and for golf course turf. Tebuconazole manages foliar ornamental horticulture diseases including powdery mildew and rusts. However, given that triazoles have a tendency to also exhibit impacts similar to growth regulators, the crop safety profile for Torque 3.6SC is not well known. From 2012 through 2014, the IR-4 Project completed 45 trials on 15 ornamental plant genera or species.

## **Materials and Methods**

Foliar applications of Torque 3.6SC (tebuconazole) at 3, 6, and 12 oz per 100 gal were applied 3 times at 14 day intervals. All experiments had an untreated control. A minimum of 10 plants (replicate treatments) were required. Phytotoxicity was planned to be recorded on a scale of 0 to 10 (0 = No phytotoxicity; 10 = Complete kill). Phytotoxicity was rated 7 days after each application. For testing, the following protocols were used: 12-010, 13-010, and 14-003. Please visit <http://ir4.rutgers.edu/ornamental/OrnamentalDrafts.cfm> to view and download these protocols.

Torque 3.6SC (tebuconazole) was supplied to researchers (See list of researchers in Appendix 1) by Cleary Chemical and NuFarm.

## **Results and Summary**

Based on the type and nature of injury seen with pesticide applications, tested plant species were placed into three categories: 1) no significant phytotoxicity or growth differences from the untreated check or any injury was transitory, 2) no or minimal transitory injury seen at the 1X rate, but the 2X and/or 4X rates did cause significant phytotoxicity, 3) Significant injury sufficient to recommend growers not utilize tebuconazole.

### **Phytotoxicity**

Across all plant species tested, Torque 3.6SC (tebuconazole) exhibited no or minimal negative impact (Table 1) on 8 plant genera or species fell into this category. Significant stunting occurred with Pansy and Zinnia at the 2x and 4x (Table 2). Narcissus exhibited moderate injury, but only after the third application (Table 3). There are 2 species or genera where less than 3 trials were conducted so there is not enough information available at this time (Table 4).

Please see Table 5 for a summary of the individual trial results.

**Table 1. List of tebuconazole treated crops with no or minimal transitory injury.**

*Antirrhinum majus*  
*Buxus sempervirens*  
*Calibrachoa sp.*  
*Osteospermum sp.*  
*Petunia sp.*

*Pseudotsuga menziesii*  
*Rhododendron sp. (Azalea)*  
*Rhododendron sp. (Rhododendron)*  
*Rosa sp.*

**Table 2. List of tebuconazole treated crops with no injury at 1X but significant injury at 2X or 4X.**

*Pelargonium sp.*  
*Viola sp.*<sup>1</sup>  
*Zinnia sp.*<sup>1</sup>

**Table 3. List of tebuconazole treated crops with significant injury at 1X.**

*Narcissus sp.*<sup>2</sup>

**Table 4. List of tebuconazole treated crops where more information is needed.**

*Hydrangea sp.* *Tulipa sp.*

<sup>1</sup> Significant stunting occurred at the higher rates.

<sup>2</sup> In a single trial (Freiberger), moderate injury occurred at all rates after the third application. Additional research is warranted on this crop to determine whether this is related to cultivar or number of applications.

**Table 5 Detailed Summary of Crop Safety Testing with Torque 3.6SC (tebuconazole)**

Notes: Table entries are sorted by crop Latin name. Only those trials with research reports received by 8/14/2015 are listed below.

PR#	Crop	Production Site	Researcher	State	Year	Application Type	Results
30700	Snapdragon ( <i>Antirrhinum majus</i> )	Greenhouse	Gu (TX A&M)	TX	2013	Foliar	No leaf injury, very minor flower tip burn, and no growth reduction with 3, 6 and 12 fl oz per 100 gal applied 3 times.
30700	Snapdragon ( <i>Antirrhinum majus</i> ) A. majus 'Rocket'	Greenhouse	Grunwald	OR	2012	Foliar	No injury or growth reduction with 3, 6 and 12 fl oz per 100 gal applied 3 times; all plants saleable.
30700	Snapdragon ( <i>Antirrhinum majus</i> ) 'Montego Mix'	Greenhouse	Grunwald	OR	2013	Foliar	No injury or growth reduction with 3, 6 and 12 fl oz per 100 gal applied 3 times; all plants marketable.
30700	Snapdragon ( <i>Antirrhinum majus</i> ) 'Montego Rose'	Greenhouse	Freiberger	NJ	2012	Foliar	No injury or significant growth reduction with 3, 6 and 12 fl oz per 100 gal applied 3 times.
30700	Snapdragon ( <i>Antirrhinum majus</i> ) 'Purple'	Greenhouse	Freiberger	NJ	2012	Foliar	No injury or significant growth reduction with 3, 6 and 12 fl oz per 100 gal applied 3 times.
31491	Boxwood ( <i>Buxus</i> sp.) B. microphylla 'Winter Gem'	Field Container	Pscheidt	OR	2014	Foliar	No injury or height reduction with 12 fl oz per 100 gal applied 3 times.
31491	Boxwood ( <i>Buxus</i> sp.) B. sempervirens 'Suffruticosa'	Field Container	Pscheidt	OR	2014	Foliar	No injury or height reduction with 12 fl oz per 100 gal applied 3 times.
31491	Boxwood ( <i>Buxus</i> sp.) 'Green Velvet'	Field Container	Pscheidt	OR	2014	Foliar	No injury or height reduction with 12 fl oz per 100 gal applied 3 times.
30701	Calibrachoa ( <i>Calibrachoa</i> sp.) C. x hybrida 'Cabaret Lavender'	Greenhouse	Hausbeck	MI	2013	Foliar	No injury or growth reduction with 3, 6 and 12 fl oz per 100 gal applied 3 times.
30701	Calibrachoa ( <i>Calibrachoa</i> sp.) 'Cabaret Purple'	Greenhouse	Williams-Woodward	GA	2013	Foliar	No significant injury or growth reduction with 3, 6 and 12 fl oz per 100 gal applied 3 times.
30701	Calibrachoa ( <i>Calibrachoa</i> sp.) 'Mini-famous Orange'	Greenhouse	Grunwald	OR	2013	Foliar	No injury or growth reduction with 3, 6 and 12 fl oz per 100 gal applied 3 times; all plants marketable.
30701	Calibrachoa ( <i>Calibrachoa</i> sp.) 'Minifamous Red'	Greenhouse	Grunwald	OR	2012	Foliar	No injury or growth reduction with 3, 6 and 12 fl oz per 100 gal applied 3 times; all plants saleable.
30704	Hydrangea ( <i>Hydrangea</i> sp.) H. arborescens 'Annabelle'	Greenhouse	Grunwald	OR	2013	Foliar	No injury or growth reduction with 3, 6 and 12 fl oz per 100 gal applied 3 times; all plants marketable.
30704	Hydrangea ( <i>Hydrangea</i> sp.) H. macrophylla 'Endless Summer'	Greenhouse	DeFrancesco	OR	2013	Foliar	Elongated internodes in all treatments including Check. No significant difference with 3 and 6, significant increase with 12, fl oz per 100 gal applied 3 times.
30704	Hydrangea ( <i>Hydrangea</i> sp.) H. paniculata 'Tardiva'	Greenhouse	Brazee	MA	2013	Foliar	No injury or growth reduction with 3, 6 and 12 fl oz per 100 gal applied 3 times.
30705	Daffodil ( <i>Narcissus</i> sp.) 'Tete-a-Tete'	Greenhouse	Freiberger	NJ	2013	Foliar	Moderate injury starting after the final application with 3, 6 and 12 fl oz per 100 gal applied 3 times; slight growth reduction.
30706	African Daisy ( <i>Osteospermum</i> sp.) 'Akila Purple'	Greenhouse	Hausbeck	MI	2013	Foliar	No injury or growth reduction with 3, 6 and 12 fl oz per 100 gal applied 3 times.
30706	African Daisy ( <i>Osteospermum</i> sp.) 'Copper Purple'	Greenhouse	Grunwald	OR	2012	Foliar	No injury or growth reduction with 3, 6 and 12 fl oz per 100 gal applied 3 times; all plants saleable.

PR#	Crop	Production Site	Researcher	State	Year	Application Type	Results
30706	African Daisy ( <i>Osteospermum</i> sp.) 'Margarita Cool Purple'	Greenhouse	Freiberger	NJ	2013	Foliar	No injury or growth reduction with 3, 6 and 12 fl oz per 100 gal applied 3 times.
30706	African Daisy ( <i>Osteospermum</i> sp.) <i>O. ecklonis</i> 'Summertime Blueberry'	Greenhouse	DeFrancesco	OR	2013	Foliar	No injury or growth reduction with 3, 6 and 12 fl oz per 100 gal applied 3 times.
30707	Geranium ( <i>Pelargonium</i> sp.)	Greenhouse	Grunwald	OR	2014		No injury or growth reduction with 3, 6 and 12 fl oz per 100 gal; all plants saleable.
30707	Geranium ( <i>Pelargonium</i> sp.) 'Pink Elite'	Greenhouse	Freiberger	NJ	2012	Foliar	No injury after the 1st applic., no to moderate injury (leaf curling) increasing with rates (3, 6 and 12 fl oz per 100 gal) after 2nd applic.; stunting at the higher rates.
30707	Geranium ( <i>Pelargonium</i> sp.) 'Pink Elite'	Greenhouse	Freiberger	NJ	2014	Foliar	No injury or significant growth reduction with 3, 6 and 12 fl oz per 100 gal applied 3 times.
30707	Geranium ( <i>Pelargonium</i> sp.) 'Scarlet'	Greenhouse	Freiberger	NJ	2012	Foliar	No injury at 3, slight leaf curling at 6 and 12 fl oz per 100 gal, applied 3 times; some stunting.
30708	Petunia ( <i>Petunia</i> sp.)	Greenhouse	Grunwald	OR	2014	Foliar	No injury or growth reduction with 3, 6 and 12 fl oz per 100 gal; all plants saleable.
30708	Petunia ( <i>Petunia</i> sp.) 'Dream Neon Rose'	Greenhouse	Freiberger	NJ	2014	Foliar	No injury or growth reduction with 3, 6 and 12 fl oz per 100 gal applied 3 times.
30708	Petunia ( <i>Petunia</i> sp.) 'Neon Rose'	Greenhouse	Freiberger	NJ	2012	Foliar	No injury or significant growth reduction with 3, 6 and 12 fl oz per 100 gal applied 3 times.
30708	Petunia ( <i>Petunia</i> sp.) 'Purple'	Greenhouse	Freiberger	NJ	2012	Foliar	No injury or significant growth reduction with 3, 6 and 12 fl oz per 100 gal applied 3 times.
30709	Fir, Douglas ( <i>Pseudotsuga menziesii</i> )	Greenhouse	DeFrancesco	OR	2012	Foliar	No injury or growth reduction with 3, 6 and 12 fl oz per 100 gal applied 3 times.
30709	Fir, Douglas ( <i>Pseudotsuga menziesii</i> )	Greenhouse	Grunwald	OR	2012	Foliar	No injury or growth reduction with 3, 6 and 12 fl oz per 100 gal applied 3 times; all plants saleable.
30709	Fir, Douglas ( <i>Pseudotsuga menziesii</i> )	Greenhouse	Grunwald	OR	2013	Foliar	No injury or growth reduction with 3, 6 and 12 fl oz per 100 gal applied 3 times; all plants marketable.
30710	Azalea ( <i>Rhododendron</i> sp.)	Greenhouse	DeFrancesco	OR	2012	Foliar	No injury or growth reduction with 3, 6 and 12 fl oz per 100 gal applied 3 times.
30712	Azalea ( <i>Rhododendron</i> sp.)	Field Container	Grunwald	OR	2014	Foliar	No injury or growth reduction with 3, 6 and 12 fl oz per 100 gal; all plants saleable.
30712	Azalea ( <i>Rhododendron</i> sp.) 'Purple Gem'	Field Container	DeFrancesco	OR	2014	Foliar	No injury or growth reduction with 3, 6 and 12 fl oz per 100 gal applied 3 times.
30711	Rhododendron ( <i>Rhododendron</i> sp.)	Greenhouse	DeFrancesco	OR	2012	Foliar	No injury or growth reduction with 3, 6 and 12 fl oz per 100 gal applied 3 times.
30713	Rose ( <i>Rosa</i> sp.) <i>R. nutkana</i>	Greenhouse	Grunwald	OR	2012	Foliar	No injury or growth reduction with 3, 6 and 12 fl oz per 100 gal applied 3 times; all plants saleable.
30713	Rose ( <i>Rosa</i> sp.) <i>R. rugosa</i>	Greenhouse	Brazeo	MA	2013	Foliar	No significant injury or growth reduction with 3, 6 and 12 fl oz per 100 gal applied 3 times.
30713	Rose ( <i>Rosa</i> sp.) 'Radrazz'	Greenhouse	DeFrancesco	OR	2013	Foliar	No significant injury or growth reduction with 3, 6 and 12 fl oz per 100 gal applied 3 times.



PR#	Crop	Production Site	Researcher	State	Year	Application Type	Results
30714	Tulip ( <i>Tulipa</i> sp.) 'Oxford'	Greenhouse	Freiberger	NJ	2013	Foliar	Very slight injury starting after the final application with 3, 6 and 12 fl oz per 100 gal applied 3 times; no growth reduction.
30720	Pansy ( <i>Viola</i> sp.) 'Golden Yellow'	Greenhouse	Freiberger	NJ	2012	Foliar	No injury with 3 and 6, slight leaf curling with 12 fl oz per 100 gal, applied 3 times; significant stunting at the higher rates.
30720	Pansy ( <i>Viola</i> sp.) 'Lavender Blue'	Greenhouse	Freiberger	NJ	2012	Foliar	Slight to moderate injury (leaf curling) increasing with rates (3, 6 and 12 fl oz per 100 gal) applied 3 times; significant stunting.
32333	Zinnia ( <i>Zinnia</i> sp.) 'Dreamland Red'	Field Container	Freiberger	NJ	2014	Foliar	No injury or growth reduction with 3, 6 and 12 fl oz per 100 gal applied 3 times.
30721	Zinnia ( <i>Zinnia</i> sp.) 'Elegans Envy'	Greenhouse	Freiberger	NJ	2012	Foliar	Slight injury (leaf curling) with 3 and 6, moderate with 12 fl oz per 100 gal, applied 3 times; significant stunting at the higher rates.
30721	Zinnia ( <i>Zinnia</i> sp.) 'Thumbelina'	Greenhouse	Freiberger	NJ	2012	Foliar	No injury or significant growth reduction with 3, 6 and 12 fl oz per 100 gal applied 3 times.
30721	Zinnia ( <i>Zinnia</i> sp.) <i>Z. elegans</i> 'Zinnita Mix'	Greenhouse	Grunwald	OR	2013	Foliar	No injury or growth reduction with 3, 6 and 12 fl oz per 100 gal applied 3 times; all plants marketable.

## Label Suggestions

In this report, 8 species exhibited minimal or no injury after foliar sprays of tebuconazole.

*Antirrhinum majus*

*Buxus sempervirens*

*Calibrachoa sp.*

*Osteospermum sp.*

*Petunia sp.*

*Pseudotsuga menziesii*

*Rhododendron sp. (Azalea)*

*Rhododendron sp. (Rhododendron)*

*Rosa sp.*

More research is needed to understand crop safety among a wider range of crops.

## Appendix 1: Contributing Researchers

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