

Landscape dormant applications of Specticle G compared to FreeHand 1.75G and Snapshot 2.5 TG

Bayer Protocol #: HE16USA01MQR

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Note¹: This report uses the, *Summary of Herbicide Mechanism of Action (MOA) According to the Herbicide Resistance Action Committee (HRAC) and Weed Science Society of America (WSSA) Classification system* (wssa.net/wp-content/uploads/HerbicideMOAClassification.pdf) and specifically the WSSA number classification system ex. microtubule assembly inhibitors as group 3.

Note²: All rated score evaluations of phytotoxicity were measured on a 1 to 10 scale, where 1 is significant damage, 6=min. acceptable and 9-10=equal or better than control (Bayer CropScience LP evaluation scale). All rated score evaluations of efficacy were measured on a 0 to 10 scale, where 10 represents complete control and ≥ 7 represents commercially acceptable weed control and 0 no control (Barolli et al., 2005; Collins et al. 1999; Duray and Davies, 1989; Mathers and Case, 2010; Samtami et al., 2007). Each interval of efficacy scoring represents a 10% loss of weed control over the test plot ex. 9 would be 10% cover, 7 would be 30%, etc.

Background. The goal of this research was to promote Specticle G (indaziflam) (Bayer Crop Science Inc, Research Triangle Park, NC) in the landscape market. The overall objective was to evaluate the utility of Specticle G as an over the top dormant application versus two major industry competitor products, i.e. Snapshot 2.5 TG (isoxaben + trifluralin) (Dow AgroSciences, LLC, Indianapolis, IN 46268) and FreeHand 1.75G (dimethenamid-p + pendimethalin, BASF Corporation, Research Triangle Park, NC 27709) with 10 common landscape ornamental plants in eight evaluations from trial initiation to end, 01/16/2015 to 06/16/2016. The experiment had five specific objectives as determined by Bayer CropScience LP: 1) describe phytotoxicity of Specticle G at rates tested; 2) characterize efficacy in the spring for rates tested; 3) compare tolerance and efficacy to chosen standard(s) (Snapshot and FreeHand); 4) was any phytotoxicity acceptable?; and 5) how long did it take for recovery?

Significance:

Few rotational products are available for landscape bed maintenance. Eighty-five percent of the industry uses SnapShot 2.5TG repeatedly and without rotation. Snapshot contains isoxaben, a cellulose inhibiting product (Group 21) for broadleaf control and trifluralin, a mitosis inhibitor (Mi) product (Group 3) for grass control. Rotating out of the Mi (Group 3) mode of action (MoA) is extremely difficult in landscape settings due to lack of available products. FreeHand offers a limited rotation as it contains pendimethalin (Group 3) and a long-chain fatty acid inhibitor dimethenamid-p (Group 15); however, many sources list Group 15's as Mi's. Therefore, FreeHand contains two Mi's. Specticle offers a true rotation away from Mi products as it contains only indaziflam, a cellulose inhibitor (Group 29). Group 29 herbicides inhibit cellulose biosynthesis (Myers et al., 2009), which is a different family than isoxaben (Group 21) although in the same MoA. In past landscape studies with Specticle G, some phytotoxicity occurred. A dormant application was evaluated to determine if phytotoxicity can be reduced and efficacy increased and/or extended.

Impact:

Side-by-side comparisons of herbicide products are the most likely way to ensure one product is chosen versus another. Without side-by-side comparisons, landscapers will often make herbicide choices based on convenience and not merit. The greatest impact of this research will be in two areas: 1) more efficient and effective herbicide use for landscape professionals, thus lower herbicide usage and costs; and 2) greater herbicide choices for landscape professionals, thus increasing control and preventing herbicide resistance in weeds.

Materials and Methods:

The trial was initiated on Jan. 16, 2016 using four mature landscape beds in Gahanna, OH and a randomized complete block design (RCBD). On the 16th, remnants of a light snow existed on some areas of the site. This snow helped to water in the herbicide after application (Fig. 1 A-E). The high on the 16th was 41°F and the low was 30°F (Accu Weather, Columbus, OH). On January 17, 2016, 0.5 inch of snow fell again helping with activation. This snow was all melted by Jan. 25, 2016, when the high was 46°F. Each granular product was pre-weighed and applied to a 14" diameter treatment plot or circle over-the-top (OTT) of each species/treatment/replication (Fig. 1 B and C). All applications were made on dormant plant materials with the exception of *Yucca filamentosa*, a broadleaf evergreen, and *Festuca glauca* 'Elijah Blue' (Elijah Blue fescue), a semi-evergreen (Fig. 1 B and D).

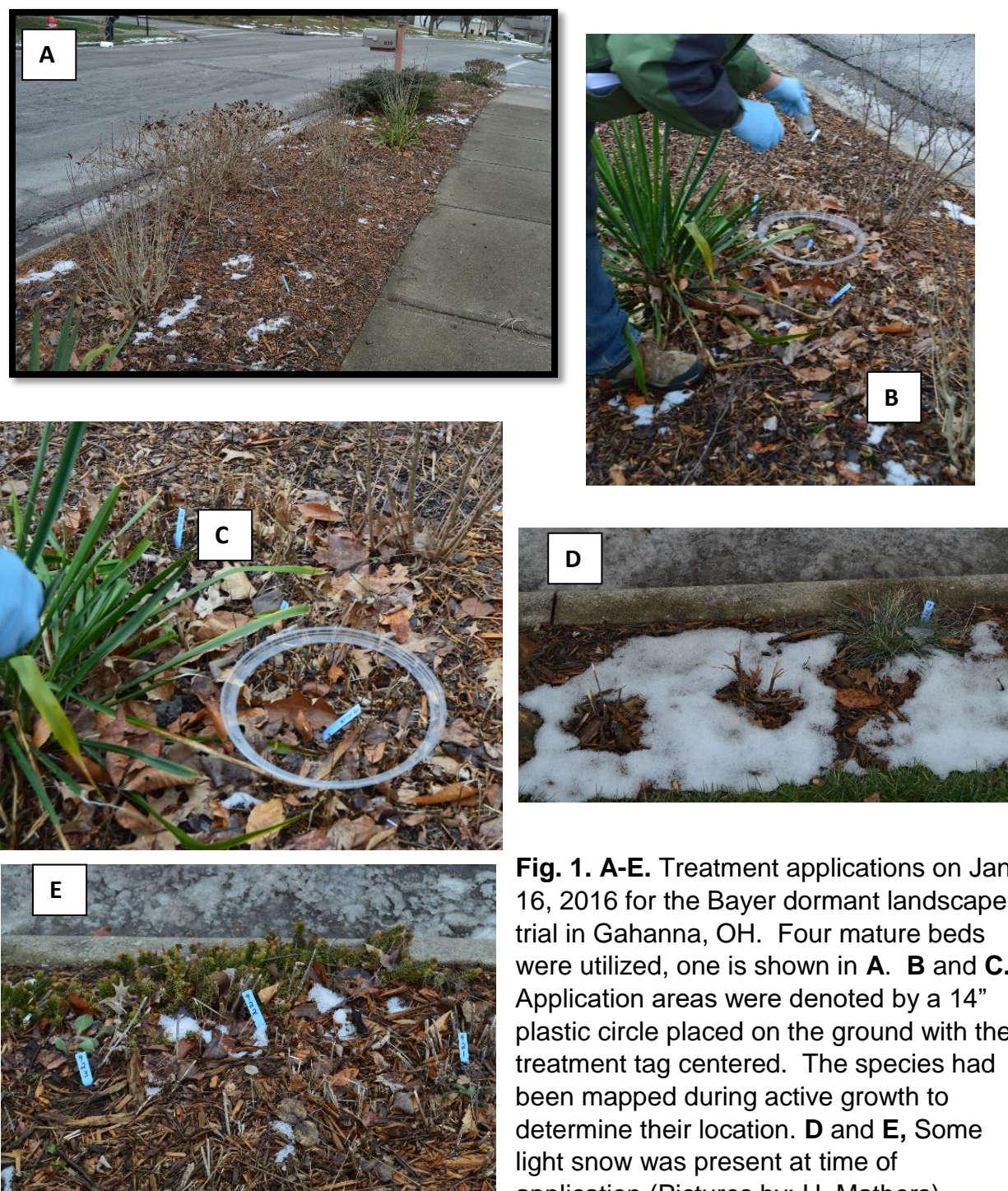


Fig. 1. A-E. Treatment applications on Jan. 16, 2016 for the Bayer dormant landscape trial in Gahanna, OH. Four mature beds were utilized, one is shown in **A**. **B** and **C**. Application areas were denoted by a 14" plastic circle placed on the ground with the treatment tag centered. The species had been mapped during active growth to determine their location. **D** and **E**, Some light snow was present at time of application (Pictures by: H. Mathers).

The ten common landscape plants were evaluated and listed below as they were ordered in the study. The Missouri Botanical Garden website was used as a source for listing each by scientific name, common name, botanical family, plant form and the

height and spread each plant would achieve at maturity (<http://www.missouribotanicalgarden.org/plantfinder/plantfindersearch.aspx>). *Yucca filamentosa* (Adam's needle) is in the Asparagaceae and is a broadleaf evergreen with mature height of 4 - 8 ft. and spread of 2 - 3 ft. *Coreopsis verticillata* 'Zagreb' (Threadleaf coreopsis) is in Asteraceae and is an herbaceous perennial with mature height of 1- 1.5 ft. and spread of 1.5 - 1.5 ft. *Berberis thunbergii* var. *atropurpurea* 'Concord' (Concord Japanese Barberry) is a member of the Berberidaceae and a deciduous shrub with mature height of 3 - 6 ft. and spread of 4 - 7 ft. *Echinacea purpurea* (Coneflower) is also a member of the Asteraceae and an herbaceous perennial with mature height of 2 - 5 ft. and 1.5 - 2 ft. spread. *Pennisetum alopecuroides* 'Moudry' (Fountain grass) is an herbaceous perennial ornamental grass that reaches 2 - 2.5 ft. height and 1.5 - 2 ft. spread at maturity. *Iris germanica* 'Immortality' (Bearded Iris) was listed as species six in the study and is a member of the Iridaceae an herbaceous perennial with 2 - 3 ft. height and 1 - 2 ft. spread. *Festuca glauca* 'Elijah Blue' (Elijah Blue fescue) is another member of the Poaceae and is a semi-evergreen herbaceous perennial. It is a bunching grass with limited spread and mature height of 6 - 12". *Ligustrum* 'Vicaryi' (Golden privet), a member of the Oleaceae is a deciduous shrub with height and spread of 6 - 12 ft. and 7 - 10 ft., respectively. *Perovskia atriplicifolia* (Russian sage) is in the Lamiaceae is an herbaceous perennial that at maturity reaches 3 - 5 ft. tall and 2 -4 ft. wide. The last species in the trial, listed as number 10, was *Salvia x sylvestris* 'Mainacht' (May Night wood sage) which is also in the Lamiaceae and an herbaceous perennial with height of 1.5 - 2 ft. and spread of 1 - 1.5 ft.

There were six treatments applied to each species with three replications. The treatments included an untreated control, Specticle G at 200, 400 and 800 lb/ac, FreeHand at 150 lb/ac and Snapshot 2.5 TG at 200 lb/ac. Osmocote Pro 17-5-11 (3-4 month) fertilizer was applied at 3 lb/1000 ft² of landscape bed. Phytotoxicity was scored as indicated in the foreword at regular intervals over five months (Table 1 and 2) for 18 plots per species or 180 plots total.

Results:

Over species and date, the only treatment with significantly greater phytotoxicity than the control was Snapshot (Table 2); however, Snapshot's phytotoxicity was not significantly different than any other treatment (Table 2). Combined over treatments and date, the *Festuca glauca* 'Elijah Blue' and the *Perovskia atriplicifolia* exhibited the most phytotoxicity (Table 2). Neither species, however, over date and treatment had unacceptable injury (Table 2). Conversely, phytotoxicity by species date and treatment indicated unacceptable injury did occur with *Festuca glauca* 'Elijah Blue', *Perovskia atriplicifolia* and *Berberis thunbergii* var. *atropurpurea* 'Concord' that persisted to the end of the trial or 5 months after treatment (5 MAT) (Table 1). Non-persisting, unacceptable injury also occurred to *Coreopsis verticillata* 'Zagreb', *Echinacea purpurea*, *Pennisetum alopecuroides* 'Moudry', and *Salvia x sylvestris* 'Mainacht' (Table 1). The *Yucca*

filamentosa, *Iris germanica* 'Immortality' and *Ligustrum* 'Vicaryi' were the only species with no unacceptable injury, with any treatment, throughout the trial (Table 1). With the exception of the *Festuca glauca*, Specticle G at the 1X rate of 200 lb/ac never caused unacceptable injury at any time in the trial. This was not the case with any other treatment including the 1X rates of FreeHand or Snapshot. Even with the *Festuca*, the Specticle G 1X was only slightly injured more than acceptable at 5 MAT.

The *Festuca glauca* had significantly greater unacceptable injury with the two high rates of Specticle (400 and 800 lb/ac) (Fig. 4) compared to the 200 lb/ac rate of Specticle or Snapshot, but not FreeHand (Table 1). All treatments with *Festuca* were more phytotoxic than the control. The *Festuca* injury with the Snapshot started the earliest of all treatments; however, at 5 MAT it was no longer unacceptable (Table 1). The FreeHand injury occurred as the plants began to grow more vigorously in the spring (May to June), possibly indicating some root inhibition (Table 1). The high rates of Specticle G began adversely affecting the *Festuca* as soon as growth was resuming in the spring, 10 weeks after treatment (WAT) or March 23, 2016. By May (4 MAT) some of the *Festuca* were near death; however, they made some recovery at 20 WAT (June 2, 2016) but, declined again as June temperatures increased (Fig. 4) (Table 1).

All treatments with the exception of Specticle G 200 lb/ac were significantly more phytotoxic than the control with *Perovskia*. The *Perovskia* unacceptable injury was greatest with the FreeHand at 5 MAT and averaged over dates when compared to any other treatment (Table 1). The only other treatment with persisting unacceptable injury at 5 MAT with the *Perovskia* was the Specticle G 400 lb/ac (Fig. 5 B) but not the 800 lb/ac (Table 1). All phytotoxic *Perovskia* treatments began adversely affecting when growth was resuming, 10 weeks after treatment (WAT) or March 23, 2016 with the exception of the Specticle 400 lb/ac rate which began at (4 MAT). Snapshot had only passing injury on *Perovskia* at 10 WAT and 3 MAT. By the end of the trial, Snapshot treated plants were significantly more injured than the control or the 200 lb/ac or 800 lb/ac Specticle G but not as injured as the Specticle 400 lb/ac or FreeHand again the worst *Perovskia* treatment (Table 1).

Berberis thunbergii var. *atropurpurea* 'Concord' suffered unacceptable injury from FreeHand and Snapshot; however, only FreeHand injury persisted to 5 MAT (Table 1). FreeHand and Snapshot were more phytotoxic than all three Specticle G rates which were never more phytotoxic than the control (Table 1). *Berberis* was slower to break dormancy than other species in the trial. With the exception of Snapshot, there was no injury before 4 MAT (Table 1). All rates of Specticle G were completely safe on *Berberis* (Table 1).

Unacceptable injury occurred to *Coreopsis verticillata* 'Zagreb' only with FreeHand at 2 MAT and 10 WAT. The FreeHand injury, however, was not significantly different than Specticle G 200 and 800 lb/ac. All *Coreopsis* grew out of injury by the

end of the trial; however, FreeHand (Fig. 2) and Specticle G 800 lb/ac plants were still more injured than any other treatment (Table 1). *Echinacea purpurea* were injured to unacceptable levels with FreeHand (Fig. 3) and Snapshot only (Table 1). By the end of study, there were no statistical differences in injury between FreeHand and Snapshot, although both were more phytotoxic than the three rates of Specticle G and the control. The three rates of Specticle G provided no injury, similar to the control (Table 1). *Pennisetum alopecuroides* 'Moudry' had injury with Specticle G at 400 and 800 lb/ac, FreeHand and Snapshot at 10 WAT (Table 1). With the exception of Specticle 400 lb/ac, all had out-grown the injury by 3 MAT; by 15 WAT even the 400 lb rate was fine (Table 1). The control also had injury at 10 WAT, which was inconsistent with the other evaluation dates and may have indicated an error in the data. The *Salvia x sylvestris* 'Mainacht' had unacceptable injury with the highest rate of Specticle G, 800 lb/ac (Fig. 8) and Snapshot. Averaged over dates, Specticle 800 lb/ac and Snapshot were not statistically different than one another but had significantly greater phytotoxicity than the other four treatments (Table 1). Injury with the 400 lb rate of Specticle was slight and passing (Fig. 7) compared to the control (Fig. 6).

By 5 MAT, efficacy in the control was lost well below commercially acceptable ranging from a low of no control (0) with *Berberis thunbergii* var. *atropurpurea* 'Concord', and *Iris germanica* 'Immortality' to a high of 5.3 in the *Festuca glauca* 'Elijah Blue' (Table 3). The average rating for 5 MAT in the control over treatments was 3.3. Depending on species, several treatments were below commercially acceptable at 5 MAT. *Berberis thunbergii* and *Iris germanica* had the lowest efficacy scores averaged across dates by treatment and at 5 MAT (Table 3). Weed control was considered lower in *Berberis* and *Iris* as there was more open ground where light could penetrate around these two to promote weed growth (Fig. 9 and 10). All treatments at 4 MAT were below commercially acceptable in the *Berberis* (Table 3) (Fig. 9B). The worst treatment for *Berberis thunbergii* var. *atropurpurea* 'Concord' was Snapshot, which went below commercially acceptable at 15 WAT and stayed the same as the control until 5 MAT when it was rated 1.3 (Table 3). The second worst weed control in *Berberis* was provided by Specticle G 200 lb/ac (Fig. 9A) which was the same as FreeHand and rated 1.0 and 2.0, respectively at 5 MAT (Table 3).

Weed control was better in *Iris* versus *Berberis* with the exception of FreeHand, which went below commercially acceptable at 10 WAT (Table 3). Specticle 400 and 800 lb/ac were still above commercially acceptable in the *Iris* at 4 MAT (Table 3). The Specticle G 200 lb/ac was not statistically different in its level of control versus FreeHand by 20 WAT; however, the Specticle G 200 lb/ac had provided perfect weed control through to 15 WAT. Snapshot lost acceptable control at 15 WAT (Table 3) but was statistically superior at 20 WAT (2.0) (Fig. 10) to FreeHand (0) (Table 3). Specticle G 800 lb/ac was the most efficacious treatment in *Iris* with a rating of 7.7 at 5 MAT, although this was not statistically different than 400 lb/ac rate (6.7), it was commercially significant (Table 3).

Efficacy was generally high in this experiment. All applications were conducted in mature landscape beds which limited competition due to early full crown development in spring. Also, applications were performed before any weeds had germinated and in cooler temperatures which seem to be advantageous for indaziflam (past trial experience). All treatment efficacies were above commercially acceptable, with the exception of the control, at 5 MAT for *Coreopsis verticillata* 'Zagreb', *Echinacea purpurea*, *Pennisetum alopecuroides* 'Moudry', *Festuca glauca* 'Elijah Blue', *Perovskia atriplicifolia* and *Salvia x sylvestris* 'Mainacht' (Table 3). When efficacy was lost in the two species not yet discussed *Yucca filamentosa*, and *Ligustrum* 'Vicaryi', it was with FreeHand, Snapshot and/or 200 lb/ac Specticle G (Table 3). The Specticle G 200 lb/ac rate provided commercially acceptable control in *Yucca* at 4 MAT, but at 5 MAT (6.3), it was not statistically different than FreeHand (5.7) (Table 3). The Snapshot was the least efficacious treatment in the *Yucca* (Table 3). FreeHand with *Ligustrum* 'Vicaryi' did not provide commercially acceptable efficacy at 4 MAT and was not different than the efficacy provided by Specticle G 200 lb/ac or the control at 4 MAT (Table 3). The FreeHand and 200 lb/ac rate of Specticle G were the worst two treatments in *Ligustrum*; however, Snapshot was statistically as efficacious as Specticle G 400 and 800 lb/ac at 5 MAT (Table 3).

Summary

A summary of efficacy and phytotoxicity results shows that although FreeHand is listed four times and Snapshot three times as the most phytotoxic treatments in this study, they are also listed twice as the least efficacious treatments (Table 4). In addition, although Specticle 400 (twice) and 800 lb/ac (once) are listed as the most phytotoxic treatments, they are never listed as the least efficacious (Table 4). Also, the Specticle G 200 lb/ac rate is listed twice as the least efficacious treatment; however, it is never listed as the most phytotoxic (Table 4). Generally, Specticle G 1X rate was superior to FreeHand and Snapshot in efficacy and reduced phytotoxicity and needs to be promoted in the landscape market as a dormant season application on mature beds. The extension of efficacy with the Specticle G in applying it dormant is very impressive. After five months, all the species had filled in well in the landscape and few weeds emerged throughout the season (Fig. 11 A and B).

Table 1. Bayer Specticle 2016 dormant landscape application trial means of phytotoxicity by species, treatment and evaluation date. Averages for each treatment are also listed by species. Bolded values indicate when injury occurred above acceptable.

Yucca filamentosa

Treatment	Rate/ac	1 MAT	2 MAT	10 WAT	3 MAT	15 WAT	4 MAT	20 WAT	5 MAT	Average
Control	--	10.0 ^z	8.7a	8.0b	10.0a	10.0a	10.0a	10.0a	10.0a	9.6a
Specticle G	200 lb	10.0a ^x	9.3a	9.3a	9.0a	10.0a	10.0a	10.0a	10.0a	9.7a
Specticle G	400 lb	9.0a	9.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	9.8a
Specticle G	800 lb	10.0a	10.0a	10.0a	10.0a	10.0a	9.0a	9.0a	9.0a	9.6a
FreeHand	150 lb	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a
SnapShot 2.5 G	200 lb	8.3b	9.0a	9.7a	10.0a	10.0a	10.0a	10.0a	10.0a	9.6a

Coreopsis verticillata 'Zagreb'

Treatment	Rate/ac	1 MAT	2 MAT	10 WAT	3 MAT	15 WAT	4 MAT	20 WAT	5 MAT	Average
Control	--	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a
Specticle G	200 lb	10.0a	10.0a	7.0b	10.0a	10.0a	10.0a	10.0a	10.0a	9.6a
Specticle G	400 lb	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a
Specticle G	800 lb	10.0a	10.0a	6.3b	10.0a	10.0a	7.0b	7.0b	7.0b	8.4b
FreeHand	150 lb	10.0a	6.0b	6.0b	10.0a	8.7a	7.0b	7.0b	7.0b	7.7b
SnapShot 2.5 G	200 lb	10.0a	10.0a	10.0a	10.0a	10.0a	9.0a	9.0a	9.0a	9.6a

Berberis thunbergii var. *atropurpurea* 'Concord'

Treatment	Rate/ac	1 MAT	2 MAT	10 WAT	3 MAT	15 WAT	4 MAT	20 WAT	5 MAT	Average
Control	--	10.0a	10.0a	10.0a	10.0a	10.0a	5.3b	8.0ab	8.0ab	8.9a

Specticle G	200 lb	10.0a	10.0a	10.0a	10.0a	10.0a	8.7a	9.0a	8.7a	9.6a
Specticle G	400 lb	10.0a	10.0a	10.0a	10.0a	10.0a	8.3a	9.0a	8.3a	9.5a
Specticle G	800 lb	10.0a	10.0a	9.3a	10.0a	10.0a	8.7a	9.0a	8.7a	9.5a
FreeHand	150 lb	10.0a	10.0a	10.0a	10.0a	9.7a	5.7b	7.3b	5.7b	8.6a
SnapShot 2.5 G	200 lb	10.0a	10.0a	6.0b	8.3b	7.0b	6.0b	7.7ab	6.7b	7.7b

Echinacea purpurea

Treatment	Rate/ac	1 MAT	2 MAT	10 WAT	3 MAT	15 WAT	4 MAT	20 WAT	5 MAT	Average
Control	--	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a
Specticle G	200 lb	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a
Specticle G	400 lb	10.0a	10.0a	7.3b	10.0a	10.0a	10.0a	10.0a	10.0a	9.7a
Specticle G	800 lb	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a
FreeHand	150 lb	10.0a	10.0a	5.7c	8.0b	4.0c	8.0b	8.0b	8.0b	7.7b
SnapShot 2.5 G	200 lb	10.0a	10.0a	6.3bc	8.0b	6.0b	7.0b	7.0b	7.0b	7.7b

***Pennisetum alopecuroides* 'Moudry'**

Treatment	Rate/ac	1 MAT	2 MAT	10 WAT	3 MAT	15 WAT	4 MAT	20 WAT	5 MAT	Average
Control	--	10.0a	10.0a	6.0ab	10.0a	8.7a	10.0a	10.0a	10.0a	9.3a
Specticle G	200 lb	10.0a	10.0a	7.3a	8.3b	10.0a	10.0a	10.0a	10.0a	9.5a
Specticle G	400 lb	10.0a	10.0a	3.3cd	6.0d	9.3a	8.0b	8.0b	8.0b	7.8b
Specticle G	800 lb	10.0a	10.0a	4.7bc	7.7bc	9.7a	9.0ab	9.0ab	9.0ab	8.6ab
FreeHand	150 lb	9.0a	10.0a	4.0cd	8.0b	9.7a	8.0b	8.0b	8.0b	8.1ab
SnapShot 2.5 G	200 lb	10.0a	10.0a	3.0d	6.3cd	9.3a	8.7a	8.7a	8.7a	8.1ab

***Iris germanica* 'Immortality'**

Treatment	Rate/ac	1 MAT	2 MAT	10 WAT	3 MAT	15 WAT	4 MAT	20 WAT	5 MAT	Average
Control	--	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a
Specticle G	200 lb	9.0a	9.7a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	9.8a
Specticle G	400 lb	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a
Specticle G	800 lb	10.0a	9.3a	8.3b	10.0a	10.0a	10.0a	10.0a	10.0a	9.7a
FreeHand	150 lb	7.0b	7.0b	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	9.3a
SnapShot 2.5 G	200 lb	7.7b	6.7b	9.0ab	6.7b	10.0a	10.0a	10.0a	10.0a	8.8a

***Festuca glauca* 'Elijah Blue'**

Treatment	Rate/ac	1 MAT	2 MAT	10 WAT	3 MAT	15 WAT	4 MAT	20 WAT	5 MAT	Average
Control	--	8.0bc	8.0b	9.0a	9.0a	9.0a	8.3a	8.3a	8.3a	8.5a
Specticle G	200 lb	9.0ab	6.7bc	4.7b	5.0b	3.3c	4.0b	4.0c	5.3b	5.3b
Specticle G	400 lb	10.0a	8.0b	3.3bc	3.0c	1.0d	1.0c	5.7b	3.0c	4.4b
Specticle G	800 lb	7.3c	10.0a	4.0bc	8.7a	5.7b	1.0c	5.3bc	3.0c	5.6b
FreeHand	150 lb	8.7abc	10.0a	8.5a	8.7a	9.3a	3.0b	5.0bc	4.0bc	7.2a
SnapShot 2.5 G	200 lb	8.7abc	5.3c	3.0c	5.0b	3.7c	4.0b	8.0a	5.0b	5.3b

***Ligustrum* 'Vicaryi'**

[illegible]

Specticle G	800 lb	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a
FreeHand	150 lb	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a
SnapShot 2.5 G	200 lb	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a

Perovskia atriplicifolia

Treatment	Rate/ac	1 MAT	2 MAT	10 WAT	3 MAT	15 WAT	4 MAT	20 WAT	5 MAT	Average
Control	--	10.0a	10.0a	10.0a	9.3a	10a	10a	10a	10.0a	9.9a
Specticle G	200 lb	10.0a	8.7a	3.3b	9.0a	10.0a	10.0a	10.0a	10.0a	8.9a
Specticle G	400 lb	10.0a	10.0a	10.0a	4.3c	5.0c	5.7c	5.7c	5.7c	7.1b
Specticle G	800 lb	10.0a	10.0a	2.7b	6.0b	7.0b	8.3b	8.3b	8.0b	7.5ab
FreeHand	150 lb	10.0a	10.0a	1.0c	10.0a	4.0d	2.7d	2.7d	2.7d	5.4c
SnapShot 2.5 G	200 lb	10.0a	10.0a	1.3c	3.7c	6.3bc	7.7b	7.7b	8.0b	6.8bc

***Salvia x sylvestris* 'Mainacht'**

Treatment	Rate/ac	1 MAT	2 MAT	10 WAT	3 MAT	15 WAT	4 MAT	20 WAT	5 MAT	Average
Control	--	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a
Specticle G	200 lb	10.0a	8.0b	7.0b	8.7a	10.0a	10.0a	10.0a	10.0a	9.2a
Specticle G	400 lb	10.0a	6.7b	6.3bc	6.7b	7.7b	8.7a	8.7a	8.7a	7.9b
Specticle G	800 lb	10.0a	2.0d	5.0c	5.3b	7.3b	7.0b	7.0b	8.0b	6.5c
FreeHand	150 lb	9.0a	7.0b	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	9.5a
SnapShot 2.5 G	200 lb	8.7a	5.0c	5.3c	5.3b	6.7b	7.0b	7.0b	7.0b	6.5c

Z = Ratings are based on a scale of 1-10 where 1=significant damage, 6=min. acceptable damage and 9-10=equal or better than control.

X = Treatments with different letters signify phytotoxicity was statistically different at p=0.05 using LS means.

Table 2. Bayer Specticle 2016 dormant landscape application trial averages of phytotoxicity means by species, treatment and evaluation date. Treatment averages across species and species averages across treatment are also listed. Bolded values indicate when injury occurred above acceptable.

	Yucca	Coreopsis	Berberis	Echinacea	Pennisetum	Iris	Festuca	Ligustrum	Perovskia	Salvia	Tmt. Av.
Control	9.6a	10a	8.9a	10a	9.3ab	10a	8.5a	10a	9.9a	10a	9.6a
Specticle G 200 lb	9.7a	9.6ab	9.6a	10a	9.5a	9.8a	5.3c	9.9a	8.9ab	9.2ab	9.2ab
Specticle G 400 lb	9.8a	10a	9.5a	9.7a	7.8b	10a	4.4cd	10a	7.1c	7.9bc	8.6ab
Specticle G 800 lb	9.6a	8.4bc	9.5a	10a	8.6ab	9.7a	5.6bc	10a	7.5bc	6.5c	8.5ab
FreeHand 150 lb	10a	7.7c	8.6ab	7.7b	8.1ab	9.3a	7.2ab	10a	5.4d	9.5ab	8.4ab
SnapShot 200 lb	9.6a	9.6ab	7.7b	7.7b	8.1ab	8.8a	5.3c	10a	6.8cd	6.5c	8.0b
Species Av.	9.7a	9.2a	9.0a	9.2a	8.6ab	9.6a	6.1bc	10.0a	7.6bc	8.3b	

Z = Ratings are based on a scale of 1-10 where 1=significant damage, 6=min. acceptable damage and 9-10=equal or better than control.

X = Treatments with different letters signify phytotoxicity was statistically different at p=0.05 using LS means.

Table 3. Bayer Specticle 2016 dormant landscape application trial means of efficacy by species, treatment and evaluation date. Averages for each treatment are also listed by species. Bolded values indicate when weed control dropped below commercially acceptable.

Yucca filamentosa

Treatment	Rate/ac	1 MAT	2 MAT	10 WAT	3 MAT	15 WAT	4 MAT	20 WAT	5 MAT	Average
Control	--	10.0 ^z a ^x	10.0a	10.0a	10.0a	10.0a	5.0c	2.0d	2.0d	7.4c
Specticle G	200 lb	10.0a	10.0a	10.0a	10.0a	10.0a	7.7b	7.0b	6.3b	8.9ab
Specticle G	400 lb	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	8.0a	9.8a
Specticle G	800 lb	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	9.7a	8.3a	9.8a
FreeHand	150 lb	10.0a	10.0a	10.0a	10.0a	10.0a	7.3b	5.7b	5.7b	8.6ab
SnapShot 2.5 G	200 lb	10.0a	10.0a	10.0a	10.0a	10.0a	4.7c	3.7c	3.7c	7.8bc

***Coreopsis verticillata* 'Zagreb'**

Treatment	Rate/ac	1 MAT	2 MAT	10 WAT	3 MAT	15 WAT	4 MAT	20 WAT	5 MAT	Average
Control	--	10.0a	10.0a	10.0a	10.0a	10.0a	9.0a	6.0b	6.0b	8.9a
Specticle G	200 lb	9.7a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	8.0a	9.7a
Specticle G	400 lb	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	8.0a	9.8a
Specticle G	800 lb	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	8.0a	9.8a
FreeHand	150 lb	10.0a	8.7a	8.7a	8.0b	8.7a	10.0a	10.0a	8.0a	9.0a
SnapShot 2.5 G	200 lb	10.0a	10.0	10.0a	10.0a	10.0a	10.0a	10.0a	8.0a	9.8a

***Berberis thunbergii* var. *atropurpurea* 'Concord'**

Treatment	Rate/ac	1 MAT	2 MAT	10 WAT	3 MAT	15 WAT	4 MAT	20 WAT	5 MAT	Average
Control	--	10.0a	9.3a	9.3ab	10.0a	5.7d	0.0c	0.0c	0.0c	5.5b
Specticle G	200 lb	10.0a	10.0a	10.0a	10.0a	10.0a	1.0bc	1.0bc	1.0bc	6.6a
Specticle G	400 lb	10.0a	9.3a	10.0a	10.0a	10.0a	3.3a	3.3a	3.3a	7.4a
Specticle G	800 lb	10.0a	9.7a	9.7ab	10.0a	8.7ab	2.7a	2.7a	2.7a	7.0ab
FreeHand	150 lb	10.0a	10.0a	10.0a	10.0a	8.0bc	2.0ab	2.0ab	2.0ab	6.8ab
SnapShot 2.5 G	200 lb	10.0a	9.0a	8.3b	10.0a	6.7cd	0.0c	1.3bc	1.3bc	5.8b

Echinacea purpurea

[illegible]

Specticle G	800 lb	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	8.0a	9.8a
FreeHand	150 lb	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	8.0a	9.8a
SnapShot 2.5 G	200 lb	10.0a	10.0a	9.3a	10.0a	10.0a	10.0a	9.0a	7.7a	9.5a

***Pennisetum alopecuroides* ‘Moudry’**

Treatment	Rate/ac	1 MAT	2 MAT	10 WAT	3 MAT	15 WAT	4 MAT	20 WAT	5 MAT	Average
Control	--	10.0a	10.0a	10.0a	10.0a	10.0a	7.0b	4.0b	4.0b	8.1b
Specticle G	200 lb	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	8.0a	9.8a
Specticle G	400 lb	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	8.0a	9.8a
Specticle G	800 lb	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	8.0a	9.8a
FreeHand	150 lb	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	8.0a	9.8a
SnapShot 2.5 G	200 lb	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	8.0	9.8a

***Iris germanica* ‘Immortality’**

Treatment	Rate/ac	1 MAT	2 MAT	10 WAT	3 MAT	15 WAT	4 MAT	20 WAT	5 MAT	Average
Control	--	10.0a	10.0a	8.3bc	7.3b	4.0b	0.0d	0.0c	0.0c	5.0bc
Specticle G	200 lb	9.7a	10.0a	5.7cd	10.0a	10.0a	2.0c	0.0c	0.0c	5.9b
Specticle G	400 lb	10.0a	10.0a	10.0a	10.0a	10.0a	8.7a	6.7a	6.7a	9.0a
Specticle G	800 lb	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	7.7a	7.7a	9.4a
FreeHand	150 lb	10.0a	10.0a	5.3d	2.0c	4.0b	4.0b	0.0c	0.0c	4.4c
SnapShot 2.5 G	200 lb	10.0a	10.0a	7.0c	10.0a	5.0b	5.0b	2.0b	2.0b	6.4b

***Festuca glauca* ‘Elijah Blue’**

Treatment	Rate/ac	1 MAT	2 MAT	10 WAT	3 MAT	15 WAT	4 MAT	20 WAT	5 MAT	Average
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Control	--	10.0a	10.0a	10.0a	10.0a	10.0a	9.3a	5.3b	5.3b	8.7a
Specticle G	200 lb	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	8.0a	9.8a
Specticle G	400 lb	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	8.0a	9.8a
Specticle G	800 lb	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	8.0a	9.8a
FreeHand	150 lb	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	8.0a	9.8a
SnapShot 2.5 G	200 lb	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	8.0a	9.8a

Ligustrum 'Vicaryi'

Treatment	Rate/ac	1 MAT	2 MAT	10 WAT	3 MAT	15 WAT	4 MAT	20 WAT	5 MAT	Average
Control	--	10.0a	10.0a	10.0a	10.0a	10.0a	5.0c	2.7d	2.7b	7.6c
Specticle G	200 lb	10.0a	10.0a	10.0a	10.0a	10.0a	4.7c	4.7c	4.0b	7.9bc
Specticle G	400 lb	10.0a	9.7a	10.0a	10.0a	10.0a	10.0a	10.0a	8.0a	9.7a
Specticle G	800 lb	10.0a	10.0a	10.0a	10.0a	10.0a	8.3b	8.3b	7.0a	9.2ab
FreeHand	150 lb	10.0a	10.0a	10.0a	10.0a	10.0a	4.7c	4.7c	4.0b	7.9bc
SnapShot 2.5 G	200 lb	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	8.0a	9.8a

Perovskia atriplicifolia

Treatment	Rate/ac	1 MAT	2 MAT	10 WAT	3 MAT	15 WAT	4 MAT	20 WAT	5 MAT	Average
Control	--	10.0a	10.0a	10.0a	10.0a	10.0a	5.3c	4.7c	4.7b	8.1b
Specticle G	200 lb	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	8.0a	9.8a
Specticle G	400 lb	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	8.0a	9.8a
Specticle G	800 lb	10.0a	10.0a	8.7a	10.0a	10.0a	10.0a	10.0a	8.0a	9.6ab
FreeHand	150 lb	10.0a	8.0b	9.0a	10.0a	10.0a	8.0b	8.0b	8.0a	8.9ab

SnapShot 2.5 G	200 lb	10.0a	10.0a	10.0a	10.0a	8.3b	8.3b	8.3b	7.0a	9.0ab
<i>Salvia x sylvestris</i> 'Mainacht'										
Treatment	Rate/ac	1 MAT	2 MAT	10 WAT	3 MAT	15 WAT	4 MAT	20 WAT	5 MAT	Average
Control	--	10.0a	10.0a	6.0b	10.0a	10.0a	9.0a	6.0b	6.0b	8.4a
Specticle G	200 lb	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	8.0a	9.8a
Specticle G	400 lb	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	8.0a	9.8a
Specticle G	800 lb	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	8.0a	9.8a
FreeHand	150 lb	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	8.0a	9.8a
SnapShot 2.5 G	200 lb	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	10.0a	8.0a	9.8a

Z = Ratings are based on a 0-10 scale with 10 being complete control, 0 no weed control, and ≥ 7 commercially acceptable control. Ratings are averaged over three replications.

X = Treatments with different letters signify efficacy was statistically different at $p=0.05$ using LS means.

Table 4. Summary of worst treatments by species for most phytotoxicity (Table 1) and least efficacy (Table 3). FreeHand is listed four times, Snapshot three times, Specticle 200 once, 400 twice and 800 lb/ac once as the most phytotoxic treatments. Snapshot, FreeHand and Specticle 200 lb/ac rate are all listed twice as the least efficacious treatments.

	Yucca	Coreopsis	Berberis	Echinacea	Pennisetum	Iris	Festuca	Ligustrum	Perovskia	Salvia
Most Phytotoxic	None	FreeHand (Passing)	FreeHand	Freehand (Passing)	Specticle 400 (Passing)	None	Snapshot	None	FreeHand	Snapshot (Passing)
				Snapshot (Passing)			Specticle 200, 400, 800			Specticle 800 (Passing)
Least Efficacious	Snapshot	None	Snapshot	None	None	None	None	FreeHand	None	None
			Specticle 200					Specticle 200		
			FreeHand							



Fig. 2. (Left) Dormant applications in a mature landscape study in Gahanna, OH showing *Coreopsis verticillata* 'Zagreb' (Threadleaf coreopsis) at 20 WAT (06/02/2016) still showing some stunting and yellowing from FreeHand compared to controls. At the end of the study some stunting still persisted but it was acceptable, all plants grew out as the season progressed. Photos by: H. Mathers



Fig. 3. (Left) Dormant applications in a mature landscape study in Gahanna, OH showing *Echinacea purpurea* at 20 WAT (06/02/2016) still showing some stunting from FreeHand compared to surrounding controls. Stunting persisted after the end of the trial and for the season but was acceptable. Photos by: H. Mathers



Fig. 4. (Left) Dormant applications in a mature landscape study in Gahanna, OH showing *Festuca glauca* 'Elijah Blue' at 5 MAT (06/16/2016) with Specticle 800 lb/ac. All treatments caused unacceptable injury with Festuca starting at 4 MAT. These 800 lb/ac rate plants never recovered and eventually died as the season progressed. Photos by: H. Mathers



Fig. 5. A and B. (Above) Dormant applications landscape study in Gahanna, OH showing *Perovskia atriplicifolia* (Russian sage) **A.** control and **B.** Specticle 400 lb/ac. Specticle 400 and 800 as well as Snapshot all had severe phytotoxicity at 3 MAT (April 26, 2016). The stunting is evident between the control and the Specticle 400 lb/ac. The 400 lb/ac stunting continued to the end of the trial at unacceptable injury levels. Eventually the plants outgrew this stunting later in the season. Photos by: H. Mathers



Fig. 6 (Left). *Salvia x sylvestris* 'Mainacht' (May Night wood sage) control plant at 15 WAT (April 27, 2016) showing no injury. Photos by: H. Mathers



Fig. 7. A, B and C. A. (Left) *Salvia x sylvestris* 'Mainacht' at 10 WAT (03/23/2016) with Specticle G 400 lb/ac. Note the severe stunting compared to **B. (Below right)**

Freehand 150 lb/ac or **C. (Below left)** Specticle 200 lb/ac. The injury with the *Salvia* was passing. Photos by: H. Mathers





Fig. 8. (Above) *Salvia x sylvestris* 'Mainacht' at 20 WAT with Specticle G 800 lb/ac. Some slight yellowing continues but is commercially acceptable. Photo by: H. Mathers



Fig. 9. A and B. A. (Left) *Berberis thunbergii* var. *atropurpurea* 'Concord' (Concord Japanese Barberry) at 20 WAT with Specticle G 200 lb/ac showing lack of efficacy caused by wild strawberry, volunteer *Rudbeckia* and sowthistle. **B.** (Below)

Berberis thunbergii var. *atropurpurea* 'Concord' (Concord Japanese Barberry) at 20 WAT with Specticle G 400 lb/ac. The area around the plant is invaded with wild strawberry. Photos by: H. Mathers





Fig.10. *Iris germanica* 'Immortality' (Bearded Iris) 4 MAT with Snapshot in Gahanna, OH showing unacceptable weed control. Photo by: H. Mathers



Fig. 11 A and B. (Above) A. By June 2 (20 WAT) most plants had grown out of any phytotoxicity **B.** June 16, 2016, as the season progressed different species came into flower and showed little lingering injuries. Some stunting effects on *Salvia x sylvestris* 'Mainacht' lingered SnapShot 200 lb/ac. The significant damage on *Perovskia atriplicifolia* from FreeHand (150 lb/ac) and on *Festuca glauca* 'Elijah Blue' from all treatments continued. There was no injury on *Ligustrum* or *Yucca* as shown above in A or B. Weed control remained high for the season. Photos by: H. Mathers