# Weed Control

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### Section Editor

# Loss of Methyl Bromide Increases Need for Preemergence Herbicides in Woody Plant Seed and Liner Beds

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**Significance to the Industry:** Forests (tracts of native growth) and the urban forests (tree populations in urban settings) are increasingly important for mitigating global pollution and climate change. The first step in forestry is the production of tree seedlings at forest seedling nurseries. The first steps in urban forestry can take three forms: 1) seedling production for root stocks to be grafted or budded with scions of selected tree cultivars; 2) seedlings for species such as *Quercus* sp. or native plants (seed propagated); and, 3) asexual propagation such as cuttings or tissue culture for species grown on their own roots. Forest and ornamental nurseries provide healthy starting materials for reforestation and aforestation. Reforestation is the planting of trees on areas covered in recent history with forests. Aforestation is planting trees on areas not covered with forests for $\geq$50 years. Intensive seedling production relies on the ability of the nursery managers to meet quality and yield goals as well as certification that the plants are essentially pest-free. Weeds are a major cause of reduction in quality and yield goals. Herbicides found effective in this study cost less than $35.00/ac, such as Treflan 1 pt/ac rate and Barricade 10 oz/ac. Treflan, Barricade and Pendulum 2G caused no to minimal damage for all woody plant seedlings evaluated. The overall goal was to cut seedling growers weed control program cost by 30%. Using the herbicides listed above would accomplish this goal. More work is needed with preemergence herbicides in seedling production nurseries. By 2015, Methyl Bromide (MeBr) will be completely phased out. The lack of alternative soil fumigants and preemergence herbicides for seedling production will dramatically reduce US seedling production and subsequently the durability of our future forests.

**Nature of Work:** Methyl Bromide (MeBr) has been used extensively as the soil fumigant of choice to manage fungal pathogens (e.g., *Fusarium*, *Alternaria*, *Phytophthora*, *Pythium, Rhizoctonia*, *Cylindrocladium* spp., *Cylindrocarpon*, and *Macrophomina*), nematodes (e.g., *Circonemoides*, *Helicotylenchus*), and yellow and purple nutsedge (species of *Cyperus*) in forest and herbaceous seedling nurseries of the US. In 1994, the Clean Air Act mandated 100% phase-out of MeBr by 2001. MeBr has been phased out internationally because it depletes stratospheric ozone, which protects life on Earth from the harmful effects of the sun's ultraviolet radiation. In 1998, the phase-out schedule was revised to reduce production and import of MeBr by the following percentages of the 1991 baseline amounts: 25% in 1999, 50% in 2001, 70% in 2003 and 100% in 2005. Later developing countries were scheduled to freeze consumption in 2002 at 1995-98 levels and reduce all use by 2015. In 2015, MeBr will be gone. There will be no more *Critical Use Exemptions* that have essentially kept the seedling nurseries in business since 2005. There has been research over the years on alternative fumigants but none have proven to be as successful for weed control (in particular) as MeBr. We had planned to test the two most promising alternatives to MeBr in these 2013 trials, Chloropicrin and Basamid with supplemental low-rates of preemergence herbicides. However, in 2012, additional regulations were placed on the use of Chloropicrin that made the use of this product impossible in these trials. Chloropicrin is a powerful tear gas; it is a highly hazardous material that can now only be used by specially trained and certified personnel. In consultation with growers, there was no desire to test Basamid (e.g. metam-sodium and dazomet) due to inconsistent pest management performance in previous trials.

Two growth stages were selected for woody plants. We hypothesized injury would be more significant for stage 1 seedlings versus stage 2: Stage 1) two to six weeks after the seedlings had emerged; Stage 2) transplant beds, two weeks after two year old seedlings were transplanted from seedbeds to the transplant beds. Trials were conducted at New Life Nursery, 3720 64$^{th}$ St. Holland, MI on deciduous and coniferous seedlings. Applications were applied in the early afternoon of May 22, 2013. There was a gentle rain, cloudy skies and the temperature was 55°F. Stage 1 trials consisted of nine treatments and four replicates that were randomized within each bed/species. Chemical treatments included trifluralin (Treflan 4 EC) (Helena Chemical Company, Collierville, TN, 38017) applied at 1/2 rate (1qt) and 1/4 rate (1 pt) per acre; prodiamine (Barricade 4FL) (Syngenta Crop Protection, LLC, Greensboro, North Carolina, 27419) applied at 1/2 rate (10 oz/ac); Barricade 4FL 1/4 rate (5 oz/ac) plus Treflan 4EC 1/4 rate (1pt/ac); oxyfluorfen + prodiamine (Biathlon) (OHP, Inc., Mainland, PA, 19451) applied at 1/4 rate (50 lb/ac); pendimethalin (Pendulum 2G) (BASF Corporation, Research Triangle Park, NC 27709) applied at 1/2 rate (100lb/ac) and oxadiazon + pendimethalin (Jewel) (Scotts-Sierra Crop Protection Company, Marysville, OH 43041) applied at 1/2 rate (50 lb/ac). The remaining two treatments to total nine were an untreated weeded check and an untreated weedy check. Three ft. X three ft. sections of beds with one ft. buffers between each were used. For Stage 2 trials, 12 treatments were conducted: dimethenamid-P + pendimethalin (FreeHand 1.75G) (BASF Corporation, Research Triangle Park, NC 27709) applied at normal rate (150 lb/ac); indaziflam (Marengo G) (OHP, Inc., Mainland, PA, 19451) applied at ½ rate (50 lb/ac) and normal rate (100lb/ac); oxyfluorfen + prodiamine (Biathlon) (OHP, Inc., Mainland, PA, 19451) applied at 3/4 rate (150 lb/ac) and 1/3 rate (75 lb/ac); pendimethalin (Pendulum 2G) (BASF Corporation, Research Triangle Park, NC 27709) applied at 1/2 rate (100lb/ac); oxadiazon + pendimethalin (Jewel) (Scotts-Sierra Crop Protection Company, Marysville, OH 43041) applied at normal rate (100 lb/ac); Barricade 4FL 1/4 rate (5 oz/ac) plus Treflan 4EC 1/2 rate (1qt/ac); dimethenamid-P (Tower) + pendimethalin (Pendulum Aqua Cap) (BASF Corporation, Research Triangle Park, NC 27709) applied at normal rates (1 qt/ac + 1 qt/ac); and, isoxaben (Gallery) (Dow Agro Sciences, LLC, Indianapolis, IN 46268) applied at 1/3 rate (0.65 lb.ac) + Barricade 4FL ½ rate (10 oz/ac). The remaining two treatments to total 12 were an untreated weeded check and an untreated weedy check. All herbicides and rates were chosen based on previous crop safety studies by the authors on a wide range of materials (1, 2 and 3).

The Stage 1 trials at New Life were conducted on common lilac, *Syringa vulgaris;* black walnut, *Juglans nigra;* and, bur oak, *Quercus macrocarpa*. Soils at New Life are Saugatuck series sands. Soils were very deep and somewhat poorly drained with cemented subsoil. Saugatuck Series soils were formed by sandy glaciofluvial deposits on lake plains, till plains, and outwash plains (4). The lilac field had been fumigated prior to fall planting with MeBr at 400 lb/ac. Post planting, a thin layer of pine mulch was applied to the lilac field to decrease wind erosion of the sandy soils. The walnut and the bur oak were also fumigated with MeBr at 400 lb/ac prior to fall planting. Lilac had emerged approximately ¼ inch above the ground at time of application on May 22, 2013. Cotyledons were present and some seedlings had their first true leaves just expanding. Due to rains becoming heavy on May 22, 2013, applications to the oak and walnuts were conducted on June 19, 2013. Thus these two species were more advanced in growth versus the lilacs at time of application. The Stage 2 trials were conducted using Norway spruce, *Picea abies* that were being grown as 2+1 transplants (2 years in the seedbed) and transplanted two weeks before application (May 22) on May 8, 2013. They were approximately six inches tall at time of application. The spruce fields had not received MeBr prior to planting nor mulch post planting. Visual ratings of phytotoxicity were based on a scale of 0-10 with 0 being no phytotoxicity and 10 death with ≤3 commercially acceptable. Visual ratings of weed control were based on a 0-10 scale with 0 being no control and 10 perfect control with ≥7 commercially acceptable. Efficacy evaluations were only conducted in *Syringa* beds. Data was analyzed using SAS® GLM. Phytotoxicity effects of treatments were compared to the controls using Dunnett's t-test (α = 0.10 and 0.05). Efficacy treatments were compared to each other using least significant difference (ls means). Evaluations were conducted every two weeks after application for 3 months or 12 WAT, unless otherwise stated.

**Results and Discussion:** The Stage 1 trials at New Life at 12 WAT showed very low phytotoxicity on the *Juglans* and the *Quercus* (Table 1). The damage on these species had been either passing on the *Quercus* as with Treflan 1 qt/ac and Biathlon 50 lb/ac, or non-existent with the *Juglans* (Table 1). Averaged across all dates of evaluation, there were four treatments that were commercially acceptable (≤3) with the *Syringa*, Treflan 1pt/ac, Treflan 1qt/ac, Barricade 10 oz/ac and Pendulum 2G 100lb/ac (data not shown). At 8 WAT, the Barricade and the Pendulum picked up phytotoxicity and exceeded the level of commercially acceptable (≥ 3) (Table 1).

Treflan 1pt/ac, Treflan 1qt/ac, Barricade 10 oz/ac and Pendulum 2G provided higher weed control than the un-weeded control at New Life (Table 3). Normal practice at New Life Nursery is zero tolerance of weeds, so the efficacy trial was unfortunately ended at 6 WAT, when it was inadvertently hand weeded by New Life staff (Table 3). Unfortunately, the weeding crew, also pulled out the plot markers at 8 WAT in the lilac and thus ended the phytotoxicity trial. We recommend that trials on woody plant seedlings be continued with Treflan, Barricade and Pendulum 2G at lower rates, with increased application frequencies, in future studies. The low phytotoxicity levels demonstrated with these products indicate their value and promise for further study in forest seedling and ornamental nurseries seed beds.

Trials on transplant beds of *Picea abies* seedlings at New Life Nursery 2 and 6 WAT with Barricade + Treflan (5 oz/ac + 1 qt/ac) provided no injury. By 6 WAT, there was phytotoxicity greater than the control but still commercially acceptable (2.8 rating) (Table 2). At 2 WAT and 4 WAT with Marengo G 100 lb/ac there was no phytotoxicity. At 6 WAT, there was minimal phytotoxicity with Marengo G 100 lb/ac. At 8 to 12 WAT, phytotoxicity with Marengo G 100 lb/ac had increased but it was still in the commercially acceptable range (2.8 rating). (Table 2). Unfortunately there were no efficacy evaluations conducted in the *Picea abies* to judge the merit of Marengo 100 lb/ac in weed prevention. Although Jewel was the most efficacious treatment (Table 3) for *Syringa*, Jewel was also the most phytotoxic (Table 1). The best treatment taking into account phytotoxicity and efficacy (Table 3) was Biathlon 50 lb/ac or ¼ rate.

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**Table 1**. Phytotoxicity of several ornamental herbicides in Stage 1 (emerged two to six weeks) seedling beds of *Syringa vulgaris*, *Juglans nigra,* and *Quercus macrocarpa*

| *Syringa vulgaris* | | | | | |
|---|---|---|---|---|---|
| Treatment | Rate | 2 WAT[z] | 4 WAT | 6 WAT | 8 WAT |
| Treflan | 1 qt | 2.0[y] | 1.0 | 0.8 | 2.0 |
| Treflan | 1 pt | 2.8 | 1.0 | 0.8 | 1.0 |
| Barricade 4FL | 10 oz | 3.5 | 0.5 | 1.5 | 3.5** |
| Barricade 4FL + Treflan | 5 oz + 1 pt | 4.0 | 3.0** | 1.8* | 4.0** |
| Biathlon | 50 lb | 5.0* | 2.0** | 2.0** | 3.5** |
| Pendulum 2G | 100 lb | 3.8 | 2.0** | 1.0 | 4.3** |
| Jewel | 50 lb | 8.3** | 5.3** | 5.5** | 6.3** |
| Untreated weeded | -- | 2.0 | 0.0 | 0.0 | 0.0 |
| Untreated | -- | 1.5 | 0.0 | 0.0 | 1.0 |
| *Juglans nigra* | | | | | |
| Treatment | Rate | 2 WAT | 4 WAT | 6 WAT | 8 WAT |
| Treflan | 1 qt | 1.0 | 0.0 | 1.0 | 0.5 |
| Treflan | 1 pt | 0.8 | 0.3 | 0.8 | 1.3 |
| Barricade 4FL | 10 oz | 0.5 | 0.5 | 0.3 | 0.5 |
| Barricade 4FL + Treflan | 5 oz + 1 pt | 0.8 | 0.3 | 0.5 | 0.3 |
| Biathlon | 50 lb | 0.3 | 0.0 | 0.3 | 0.3 |
| Pendulum 2G | 100 lb | 0.0 | 0.3 | 0.5 | 1.0 |
| Jewel | 50 lb | 0.3 | 0.3 | 0.3 | 0.5 |
| Untreated weeded | -- | 0.3 | 0.3 | 1.5 | 0.8 |
| Untreated | -- | 0.8 | 0.0 | 1.3 | 1.3 |
| *Quercus macrocarpa* | | | | | |
| Treatment | Rate | 2 WAT | 4 WAT | 6 WAT | 8 WAT |
| Treflan | 1 qt | 2.8 | 0.8 | 1.8 | 2.8 |
| Treflan | 1 pt | 1.5 | 0.3 | 0.5 | 0.0 |
| Barricade 4FL | 10 oz | 1.3 | 0.3 | 0.5 | 0.0 |
| Barricade 4FL + Treflan | 5 oz + 1 pt | 2.3 | 0.5 | 0.5 | 0.8 |
| Biathlon | 50 lb | 2.0 | 0.5 | 2.0 | 1.0 |
| Pendulum 2G | 100 lb | 0.3 | 0.0 | 0.8 | 0.0 |
| Jewel | 50 lb | 1.3 | 0.5 | 1.5 | 0.3 |
| Untreated weeded | -- | 0.0 | 0.0 | 0.0 | 0.0 |
| Untreated | -- | 0.3 | 0.5 | 0.0 | 0.0 |

z = Weeks after treatment

y = Visual ratings based on a 0-10 scale with 0 being no phytotoxicity and 10 death with ≤3 commercially acceptable

*, ** significantly different from the untreated weeded control based on Dunnett's t-test (α = 0.10 and 0.05, respectively

**Table 2.** Phytotoxicity of several ornamental herbicides on Stage 2 *Picea abies* seedlings at New Life Nursery, Holland, MI.

| Treatment | Rate | 2 WAT[z] | 4 WAT | 6 WAT | 8 WAT | 10 WAT | 12 WAT |
|---|---|---|---|---|---|---|---|
| FreeHand | 150 lb | 0.8[y] | 0.0 | 0.8 | 1.8 | 1.8 | 1.5 |
| Marengo | 50 lb | 0.0 | 0.0 | 0.8 | 0.8 | 1.3 | 1.3 |
| Biathlon | 150 lb | 1.5 | 0.0 | 0.3 | 0.3 | 0.3 | 0.3 |
| Pendulum 2G | 100 lb | 0.8 | 1.5** | 1.8 | 2.8** | 3.0** | 2.3* |
| Biathlon | 75 lb | 2.5 | 0.0 | 0.5 | 0.8 | 0.5 | 0.3 |
| Marengo | 100 lb | 1.0 | 1.0 | 1.5 | 3.0** | 2.8** | 2.8** |
| Jewel | 100 lb | 0.5 | 0.0 | 0.5 | 1.0 | 0.0 | 0.0 |
| Barricade + Treflan | 5 oz + 1 qt | 2.0 | 0.8 | 1.3 | 2.5[√]* | 2.0 | 2.8** |
| Tower + Pendulum | 1 qt + 1 qt | 0.8 | 0.3 | 0.3 | 0.8[√] | 1.3 | 1.8 |
| Gallery + Barricade | 0.65 lb +10 oz | 1.0 | 0.5 | 1.5 | 1.8[√] | 1.5 | 1.3 |
| Untreated | -- | 0.5 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 |
| Untreated weeded | -- | 0.5 | 0.0 | 0.3 | 0.8 | 0.0 | 0.3 |

z = Weeks after treatment

y = Visual ratings based on a 0-10 scale with 0 being no phytotoxicity and 10 death with ≤3 commercially acceptable

*, * Significantly different from the untreated weeded control based on Dunnett's t-test ($\alpha$ = 0.10 and 0.05, respectively).

√ = Treatment was reapplied on this date.

**Table 3.** Efficacy of several ornamental herbicides in seed beds at New Life Nursery, Holland, MI, May to June, 2013

| | | New Life[y] | |
|---|---|---|---|
| Treatment | Rate/ac | 4 WAT[x] | 6 WAT |
| Treflan | 1 qt | 8.3[wv]b | 7.8 bc |
| Treflan | 1 pt | 7.5 b | 7.6 cd |
| Barricade 4FL | 10 oz | 8.0 b | 7.6 cd |
| Barricade 4FL + Treflan | 5 oz + 1 pt | 7.8 b | 7.3 cd |
| Biathlon | 50 lb | 8.5 b | 8.4 ab |
| Pendulum 2G | 100 lb | 8.3 b | 7.3 cd |
| Jewel | 50 lb | 9.8 a | 8.9 a |
| Untreated weeded | -- | 6.3 c | 7.0 d |
| Untreated | -- | 6.0 c | 6.1 e |

y = Treatment means were taken from a *Syringa* liner beds

x = Weeks after treatment

w = Visual ratings based on a 0-10 scale with 0 being no control and 10 perfect control with ≥7 commercially acceptable

v = Treatment means followed by the same letter in the same column are not significantly different, based on ls means (α = 0.05)

## Efficacy of Preemergence-Applied, Granular Flumioxazin (Broadstar®) as Influenced by Moisture and the Distance Separating Prills and Weed Seed

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**Significance to Industry :**These data indicated that flumioxazin in a sprayable dry-flowable and a granular do not provide the equal control of hairy bittercress or spotted spurge, even when applied at equivalent rates. The sprayable formulation provided superior control of both weed species at all rates while granular showed a distinct correlation with rate response to weed control. This effect was determined to be derived from inadequate spacing of the granular formulations prills when applied at the labeled rate.

**Nature of Work:** Flumioxazin provides both preemergent and early postemergent control of broadleaf weeds (1). Flumioxazin works by inhibiting protoporphyrinogen oxidase, which is the last common enzyme in the biosynthesis of chlorophylls and other similar molecules with a tetrapyrole structure (5, 6). Two different formulations of flumioxazin are currently available: a sprayable dry-flowable (SureGuard 51WDG®)(2), and a granular (BroadStar 0.25G®)(4). Both formulations are commonly used in nursery production and landscape maintenance industries. BroadStar is intended to be applied over the top where it will fall through, and/or be washed off the foliage, and onto the growing media surface. Foliar injury was reported soon after the introduction of this product. For example, Stamp and Chandler reported that foliar-applied Broadstar was injurious to *Plumbago auriculata* Lam (7). Wet foliage aggravated this injury. In response to this injury potential, Broadstar was subsequently reformulated with a coating to minimize the injury potential (3). Unfortunately growers have reported less weed control with this new granular formulation which is being perceived as less effective than the sprayable formulation when applied at an equivalent rate. SureGuard is labeled at a rate range, 0.25 to 0.375 lb. ai/a, while BroadStar is labeled at a single rate; i.e. 0.375 lb. ai/a. Reports of decreased efficacy with the granular formulation led us to hypothesize that a greater amount of water may be required to activate the granular formulation relative to the sprayable formulation. Our first objective of this research was to determine if additional moisture for activation would render the granular formulation equivalent in efficacy to the sprayable formulation. Our second objective was to determine the relationship between the distance separating an individual prill of the granular formulation and a weed seed and the chances that the germinating seed would be killed by the herbicide.

**Influence of Activation Moisture and Formulation.** Pots (trade gallon or 2.8 l) were filled with a pine bark-sand (6:1, v:v) substrate. After 4 days for settling, three moisture levels, low, medium, and high, were established by differential irrigation. Low moisture pots were watered once, to saturation, 4 d prior to the scheduled herbicide treatment. Medium pots were saturated 1 d prior to treatment; and high moisture level pots were saturated 1 h before treatment. Herbicide treatments consisted of the aforementioned granular and sprayable flumioxazin formulations. Both formulations were applied at 0.25 and 0.375 lb ai/a (0.28 and 0.42 kg ai/ha$^{-}$). The sprayable formulation was applied using an enclosed-cabinet sprayer; granular formulation was applied with a hand-held shaker. Treated pots received a one-time irrigation of either 0.5, 1.0, 2.0, or 4.0 inches immediately after herbicide applications. Each pot was seeded with 25 weed seeds 1 d after the one-time irrigation. A standard irrigation schedule of 0.6 cm applied twice each day was resumed 2 days after seeding.

The experiment consisted of a factorial treatment arrangement of the three at-application moisture levels, two flumioxazin formulations, two flumioxazin rates, and four after application, one-time irrigation levels, resulting in 48 treatments. A nontreated, no-flumioxazin control treatment was also included. This control had a medium at-application moisture level, and no irrigation 1 day prior to seeding. Each treatment was replicated six times. Pots were maintained in a retractable roof greenhouse. A completely random experimental design was used. The experiment was repeated three times with hairy bittercress (*Cardamine hirsute*) and two times with spotted spurge (*Euphorbia maculata*). Weed seedlings were counted on a weekly basis for 9 weeks after seeding. Weed foliage fresh weights were determined after the final count. Both the seedling stand count and the foliage weight data were expressed as percent reduction relative to the non-treated control. Data were subjected to ANOVA. Fisher's protected LSD test at the 0.05 level was used to compare between individual means of experimental variables.

**Herbicide Prill-Weed Seed Separation Distance.** As previously mentioned, the granular formulation is only registered at 0.375 lb ai/a (42 kg/ha). This rate is equivalent to 168 kg/ha or 168 mg product per 100 cm$^2$ (39.37 in$^2$). The authors determined that the average weight of 100 prills was 98 mg. Assuming that the 171 prills were to be evenly spaced in a grid pattern over 100 cm$^2$, each prill would occupy 0.58 cm$^2$; which translates to the prills being spaced 7.6 mm apart in a grid pattern. Through geometry it can be determined that seed positioned exactly in the middle of this grid spacing would be separated 5.4 mm from the nearest prill(s); 5.4 mm = [(7.6 mm * √2)/2]. We hypothesized that the granular formulation would only be effective provided that the prill to spotted spurge seed spacing did not exceed the 5- to 6-mm range.

A very fine commercial potting mix was placed into plastic nursery flats, and wetted to saturation. Using plastic templates, 25 individual herbicide prills were placed on the media surface in a 5-by-5 grid pattern, with the individual prills spaced either 6, 9, 12, 15, 18 or 21 mm apart. Spotted spurge seeds were then placed in a 4-by-4 grid pattern centered exactly within the grid of prills. This experiment was only conducted with spotted spurge. The prill-seed separation distance was 4.2, 6.2, 8.5, 10.6, 12.7, and 14.5 mm for the six prill spacings, respectively. Each of the six prill-seed spacing distances was replicated four times. In addition, 100 seeds were broadcast over the same media to determine seed germination. This treatment was also replicated four times across two flats. Flats were watered twice daily with a mist nozzle. Number of spotted spurge seedlings was determined 2 weeks after starting the experiment. This number was converted to a percent control value by contrasting it to the non-treated. Control was regressed against the six prill-seed spacing distances using a nonlinear model.

**Results and Discussion:**

**Influence of Activation Moisture and Formulation.** For hairy bittercress and spotted spurge, control, as indicated by weed counts and fresh weight, was influenced almost exclusively by flumioxazin rate and formulation. Conversely, neither pre-application moisture nor post application, single-event irrigation had any effect on flumioxazin efficacy, regardless of formulation (Table 1). In one case, the third repetition with hairy bittercress, control was numerically increased (but not significantly different) with additional irrigation. Across both weed species, control was superior with the sprayable formulation, such that a rate response was not evident. A rate response was frequently detected with the granular formulation.

**Herbicide Prill-Weed Seed Separation Distance.** Nonlinear regression of spotted seedling survival data revealed that $\geq$ 99% control required a prill-seed separation of $\leq$ 5.2 mm. This prill-seed separation requirement is only marginally obtained with the current registered rate, i.e 0.42 kg ai/ha or 168 kg product/ha. The relationship between control and prill-seed separation distance cannot be manipulated by additional activation moisture. Inadequate contact between the spotted spurge seeds and the flumioxazin-containing prills is likely the sole cause of inadequate control with the granular formulation.

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Table 1. ANOVA of 'control' data for experiments with spotted spurge

| Source of variation | Round 1 (September 2010) | Round 2 (August 2011) |
|---|---|---|
| Main effects | --------------------------------(probability)------------------------------ | |
| Pre-moisture | NS | NS |
| Post irrigation | NS | NS |
| Formulation | * | * |
| Rate | * | * |
| Significant 2-way interactions | | |
| | Form*rate | Form*rate |
| Control= percent reduction in foliage fresh weight at ~10 wks after treatment relative to nontreated control | | |