Early Postemergence Control of Spurge©

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Two experiments were conducted to evaluate early postemergence control of spotted spurge (*Chamaesyce maculata*) in nursery crops using preemergence active herbicides. In expt. 1, spotted spurge were overseeded at two different dates in a commercial pine bark substrate and grew until reaching the cotyledon to one leaf stage or the two to four leaf stage. Herbicides Broadstar 1604 (flumioxazin), EXC3898 (Prodiamine 0.5%, S-metolachlor 1.5%, Mesotrione 0.13%), V-10142 (imazosulfuron), and Tower 6.0 EC (dimethenamid-P) were then applied postemergence at the label rate (x) and 2x the label rate to plants either at the cotyledon to one leaf stage (C-1L) or at the two to four leaf (2-4L) stage. In general, the V10142 and Tower treatments provided the greatest postemergence control in the C-1L. Tower also provided greatest control on spurge in the 2-4L. In experiment 2, postemergence control was evaluated in the C1-L and 2-4L stages with Broadstar 1604, FreeHand (dimethenamid-P + pendimethalin), Tower, and Pendulum 3.3 EC (pendimethalin) at the x and 2 x the label rate. FreeHand at the 2x rate, along with Tower and Pendulum at both rates provided the greatest spurge control in the C-1L. Tower (2x) and Pendulum (both rates) provided greatest spurge control in the 2-4L.

INTRODUCTION

For preemergence applied herbicides to be effective, containers must be weed free prior to herbicide application (Judge and Neal, 2006). In the southeastern United States, it is common for growers to apply preemergent active herbicides every eight to ten weeks during the growing season (Judge et al., 2004). Spurge germinates very quickly and has no dormancy requirement, thus spurge often germinate between herbicide applications. The color and low-growing habit make spurge difficult to see in containers, making it difficult for those handweeding the containers. As a result, small plants are often left behind which are not controlled by the preemergence herbicide application (Judge and Neal, 2006). These small spurge plants must be removed either by hand or by chemical means for effective spurge control, however hand weeding can be expensive. A useful tool for nursery producers would be a herbicide which has

postemergence activity and would also provide preemergent weed control. The objective of this research was to evaluate selected herbicides for postemergence control of spurge in two growth stages.

MATERIALS AND METHODS

Experiment One – Postemergence spurge control was tested at two different stages of growth, cotyledon to 1 leaf (C-1L) and 2 to 4 leaf (2-4L). On 19 June 2008, 3.5 in were filled with pinebark:sand (6:1) (v:v) substrate that had previously been amended with 8.3 kg/m^3 (14 lb/yd^3) of 17-6-12 Polyon control-release fertilizer (8 to 9 month), 2.97 kg/ m^3 (5 lb/yd^3) of lime, and 0.9 kg/m^3 (1.5 lb/yd^3) Micromax. A small pinch of weed seed was surface sown to pots by hand, placed in full sun, and received overhead irrigation daily. Spurge grew for 11 days until treatment and reached the 2 to 4 leaf stage. On 26 June 2008, additional pots were handled as previously described and overseeded 6 days before treatment, reaching the cotyledon to 1 leaf. On 1 July 2008, herbicides were applied to spurge at each growth stage. Treatments included the following herbicides at their maximum label rate (x), and at 2x the maximum label rate: Broadstar 1604 0.25G (new formulation) (Valent U.S.A. Corp., Walnut Creek, CA), (flumioxazin) at 0.375 lbs ai/A (150 lbs product/A) and 0.75 lbs ai/A (300 lbs product/A), EXC3898 2.13G (Syngenta Crop Protection Inc., Greensboro, NC), at 2.13 lbs ai/A (100 lbs product/A) and 3.2 lbs ai/A (150 lbs product/A), V-10142 0.5G (Valent USA Corporation, Walnut Creek, CA) (imazosulfuron) at 0.375 lbs ai/A (75 lbs product/A) and 0.75 lbs ai/A (150 lbs product/A), and Tower 6.0 EC (BASF Corporation, Research Triangle Park, NC), (dimethenamid-P) at 1.5 lbs ai/A (32 fl. oz/A) and 3.0 lbs ai/A (64 fl. oz./A). Broadstar, EXC3898, and V-10142 were applied with a hand-shaker. Tower was applied at a rate of 20 gallons per acre with a CO_2 backpack spray (80-04 nozzle) at 25 psi. Each growth stage received 8 herbicide treatments with 8 single pot replications per treatment. A non-treated control group was also maintained for each growth stage. Visual injury ratings were recorded at 14 and 21 days after treatment (DAT) using a 1 to 10 scale (1 = no injury, 10 = dead plant). Shoot fresh weights were also recorded at 21 DAT. Pots were arranged by growth stage (cotyledon to 1 leaf and 2 to 4 leaf) in a completely randomized design. Pairwise comparisons were performed for each growth stage using a generalized linear model using Duncan's Multiple Range Test at $P \leq 0.05$.

Experiment 2. Materials and methods were similar to experiment 1 with the following exceptions: FreeHand 1.75G (BASF Corporation, Research Triangle Park, NC) (dimethenamid-P + pendimethalin) was

applied at 3.5 lbs ai/A (200 lbs product/A) and 7.0 lbs ai/A (400 lbs product/A), and Pendulum 3.3 EC (BASF Corporation, Research Triangle Park, NC) (pendimethalin) was applied at 2 lbs ai/A (78 fl. oz/A) and 4.0 lbs ai/A (156 fl. oz/A). V-10142 and EXC3898 treatments were not included in experiment 2 due to observed ornamental crop injury on an adjacent study (data not shown). On 31 July 2008, pots were filled with substrate used in expt. 1 and spurge seed were surface sown by hand 14 days before treatment reaching the 2 –4L. On 7 August 2008, additional pots were filled with same substrate and spurge seed were surface sown 7 days before treatment reaching the C-1L. Pots were placed in full sun under over-head irrigation as in experiment 1. On 14 August 2008, each growth stage was treated with herbicides including Broadstar at 150 and 300 lbs product/A, FreeHand at 200 and 400 lbs product/A, Tower at 1.5 and 3.0 lbs aia, and Pendulum at 2.0 and 4.0 lbs aia. Broadstar and FreeHand were applied using a handshaker while Tower and Pendulum were applied with a CO^2 backpack sprayer (80-04 nozzle) at 20 gallons per acre at 25 psi. Each growth stage contained 9 treatments with 6 single pot replications per treatment. Pots were arranged by growth stage (C-1L and 2-4L) in a completely randomized design. Visual injury ratings were taken at 10, 20, and 30 DAT. Fresh weights were taken at 30 DAT. Pairwise comparisons were performed for each growth stage using a generalized linear model using Duncan's Multiple Range Test at $P \leq 0.05$.

RESULTS

Experiment 1. At 14 DAT, Broadstar had little effect on the spurge in the C-1L stage and was similar to the non-treated control group (Table 1). Flumioxazin has been previously reported as having excellent postemergent spurge control ($\geq$ 99%) when applied to spurge in the C-1L stage (Judge and Neal, 2006). Flumioxazin has also been shown to provide control of weeds commonly found in agronomic crops such as common lambsquarter (*Chenopodium album*), common ragweed (*Ambrosia artemisifolia*), morningglory (*Ipomoea purpurea*), palmer amaranth (*Amaranthus palmeri*), and other toublesome weeds (Askew et al., 2002). However, Broadstar used in this study was the new V1604 formulation, which has been formulated to reduce potential crop injury when applied over the top of container ornamentals. While the new formulation is safer for use on ornamentals, it seems to have reduced postemergence weed control. Tower and V10142 provided the best postemergence control of spurge in the cotyledon stage of any herbicide treatment when applied at the 2x rate (9.1 and 7.1). EXC3898 at 1x and 2x rates, V10142 at 1x and 2x rates, and Tower at the label rate each provided similar control. By 21 DAT, spurge in the C-1L stage had

the highest injury ratings when treated with Tower at the 2x rate (8.9). EXC3898 and V10142 at the 2x rate provided the next best control (6.0 and 5.2 respectively). Broadstar again provided least control of any herbicide treatment and was similar to the non-treated control group at 21 DAT. C-1L fresh weights indicate that the best control was achieved when spurge was treated with Tower and V10142 at both rates, and EXC3898 at the 2x rate. The active ingredient in Tower, dimethenamid-p, is marketed as a preemergence active herbicide, and no previous work was found discussing dimethenamid-p's postemergence activity.

Spurge exhibited almost no visual injury in any herbicide treatment once reaching the 2-4L with the exception of Tower which provided some control at both rates tested (Table 1). At 14 DAT, Tower was the only treatment which was not similar to the non-treated control group. This trend continued at 21 DAT, however V10142, and EXC3898 2x rates began to have a marginal effect on the spurge. While Tower provided the highest injury ratings at 21 DAT, spurge had begun to recover from the Tower treatments and injury ratings from 14 DAT (5.7 and 6.6) where noticeably less at 21 DAT (4.5 and 5.1). This was true of almost all treatments and indicates that spurge had been affected by the herbicides initially, but began to recover. Fresh weights were similar among all herbicide treatments which also indicate that herbicides lacked long lasting control of spurge after it reached the 2-4L.

Experiment 2. At 10 DAT, Broadstar at the 1x rate had little effect on spurge in the C-1L stage (rating 2.1), while at the 2x rate had excellent activity (9.0) (Table 2). This trend continued at 20 DAT, however by 30 DAT, spurge began to recover (rating of 6.7). Spurge in the C-1L stage treated with FreeHand at label rate were injured at 10 and 20 DAT, but began to recover at 30 DAT. However, when the rate of FreeHand was doubled, by 30 DAT all pots were given an injury rating of 9 or higher. Tower at the label rate had excellent activity throughout the study on C-1L spurge, and at 2x rate had an injury rating of 10 on all dates. Pendulum provided similar results to Tower at both rates tested. Fresh weights show no differences in treatments receiving Broadstar at label rate and the non-treated control (Table 2). Fresh weights also indicate Broadstar 2x ate was similar to FreeHand at the label rate while FreeHand at the 2x, Tower at both rates, and Pendulum at both rates provided the best control of spurge in the C-1L stage.

Broadstar had little effect on spurge in the 2-4L at either rate and were similar to the non-treated control on all dates in injury ratings, however fresh weights show Broadstar provided some degree of control

(Table 2). FreeHand at the label rate and 2x rate had activity at 10 DAT, and were similar to Tower and Pendulum at the 1x and 2x rates, respectively. Tower at 2x rate (8.8) and Pendulum at the 2x rate (7.2) provided the best control of 2 to 4 leaf spurge at 10 DAT. At 20 DAT, the best control was achieved with FreeHand at 2x rate, Tower at 2x rate, and both rates of Pendulum. Fresh weights taken at 30 DAT show Broadstar had the least effect of any herbicide. FreeHand at both rates had similar fresh weights to Tower at label rate and Pendulum at 2x rate. Tower at 2x rate and Pendulum at 2x rate had similar fresh weights to FreeHand at 2x rate.

DISCUSSION

In summary, the nursery herbicides Tower at both the 1x and 2x rates, FreeHand at the 2x rate, and Pendulum at the 1x and 2x rate provided effective postemergence control of spurge when applied in the early stages of germination (C-1L). Spurge became more difficult to control once reaching the 2-4L stage, however Tower (2x) and Pendulum (both rates) did provide effective control at this growth stage. Application of these herbicides for postemergence control of spurge could reduce labor costs from hand weeding while providing pre-emergent activity. If small spurge plants are present before or during the application of pre-emergence active herbicides FreeHand, Tower, or Pendulum, these herbicides could provide some degree of post-emergence activity depending on the growth stage of the spurge. While these herbicides were found to provide postemergence activity, they did so sometimes by applying the 2x label rate, which is not recommended and should only be done if the weed problem is unmanageable. Grower testing is also necessary due to potential injury from application of EC herbicides on some ornamentals during hot summer months.

LITERATURE CITED

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Table 1. Exp. 1. Spurge (*Chamaesyce maculata*) early postemergence injury ratings[Z] and fresh weights.

		Growth Stage					
		Cotyledon - 1 Leaf			2-4 Leaf		
Treatment	**Rate**	14 DAT	21 DAT	F.W.[U]	14 DAT	21 DAT	F.W.
Broadstar	150 lbs[X]	1.7 c	2.0 ef	2.8 abc	1.7 b	2.1 bc	2.1 ab
Broadstar	300 lbs	2.4 c	2.1 ef	3.5 ab	1.7 b	1.5 c	3.4 a
EXC3898	100 lbs	5.4 b	3.0 de	2.3 bc	1.5 b	2.7 b	2.7 ab
EXC3898	150 lbs	6.9 b	6.0 b	1.1 cd	2.5 b	1.2 c	3.1 a
V10142	75 lbs	6.1 b	4.2 cd	1.8 bcd	1.9 b	2.1 bc	3.1 a
V10142	150 lbs	7.1 ab	5.2 bc	1.1 cd	1.2 b	2.9 b	3.0 ab
Tower	32 oz/A	6.2 ab	4.9 bc	1.0 cd	5.7 a	4.5 a	1.8 ab
Tower	64 oz/A	9.1 a	8.9 a	0.2 d	6.6 a	5.1 a	1.4 b
Non-treated	****	1.0 c	1.0 f	4.2 a	1.0 b	1.0 c	3.3 a

[Z] Ratings on scale of 1 to 10 (1 = no injury, 10 = dead plant).

[Y] DAT = Days after treatment.

[X] Rate given at pounds per acre.

[W] aia = active ingredient per acre.

[V] Means separated using Duncan's Multiple Range Test at $P = 0.05$.

[U] F.W. = Fresh weights of spurge taken 21 DAT and reported in grams.

Table 2. Exp. 2. Spurge (*Chamaesyce maculata*) early postemergence injury ratings[Z] and fresh weights.

		Growth Stage							
		Cotyledon - 1 Leaf				2-4 Leaf			
Treatment	**Rate**	10 DAT[Y]	20 DAT	30 DAT	F.W.[U]	10 DAT	20 DAT	30 DAT	F.W.
Broadstar	150 lbs[X]	2.1 d[V]	2.0 c	1.0 d	5.6 a	1.2 d	1.3 d	1.0 d	6.4 b
Broadstar	300 lbs	9.0 ab	9.1 a	6.7 b	0.8 bc	2.0 d	2.2 d	1.0 d	6.7 b
FreeHand	200 lbs	6.3 c	7.6 b	3.9 c	1.8 b	3.8 c	5.7 bc	5.0 bc	1.7 cd
FreeHand	400 lbs	8.3 b	9.7 a	9.9 a	0.0 c	5.2 c	6.8 ab	6.0 b	1.3 cd
Tower	1.5 lbs aia[W]	9.3 ab	9.6 a	10.0 a	0.0 c	4.7 c	4.7 c	4.0 c	2.5 c
Tower	3.0 lbs aia	10.0 a	10.0 a	10.0 a	0.0 c	8.8 a	8.5 a	8.7 a	0.1 d
Pendulum	2 lbs aia	9.1 ab	9.9 a	10.0 a	0.0 c	4.7 c	7.7 a	8.0 a	0.6 cd
Pendulum	4 lbs aia	9.7 a	10.0 a	10.0 a	0.0 c	7.2 b	8.7 a	8.7 a	0.1 d
Non-treated	****	1.0 e	1.0 c	1.0 d	6.6 a	1.0 d	1.2 d	1.0 d	12.0 a

[Z] Ratings on scale of 1 to 10 (1 = no injury, 10 = dead plant).

[Y] DAT = Days after treatment.

[X] Rate given at pounds per acre.

[W] aia = active ingredient per acre.

[V] Means separated using Duncan's Multiple Range Test at $P = 0.05$.

[U] F.W. = Fresh weights of spurge taken 30 DAT and reported in grams.