Do Granular Herbicide Applications Effectively Control Broadleaf Weeds in Turf?

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SUMMARY: Postemergence herbicides such as 2,4-D, MCPP and others are generally much more effective at controlling weeds when sprayed on the foliage than when applied as a granular herbicide/fertilizer combination product. Furthermore, when applied as a granule, these broadleaf herbicides more effectively control weeds when applied to moist foliage rather than dry turf. The reason for this is that most postemergence herbicides require foliar uptake. However, new herbicides that can be taken up through plant root systems may provide improved weed control as granules but this has not been sufficiently explored. The objectives of this experiment were to 1) determine which herbicides most effectively control ground ivy and white clover, 2) determine the best method of herbicide application, and 3) determine if any herbicide by application method interactions exist. Data from both weed species support that 1) when using traditional broadleaf herbicides that liquid applications are better than granular applications for controlling weeds, 2) granular applications to moist turf are more effective than granular applications to dry turf, and 3) new herbicides with root activity can control susceptible weeds equally well as liquid or granular applications. NOTE: State registration for Imprelis was cancelled and federal registration was later cancelled by the U.S. Environmental Protection Agency. This cancellation does not allow the continued use of Imprelis herbicide in the U.S. Any such applications are illegal.

Postemergence herbicides such as 2,4-D, MCPP and others are useful for weed control when sprayed on the foliage or when applied as a granular herbicide/fertilizer combination product (Neal, 1993). When applied as a granule, these broadleaf herbicides more effectively control weeds when applied to moist foliage rather than dry turf (Jagschitz et al., 1983; Scott, 1995; Loughner and Nolting, 2012). The reason for this is that most postemergence herbicides require foliar uptake. Uptake of granular combination products can be improved if weed foliage is wet at the time of application such as in the early morning when dew is present or following an irrigation application as this helps the granules to stick to the weed foliage allowing the herbicide to enter the leaf tissue. Even when granular herbicides are applied to wet foliage, these products are still generally less effective than sprays (Neal, 1993). However, new herbicides that can be taken up through plant root systems may provide improved weed control when applied as granules but this has not been sufficiently explored. Ground ivy (Glechoma hederacea) and white clover (Trifolium repens) are problematic weeds in lawns and these species were selected for this experiment to 1) determine which herbicides (penoxsulam, aminocyclopyrachlor, and a mixture of 2,4-D + MCPP + dicamba) most effectively control ground ivy and white clover, 2) determine the best method (granules on wet turf, granules on dry turf, and liquid on dry turf) of herbicide application, and 3) determine if any herbicide by application method interactions exist.

ADDITIONAL INDEX WORDS:
2,4-D; aminocyclopyrachlor; dicamba; Imprelis; Lockup; mecoprop; penoxsulam; Trimec; Sapphire.

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MATERIALS AND METHODS

The experiment was conducted at the W.H. Daniel Turfgrass Research and Diagnostic Center in West Lafayette, IN. The first area was a Kentucky bluegrass (*Poa pratensis*) blend with a history of ground ivy pressure and the second area was a perennial ryegrass (*Lolium perenne*) blend with

a history of white clover pressure. Experimental design was a 3 (herbicides) × 3 (turf wetness) factorial randomized complete block with three replications and an individual plot size of 25 ft^2. The three herbicides were Lockup (granular penoxsulam), Sapphire (liquid penoxsulam), Imprelis (aminocyclopyraclor granular and liquid), and Trimec (2,4-D + MCPP + dicamba, granular and liquid). The three application strategies were granules on wet turf, granules on dry turf, and liquid spray on dry turf. Plots were treated with herbicides on 12 October 2010. Herbicides were applied in 80 gpa water with a CO_2-pressurized sprayer at 30 psi. Plots were visually rated for ground ivy and clover coverage respectively. All data were analyzed using SAS (SAS Institute, Inc). Means separated using Fisher's protected least significant difference when F tests were significant at α=0.05.

Results and Discussion

For the majority of rating dates, ground ivy coverage was affected only by herbicide treatments (Table 1) with Imprelis. On 5 May 2011, following the 12 October 2010 applications a herbicide by application strategy interaction did exist due to difference in control from Trimec formulations where the liquid spray applications reduced ground ivy coverage most, followed by the granular Trimec application to wet turf, followed by granular Trimec application to dry turf (Table 2). This is consistent with our current understanding of how foliar uptake herbicides work and is consistent with previous research (Jagschitz et al., 1983; Neal, 1993; Scott, 1995; Loughner and Nolting, 2012).

Some difference within treatment were observed on the control of white clover on 5 May and 7 June, but all treatments reduced white clover to <4% compared to the untreated check (20%) when evaluated on 7 June (Table 3). On 15 April 2011 a herbicide by application strategy interaction did exist due to difference in control from Trimec formulations where the foliar spray provided better control than the granular applications (Table 4). On 7 July 2011, following the 12 October 2010 applications a herbicide by application strategy interaction did exist due to difference in control from Trimec formulations where the liquid spray applications reduced white clover coverage most, followed by the granular Trimec application to wet turf, followed by granular Trimec application to dry turf (Table 4). Data collected on white clover control is consistent with previous work (Loughner and Nolting, 2012) documenting the efficacy of moist vs. dry and liquid vs. granular. Imprelis and penoxsulam both can be taken up by plant roots which allow them to work effectively as granular applications.

Data from both weed species support that 1) when using traditional broadleaf herbicides that liquid applications are better than granular applications for controlling weeds, 2) granular applications to moist turf are more effective than granular applications to dry turf, and 3) new herbicides with root activity can control susceptible weeds equally well as liquid or granular applications.

Following the initiation of this experiment, the Office of Indiana State Chemist issued a stop sale, use, or removal order (SSURO) for the herbicide Imprelis due to injury to non-target vegetation (Patton et al., 2011). The herbicide was deemed to be MISBRANDED. This SSURO requires DuPont Professional Products to cease all sale, distribution and use of DuPont Imprelis herbicide in the State of Indiana, effective August 1, 2011. As a result, Imprelis may no longer be used in Indiana and product should be returned to DuPont via their recall and refund program. The objectives of this research were to evaluate the efficacy of Imprelis for weed control and these authors did not evaluate the safety of this herbicide on trees or shrubs.

References

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Table 1. Herbicide effects on ground ivy coverage across application strategy (granular or spray applications).

Treatment [a]	rate	Ground ivy					
		12 Oct	25 Oct	11 Nov	15 April	7 June	7 July
					%		
penoxsulam	0.03875 lb ai/A	84 b [b]	79	61 a	6 a	55 a	78 a
aminocyclopyraclor	0.07 lb ai/A	92 a	77	26 b	0 b	1 b	2 b
2,4-D, MCPP, and Dicamba	180 lb/A	87 ab	76	67 a	3 ab	62 a	85 a
Untreated [c]		90	77	72	4	78	95
ANOVA							
Herbicide		0.0255	NS	<0.0001	0.0058	<0.0001	<0.0001
Application Strategy		NS	NS	NS	NS	NS	NS
Herbicide × Application Strategy		NS	NS	NS	NS	NS	NS

[a] Means of three replications and three turf application strategies (granular to dry turf, granular to wet turf, and liquid to dry turf).
[b] Within columns, means followed by the same letter are similar.
[c] Presented for comparison only.

Table 2. Control of ground ivy as affected by herbicide and application strategy (granules on wet turf, granules on dry turf, and liquid spray on dry turf).

Treatment [a]	rate	Turf wetness	Ground ivy
			5 May
			%
Lockup (granular penoxsulam)	0.03875 lb ai/A	wet	25 bc [a]
Lockup (granular penoxsulam)	0.03875 lb ai/A	dry	27 b
Sapphire (liquid penoxsulam)	0.03875 lb ai/A	dry	27 b
Imprelis (granular)	0.07 lb ai/A	wet	1 d
Imprelis (granular)	0.07 lb ai/A	dry	1 d
Imprelis (liquid)	0.07 lb ai/A	dry	0 d
Trimec (granular)	180 lb/A	wet	27 b
Trimec (granular)	180 lb/A	dry	40 a
Trimec (liquid)	4 pt/A	dry	13 c
Untreated [b]			35
ANOVA			
Herbicide			<0.0001
Application Strategy			0.0485
Herbicide × Application Strategy			0.0332

[a] Within columns, means followed by the same letter are similar.
[b] Presented for comparison only.

Table 3. Herbicide effects on white clover coverage across application strategy (granular or spray applications).

Treatment [a]	rate	White clover				
		12 Oct	25 Oct	11 Nov	5 May	7 June
		%				
penoxsulam	0.03875 lb ai/A	29	21	10	1 ab [b]	3 a
aminocyclopyraclor	0.07 lb ai/A	33	19	5	0 b	0 b
2,4-D, MCPP, and Dicamba	180 lb/A	29	19	9	2 a	3 a
Untreated [c]		37	37	30	15	20
ANOVA						
Herbicide		NS	NS	NS	0.0445	0.0055
Application Strategy		NS	NS	NS	0.0445	NS
Herbicide × Application Strategy		NS	NS	NS	NS	NS

[a] Means of three replications and three turf application strategies (granular to dry turf, granular to wet turf, and liquid to dry turf).
[b] Within columns, means followed by the same letter are similar.
[c] Presented for comparison only.

Table 4. Control of white clover as affected by herbicide and application strategy (granules on wet turf, granules on dry turf, and liquid spray on dry turf).

Treatment [a]	rate	Turf wetness	White clover	
			15 April	7 July
			%	
Lockup (granular penoxsulam)	0.03875 lb ai/A	wet	4 b [a]	3 bc
Lockup (granular penoxsulam)	0.03875 lb ai/A	dry	0 b	2 c
Sapphire (liquid penoxsulam)	0.03875 lb ai/A	dry	0 b	2 c
Imprelis (granular)	0.07 lb ai/A	wet	0 b	0 c
Imprelis (granular)	0.07 lb ai/A	dry	0 b	0 c
Imprelis (liquid)	0.07 lb ai/A	dry	0 b	0 c
Trimec (granular)	180 lb/A	wet	15 a	6 b
Trimec (granular)	180 lb/A	dry	20 a	10 a
Trimec (liquid)	4 pt/A	dry	0 b	2 c
Untreated [b]			37	20
ANOVA				
Herbicide			0.0007	0.0001
Application Strategy			0.0354	0.0387
Herbicide × Application Strategy			0.0311	0.0173

[a] Within columns, means followed by the same letter are similar.
[b] Presented for comparison only.