Self-felting Wool Pellets as a Means of Weed Control During Propagation and Liner Production©

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INTRODUCTION

Economic pressure to produce quality perennial plants in the least amount of time involves an intensive use of water, fertilizers, and pesticides. Unfortunately, these practices also provide optimal conditions for weeds and the necessity for frequent applications of herbicides. Furthermore, in order to reduce labor costs, many plants are propagated, grown-on as liners, and shipped in the same container. This opens a wide window for establishment of weeds. When these liners are potted up into larger containers the presence of weeds or weed seeds only exacerbates the problem.

Wulpak, self-felting wool pellets (Wilbro, Inc., Norway, South Carolina) show promise for potential use in weed management. They may control weeds alone or in combination with chemical herbicides. First, it is difficult to use many herbicides for propagation in an enclosed greenhouse due to potential volatilization or labeling restrictions. Second, many species, especially herbaceous perennials, are sensitive to herbicides that are available (Bhandary et al., 1997a; Bhandary et al., 1997b; Fernandez et al., 1999); thus wool pellets may provide weed suppression without causing a phytotoxic response. Wool pellets may also bind herbicides to the layer of wool, reducing leaching into the root zone and herbicide contamination of runoff. Finally, previous research has shown that copper-treated fabric disks have suppressed weed growth in container-grown willow oaks (Appleton and French, 2000), so use of wool pellets and Spin Out™ (copper hydroxide) (Griffin LLC, Valdosta, Georgia) may provide weed suppression without the use of herbicides. Therefore, our objectives were to determine weed control efficacy of Wulpak alone and in conjunction with herbicides or Spinout during propagation and liner production.

MATERIALS AND METHODS

Three separate experiments examined timing of Wulpak application and the combination of Wulpak and herbicides for use in liners of five herbaceous species and two woody species. In all experiments, flats were inoculated with three species of weeds; hairy bittercress (*Cardamine hirsuta*), liverwort (*Marchantia* spp.), and yellow woodsorrel (*Oxalis* spp.) by placing flats of these weeds every 3 ft in the growing area.

Experiment 1: Weed Control During Production of Four Herbaceous Perennials and One Woody Species. Conducted at Walters Gardens, Zeeland, Michigan, this experiment involved the use of Wulpak wool pellets and herbicides in the growing-on phase under shade cloth. Species used were Siberian bugloss (*Brunnera macrophylla*), royal fern (*Osmunda regalis*), spotted deadnettle (*Lamium maculatum* 'White Nancy'), butterfly bush (*Buddleja davidii*), and Oriental poppy (*Papaver orientale* 'Carneum'). The study consisted of four treatments applied to rooted liners: wool pellets [14.4 $g \cdot m^{-2}$ of surface(5.5 oz per ft^2)] alone, wool pellets

treated with Spin Out®, wool pellets treated with the herbicide Gallery 75 DF (isoxaben), and a control consisting of no treatment.

Initial measurements of plant height and root and shoot dry weights were recorded on subsamples when the study commenced 25 May. At this time, plants were evaluated with an overall visual rating. Additional measurements of plant height, weed density per flat, visual rating, plant survival, and substrate moisture were recorded 29 June and 16 Aug. when plants were harvested. At harvest, shoot and root dry weights were obtained and dry mass accumulation was calculated. Treatment effects were compared by analysis of variance (PROC GLM, SAS Institute, Cary, North Carolina) and significant differences among treatments were separated by Tukey's Studentized Range (HSD) test.

Experiment 2: Timing of Wool Pellet Application in Liners of Two Woody Species. Cuttings of *Hydrangea serrata* 'Blue Bird' and *Itea virginica* 'Henry's Garnet' were collected 25 May 2000, inserted in 18- (3.25-inch cells) or 32-cell flats (2.5-inch cells), respectively, and rooted under intermittent mist at Spring Meadow Nursery, Grand Haven, Michigan. The study consisted of three treatments: an application of wool pellets (14.4 $g \cdot m^{-2}$ of surface) prior to sticking, an application to rooted liners, and a control consisting of no wool pellets.

Initial measurements were recorded when the study commenced 25 May. Additional measurements of plant height, weed density per flat, visual rating, plant survival, and substrate moisture were recorded 23 June and 15 Aug. when plants were harvested. Substrate moisture content was measured with a Theta Probe Soil Moisture Sensor ML2X (Delta-T Devices, Ltd., Cambridge, U.K.). At harvest, dry weights were recorded and statistical analysis was performed as described above.

Experiment 3: Weed Control in Liners of Two Woody Species. Conducted at Spring Meadow Nursery, the study consisted of five treatments applied to rooted liners of *H. serrata* 'Blue Bird' and *I. virginica* 'Henry's Garnet': wool pellets (14.4 $g \cdot m^{-2}$ of surface), wool pellets treated with SpinOut or the herbicides Gallery 75 DF (isoxaben) and Factor 65 WG (prodiamine), and a control consisting of no treatment. Initial measurements were recorded when the study commenced 25 May. Additional measurements of plant height, weed density per flat, visual rating, and plant survival were recorded 23 June and 15 Aug. when plants were harvested. At harvest, dry weights were recorded and statistical analysis was performed as described above.

RESULTS AND CONCLUSIONS

Application of Wulpak wool pellets suppressed weeds in containerized perennials, but its effectiveness depended on species. The application of Wulpak or Wulpak + SpinOut was an effective means of weed control for Siberian bugloss and butterfly bush, Wulpak + SpinOut and Wulpak + Gallery was effective for spotted deadnettle, and Wulpak + SpinOut was effective for Oriental poppy. Wulpak and Wulpak + SpinOut increased shoot dry weight accumulation in all species (Table 1). These two treatments were often equal to or better than the control in regards to root dry weight accumulation. The increased growth under Wulpak could be due to the slow release of nitrogen as the wool breaks down.

Regardless of herbaceous species, the highest rate of plant survival occurred under control conditions. Wulpak and Wulpak + SpinOut treatment resulted in lower

Table 1. Effect of Wulpak on root and shoot dry weight accumulation, survival, and weed density per flat of *Brunnera macrophylla*, *Buddleja davidii*, *Lamium maculatum* 'White Nancy', *Osmunda regalis*, and *Papavar orientale* 'Carneum'.

Treatment	Root dry weight accumulation per plant (g)	Total shoot dry weight per flat (g)	Plant survival (%)	Weed density per flat (%)
Brunnera				
No Wulpak	2.27 ab	35.8 ab	93.8 a	8.0 ab
Wulpak	2.99 a	42.9 a	83.7 ab	2.0 b
Wulpak + Spinout	1.72 ab	41.4 a	92.5 a	1.0 b
Wulpak + Gallery	1.29 b	21.0 b	68.7 b	15.0 a
Buddleja				
No Wulpak	0.39 ab	51.4 a	100.0 a	67.5 a
Wulpak	0.68 a	50.7 a	87.5 a	16.2 bc
Wulpak + Spinout	0.63 a	52.3 a	95.0 a	3.7 c
Wulpak + Gallery	0.31 b	25.7 b	43.7 b	50.0 ab
Lamium				
No Wulpak	1.27 a	43.1 a	96.0 a	20.0 ab
Wulpak	0.35 c	40.8 a	61.0 b	38.7 a
Wulpak + Spinout	0.51 bc	50.8 a	74.0 ab	5.5 b
Wulpak + Gallery	0.89 ab	43.2 a	60.0 b	10.0 b
Osmunda				
No Wulpak	1.20 a	10.8 a	92.5 a	100.0 a
Wulpak	0.50 a	1.5 b	12.5 b	100.0 a
Wulpak + Spinout	1.33 a	9.6 a	65.0 a	100.0 a
Wulpak + Gallery	0.69 a	1.1 b	20.0 b	100.0 a
Papaver				
No Wulpak	0.71 ab	12.5 a	71.0 a	20.0 b
Wulpak	0.79 a	10.7 a	46.2 b	21.2 b
Wulpak + Spinout	0.96 a	11.2 a	52.2 ab	5.5 c
Wulpak + Gallery	0 b	0 b	0 c	100.0 a

Mean separation among treatments by Tukey's Studentized Range (HSD) test, $P \leq 0.05$.
Treatments with identical letters are not significantly different.

Table 2. Effect of Wulpak treatment on dry weight accumulation, survival, and weed density 75 days after treatment for *Hydrangea serrata* 'Blue Bird'.

Treatment	Shoot dry weight accumulation per plant (g)	Root dry weight accumulation per plant (g)	Plant survival (%)	Weed density per flat (%)
Wulpak + SpinOut	11.2 a	5.8 a	90.1 a	0.2 b
Wulpak	10.0 a	4.8 ab	94.4 a	0.5 b
Wulpak + Gallery	7.1 ab	4.7 ab	86.1 a	0.7 b
Control	4.6 bc	2.4 bc	86.1 a	1.3 ab
Wulpak + Factor	0.9 c	0.1 c	77.8 b	5.0 a

Mean separation among treatments by Tukey's Studentized Range (HSD) test, $P \leq 0.05$.
Treatments with identical letters are not significantly different.

Table 3. Effect of timing of Wulpak application on plant visual rating, survival, weed density, and weed dry weight per flat. Data is averaged over species.

Treatment	Visual rating	Plant survival (%)	Weed density per flat (%)	Weed dry weight per flat (g)
No Wulpak (Control)	4.6 a	99.3 a	16.2 b	1.6 b
After rooting	4.5 a	92.8 a	5.2 b	0.9 b
Prior to sticking	2.6 b	36.9 b	76.4 a	8.9 a

Mean separation among treatments by Tukey's Studentized Range (HSD) test, $P \leq 0.05$.
Treatments with identical letters are not significantly different.

survival rates, but the differences were not always significant. Gallery was detrimental to all herbaceous species and killed 100% of the Oriental poppies. There are two main reasons why Wulpak treatments resulted in higher plant mortality. First, plants of royal fern, Oriental poppy, and to some extent Siberian bugloss, were rather small when wool pellets were applied. Upon wetting, they swelled and smothered many of these small plants. If Wulpak was applied after the plants had more time to become established this problem could be at least partially solved. Second, the application of Wulpak significantly increased substrate moisture (0.346 vs. 0.287 volumetric moisture fraction). This can be a positive or negative influence on plant growth depending on the watering regime.

Similarly, the application of Wulpak suppressed weeds in liners of the woody species *H. serrata* 'Blue Bird' and *I. virginica* 'Henry's Garnet', but their use is

questionable during propagation of cuttings (Tables 2 and 3). Once cuttings of *Hydrangea* were rooted, the application of Wulpak + Spinout and Wulpak alone actually enhanced plant growth and reduced the presence of weeds when compared to the control. However, there is still the question of whether it is economically feasible to apply Wulpak by hand to existing liners. It would be easier to stick cuttings into flats where Wulpak has already been applied, but when we tested this method our results here were not encouraging. The high plant mortality and limited growth during propagation for cuttings stuck in flats already containing a Wulpak mulch layer was probably caused by the high substrate moisture levels. Reducing the amount of water applied may solve this problem, assuming that the foliage of the cuttings do not desiccate in the process.

Acknowledgment: Funding for this study was provided by Wilbro, Inc., Norway, South Carolina; Walters Gardens, Zeeland, Michigan; Spring Meadow Nursery, Grand Haven, Michigan., MSU Project GREEN (Generating Research and Extension to meet Economic and Environmental Needs, and the Michigan Agricultural Experiment Station, East Lansing, Michigan.

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