

Project Title: Utilization of weed suppressive ground covers in nursery and Christmas tree settings for enhanced weed management and soil amelioration

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Abstract: Nineteen cool season grass cultivars were selected for further field evaluation in 2006, based upon their potential to overwinter well in the Northeast and to tolerate stressful production site conditions. We were particularly interested in their winter hardiness, and ability to rapidly establish a dense stand and suppress annual and perennial weeds under minimal maintenance, simulating conditions encountered in low maintenance production sites. Grasses were seeded on September 10, 2005 at 4lbs/1000 sq ft on a well-drained Hudson silt loam soil in Ithaca NY, at the Bluegrass Lane Turf and Landscape Research Center. Plots were evaluated in April 2006 for winter hardiness and survival, and later in May, June and July 2006 for their ability to produce cover or above-ground biomass, and also to suppress the establishment of weeds. Plots received no fertilization and no irrigation after seeding, and minimal monthly mowing with a large commercial rotary mower. Grasses which performed exceptionally well in terms of weed suppression and biomass production included crested wheatgrass, creeping meadowgrass, no-mow fescue, Rebel Exceda tall fescue, Tar Hill II tall fescue, and Russian winter rye. Columbra and Intrigue chewing fescue and Palmer perennial ryegrass were also good performers. These cultivars generally produced greater than 80 to 90% stands of cover

with minimal weed infestation by July 10, 2006 and continued to perform well into the fall of 2006. Grasses which performed poorly as evaluated by formation of less than 60% stands and supported large weed infestations included redtop, and Arizona fescue.

Grasses will be further evaluated for their ability to withstand environmental stress and perform under low maintenance conditions both in Ithaca and Riverhead NY locations. In additional studies performed at Marcus Nurseries in Allegheny County, several groundcovers proved to be exceptional performers in nursery settings, 2 years after establishment. These groundcovers established and overwintered effectively, and were significantly weed suppressive. They also had no deleterious effects on growth of Frazier fir seedlings transplanted into killed groundcover strips. Best cover crop performers in nursery settings included Intrigue and Wilma fine fescue, and white clover/fine fescue mixtures. Palmer and Prelude perennial ryegrass provided poor weed suppression, despite good initial establishment. Fine fescues were generally most weed suppressive compared to all other groundcovers evaluated and required limited mowing for maintenance.

Background and Justification: Many northeastern states have a large number of Christmas tree and conifer producers, including New York State. Long-term weed management in the nursery has been cited by NY State producers as a key pest management problem, and one that can limit crop growth rate and quality. As a result, groundcovers are typically established in row middles and alleys to prevent soil erosion, assist in weed suppression and allow enhanced access to the production site in wet conditions. The selection of a groundcover for seeding large areas in established row middles involves several key criteria for enhanced performance. First, the groundcover

must require limited mowing maintenance to reduce labor costs. Secondly, it must require limited irrigation or rainfall and tolerate poor soils, pH extremes and occasionally compacted sites. Thirdly, a successful row middle establishment must suppress weed infestation and reduce spread of invasive weeds in these settings, while not attracting deer or other mammals to the planting area. Lastly, it should require limited reseeding and be easily maintained over long periods of time. Given these criteria, it is a challenging task to select one groundcover that meets all of these requirements. However, recent research is now underway to select for stress tolerance and weed suppression in low maintenance grass breeding programs at the University of Rhode Island and at Rutgers University. In addition, field screening of grasses for reduced maintenance settings is underway at the University of Rhode Island, Pennsylvania State University and Cornell University, among other programs (Weston et. al., 2006; Eom et.al. 2005).

In attempting to surmise which grasses or mixtures of grasses might later be suitable for nursery and Christmas tree production sites New York State with respect to the above-mentioned criteria, a literature review revealed that certain fine leaf and other fescues are known to be exceptionally weed suppressive over time from previous field evaluations (Bertin and Weston, 2003; Weston and Bertin, 2004). In some cases, weed suppression provided by established grass stands has been attributed to competition for resources and also to allelopathic plant properties (Weston, 1996; Weston and Duke, 2003; Weston, 2005). In addition, it has been suggested that other native species may be well-adapted to NY State growing conditions and also able to prevent erosion and weed infestation when well-established (Eom et. al., 2005; Eom et. al. 2006). However, not a great deal of work has been conducted on this subject using replicated field trials and

controlled seeding conditions for evaluation. Therefore, we decided to evaluate a selection of twenty cool season native and non-native grasses in two locations, Ithaca and Riverhead NY. For purposes of this report, we will present results from only the Ithaca location at this time. In addition, we have evaluated selected groundcovers for long-term performance in nursery/Christmas tree production settings in Allegheny County New York, and their ability to suppress weeds without interfering with Christmas tree growth over time.

Materials and Methods: Nineteen cool season grass cultivars were selected for further field evaluation based upon their potential to overwinter well in the Northeast and to tolerate stressful roadside conditions, after a thorough literature review (Table 1). We were particularly interested in the grasses' winter hardiness, their ability to rapidly establish a dense stand after seeding, and also to suppress annual and perennial weeds under minimal maintenance, simulating roadside management conditions. Grasses were seeded on September 10, 2005 at 4lbs/1000 sq ft on a well-drained Hudson silt loam soil in Ithaca NY, at the Bluegrass Lane Turf and Landscape Research Center. Plots were seeded by hand after preparation by tillage and cultivation, and after seeding plots were rolled to increase seed soil contact to enhance germination. Plots were not irrigated or fertilized following seeding. Plots were evaluated in April 2006 for winter survival, and later in May, June and July 2006 for their ability to produce cover or above-ground biomass, and also to suppress the establishment of weeds. Plots received minimal monthly mowing with a large commercial rotary mower to simulate roadside typical roadside management conditions. Using similar procedures, cover crops were hand

seeded and established in September 2004 at Marcus Farms in a randomized complete block design with 3 replicates. After seeding plots were rolled but not irrigated. All moisture received was by natural rainfall. Frazier fir seedlings were established by transplanting by hand in killed strips in each established cover crop. Crops were killed by treatment with glyphosate. Periodic mowing of cover crops was performed as needed.

Table 1. Nineteen cool season grasses evaluated in Ithaca NY in a low maintenance setting in 2006..

1	Crested wheatgrass	<i>Agropyron cristatum (L.) Gaertn.</i>
2	Redtop	<i>Agrostis stolonifera L</i>
3	Creeping meadowgrass	<i>Poa pratensis L</i>
4	Smooth brome	<i>Bromus inermis Lesser</i>
5	Streambank Wheatgrass	<i>Elymus lanceolatus (Scribn. & J.G. Sm.) Gould</i>
6	"No Mow" Fescue	<i>Festuca rubra L.</i>
7	Arizona Fescue	<i>Festuca arizonica Vasey</i>
8	Columbra chewings fescue	<i>Festuca rubra subsp. commutata L</i>
9	Intrigue chewings fescue	<i>Festuca rubra subsp. commutata L.</i>
10	Sandpiper chewings fescue	<i>Festuca rubra subsp. commutata L</i>
11	Oxford hard fescue	<i>Festuca trachyphylla Hack Krajina</i>
12	Reliant II hard fescue	<i>Festuca trachyphylla Hack Krajina</i>
13	Rebel Exeda tall fescue	<i>Lolium arundinaceum (Schreb.) S.J. Darbyshire</i>
14	Tar Hill 2 tall fescue	<i>Lolium arundinaceum (Schreb.) S.J. Darbyshire</i>
15	Palmer perennial ryegrass	<i>Lolium perenne L.</i>
16	Prelude perennial ryegrass	<i>Lolium perenne L.</i>
17	Russian wild rye	<i>Psathyrostachys juncea Nevski</i>
18	Weeping alkaligrass	<i>Puccinellia distans Jacq Parl</i>
19	Zenith zoysiagrass	<i>Zoysia japonica L</i>

Results and Discussion: Initial evaluation of grass plots in the month of April indicated that several had not successfully established or overwintered when evaluated in early April. Limited to no growth was present in plots seeded to redtop, Zenith zoysiagrass, Sandpiper chewings fescue, Reliant II hard fescue and Arizona fescue. Several of these grasses including Sandpiper and Reliant II fine fescue as well as zoysiagrass were generally well established with significant ground cover by July, indicating a longer

period for adequate biomass generation was observed in the Ithaca environment.

However, Arizona fescue and redtop currently have limited establishment in this field site. Since all seed purchased was fresh and growing conditions including rainfall amounts, snow cover and warm spring temperatures were optimal, it may be that redtop and Arizona fescue are either not well-adapted to this region or are particularly difficult to germinate and establish.

In comparison, several grasses were well-established by early April, thereby preventing early season weed infestation to occur in these plots, due to adequate cover and competition for resources. Grass establishment, biomass production and percent overall cover continued to increase through July, with certain tall fescues and fine fescues performing well, including Rebel Exceeda and Tar Heel II tall fescue, as well as Intrigue and Columbra fine fescue. Top performers included crested wheatgrass and creeping meadowgrass, along with no-mow fine fescue and Russian wild rye. Weed suppression tended to be strongly and positively correlated with increased cover provided by the cool season grasses. Although weed growth increased over time, certain covers were still exceptionally weed suppressive with limited to no infestation of annual or perennial weeds by July 2006. In addition, certain cool-season grasses exhibited strong aesthetic appeal. Those that provided good dark green color and texture, along with dense cover included perennial ryegrasses Palmer and Prelude and several fine fescues, along with Russian wild rye. Wheatgrasses eventually appeared somewhat yellowed and chlorotic by May.

Despite limited maintenance and no inputs of fertilizer or irrigation water, exceptional establishment and biomass production was noted in several cool-season

grasses, represented by different genotypes. With only monthly mowing to assist in eliminating weed infestation over time, most grasses proved to be well-established with limited weed infestation by July 2006. Interestingly, a few covers offered great color and appeal as well as weed suppression. We feel that certain tall and fine fescue cultivars as well as native species such as creeping meadowgrass, crested wheatgrass and wild ryes may also offer strong potential to provide attractive and competitive groundcovers in roadside settings.

Further research performed in Christmas tree and conifer production sites experiencing drought and poor soils will be needed to assess performance in more difficult conditions actually encountered in non-irrigated production settings. As a result, 10 groundcovers were evaluated for long-term performance in a non-irrigated nursery setting in Western NY, at Marcus Farms Nurseries. Results of these studies indicated that certain groundcovers were particularly effective in suppressing weeds while not interfering adversely with Christmas tree seedling growth, 2 years after seeding in transplanted Christmas tree production sites. Best performers included Intrigue, Wilma and Oxford fine fescues as well as white clover/fine fescue (Reliant II) mixtures. Poorest performers included white clover monocultures, glyphosate tolerant fine fescues including Pure Gold, and perennial ryegrasses Palmer and Prelude. Although perennial ryegrasses provided good early cover, weed encroachment over time was noted and additional mowing to maintain stands over time was required, in comparison to fine fescues.

The choice of groundcover had limited effect on fir seedling growth with no significant effect on seedling number in plots or tree height. Further studies to evaluate the long-term impact of groundcover selection upon Christmas tree growth and quality

are underway. Based on 2 years of performance, certain fine fescue cultivars are excellent choices for utilization in low maintenance nursery production settings in monocultures or in mixtures.

In summary, this project has generated information that allows producers to select cost effective groundcovers or mixtures to establish for long-term usage in conifer production sites. According to the 2002 Agricultural Census, the six New England States plus New York State produced over a million and a quarter Christmas trees on approximately 3500 farms covering over 535,000 acres. In New York alone, there were 52 producers of container or 'balled and burlapped' coniferous evergreens generating more than \$5.2 million in total sales (USDA Nursery Crops 2003 Summary). The use of selected groundcovers in conifer nurseries is gaining increased interest for several reasons. In these studies, the use of certain groundcovers has resulted in significantly reduced weed infestation problems in production settings and research sites, with no apparent detrimental effects on fir size and quality. The long-term reduction in weed infestation in production sites should result in greatly reduced numbers of weed propagules in the soil seed bank, and may limit the need for additional herbicide applications over time. In addition, cleaner row middles may lead to enhanced crop quality, more rapid growth rates due to reduced competition with weeds, and fewer infestations of additional pests which utilize weeds as host plants. Ease of access to established plantings and reduced soil erosion on sloped production sites are added benefits of successful cover crop establishment, along with addition of fixed N by legume cover crops.

Project Location: Research was conducted in Ithaca NY, Riverhead NY and Arkport NY.

Sample of Resources Developed: Two websites have been developed for selection of low maintenance groundcovers for use in landscapes, roadside settings and nurseries. They can be accessed from the Cornell Gardening homepage and are entitled: Fescues for low maintenance settings and Grass/Forb Mixtures for Low Maintenance Settings. An IPM pest management manual for NY State Christmas tree producers is also planned and forthcoming.

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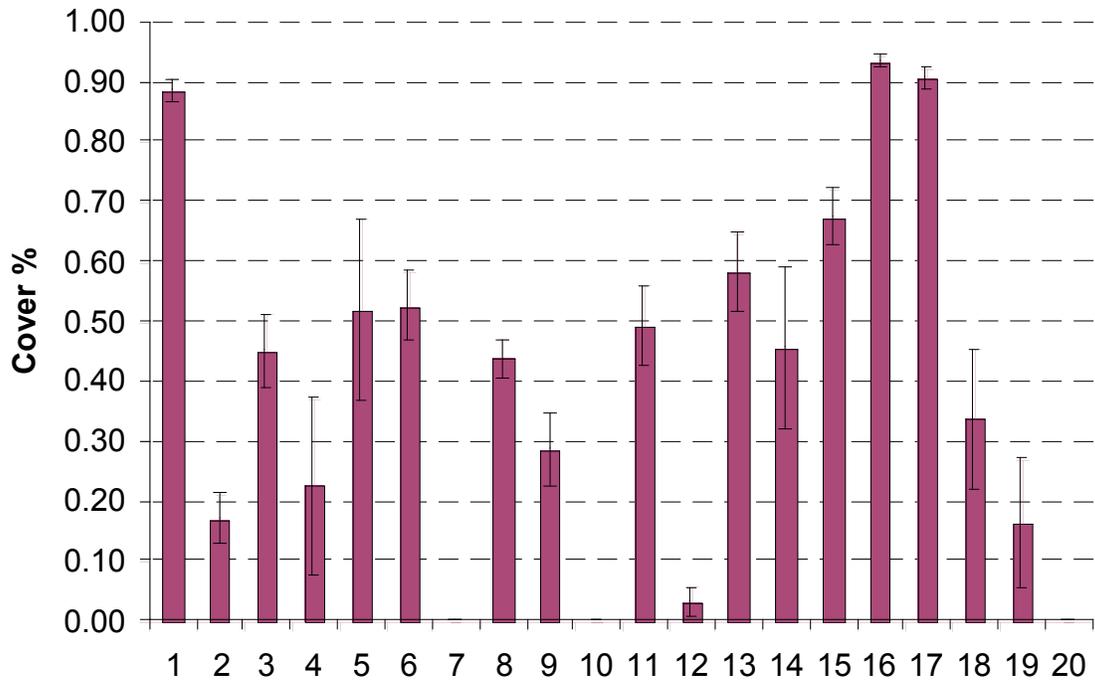


Figure 1. Mean percentage of cover for crop and weeds in each grass species evaluated in May, 2006. Averages were calculated on the basis of 8 replicates per treatment. Treatment 20 is an unseeded control, which became later infested with turf and weedy grasses.

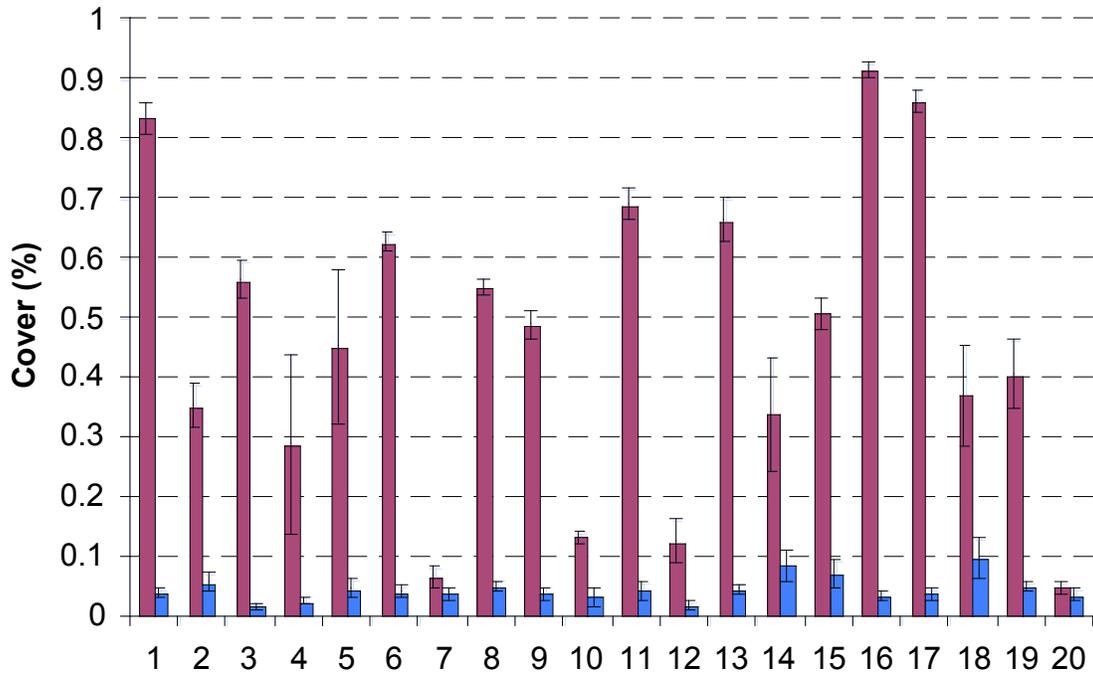


Figure 2. Mean percentage of cover for crop and weeds in each grass species evaluated in June, 2006. Averages were calculated on the basis of 8 replicates per treatment. Treatment 20 is an unseeded control, which became later infested with turf and weedy grasses.

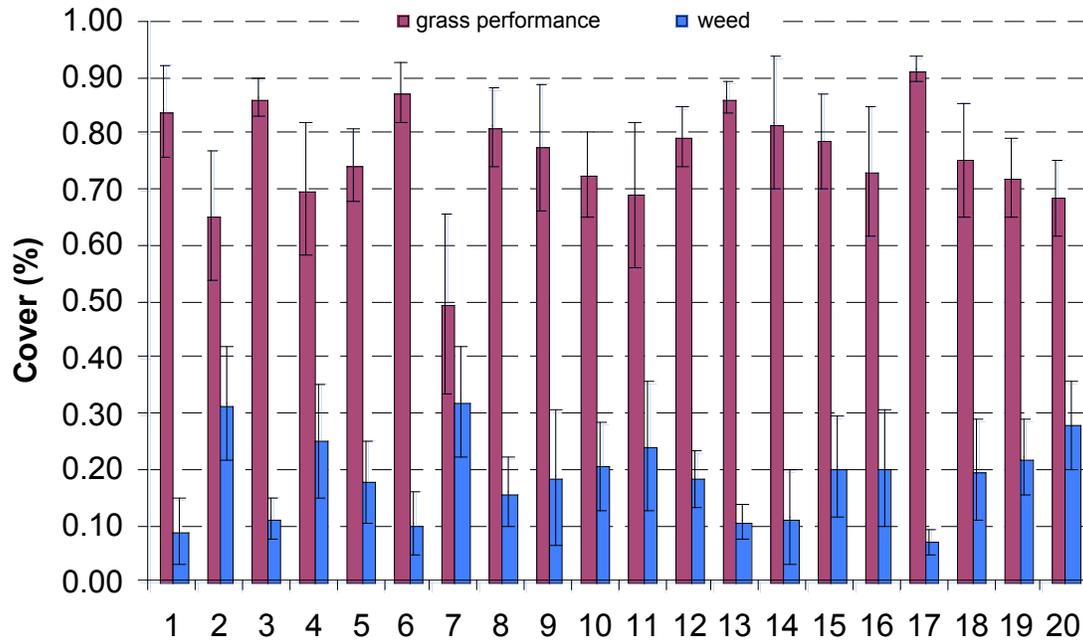


Figure 3. Mean percentage of cover for crop and weeds in each grass species evaluated in July, 2006. Averages were calculated on the basis of 8 replicates per treatment. Treatment 20 is an unseeded control, which became later infested with turf and weedy grasses.

Table 2. Percentage soil cover and fir tree height in cover crops established in row middles of Christmas tree seedlings in Fall 2006. Cover crops were established in Fall 2004 at Marcus Farms. Means are calculated on the basis of 3 replicates.

Cover Crops Evaluated	% Cover	Fir Seedling Height.
Palmer Perennial Rye	45	19
Clover + Reliant II Fescue	78	21
Salem Stong Creeping Fescue.	83	19
Prelude Perennial Rye	35	24
White clover	53	24
Oxford Fine Fescue	80	21
Pure Gold Fine Fescue.	40	19
Wilma Fine Fescue	84	20
Intrigue Fine Fescue	93	19
Reliant II Fine Fescue.	77	20