Appalachian Plant Materials Center

Alderson, West Virginia

2010

Technical Report

Crimson clover in blossom in Transition to Organics Technology Development Study

Study Number: WVPMC-T-0902-CP

Study Title:

Transition to Organic Production Cover Crop Trial and Field Corn Nitrogen Response to Rolled Cover Crop Mulches

Introduction:

Transition to organic production requires cessation of chemical herbicides for cover crop and weed suppression. The purpose of this study is to refine and transfer organic crop management techniques to the organic farming community.

Objective(s):

To evaluate the effectiveness of several cereal grains and annual legumes as soil cover in cropland.

To evaluate the effectiveness o delivery of nitrogen from the annual legume component of the cover crop to the succeeding crop.

To evaluate the effectiveness of a mechanical roller crimper as a non-herbicide means of achieving cover crop suppression.

Discussion:

This study was initiated in 2009 and will be continued for at least 3 years. Data collected from the 2009 study and a summary of the 2010 study is presented in Appendix 1 of this Report.

Study Number(s): **WVPMC-T-0201-0T**

Study Title(s): **Stones River National Battlefield Reimbursable Agreement**

Introduction:

Stones River National Battlefield has a need to preserve native plant resources and revegetate parklands with germplasm from within park boundaries where possible to maintain the genetic resources within the park. The NPS does not have the personnel, expertise, or equipment needed to propagate quantities of the required seed and plants. The NRCS has the personnel and is equipped to propagate and clean quantities of seed sufficient to meet the NPS needs within the required time frame and conduct evaluations on plant species to determine adaptation and cultural requirements for establishment.

Objective(s):

The objective of this study is to produce transplants of local ecotype native plants for use in landscape restoration within the confines of the battlefield, while developing technology products, e.g. propagation protocols, plant guides, etc., for these native species. Information on the culture of most of the native plants in this study is nonexistent.

Discussion:

To date, the Appalachian PMC has conducted evaluations of approximately 35-40 native plant species for the NPS, and has propagated and delivered several thousand plants for use in landscape restoration within Stones River National Battlefield. Several technology products, e.g. plant propagation protocols, have been developed from this study, and several additional technology products are in process. Technology products for this project developed in 2010 are presented in Appendix 2 of this Report.

Study Number(s): WVPMC-P-0501-PA

Study Title(s): Eastern Gamagrass for the Appalachian Region

Introduction:

Tripsacum dactyloides, **Eastern gamagrass, is a perennial, warm-season native grass. It is highly productive and very palatable to grazing livestock, especially cattle. Once thought to be relatively common throughout the Region, gamagrass is now rare and found only in those locations that have not been impacted by grazing livestock. While there are several cultivars of gamagrass available in the marketplace, the commercially available cultivars do not have origins within the Appalachian Region, nor has their adaptability to the Region's climatic regime been thoroughly vetted. The intent of this study is to evaluate the adaptability of several accessions to the Appalachian Region.**

Objective(s):

The objective of this study is to evaluate and select an accession of Eastern gamagrass that exhibits improved adaptability to Appalachian climate, soils, and management conditions.

Discussion:

Accession 9093678 was collected as clones from an upland location in North-Central West Virginia prior to 2005. From 2005 until present, twenty-five plants of this accession have been maintained in an observation garden in association with a like number of plants from three commercially available cultivars and one unreleased accession from Maryland. The commercially available cultivars are: 'Pete', 'Meadowcrest' (a colchicine induced tetraploid), and 'Highlander'. The unreleased accession from Maryland apparently is the diploid parent of 'Meadowcrest'. Observations made annually have consistently shown that performance of accession 9093678 has been equal to the performance of 'Highlander' and superior to the performance of 'Pete', 'Meadowcrest' and the unreleased Maryland diploid. The principal observed difference between 'Highlander' and 9093678 has been maturity; with 9093678 being approximately 14 days later maturing. A small seed increase block of 9093678 was established in 2009 in order to obtain quantities of seed to establish field trials for this accession. Seed to begin establishment of field trials is expected to be available circa 2012.

Study Number(s): WVPMC-P-0803-PA

Study Title(s): Effect of Latitude and Elevation Related Light Effects on Persistence, Hay Yield, and Chemical Composition of Tanniferous Forages

Introduction:

Plants that contain condensed tannins (CT) can address the first of two or three possible mechanisms of bioactivity against gastrointestinal parasites of small ruminants. The CT are a diverse class of polyphenolic compounds that interact with biological systems I a variety of ways. Moderate levels of CT in forage have long been known to prevent pasture bloat, but many new benefits have been discovered. Positive effects of CT occur at dietary concentrations between 25 and 45 g/kg of dry matter (DM) and include improved protein nutrition via increased rumen undegraded protein (RuDP), reduced GI parasitism, and antioxidant activity. Temperate CT-containing forage legumes with potential effects on parasitism in small ruminants include serecia lespedeza (*Lespedeza cuneata*), sainfoin (*Onobrychis viciifolia*), birdsfoot trefoil (*Lotus corniculatus* L.), big trefoil (*L. pedunculatus*), and sulla (*Hedysarum coronarium* L.). Of these, only serecia lespedeza and birdsfoot trefoil are well-known in the U. S. and have cultivars developed for varying CT content. Serecia lespedeza and sainfoin retain their antihelmintic activity when preserved as hay and fed as the sole diet or as a supplement to pasture. Use of preserved forage rather than pasture will increase management flexibility by allowing forage with antibhelmintic properties to be stored until it is needed. Despite intense producer interest in all of these tanniferous forages, there is little data regarding their suitability for Appalachia. Therefore, this proposal focuses on determining suitability of tanniferous legumes as potential hay crops for Appalachia.

Discussion:

Condensed tannin-containing forage species are being evaluated for economicl potential for hay production under central Appalachian growing conditions, using criteria of yield, forage quality, and stand persistence. Perrenial forage species containing condensed tannins are being grown for a minimum of 3 years at multiple locations selected to provide a range of growing environments. Plots were established at the PMC near Alderson, WV in the Spring of 2008.

In 2010, the first year of harvests was completed in Alderson, WV. The objective of this trial is to compare yields and condensed tannin content of legumes grown at a variety of different latitudes and altitudes with potentially variable UV-B radiation levels. Alderson results will be compared with forages grown in Bragg, WV, and Rock Springs, PA. Yield data for the Alderson plots is presented in Table 1 below.

Table 1. Total dry matter yield of tannin-containing forage legumes grown in Alderson, WV.

Species	Cultivar	DMY (kg/ha)	SE
birdsfoot trefoil	Pardee	11701 a	293
	Norcen	11055 a	573
sericea lespedeza	Serala	8704 b	682
	Interstate	8232 bc	502
	Grazer	7210 c	561
Alfalfa (Control)	Alfagraze	8003 bc	352
sainfoin	Eski	5294 d	316
	Remont	4940 d	644
big trefoil	ARS-1221	2581 e	210
slender lespedeza	Slender	2258 e	208

In Alderson in 2010, summed over cuttings, birdsfoot trefoil yielded more forage than all other entries including the alfalfa control. Summed sericea lespedeza yields were similar to alfalfa, and greater than sainfoin. Big trefoil and slender lespedeza yields were lowest. The only specie with a difference among cultivars was sericea lespedeza, where 'Serala' yielded more forage than 'AU Grazer.'

This study will be continued in 2011.

Study Number: **WVPMC-T-0104-OT**

Study Title: **US Army Corps. of Engineers Ecosystem Restoration Reimbursable Project**

Introduction:

The Marmet Locks and Dam are located in Kanawha County, WV, on the Kanawha River a short distance upstream of Charleston, WV. The Marmet Locks and Dam Project includes building a new lock and approach channel located on the river right side to accommodate larger tows. The USACE , as a part of their site mitigation plan, wishes to preserve local plant ecotypes for re-establishment on the site upon completion of construction. The local ecotypes of interest are not available commercially.

Objective:

The objective of this project is to assemble or propagate and maintain specific numbers of local ecotypes of six woody species for use by the USACE at their Marmet construction site.

Discussion:

This project was initiated during 2001. Seedling plants of *Acer saccharinum* - silver maple, *Lindera benzoin* – spicebush, *Sambucus canadensis* – elderberry, *Asimina triloba* – pawpaw, and *Sassafras albidum* sassafras were lifted from the construction site during the spring and early summer. These plants were placed into pots and transported to the Alderson PMC. These plants are being maintained in shade structures at the PMC until completion of construction. Seed of *Acer saccharinum, Lindera benzoin, Asimina triloba,* and *Aesculus octandra* –yellow buckeye were also harvested from the site during 2001. These seeds were used to produce seedlings at the PMC to assist with fulfillment of the agreement with the USACE. It is important to note that all plants produced under this agreement are for the exclusive use by the USACE at the Marmet construction site. However, one or more of these species may be made available to the public by the Alderson PMC in the future as source identified releases in conjunction with the USACE. Reintroduction of plants to the site was begun in 2007, but was not completed until 2009 because of extensive construction delays. Plant performance on this highly disturbed site will be monitored for at least 5 years. Potential technology products resulting from this project include: propagation protocols, plant guides, journal articles, and technology notes pertaining to post construction establishment and management of native woody species.

Study Number: **WVPMC-P-0101-TE**

Study Title:

West Virginia Balsam Fir Increase – A cooperative project with The Nature Conservancy, US Fish and Wildlife Service, US Forest Service, and The West Virginia Highlands Conservancy.

Introduction:

In West Virginia, balsam fir is found only at high elevations and in conjunction with damp woods and mountain swamps. Although it is not listed as endangered, it is considered to be a somewhat rare plant in West Virginia. Dr. Earl Core, in Flora of West Virginia, describes balsam fir as a tree 10-25 meters tall, 1 meter in diameter, and having a bark warty with resin blisters. Hence, the name "blister pine" commonly used in the Alleghenies.

One of the more alarming contemporary problems in the Appalachians is the rapid depletion of balsam fir forests linked to the Balsam wooly adelgid, an exotic, sap-sucking insect that causes mortality within 2-3 years of initial contact. Although undetected for many years, the adelgid infestation is now widespread and appears to be growing in WV and elsewhere.

Objective:

The objective of this project is to maintain a seed bank for the West Virginia balsam fir, to propagate seedlings for replanting in the areas where the seed originated, and to develop source identified releases for West Virginia balsam fir.

Discussion:

In August 2000 ten volunteers harvested balsam fir seeds from 4 locations within the Allegheny Highlands of West Virginia. These seeds were processed and delivered to Alderson PMC for seed banking and production of seedlings. Limited quantities of seedlings of the four accessions were produced at the PMC in 2003. Approximately 100 seedlings were returned to Canaan Valley Wildlife Refuge in 2005. Additionally, several hundred seedlings were returned to the Park during the period from 2006 – 2009. Seedling production of all four accessions was continued in 2010.

Study Number(s): **WVPMC-P-0105-OT, WVPMC-P-0106-OT, WVPMC-P-0107-OT**

Study Title(s): **Intercenter Plant Evaluation Studies**

Introduction:

Intercenter plant evaluations are used to help determine the area of adaptation of potential releases. Additionally, these studies may be useful in evaluating potential aggressive or invasive properties of candidates for release under controlled conditions outside of the releasing PMC service area. Intercenter evaluation studies are developed with regard to the environmental diversity of the area served by the releasing PMC and the anticipated area of adaptation for the release candidate.

Objective:

The objective of these studies is to evaluate the area of adaptation for 4 species and 5 accessions that are potential releases from the Big Flats PMC.

Discussion:

The Alderson PMC received seed of *Agropyron* genus-intermediate wheatgrass, *Sorgastrum nutans*-Indiangrass, two accessions of *Spartina pectinata*-prairie cordgrass, and *Agrostis gigantea*-redtop in 2001. Seeds of each genus and accession were planted in cone-tainers in the greenhouse in late winter of 2001. Seedling plants were transplanted from the greenhouse to observation rows in Field 1 mid-spring of 2001. 100 plants of intermediate wheatgrass, Indiangrass, and redtop and 50 plants of each accession of prairie cordgrass were transplanted into the observation area. Plants were evaluated for survival in September 2001. All species and accessions exhibited 100 percent survival. These plants were evaluated twice annually through 2009. An adaptability report for each species is being prepared and will be available circa 2011.

APPENDIX 1.

Technology Products for the Transition to Organic Production Cover Crop Trials and Field Corn Nitrogen Response to Rolled Cover Crop Mulches

2009 DRY MATTER YIELDS FOR SEVERAL COVER CROP SPECIES AND CULTIVARS

EXPERIMENT 1. Planting Date: 17 September 2008 - Harvest Date 15 May 2009

COVER CROP SPECIES/CULTIVAR	DRY MATTER YIELD (T/Ac.)
Triticum spelta L.	2.92
*Secale cereale*L. 'Wheeler'	2.91
Secale cereale L. 'Aroostock'	3.46
*Triticum aestivum*L.	2.98
x Triticosecale rimpaui Wittm.	3.31
*Secale cereale*L. 'Abruzi'	2.5

EXPERIMENT 2. Planting Date: 2 October 2008 - Harvest Date 15 May 2009

COVER CROP SPECIES/CULTIVAR	DRY MATTER YIELD (T/Ac.)
Triticum spelta L.	2.69
*Secale cereale*L. 'Wheeler'	2.22
Secale cereale L. 'Aroostock'	2.63
*Triticum aestivum*L.	3.31
x Triticosecale rimpaui Wittm.	3.21
*Secale cereale*L. 'Abruzi'	3.17

EXPERIMENT 3. Planting Date: 15 October 2008 - Harvest Date 15 May 2009

COVER CROP SPECIES/CULTIVAR	DRY MATTER YIELD (T/Ac.)
Triticum spelta L.	1.96
*Secale cereale*L. 'Wheeler'	2.02
Secale cereale L. 'Aroostock'	2.51
*Triticum aestivum*L.	3.07

x Triticosecale rimpaui Wittm.	2.21
Secale cereale L. 'Abruzi'	3.18

EXPERIMENT 4. planting Date: 29 October 2008 - Harvest Date 15 May 2009

COVER CROP SPECIES/CULTIVAR	**DRY MATTER YIELD (T/Ac.)**
Triticum spelta L.	1.54
Secale cereale L. 'Wheeler'	2.58
Secale cereale L. 'Aroostock'	1.97
*Triticum aestivum*L.	2.6
x Triticosecale rimpaui Wittm.	2.07
*Secale cereale*L. 'Abruzi'	2.65

Transition to Organic Production Cover Crop Trial and Field Corn Nitrogen Response to Rolled Cover Crop Mulch

USDA Plant Materials Center, Alderson West Virginia
2010 Cover Crop trial/Field Corn Nitrogen Response to Rolled Cover Crop Mulch
Replications: 4
Planting Dates: 4 dates , 1st planting: September 3rd; 2nd planting 16 or 17th Sept. ; 3rd planting Oct. 4-7 and 4th planting October 25-29
Treatments:

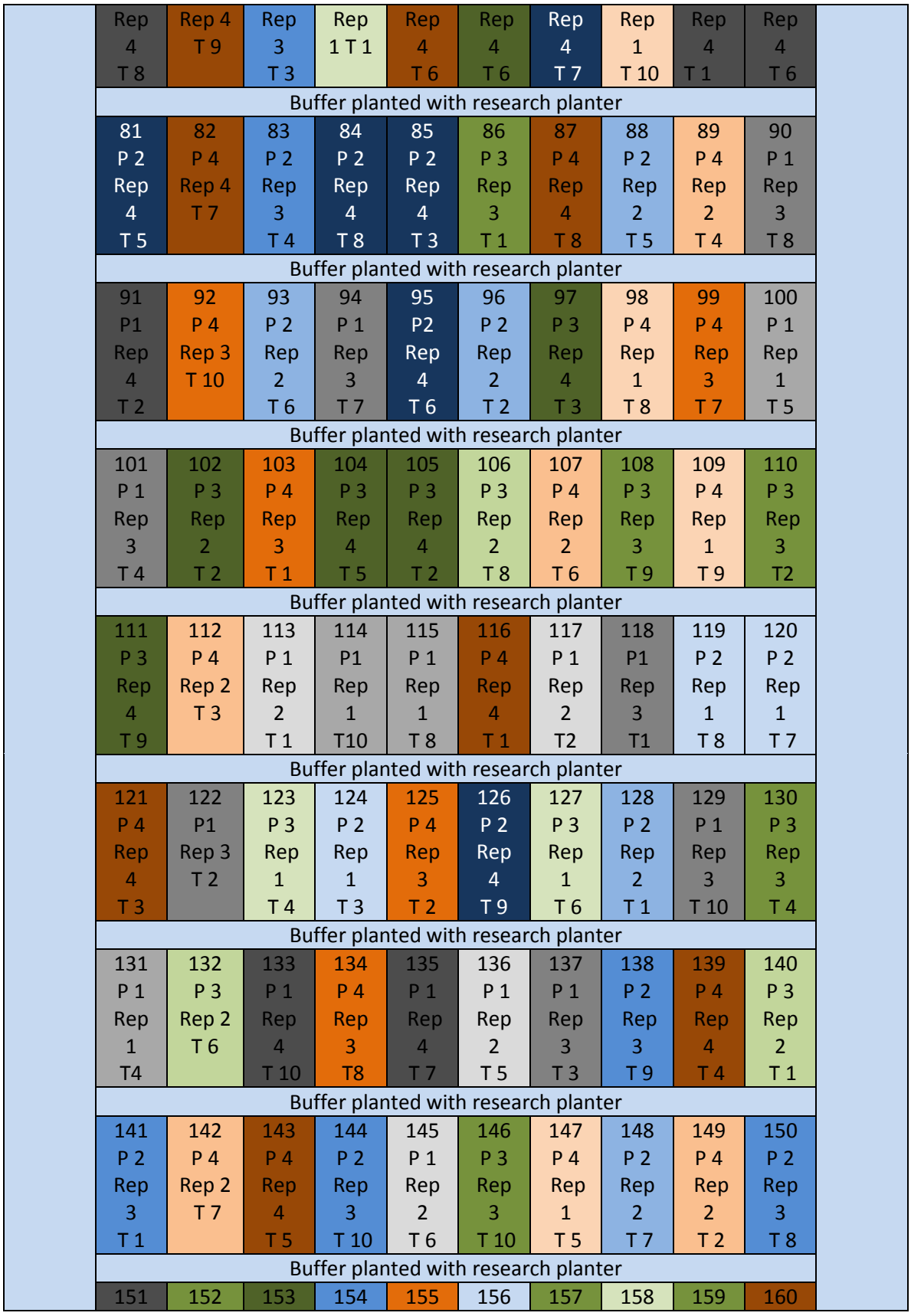
1) Crimson Clover
2) Crimson Clover/Aroos. Rye
3) Purple Bounty
4) Purple Bounty/Aroos. Rye
5) Common Vetch
6) Common Vetch/ Aroos. Rye
7) Cover Crop Wheat
8) Common Barley
9) Purple Bounty/Common Barley
10) Aroos. Rye

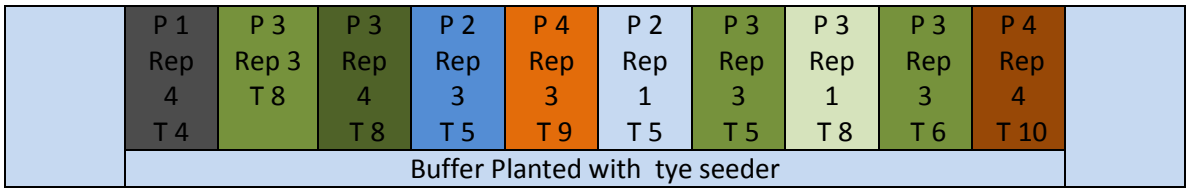
Treatment	Lbs/Acre	Ounces/ 30 ft sq. 16 oz = 1 lb	Grams / 30 ft. sq. 1 oz = 28.3495 grams
Crimson Clover	20 lb per acre	0.22	6 grams
Crimson Clover/Aroos. Rye	15 lbs crimson clover/ 112 lb rye		4.6 grams cc and 35 grams a. rye
Purple Bounty	30 lbs acre		9.4 grams
Purple Bounty/Aroos. Rye	30 lbs vetch and 112 lbsrye		9.4 grams vetch and 35 grams rye
Common Vetch	30 lb acre		9.4 grams vetch
Common Vetch/ Aroos. Rye	30 and 112		9.4 grams vetch and 35 grams rye
Cover Crop Wheat	120		37.5 grams wheat
Common Barley	100	1.1 oz	31.2 grams barley
Purple Bounty/Common Barley	30 and 100		9.4 grams vetch and 31.2 grams barley
Aroos. Rye	112		35 grams rye

Individual plot size: 2.5 ft by 10ft. Area: 25 ft^2
Space Between individual Plots: 2 ft. break, to be planted to oats at second planting
Total plot width: Ten treatment plots at 2.5 ft per plot so, 50 ft. Not including buffer strips of rye, 4 ft. each side
Total plot length: 16 treatment plots plus 2 ft break between each plot = 200 ft.

Cover Crop sequential planting plot map

Buffer planted with tye seeder											
Buffer Planted with tye seeder	1 P 1 Rep 2 T 7	2 P 4 Rep 3 T 3	3 P 3 Rep 1 T 5	4 P 2 Rep 2 T 4	5 P 4 Rep 2 T 1	6 P 2 Rep 1 T 6	7 P 4 Rep 1 T 1	8 P1 Rep 1 T 9	9 P 1 Rep 2 T 9	10 P 2 Rep 2 T 3	Buffer Planted with tye seeder
	Buffer planted with research planter										
	11 P 4 Rep 1 T 7	12 P1 Rep 4 T 3	13 P 4 Rep 3 T 6	14 P 4 Rep 1 T 6	15 P 1 Rep 3 T 6	16 P 3 Rep 3 T 7	17 P 1 Rep 2 T 8	18 P 4 Rep 1 T 2	19 P 3 Rep 1 T 10	20 P 3 Rep 1 T 2	
	Buffer planted with research planter										
	21 P3 Rep 1 T 7	22 P 2 Rep 1 T 10	23 P 4 Rep 3 T 5	24 P 2 Rep 3 T 6	25 P 3 Rep 3 T 3	26 P 3 Rep 1 T 3	27 P 2 Rep 4 T 4	28 P 2 Rep 1 T 9	29 P 4 Rep 4 T 2	30 P1 Rep 3 T 5	
	Buffer planted with research planter										
	31 P 2 Rep 3 T 7	32 P2 Rep 1 T 1	33 P 3 Rep 2 T 3	34 P 1 Rep 2 T 10	35 P 2 Rep 4 T 1	36 P1 Rep 1 T 7	37 P 4 Rep 2 T 5	38 P 2 Rep 4 T 10	39 P 2 Rep 4 T 2	40 P 4 Rep 1 T 4	
	Buffer planted with research planter										
	41 P 3 Rep 2 T 9	42 P1 Rep1 T2	43 P 1 Rep 3 T 9	44 P3 Rep 4 T 7	45 P 4 Rep 2 T 10	46 P 4 Rep 2 T 9	47 P 3 Rep 1 T 9	48 P 1 Rep 1 T 6	49 P 2 Rep 1 T 4	50 P 1 Rep 2 T 3	
	Buffer planted with research planter										
	51 P 3 Rep 2 T 4	52 P 1 Rep 4 T 9	53 P 2 Rep 2 T 9	54 P 3 Rep 4 T 10	55 P 3 Rep 4 T 1	56 P 4 Rep 1 T 3	57 P 1 Rep 1 T3	58 P 3 Rep 4 T 4	59 P 1 Rep 1 T 1	60 P 4 Rep 3 T 4	
	Buffer planted with research planter										
	61 P 4 Rep 2 T 8	62 P 3 Rep 2 T 10	63 P2 Rep 1 T 2	64 P 2 Rep 3 T 2	65 P 3 Rep 2 T 7	66 P 1 Rep 4 T 5	67 P 3 Rep 2 T 5	68 P 2 Rep 2 T 10	69 P 1 Rep 2 T 4	70 P 2 Rep 2 T 8	
	Buffer planted with research planter										
	71 P 1	72 P 4	73 P 2	74 P 3	75 P 4	76 P 3	77 P 2	78 P 4	79 P 1	80 P1	


Rep 4 T 8
Rep 4 T 9
Rep 3 T 3
Rep 1 T 1
Rep 4 T 6
Rep 4 T 6
Rep 4 T 7
Rep 1 T 10
Rep 4 T 1
Rep 4 T 6
Buffer planted with research planter
81 P 2 Rep 4 T 5
82 P 4 Rep 4 T 7
83 P 2 Rep 3 T 4
84 P 2 Rep 4 T 8
85 P 2 Rep 4 T 3
86 P 3 Rep 3 T 1
87 P 4 Rep 4 T 8
88 P 2 Rep 2 T 5
89 P 4 Rep 2 T 4
90 P 1 Rep 3 T 8
Buffer planted with research planter
91 P1 Rep 4 T 2
92 P 4 Rep 3 T 10
93 P 2 Rep 2 T 6
94 P 1 Rep 3 T 7
95 P2 Rep 4 T 6
96 P 2 Rep 2 T 2
97 P 3 Rep 4 T 3
98 P 4 Rep 1 T 8
99 P 4 Rep 3 T 7
100 P 1 Rep 1 T 5
Buffer planted with research planter
101 P 1 Rep 3 T 4
102 P 3 Rep 2 T 2
103 P 4 Rep 3 T 1
104 P 3 Rep 4 T 5
105 P 3 Rep 4 T 2
106 P 3 Rep 2 T 8
107 P 4 Rep 2 T 6
108 P 3 Rep 3 T 9
109 P 4 Rep 1 T 9
110 P 3 Rep 3 T2
Buffer planted with research planter
111 P 3 Rep 4 T 9
112 P 4 Rep 2 T 3
113 P 1 Rep 2 T 1
114 P1 Rep 1 T10
115 P 1 Rep 1 T 8
116 P 4 Rep 4 T 1
117 P 1 Rep 2 T2
118 P1 Rep 3 T1
119 P 2 Rep 1 T 8
120 P 2 Rep 1 T 7
Buffer planted with research planter
121 P 4 Rep 4 T 3
122 P1 Rep 3 T 2
123 P 3 Rep 1 T 4
124 P 2 Rep 1 T 3
125 P 4 Rep 3 T 2
126 P 2 Rep 4 T 9
127 P 3 Rep 1 T 6
128 P 2 Rep 2 T 1
129 P 1 Rep 3 T 10
130 P 3 Rep 3 T 4
Buffer planted with research planter
131 P 1 Rep 1 T4
132 P 3 Rep 2 T 6
133 P 1 Rep 4 T 10
134 P 4 Rep 3 T8
135 P 1 Rep 4 T 7
136 P 1 Rep 2 T 5
137 P 1 Rep 3 T 3
138 P 2 Rep 3 T 9
139 P 4 Rep 4 T 4
140 P 3 Rep 2 T 1
Buffer planted with research planter
141 P 2 Rep 3 T 1
142 P 4 Rep 2 T 7
143 P 4 Rep 4 T 5
144 P 2 Rep 3 T 10
145 P 1 Rep 2 T 6
146 P 3 Rep 3 T 10
147 P 4 Rep 1 T 5
148 P 2 Rep 2 T 7
149 P 4 Rep 2 T 2
150 P 2 Rep 3 T 8
Buffer planted with research planter
151
152
153
154
155
156
157
158
159
160


P 1 Rep 4 T 4
P 3 Rep 3 T 8
P 3 Rep 4 T 8
P 2 Rep 3 T 5
P 4 Rep 3 T 9
P 2 Rep 1 T 5
P 3 Rep 3 T 5
P 3 Rep 1 T 8
P 3 Rep 3 T 6
P 4 Rep 4 T 10
Buffer Planted with tye seeder

Conservation Tillage of Pumpkins: Potential Advantages for West Virginia Producers[1]

Lewis W. Jett[2] and Tom Basden[3]
West Virginia University, 2102 Agriculture Building, Morgantown, WV 26506

Introduction:

Pumpkins (*Cucurbita pepo*) are grown in every county of West Virginia, often on sloping land. Pumpkins are a popular fall, ornamental vegetable direct marketed to consumers or sold "u-pick" to consumers as a part of fall agritourism. Pumpkins are often grown by plowing and disking the land several times before planting followed by 1-2 cultivations to control weeds before the vines close canopy. Often, most if not all of the fertilizer for the crop is applied at planting. Heavy rainfall can cause significant erosion of the topsoil as well as leaching of fertilizer nutrients into streams and ponds. Since most growers do not irrigate pumpkins, late summer drought often reduces pumpkin numbers and size. Weed competition is also a significantly limiting factor in pumpkin production since there are very few herbicides labeled for pumpkins.

Diseases such as powdery mildew which infects the leaves and stem of the pumpkin can significantly lower marketable quality and yields. Fruit rots (black rot, *Fusarium,* etc.,) can be a significant problem if wet weather occurs during late summer or fall.

Growing many agronomic crops by conservation tillage or no-till has been practiced for many years, while this practice has not been widely adopted for horticulture crops in the northeast U.S. A few progressive growers in the Mid-Atlantic region have been using no-till for production of crops such as tomatoes, cabbage, pumpkins and squash for several years with some success. However, no-till vegetable crop production has not been evaluated or demonstrated in West Virginia, and thus has not been adopted by growers.

West Virginia, with sloping terrain is a suitable place to evaluate the benefits of conservation tillage. With no-till production, a cover crop is seeded in the fall or spring. Cover crops provide many benefits such as erosion control, weed control, nutrient retention, early field access as well as keeping the fruit cleaner and more disease free (McClurg, et al., 2003). The following spring, the cover crop is mowed or rolled and the vegetable crop seeded or transplanted into the mulch. Strip tillage, in which a narrow strip within the cover crop is tilled with a rotary tiller, could be a suitable conservation tillage practice for pumpkins. The inter-row space remains untilled and provides residue for the pumpkins to vine. In addition, fertilizer can be applied to the tilled soil at planting or as a sidedress.

Conservation tillage does present some challenges to vegetable production such as the cooler soil temperatures which can affect seed germination. A wet growing season can delay planting significantly with conservation tillage. Establishment of the cover crop must be done the fall prior to the crop year. This can be difficult to accomplish if rainfall is limiting in the fall. The purpose of this project is to evaluate conservation tillage production of pumpkins in West Virginia.

[1]Research funded in part by WV Dept. of Agriculture Specialty Crop Block Grant.
[2]Commercial Horticulture Extension Specialist
[3]Nutrient Management Specialist
The authors wish to thank the USDA Plant Materials Center for assistance with this project.

Materials and Methods:

Grass/legume mixtures are often used for conservation tillage (SARE, 1998). The grass provides biomass and the legume fixes nitrogen for the subsequent crop. Rye (*Secale cereale*) and hairy vetch (*Vicia* sp.,) were drilled in a 150 ft x 150 ft plot at the USDA Plant Materials Center near Alderson, WV on September 10, 2009 (Figure 1). The soil at this site was a sandy loam with a pH of 6.0. The seeding rate for cereal rye was 90 lbs/acre and hairy vetch was seeded 20 lbs/acre rate. After seeding, a deer fence was placed around the plots to prevent browsing by wildlife in the fall and winter.

Figure 1. Rye/hairy vetch over crops were established in September at the USDA Plant Materials Center near Alderson, WV.

The following spring, the rye and vetch were either rolled with a 6 ft roller/crimper unit mounted on the front of a tractor or mowed with a bush hog rotary mower and strip tilled with a 5 ft tiller (Figs. 2, 3, 4).

Figure 2. A tractor-mounted, roller-crimper was used to mechanically kill the cover crop and prepare the site for seeding.

Figure 3. The rye/hairy vetch was rolled in late May 2010, approximately 3 weeks before seeding pumpkins.

Figure 4. The strip-tilled plots were mowed with a rotary mower and tilled with a rear-mounted tiller at the time of planting.

There was some survival of the hairy vetch in the rolled plots that required an additional application of *Glyphosate* herbicide prior to seeding (Figure 5)

Figure 5. Survival of hairy vetch after rolling.

Conventional tillage was evaluated by tilling a plot adjacent to the cover crop block. This plot had no cover crop established on it the previous year. On June 15, 2010,

pumpkins (cv. 'Gladiator') were hand-seeded into the plots. Two seeds were sown per hill. A bulb planter was used on the no-till block to make a planting hole approximately 1.5"deep. Within the strip tillage and conventional tillage plots, the pumpkins were hand-seeded by making a planting hole with a hoe. The pumpkins were spaced 4 feet between plants within the row and 8 feet between rows (Figure 6). Each tillage method had 4 rows (150 ft long) with four replications per tillage method. No fertilizer was applied at planting. At thinning, nitrogen applied as 42-0-0 was side-dressed to the plots at the rate of 50 lbs/acre, which is 50% of the recommended nitrogen rate for conventional tillage pumpkins.

Figure 6. The pumpkins were thinned to the most vigorous plant/hill.

After thinning, no weeding or irrigation was performed. No pesticides were applied. The 2010 growing season was above average for temperature and below average for rainfall. On October 25, the pumpkins were harvested For each tillage method, green and orange pumpkins were counted and weighed. Data were analyzed using Costat statistical software.

Results and Discussion:

The pumpkins growing in the no till system seemed to exhibit a slower growth rate during the first 1/3 of the growing season relative to the strip and conventional tillage pumpkins. However, these pumpkins did seem to compensate and catch up to growth observed with the other tillage methods. Weed growth was significantly reduced by the no till system (Figure 7). However, as mentioned previously, the hairy vetch which survived the rolling/crimping process had to be desiccated with an herbicide prior to planting. With strip tillage, the weeds did emerge, but fewer weeds were observed in the tilled area and more in the interrow space where the mulch had been chopped and moved by the rotary mower. Perhaps the effectiveness of the mulch is reduced by chopping re4lative to rolling. Conventional tilled plots had significant weed competition.

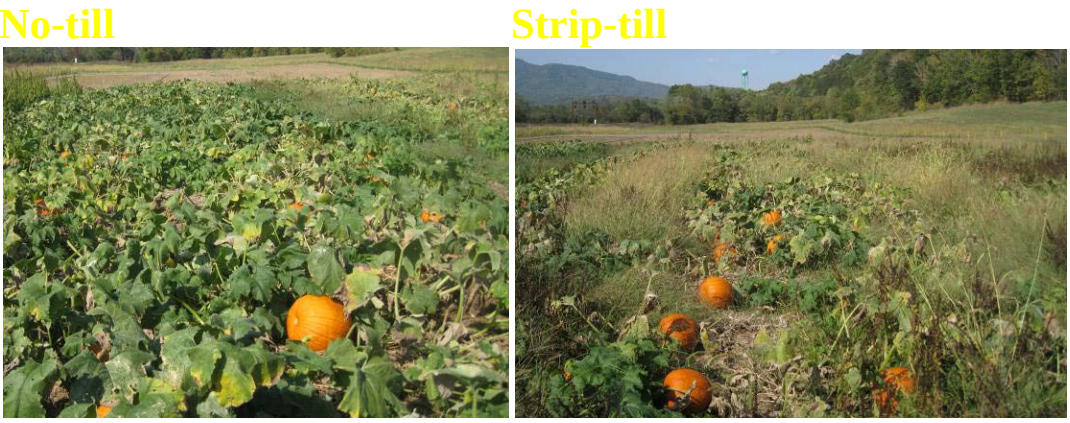


Figure 7. Weed growth in no till versus strip till pumpkin plots.

Strip till pumpkins had a significantly larger fruit set relative to no-till pumpkins (Table 1). However, the average fruit weight was significantly greater with no tillage resulting in a larger tonnage harvested per acre with fewer pumpkins. Whether by weight or fruit count, conservation tillage increased marketable yields by more than 50% relative to conventional tillage pumpkins. Pumpkins produced using the no till system were clean and ready to market (Figure 8). The strip tillage pumpkins were slightly dirtier and may require washing before marketing.

In 2009, a variety trial which included 'Gladiator' in a conventional tillage system, used recommended fertilizer rates (100 lbs N /acre) and pesticides (Jett, 2009). Yields from this evaluation were 1815 pumpkins per acre, 17 t/acre with an average weight of 19 lbs/pumpkin which are very equal to no-till yields received in 2010 under more stressful growing conditions and fewer inputs.

Further evaluation of conservation tillage must be conducted. Growers and extension personnel must be introduced to the system components. In 2010, a Cover Crop Field Day was conducted which demonstrated the rolling process (Figure 9). Replacing the hairy vetch legume with a shorter stature plant that is completely killed by rolling will improve the viability of the system.

Figure 8. No-till pumpkins were clean with excellent size and quality.

Table 1. Marketable yield of pumpkins grown in conservation versus conventional tillage.

Tillage method	Avg. wt/pumpkin (lbs)	Yield/acre (tons)	No./plant	No./acre
Conventional	12.0	7.7	0.9	1266
Strip Tillage	16.8	19.8	1.7	2363
No Tillage	21.3	18.9	1.3	1777
LSD $_{(0.05)}$[1]	*3.7*	*2.6*	*0.7*	*498*

[1]Means which differ by more than the LSD value are significantly different at P = 0.05.

Figure 8. A *Cover Crop Workshop* held in May, 2010 discussed cover crop choices and demonstrated the rolling/crimping process.

Literature Cited:

Jett, L. W. 2009. Pumpkin Cultivar Evaluations for West Virginia. *Midwest Vegetable Trial Report for 2009*. pp. 104-106.

McClurg, C.A., S. Reiners, D. Riggs and R. Rouse. 2003. Cultural Practices in Pumpkin Production Guide, NRAES Publication 123.

SARE. 1998. Managing cover crops profitably. 2nd ed., Sustainable Agriculture Network handbook series.

Cover Crop Training, Conservation Practice Standard Evaluation of New and Standard Cover Crop Varieties and 4 Separate Fall Planting Dates

Background

The NRCS in West Virginia assists farmers to reduce erosion, improve nutrient management, protect soil quality and encourages the use of integrated pest management on cropland. NRCS has committed technical and financial assistance for vegetable and producers to meet these goals thru the development of voluntary conservation plans and accelerated application using Farm Bill programs. A critical element of these plans is to insure correct timing and accepted methods of cover crop production to improve nutrient cycling, minimize the loss of nutrients to ground or surface water, and improve irrigation water management and soil quality. West Virginia University Extension Service has a long term commitment with NRCS, Conservation Districts and farmers to bring this type of research and technology to the agriculture community.

The Extension Service has historically assisted vegetable crop production, development of IPM for cropland, nutrient management for inclusion in the NRCS 590 standard, and has provided training to farmers on organic and sustainable crop production. This assistance and cooperation has resulted in a better understanding of farmer and agency needs to provide sound and coordinated vegetable production and resource management plans.

These new demonstrations at the Plant Materials Center in Alderson WV were established to evaluate and demonstrate the positive attributes of adding cover crops to cropping systems. The final products have been seasonal field trials of NRCS released cultivars and commercially available cover crops, publication of a technical report "Cover Crop Response to Late Season Planting and Nitrogen Application" and a third year of in-field training of NRCS and WVU staff based on results of the demonstrations.

Goals

The goal of this Demonstration and Evaluation project is to promote an understanding of cover crop plant species, proper planting dates, and how to incorporate these cover crops into a vegetable production system. This educational product can best be described as work force development. This project will improve the adoption of cover crop systems with vegetable producers in West Virginia and add these nutrient management, water quality and conservation practices to the WV NRCS conservation practice standards manual.

Methods

To evaluate the USDA NRCS Cover Crop Conservation Practice Standard a 2 year study was designed. Determination of the optimum planting date and most suitable cover crop species were the two questions we wanted to answer. We selected 10 cover crop species and or mixtures (small grains with winter annual legumes), including 1) Crimson Clover, 2) Crimson Clover/Aroostook Rye, 3) Purple Bounty (new hairy vetch release), 4) Purple Bounty/Aroos. Rye, 5) Common hairy vetch, 6) Common Vetch/Aroos. Rye, 7) Cover Crop Wheat, 8) Common Barley, 9) Purple Bounty/Common Barley and 10) Aroos. Rye. We planted these ten treatments in fall 2009. In April, 2010

ground cover determinations were conducted. The plots were rated for % ground cover of the cover crop, % weed cover and the wetness of the plots (low spots). The cover crop plots were allowed to reach close to maturity and on May 27th all treatments were rolled with the roller crimper. The plot was not uniformly dead so herbicide was applied on June 16th. On June 22 the plots were planted to a single row of corn, approximately 6 lbs seed, Southern States 791 CL a 117 day field corn. Two buffer rows on the outer edges to remove edge effect. When the corn was 12-16 inches in height soil samples were pulled from each treatment plot. Sample depth was 12 inches and 4 samples were taken from each plot. The soils were placed in coolers on ice and were prepared, dried and analyzed by Nitrate N using the Cardi nitrate ion meter. Using the Penn State Agronomy Guide website a side dress nitrogen recommendation was determined for 120 Bu/Acre corn. August 12 we side-dressed the corn plants in each plot with the recommended nitrogen using urea as a source. At the time of side-dressing the plots were rated for corn vigor, weed cover, volunteer cover, species (cover crop). Corn plots were harvested October 21, 119 days after planting, the ears were collected and placed in bags to dry down. Four corn stalks were harvested from each plot, placed in coolers with ice and taken to Morgantown to the drying ovens. The corn ears will be shelled and plot yield determined. The corn stalks are dried and will be ground and nitrate N concentration will be determined. These steps will be repeated next year to collect two data sets for this low input corn production/cover crop system.

APPENDIX 2.

Stones River National Battlefield Technology Products

Protocol Information

USDA NRCS - Appalachian Plant Materials Center
P. O. Box 390
Alderson, West Virginia 24910
304-445-3005
304-445-7049
John.Vandevender@wv.usda.gov

United States Department of Agriculture
Natural Resources Conservation Service

Family Scientific Name:	**Cyperaceae**
Family Common Name:	**sedges**
Scientific Name:	***Carex amphibola* Steud.**
Common Name:	**eastern narrowleaf sedge**
Species Code:	**CAAM8**
Ecotype:	**Stones River**
Known Invasiveness:	**none**
Propagation Goal:	**Plants**
Propagation Method:	**Seed**
Product Type:	**Container (plug)**
Stock Type:	**1+0 container plug**
Time To Grow:	**6 Months**
Target Specifications:	**A well developed plant suitable for mechanical transplanting that has at least 6 inches of top growth and a dense, fibrous root system.**
Propagule Collection:	**Seed of Stones River source eastern narrowleaf sedge was hand harvested from existing populations within the confines of Stones River National Battlefield.**
Pre-Planting Treatments:	**Seed is planted into round cell greenhouse flat liners with 38 cells per flat that have been filled with coarse processed bark and composted pine bark growing medium. Seed is surface sown at a rate of 3-5 seeds per cell and lightly covered with starter sized, 1/16" - 1/8" diameter, granite poultry grit to combat damping off diseases. Prepared flats are lightly hand watered to slightly moisten the growing medium and cold stratified at 35 degrees Fahrenheit for a minimum of 30 days.**
Growing Area Preparation/ Annual Practices for Perennial Crops:	**Stratified seed is placed in a greenhouse maintained under natural lighting and at a minimum temperature of 70 degrees**

	Fahrenheit. Soil moisture is maintained during germination by bottom watering. Flats are placed in shallow trays that permit water levels around the flats to be maintained at approximately a one inch depth.
Establishment Phase:	**Germination typically occurs 10- 14 days after placement in the greenhouse.**
Length of Establishment Phase:	**10-14 days**
Active Growth Phase:	**After germination, seedlings are maintained in a greenhouse environment 4-6 months to promote development of a plug with at least 6 inches of top growth and a dense, fibrous root system suitable for mechanical transplanting. Watering is reduced to overhead hand watering once daily. Seedlings receive a water soluble complete fertilizer bi-weekly until hardening.**
Length of Active Growth Phase:	**4-6 months**
Hardening Phase:	**Acclimation is typically accomplished through placement of seedlings outdoors in a protected location for a 2-4 week period prior to transplanting.**
Length of Hardening Phase:	**2-4 weeks**
Outplanting performance on typical sites:	**To establish seed production fields, plugs are mechanically transplanted into a conventionally tilled seedbed. Rows are typically spaced 40 inches apart. Spacing between plugs within rows is 12 inches. Once transplanting is completed, at least 1 inch of irrigation water is applied to enhance root-soil contact and stimulate plant growth.**
References:	**USDA, NRCS. 2010. The PLANTS Database (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.**

Citation:

Vandevender, John 2010. Propagation protocol for production of container *Carex amphibola* Steud. plants (1+0 container plug); USDA NRCS - Appalachian Plant Materials Center, Alderson, West Virginia. In: Native Plant Network. URL: http://www.nativeplantnetwork.org (accessed 5 August 2010). Moscow (ID): University of Idaho, College of Natural Resources, Forest Research Nursery.

Protocol Information

USDA NRCS - Appalachian Plant Materials Center
P. O. Box 390
Alderson, West Virginia 24910
304-445-3005
304-445-7049
John.Vandevender@wv.usda.gov

United States Department of Agriculture
Natural Resources Conservation Service

Family Scientific Name:	**Cyperaceae**
Family Common Name:	**sedges**
Scientific Name:	***Carex blanda* Dewey**
Common Name:	**eastern woodland sedge**
Species Code:	**CABL**
Ecotype:	**Stones River**
Known Invasiveness:	**none**
Propagation Goal:	**Plants**
Propagation Method:	**Seed**
Product Type:	**Container (plug)**
Stock Type:	**1+0 container plug**
Time To Grow:	**6 Months**
Target Specifications:	**A well developed plant suitable for mechanical transplanting that has at least 6 inches of top growth and a dense, fibrous root system.**
Propagule Collection:	**Seed of Stones River source eastern woodland sedge was hand harvested from existing populations within the confines of Stones River National Battlefield.**
Pre-Planting Treatments:	**Seed is planted into round cell greenhouse flat liners with 38 cells per flat that have been filled with coarse processed bark and composted pine bark growing medium. Seed is surface sown at a rate of 3-5 seeds per cell and lightly covered with starter sized, 1/16" - 1/8" diameter, granite poultry grit to combat damping off diseases. Prepared flats are lightly hand watered to slightly moisten the growing medium and cold stratified at 35 degrees Fahrenheit for a minimum of 30 days.**
Growing Area Preparation/ Annual Practices for Perennial Crops:	**Stratified seed is placed in a greenhouse maintained under natural lighting and at a minimum temperature of 70 degrees Fahrenheit. Soil moisture is maintained during germination by bottom watering. Flats are placed in shallow trays that permit water levels around the flats to be maintained at approximately a one inch depth.**
Establishment Phase:	**Germination typically occurs 10- 14 days after placement in the greenhouse.**

Length of Establishment Phase:	**10-14 days**
Active Growth Phase:	**After germination, seedlings are maintained in a greenhouse environment 4-6 months to promote development of a plug with at least 6 inches of top growth and a dense, fibrous root system suitable for mechanical transplanting. Watering is reduced to overhead hand watering once daily. Seedlings receive a water soluble complete fertilizer bi-weekly until hardening.**
Length of Active Growth Phase:	**4-6 months**
Hardening Phase:	**Acclimation is typically accomplished through placement of seedlings outdoors in a protected location for a 2-4 week period prior to transplanting.**
Length of Hardening Phase:	**2-4 weeks**
Outplanting performance on typical sites:	**To establish seed production fields, plugs are mechanically transplanted into a conventionally tilled seedbed. Rows are typically spaced 40 inches apart. Spacing between plugs within rows is 12 inches. Once transplanting is completed, at least 1 inch of irrigation water is applied to enhance root-soil contact and stimulate plant growth.**
References:	**USDA, NRCS. 2010. The PLANTS Database (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.**

Citation:

Vandevender, John 2010. Propagation protocol for production of container *Carex blanda* Dewey plants (1+0 container plug); USDA NRCS - Appalachian Plant Materials Center, Alderson, West Virginia. In: Native Plant Network. URL: http://www.nativeplantnetwork.org (accessed 5 August 2010). Moscow (ID): University of Idaho, College of Natural Resources, Forest Research Nursery.

Protocol Information

USDA NRCS - Appalachian Plant Materials Center
P. O. Box 390
Alderson, West Virginia 24910
304-445-3005
304-445-7049
John.Vandevender@wv.usda.gov

United States Department of Agriculture
Natural Resources Conservation Service

Family Scientific Name:	**Cyperaceae**
Family Common Name:	**sedges**
Scientific Name:	***Carex cherokeensis* Schwein**
Common Name:	**Cherokee sedge**
Species Code:	**CACH3**
Ecotype:	**Stones River**
Known Invasiveness:	**none**
Propagation Goal:	**Plants**
Propagation Method:	**Seed**
Product Type:	**Container (plug)**
Stock Type:	**1+0 container plug**
Time To Grow:	**6 Months**
Target Specifications:	**A well developed plant suitable for mechanical transplanting that has at least 6 inches of top growth and a dense, fibrous root system.**
Propagule Collection:	**Seed of Stones River source Cherokee sedge was hand harvested from existing populations within the confines of Stones River National Battlefield.**
Pre-Planting Treatments:	**Seed is planted into round cell greenhouse flat liners with 38 cells per flat that have been filled with coarse processed bark and composted pine bark growing medium. Seed is surface sown at a rate of 3-5 seeds per cell and lightly covered with starter sized, 1/16" - 1/8" diameter, granite poultry grit to combat damping off diseases. Prepared flats are lightly hand watered to slightly moisten the growing medium and cold stratified at 35 degrees Fahrenheit for a minimum of 30 days.**
Growing Area Preparation/ Annual Practices for Perennial Crops:	**Stratified seed is placed in a greenhouse maintained under natural lighting and at a minimum temperature of 70 degrees Fahrenheit. Soil moisture is maintained during germination by bottom watering. Flats are placed in shallow trays that permit water levels around the flats to be maintained at approximately a one inch depth.**
Establishment Phase:	**Germination typically occurs 10- 14 days after placement in the greenhouse.**

Length of Establishment Phase:	**10-14 days**
Active Growth Phase:	**After germination, flats are removed from the trays of water and placed on greenhouse benches. Seedlings are maintained in a greenhouse environment 4-6 months to promote development of a plug with at least 6 inches of top growth and a dense, fibrous root system suitable for mechanical transplanting. Watering is reduced to overhead hand watering once daily. Seedlings receive a water soluble complete fertilizer bi-weekly until hardening.**
Length of Active Growth Phase:	**4-6 months**
Hardening Phase:	**Acclimation is typically accomplished through placement of seedlings outdoors in a protected location for a 2-4 week period prior to transplanting.**
Length of Hardening Phase:	**2-4 weeks**
Outplanting performance on typical sites:	**To establish seed production fields, plugs are mechanically transplanted into a conventionally tilled seedbed. Rows are typically spaced 40 inches apart. Spacing between plugs within rows is 12 inches. Once transplanting is completed, at least 1 inch of irrigation water is applied to enhance root-soil contact and stimulate plant growth.**
References:	**USDA, NRCS. 2010. The PLANTS Database (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.**

Citation:

Vandevender, John 2010. Propagation protocol for production of container *Carex cherokeensis* Schwein plants (1+0 container plug); USDA NRCS - Appalachian Plant Materials Center, Alderson, West Virginia. In: Native Plant Network. URL: http://www.nativeplantnetwork.org (accessed 5 August 2010). Moscow (ID): University of Idaho, College of Natural Resources, Forest Research Nursery.

Protocol Information

USDA NRCS - Appalachian Plant Materials Center
P. O. Box 390
Alderson, West Virginia 24910
304-445-3005
304-445-7049
John.Vandevender@wv.usda.gov

United States Department of Agriculture
Natural Resources Conservation Service

Family Scientific Name:	**Cyperaceae**
Family Common Name:	**sedges**
Scientific Name:	***Carex oxylepis* Torr. & Hook.**
Common Name:	**sharpscale sedge**
Species Code:	**CAOX**
Ecotype:	**Stones River**
Known Invasiveness:	**None**
Propagation Goal:	**Plants**
Propagation Method:	**Seed**
Product Type:	**Container (plug)**
Stock Type:	**1+0 container plug**
Time To Grow:	**6 Months**
Target Specifications:	**A well developed plant suitable for mechanical transplanting that has at least 6 inches of top growth and a dense, fibrous root system.**
Propagule Collection:	**Seed of Stones River source sharpscale sedge was hand harvested from existing populations within the confines of Stones River National Battlefield.**
Pre-Planting Treatments:	**Seed is planted into round cell greenhouse flat liners with 38 cells per flat that have been filled with coarse processed bark and composted pine bark growing medium. Seed is surface sown at a rate of 3-5 seeds per cell and lightly covered with starter sized, 1/16" - 1/8" diameter, granite poultry grit to combat damping off diseases. Prepared flats are lightly hand watered to slightly moisten the growing medium and cold stratified at 35 degrees Fahrenheit for a minimum of 30 days.**
Growing Area Preparation/ Annual Practices for Perennial Crops:	**Stratified seed is placed in a greenhouse maintained under natural lighting and at a minimum temperature of 70 degrees Fahrenheit. Soil moisture is maintained during germination by bottom watering. Flats are placed in shallow trays that permit water levels around the flats to be maintained at approximately a one inch depth.**
Establishment Phase:	**Germination typically occurs 10- 14 days after placement in the greenhouse.**

Length of Establishment Phase:	**10-14 days**
Active Growth Phase:	**After germination, flats are removed from the trays of water and placed on greenhouse benches. Seedlings are maintained in a greenhouse environment 4-6 months to promote development of a plug with at least 6 inches of top growth and a dense, fibrous root system suitable for mechanical transplanting. Watering is reduced to overhead hand watering once daily. Seedlings receive a water soluble complete fertilizer bi-weekly until hardening.**
Length of Active Growth Phase:	**4-6 months**
Hardening Phase:	**Acclimation is typically accomplished through placement of seedlings outdoors in a protected location for a 2-4 week period prior to transplanting.**
Length of Hardening Phase:	**2-4 weeks**
Outplanting performance on typical sites:	**To establish seed production fields, plugs are mechanically transplanted into a conventionally tilled seedbed. Rows are typically spaced 40 inches apart. Spacing between plugs within rows is 12 inches. Once transplanting is completed, at least 1 inch of irrigation water is applied to enhance root-soil contact and stimulate plant growth.**
References:	**USDA, NRCS. 2010. The PLANTS Database (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.**

Citation:

Vandevender, John 2010. Propagation protocol for production of container *Carex oxylepis* Torr. & Hook. plants (1+0 container plug); USDA NRCS - Appalachian Plant Materials Center, Alderson, West Virginia. In: Native Plant Network. URL: http://www.nativeplantnetwork.org (accessed 5 August 2010). Moscow (ID): University of Idaho, College of Natural Resources, Forest Research Nursery.

Protocol Information

USDA NRCS - Appalachian Plant Materials Center
P. O. Box 390
Alderson, West Virginia 24910
304-445-3005
304-445-7049
John.Vandevender@wv.usda.gov

United States Department of Agriculture
Natural Resources Conservation Service

Family Scientific Name:	**Poaceae**
Family Common Name:	**Grass**
Scientific Name:	***Dichanthelium acuminatum* (Sw.) Gould & C. A. Clark**
Common Name:	**tapered rosette grass**
Species Code:	**DIAC2**
Ecotype:	**Stones River**
Known Invasiveness:	**none**
Propagation Goal:	**Plants**
Propagation Method:	**Seed**
Product Type:	**Container (plug)**
Stock Type:	**1+0 container plug**
Time To Grow:	**6 Months**
Target Specifications:	**A well developed plant suitable for mechanical transplanting that has at least 6 inches of top growth and a dense, fibrous root system.**
Propagule Collection:	**Seed of Stones River source tapered rosette grass was hand harvested from the primary (spring) flowering heads from existing populations within the confines of Stones River National Battlefield.**
Pre-Planting Treatments:	**Conditioned seed is planted into round cell greenhouse flat liners with 38 cells per flat that have been filled with coarse processed bark and composted pine bark growing medium. Seed is surface sown at a rate of 3-5 seeds per cell and lightly covered with starter sized, 1/16" - 1/8" diameter, granite poultry grit to combat damping off diseases. Prepared flats are lightly hand watered to slightly moisten the growing medium.**
Growing Area Preparation/ Annual Practices for Perennial Crops:	**Stratified seed is placed in a greenhouse maintained under natural lighting and at a minimum temperature of 70 degrees Fahrenheit. Soil moisture is maintained during germination by an automatic overhead watering system set to cycle for 20 seconds every thirty minutes during daylight hours.**
Establishment Phase:	**Germination typically occurs 7 - 10 days after placement in the greenhouse.**

Length of Establishment Phase:	**7-10 days**
Active Growth Phase:	**After germination, seedlings are maintained in a greenhouse environment 2-4 months to promote development of a plug with at least 6 inches of top growth and a dense, fibrous root system suitable for mechanical transplanting. Watering is reduced to overhead hand watering once daily. Seedlings receive a water soluble complete fertilizer bi-weekly until hardening.**
Length of Active Growth Phase:	**2-4 months**
Hardening Phase:	**Acclimation is typically accomplished through placement of seedlings outdoors in a protected location for a 1-2 week period prior to transplanting.**
Length of Hardening Phase:	**1-2 weeks**
Outplanting performance on typical sites:	**To establish seed production fields, plugs are mechanically transplanted into a conventionally tilled seedbed. Rows are typically spaced 40 inches apart. Spacing between plugs within rows is 12 inches. Once transplanting is completed, at least 1 inch of irrigation water is applied to enhance root-soil contact and stimulate plant growth.**
Other Comments:	**Dicnantheliums are characterized by two distinct blooming periods. The conspicuous primary flowering heads are terminal to the culms and are produced in late spring and early summer. Secondary flowering heads are produced from the leaf axils beginning in mid-summer and continuing into early autumn. The primary flowering heads usually have a lower seedset than the secondary ones, which have flowers that remain closed and are self pollinated. However, seed produced by the primary flowers appears to germinate more readily than seed from the secondary flowers.**
References:	**USDA, NRCS. 2010. The PLANTS Database (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.**

Citation:

Vandevender, John 2010. Propagation protocol for production of container *Dichanthelium acuminatum* (Sw.) Gould & C. A. Clark plants (1+0 container plug); USDA NRCS - Appalachian Plant Materials Center, Alderson, West Virginia. In: Native Plant Network. URL: http://www.nativeplantnetwork.org (accessed 5 August 2010). Moscow (ID): University of Idaho, College of Natural Resources, Forest Research Nursery.

Protocol Information

USDA NRCS - Appalachian Plant Materials Center
P. O. Box 390
Alderson, West Virginia 24910
304-445-3005
304-445-7049
John.Vandevender@wv.usda.gov

United States Department of Agriculture
Natural Resources Conservation Service

Family Scientific Name:	**Poaceae**
Family Common Name:	**Grass**
Scientific Name:	***Dichanthelium commutatum* (Schult.) Gould**
Common Name:	**variable panicgrass**
Species Code:	**DICO2**
Ecotype:	**Stones River**
Known Invasiveness:	**none**
Propagation Goal:	**Plants**
Propagation Method:	**Seed**
Product Type:	**Container (plug)**
Stock Type:	**1+0 container plug**
Time To Grow:	**6 Months**
Target Specifications:	**A well developed plant suitable for mechanical transplanting that has at least 6 inches of top growth and a dense, fibrous root system.**
Propagule Collection:	**Seed of Stones River source variable panicgrass was hand harvested from the primary (spring) flowering heads from existing populations within the confines of Stones River National Battlefield.**
Pre-Planting Treatments:	**De-tufted seed is planted into round cell greenhouse flat liners with 38 cells per flat that have been filled with coarse processed bark and composted pine bark growing medium. Seed is surface sown at a rate of 3-5 seeds per cell and lightly covered with starter sized, 1/16" - 1/8" diameter, granite poultry grit to combat damping off diseases. Prepared flats are lightly hand watered to slightly moisten the growing medium.**
Growing Area Preparation/ Annual Practices for Perennial Crops:	**Stratified seed is placed in a greenhouse maintained under natural lighting and at a minimum temperature of 70 degrees Fahrenheit. Soil moisture is maintained during germination by an automatic overhead watering system set to cycle for 20 seconds every thirty minutes during daylight hours.**
Establishment Phase:	**Germination typically occurs 7 - 10 days after placement in the greenhouse.**

Length of Establishment Phase:	**7-10 days**
Active Growth Phase:	**After germination, seedlings are maintained in a greenhouse environment 2-4 months to promote development of a plug with at least 6 inches of top growth and a dense, fibrous root system suitable for mechanical transplanting. Watering is reduced to overhead hand watering once daily. Seedlings receive a water soluble complete fertilizer bi-weekly until hardening.**
Length of Active Growth Phase:	**2-4 months**
Hardening Phase:	**Acclimation is typically accomplished through placement of seedlings outdoors in a protected location for a 1-2 week period prior to transplanting.**
Length of Hardening Phase:	**1-2 weeks**
Outplanting performance on typical sites:	**To establish seed production fields, plugs are mechanically transplanted into a conventionally tilled seedbed. Rows are typically spaced 40 inches apart. Spacing between plugs within rows is 12 inches. Once transplanting is completed, at least 1 inch of irrigation water is applied to enhance root-soil contact and stimulate plant growth.**
Other Comments:	**Dicnantheliums are characterized by two distinct blooming periods. The conspicuous primary flowering heads are terminal to the culms and are produced in late spring and early summer. Secondary flowering heads are produced from the leaf axils beginning in mid-summer and continuing into early autumn. The primary flowering heads usually have a lower seedset than the secondary ones, which have flowers that remain closed and are self pollinated. However, seed produced by the primary flowers appears to germinate more readily than seed from the secondary flowers.**
References:	**USDA, NRCS. 2010. The PLANTS Database (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.**

Citation:

Vandevender, John 2010. Propagation protocol for production of container *Dichanthelium commutatum* (Schult.) Gould plants (1+0 container plug); USDA NRCS - Appalachian Plant Materials Center, Alderson, West Virginia. In: Native Plant Network. URL: http://www.nativeplantnetwork.org (accessed 5 August 2010). Moscow (ID): University of Idaho, College of Natural Resources, Forest Research Nursery.

Protocol Information

USDA NRCS - Appalachian Plant Materials Center
P. O. Box 390
Alderson, West Virginia 24910
304-445-3005
304-445-7049
John.Vandevender@wv.usda.gov

United States Department of Agriculture
Natural Resources Conservation Service

Family Scientific Name:	**Poaceae**
Family Common Name:	**Grass**
Scientific Name:	***Dichanthelium dichotomum* (L.) Gould**
Common Name:	**cypress panicgrass**
Species Code:	**DIDI6**
Ecotype:	**Stones River**
Known Invasiveness:	**none**
Propagation Goal:	**Plants**
Propagation Method:	**Seed**
Product Type:	**Container (plug)**
Stock Type:	**1+0 container plug**
Time To Grow:	**6 Months**
Target Specifications:	**A well developed plant suitable for mechanical transplanting that has at least 6 inches of top growth and a dense, fibrous root system.**
Propagule Collection:	**Seed of Stones River source cypress panicgrass was hand harvested from the primary (spring) flowering heads from existing populations within the confines of Stones River National Battlefield.**
Pre-Planting Treatments:	**De-tufted seed is planted into round cell greenhouse flat liners with 38 cells per flat that have been filled with coarse processed bark and composted pine bark growing medium. Seed is surface sown at a rate of 3-5 seeds per cell and lightly covered with starter sized, 1/16" - 1/8" diameter, granite poultry grit to combat damping off diseases. Prepared flats are lightly hand watered to slightly moisten the growing medium.**
Growing Area Preparation/ Annual Practices for Perennial Crops:	**Stratified seed is placed in a greenhouse maintained under natural lighting and at a minimum temperature of 70 degrees Fahrenheit. Soil moisture is maintained during germination by an automatic overhead watering system set to cycle for 20 seconds every thirty minutes during daylight hours.**
Establishment Phase:	**Germination typically occurs 7 - 10 days after placement in the greenhouse.**

Length of Establishment Phase:	**7-10 days**
Active Growth Phase:	**After germination, seedlings are maintained in a greenhouse environment 2-4 months to promote development of a plug with at least 6 inches of top growth and a dense, fibrous root system suitable for mechanical transplanting. Watering is reduced to overhead hand watering once daily. Seedlings receive a water soluble complete fertilizer bi-weekly until hardening.**
Length of Active Growth Phase:	**2-4 months**
Hardening Phase:	**Acclimation is typically accomplished through placement of seedlings outdoors in a protected location for a 1-2 week period prior to transplanting.**
Length of Hardening Phase:	**1-2 weeks**
Outplanting performance on typical sites:	**To establish seed production fields, plugs are mechanically transplanted into a conventionally tilled seedbed. Rows are typically spaced 40 inches apart. Spacing between plugs within rows is 12 inches. Once transplanting is completed, at least 1 inch of irrigation water is applied to enhance root-soil contact and stimulate plant growth.**
Other Comments:	**Dicnantheliums are characterized by two distinct blooming periods. The conspicuous primary flowering heads are terminal to the culms and are produced in late spring and early summer. Secondary flowering heads are produced from the leaf axils beginning in mid-summer and continuing into early autumn. The primary flowering heads usually have a lower seedset than the secondary ones, which have flowers that remain closed and are self pollinated. However, seed produced by the primary flowers appears to germinate more readily than seed from the secondary flowers.**
References:	**USDA, NRCS. 2010. The PLANTS Database (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.**

Citation:

Vandevender, John 2010. Propagation protocol for production of container *Dichanthelium dichotomum* (L.) Gould plants (1+0 container plug); USDA NRCS - Appalachian Plant Materials Center, Alderson, West Virginia. In: Native Plant Network. URL: http://www.nativeplantnetwork.org (accessed 5 August 2010). Moscow (ID): University of Idaho, College of Natural Resources, Forest Research Nursery.

Protocol Information

USDA NRCS - Appalachian Plant Materials Center
P. O. Box 390
Alderson, West Virginia 24910
304-445-3005
304-445-7049
John.Vandevender@wv.usda.gov

United States Department of Agriculture
Natural Resources Conservation Service

Family Scientific Name:	**Poaceae**
Family Common Name:	**Grass**
Scientific Name:	***Dichanthelium laxiflorum* (Lam.) Gould**
Common Name:	**openflower rosette grass**
Species Code:	**DILA9**
Ecotype:	**Stones River**
Known Invasiveness:	**none**
Propagation Goal:	**Plants**
Propagation Method:	**Seed**
Product Type:	**Container (plug)**
Stock Type:	**1+0 container plug**
Time To Grow:	**6 Months**
Target Specifications:	**A well developed plant suitable for mechanical transplanting that has at least 6 inches of top growth and a dense, fibrous root system.**
Propagule Collection:	**Seed of Stones River source openflower rosette grass was hand harvested from the primary (spring) flowering heads from existing populations within the confines of Stones River National Battlefield.**
Pre-Planting Treatments:	**De-tufted seed is planted into round cell greenhouse flat liners with 38 cells per flat that have been filled with coarse processed bark and composted pine bark growing medium. Seed is surface sown at a rate of 3-5 seeds per cell and lightly covered with starter sized, 1/16" - 1/8" diameter, granite poultry grit to combat damping off diseases. Prepared flats are lightly hand watered to slightly moisten the growing medium.**
Growing Area Preparation/ Annual Practices for Perennial Crops:	**Stratified seed is placed in a greenhouse maintained under natural lighting and at a minimum temperature of 70 degrees Fahrenheit. Soil moisture is maintained during germination by an automatic overhead watering system set to cycle for 20 seconds every thirty minutes during daylight hours.**
Establishment Phase:	**Germination typically occurs 7 - 10 days after placement in the greenhouse.**

Length of Establishment Phase:	**7-10 days**
Active Growth Phase:	**After germination, seedlings are maintained in a greenhouse environment 2-4 months to promote development of a plug with at least 6 inches of top growth and a dense, fibrous root system suitable for mechanical transplanting. Watering is reduced to overhead hand watering once daily. Seedlings receive a water soluble complete fertilizer bi-weekly until hardening.**
Length of Active Growth Phase:	**2-4 months**
Hardening Phase:	**Acclimation is typically accomplished through placement of seedlings outdoors in a protected location for a 1-2 week period prior to transplanting.**
Length of Hardening Phase:	**1-2 weeks**
Outplanting performance on typical sites:	**To establish seed production fields, plugs are mechanically transplanted into a conventionally tilled seedbed. Rows are typically spaced 40 inches apart. Spacing between plugs within rows is 12 inches. Once transplanting is completed, at least 1 inch of irrigation water is applied to enhance root-soil contact and stimulate plant growth.**
Other Comments:	**Dicnantheliums are characterized by two distinct blooming periods. The conspicuous primary flowering heads are terminal to the culms and are produced in late spring and early summer. Secondary flowering heads are produced from the leaf axils beginning in mid-summer and continuing into early autumn. The primary flowering heads usually have a lower seedset than the secondary ones, which have flowers that remain closed and are self pollinated. However, seed produced by the primary flowers appears to germinate more readily than seed from the secondary flowers.**
References:	**USDA, NRCS. 2010. The PLANTS Database (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.**

Citation:

Vandevender, John 2010. Propagation protocol for production of container *Dichanthelium laxiflorum* (Lam.) Gould plants (1+0 container plug); USDA NRCS - Appalachian Plant Materials Center, Alderson, West Virginia. In: Native Plant Network. URL: http://www.nativeplantnetwork.org (accessed 5 August 2010). Moscow (ID): University of Idaho, College of Natural Resources, Forest Research Nursery.

Protocol Information

USDA NRCS - Appalachian Plant Materials Center
P. O. Box 390
Alderson, West Virginia 24910
304-445-3005
304-445-7049
John.Vandevender@wv.usda.gov

United States Department of Agriculture
Natural Resources Conservation Service

Family Scientific Name:	**Poaceae**
Family Common Name:	**Grass**
Scientific Name:	***Dichanthelium malacophyllum* (Nash) Gould**
Common Name:	**softleaf rosette grass**
Species Code:	**DIMA5**
Ecotype:	**Stones River**
Known Invasiveness:	**none**
Propagation Goal:	**Plants**
Propagation Method:	**Seed**
Product Type:	**Container (plug)**
Stock Type:	**1+0 container plug**
Time To Grow:	**6 Months**
Target Specifications:	**A well developed plant suitable for mechanical transplanting that has at least 6 inches of top growth and a dense, fibrous root system.**
Propagule Collection:	**Seed of Stones River source softleaf rosette grass was hand harvested from the primary (spring) flowering heads from existing populations within the confines of Stones River National Battlefield.**
Pre-Planting Treatments:	**De-tufted seed is planted into round cell greenhouse flat liners with 38 cells per flat that have been filled with coarse processed bark and composted pine bark growing medium. Seed is surface sown at a rate of 3-5 seeds per cell and lightly covered with starter sized, 1/16" - 1/8" diameter, granite poultry grit to combat damping off diseases. Prepared flats are lightly hand watered to slightly moisten the growing medium.**
Growing Area Preparation/ Annual Practices for Perennial Crops:	**Stratified seed is placed in a greenhouse maintained under natural lighting and at a minimum temperature of 70 degrees Fahrenheit. Soil moisture is maintained during germination by an automatic overhead watering system set to cycle for 20 seconds every thirty minutes during daylight hours.**
Establishment Phase:	**Germination typically occurs 7 - 10 days after placement in the greenhouse.**

Length of Establishment Phase:	**7-10 days**
Active Growth Phase:	**After germination, seedlings are maintained in a greenhouse environment 2-4 months to promote development of a plug with at least 6 inches of top growth and a dense, fibrous root system suitable for mechanical transplanting. Watering is reduced to overhead hand watering once daily. Seedlings receive a water soluble complete fertilizer bi-weekly until hardening.**
Length of Active Growth Phase:	**2-4 months**
Hardening Phase:	**Acclimation is typically accomplished through placement of seedlings outdoors in a protected location for a 1-2 week period prior to transplanting.**
Length of Hardening Phase:	**1-2 weeks**
Outplanting performance on typical sites:	**To establish seed production fields, plugs are mechanically transplanted into a conventionally tilled seedbed. Rows are typically spaced 40 inches apart. Spacing between plugs within rows is 12 inches. Once transplanting is completed, at least 1 inch of irrigation water is applied to enhance root-soil contact and stimulate plant growth.**
Other Comments:	**Dicnantheliums are characterized by two distinct blooming periods. The conspicuous primary flowering heads are terminal to the culms and are produced in late spring and early summer. Secondary flowering heads are produced from the leaf axils beginning in mid-summer and continuing into early autumn. The primary flowering heads usually have a lower seedset than the secondary ones, which have flowers that remain closed and are self pollinated. However, seed produced by the primary flowers appears to germinate more readily than seed from the secondary flowers.**
References:	**USDA, NRCS. 2010. The PLANTS Database (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.**

Citation:

Vandevender, John 2010. Propagation protocol for production of container *Dichanthelium malacophyllum* (Nash) Gould plants (1+0 container plug); USDA NRCS - Appalachian Plant Materials Center, Alderson, West Virginia. In: Native Plant Network. URL: http://www.nativeplantnetwork.org (accessed 5 August 2010). Moscow (ID): University of Idaho, College of Natural Resources, Forest Research Nursery.

Protocol Information

USDA NRCS - Appalachian Plant Materials Center
P. O. Box 390
Alderson, West Virginia 24910
304-445-3005
304-445-7049
John.Vandevender@wv.usda.gov

United States Department of Agriculture
Natural Resources Conservation Service

Family Scientific Name:	**Poaceae**
Family Common Name:	**Grass**
Scientific Name:	***Dichanthelium villosissmum*** **(Nash) Freckmann**
Common Name:	**whitehair rosette grass**
Species Code:	**DIVI7**
Ecotype:	**Stones River**
Known Invasiveness:	**none**
Propagation Goal:	**Plants**
Propagation Method:	**Seed**
Product Type:	**Container (plug)**
Stock Type:	**1+0 container plug**
Time To Grow:	**6 Months**
Target Specifications:	**A well developed plant suitable for mechanical transplanting that has at least 6 inches of top growth and a dense, fibrous root system.**
Propagule Collection:	**Seed of Stones River source whitehair rosette grass was hand harvested from the primary (spring) flowering heads from existing populations within the confines of Stones River National Battlefield.**
Pre-Planting Treatments:	**De-tufted seed is planted into round cell greenhouse flat liners with 38 cells per flat that have been filled with coarse processed bark and composted pine bark growing medium. Seed is surface sown at a rate of 3-5 seeds per cell and lightly covered with starter sized, 1/16" - 1/8" diameter, granite poultry grit to combat damping off diseases. Prepared flats are lightly hand watered to slightly moisten the growing medium.**
Growing Area Preparation/ Annual Practices for Perennial Crops:	**Stratified seed is placed in a greenhouse maintained under natural lighting and at a minimum temperature of 70 degrees Fahrenheit. Soil moisture is maintained during germination by an automatic overhead watering system set to cycle for 20 seconds every thirty minutes during daylight hours.**
Establishment Phase:	**Germination typically occurs 7 - 10 days after placement in the greenhouse.**

Length of Establishment Phase:	**7-10 days**
Active Growth Phase:	**After germination, seedlings are maintained in a greenhouse environment 2-4 months to promote development of a plug with at least 6 inches of top growth and a dense, fibrous root system suitable for mechanical transplanting. Watering is reduced to overhead hand watering once daily. Seedlings receive a water soluble complete fertilizer bi-weekly until hardening.**
Length of Active Growth Phase:	**2-4 months**
Hardening Phase:	**Acclimation is typically accomplished through placement of seedlings outdoors in a protected location for a 1-2 week period prior to transplanting.**
Length of Hardening Phase:	**1-2 weeks**
Outplanting performance on typical sites:	**To establish seed production fields, plugs are mechanically transplanted into a conventionally tilled seedbed. Rows are typically spaced 40 inches apart. Spacing between plugs within rows is 12 inches. Once transplanting is completed, at least 1 inch of irrigation water is applied to enhance root-soil contact and stimulate plant growth.**
Other Comments:	**Dicantheliums are characterized by two distinct blooming periods. The conspicuous primary flowering heads are terminal to the culms and are produced in late spring and early summer. Secondary flowering heads are produced from the leaf axils beginning in mid-summer and continuing into early autumn. The primary flowering heads usually have a lower seedset than the secondary ones, which have flowers that remain closed and are self pollinated. However, seed produced by the primary flowers appears to germinate more readily than seed from the secondary flowers.**
References:	**USDA, NRCS. 2010. The PLANTS Database (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.**

Citation:

Vandevender, John 2010. Propagation protocol for production of container *Dichanthelium villosissmum* (Nash) Freckmann plants (1+0 container plug); USDA NRCS - Appalachian Plant Materials Center, Alderson, West Virginia. In: Native Plant Network. URL: http://www.nativeplantnetwork.org (accessed 5 August 2010). Moscow (ID): University of Idaho, College of Natural Resources, Forest Research Nursery.