

# *Annual Report*

## **Developing No-Tillage Seeding Methods for Roadside Flowers**

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# **I. Introduction**

No-till planting systems can improve: 1) soil conservation, 2) soil moisture retention, 3) organic matter conservation, and 4) weed control. The adoption of no-till planting systems that incorporate appropriate herbicides has helped to control weeds while conserving soil in crops such as corn and soybeans. More recently no-till has been adapted to sowing native warm-season grasses for forage. In a no-till system, a specially designed drill plants seed into killed vegetative stubble. In this way, weed seed are not brought to the surface (as happens in conventional tillage and planting); therefore, some annual weeds pose less of a problem. Another advantage of no-till is that the soil is not left bare and so exposed to erosion or evaporation. No-till methods can therefore provide an establishment advantage in both wet and dry years. A no-till planting can typically be done sooner after a rain than can the full set of operations associated with conventional planting. When soil moisture is at a premium (droughty years), the no-till approach conserves soil water and provides some advantage to the seed, if they are properly planted. Another advantage of no-till is that decomposing vegetation provides organic matter as well as helps to retain soil moisture. The disadvantages of no-till methods can include reduced control of some perennial weeds, an inability to cultivate for weed control, and the necessity of planting in rows (albeit very narrow rows).

The no-till technique may be desirable for seeding roadside flowers for the same reasons that it is favored with field crops. Soil erosion, moisture retention, weed control, and organic matter accumulation are all valid concerns of VDOT roadside managers. VDOT requested that we try to establish roadside flowers with no-till techniques. In response, we developed a four-phase research approach to applying no-till technology to the roadside environment: 1) test the feasibility of no-till methodology for establishing desirable annuals and perennials; 2) compare no-till and conventional seeding systems across the three physiographic regions of Virginia; 3) determine how to manage a site prior to and following no-till seeding to minimize weediness; and 4) incorporate plant mixes into a no-till seeding system with complementary herbicides. The first two phases of examining no-till for roadside plantings will be the focus of this report.

## **II. Adapting Roadside Flower Plantings to No-Till Techniques - Fall 1999 Demonstration/Study**

### **Objectives:**

The objectives of this demonstration were: 1) to examine the feasibility of using a no-till seeder for planting selected roadside flower species into a killed sod, and 2) to make some observations on likely or suitable no-till seeding rates.

## Procedures for Establishment and Maintenance:

On September 15, 1999, poppy (*Papaver rhoeas*), purple coneflower (*Echinacea purpurea*), lanceleaf coreopsis (*Coreopsis lanceolata*), and long-head (upright) coneflower (*Ratibia columnifera*) were sown with a Tye Pasture Pleaser no-till drill on an essentially level site at the Northern Piedmont Agricultural Research and Extension Center in Orange, VA. Before seeding, the existing vegetation of mostly tall fescue (*Festuca arundinacea*) with some weeping lovegrass (*Erogrostis curvula*) was sprayed twice with glyphosate (1 gal/A) on September 8, 1999. This atypical glyphosate application, which was used because of delays in funding and weather constraints, is not ideal and is not recommended; and it may partially account for difficulties observed later with control of some weeds. The seed was sown at a rate of approximately 20 lb pure live seed (PLS)/ A. On an adjacent site, the same species were planted at the same rate using conventional tillage. In the summer of 2000, bull thistle (*Cirsium vulgare*) and horseweed (*Conyza canadensis*) weeds were removed by hand. Poppy plots (the only annual) were not reseeded. The area was mowed with a bush hog in November 2000 to minimize competition from old vegetation in the next season.

## Results:

Both the no-till and conventional sites were assessed on November 16, 1999, by which time all species had germinated and were performing well with minimal weed competition. In the spring of 2000, all species in the no-till area were still performing well with minimal competition evident from weeds. In the conventionally tilled area, weeds were more prevalent than in the no-till plots. In May 2000, the poppy plants in the no-till and conventional tilled areas were in full flower and covered 90% of the ground<sup>1</sup>. In August 2000, nearly one year after sowing, lanceleaf coreopsis (85 to 95% ground cover) and long-head coneflower (75 to 85%) had similar plant density or ground coverage in both conventional and no-till areas. In both the coreopsis and long-head coneflower no-till plantings, horseweed was the only weed visible above the flower canopy. The no-till strips planted with purple coneflower had more visible weeds than the other no-till plots. These plants grew to only approximately 2 feet, and taller weeds grew above the stand. The purple coneflowers did not flower during the 2000 growing season after fall, 1999 planting.

Eighteen months after seeding (June 2001) the areas were again evaluated. Ground coverage by flowers and weeds was measured as percent ground cover (Table 1). We cannot statistically compare conventional tillage with no-till seeding, because the two methods were not used within a block; however, the data suggest little difference between the two planting systems for the coreopsis and long-head coneflower. Because these plants covered the area nearly completely, weeds were insignificant. However, purple coneflower performance appeared to be better in the conventionally planted area than in the no-till area. This species is typically slow to germinate and grow in first year; therefore, shading from weeds may have hampered its performance.

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<sup>1</sup> Percent ground cover (density) was determined by visual estimation.

**Table 1.** Percent ground cover of desired species and weeds in plots planted by no-till and conventional methods on September 15, 1999 and measured on June 13, 2001. Poppy was not re-seeded in fall, 2000, thus no data are reported.

Species	No-till		Conventional	
	Flowers	Weeds	Flowers	Weeds
	..... % Ground Cover .....			
Coreopsis	95	2	100	0
Purple coneflower	45	55	75	20
Long-head coneflower	84	8	90	10

The roadside visibility of these four species was noted in the spring and summer of 2000 and 2001. The lanceleaf coreopsis and poppy are no doubt the more striking species. They both could be seen 1 mile away. The long-head coneflower and purple coneflower would not be as striking when traveling at 45 miles/hour, but both species would be well suited in a perennial “natural meadow” design. The long-head coneflower grows no taller than 2.5 to 3 feet, but its spreading bush habit seems to discourage weeds. Purple coneflower, long-head coneflower, and lanceleaf coreopsis could likely be planted as a mixture. If Maximillian sunflower (*Helianthus maximilliani*) were also included in the mixture, flowers would bloom from late June until frost.

**Conclusions:**

This demonstration suggests that the four species that were used can be successfully seeded with a no-till planter. Some additional measures were needed for control of bull thistle and horseweed, but we feel a pre- or post-plant sequence of herbicides could control even these species.

The seeding rates used are high for roadside plantings. Because this was a new technique, we clearly did not want to plant too few seed. The resulting poppy, coreopsis, and long-head coneflower stands were very dense with few weeds. This work confirmed and completed the first step in our over-all objectives. The next step was to directly statistically compare no-till and conventional planting systems.

### III. Comparing the Performance of Fall-Planted Roadside Flowers Using No-till and Conventional Techniques in the Coastal Plain, Piedmont, and Valley and Ridge of Virginia

#### Objective:

The objective is to compare no-till and conventional planting techniques for establishment of selected roadside flower species when planted in the Fall in the three major physiographic regions of Virginia.

#### Methods and Materials:

A study was established in September 2000. A nearly level site in Gloucester (Coastal Plain), Culpeper (Piedmont), and Harrisonburg (Valley and Ridge) was selected. The soils from each site were typical of their region.

Poppy, purple coneflower, lanceleaf coreopsis, and long-head coneflower were planted in strip plots as pure stands at the rates shown in Table 2. Half of each area was sown using conventional tillage methods, and the rest was planted with a Tye Pasture Pleaser no-till drill following herbicide treatments. The strip plots (160 sq. ft.) were arranged in a randomized block design. Seeding treatments were replicated four times (2 seeding methods x 4 species x 4 replications).

**Table 2.** The seeding rates for four species that were fall-planted by no-till and conventional methods. Rates are reported as pure live seed (PLS).

Species	Seeding rate (PLS lb/A)
Poppy	14
Purple coneflower	14
Lanceleaf coreopsis	14
Long-head coneflower	18

In early August and again in early September 2000, before seeding, glyphosate (1 gal/A) was applied to the entire research site at all locations to kill the existing vegetation. The vegetation was then mowed with a bush hog to approximately 6 inches. In Harrisonburg and Culpeper, the cut residue was removed with a tractor-pulled rake. The Gloucester site was not raked. For the conventional tillage treatment, the soil was rototilled to 4 to 6 inches at the time of planting, the seed was broadcast by hand, and then the plots were rolled with a garden-type roller. The Gloucester site was seeded on September 20, Culpeper was seeded on September 27, and

Harrisonburg was seeded on September 18. The fertilizer and lime amendments at each site are listed in Table 3. Lime was added to achieve a pH at each site of approximately 6.7. Plateau™ (4 oz/A), selective herbicide, was applied to the no-till and conventional plots after planting.

**Table 3.** Amendments applied to the three sites for no-till and conventional plantings in fall 2000.

Amendment or pH	Location		
	Gloucester	Culpeper	Harrisonburg
15-30-15	300 lb/A	300 lb/A	300 lb/A
0-46-0	200 lb/A	200 lb/A	200 lb/A
Dolomitic limestone	1 T/A	1.5 T/A	0
pH prior to adding lime	5.9	6.0	6.7

### Results:

On October 27, the plots in Gloucester and on November 1 plots in Culpeper and Harrisonburg were evaluated (Table 4). The data for Harrisonburg show that there was low seedling emergence, apparently because of lack of moisture. The Harrisonburg site received at least 1 inch of rain the day after sowing but then received no additional rain for 6 weeks. The other two sites received rain in small quantities but more frequently than Harrisonburg. No-till seed placement may have provided some advantage in Culpeper but showed no distinct value (or disadvantage) at the other two sites.

**Table 4.** Emergence of seedlings of four species from conventional and no-till plantings about five weeks after planting at three Virginia locations in mid-September 2000. The number of plots (out of four) that had at least five rows (out of eight) of visible seedlings.

Species	Location					
	Gloucester		Culpeper		Harrisonburg	
	No-till	Conventional tillage	No-till	Conventional tillage	No-till	Conventional tillage
Lanceleaf coreopsis	4	4	4	4	1	1
Purple coneflower	4	4	3	2	4	1
Long-head coneflower	3	4	4	2	0	2
Poppy	4	4	4	4	4	4

Percent density or ground cover data were determined for each species in Spring 2001. The Gloucester and Harrisonburg sites were evaluated in April (data not shown) and early June (Table 5). The Culpeper site was evaluated only once; because, soon after our April visit, a truck drove through the site, severely damaging the planting. There were no significant differences between the no-till and conventionally planted poppy for all the sites. In contrast, there were differences in the two planting systems for the perennial species. The conventional system plots performed better than the no-till system in Gloucester and Harrisonburg. However, the opposite was observed in Culpeper. These contrasting findings are difficult to explain. In Harrisonburg and, to a lesser degree, in Culpeper the drought coupled with the long freeze in December 2000 may have affected plant performance, thus resulting in variable plant response.

Weed density was measured in June 2001 at Gloucester and Harrisonburg (Table 6). There were no significant differences in the two planting systems, except for coreopsis in Gloucester. However, the no-till plots generally tended to have more weeds than the cultivated plots. The troublesome weeds in these sites were Johnsongrass (*Sorghum halpense*) in Gloucester and Canada thistle (*Cirsium arvense*) in Harrisonburg, both perennials. This finding supports the observations of others that perennial weeds are better discouraged by tillage. No-till systems are better suited for annual weed control, and/or will require additional chemical controls.

The study in Culpeper was terminated in June 2001 due the traffic damage and in Gloucester in fall 2001 due to weed infestation. The Harrisonburg site will be evaluated in spring 2002 for a last time.

**Table 5.** Percent ground cover in Spring 2001 of four species planted in fall 2000. The Gloucester (Coastal Plain) and Harrisonburg (Valley and Ridge) sites were evaluated in early June. The Culpeper (Piedmont) site was evaluated in early April. Means for treatments (no-till vs. conventional) within the same column and species, and with the same letter were not significantly different at the 5% level according to Student, Newman and Kuels test.

Planting Method	Location		
	Gloucester	Culpeper	Harrisonburg
<b>Coreopsis</b>			
No-till	45b	54a	3b
Conventional	84a	4b	31a
<b>Purple coneflower</b>			
No-till	12b	20a	28a
Conventional	26a	1b	34a
<b>Long-head coneflower</b>			
No-till	11b	54a	2a
Conventional	59a	2b	18a
<b>Poppy</b>			
No-till	84a	79a	79a
Conventional	84a	68a	74a

**Table 6.** Percent ground cover by weeds in June 2001, for Gloucester (Coastal Plain) and Harrisonburg (Valley and Ridge) sites planted in fall 2001. Means for treatments (no-till vs. conventional) within the same column and species and with the same letter are not significantly different at the 5% level according to Student, Newman and Kuels test.

Planting Method	Location	
	Gloucester	Harrisonburg
<b>Coreopsis</b>		
No-till	45a	75a
Conventional tillage	10b	55a
<b>Purple coneflower</b>		
No-till	69a	70a
Conventional	65a	53a
<b>Long-head coneflower</b>		
No-till	65a	70a
Conventional	34a	55a
<b>Poppy</b>		
No-till	14a	15a
Conventional	6a	16a

## Conclusions:

Definitive conclusions are difficult to draw from the data collected in this study. Fall plantings may be inherently more risky with our current weather trends. When considering the overall performance for both no-till and conventional systems, the Gloucester site was the most consistent. The performance at the Culpeper site could be evaluated only in April, prior to the trucks damaging the plots. This was a disappointment, but unfortunately, this is the risk of roadside research. The drought and unusually hard December freeze hindered the establishment and growth of all species in Harrisonburg and to a lesser degree in Culpeper.

We can conclude that poppy performance was more uniform across sites than the perennial species and that poppy adapted readily to fall no-till plantings. The data show us that *Papaver rhoeas* is very tolerant of a variety of soil and weather conditions. Dependable plant performance is a desirable characteristic and explains why roadside managers continue to use this plant.

## IV. Comparing the Performance of Spring-Planted Roadside Flowers Using No-till and Conventional Techniques in the Coastal Plain, Piedmont, and Valley and Ridge of Virginia

### Objective:

The objective is to compare no-till and conventional planting techniques for establishment of selected roadside flower species when planted in the Spring in the three major physiographic regions of Virginia.

### Methods and Materials:

A study was established in the three regions of Virginia in April/May 2001. A nearly level site in Gloucester (Coastal Plain), Culpeper (Piedmont), and Harrisonburg (Valley and Ridge) was selected. The soils from each site were typical of their region.

Cosmos (*Cosmos bipinnatus*), gloriosa daisy (*Rudbeckia fulgida* var. *speciosa*), tickseed coreopsis (*Coreopsis tinctoria*), and annual sunflower (*Helianthus annuus*) were planted in strip plots as pure stands at the rates shown in Table 7. Half of each area was sown using conventional tillage methods, and the rest was planted with a Tye Pasture Pleaser no-till drill. The strip plots (160 sq. ft.) were arranged in a randomized block design. Seeding treatments were replicated four times (2 seeding methods x 4 species x 4 replications).

**Table 7.** The seeding rates for four species in a Spring-planted study comparing no-till and conventional methods. Rates are reported as pure live seed (PLS).

Species	Seeding rate (PLS lb/A)
Cosmos	15
Gloriosa daisy	3
Tickseed coreopsis	4
Annual sunflower	10

In early March 2001 and again in early April 2001, before seeding, glyphosate (1 gal/A) was applied to the entire research site at all locations to kill the existing vegetation. The vegetation was then mowed with a bush hog to a height of approximately 6 inches. In Harrisonburg and Culpeper, the mown residue was removed with a tractor-pulled rake. The Gloucester site was not raked. For the conventional tillage treatment, the soil was rototilled to 4 to 6 inches at the time of planting, the seed was broadcast by hand, and then the plots were rolled

with a garden-type roller. The Gloucester site was seeded on April 3, Culpeper was seeded on April 9, and Harrisonburg was seeded on May 2. We had intended to seed all the sites at the same time, but rains postponed seeding at Harrisonburg. The fertilizer and lime added to each site are listed in Table 8. Lime was added as needed to produce a pH of approximately 6.5. No post-planting herbicides were used, but the area around the plots was mowed in late May.

**Table 8.** Amendments applied to the three sites in a Spring planting comparing no-till and conventional methods.

Amendment or pH	Gloucester	Culpeper	Harrisonburg
0-46-0	200 lb/A	200 lb/A	200 lb/A
Dolomitic limestone	4 T/A	1.5 T/A	0
pH prior to adding lime	5.0	5.8	6.5

## Results:

The three sites were evaluated in the Spring and Summer of 2001. The general observation is that there were no differences between the two planting systems in all three regions of Virginia (Table 9). The cosmos, gloriosa daisy, and tickseed coreopsis performed well. The cosmos covered an average of 85 to 94% of the ground by mid-summer, while gloriosa daisy covered an average of 78 to 84% of the area, and tickseed coreopsis covered an average of 70 to 84% of the ground. The annual sunflower establishment was sparse and scattered. We now realize that, due to the seed's strong dormancy (laboratory tests indicated that 85% of the seed was dormant), it should be pre-treated or planted in late Fall instead of in the Spring. The seeding rates for all but the sunflower were adequate to create uniform coverage and generally reduce weeds. One could increase the seeding rate to 5 or 6 lbs/A if a denser stand of tickseed is desired. There was no significant difference between the no-till and conventional plantings in percent ground cover by weeds (Table 10). An herbicide other than pre-plant glyphosate was not used, because we wanted to determine if there were treatment differences due to weeds. Giant foxtail (*Setaria glauca*) and fall panicum (*Panicum dichotomiflorum*) were a minor problem at all sites. The weed density was the greatest for the sunflower plots, because the sunflowers performed poorly in comparison to the other species.

**Table 9.** Percent ground cover by spring-planted cosmos, gloriosa daisy, tickseed coreopsis, and annual sunflower in Spring and Summer of 2001. Means for treatments (no-till vs. conventional) within the same column and species, and with the same letter are not significantly different at the 5% level according to Student, Newman and Kuels test.

Planting Method	Locations (planting date)					
	Gloucester (April 3)		Culpeper (April 9)		Harrisonburg (May 2)	
	May 8	June 9	June 12	August 7	June 1	August 4
<b>Cosmos</b>						
No-till	97a	96a	70a	82a	75a	93a
Conventional	78b	92a	71a	89a	69a	81a
<b>Gloriosa daisy</b>						
No-till	78a	80a	78a	85a	66a	81a
Conventional	70a	76a	61a	84a	54a	81a
<b>Tickseed coreopsis</b>						
No-till	86a	81a	78a	65a	59a	79a
Conventional	81a	86a	74a	76a	64a	74a
<b>Sunflower</b>						
No-till	21a	44a	18a	35a	3a	9a
Conventional	19a	38a	11a	35a	3a	13a

**Table 10.** Percent ground cover by weeds within the Spring-planted flower plots in June 2001. Means for treatments (no-till vs. conventional) within the same column and with the same letter are not significantly different at the 5% level according to Student, Newman and Kuels test.

Planting Method	Location (planting date)	
	Gloucester (April 3)	Culpeper (April 9)
<b>Cosmos</b>		
No-till	3a	19a
Conventional	5a	15a
<b>Gloriosa Daisy</b>		
No-till	11a	12a
Conventional	13a	25a
<b>Tickseed Coreopsis</b>		
No-till	15a	14a
Conventional	10a	20a
<b>Sunflower</b>		
No-till	29a	74a
Conventional	31a	75a

**Conclusion:**

No-till and conventional tillage planting systems can be recommended to Spring-plant cosmos, gloriosa daisy, tickseed coreopsis, and annual sunflower. The spring-planted cosmos, gloriosa daisy, and tickseed coreopsis stands performed better than expected. All three species provided highly visible mono-stands. The sunflower did not perform well, but there was no difference between the two planting systems. We recommend that sunflowers be sown in late fall to early winter. This may help break the dormancy (Ernst Conservation Seed Company, personal communications). The rain fortunately was abundant in the early spring 2000 for this study, unlike the proceeding fall study. More consistent rainfall may be one advantage to seeding early in the spring.

## V. Comparing the Performance of Fall-Planted Roadside Flowers No-till Established at Three Seeding Rates in the Piedmont

### Objective:

The objective is to examine seeding rate as a variable for establishing roadside no-till plantings in the Fall in the Piedmont.

### Methods and Materials:

A study was established in September 2000 on a nearly level site in Culpeper, VA (Piedmont). Poppy, purple coneflower, lanceleaf coreopsis, and long-head coneflower were planted as pure stands at various rates (Table 11). The seed was planted with a Tye Pasture Pleaser no-till drill following herbicide treatments. The strip plots (160 sq. ft.) were arranged in a randomized block design. Seeding treatments were replicated four times (3 seeding rates x 4 species x 4 replications).

Table 11. Seeding rates in pure live seed (PLS) lb/A for four species of roadside flowers planted in the Fall using no-till methods.

Seeding rate	Poppy	Purple coneflower	Lanceleaf coreopsis	Long-head coneflower
Low	4 lb/A	3.5	3.5	5
Medium	8	7	7	9
High	14	14.5	14	18

In early August 2000, and again in early September, glyphosate (1 gal/A) was applied to the site to kill the existing vegetation. The area was then mowed with a bush hog to approximately 6 inches. The site was raked to remove the mown residue prior to seeding. Applications of 15-30-15 (300 lb/A) and 0-46-0 (200 lb/A) fertilizer were applied at the time of seeding. Lime (2.5 T/A) was also applied at this time. Plateau (4 oz/A) was applied to the entire area after planting.

### Results and Conclusions:

On April 4, 2001 percent ground cover data were collected (Table 12). The higher seeding rates of coreopsis and long-headed coneflower provided the best coverage. For poppy and purple coneflower, medium seeding rate provided the best cover. If the three perennial species were used in mixes, the lower rates may be adequate. In our experience, 1 lb/A of poppy is adequate in a seed mixture, because it tends to dominate stands easily. No other data were collected for this

study, because trucks repeatedly drove through the plots soon after the April data were collected. Therefore, we cannot provide a strong seeding rate recommendation based on this study. It is unfortunate that this study was lost; perhaps it can be repeated in the future.

**Table 12.** Percent ground cover on April 4, 2001 for coreopsis, purple coneflower, long-headed coneflower, and poppy that was fall-seeded. Means across a row followed by the same letter are not different at the 5% level according to the Student, Newman and Kuels test.

Species	Seeding Rate		
	Low	Medium	High
Lanceleaf Coreopsis	28b	35b	60a
Purple coneflower	8b	22a	20a
Long-head coneflower	22c	38b	51a
Poppy	60b	75a	82a

## VI. No-Till Seeder Demonstration

On April 5, 2001, a no-till seeder demonstration was held at the Northern Piedmont Agricultural Research and Extension Center in Orange, VA. In late March 2001, one application of glyphosate (1 gal/A) was applied to kill the existing vegetation. The area was then mowed with a bush hog to approximately 6 inches. Lime (0.5 T/A) was also applied at this time. Four no-till seeders were featured: Tye, John Deere, Great Plains and Truax. Each seeder was adjusted to plant seed between a quarter to half an inch deep. Also, the coulter's pressure was adjusted to cut through the sod and clayey heavy Piedmont soil. The field was planted with the following mixture of seed:

*Schizachyrium scoparium* (little bluestem) @ 10 lb/A  
*Coreopsis lanceolata* (lance-leaf coreopsis) @ 3  
*Echinacea purpurea* (purple coneflower) @ 1.8  
*Papaver rhoeas* (poppy) @ 1.8  
*Rudbeckia hirta* (black-eyed susan) @ 1  
*Centaurea cyanus* (bachelor button) @ 1.8  
*Coreopsis tinctoria* (tickseed coreopsis) @ 1  
*Cosmos bipinnatus* (garden cosmos) @ 2  
*Ratibia columnifera* (long-head coneflower) @ 2.4  
*Fagopyrum esculentum* (buckwheat) @ 1.8  
*Trifolium incarnatum* (crimson clover) @ 1.8  
 Total mix = 18 flower lb /A + grass = 28 lb/A

On June 13, 2001 percent ground cover was estimated for areas planted by each seeder. The planting made by the Tye and John Deere seeders resulted in 50% of the ground being covered. The stand from the Great Plains seeder covered about 40% of the area. However, the Truax seeding failed, with less than 1% coverage. We believe that the chain on the Truax drill was not engaged at the time of seeding, because the same failure happened to a planting of oats that was done that same day. The overall low performance across the site was likely due to low rainfall. It rained several days prior to and after seeding, but then not again until a month later. It is possible that some of the seed may therefore have germinated and then the seedlings desiccated due to lack of moisture.

All of the no-till seeders that we examined seem to be adequate to cut through the killed sod and plant the seed where needed. The seeder designs vary, but the overall seeding result is similar. The following differences were noted:

- The seed box on the Truax seeder was specifically designed to seed wildflowers and long-awned (fluffy) native grasses<sup>2</sup>. The other seeders were originally designed for agricultural crops but can be easily modified to plant a range of seed, from tiny to large, and slick to fluffy.
- The most difficult seed to plant is the fluffy seed, because it “bridges” in the hopper or seed box. In the seeders that do not have a special box adapted to handle this type of seed (often called a “fluffy seed box”), the seed can be put in the largest hopper and mixed with an agent such as soybean meal. The fluffy box on the Truax is well-equipped to handle the difficulty.
- Controlling the depth of seeding is very important, and all of these seeders have the ability to do this; however, some seeders, i.e. Truax, are designed to make this adjustment easier than others.
- The coulters for the Truax are very aggressive and work well in thick sod.
- Calibration consists of jacking up the seeder and collecting seed from a set number of spouts with a designated number of wheel turns. All these seeders are calibrated the same way.
- Seeder transportation methods are different among seeders. The Truax seeder requires a trailer; the Tye can be towed behind a truck.

All the seeders that were examined in this demonstration appear to be adequate for no-till planting of roadside flowers (Appendix A). The decision to purchase a seeder most likely will be based on if a fluffy seed box is required, size of seeder required, ease of transporting (some are road-worthy without a trailer), and cost<sup>3</sup>.

## **VII. General Conclusions From These Studies**

The main question that we have focused our research on is, whether no-till seeding technology can be applied to planting roadside flowers in Virginia. Our work clearly demonstrates that no-till planting can establish very acceptable stands of a number of species. Furthermore,

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<sup>2</sup> Please note that Truax is not the only company to offer a fluffy box. The other brands also have fluffy seed boxes, but we did not examine any of them.

<sup>3</sup> For internet information on seeders, please view <http://filebox.vt.edu/users/jodaniel>.

several different manufactures make no-till planters that will work with seeds used in roadside plantings. Thus, the first objective of the four-phase research approach that was outlined in the introduction has been fulfilled.

The next proposed step was to compare no-till and conventional seeding systems in three regions of Virginia. The overall result is that there were no consistent differences between the two systems for the annual or biennial species, poppy, cosmos, gloriosa daisy, tickseed coreopsis and sunflower. In contrast, the performance of the three fall-sown perennials, lanceleaf coreopsis, purple coneflower and long-head coneflower, varied between planting systems from site-to-site. These perennials were slower to establish and mature than the annuals, thus they may be more dependent upon site-specific conditions. This may explain the diverse overall species by site responses observed in our studies. We believe that more research would help us to better understand the site, soil, herbicide, and fertility requirements for successful perennial establishment.

We are in the third phase in our research approach to studying no-till system technology. We are currently examining alternative site preparation methods and herbicide regimes to help improve no-till planting performance, and we are evaluating various native perennial plants. The fourth and final component of our work will be to incorporate plant mixes into a no-till seeding system with complementary herbicides.

Appendix A. A comparison of the smallest models of John Deere, Great Plains, Truax, and Tye no-till seeders that were available at the time of this report.

Manufacturer	John Deere	Great Plains	Truax	Tye
Model	1560	605NT	FLXII-88	2005
Working width of seeder	10'	5' 1"	5' 4"	5'
Row spacing	7.5"	7.5"	8"	8", 7.5", or 6.5"
Number of openers	16	8	8	7,8, or 9
Weight	6430 lbs	2280 lbs	2640 lbs	1440 to 1640 lbs
Seed box options	Grain, grass, legume	Grain, grass, legume, native grass	Grain, grass, legume, native grass	Grain, grass, legume, native grass
Seed meter type	Fluted feed cup	Fluted feed cup, agitator	Fluted feed cup, metal wheel picker	Internal fluted feed cup
Disk design	Deere furrow opener, single disk	Double-disk opener	Double-disk opener	Double-disk opener
Press wheel width	1"	1"	1.75"	1"