Establishing Row-middle Ground Cover Options for High Density Apple Orchards in Western NY

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Soil or grass is the most common row-middle ground cover in apple orchards in Western NY. Many different grasses and grass mixtures are available. The OVN-Mix (Orchard-Vineyard-Nursery Mix - 40% proprietary perennial ryegrass, 30% creeping red fescue, 30% chewing fescue) is the most common ground cover mix seeded after an apple orchard is planted today. Ideally, preparation for ground-cover establishment should begin at the same time as preparations for orchard establishment. Once the trees are planted, posts, wires, and trickle irrigation should be installed quickly to support tree growth, followed by ground cover seeding and rolling. The entire sequence of orchard tasks (early tree planting, post/wire/trickle installation, and ground cover seeding) should be conducted immediately after planting (Figures 1-5). A new orchard planted as early as possible will facilitate grass germination in the rainy season late April-early May. A ground cover should germinate and establish quickly, and thereafter should not require much maintenance (re-seeding of bare spots, fertilization, or chemical weed control). It also has to be resilient under heavy machinery traffic for chemical thinning, liming, brushing, harvest, and insect and disease control (especially at the bottom of more steep slopes). A good ground cover establishment must be achieved with an optimal and economical seeding rate and must be maintained with minimal extra effort by the fruit grower. It should be chosen with specific requirements for climate and rainfall to maximize establishment and maximum growth. It should also be managed so that competition for nutrients and water with young apple trees is minimal.

Traditional grass ground cover options require mowing several times each year (4-6 times per season) to a height of 3-5 inches. Mowing before or during harvest facilitates moving ladders, platforms, sprayers, hedgers, tractors, and bins through the orchard. High-density apple orchards should be mowed after harvest or late in the fall to remove habitat favorable for rodents. The ideal ground cover characteristics for a fruit grower looking to minimize high fuel costs, time, and labor when establishing a high density orchard as the Tall Spindle apple system are: (1) a ground cover that help maintain soil structure, (2) encourage water infiltration, (3) reduce soil erosion, (4) reduce mud, (5) secure and maintain a good driving surface, and (6) require minimal mowing per season.

In this study, we compared a Low-Grow Mix grass option (a lawn seed from Preferred Seed™) with the more widely adopted ground cover OVN-Mix. The main objectives of this study were: (1) evaluate a new ground cover option (Low-Grow mix) for high-density apple orchards for two years in Western NY, and (2) set up two replicated ground cover demonstration plots at grower farms at each side of Rochester, NY.
and an oat nurse crop was added at a rate of 16lbs/acre on March 16, 2012. The Mason GC site was monitored visually in 2012 and was evaluated for survival on May 21, 2013.

A new GC site (called “GC Fowler trial”) was established with a third grower cooperator in May 2, 2012 (Table 2). The site used a Super Spindle high-density orchard (2ft x 10ft spacing) of Fuji and Gala on M.9T337 that had been planted in the Fall of 2011. The following GC management systems were studied: Trt1 (untreated-natural vegetation), Trt 2 (OVN-mix 16lbs/acre), Trt 3 (Low-Grow mix 16lb/acre), Trt 4 (OVN-mix 22lbs/acre), Trt 5 (Low-Grow mix 22 lbs/acre), and Trt 6 (Dutch clover at 16lbs/acre). The GC Fowler trial compared side-by-side both ground cover mixes and two lower seeding rates. Ground was properly worked and GC mixes were seeded with a Brillion seeder. Ground covers were well established, maintained, and mowed when needed by grower cooperator. Soil coverage (GC coverage, weed coverage, and GC height) was monitored in 2012 and 2013 seasons.

Results and Discussion

The 2011 year was a challenging season weather-wise. We experienced a cool/wet spring, followed by a hot/dry summer. Apparently, the Mason ground cover plots were seeded at the beginning of the heat wave and were more affected by these extreme weather conditions than the Lamont ground cover plots. The Lamont site was seeded in August after the severe heat left our region. GC plots were not well established at the Mason site.

2011 temperatures were unseasonably warm in Western NY with over 15 days at 90°F or above during the June and July months. During that period, the cooler optimum soil temperatures for seed germination of cool-season grasses did not occur (59-86°F for Kentucky bluegrass, rough bluegrass, 59-77°F for creeping red fescue, sheep fescue, 69-77°F for chewing fescue, and annual ryegrass). Overall maximum temperatures for the months of June, July, August, and September, 2011 were 91°F, 99.5°F, 86°F, and 86°F, respectively.

At the Mason site, Dutch clover plants rapidly emerged 9 to 11 days after planting as minimal soil temperatures of 75°F or more occurred at the site. The native grass and broadleaf populations also emerged and contaminated the plots as they were

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**Materials and Methods**

**2011 Ground Cover (GC) Plantings:** Two ground cover trials were planted in 2011. The Mason GC and the Lamont GC trials were seeded on June 9 and August 15, respectively. At both sites, three replications of six ground covers treatments (Table 1) were seeded (hand-broadcasted at Mason and mechanically seeded with a Brillion seeder at Lamont), maintained, and mowed when needed by grower cooperators. At the Mason GC site, ground cover seeds were hand-broadcasted into plots. Plots were raked, and then rolled with a packer to shallowly incorporate seed and pack the surface. The Mason GC trial was mowed on August 4, 22, Sept.28, and Nov 15. The Lamont GC trial was mowed only one time at the end of the growing season on Nov. 18. Percentage cover of sod row middles and weed composition were evaluated on August 22 at the Mason GC site and on Sept. 30 and October 6 at the Lamont GC site.

**2012 Ground Cover (GC) Plantings:** The Mason GC site failed to establish in 2011. All the same plots were reseeded (same treatments, rates, hand-broadcasted, and raked as in 2011) and the GC Fowler trial was established at the Fowler site during 2012 in the Western NY fruit region.
favored by the hot and dry soil conditions. Overall ground cover emergence did not look very good and was delayed for more than a month. Plots were not irrigated before or after the ground covers were seeded as soil moisture was adequate at planting. The first rain (0.45 inches) occurred 13 days after plots were seeded. Total rainfall for the months of June and July was less than two inches. Rains increased and were 7.09 and 5.17 inches for August and September, respectively. The emergence of our June 2011 seeding of ground covers was almost zero and difficult to quantify early because grass identification was difficult and weed pressure (on-site grasses) was medium-high. Typically, with a few exceptions per plot, ground cover seeds did not germinate or emerged poorly without rain or irrigation. Plots were not hand weeded to identify seeded grasses. We did not see differences in the ability of the two grass mixtures to emerge, establish a stand, and compete with weeds in 2011 (Table 3). By the end of August 2011, the OVN-mix and the Low-Grow mix treatments did not successfully establish, did not fill in well and were severely contaminated by summer weeds mainly crabgrass and not by fine fescues as expected. Soil coverage of fine fescues was less than five percent for both mixes.

In the early spring of 2012 the Mason plot was reseeded. With early spring seeding the freezing and thawing of soil surface helps seeds come in contact with soil. A spring seeding can be conducted from mid-March to late May and can be appropriate for good seed germination if there is good rainfall. In 2012 the overall maximum temperatures for the months of June, July, August and September, 2012 were 91°F, 95.6°F, 90.1°F, and 84.8°F, respectively. Total rainfall for the months of March, April, May, June and July was 1.59”, 3.03”, 1.32”, 3.23”, and 2.38”, respectively. Summer rains increased compared with 2011 but did not help rapid establishment before seed viability of the semi-exposed seeds was reduced. The Mason GC plots were again not successfully established. The seeding technique did not work so well on this sandier soil compared with heavier soils with high clay content. The use of a heavy roller (to prepare a firm and leveled seedbed) or the use of a Brillion seeder may have helped to increase GC establishment. This soil had little or no summer rainfall in 2011 and a bit more in 2012. Mason GC plots were not evaluated by the end of 2012 and a very poor establishment was observed by the author (data not taken).

In May 2013, final measurements at the Mason site were taken for all treatments to give us additional information on ground cover survival. Both grass populations were sparse, did not properly establish, and did not provide adequate cover and good weed suppression. Apparently, both mixes of grass ground covers showed disadvantages in terms of decreased adaptation to drought conditions in 2011 and a very low capacity of recovery in 2012 and 2013, although the Dutch clover showed to be a more tolerant ground cover and survived better to these conditions. GC species at the Mason site did not establish well in year 2 and 3, and by May 21” 2013 the species mixtures has changed. GC treatments were mostly comprised of clover with a trace of rye and native grass populations. In some cases, we measured 25-95% bare ground on several plots. At Mason, the use of a Brillion seeder would have placed the seeds more deeply in the ground and seeds would have had more soil moisture available for germination and better establishment. Better soil preparation may have also helped to prevent this failure.

At the Lamont GC site, all ground covers grew reasonably well in 2011, 2012. Overall ground cover emergence looked pretty good for all treatments 45 days after the plots were seeded in 2011. Soil moisture was adequate at the moment of planting and plots did not receive supplemental irrigation. First germination was observed with the Dutch white clover seeds 9 days after plots were seeded, followed by the OVN-mix, and lastly by the Low-Grow mix. Overall maximum temperatures for the months of August, Sept., and October were 69.2°F, 63.3°F, and 50.8°F, respectively. Two months after planting, the rain measurements were two times higher than at the Mason GC site and were 3.94 and 4.41 inches, respectively. Average air temperatures were also lower and not as severe. By the end of the 2011 growing season, the low-gow mix grasses were 4-5 inches shorter than the OVN-mix grasses and both averaged an 85% or more of soil coverage (Table 4). Weed pressure and composition was numerically higher and more diverse only in the untreated plots. In 2012, both rates of the OVN-Mix continued covering the soil and competed against weeds better than the Low-Grow mixes. Clover soil coverage was the lowest by the end of year 2.

At the Fowler GC site (a study that was established early in the spring of 2012 to collect missed information from the Mason site that did not establish in 2011), all ground covers grew reasonably well in 2012 and 2013. Overall ground cover emergence was excellent one month after plots were seeded with

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<th>5/21/13</th>
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<td>8</td>
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Table 3. Ground cover height (inches), ground cover coverage (%), and weed coverage (%) by six groundcover treatments at an on-farm research trial during 2011, 2012, and 2013 in Wayne County, NY (GC Mason site).

| Trt #  | 8/17/12 | 6/6/12 | 5/21/13 | 10/6/11 | 8/17/12 | 6/6/12 | 5/21/13 | 10/6/11 | 8/17/12 | 6/6/12 |
|-------|--------|--------|--------|---------|--------|--------|--------|---------|--------|
| GC height (inches) | GC Coverage (%) | Weed Coverage (%) |
| 1 | 7.73 | 6.5 | 7.76 | 61.66 | 71.08 | 78.66 | 84.16 | 38.33 | 27.16 | 19.66 |
| 2 | 6.54 | 6.58 | 7.48 | 78.33 | 92.5 | 93.16 | 92.66 | 21.66 | 5.25 | 6 |
| 3 | 8.25 | 6.08 | 7.68 | 46.66 | 37.58 | 69.16 | 71.66 | 53.33 | 61.58 | 30.83 |
| 4 | 7.79 | 7 | 7.91 | 40 | 66.91 | 82.08 | 84.16 | 60 | 30.41 | 17.91 |
| 5 | 8.33 | 8 | 9.75 | 11.66 | 51.25 | 71.25 | 69.16 | 88.33 | 42.5 | 28.75 |
| 6 | 10.37 | 5.08 | 10.21 | 90 | 78.33 | 80 | 70.33 | 10 | 20.83 | 19.16 |

Table 4. Ground cover height (inches), ground cover coverage (%), and weed coverage (%) by six groundcover treatments at an on-farm research trial during 2011, 2012, and 2013 in Orleans County, NY (GC Lamont site).
a Brillion seeder. Soil moisture was adequate at the moment of planting and plots did not receive supplemental irrigation. First germination occurred with the Dutch white clover seeds 11 days after plots were seeded, followed by the OVN-mix, and by the Low-Grow mix. The two Low-Grow rates covered the soil better than the two OVN-mixes on Sept, 2012. By May 2013, soil coverage for both grass mixes was similar (regardless of the two rates tested). By the end of the 2012 growing season, the low-grow mix grasses were similar in height as the OVN-mix grasses and both of the high seeding rates tested averaged a 68% or more of soil coverage (Table 5).

Dutch clover germinated and established more quickly than both grass mixes at the Fowler site. Clover can become a weed problem within the tree row. Clover control in the tree rows has been difficult with herbicides, even with glyphosate (Deborah Breth-personal communication), and could increase soil nitrogen levels in the tree-row spacing. Legumes are also a good habitat for voles. However, it was the GC treatment that most impressed the grower by the end of the year 1. By May 2013, the clover treatment had almost completely suppressed weeds in these plots.

### Summary

There were no consistent benefits of using the new low maintenance mixture of fescue seeds (Low-Grow mix) using either the low or high rates over two years of continuous observation. Evaluation of weed coverage (%), ground cover coverage (%), and ground cover height (inches) in year 2 and at the beginning of year 3 determined that the Low-Grow Mix is not yet a better replacement to the widely used OVN-Mix. The Low-Grow mix is perhaps a more difficult grass mix to establish because it contains small, lower vigor seedlings that produce initially less above ground biomass and does not include perennial or annual ryegrass for better establishment. It also did not show to be a more drought tolerant grass mix in 2011. Planting a low growing low maintenance mixture of fescues with a nurse crop such as annual ryegrass or oats at a low seeding rate would be more successful. A low growing mixture of hard fescues (50-55% or more) with a 20% annual ryegrass could potentially reduce the need for mowing in a NY apple orchard and become a better mid-row ground cover option for heavy traffic areas. The ryegrass will help establish the hard fescues and then will die the next year. Our research shows that the OVN-mix is still a good ground cover mix and one of the cheapest options for new high density apple plantings. A successful grass ground cover establishment in Northeastern apple fruit regions requires planting either early in the spring or late in the summer (August 15-Sept.15) and the use of a heavy roller to prepare a good firm and leveled seedbed and the use of a Brillion seeder.

### Acknowledgements

This project was funded by NE Sustainable Agriculture

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### Table 5. Ground cover height (inches), ground cover coverage (%), and weed coverage (%) by six ground cover treatments at an on-farm research trial during 2012 and 2013 seasons in Wayne County, NY (GC Fowler site)

<table>
<thead>
<tr>
<th>Trt #</th>
<th>GC height (inches)</th>
<th>GC Coverage (%)</th>
<th>Weed Coverage (%)</th>
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<td></td>
<td>8/2/12</td>
<td>9/24/12</td>
<td>5/23/13</td>
</tr>
<tr>
<td>1 (native)</td>
<td>3.7</td>
<td>10.2</td>
<td>14.6</td>
</tr>
<tr>
<td>2 (OVN low rate$^1$)</td>
<td>3.6</td>
<td>5.9</td>
<td>17.2</td>
</tr>
<tr>
<td>3 (Low-Grow low rate$^1$)</td>
<td>3.6</td>
<td>4.4</td>
<td>19.6</td>
</tr>
<tr>
<td>4 (OVN high rate$^2$)</td>
<td>4</td>
<td>5.7</td>
<td>16.2</td>
</tr>
<tr>
<td>5 (Low-Grow high rate$^2$)</td>
<td>4.1</td>
<td>5.7</td>
<td>15.2</td>
</tr>
<tr>
<td>6 (clover$^3$)</td>
<td>4.1</td>
<td>9.1</td>
<td>9.8</td>
</tr>
</tbody>
</table>

$^1$OVN-Mix and Low-Grow Mix at 16lb/acre  
$^2$OVN-Mix and Low-Grow Mix at 22lb/acre  
$^3$Dutch clover at 16lb/acre

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