NORTHWEST CROPS & SOILS PROGRAM

THE UNIVERSITY OF VERMONT EXTENSION

Solar Corridor Cropping Systems

Introduction

With increased interest in soil conversation and health, strategies to enhance implementation of cover cropping in corn silage cropping systems have been gaining more attention. Interseeding is one such strategy of interest as cover crops are planted into an established corn crop. In Vermont, with such a short growing season, interseeding could help overcome fall establishment challenges and increase the diversity of cover crop species grown. However, cover crop establishment and success using interseeding has been variable. Some of the challenges are a result of the relatively high density and narrow row spacing corn silage systems often utilize. A potential solution to these challenges would involve altering the row spacing and corn populations to better accommodate cover crop establishment. Increasing the space between crop rows to allow for cover crop establishment is the hallmark of the solar corridor approach. Previously investigated in grain corn systems in the Midwest, the solar corridor cropping system (SCCS) is now being researched as a potential strategy to meet soil conservation goals while remaining a viable corn silage production practice for farmers in the northeast region.

Solar Corridor Cropping System (SCCS)

The solar corridor cropping system integrates row crops with solid-seeded cover crops in broad strips or corridors. The corridors allow for more efficient capture of solar radiation by each crop by providing more uniform vertical distribution of sunlight.

While a typical corn silage system utilizes high corn seeding rates planted in 30-inch rows, in the solar corridor system, corn is planted in wider rows (i.e. 60-inch) and a cover crop is interseeded in between the rows of corn (Figures 1 and 2). By increasing the row spacing, more light will penetrate through the corn canopy to the interseeded cover crop, helping it establish and produce more biomass than it would in a traditional narrow row spacing.

Figure 1. Traditional corn silage system with 30-inch corn row width, Alburgh, VT, 2019.

Figure 2. Solar corridor cropping system with 60-inch corn row width, Alburgh, VT, 2019.

Farmers cover crop to improve soil health and minimize soil and nutrient losses to the environment. Using SCCS can allow farmers to establish cover crops earlier in the season, increasing the potential diversity and productivity of cover crops providing greater soil health and environmental benefits (Figure 3). These systems may also reduce input costs through increased nutrient retention or weed control. Additionally, depending on the species utilized, this system could provide additional benefit such as forage once the corn crop is harvested.

Figure 3. Solar corridor cropping system, Alburgh, VT 2019.

Challenges

There are several challenges to consider when beginning to implement the SCCS. Firstly, while increasing the inter-row space will increase the amount of light available to both the cash crop and interseeded cover crop, yield loss can occur if plant population is not adjusted (Figure 4). Corn planted in 60-inch rows will have to be planted at twice the seeding rate of corn planted in 30-inch rows to ensure comparable plants per acre. To overcome this, some have investigated the use of a twin-row planting configuration (Figure 5). However, this is not a common practice in the northeast region and requires specialized equipment. Similarly, interseeding requires specialized equipment to accommodate seeding into a growing corn crop, typically around the V6 growth stage. Equipment must provide adequate seeding conditions (i.e., seed to soil contact) without damaging the standing crop. Farmers in this region do not commonly own this specialized equipment as the technology has yet to be proven effective enough in this region to warrant such an investment.

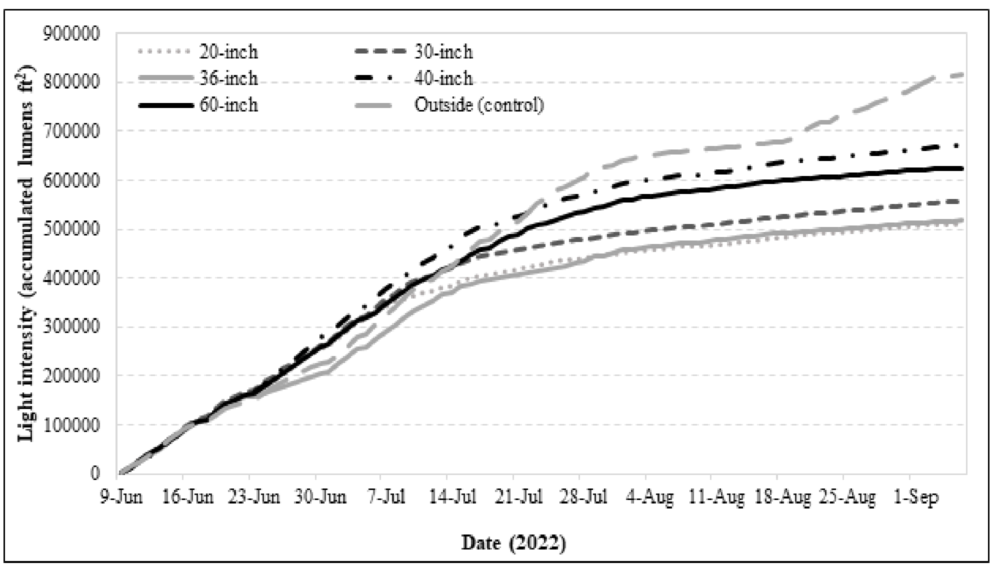

Figure 4. Light intensity at the soil surface by row width compared to a control in Trial 1, Alburgh, VT, 2022.

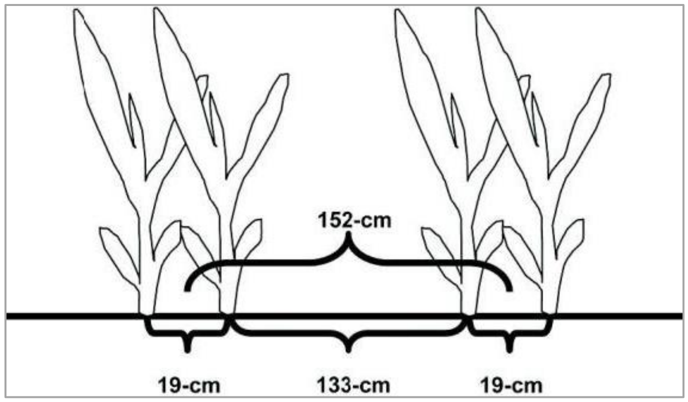

Figure 5. Twin-row plant configuration for the solar corridor. Nelson K.A. 2014.

Research Trials

To overcome these challenges, research applying this principle to northeast corn silage systems is needed. The University of Vermont Extension Northwest Crops & Soils Program conducted several field trials exploring the use of various row spacings and cover crop species/mixtures to increase cover crop success while maintaining sufficient corn silage yields.

Over four years, results indicated yield reductions ranging from 3-13 tons ac^{-1} are experienced by increasing row spacing from 30” to 60” (Figure 6). In these trials, target plant populations per acre were the same across the two row spacings. This required increasing the in-row plant population to compensate for the reduced number of rows. Achieving these high seeding rates consistently is challenging without the use of precision planting technology and equipment.

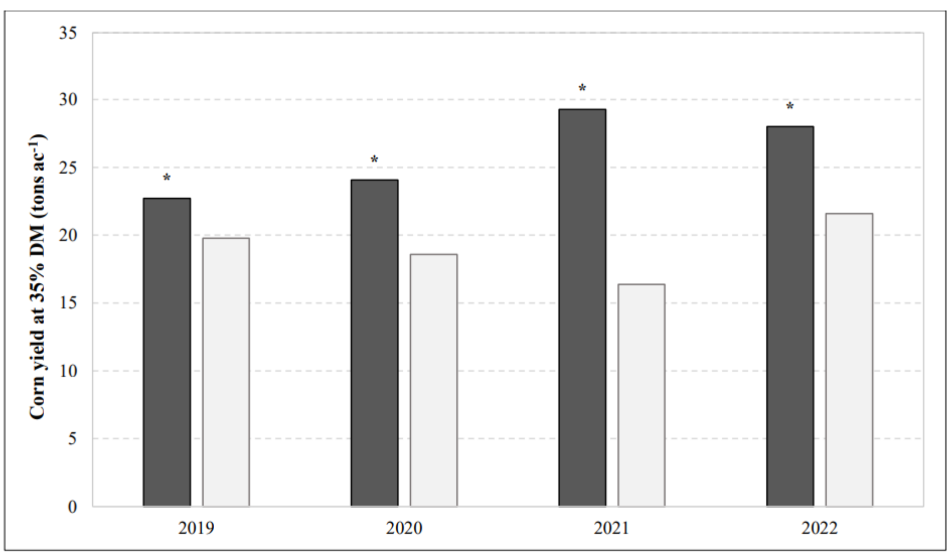

Figure 6. **Corn silage yield in 30” and 60” rows by year, Alburgh, VT, 2019-2022.** An asterisk (*) indicates a statistically significant (p=0.10) difference between treatments for that year.

Cover crop species including cow peas, sunn hemp, sunflower, buckwheat, annual ryegrass, orchardgrass, alfalfa, and tillage radish were used in the trials. Over the past 4 years of research trials at Borderview Research Farm, cover crops planted into 60-in rows produced more biomass than in 30-in rows, regardless of cover crop type (Figure 7). Yields ranged from 2.8 to 4.2 times higher in the wide rows compared to traditional 30" rows. The type of cover crop did not impact the overall corn silage yield or quality.

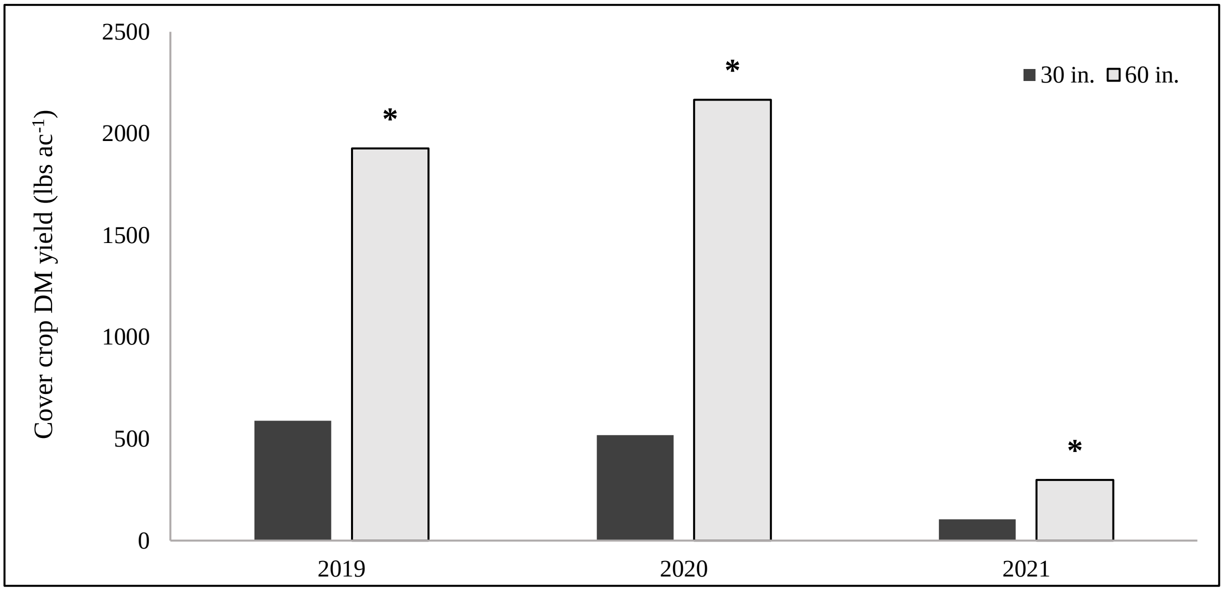

Figure 7. **Cover crop yield in 30" and 60" rows by year, Alburgh, VT, 2019-2021.** An asterisk (*) indicates a statistically significant (p=0.10) difference between treatments for that year.

Selecting a cover crop species for interseeding is challenging. The ideal candidate must meet the following criteria:

- can be seeded in early summer,
- establishes quickly but not too vigorously as to not outcompete the corn,
- can continue to grow once shaded by the corn canopy,
- does not grow too tall as to avoid being harvested with the corn crop,
- quickly resumes growth once corn crop is removed in fall,
- provides maximum soil and environmental benefits (i.e., nutrient retention, erosion prevention, pollinator habitat, etc.),
- provides additional crop value (i.e., forage crop), and
- minimizes seed expenses.

Figure 8. From left to right: orchardgrass/alfalfa mix (left and left of center), orchardgrass, and alfalfa interseeded into corn silage.

While it would be great if one cover crop species could accomplish this entire list, it is more likely that several would need to be used in a mixture. A common mixture used for interseeding in Vermont includes annual ryegrass, red clover, and tillage radish. However, one of the goals this mixture does not achieve is providing additional forage value through overwintering or perennial species. To address this, we evaluated using orchardgrass, alfalfa, and an orchardgrass/alfalfa mix as an interseeded crop into the same row spacings previously described through replicated plot trials. We also worked with two local farms to try seeding alfalfa in 20” and 40” spacings and 30” and 60” spacings at the field level.

Success through two years of trials was variable. The slower growth of the perennial species provided opportunities for weeds to establish especially in the wider row scenarios where light infiltration was greater. However, these challenges can likely be overcome through changes in weed management prior to transitioning to the solar corridor cropping system. As with any planting, conditions at and following interseeding influenced forage establishment and survival (Figure 8). On one farm where alfalfa establishment was quite successful, the field was revisited the following spring prior to termination (Figure 9). While biomass was not collected, the average alfalfa plant density was 6 plants/ft^2 which is above what would typically be considered the minimum for a productive stand of alfalfa. Additional high-quality forage could be harvested from such a stand, or it could be terminated providing additional nitrogen for the subsequent cash crop potentially yielding savings on purchased fertilizer.

Considerations for Implementing SCCS Successfully

Weed control

- Use of residual herbicides prior to establishing cover crops will reduce their establishment success. Select herbicides that meet your weed control goals without interfering with your cover cropping goals.
- While the wider rows allow more light to reach the cover crop, traditional dense rows (30" or less) shade out the weeds. This may lead to wide rows allowing more weed growth if cover crop establishment is poor.

Corn variety selection

- When using wider row spacings higher populations are utilized to compensate for the reduced crop rows in production. Therefore, it is important to select varieties that perform well at higher populations. This may include utilizing varieties with vertical leaf structures.

Damage at harvest

- If the cover crop is too tall when the corn is being harvested, the cover crop can get chopped with the corn during harvest. Additionally, during wet conditions, the cover crop can be damaged during corn harvest.

Figure 9. Alfalfa in the spring following interseeding into corn silage with 40" row spacing.

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