Direct-seeding Legumes into Orchard Alleys for Nitrogen Production

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Introduction

Nitrogen is a critical nutrient needed in most Pacific Northwest orchards, and can be challenging to provide to organic orchards. Planting legumes instead of grass in orchard alleys offers the opportunity to grow a portion of the orchard nitrogen need from N fixation, a renewable source. However, the orchard alley presents unique hurdles to legume production, especially shade and machinery traffic. Little screening, much less breeding, of legume species or cultivars has been done for their adaptability as an orchard understory crop. Orchard irrigation systems must be sufficient to supply the needed water to the legume. The legume can be mowed in place or mowed and blown on to the tree row for maximum effect with a special mower. Tilling the drive alley to plant a legume can be a renewable source. However, the orchard alley presents unique hurdles to legume production, especially shade and machinery traffic. Little screening, much less breeding, of legume species or cultivars has been done for their adaptability as an orchard understory crop. Orchard irrigation systems must be sufficient to supply the needed water to the legume. The legume can be mowed in place or mowed and blown on to the tree row for maximum effect with a special mower. Tilling the drive alley to plant a legume can

Methods

The trial was established in April 2008 in a mature block of ‘Gala’/M.26 apple on a multiwire trellis with a 3-dimensional canopy. Just over 4-ft width was present between the limbs on each side of the alley. Each plot consisted of a full-length tree row (90’) straddled on each side by the same vegetation treatment. Prior to planting, a 4-ft strip down the center of the alley was treated with herbicide (17 April) to kill or suppress the existing vegetation, except for about 100’ at the north end of each alley which was unprayed to represent the situation most organic growers would face. Legumes were then planted on 19 May with a 4-ft wide/Truax Flex-i-II drill with double-disk openers and press wheels (Figs. 1-4). Seed was planted 1/4-1/2” deep. The block was irrigated frequently as needed to maintain a moist soil surface until the seeds emerged (27 May).

Results

All the legumes had excellent emergence in 2008 (Fig. 5, 6). Ladino clover closed its canopy by mid-summer, while alfalfa grew 20-24” tall with little branching. Kura clover is known to be slow at establishment, and steadily improved its stand over the three years. The tissue N concentration in the legumes exceeded that of the grass control (Table 1).

In 2009 (Yr 2), all species performed well. While there was no significant difference in cover crop biomass between pre-emergent herbicide and not, the sprayed samples had a higher concentration of the legume in the biomass, boosting their total N content (Table 2).

Legume treatments were alfalfa (Medicago sativa ‘Radiant’), jumbo Ladino white clover (Trifolium repens), bermudagrass ‘Fescue’, and Kura clover (Trifolium ambiguum ‘Prairie’). A fifth treatment was the established grass as a control. All legumes were inoculated with the appropriate Rhizobium species prior to planting. Each treatment was replicated 4 times. Germination and stand establishment were monitored during Year 1 (2008), with a single ‘mow and blow’ cutting on 27 August, when cover crop biomass was measured and samples taken for total N in the tissue. In 2009, cover crops were mowed 4 times (29 May, 3 July, 20 August, 1 October). Ladino clover tended to be flowering by mowing but not the other species. Soil samples from the tree row (0-12” depth) were taken bi-weekly for nitrate and ammonium. Plant Root Simulator probes were recovered at the same interval to monitor root available N adsorbed onto their anion-exchange membranes. In 2010, the same procedures were followed, with 5 mow and blow dates (6 May, 17 June, 23 Jul, 25 August, 24 September).

Table 1. Tissue N concentration of pre-plant herbicide on cover crop biomass.

Table 2. Effect of pre-plant herbicide on cover crop biomass.

Conclusions

• Direct seeding legumes into existing vegetation was successful
• Can grow nearly half the available N needed for apples (7 effective swath)
• Water seeding results will provide proportionally more N
• Need more assessment of N release and volatile losses
• Narrower drill row spacing will enhance establishment and competitiveness
• Shade, traffic are affecting cover crop growth
• Spraying out grass before planting helped, but all legumes had reasonable stands; compensate with double pass, higher seeding rate
• Need multiple years to assess species performance, need testing of more novel species
• Combinations of species should be explored; alfalfa + Ladino clover to exploit different spaces; alfalfa + kura to extend stand longevity

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More information at our website:
http://organic.tfrec.wsu.edu/OrganicIFP/OrchardFloorManagement/s/