Cover Crop Research at the University of Rhode Island

Rebecca Brown*, Gabrielle Torphy, and Tim Sherman

University of Rhode Island Department of Plant Sciences and Entomology, 210 Woodward Hall, Kingston, RI 02881

* Contact for more information. Email brownreb@uri.edu. Phone 401-874-2755

Cover crops provide many important services as part of a vegetable production system, including reducing runoff and soil erosion, capturing nutrients within the root zone, fixing nitrogen, building soil organic matter, and suppressing weed growth. Much of the research on cover crops has focused on winter cover crops or on crops that remain in place for one or more growing seasons. Rotation with long term forage or grain crops maximizes the benefits of cover crops, but is frequently economically unfeasible for peri-urban farms where high land costs combine with limited infrastructure for harvesting, storing, and marketing forage and grain crops. Winter cover crops are of limited utility when farmers are using season extension practices to plant vegetables as early as possible in the spring, and prolong harvest as late as possible in the fall. These limitations have led to cereal rye being the cover crop of choice for winter, and buckwheat being the most widely used summer cover crop.

Both cereal rye and buckwheat provide benefits. Rye is extremely winter hardy, and can be planted as late as early November in Rhode Island. It is effective at reducing runoff and soil erosion and capturing nutrients within the root zone. While rye can provide large amounts of organic matter, realizing this benefit requires letting the rye grow until late spring which delays planting of the vegetable crop. In practice, rye is often incorporated in early spring and contributes minimal organic matter. Buckwheat germinates and grows very quickly in warm soil, effectively suppressing many annual and perennial weeds. It is an excellent phosphorous scavenger. The biomass is easily incorporated and breaks down quickly without being allelopathic. The flowers are attractive to pollinators and beneficial insects. However, buckwheat matures very quickly in the heat of summer, and if termination of the cover crop is delayed it will self-seed, becoming a weed in the following crop. Buckwheat residue degrades quickly, contributing little to the soil organic matter levels.

The vegetable production team at the University of Rhode Island has been investigating alternatives to buckwheat for short-season summer cover crops, seeking crops that suppress weeds effectively but also contribute significant organic matter to the subsequent crop or fix nitrogen. This report presents the results of the first year of a two year study funded by an NRCS Conservation Innovation Grant.

Alternatives to Buckwheat

The objective of this portion of the study was to evaluate some of the newer summer cover crop species to identify crops which mature in the same 6-8 week period as buckwheat, but would provide different benefits and decreased likelihood of self-seeding. We tested teff (*Eragrostis teff* cv. Dessie), Japanese millet (*Echinochloa esculenta* VNS), sunn hemp (*Crotalaria juncea* cv. Tillage Sunn), and chickling vetch (*Lathyrus sativus* cv. AC Greenfix). Teff and Japanese millet are warm-season annual grasses, able to produce abundant biomass under warm, dry conditions.

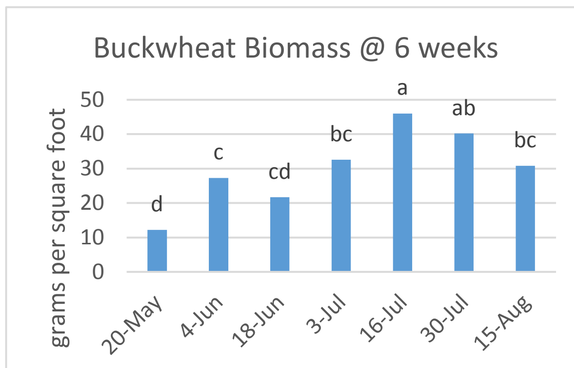
Table 1. Standard seeding rates

Crop	Target rate
Buckwheat	50 lbs/acre
Teff	9 lbs/acre
Japanese Millet	20 lbs/acre
Sunn Hemp	50 lbs/acre
Chickling Vetch	80 lbs/acre

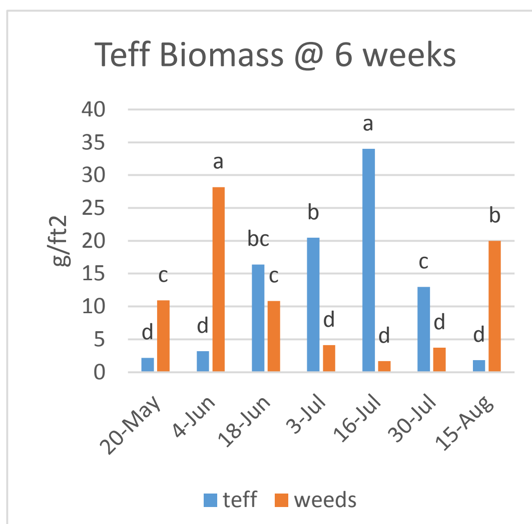
Sunn hemp and chickling vetch are annual legumes with the potential to fix 60-100 pounds of nitrogen per acre within 6-8 weeks of seeding. Sorghum and sorghum-sudangrass (Sudex) were not included in this study because under our conditions they require 10 weeks or longer to fulfill their potential.

Buckwheat, sunn hemp, teff, and Japanese millet were seeded at the standard rate (Table 1) every two weeks from May 20 to August 15, while chickling vetch was seeded from July 15 to August 16. Data were collected on seedling emergence, crop biomass, and weed biomass at 6 weeks after seeding, and crop biomass at 8 weeks after seeding. Biomass samples were cut at one inch above the soil surface and dried to constant moisture before weighing. We also tested alternate seeding rates for teff, sunn hemp, and Japanese millet, planting each crop at four rates on June 18. Sunn hemp, buckwheat, and chickling vetch were seeded with a standard grain drill, while teff and Japanese millet were seeded with a Brillion cultipacker. Plots were 1500 square feet, with data collected from six randomly placed 1 square foot quadrats within each plot. Legume seeds were inoculated with compatible rhizobia bacteria prior to seeding. Grass plots were fertilized at seeding with Nature's Turf 8-1-9 organic fertilizer at 40 lb N/acre.

Effects of Seeding Date



Dry biomass production for buckwheat six weeks after planting ranged from 12 g/ft^2 to 46 g/ft^2 with the May 20 seeding producing the least biomass, and the July 16 seeding producing the most. July 16 and 30 were the best seeding dates, followed by July 3 and August 15. Weed biomass was low with no significant differences between seeding dates. Biomass increased substantially between weeks 6 and 8 for the June 4 and July 3 seedings, but not the other dates.



Dry biomass for Japanese millet ranged from 3 g/ft^2 to 39 g/ft^2 at 6 weeks after planting, and from 4 g/ft^2 to 70 g/ft ^{2}at 8 weeks after planting. Biomass production was significantly greater for the July 16 seeding than any other date. Japanese millet biomass production was highly variable within individual plots, suggesting that this species is sensitive to small differences in soil quality.

Teff biomass production also peaked in the July 16 seeding, with 34 g/ft ^{2} at 6 weeks and 50 g/ft ^{2} at 8 weeks. Teff was effective at suppressing weeds in seedings between June 18 and July 30, but not in earlier or later seedings.

Sunn hemp performed poorly on all seeding dates, with biomass at 8 weeks ranging from 1 g/ft ^{2} to 17 g/ft ^{2}. Weed biomass exceeded sunn hemp biomass on all dates except July 16, when sunn hemp 6 week biomass peaked at 8 g/ft ^{2}.

Chickling vetch was seeded on only 3 dates out of concern that as a cool season legume it would perform poorly in mid-summer. The species has the potential to produce over 1 ton of biomass per acre, but the best of our yields was only 1100 lbs/ac. Biomass at eight weeks ranged from 8 to 12 g/ft ^{2}with the highest production from the July 30 seeding. Chickling vetch out-performed sunn hemp on all three dates that both crops were seeded. Weed biomass greatly exceeded chickling vetch biomass six weeks after the July 16 seeding, but the other planting dates were much less weedy.

Effects of Seeding Rate

Sunn hemp, teff, and Japanese millet are less commonly used cover crops than buckwheat and ideal seeding rates have not been established for southern New England. Teff was seeded at 7, 8.5, 12, and 18 lbs/acre. Japanese millet was seeded at 11, 22, 33, and 44 lbs/acre. Sunn hemp was seeded at 12.5, 20, 25, and 33 lbs per acre. Crop biomass was measured at 10 weeks after seeding as well as at 6 and 8 weeks, and weed biomass was measured on all three dates.

Seeding rate did not significantly affect biomass production for teff at 6 or 10 weeks, and only slightly affected biomass at 8 weeks. All seeding rates were able to out-compete the weeds. Japanese millet biomass increased with seeding rate, but differences were mostly not significant due to high variability. The 33 lb rate produced the most biomass overall, with 82 g/ft ^{2} at 10 weeks. The second highest biomass production was with the 44 lb rate, which produced 75 g/ft ^{2} of biomass at 8 weeks. Biomass production increased between weeks 8 and 10 for all rates except the 44 lb rate. Increasing the seeding rate of Japanese millet significantly reduced weed biomass at 6, 8 and 10 weeks, with the 44 lb rate consistently having the least weeds, and the 11 lb rate having the most. Seeding rate did not have any effect on sunn hemp biomass production.

Conclusions

Teff seeded at 7-9 pounds per acre is effective if seeded from mid June through July. Teff's ability to suppress weeds is comparable to buckwheat, with the added advantage that teff can be mowed or grazed at any time after establishment. In addition teff will not mature seed under New England conditions, so will not become a weed. While a 50 lb bag of teff seed costs significantly more than a 50 lb bag of buckwheat seed, the much lower seeding rate for teff means that the cost per acre is much less. Japanese millet has the potential to be a valuable high biomass cover crop, but it needs to be seeded at a minimum of 33 lbs per acre, and higher rates would further improve weed suppression. Sunn hemp does not appear to be a viable option under Rhode Island conditions due to our relatively cool summers. It may be useful in more inland areas of New England where summers are hotter. Chickling vetch may be a useful summer legume, but it needs to be tested at a greater range of seeding dates.