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Cover Crops and Green Manure Crops: Benefits, Selection, and Use

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Introduction

A cover crop is a crop grown to protect the soil from erosion. A green manure is a crop which is plowed under for soil improvement. If a cover crop is plowed into the soil, it becomes a green manure. Cover and green manure crops were used extensively before the development of synthetic fertilizers and pesticides. Recent interest in sustainable agriculture have farmers reconsidering the use of these crops. Both cover and green manure crops provide benefits that may increase consideration for their use. They can:

- prevent soil erosion by water and wind;
- retain soil moisture by acting as a mulch;
- add organic residues that may lead to soil organic matter increases;
- fix atmospheric nitrogen (legumes), thereby increasing soil nitrogen levels;
- cycle or hold nutrients, then return them to the soil when the plants are turned under then decompose;
- reduce soil compaction if the crop has a tap root that helps to loosen the soil;
- improve soil structure via aggregate formation;
- suppress or control weeds by competing for light, water and nutrients, and;
- attract predaceous, parasitic and beneficial pollinating insects.

In New Jersey, traditional cover crops include small grains such as rye or wheat. Hairy vetch, clovers and other grasses and legumes are gaining popularity. However, selecting and integrating cover and green manure crops into a production system should entail evaluation of your own production system and the characteristics of the individual species.

Selection

In selecting a cover crop, first identify your objective, problem or need. Determine what would be the ideal species that would fit your needs, then match this with the best available cover/green manure crop.

- To control soil erosion, plant crops that establish quickly to provide soil coverage such as rye, forage-type ryegrass, hairy vetch and crimson or sweet clover. Grasses (including small grains) have fibrous root systems and help to hold soil in place.

- To increase organic matter, plant non-legumes or mixture of grasses and le-

gumes. Small grains can provide significant amounts of biomass vegetation. Once tilled under, the vegetation decomposes over time, adding valuable organic matter and humus. During this process, nitrogen may become immobilized or unavailable to plants, particularly when crop residues or stalks are tilled into the soil. Combining these crops with legumes, or applying additional nitrogen fertilizer or manure, can help to reduce this problem by accelerating decomposition of the more mature crop material.

- To supply nitrogen to subsequent crops, select a legume. Legumes include alfalfa, clovers and hairy vetch. Through a symbiotic relationship with *Rhizobium* spp. bacteria, legumes can fix atmospheric nitrogen. Legumes can supply up to 300 lb. N/A, with 20 to 60 percent available to next crop, depending on type of legume, weather and soil conditions, and stand. Potential nitrogen contributions for selected legumes are listed in Table 1.

Table 1. Potential Nitrogen Fixation of Selected Legumes

Crop	Estimated Production lbs. N/A/year
alfalfa	160-200
clover, alsike	120-140
clover, Ladino	180-200
clover, sweet	140-180
crownvetch	80-120
hairy vetch	80-250

- To prevent nutrient loss over winter, small grains can be planted in the fall. These crops use residual soil nitrogen from the preceding crop fertilization that might be lost from the upper soil profile by leaching. Once the crop is incorporated in the soil, nitrogen and other nutrients become available to subsequent crops by their decomposition.

- To loosen compacted soils and break plow-pans, plant crops with taproots. These include alfalfa, any of the clovers and the sweet clovers.

- Cover crops can provide an increment of weed control by competing for light, water and nutrients. Fast growing covers such as buckwheat, or large biomass producers such as hairy vetch or sudangrass, can be grown. Using higher seeding rates also increases the competitiveness of the cover crop.

- Cover crops may attract beneficial insects, particularly when flowering, as they provide a food source. However, allowing these crops to reach maturity may complicate their control if they have gone to seed or have excessive growth that is difficult to incorporate.

Integration

Cover and green manure crops can be grown at different times of the year. Depending on the crop rotation being used, they can be grown after a cash crop or overseeded (planted into a standing crop). They can protect the soil over winter, then be plowed into the soil. It is important to identify the time period that the cover or green manure crop can be successfully established. Then, one must consider how the crop will be planted. To begin, consider the following:

- Examine your crop rotation and note when the cash crops are planted and

harvested. Look for open times when a cover crop can be established. Plan ahead as timing is critical.

- Predict the weather conditions at and after establishment. Can the cover crop be planted with adequate time to germinate and establish before winter, or mature and be controlled before the next cash crop and still provide the benefits you are seeking? Try to broadcast seed before rains are expected to help establishment.

- Consider how the crop will be established. Must the seed be incorporated? Can it be relied upon to germinate on the surface? If not, overseeding with a broadcast seeder is not an option. Will the cover/green manure crop seed be relay cropped or companion seeded? Relay cropping is the establishment of the cover crop in the standing cash crop. Planting a cover while cultivating corn is an example. Companion cropping is planting both the cover and cash crop at the same time. Can the cover crop be over seeded into the existing crop? This method is also called intercropping. Is the crop shade tolerant? Consider the use and time for establishment by considering life cycle, hardiness and growth rate.

- Determine how the crop will be controlled. Can or will you mow, spray, till or graze it? This depends on your production system as well as the characteristics of the cover and green manure crops. Some crops such as hairy vetch and crimson clover must be controlled before its seed matures unless its perpetuation is desired. Sudangrass is a tall, fast growing plant that may require mowing throughout the season. In these cases, the crops may require additional efforts or techniques to handle them.

By combining the selection and integration process when planning, a list of needs or requirements can be drawn up. Then, using additional information, such as that contained in Table 2, one or more species can be selected for use. Understand that it may be difficult to determine what species might be best suited, as individual production practices and conditions will vary greatly for every farmer.

Evaluation

Before planting one species on a large scale, evaluate the choices that appear to be best suited for your needs. Use test strips within your field. One method is to select areas that are 10 x 50 feet or larger. Plant at least 2 species or several varieties of one species. Record date and rate of seeding and subsequent weather conditions, particularly those affecting emergence and establishment of the seedlings. Also note vigor, competitiveness and ease of control. Then select the best species for your situation, considering cost, availability of seed, ease of establishment, degree of erosion control, weed control, or benefit to the following cash crop.

Conclusions

Cover or green manure crops can be very beneficial when the correct crop is selected and properly used. When selecting a cover or green manure species, first identify your objectives or needs and the time period when the cover crop can be successfully established. Then consider which would best fit your situation and match it with the best available species. To determine the best fit for your conditions, test several species within your field, then choose the best based on performance, cost and availability.

Table 2. Characteristics of Selected Cover and Green Manure Crops Suitable for New Jersey.

Cover Crop/ Green Manure	Type	Life Cycle	Winter Hardiness	Shade Tolerance	Seeding Rate (#/A)	Comments/Additional Information
alfalfa	legume	P	good	poor	15-20	• expensive seed • moderately slow to establish • well drained fields only
barley	small grain	WA	moderate	—	90-120	• unlike other small grains, cannot tolerate moist soil, low pH or fertility
birdsfoot trefoil	legume	P	good	—	5-6	• seedlings uncompetitive • excellent in wet, poor fertility sites
buckwheat	broadleaf	SA	none	moderate	35-60	• fast grower • mid-summer smother/cover crop • germinates well in dry soil
clover, alsike	legume	B/P	good	moderate	4-7	• best clover for wet sites and acidic soils
clover, crimson	legume	P	moderate	high	15-20	• fast grower • good for overseeding • shade tolerant • central/south NJ
clover, red	legume	P	good	high	10-12	• short lived • taproot can break up compacted soil • can broadcast seed
clover, subterranean	legume	WA	fair	poor	9-20	• residue provides good weed control • can no-till plant into • dies in July if planted previous fall • reseeds
clover, sweet	legume	A/B	none	high	8-15	• requires pH > 6 • good summer cover and smother crop • fast grower • high biomass producer
clover, white sweet	legume	B/A	good	moderate	8-15	• requires pH > 6 • taproot can break up compacted soil • high biomass
clover, white	legume	P	good	high	1-2	• low growing • easy to maintain • high nitrogen fixation
crownvetch	legume	P	good	moderate	5-15	• slow germination • expensive • long lived • excellent erosion control
millet, pearl	grass	SA	none	—	15-25	• rapid growth • large biomass production • tolerates pH of 5
oats, spring	small grain	A	none	moderate	64-96	• drill or broadcast • fast grower • winter kills
rye, winter	small grain	WA	excellent	high	84-112	• most hardy cover crop • quick germination and growth • tolerates wet, dry, low fertility and low pH conditions
ryegrass, annual	grass	WA	none	high	20	• quick growth • competitive • broadcast, drill or aerial seed
ryegrass, perennial	grass	P	very good	moderate	14-25	• short lived • quick growth • excellent root system • use forage types
sudangrass	grass	SA	none	—	25-35	• rapid growth • large biomass production • requires pH > 6
vetch, hairy	legume	WA	moderate	moderate	20-30	• large biomass production • use of tillage to control before seed matures • can seed with rye • little fall growth, excellent spring development
wheat, winter	small grain	WA	good	—	90-120	• easy to establish • drill or broadcast seed

A=annual, SA=summer annual, WA=winter annual, B=biennial, P=perennial. Seeding rates vary depending on establish method and time. One-third times higher rates for overseeding.

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