THE ORGANIC WAY - SELECTING GREEN MANURE CROPS FOR SOIL FERTILITY

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Editors note: With organic production, management of fertility is a critical issue, and use of green manures is a primary tool to deliver needed nitrogen and other crop nutrients. The following article by Dr. Sanchez is reprinted from the Vegetable and Small Fruit Gazette, Penn State Dept. of Horticulture, which can be found online at:
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In organic growing the philosophy behind soil fertility is to feed the soil and the soil in turn will feed the cash crop. Cover crops, green manures, animal manures and sound crop rotations are used to improve and/or maintain soil fertility. This article focuses on the use of green manures.

Green manures are crops that are turned into the soil while they are young and succulent, rather than harvested, to improve the organic matter content. As the organic matter is decomposed nutrients are released that can be used by subsequent crops. Several factors influence the release of nutrients from green manure crops including soil temperature and moisture and placement. In general, nutrient release will be slower at lower soil temperatures because the soil organisms that breakdown organic matter have lower biological activity or work slower at lower temperatures. Nutrient release is slower when soil is dry or waterlogged for the same reason. When green manure crops are not turned into the soil and left on the soil surface, breakdown and release of nutrients will be relatively slow due to drying of the plant tissues. When the green manure crop is incorporated into the top 6-8 inches of the soil, it will breakdown more rapidly because this is the area of the soil where most of the organisms that breakdown plant tissues are. When the green manure crop is soil incorporated deeper than 8 inches, it will decompose more slowly because lower oxygen levels at deeper soil depths limit the number of organisms that breakdown plant tissues.

Selecting a green manure crop to incorporate into a cropping rotation involves three steps:

1. Decide on the purpose of the green manure crop.
2. Identify a planting niche. Select a green manure crop that meets your goals.

Green manure crops can be used to provide nitrogen, increase the organic matter content and/or scavenge nutrients in the soil. Legume species are the best choice for adding nitrogen to the soil because they are able to establish relationships with bacteria in the soil that turn nitrogen in the atmosphere into a form that the plant can use. As illustrated in the table below, legume species differ in the amount of nitrogen they can add to the soil.

Legume Species	Nitrogen-fixing Capacity
Alfalfa	High*
Hairy vetch	High
Cowpeas	High
Crimson clover	Moderate
Field peas	Moderate
White clover	Moderate
Red Clover	Moderate
Common Bean	Low

*High = greater than 150 lb/acre/yr; moderate = 50 to 150 lb/acre/yr; low = less than 50 lb/acre/yr. Table adapted from Northeast Cover Crop Handbook.

When growing a green manure crop to increase the organic matter content in the soil, non-legume species or mixtures of grasses and legume species are good options. The tissues of legume species have a low carbon to nitrogen ratio, which results in a relatively quick release of nitrogen as the plants breakdown. Because of this they add nitrogen relatively quickly to the soil but the amount of organic matter contributed to the soil is limited over the long-term. Green manure crops grown to increase the soil organic matter content are generally those with large above-ground plant canopies and include annual ryegrass, cereal rye, triticale, sorghum/Sudan grass and hairy vetch. Green manure crops can also be grown to scavenge nutrients left in the soil after the cash crop is harvested and thereby prevent the loss of those nutrients through leaching. In this case, select a crop with a large, deep root system that develops quickly because deep-rooted crops can recycle nutrients from deep in the soil. Options include small grains, cereal rye, triticale, rapeseed, annual ryegrass, oil seed radish, mustard and some legume species.

Once the purpose for growing the green manure crop is decided, the next step is to identify where the green manure crop fits into a cropping rotation. If it will be grown in the fall, cool season crops including vetches, peas, annual and perennial clovers, ryegrass or barley are good choices. If it will be grown in the late spring or summer, warm season crops including sorghum/Sudan grass, cowpeas or buckwheat are good choices. Land can be devoted exclusively to growing a green manure crop or it can be interplanted or undersown along with the cash crop.

These are some final tips to consider when selecting a green manure crop. Determine characteristics that are undesirable and avoid plants with those characteristics. For example, some plants with large above ground canopies are difficult to manage if the proper equipment is unavailable. Also, consider cost and seed availability in the final decision. Finally, it can be difficult to find a green manure crop that meets all soil fertility goals and likely trade-offs will have to be made.

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