Cover crops can be a key soil improvement resource for conventional and organic growers alike. Here is an introduction to the role and selection of cover crops for farming systems. There are cover crops to fit almost every type of cropping system. For Certified Organic agriculture, according to the USDA National Organic Program Standards “the producer is required to implement a crop rotation, including but not limited to sod, cover crops, green manure crops, and catch crops.”

Many types of plants can be grown as cover crops. There are two broad general categories of cover crops – non-leguminous and leguminous. The leguminous cover crops fix and add nitrogen to the soil. Non-leguminous cover crops are users of N and hold it until either incorporated or fed ass forage. Non legumes are often preferred on erosive soils. Each plant type has advantages over the other and differs in its area of adaptability.

In choosing a cover crop for soil improvement, first identify the purpose or the primary function of the cover crop based on the needs of your system. Use the list below to identify the primary function(s) of the cover crop:

Provide nitrogen – Growing legume cover crops is one of the most important tools to increase soil fertility. The main benefit of using a legume as a green manure is that the legumes fix nitrogen from the atmosphere and convert it into a form that is available to other plants. Choose legumes that are adapted to your area. Legumes (peas, vetches, clovers, beans and alfalfas) grow in a symbiotic relationship with soil dwelling bacteria (rhizobia). The bacteria take gaseous nitrogen from the air trapped in the soil and convert or ”fix” this nitrogen into a form that the plant can use, in exchange the plant provides carbohydrates to the rhizobial bacteria. Legumes vary from one another in the percent of nitrogen they contain on a dry matter basis. Legumes contain nitrogen in both their top growth and in their roots. A high percentage of the biologically fixed nitrogen is in the top growth, so it is important to manage them to let them grow long enough to produce their full high potential amount of biomass.. The residues of these crops can contribute substantial nitrogen (75 to over 150 units of N) to following crops.

Increase soil organic matter - By improving the soil biological activity, cover crops can conserve or increase soil organic matter if they are managed to grow long enough to produce a high amount of biomass. A major benefit from green manures is the addition of carbon compounds in the form of organic matter to the soil. Over time, soil organic matter is decreased through tillage and biological activity. Adding crop residues back to the soil also helps maintain soil organic matter. Complex soil structure is built by the addition of organic matter. In no-till systems where there is limited incorporation of plant residues, cover crops are important key to building soil organic matter. The roots will physically penetrate the soil and release carbon compound root exudates in the soil at varying depths as the roots grow deeper. When these cover crops are terminated their dying root biomass becomes incorporated organic matter at various depths. Obviously, a plant with large root biomass will do this job the best. With summer annuals like the sorghum family, harvesting the forage at

least once drives the roots deeper into the soil. With cool season grasses, each harvest causes the roots to shed about half their biomass and it regrows as the leaves regrow.

Improve the nutrient availability in the soil - Nutrient availability is improved because the cover crop plant roots release 80% of the sugars that the plant produces into the soil to feed the soil microorganisms that build soil and in turn mineralize, recycle and release nutrients to the next crop. When incorporated into the soil, cover crop biomass is decomposed by soil bacteria and fungi. Through this process of biological decomposition the soil nutrients are recycled. Look for high biomass –producing cover crops. In addition, increased plant residues associated with cover crops in a system improve the soil environment for certain beneficial organisms. Organisms such as earthworms, insects and microorganisms can improve soil quality and increase nutrient availability by quickly decomposing organic matter and plant residues.

As a summer cover crop, consider sorghum-Sudan grass hybrids. Fall-planted winter annuals, such as cereal rye and triticale plus certain deep-rooted annual ryegrasses work well. The legumes which produce much biomass include hairy vetch, alfalfa, medium red clover, ladino white clover, field peas, sweet clover and crimson clover. Mixes of legumes and cereal crops can be used as well.

Scavenge nutrients – Soluble plant-available nutrients, especially nitrogen, are left in the soil after the cash crop has been harvested. Over the winter, bare soil is prone to losses of nutrients both into the air by volatilization and to water by leaching or by erosion. Growing a cover crop will reduce those loses by taking up the nutrients into their own tissue. The nutrients in cover crops are not always directly available to plants. The soil microbes decompose the cover crop residues, taking up some of the nutrients and releasing the rest to the soil environment. When the plants and the soil microbes decompose, the nutrients contained in them become available for the next growing crop in the rotation like a slow-release fertilizer. Legumes and grasses have symbiotic relationships with fungi that produce mycorrhizal hyphae (fungus roots) which branch through the soil and can help the plant scavenge nutrients (e.g. phosphorous). These fungi must be in association with a living root to survive. By having legumes, brassicas and/or grass cover crops growing after the cash crop, these microbial –plant root relationships can be maintained throughout the rotation to help foster further nutrient scavenging and cycling.

Examples of crops used for this purpose are annual clovers, specially-bred daikon radishes whose roots tend to grow straight down and penetrate 25 to 35 inches into the soil and certain annual ryegrasses which grow down even further (40 to 60 inches buy the next spring.

Prevent soil erosion and runoff – Cover crops can protect soil from raindrop impact and wind. . Choose species that grow rapidly and cover the soil surface quickly. Most of the same crops that are used for nutrient scavengers also provide good soil cover. The cover protects the soil from direct raindrop impact and also impeding the velocity of rainwater

flowing across the soil surface and thus reducing erosion potential, also covering the soil surface from direct wind gusts.

Improve soil structure – Increasing the soil organic matter with cover crops as previously mentioned improves the soil structure. As plant residues degrade, the soil microbes feeding on them release compounds into the soil. These compounds are gums, waxes and other exudates that have “glue-like” properties which cement soil particles together to form stable soil aggregates. Soil components aggregated together result in improved soil structure and tilth. Grasses have mycorrhizae associations as do legumes, however, grasses are characterized by dense masses of fibrous roots that improve the soil structure by exuding polysaccharides (sugars). The polysaccharides stimulate soil microorganisms which in turn exude gums that aggregate soil particles. Aggregates contribute to greater soil permeability, soil porosity, aeration, water infiltration and holding capacity, cat-ion exchange capacity, ease of crop emergence and root growth. Added organic matter also alleviates compaction by reducing the bulk density of the soil.

Improve drainage and alleviate compaction – Deep-rooted plants can help break through compacted layers in the soil such as a hard pan, or as it is sometimes known, plow pan. This will improve drainage. The penetrating roots of the cover crops make channels through which soil water can move after the root system decomposes. Species to consider are certain annual ryegrasses, sweet clovers and brassicas. These winter cover crops with large tap roots or massive root systems can help to alleviate some of the effects of soil compaction by penetrating the compacted layer when the soil is wet and relatively soft during the winter.

Provide mulch to conserve soil moisture:– Choose cover crops with a combination of high above-ground biomass and moderate or high carbon/nitrogen ratios. The microbes that decompose crop residues use carbon as an energy source and nitrogen to build tissue. If residues have a C/N ratio higher than 25:1, the microbes will need to gather N from the surrounding environment to do their work. Generally speaking, the higher the C/N ratio of the cover crop residue, the more slowly decomposition will occur and the longer the residue will serve as both a moisture conserving and weed-suppressing mat. The small grain cover crops are well suited for this. Most legume residues with higher nitrogen content will decompose more rapidly and be less effective as mulch. Mature rye and triticale can be effectively used as weed suppressing mulches when rolled down which also conserves soil moisture evaporation by keeping the soil covered.

No-Till for Organic Farmers: Recent progress has been made in organic no-till and killed mulch no-till systems using a crimper/roller that is mounted to the front of a tractor to roll down and mechanically kill fall-planted small grains or hairy vetch cover crops in the spring. With the front-mounted roller the process is a time and energy saver being a one-pass system of roll and plant. A no-till planter or no-till trans-planter can be used to cut through the mat of rolled-down cover crop and then seed or transplant into it. Winter annual

cover crops are used to cover the soil and recycle nutrients from fall through early spring and then rolled and into a weed-suppressing killed cover crop mat to no-till plant into. The rolled down cover crop deters weed emergence by the formation of the physical barrier of the cover crop residue, in addition, light transmittance to the soil surface declines with increasing residue biomass. Many weeds require light to activate a germination process prior to emergence. Reducing the amount of light reaching the soil surface by the residue is an important factor inhibiting weed germination. Early weed suppression provided by the cover crop residue will permit crops to become established before weeds.