

MULCH CORNER

LIVING MULCHES

By John Ferguson

Last Saturday at the Woodlands Landscaping Solutions garden event I was asked by several people how they could economically improve their soil on large acreages. We can do this by using what is known as Living Mulches. Depending on the goal it is also known as cover crops, green manures, etc., and it is done by growing plants just for the purpose of creating organic matter for the soil and they serve very similar purposes hence; many functions and benefits overlap. In general Living mulches are to be mowed and left on top of the soil or left standing, while green manures are to be tilled in. These mulches are generally used in agriculture; however, they can be also be used whenever one wants to improve the soil quality on larger areas.

Living mulches are showing greater and greater promise as we begin to understand natural systems better. Living mulches have many positive environmental aspects that we are beginning to measure and quantify, from reducing erosion, to increasing beneficial insects and microbes, to increasing water infiltration into the soil, and to increasing soil organic matter (humus), and many more. Living mulches are very cost effective for large areas as seen in agriculture such as orchards and vineyards.

For example, an appropriate cover crop (or living mulch) planted in late fall will:

keep the garden green all winter,

prevent erosion,

prevent soil compaction,

control winter weeds,

add large amounts of organic matter to the soil,



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control certain insect pests,
reduce erosion,
reduce surface water pollution (natural filtration system),
some species fix large amounts of nitrogen into the soil,
improve soil structure and tilth,
store and recycle nutrients,
increase soil productivity and carrying capacity.
many types attract beneficial insects which help control pests
reduce pest species
facilitate biofumigation to reduce pathogens

New studies have shown that some living mulches (cover crops like crimson clover) can reduce weed seed germination by 27% even after being worked into the soil. The studies also showed that if the nitrogen supplied by the clover was supplied by ammonium nitrate chemical fertilizer, then weed seed germination increased by 75%! Penn State University has been researching living mulches since 1975. New data indicates that living mulches tend to reduce frost damage on many species of plants.

Studies have shown that even a grass cover crop can add over a dry ton of organic matter per year to the soil just from the root mass. In some case this can reach over 5 tons/acre per year with another 1-2 tons from the above ground leaves and stems. Many living mulches can add several times these amounts of organic matter. In addition these plants produce root exudates to stimulate the growth of beneficial microbes (another type of organic matter).

For years many people have sworn by living mulches (cover crops, groundcovers, etc.). Researchers at the USDA in Beltsville, Maryland [HortScience 32(4):659-663 1997] have done studies comparing hairy vetch (*Vicia villosa*, a winter hardy legume) and plastic. The vetch plots had a longer season and produced up to twice as



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many tomatoes. Vetch is less expensive, more environmentally friendly, and enriches the soil by adding organic matter and nitrogen. Note, ARS scientists found that on tomatoes, growers using vetch had an average

increase in profits of 65% compared to those growers using plastic. Other crops that had a strong positive response to vetch mulch were melons, snap beans, peppers, and eggplants. For southern gardens crimson clover (*Trifolium incarnatum*) is a good option (also attracts several beneficial insects). Additional research at the USDA in Beltsville, Maryland [HortScience 31(1):65-73 1996] has shown higher yields and nitrogen levels in tomatoes when a living mulch was used when compared to black plastic even when twice the amount of fertilizer was used.

The USDA has found that snap beans yield in mulches from mixed annual winter legumes were comparable to those when synthetic fertilizer was used and for over 3 years, the yields were higher than conventional tillage systems (HortScience, December 1997). Additionally, the living mulch systems required no water, herbicide, fertilizer or other treatment until they were mowed. Other benefits from the mulch system included no runoff or erosion (HortScience, Vol.32 (7):1191-1193, December 1997).

Research at Kansas State University has shown that yields from muskmelons were much higher when beef manure was combined with living mulches (hairy vetch, Austrian winter pea, alfalfa, and winter wheat) than by using synthetic nitrogen fertilizer (HortScience, Vol. 31(1):62-64, February 1996).

Other studies have found that the type of living mulch affects the availability of nutrients in successive crops. For example, it has been found that red clover produces twice the amount of available nitrogen to successive crops (i.e. corn) when compared to oats, rye, oilseed radish, etc. Yields of successive crops were also increased.

New research is finding that certain plants when used as living mulches suppress soil borne diseases. For example researchers have found that Sudan grass and sweet corn suppress pathogenic fungus such as *Verticillium* wilt.

Many types of pathogenic nematodes are suppressed by sudan grass, rapeseed, white mustard, elbon rye, canola, etc. These plants also produce chemicals that are allelopathic or toxic to other plants,



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hence they can also be used for weed control. Using *Tagetes* sp. as living mulch has been found to reduce populations of root-lesion nematodes in a few months to a level where they do not cause significant damage. The effects have

been found to persist for several years. It was also found that the seed cost for living mulch was about half that of chemical fumigation.

Other studies in the Salinas Valley of California have found that low cost cover crop methods can reduce soil nitrate leaching by 37-70% in intensive vegetable production systems without hurting yields.

In commercial agriculture other factors come into play when using living mulches. Tillage, compaction from farm vehicles, preservation of beneficial insects, etc. are all factors and are beyond the scope of this article. Many new research studies on these issues have been published in the last couple of years and can be found in journals at the local library.

Remember that in using living mulches, as in all plants, repeated use of one species, in one spot, will over time increase the chance that certain diseases may develop in the soil. It is a good practice to rotate the living mulch and even use multiple or mixed species at the same time.

Using Living Mulch

Living mulch is often used as a cover crop while the main crop is growing. The cover crop will produce old leaves, stems, spent flowers, seed and seed pods, etc. as the plants grow. These are often mowed to keep the cover crop from competing with the main crop, adding organic matter to the soil, and to help build a soil surface mulch layer.

Hay fields, orchards, vineyards and other types of large plantings are getting good results from "Living Mulches". Some types fix nitrogen for the primary crops, others provide a home or attract beneficial insects that control pests in addition to enriching the soil. We need to remember that plants and their root exudates affect the microbes that live in the soil. These affects can often be carried over to the next crop. For example if the living mulch or previous crop stimulates more beneficial microbes then



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disease or even supplemental nitrogen requirements on the next crop can be reduced. Some of the beneficial metabolites produced can result in enhanced growth of the next crop.

Researchers are also learning that cover crops and living mulches can alter the amount and types of pathogens in the soil. Sometimes the cover crop will release anti-microbial volatile compounds which have a biofumigation effect. This has been well documented with members of the Mustard family (Cruciferae).

The gaseous chemicals produced by the plant while it is growing or when it is turned under and decomposing can kill some types of soil microbes including many pathogens. Hence, when the next crop is grown it will experience less disease pressure. Research is beginning on different aspects of natural biofumigation.

Biofumigation uses soil microbes to biodegrade a organic material (mulch, root exudates, etc.). Depending on the type of organic matter some of the breakdown products are volatile gases that adversely affect soil borne pathogens. The cruciferae family mentioned above contains compounds called gluosinolates that in the presence of the enzyme myrosinase (occurs in the tissues of microbes or produced by microbes), break down into isothiocyanate, nitriles, carbon disulfide or thiocyanate. Many of these are chemical fumigants with the potential to kill pathogens in the soil. For example a recent study showed that volatile compounds released from soil amended with meadow foam seed meal, completely suppressed sporulation by *Phytophthora ramorum* and *Pythium irregulare*. Soil potting mix amended with only 1% meadow foam seed meal showed striking growth enhancement of conifer seedlings. Another experiment with papaya (*Carica papaya*), meadow foam seed meal at 1% by volume greatly stimulated plant growth without suppressing mycorrhizal formation.

Limitations: Living Mulch is not suitable for crops or plants that are short, shallow rooted, or sensitive to low moisture or drought conditions that could be enhanced by the Living Mulch. Also if the soils are very sandy or other types of low fertility the effects of competition may make living mulches unsuitable.

If used in vegetable production, several studies have found it is best to delay planting of the living mulch until the primary crop is established. It has been found that about 1/3 of the way through the crop cycle works well for many crops.



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Some living mulches have different effects on the soil hence different benefits. One type may improve water infiltration into the soil better than another. A courser type plant material may reside on the surface longer since it decomposes at a slower rate. Living mulch with strong tough stalks (lignin) may encourage fungi in the soil while a soft grass living mulch may decompose quickly and encourage bacteria in the soil.

Living mulch can be planted similarly to any other plant seed. A loose friable soil makes a good seedbed. For small areas after the seeds are spread around, lightly raking the soils can help cover the seed and ensure good soil-seed contact. For large areas follow standard agricultural practices for your area.

Some living mulch can be used in winter while others are best suited for hot weather. Also, it is best to keep the living mulch mowed to prevent seeds from forming unless the land is going to lie fallow for a while.

Your local Agricultural Extension offices are often a great source of information on what types will work best on any given soil and appropriate for the time of the year.