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Cover Crops: Keeping Soil in Place While Providing Other Benefits

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Increasing crop yield and preserving the environment are two important concerns for agricultural scientists in the twenty-first century. To address these challenges, agricultural production systems must be adjusted to maximise yields while minimising environmental pollution. Crop residue management is an essential component for achieving long-term crop sustainability. Crop residues have traditionally been used as mulch to conserve soil and water, as well as an input for preserving soil organic matter and returning nutrients to the soil. Cover crops in cropping systems are an effective strategy for achieving these goals. Cover crops play an important role in increasing the productivity of subsequent row crops by enhancing the physical, chemical, and biological properties of the soil. They are grown to prevent soil erosion and nutrient loss due to runoff or leaching. They improve the structure and water-holding capacity of the soil, increasing the efficacy of added N fertiliser.

Cover crops can be leguminous or non-leguminous. Leguminous cover crops provide a significant amount of biologically fixed N to the primary crop, as well as ease of decomposition due to their low C/N ratio. Legume cover crops have a strong ability to absorb low available nutrients in the soil profile and can aid in increasing plant nutrient concentrations in the surface layers of soil. Some non-leguminous cover crops have higher N scavenger capacity than leguminous crops, and because the growth of these scavenging grass cover crops is sometimes limited by N deficiency, growing grass/legume mixtures appears to be the best strategy for maximising benefits of cover crops.

Role of Cover Crops in Improving Soil and Crop Productivity

Cover crops have the ability to establish rapidly under less-than-ideal conditions, provide adequate dry matter or soil cover, fix atmospheric nitrogen (N), establish a deep root system to facilitate nutrient uptake from lower soil depths, produce organic matter with a low carbon/nitrogen (C/N) ratio, and have no phytoxic or allelopathic effects on subsequent crops. In addition to fixing nitrogen, cover crops minimise NO_3 leaching from agriculture fields. It has been observed that using rye in field cropping system as a cover crop improved soil compaction, controls erosion and inhibited weed emergence (Blum *et al*., 1997). Cover crop residue protects soil from raindrop impact and wind shear. Crop residues on the soil surface affect radiation balance and energy fluxes, as well as slowing the rate of evaporation from soil. They may also help to reduce the negative effects of global warming by increasing CO_2 and N sequestration in the atmosphere. When cover crop decomposes, they provide additional vital nutrients to subsequent crops. The enrichment of soil with essential nutrients varies with cover crop, particularly the amount of dry matter produced and the concentration of nutrients in the dry tissues. Also cover crops have been shown to improve the P uptake of subsequent crops. Cover crop residues may convert relatively unavailable native and residual fertiliser P

to chemical forms that are more available to subsequent crops. Alfalfa (*Medicago sativa* L.), red clover (*Trifolium pratense* L.), sweet clover (*Melilotus officinalis* L.), and lupine (*Lupinus albus* L.) may absorb more phosphorus from low-phosphorus soils than most other crops. Cover crops are known to improve the physical, chemical, and biological conditions of the soil, which in turn improves the yields of subsequent crops.

Table 1. Major cover crops of tropical and temperate regions (Fageria *et.al*, 2005)

Tropical region		Temperate region	
Common name	**Scientific name**	**Common name**	**Scientific name**
Sunnhemp	*Crotalaria juncea L.*	Hairy vetch	*Vicia villosa Roth*
Sesbania	*Sesbania aculeata Retz Poir*	Barrel medic	*Medicago truncatula Gaertn*
Sesbania	*Sesbania rostrata Bremek & Oberm*	Alfafa	*Medicago sativa L.*
Cowpea	*Vigna unguiculata L. Walp.*	Black lentil	*Lens culinaris Medikus*
Soybean	*Glycine max L. Merr.*	Red clover	*Trifolium pratense L.*
Clusterbean	*Cyamopsis tetragonoloba*	Soybean	*Glycine max L. Merr.*
Alfalfa	*Medicago sativa L.*	Faba bean	*Vicia faba L.*
Egyptian clover	*Trifoliam alexandrium L.*	Crimson clover	*Trifolium incarnatum L.*
Wild indigo	*Indigofera tinctoria L.*	Ladino clover	*Trifolium repens L.*
Pigeon pea	*Cajanus cajan L. Millspaugh*	Subterranean clover	*Trifolium subterraneum L.*
Mungbean	*Vigna radiata L. Wilczek*	Common vetch	*Vicia sativa L.*
Lablab	*Lablab purpureus L.*	Purple vetch	*Vicia benghalensis L.*
Graybean	*Mucuna cinerecum L.*	Cura clover	*Trifolium ambiguum Bieb.*
Buffalobean	*Mucuna aterrima L. Piper & Tracy*	Sweet clover	*Melilotus officinalis L.*
Crotolaria		Winter pea	*Pisum sativum L.*
Breviflora	*Crotolaria breviflora*		
White lupin	*Lupinaus albus* L.	Narrowleaf vetch	*Vicia angustifolia L.*
Milk vetch	*Astragalus sinicus* L.	Milk vetch	*Artragalus sinicus L.*
Crotalaria	*Crotalaria striata*		
Zornia	*Zornia latifolia*		
Jackbean	*Canavalia ensiformis* L. DC.		
Tropical kudzu	*Pueraria phaseoloides (Roxb.) Benth.*		
Velvetbean	*Mucuna deeringiana Bort. Merr.*		
Adzuki bean	*Vigna angularis*		
Brazilian stylo	*Stylosanthes guianiensis*		
Jumbiebean	*Leucaena leucocephala Lam. De Wit*		
Desmodium	*Desmodiumovalifolium Guillemin & Perrottet*		
Pueraria	*Pueraria phaseoloides Roxb.*		

Benefits of Planting Cover Crops

1. The protective canopy formed by a cover crop reduces the impact of rain drops on the soil surface thereby decreasing the disintegration of soils aggregates.
2. A cover crop reduces soil loss due to sheet and rill erosion by slowing the velocity of runoff from rainfall and snowmelt.
3. A cover crop regimen increases soil organic matter over time, resulting in improved soil structure and stability, as well as increases moisture and nutrient holding capacity for plant growth.
4. A cover crop improves soil quality by increasing the biological, chemical, and physical properties of the soil.
5. A cover crop acts as a "trap crop," storing nutrients from manure, mineralized organic nitrogen, or underutilised fertiliser until the next year's crop can use them, decreasing nutrient runoff and leaching.
6. Cover crops reduce losses of total P, but extract soil P to available forms and may increase losses of dissolved P.
7. Cover crops reduces soil moisture deeper into the soil profile through evapotranspiration, leading in improved tillage and traffic conditions.
8. A cover crop is a natural way of controlling soil diseases and pests. It can also be used as a mulch or cover to help control weed growth.

Conclusion

In recent years the importance of cover crops in crop production is increasing due to concern for improving soil quality and reducing chemical inputs. Cover crops have a number of advantages, including improved soil fertility, structure, water retention, and groundwater quality, as well as reduced soil erosion and improved insect control. Choosing the correct cover crop is important to cover cropping success. Furthermore, as with cash crops, cover crops, should be rotated on a regular basis to minimise the accumulation of plant-specific pests. With proper selection, use, and management of cover crops, it is possible to improve productivity and also could contribute to improved soil, water, and environmental quality.

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