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COVER CROPS: WHAT ARE THEY AND WHY ARE THEY USED

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Cover crops are crops (grasses or legumes) planted between, or sometimes with, regular crops primarily to protect and improve the soil. Depending on the type of cover crop and how it is used, benefits can include improved soil fertility and quality, moisture conservation, decreased soil erosion and control of weeds, pests and diseases.

If the cover crop is incorporated into the soil while green or soon after flowering it is termed a green manure. The purpose of a green manure is soil improvement through the addition of organic matter. Green manure crops are commonly nitrogen-fixing legumes that reduce the nitrogen required for the following crop. “Catch crops” are cover crops planted to retain and recycle plant nutrients following a main crop, thus preventing leaching, while a living mulch is a cover crop that is inter-planted with an annual or perennial cash crop in order to suppress weeds, reduce soil erosion, improve soil fertility and improve water infiltration.

Figure 1: White clover between cabbage rows

Benefits of cover crops

Improved soil fertility

One of the primary uses of cover crops is to increase soil fertility. Nitrogen production from legumes ranges from 45 to 220 kg ha^{-1} N per year. The amount of N available depends on the species of legume grown, the total biomass produced and the percentage N in the plant tissue. The portion of green-manure N available to a following crop is usually about 40 - 60% of the total amount contained in the legume. In addition to nitrogen from legumes, cover crops accumulate phosphorus, potassium, calcium, magnesium, and sulphur during a growing season. If the cover crop is incorporated as a green manure or laid down as mulch the nutrients are slowly released back into the soil during decomposition. The breakdown of green manures also influences nutrient availability through the formation of carbonic and other organic acids by microbial activity. Phosphates and exchangeable nutrients are released when the organic acids react with insoluble minerals in the soil. This quality of cover crops is sometimes termed the fertiliser replacement value.

Soil quality management

Cover crops can improve soil quality by increasing soil organic matter levels over time. Soil structure is improved during the breakdown of organic matter in the soil when compounds, such as gums, waxes and resins, are formed that are resistant to decomposition. These compounds help bind together soil particles as aggregates. A well-aggregated soil is well-aerated and has a high water infiltration rate.

Certain cover crops, such as fodder radish, have roots that are able to penetrate and break up compacted layers in the soil. More shallow-rooted cover crops are also useful in relieving compacted surface soil layers.

Figure 2: Jap radish can help to break up compacted soil

Erosion control

Soil erosion can irreparably reduce the productive capacity of agroecosystems. Cover crops that quickly provide a high percentage of ground cover can be planted to physically slow down the velocity of rainfall before it contacts the soil surface, preventing soil splashing and erosive surface runoff. In addition, root networks anchor the soil in place, reducing soil movement. Research has shown that fields with winter cover ploughed under in the spring have 55% less runoff and 50% less soil loss annually than do fields with no winter cover. Sowing a mix of leguminous and grassy-type cover crops increases the ground coverage as well as providing some nitrogen to the following crop.

Water management

Cover crops often reduce the rate and quantity of water that drains off a field by acting as a physical barrier at the soil surface. A soil cover of decomposing organic matter also improves the stability of soil aggregates; this reduces the break-up of aggregates with raindrop impact thereby reducing the clogging of pores and the formation of soil crusts. Infiltration of water into the soil increases and water runoff during rainy periods is reduced. Cover crop root growth results in the formation of soil pores, which allows water to filter through the soil profile rather than draining off as surface flow. Mulch remaining from a killed cover crop also reduces water evaporation from the soil surface. With increased water infiltration the potential for soil water storage and the recharging of aquifers can be improved.

Weed, disease & pest management

Cover crops take up space and light, thereby shading the soil and reducing the opportunity for weeds to establish themselves. In addition to competition-based weed suppression, allelopathic plants, such as rye and sorghum, release natural toxins that inhibit or slow the growth of other nearby plants.

Some cover crops are used as so-called “trap crops” to attract pests away for the crop of value and toward what the pest sees as a more favourable habitat. Trap crop areas can be established within crops, within farms or within landscapes. In many cases the trap crop is grown during the same season as the food crop being produced. Other cover crops are used to attract natural predators of pests. If the cover crop is killed or mowed and left to form a mulch it can provide significant weed control in no-till cropping systems. Increased numbers of beneficial insects have been noted to be associated with cover crops. These insects reduce the incidence of serious pest outbreaks because they act as natural controls to bring pest populations back into balance. Using the cover crop as a mulch provides a habitat in which beneficial insects can live until the main crop is growing. This establishes a larger population of beneficial insects earlier in the growing season compared with when only a main crop is grown. This form of biological control is known as habitat augmentation.

Possible crops to use

It is important to identify what is required from a cover crop in order to determine the best cover species. Cover crops commonly used in KwaZulu-Natal are oats, stooling rye, vetch and triticale (these are often used as a winter cover in maize lands). Forage sorghum is also used (in summer), but less frequently. Cow pea, dry beans and soya beans tend to be used in rotation with other crops, but can be used as intercrops with maize. Other possible cover crops are listed in Table 1.

Figure 3: Cowpea intercrop in maize

Limitations of cover crops

While cover crops can help to conserve water, in years with below average precipitation they can draw down soil water supply in the spring, particularly if climatic growing conditions are good. In these cases farmers often face a tradeoff between the benefits of increased cover crop growth and the drawbacks of reduced soil moisture for crop production that season.

Table 1. Possible cover crop species for South Africa (Source: Dr A Calegari, Agronomic Institute, Londrina, Brazil)

Winter species	Use
Serradella	Forage, cover, nitrogen fixing
Field pea	Forage, cover, grain, nitrogen fixing
Hairy vetch	Forage, cover, nitrogen fixing
Common vetch	Forage, cover, nitrogen fixing
Blue lupin	Cover, human & animal food, nitrogen fixing
White lupin	Cover, human & animal food, nitrogen fixing
Faba beans	Forage, cover, human & animal food, nitrogen fixing
Radish	Forage, cover
Black oat	Forage, cover
White oat	Forage, cover, grain
Annual ryegrass	Forage, cover
Stooling rye	Forage, cover, grain
Triticale	Forage, cover, grain

Summer species	Use
Indigofera spicata	Cover, nitrogen fixing, potentially toxic if grazed
Cowpea	Forage, cover, nitrogen fixing
Sunnhemp	Forage, cover, nitrogen fixing, some varieties toxic
Crotalaria spectabilis	Cover, nitrogen fixing, potentially toxic if grazed
Crotalaria ochroleuca	Cover, nitrogen fixing, potentially toxic if grazed
Crotalaria mucronata	Cover, nitrogen fixing, disrupt compacted soils, toxic
Crotalaria breviflora	Cover, nitrogen fixing, potentially toxic if grazed
Italian millet	Forage, cover
Pearl millet	Forage, cover
Finger millet	Cover, human & animal food

Further reading

Clark, A. 2007. Managing cover crops profitably 3rd ed. Handbook Series book 9. Sustainable Agriculture Network, Beltsville, MD. (The online version of this publication is available at http://www.sare.org)

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