



White Clover

Jody Smith¹ and Hector Valenzuela²

Departments of ¹Natural Resources and Environmental Management and ²Tropical Plant and Soil Sciences

A popular temperate legume, white clover (*Trifolium repens*, also known as Dutch White, New Zealand White, or Ladino) can be grown successfully in the subtropics and tropics during cool seasons or at higher elevations. White clover improves soil quality, nourishes beneficial insects, and can be used in pastured animal systems.

Characteristics

White clover is a long-lived perennial that may behave as a winter annual legume in some subtropical locations such as Hawaii and Florida. It is smooth-stemmed, with trifoliate leaves. The leaflets are oval or circular; their edges have tiny serrations, and there are whitish markings on the middle of the upper surface. The seedlings initially grow a tap root and then stolons arising from leaf axils form a branched, radiating network, colonizing bare soil spaces. When the short-lived seedling plant dies, the stems arising from rooted stolons grow independently.

The initial taproot may grow to 3 ft (0.9 m) deep. Secondary roots developing from the stolon are mainly shallow (8 inches, 20 cm) but can extend to 30–60 inches (0.75–1.5 m) in deep, friable soils. Stands regenerate themselves both by reseeding and by vegetative growth. The plants can reach a height of 8–12 inches (20–30 cm) but are normally 4–6 inches (10–15 cm) tall.

Environmental requirements

White clover grows on a wide range of soils but grows better on clays and loams than on sandy soils. The soil pH range for white clover is between 5.5 and 7.0. White clover grows best where annual rainfall is between 35 and 50 inches (900–1300 mm) and conditions are cool and moist. The plant has some tolerance of shade, heat, flooding, and drought.

Benefits provided by white clover

EXCELLENT for attracting beneficial insects, for reduced- or non-chemical pest management, for controlling erosion, suppressing weeds once established, and as a source of organic nitrogen

GOOD for quick growth and establishment, for bearing equipment traffic

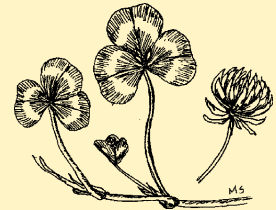
TOLERATES low fertility soils

FAIR shade tolerance

SUITABLE for higher elevations

GOOD forage for animal grazing systems; high production, nutritional quality, and palatability

USE IN plantation and orchard cropping systems including macadamia and coffee, in vineyards, and as a living mulch in vegetable cropping systems



In Hawaii, white clover grows year-round at elevations from 1500 to 7000 ft that receive 35–80 inches (900–2000 mm) of rainfall., according to the USDA Natural Resources Conservation Service (NRCS). The plant may go dormant during the winter months at the higher elevations and also during dry seasons at any elevation.

Cultivars

The white clover cultivars commonly recommended by the Hawaii NRCS are ‘Haifa’, ‘Huia’, ‘Grasslands’, and ‘New Zealand’ (a medium-sized white clover).

Establishment

Broadcast 5–14 lb (2.25–6.35 kg) pure live seed per acre, or drill 3–9 lb (1.4–4 kg) pure live seed per acre. Inoculate seeds with a red clover or white clover type rhizobia inoculant. Inoculation is probably unnecessary if inoculated clover was grown in the same field within the past 3 years. Avoid exposing inoculant or inoculated seed to high temperature or direct sunlight.

Broadcast and cover or drill to a depth of $\frac{1}{4}$ – $\frac{1}{2}$ inch (6–12 mm). White clover is normally established with a mechanical planter at the beginning of a rainy season. Seeding should be preceded by a phosphorus fertilizer application to ensure good establishment. It is possible to sow white clover into an established grass sod, such as a pasture. Before sowing, the grass is mowed or grazed to 4 inches or less, followed by a light disking or chopping. After drilling 3–9 lb of white clover seed per acre, go over the field with a cultipacker or land-roller to firm the seedbed and establish good seed-to-soil contact.

Uses

Soil quality improvement

White clover is a perennial legume that, depending on moisture availability, produces about 1–3 tons dry matter per acre, which contains about 80–200 lb of nitrogen (N). Its N contribution to the soil is normally about 130 lb/acre when plowed at the early flowering stage. To maximize white clover’s N-fixing ability, the soil should have adequate phosphorus, sulfur, and micronutrients, especially iron, and molybdenum, suitable pH, and good aeration (no compaction or waterlogging). When growing white clover, farmers should quickly see improvements in the topsoil. The plant’s extensive root system makes the soil more friable, improving tilth and water infiltration.

Weed control and living sod systems

White clover is an excellent choice for a “living mulch” cropping system as long as it does not build up nematode populations or other pests that might attack the companion cash crop. It is shade tolerant, withstands traffic,

grows fairly low, and survives repeated mowing. However, it must be managed to avoid competition with the cash crop for nutrients, light, and moisture. Management approaches to prevent it from competing with the cash crop include mowing it and using its residues as an in-row mulch, partial rotary tillage, and use with a tall cash crop to outshade the clover in the understory. White clover has been used as a cover crop/living mulch in orchards and with vegetables such as sweet corn and winter squash.

Erosion control on slopes

Once established, white clover can be relied upon as a soil conservation tool to preserve valuable topsoil on sloping fields or other erosion-prone areas.

Grass/legume mixtures

Sustainable farming systems often mix two or more cover crops to combine the agronomic benefits of using grasses and legumes. When well designed, this method of crop diversification tends to reduce the farmer’s risks from soil, pest, and weather problems. Carefully selected grass-legume combinations can also improve the soil quality and nutrient levels, as well as increase herbage quality in rotational grazing systems. A possible combination is to interplant white clover with annual ryegrass. White clover is also commonly interplanted with kikuyu-grass (*Pennisetum clandestinum*), pangolagrass (*Digitaria decumbens*), dalisgrass (*Paspalum dilatatum*), cocksfoot (*Dactylis glomerata*), and perennial ryegrass (*Lolium perenne*).

Pasture

White clover is highly palatable and digestible, with a high protein content (over 15%) and over 70% digestibility. It is the most important pasture legume in many temperate parts of the world. Even though it is often grown in mixture with grasses, it can be seeded alone for use as poultry or swine pasture. However, it can cause bloat in ruminants if not grazed carefully. A white clover–grass mixture often yields about 8 tons/acre of green forage in low rainfall areas and up to 60 tons/acre in areas with adequate, uniform rainfall. Nitrogen applications of 40–60 lb/acre plus phosphorus applications can effectively maintain a clover-grass pasture. If a bunchgrass such as ryegrass or cocksfoot is used in the mix-

ture, periodically allow the grasses to reseed by temporarily withholding livestock from grazing in that field.

Cover crop maintenance

Adequate potassium and phosphorus levels must be available in the soil to ensure a healthy stand of white clover. When grown in legume-grass mixtures, excessive N in the soil will result in excessive growth of the companion grassy species. In soils with low N levels, white clover will likely have a competitive advantage over companion crops. Because white clover withstands intensive grazing and trampling, frequent mowing will keep the white clover competitive with the companion grass species. When planting white clover at lower elevations, a weaker, less competitive stand may result, which may be an advantage if the companion grass or cash crop species is not overly competitive. A white clover-grass pasture should maintain a 20–40% clover cover in the mixture. Normally, a 30-day grazing cycle is effective to prevent the grass from overtaking the field. Livestock are normally allowed to graze when the grass is about 10–12 inches high and are removed when the grazed clover-grass mixture is reduced to a 2–3 inch stubble.

Management cautions

White clover must be carefully managed to keep it from competing with the companion cash crop for light, nutrients, and moisture. Hand mowing, in-row mulching, or rotary tilling the white clover may be necessary. Mowing alone may not be enough, especially during dry years when the clover competes strongly for soil moisture.

Suppressing white clover with herbicides is difficult. Farmers have experienced a similar difficulty when trying to use herbicides to control the growth of well established perennial peanut cover crops. Thus, killing a white clover stand may pose a challenge. Multiple growth-management approaches such as thorough uprooting (mechanically undercutting) and incorporation by chisel plowing or moldboard plowing, field cultivating, rotary

tilling, or using a suitable herbicide (e.g., glyphosate) may be necessary to manage its growth. Extremely close mowing and partial tillage that leave roots undisturbed will suppress but not kill white clover.

Pest problems

White clover insect pests include the potato leafhopper (*Empoasca fabae*), meadow spittlebug (*Philaenis spumarius*), clover leaf weevil (*Hypera punctata*), alfalfa weevil (*Hypera postica*) and lygus bug (*Lygus* spp.). Slugs also attack white clover. White clover is reported to be fairly tolerant of nematodes and leaf diseases but is susceptible to root and stolon rots (caused by a complex of diseases involving *Fusarium*, *Rhizoctonia*, *Colletotrichum*, *Leptodiscus*, and *Curvularia*). *Sclerotinia* may affect white clover during hot, humid periods. In



Sustainable Agriculture in Hawaii . . .

. . . integrates three main goals—environmental health, economic profitability, and social and economic equity. Sustainable farms differ from conventional ones in that they rely more on management practices such as crop diversification and crop rotation, agroforestry, integrated pest management, rotational grazing, and innovative marketing strategies. For further information on Sustainable Agriculture in Hawaii, contact:

Dr. Richard Bowen,
Hawaii SARE Program Coordinator
phone (808) 956-8708
e-mail: <rbowen@hawaii.edu>
<<http://www.ctahr.hawaii.edu/sustainag/>>

This material is based on work supported by the Cooperative State Research, Education, and Extension Service, U. S. Department of Agriculture, and the Agricultural Experiment Station, Utah State University, under Cooperative Agreement 98-ESAG-1-0340. Portions of this text were adapted from the USDA Natural Resources Conservation Service Hawaii Field Office Technical Guide, Section IV, Code 340, "Cover and Green Manure Crop" May 1992. Plant drawing reprinted from *Managing Cover Crops Profitably*, 2nd edition, published by USDA's Sustainable Agriculture Network (SAN), original illustration by Marianne Sarrantonio and Elayne Sears. Logo drawing courtesy of Deitrich Varez.



Europe white clover is affected by the cyst (*Heterodera trifolii*) and stem (*Ditylenchus dipsaci*) nematodes. White clover is susceptible to root-knot nematodes (*Meloidogyne* sp.), but some cultivars show tolerance of *M. incognita*. The sting, meadow, and clover cyst nematodes also attack white clover. Select resistant cultivars, cut or graze regularly to stimulate new growth, and maintain soil fertility to help white clover resist disease damage. Several viral diseases affect white clover in various parts of the world, but little research has been conducted to document virus diseases of white clover in Hawaii. Virus diseases that affect white clover include alfalfa mosaic virus, white clover mosaic, clover yellow mosaic, and peanut stunt virus.

For assistance:

Contact your nearest Cooperative Extension Service office for additional assistance in selecting appropriate cover crops and green manures for your farm and cropping situation. Help can also be obtained from the USDA Natural Resources Conservation Service field offices located on each island.

Visit CTAHR's Sustainable Agriculture for Hawaii Program Website at <<http://www.ctahr.hawaii.edu/sustainag>> to find additional information about green manure and cover crops. The site also includes references and links to other useful on-line resources.