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Lupins– *Lupinus* spp.

Lupins are cool-season annual legumes that fix high levels of Nitrogen and can be grown in a wide range of conditions. Lupins have aggressive taproots, especially the narrow-leaf cultivars. You can kill lupins mechanically or with herbicides. Their hollow stems crush or break readily, making it easy to plant cash crops using conservation tillage equipment.

Three lupin species are generally grown for agricultural purposes, these include: White lupins (Lupinus albus), Blue lupin (Lupinus angustifolius) and Yellow lupin (Lupinus luteus).

White lupins (Sweet)

Blue lupins (Bitter)

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Strengths	Limitations
• 2-13 t DM/ha/season **Depending on environmental conditions and management** • Exudes malic/citric acid which makes P more readily available for plant uptake. • Some species are cold tolerant • Strong taproot • Well adapted to acidic soils • Grow well on disturbed and poor soils • Fixes nitrogen • Often used as a disease break crop	• High levels of alkaloids • Lupinosis can occur

What can it be used for?

Cover Crop: Lupins improve soil health as they readily fixing nitrogen. They also enhance the availability of Phosphorous in the soil.

Cover cropping with lupins in a wheat production system, has shown to increase yields, aggregate stability, increase organic matter and slow the decline in pH of the soil. Blue lupins are mostly cultivated for soil improvement and usage as a green manure.

Grazing: White lupin can be used as a late winter feed. It can be actively grazed or supplemented as a dry forage. Blue lupin stubble is often utilized as grazing forage in the late winter and early spring. Blue lupin has been used for grazing in Australia since the 19th century. It is usually grazed before flowering stage and can be grazed several times during the season. This crop is especially valuable as a fattening feedstuff during dry spells. Although it is used for grazing, lupinosis can occur and grazing management is essential. It

is advised to only graze blue lupin once most of the growth has already taken place, as alkaloid levels are high in young plant parts. After harvest for lupin seed, the stubble and fallen seed is a valuable feed source for sheep. In South Africa dry lupin lands can be grazed from November to until February.

Lupins have been successfully grown alongside cereals to form a more nutritious pasture.

Hay: Lupins can be dried and fed as hay. Timing of harvest is essential to allow for optimal forage quality.

Silage: Lupins can be used to make whole plant silage for livestock. Both stubble and seed from blue lupins can be ensiled and fed as additional feed. Blue lupins have a high sugar content and ferment better at flat pod stage. The high protein content and high seed and green material production provides the necessary carbohydrates for the ensiling process.

Phytoremediation: Lupins have been used on abandoned mines (specifically mercury mines) for its tolerance to contaminants. Lupins possess the ability to mobilize trace elements by means of carboxylates and enzyme exudation as well as decreasing the pH of the rhizosphere. White lupins are more effective at mobilizing trace elements.

Human consumption: Sweet white lupin seeds (alkaloid levels below 0.02%) have been used for human consumption for many decades already. White lupin seeds are used to make flour which is rich in nutrients and fibre. The flour is often added to pasta, cake and other baked goods, cereals as well as meat products for emulsification.

Production potential: Blue lupin production can range from 2.2-13t DM/ha. Blue lupins tend to produce the highest biomass out of the three. Yellow and white lupins yield approximately 5-8t DM/ha, while blue lupins yield 8-13t DM/ha seed production is also different for the different species. White and yellow lupins can yield 800-1000kg/ha while blue lupins yield 500-600kg/ha.

Metabolic disturbances in animals on cultivated pastures:

Alkaloids: High levels of quinolizidine alkaloids affect the palatability, consumption and feed utilization. Lupins have been reported to have alkaloid contents up to 4%. Lupins with alkaloid contents below 0.01% have little to no effect on the above mentioned. Quinolizidine alkaloids can cause the following problems in sheep: Tremors, convulsions, respiratory problems (laboured breath and paralysis) and depression. In severe cases it can lead to death.

Lupinosis: Lupinosis is caused by mycotoxins which are a byproduct of a fungal infection (*Diaporthe toxica*) in the plant. These toxins cause sever liver damage which results in jaundice, lethargy and loss of appetite. It can also lead to death in some instances. Sheep are more sensitive than cattle to lupinosis, however it can be avoided completely by proper management of the cutting and storage processes.

Establishment

Climate: Optimal temperature ranges are different for different species within the *Lupinus* genus. Temperature ranges include temperatures from 5°C to 26°C. The optimal

temperature range for white lupins are 18-24°C, however it can tolerate temperatures as low as -6°C while in their vegetative stage. Yellow lupins prefer temperatures between 6-26°C. Both blue and yellow lupins are long day plants and start flowering when daylengths increase.

Moisture: Lupins thrive in areas with 380mm-990mm of rain during the growing season. Lupins are considered to be intolerant to waterlogging, although white lupin is slightly more tolerant of this condition. In South Africa most success has been obtained in the Western Cape although lupins can be planted in both winter and summer rainfall areas.

Soil: Lupins are adapted to very poor and acidic soils. White lupins can grow at a pH 4.8-8.2, blue lupins grow between pH 4.9-8.2 and yellow lupins grow between pH 4.5-8.2. Lupins are adapted to many soil types, but heavy clay soils which are prone to waterlogging should be avoided. Sandy-loam soils are considered the best for lupin production. Although some lupins are relatively tolerant of calcareous soils, iron (Fe) deficiencies are much more prevalent on these soils. Some varieties of lupins are tolerant of saline soils, and some not at all. Lupins increase the water holding capacity and decreases compaction of the soil by aerating the soil with their deep taproots. These taproots also allow the species to extract nutrients and water from deep within the soil profile.

Fertilization: Different lupin species have different nutrient requirements and are prone to different nutrient deficiencies. White lupins require higher soil fertility than blue or yellow and are susceptible to Phosphorous deficiencies. Blue lupins are

susceptible to Phosphorous, Potassium and Cobalt deficiencies. Yellow lupins are mostly susceptible to Iron and Manganese deficiencies, however they tolerate high concentrations of Aluminium.

A soil analysis before establishment is essential

	Nitrogen (N)	Phosphorous (P)	Potassium (K)	Sulphur (S)	Calcium (Ca)	Magnesium (Mg)
Removal Rates (kg) for 1 ton of grain Blue Lupin	51,2	3,0	8,0	2,3	2,2	1,6
Removal Rates (kg) for 1 ton of grain White Lupin	57,3	3,6	8,8	2,5	2,0	1,3

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Methods: Lupins should be inoculated with *Bradyrhizobium lupine* prior to planting. This allows the plant to fix nitrogen. Lupins are planted using a seed drill, however successful establishment can also be achieved by means of broadcasting. It is essential to prepare a weed free seedbed prior to planting. Seeding depth should be between 2.5-5cm.

Seeding rate:	kg/ha
White lupin (*Lupinus albus*)	56-180
Blue lupin (*Lupinus angustifolius*)	65-90
Yellow lupin (*Lupinus luteus*)	45-80

***Usage as well as environmental conditions (soil type, soil health, climate, rainfall) will determine seeding rates.**

Planting time: For winter rainfall regions it is recommended to plant lupins in autumn (March) as the slightly warm weather enhances early growth which helps to suppress weed growth. In summer rainfall regions lupins can be planted as soon as

the rainy season starts (September/October), if the crop is irrigated it can be planted as early as August.

Management

Utilisation: When lupins are harvested for seed, it is best to do the harvesting in cool conditions. This allows for a reduced risk of shattering and damage. It can easily be harvested with a normal header type harvester.

Diseases: Yellow and white lupin is more susceptible to anthracnose (*Colletotrichum gloeosporioides*) than blue lupin. Anthracnose causes twisting and bending of the stems, as well as brown lesions with pink/orange spore clusters. These spore masses cause the stems to weaken and collapse, however they can also occur on developing pods.

Sclerotinia is often found in white and blue lupin fields. This disease causes the stems to collapse, and is difficult to control. The best control measure is to rotate the crop with other non-susceptible hosts.

Brown leaf spot (*Septoria glycines*) in blue lupin, causes premature leaf drop and can lead to complete defoliation.

Root rot in lupins are often caused by the cucumber mosaic virus. The disease is spread by means of aphids, however it can also be seed borne.

Other fungal diseases that should be noted is *Ascochyta* sp, *Fusarium avenaceum, Fusarium oxysporum* and *Pleiochaeta setosa*.

Pests: Leaffooted bugs (Leptoglossus phyllopus) has been

reported to survive longer on low-alkaloid blue lupin strains, than on high-alkaloid strains. This should be taken into consideration when using lupin as a cover crop, as leaffooted bugs are pests on many row, field and orchard crops. Lupins are susceptible to a wide range of nematode species, with blue lupin being the most susceptible. Other pests to consider include: Aphids, which transmit viral diseases and cause plant damage; maggots and moth larvae, which cause the seedlings to die; slugs, mired bugs, thrips and budworms which attack the leaves and seed pods.

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Resources

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