

Cultivation of white lupin

A cool-season and environmentally friendly protein crop

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White lupin (*Lupinus albus*) is a different botanical species to narrow-leaved or „blue“ lupin (*Lupinus angustifolius*). It tolerates heavier soil and has a higher yield potential, but does not ripen until August/September. Important cultivation practices include the use of healthy, certified seed, sowing as early as possible and using the right cultivar to reduce the impact of the fungal disease anthracnose, which is spread through the seed. The most important experiences from organic farming are summarised here.



Figure 1. The white lupin

Decision-making aids

White lupin is the most valuable protein crop after soybean for animal feed and human nutrition due to the high protein content and good amino acid profile. The yields are usually around 3 t/ha, typically varying from 2 to 4 t/ha. Advantages over soybeans include above all the possibility of sowing in March (frost down

Applicability

Topic: Cultivation of the white lupin

For: Growers of grain legumes

Where: Free-draining soils with low lime content

Sowing time: March (April), earliest possible

Harvest time: Late (August-September)

Technique: Either narrow row spacing like for cereals and harrowing once or twice, or 50 cm row spacing with inter-row hoeing. Combine harvester

Follow-up: Identify a market before sowing. Very suitable as raw material for food products

Role in the farming system: Cold-tolerant protein crop without N-fertilization with benefits for subsequent crops

to -5 °C is no problem), a better preceding-crop or break-crop effect, and clearly visible flowers which are attractive for pollinators. Lupin thrives well in acidic, low phosphorus soils. Disadvantages of white lupin are the risk of losses due to anthracnose, problems with late weed infestations, and a relatively late harvest (mid to late August). The marketing of lupin also requires care.

Anthracnose

Avoiding anthracnose is key to success. Anthracnose is a leaf-spot disease transmitted through the seed. The use of visually clean certified seed is the foundation of control. All cultivars available so far are susceptible to the disease. In Germany, the less susceptible cultivar "Frieda" has been approved since 2019.

This cultivar has proven itself in cultivation in 2019 at two trial locations in Switzerland. The French cultivar "Sulimo" has also proven to be less susceptible and very high-yielding (at two locations and in three trial years). From 2020 on, "Celina", which according to the breeder is less susceptible, will be available, but we have no experience with it, yet. The risk of anthracnose is reduced in dry summers and on windy or open sites with soils with pH values below 7.

Site and sowing

Calcium carbonate content of the soil:

Lupin is very sensitive to the calcium carbonate content (CaCO_3 , lime and chalk) in soil. Field testing at the Research Institute of Organic Agriculture FiBL shows that viable cultivation is possible where soil lime or chalk levels are below 3 %. Trying the crop first on a small scale will help identify viable sites where lime or chalk levels are between 3-10 %. Cultivation with lime or chalk levels above 10 % is not possible. Since soils with a higher lime content generally also have higher pH, soil pH is used as an indicator of the suitability of a site. As a general rule, the soil pH should be lower than 7. Studies from France have shown that especially the lime in the fine clay and silt fractions prevents lupin from absorbing iron from the soil, which the nodules need for nitrogen fixation. The result is a nitrogen deficiency which is indicated by yellowish leaves and poor growth (calcium chlorosis). The susceptibility to anthracnose is also increased on such a soil. Plants from inoculated seeds should have a strong dark green colour reflecting high rates of nitrogen fixation facilitated by adequate iron supplies.

Inoculation: Biological nitrogen fixation in lupin, as in soybean, depends on symbiosis with a strain of *Bradyrhizobium* that is not normally found in soils where no lupin cultivation took place in the preceding years. Therefore, lupin responds to seed inoculation. This allows the roots to form nitrogen-fixing nodules together with the bacteria, and nitrogen fertilisation is not necessary. Experiments have impressively shown that inoculation can easily lead to a doubling or tripling of the yield. The most common of these inoculants is a black peat-based powder containing living bacteria.

It can be ordered together with the seed in the seed production. It is however best mixed with the seed immediately before sowing until the seeds are fully dark-stained. Since UV light kills the bacteria, the inoculant and the finished inoculated seeds should be protected from sunlight and stored in a cool place (see also Practice Note 1).

Cultivation and harvest

Cultivation: The stale seedbed technique provides a foundation of weed control both in conventional and organic crops. Tined weeding within three days after sowing can also be used. Special care should be taken not to disturb the seed. Inter-row cultivation can be used approx. 4-6 weeks after sowing (Figure 2) in a way similar to soybean (see also Practice Note 2). Ideally, inter-row cultivation should be carried out in the afternoon when plant turgor is low to avoid injury. The crop can be effectively inspected for anthracnose under dry conditions approximately 8 weeks after sowing, at the beginning of flowering. At this time the first patches of anthracnose might become visible (Figure 4). Removal of the infected plants by hand can help prevent the disease from spreading even more rapidly from these patches.

Harvesting: White lupin matures late, usually at the end of August/beginning of September. In very hot years (such as 2015 and 2018) they could be harvested in the first week of August. Rainfall in July and August can delay harvest, especially when it stimulates the late production of new side shoots. The right time for threshing is reached when the seeds in the pods „rattle“ when shaken and when most of the straw is brown (Figure 3). The pods of white lupin are clearly more shatter-resistant than those of blue lupin. The seeds are large, so the combine concave must be as wide open as possible. The threshing drum speed should be set at the lowest level, and the fan speed should be high for rapid straw separation. The moisture content of the crop should be at or below 14 %. Low temperature drying (below 35 °C air temperature) should be used if drying is necessary.



Figure 2. Weed control is particularly important for the prevention of late weeds. The crop can be weeded mechanically in the early stages.



Figure 4. The dreaded anthracnose disease leads to localised twisted growth of whole plants at flowering time (left) and to black, twisted pods at maturity (right). The worst disease patches can be removed from the field by hand at flowering time.



Figure 3. In flower, pods filling, and ripe white lupin

Sources

Arncken, C., Böhler, D., Clerc, M., Hohmann, P., Messmer, M., 2016. Information on blue and white lupins on the field trial in the lupin field trial, 06.07.2016, Oberer Berghof, Mellikon AG. Research Institute of Organic Agriculture FiBL, Frick (in German). Available at www.orgprints.org/30660/1/arncken-et-al-2016-Praesentation-Lupinen-Flurgang.pdf

Arncken, C. Data and records from field trials conducted during 2014-2019 at the Research Institute of Organic Agriculture FiBL, Frick (publication in preparation).

Further Information

Literature

Dierauer, H., Böhler, D., Kranzler, A., Zollitsch, W., 2004. Lupins. Leaflet (German). Research Institute of Organic Agriculture FiBL, Frick. www.fibl.org/de/shop/1308-lupinen.html

Dierauer, H., Clerc, M., Böhler, D., Klaiss, M., Heggin, D., 2017. Successful cultivation of grain legumes in mixed cultivation with cereals (German). Research Institute of Organic Agriculture FiBL, Frick. www.shop.fibl.org/chde/1670-koernerleguminosen-mischkulturen.html

Duthion, C., 1992, Comportement du lupin blanc, *Lupinus albus* L, cv Lublanc, en sols calcaires. Seuils de tolérance à la Chlorose. *Agronomie* 12, 439-445. www.hal.archives-ouvertes.fr/hal-00885488/document

Gresta, F., Wink, M., Prins, U., Abberton, M., Capraro, J., Scarafoni, A. & Hill, G., 2017. Lupins in European cropping systems. In: Murphy-Bokern, D., Stoddard, F. and Watson, C. 2017. *Legumes in cropping systems*, p. 88-108, Wallingford: CABI Publishing.

Websites and videos

Pages on the cultivation of organic lupins in German and French on the web platform Bioaktuell.ch, Research Institute of Organic Agriculture FiBL, www.bioaktuell.ch/pflanzenbau/ackerbau/koernerleguminosen/biolupinen.html.

The website of the German lupin network is a valuable resource: www.lupinen-netzwerk.de/Kategorie/anbau/allgemeines/.

Forschungsinstitut für biologischen Landbau FiBL, 2020. Lupinenanbau – Erfolg mit neuen Sorten. YouTube-Kanal FiBLFilm. German (English subtitles can be chosen under “settings”) www.youtube.com/watch?v=ELyQAP6gT4g&feature.

Research Institute of Organic Agriculture FiBL, 2020. Machine demonstration: Mechanical weed control in soya. YouTube channel Legume Hub (in German). www.youtube.com/watch?v=9iWR-pEfO-g&t=1s.

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