**Medicago sativa**

**Scientific name**

*Medicago sativa* L.

**Subordinate taxa**

- *Medicago sativa* L. subsp. *glomerata* (Balb.) Rouy
- *Medicago sativa* L. nothosubsp. *hemicycla* (Grossh.) C.R. Gunn
- *Medicago sativa* L. subsp. *sativa*

**Synonyms**

- *Medicago glutinosa* M. Bieb. subsp. *praefalcata* Sinskaya
- *Medicago komarovii* Vassilcz.
- *Medicago media* Pers.
- *Medicago sativa* L. subsp. *ambigua* (Trautv.) Tutin
- *Medicago sativa* L. subsp. *praefalcata* (Sinskaya) C.R. Gunn
- *Medicago schischkinii* Sumnev.
- *Medicago tianschanica* Vassilcz.
- *Medicago trautvetteri* Sumnev.
- *Medicago vardanis* Vassilcz.
- *Medicago × varia* Martyn

**Family/tribe**


**Common names**

bastard medic, sand lucerne, variegated lucerne (English); luzerne bigarrée, luzerne intermédiaire (French); bastardluzerne, sandluzerne (German); alfalfa de las arenas, alfalfa híbrida (Spanish); alfalfa (USA).

**Morphological description**

An herbaceous perennial with deeply penetrating taproot. Stems procumbent, ascending to erect, arising from a woody base, 30–80 (–120) cm long. Leaf trifoliolate; stipules triangular, 5–15 mm long; pubescent on lower surface, glabrous on upper surface, coarsely toothed; petiole pubescent, 5–30 mm long, leaflets narrow, oblong to ovate or obovate, 8–28 mm x 3–15 mm, dentate near apex, glabrous on upper surface, slightly pubescent on lower surface. Inflorescences in dense racemes with 10–35 flowers, on peduncles 1–5 cm long; pedicel 1.5–2 mm long; calyx 5-lobed, 3–6 mm long, tube and pointed teeth about equal in length; corolla purple or blue, rarely white. Pod curled, 3–10 mm in diameter, indehiscent, not spined, containing 2–6 seeds. Seeds yellow to brown, kidney-shaped to ovoid, 1–2.5 mm x 1–1.5 mm.

**Distribution**

Native to:

Lucerne is a plant from the Near East and central Asia. It is generally agreed to have originated in Asia Minor, Transcaucasia, Iran and the highlands of Turkmenistan.

It is now naturalised from China to Spain and from Sweden to North Africa.

**Uses/applications**

Lucerne was one of the first forage crops to be domesticated. It is used as multi-purpose forage, being able to be used for both grazing and conservation (hay, silage, meal and forage dehydration). It can be sown as a pure stand or in mixtures with both temperate and tropical grasses. The seed can also be used for human consumption as sprouts.

**Ecology**

**Soil requirements**

Lucerne demands deep, well-drained soils with a neutral to slightly alkaline pH. It will grow in sands to moderately heavy clays, provided drainage is satisfactory as it is intolerant of even short periods of waterlogging.

**Moisture**
It is a crop, which is relatively drought tolerant and will produce yields about in proportion to the water supply. In periods of drought, it will adjust plant density to cope with the availability of water supply. Its taproot is capable of following water supply to considerable depths (up to 8 m, but more commonly 2-3 m). It is well suited to growing under irrigation.

**Temperature**

Optimum temperatures for dry matter production appear to be in the range 15-25°C in the day and 10-20°C during the night. However this may differ with the winter activity level of the cultivar (how quickly it can grow during the cool season). Again there is variation in the way lucerne cultivars react to cold. The foliage of winter active cultivars can be damaged by frost and killed by snow while winter dormant cultivars avoid damage by remaining dormant during freezing conditions.

**Light**

Lucerne needs high light intensity for maximum growth but its erect growth habit allows it to compete well for light when sown in mixtures. Young seedlings are intolerant of shading as a result of competition from broadleaved weeds. Hence defoliation is an oft-used method of correcting weed problems in establishing pure stands or grass competition in mixed stands.

**Reproductive development**

In the subtropics lucerne plants flower throughout the year. Winter dormant cultivars have a high proportion of plants that have a long-day flowering requirement but winter active cultivars have a greater proportion of day neutral plants. The length of time to first flower appearance varies with season as the plant’s response to day length is influenced by temperature.

**Defoliation**

Defoliation timing is most appropriately matched to the build up of carbohydrate reserves in the plant’s roots. Levels in the roots are lowest about 2 weeks after cutting and reach a maximum at full bloom. This varies with the winter activity of the cultivar and with time of the year. The timing of defoliation for the older Australian cultivar ‘Hunter River’ (which is a semi winter dormant cultivar) was determined when 10% of the stems on individual plants were flowering. However many of the highly winter active cultivars do not flower as actively and timing is best done when the basal shoots are around 5 cm in length.

Lucerne is intolerant of continuous grazing. It should be rotationally grazed for long-term persistence, whether grown as a pure stand or in mixed swards. Even under extensive grazing, where rotational grazing can not be easily employed, lucerne should be given at least one, and preferably more, stock-free periods a year.

Management practices designed to extend the life of grazed lucerne stands include - low stocking rates, ensuring that the lucerne stand is well established before grazing, sowing palatable species with lucerne so that lucerne is not preferentially grazed and using disease-resistant dormant and semi-dormant cultivars with low crowns.

**Fire**

Lucerne is relatively tolerant of fire, at least when it has been defoliated as many growers use a fire to get rid of spoiled hay in windrows. This is usually a cool fire as it the material is compacted and moist. Hot fires, where the stand is upright and the material quite dry, may be more damaging.

**Agronomy**

Guidelines for the establishment and management of sown pastures.

**Establishment**

Under the grazing or cutting schedules used in the subtropics, lucerne rarely sets seed so the initial population achieved at establishment strongly influences the long-term performance of the lucerne stand. Lucerne should be established in a fine, firm, weed-free seedbed. Sowing rate depends on what the stand will be used for; pure swards under irrigation should be sown at 12-15 kg/ha, dryland pure swards at 4-8 kg/ha and mixed swards for grazing at 1-3 kg/ha. Lucerne will establish throughout the year in the subtropics but autumn and early winter are best as weed competition is lowest at these times. Weed control (strategic mowing or grazing, pre- and post-establishment herbicide application) is essential during the establishment phase in pure swards used for hay production. For grazed swards, strategic slashing or mowing will control most weed problems.

**Fertiliser**

Lucerne needs medium to high fertility soils with a neutral to moderately alkaline pH for optimum production. Potassium, phosphorus and sulphur levels need to be maintained at the following levels: K - 0.3 m. equiv./100g; P - 25 mg/kg, S - 10 mg/kg. The plant’s nodules should satisfy nitrogen requirements if inoculation is effective. Responses to nitrogen fertiliser can occur in winter but the economics are questionable. On marginal fertility soils, responses to magnesium, manganese, zinc, molybdenum, boron and copper can occur. Test strips of the respective nutrient should be applied to determine if soils are deficient. Aluminium toxicity can occur on soils with pH of lower than 5.5.

**Compatibility (with other species)**

Lucerne is compatible with tropical grasses under rain grown conditions, especially in drier environments (<600 mm). In higher rainfall areas, disease and grass competition limit its life span to 1-2 years.

Lucerne is compatible with temperate grasses, especially prairie grass (Bromus spp.), under irrigation. It is less compatible with
ryegrass (Lolium spp.) and white clover (Trifolium repens) cultivars, especially if the stand is used for hay making. Management should aim to reduce competition from the companion grass to improve lucerne stand longevity.

**Companion species**

Grasses: Panicum maximum, Cenchrus ciliaris, Chloris gayana, prairie grass (Bromus spp.).
Legumes: Clitoria ternatea, Macroptilium bracteatum, M. lathyroides, M. atropurpureum.

**Pests and diseases**

Lucerne is susceptible to an extremely large range of pests and diseases in the subtropics. Phytophthora root rot, anthracnose and other crown rots, rhizoctonia and the leaf diseases (stemphylium and pepper spot) are the most serious diseases. Spotted and blue green aphids, jassids and leaf roller are the most damaging pests. Considerable breeding effort has gone into improving the pest and disease resistance of current lucerne cultivars. However it needs to be realised that, at best, these cultivars are tolerant, rather than resistant. Severe infestations or infections will still result in substantial damage.

**Ability to spread**

Lucerne has little ability to spread in the subtropics because it rarely sets seed under the management conditions imposed.

**Weed potential**

Lucerne has a very low rating as a potential weed. It sets little seed, is not highly competitive with even moderately aggressive grasses and is highly susceptible to most herbicides that are active against broadleaved species.

**Feeding value**

**Nutritive value**

It is usually considered the 'King of Fodders' because it grows throughout the year if soil moisture is available. Protein and calcium levels are high, relative to other fodders, but metabolizable energy (ME) and phosphorus levels are low. ME and phosphorus levels are good in young growth but drop rapidly as the foliage matures. Intake of digestible nutrients by livestock is higher than for most other forages. Level of fibrous tissue is low and this allows rapid passage through the rumen. Lucerne foliage is highly digestible.

**Palatability/acceptability**

Lucerne is highly palatable. There are some cultivar differences in palatability and this is thought to be the result of different protein fractionations.

**Toxicity**

Bloat is the major limitation to grazing lucerne. A combination of management and control measures can be used to reduce the risk of animals bloatng on lucerne. Hungry animals are more at risk of bloat so provide animals with access to a source of roughage before or during grazing. There is usually reduced risk of bloat in mixed stands under rain grown conditions. Access to anti-bloating agents (drenching, in their water supply, rumen capsules or sprayed on foliage) is essential in intensively grazed situations. Wethers can get more pizzle rot on lucerne than if grazing grass pastures. Enterotoxaemia can also be a problem with sheep. Both can be controlled by injections.

**Production potential**

**Dry matter**

Under irrigation, lucerne is capable of producing 25-27 t/ha dry matter in the first year of a stand and this can fall to as little as 8-15 t/ha by the third year. Production can be related to plant density, level of disease and pest resistance and winter activity level of the cultivar. Under rain-grown situations it is also determined by availability of soil moisture. Good irrigated stands can produce 20 t/ha of hay per year (allowing for at least one spoiled cut per year). A utilisation figure of 50% is expected under grazed conditions.

**Animal production**

When green feed is available, daily liveweight gains for beef cattle will be around 0.7 kg/head/day compared with 1 kg/head/day on oats, improved tropical pasture and native pasture. This reduced weight gain is a result of the lower energy availability. However lucerne grows throughout the year so, over the full year, supplementing native pasture with lucerne can increase gains from 0.5 to 0.7 kg/head/day at double the stocking rate. Irrigated lucerne can carry a beef cow and a calf on 0.5 to 1 ha on a year-round basis. Supplementing dairy cows grazing tropical grasses with lucerne can raise milk production from 10-12 to 14-15 L/cow/day. This can increase to 20 L/cow/day if the cows are further supplemented with grain to combat the energy deficiency. Sheep numbers can be increased from 6 to 15/ha by supplementing native pasture with lucerne. Irrigated lucerne can carry more than 80 dry sheep equivalents/ha from October to May.

**Genetics/breeding**

Lucerne is a naturally outcrossing plant that requires bees for pollination. It can self, although outcrossing is the more likely mode of breeding. Inheritance within lucerne is a complex process as the plant is an autotetraploid, which produces a diploid gamete. Lucerne is very sensitive to even a small level of inbreeding, which results in substantial depression in yield.
There has been an enormous amount of effort conducted into plant breeding on lucerne around the world through both Government and commercial breeding organisations. Most of the work has gone into selecting lucerne cultivars with winter activity levels and disease and insect resistances suited to various lucerne-growing regions. The number of lucerne cultivars registered around the world numbers in the hundreds.

**Seed production**

Seed production is a specialised activity in both Australia and overseas. Fertiliser management, irrigation, weed control and the availability of bees for pollination need to be controlled for optimum seed production. There can be substantial differences between cultivars in potential seed production and this can affect the usefulness of a cultivar.

In Australia, commercial seed production is concentrated in southern states, particularly South Australia. Little seed is produced in subtropical areas.

**Herbicide effects**

Weeds reduce yield, quality and the useful life of pure lucerne stands, but are less of a problem in mixed swards. No one herbicide will control all weeds in lucerne. Choice depends on the type of weed and on the stage of growth of lucerne. There are also differences in the tolerance of some lucerne cultivars to herbicides. Herbicides can be used to selectively take out grasses or broadleaved weeds or to be used pre-planting or post planting to tackle weeds at different stages of the crop.

**Strengths**

- Year-round production.
- High quality.
- Dual purpose (grazing or conservation).
- Ability to extract water from deep soil layers.
- Persistent.
- Wide range of climatic adaptation.
- Responsive to irrigation.

**Limitations**

- Low energy levels.
- Restricted soil adaptation (fertile, well-drained).
- Cannot stand continuous grazing.
- Causes bloat.
- Susceptible to waterlogging.

**Selected references**


**Internet links**

http://www.hort.purdue.edu/newcrop/duke_energy/Medicago_sativa.html
http://www.ca.uky.edu/agc/pubs/agr/agr76/agr76.htm
http://www.ca.uky.edu/agc/pubs/id/id97/id97.htm

**Cultivars**

<table>
<thead>
<tr>
<th>Cultivars</th>
<th>Country/date released</th>
<th>Details</th>
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<tbody>
<tr>
<td>‘CUP 101’</td>
<td>USA</td>
<td>The first cultivar resistant to blue green aphids, and the source of resistance and winter activity for many Australian cultivars.</td>
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<tr>
<td>‘Siriver’</td>
<td>ACT (1978)</td>
<td>Bred by CSIRO.</td>
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<tr>
<th>Promising accessions</th>
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<tr>
<td>'WL 515', 'WL 525 HQ'</td>
<td>USA</td>
<td>Released by Wrightson Seeds Pty Ltd.</td>
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<tr>
<td>'Rippa'</td>
<td>USA</td>
<td>Released by Pacific Seeds Pty Ltd.</td>
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<tr>
<td>'Rapide', 'Alpha Express'</td>
<td>USA</td>
<td>Released by Seedmark Pty Ltd.</td>
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None reported.