Making hay in lucerne seed production systems

Production
Use best management practices to maximise the hay yield of each cut. Yield will depend on the health and the growth stage of the crop. In seed production systems, one or two hay cuts per year are possible.

Quality
High quality lucerne hay is green, leafy (high leaf:stem ratio) and dust free. It has around 19% crude protein, 65% digestibility and metabolisable energy of 9 MJ/kg DM. The better the quality, the higher the return.

Persistence
Lucerne stands can produce good quality hay as well as seed for at least 3-5 years (irrigated) or 4-7 years (dryland) if managed well.

Weather conditions, haymaking techniques and skills, and the time it takes to make the hay, are among the most important of many factors that will influence final hay yield and quality.

Once the hay is cut, the highest possible feed value of the product is set. The aim of haymaking is to preserve the nutrients of the plant material and make the hay in such a way that it is safe for storage.

Plan for quality hay
*Plan ahead, be prepared and do the job properly. Timeliness is critical.*
Planning and preparation should occur well before the haymaking season.
- Suitable, well-maintained machinery must be available.
- Paddocks should be free of objects that might damage machinery and materials that might contaminate the hay.
- Access from the paddock and to the storage site should be prepared, as should the storage site itself.
- Withholding periods associated with any herbicides and insecticides must be passed.
- Feed testing and quality assurance systems, such as the Australian Fodder Industry Association’s Fodder Care Program, should be in place to ensure the best possible hay is produced.
Mowing

Mow lucerne at the correct growth stage to optimise quality, yield and stand persistence.

Mowing (cutting) time is critical for high quality lucerne hay. It will be a compromise between the growth stage of the crop, irrigation schedule and weather, as well as other factors. Calendar date and visual assessment serve as a guide to mowing time, but plant growth stage of lucerne is a more accurate predictor (Table 1).

The growth of crown shoots is usually a better guide to mowing time than flowering, as flowering is controlled by day length and some lucerne varieties produce crown shoots well before flowers appear in spring or autumn.

Mow lucerne at a height that will not damage the crowns or new shoots.

Aim to mow when crown shoots are at least 2 cm high but below cutting height. Leave enough stubble to keep the cut plant material off the ground for aeration and to stop the hay absorbing moisture from the ground. A stubble height of 7–10 cm is ideal.

Wide, uniform swaths allow rapid initial drying of the cut hay but driving on the mown lucerne will slow drying, so make the swath width fit between the tyres of machinery being used. Leave some ground uncovered to allow the hay to be turned (raked) onto dry ground to assist drying.

Mower blades should be kept sharp so the lucerne can be cut as cleanly as possible. Blunt blades damage the stems, which in turn encourages disease to enter the plant, leaves uncut clumps that will contaminate the next cut and increases tractor power requirements.

Cut only as much crop as can be baled in one day to avoid excess field losses.
### Table 1. Growth stages of lucerne as a guide to mowing time

For more detailed descriptions of plant growth stages and recommendations for mowing time, refer to Table 9.7 (page 80) of *Producing Quality Lucerne Hay*.  

<table>
<thead>
<tr>
<th>Growth stage</th>
<th>Comment</th>
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</table>
| **Vegetative & pre-flower** | **Too early to cut**  
Crop leafy and no sign of flowers  
Mowing at this stage produces very high quality hay but yield per cut is low and the root reserves have not built up adequately. Frequent mowing before the stand is ready reduces stand persistence, but this is generally not an issue in seed production systems. |
| **Early bud**          | **Good quality, low yield**  
Crown shoots 1 cm long on half of the plant. Flower buds start to appear.  
Lucerne mown at this stage has excellent quality but yield per cut is lower than if left until later. This is a good mowing time if aiming for the prime hay market. In hay only systems, always mowing at this stage may enable an extra cut per season but will not deplete root reserves. |
| **10% flower**         | **Lower quality, higher yield**  
Crown shoots 1–2 cm on over half the plants. About 10% of stems have open flowers.  
10% flower is the traditional indicator for mowing—this stage is a good compromise between quality, yield and persistence of the stand. Mow earlier if aiming for highest quality hay. |
| **Full bloom**         | **High yield, low quality, longer stand life**  
Crown shoots more than 5 cm long on most plants. At least half the stems have open flowers.  
Mowing at this time can increase hay yield but reduces quality, as well as reducing the total number of cuts possible for the season in a hay only system. In hay production systems, allow the stand to reach full bloom once a year to replenish the root reserves and extend the life of the stand. In a ‘hay and seed’ system, a hay cut this late would compromise seed production. |
| **Seed-pod stage**     | **Limited hay production**  
Pods formed on all plants.  
This stage is too late for good hay production. The hay will be poor quality due to a low leaf:stem ratio and woody stems, the hay will be difficult to dry, and regenerating shoots will be damaged. Cutting hay at this stage will be in conflict with seed production. |
Curing lucerne

Dry the mown lucerne as quickly as possible to preserve quality and yield, and enable hay to be stored as quickly as possible.

Curing—the drying of mown lucerne in the field—is a crucial step in the production of quality lucerne hay, affecting both storage and feed value.

For successful storage, the cut lucerne must be dried from 80–90% moisture down to 15–20%.

The most important component of lucerne hay is the leaf, which contains 70% of the protein and more than 65% of the digestible energy of the whole plant. Leaves can become brittle and be lost during haymaking as they dry much quicker than stems, reducing both hay yield and quality. The curing process should aim to remove moisture from the leaves and the sap (moisture) within the stems, the leaves should then be allowed to rehydrate before baling, to retain as much leaf as possible.

The curing of lucerne hay is a two-stage process. The first stage, wilting, occurs in the field within a few hours of cutting. Wilting accounts for a large proportion of the moisture loss from the cut lucerne and should be as fast as possible to preserve hay quality.

The second stage of curing starts when the mown hay reaches about 50% moisture and moisture is drawn from within the stems (sap moisture). The drying rate at this stage is about one hundredth of the initial drying rate.

Make hay while the sun shines.

Curing may take one to three days in dry, sunny summer weather, or could require five to seven rain-free days under cloudy, cool conditions on moist soil.

Wind speed, relative humidity and solar radiation have a large influence on curing. A 20% increase in wind speed or a 20% decrease in relative humidity can speed drying by more than 50%. In very humid conditions (> 90% relative humidity) the hay may not dry adequately for storage. Warm days with low humidity, plenty of sunlight and wind are ideal.

Table 2. Factors affecting the curing of lucerne in the field

<table>
<thead>
<tr>
<th>Wind speed</th>
<th>Maturity &amp; leafiness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative humidity</td>
<td>Conditioning</td>
</tr>
<tr>
<td>Solar radiation</td>
<td>Swath density &amp; thickness</td>
</tr>
<tr>
<td>Air temperature</td>
<td>Swath width</td>
</tr>
<tr>
<td>Soil moisture</td>
<td>Bale size &amp; density</td>
</tr>
</tbody>
</table>
Conditioning

Conditioning can speed up the drying rate of hay by up to 30%.

The leaves of lucerne dry three to five times faster than stems. The aim of conditioning is to crimp or crush the stems so they dry more quickly, and the hay is ready for baling as soon as possible.

Modern mowers are often integrated with a roller or tined conditioner, however if the lucerne is conditioned in a separate operation it should be done while the plant is fresh. Conditioning the hay when it is wet results in less leaf loss and produces softer, better quality hay.

With roller conditioners it is critical to adjust the width and pressure of the rollers to match the volume and density of the crop. Super-conditioners tear or crush the hay more severely than standard conditioners. The more aggressively the hay is conditioned the faster it will re-wet and the greater potential for damage. Super-conditioned hay must be baled and shedded quickly to avoid rain damage.

Tined conditioners commonly used for other crops can be used, but they should not be too aggressive as this can cause leaf loss of lucerne hay.

Chemical or biological additives can be applied to mown hay at cutting or baling to speed drying or stop microbial spoilage of hay. This allows hay to be baled at slightly higher moisture content and can result in softer greener hay.

Raking

Complete raking before the hay reaches 40% moisture content. Handle hay gently and don’t over-rake.

Lucerne swaths should be raked into windrows as soon as the hay is well wilted. There should be no sign of water on the surface, but still enough moisture for the leaves and stems to be strong and pliable.

Swaths can be tedded (fluffed up and spread out) before raking to aid drying but this should only be done straight after mowing to remove excess moisture after heavy dews or rain, to allow the forage to wilt quickly.

The moisture content of the hay at raking is critical. In humid environments hay may need frequent raking, while in very dry conditions raking may not be necessary at all. Raking should be completed before the crop reaches 40% moisture content (60% dry matter content). If too wet, the hay will wrap around the rake or flop together to form tight, poorly aerated windrows; if too dry the leaves will shatter.

About 30% of lucerne dry matter can be lost if raking is delayed until close to baling, when moisture content is about 18%. Most of this loss will be leaf, so quality will also be reduced. If raking has to be delayed until just before baling, it should be done after the hay has reabsorbed moisture from dew. The hay should be soft, but not wet.
Windrows

Windrows help bulky crops dry under cloudy, slow-drying conditions and in very dry conditions they can help preserve the colour of hay.

In spring and early summer, when conditions are not ideal for drying, loose, fluffy windrows allow maximum airflow for drying, minimum contact with the soil to prevent hay from wetting from underneath and offer some protection from sunlight to help prevent bleaching.

Tight, narrow windrows are ideal for baling. Two to four windrows can be raked into one large windrow for baling, depending on bale size. Narrow windrows also allow the ground in between to dry out, and windrows can be turned onto dry soil to aid the drying of the hay.

Heavy windrows should be avoided, as they tend to collapse under their own weight, which will restrict airflow and impede drying.

Baling

Bale at the moisture content appropriate to bale size and density.

Be patient and bale the hay when it is ready. Hay baled and stored at more than 23% moisture content will deteriorate due to mould, may heat in storage and in some situations, spontaneously combust. Any heat generated in the bale will use energy and reduce feed value. Hay baled at low moisture content will have brittle leaves that shatter. Baling hay at very low moisture content may result in excessive leaf loss, powdering, poor bale density, and difficult handling and storage.

The recommended moisture content of the hay will depend on the size and density of the bale (Table 3). The larger the bale and the higher its density, the more critical is moisture content. Moisture content can be assessed in-field by methods described in Table 4.

Dry matter losses from the baling operation can be reduced by:

- ensuring moisture content of the hay is correct
- adjusting the baler pickup and bale chamber
- using wider windrows
- travelling faster when baling.

Table 3. Suggested moisture contents for baling lucerne for safe storage

<table>
<thead>
<tr>
<th>Bale type</th>
<th>Hay moisture content (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small square</td>
<td>18–20</td>
</tr>
<tr>
<td>Medium square, large round</td>
<td>14–18</td>
</tr>
<tr>
<td>Large square</td>
<td>12–14</td>
</tr>
<tr>
<td>Export hay</td>
<td>&lt;12</td>
</tr>
</tbody>
</table>

Source: Frank Mickan, Department of Primary Industries, Victoria.
Storing hay

Store hay at the correct moisture content and protect the hay from the elements.

Good hay storage is critical to maintain hay quality and yield, and to prevent hayshed fires. Loss of feed quality can be high if hay is stored too moist (Table 5), in leaky sheds or stored in the open. Hay continues to dry in storage if conditions are suitable.

Once stacked, monitor the temperature of the stored hay on a regular basis for the first 6–8 weeks. Check older stacks occasionally. A tobacco-like smell indicates imminent ignition of the hay.

Table 5. Loss of feed quality caused by the heating of moist hay

<table>
<thead>
<tr>
<th>Maximum stack temperature (°C)</th>
<th>Feed quality</th>
<th>Hay characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Protein (%)</td>
<td>Energy (%)</td>
</tr>
<tr>
<td>&lt; 45</td>
<td>0</td>
<td>5–10</td>
</tr>
<tr>
<td>45–55</td>
<td>10–30</td>
<td>5–15</td>
</tr>
<tr>
<td>&gt; 49</td>
<td>30–80</td>
<td>15–30</td>
</tr>
<tr>
<td>55–70</td>
<td>100</td>
<td>40–70</td>
</tr>
</tbody>
</table>

Source: F. Mickan, Department of Primary Industry, Victoria and V. Marble, University of California, Davis, USA.
Lucerne stand care

Remove bales quickly from the paddock and keep wheel traffic to a minimum.

The persistence of the lucerne stand depends on the care and timeliness of most aspects of the haymaking operation. Remove bales from the paddock as soon as possible to allow even regrowth of the lucerne crop. Keep wheel traffic of vehicles and machinery to a minimum to avoid damage to the crowns and new growth.

The removal of hay bales as soon as possible will also ensure that flowering of the seed crop is uniform. Regrowth of the areas where bales have remained in the paddock, and the wheels tracks associated with carting, can lag behind regrowth of the rest of the paddock.

Preventing hayshed fires

- Ensure hay has dried evenly and adequately throughout the paddock. Check multiple windrows in the paddock and check multiple points in the windrow. Even small wet patches in a windrow (wet slugs) can result in hay stack fires.
- Bale hay at the right moisture content (Table 3).
- Store hay at the right moisture content — especially large square bales.
- Use shed layouts that provide adequate airflow through the stack and good ventilation at the top to dissipate heat.
- Repair any leaks in the shed roof to avoid moisture that could activate microbes that cause hay to heat.
- **Monitor stacked hay for heating** — regularly check the temperature of the stack with a crowbar. Hay will normally heat slightly when first stored but then cool down again. However, if after several hours, the crowbar is too hot to hold, or if the hay turns dark brown or smells like tobacco, the hay is ready to ignite. Pull the stack apart carefully. Be aware that bales that have reached the critical temperature may ignite as they are exposed to air. Always keep water and fire fighting equipment on hand.
- **Never walk on top of heating hay stacks** — smouldering bales could collapse with your weight and if you fall in, the accompanying air could ignite the stack.
- Store the hay in multiple stacks to reduce potential losses should a fire occur.

This project summary is based on the RIRDC publication *Producing Quality Lucerne Hay*. The tables presented in this project summary are wholly or partly based on tables in that publication.

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