

# Keeping litter friable and 'working'



## Litter tilling

### Tilling to keep litter friable

When combined with adequate ventilation and heating, litter tilling (also known as litter conditioning, turning, stirring, rotary hoeing and power harrowing) can keep litter friable enough for chickens to 'work' it.

When chickens work the litter, they break it up and mix in fresh droppings, helping prevent caking of the litter surface. Stirring friable litter increases its surface area and brings damp particles to the surface, allowing water to evaporate and be ventilated out of the shed. If the litter surface becomes crusted or caked, chickens may not be able to break it up. This is where litter tilling machinery can be used.

Australian meat chicken growers are world leaders when it comes to litter tilling. About 90% of our growers regularly till litter, using machinery ranging from small walk-behind units to large tractor-driven units. Litter tilling machinery is either purpose built or adapted from other agricultural operations (e.g. rotary hoes or power harrows). Some growers have developed their own machines or methods to achieve better outcomes.

Litter tilling isn't without risks and challenges. In some countries, litter tilling is discouraged because of potential risks associated with the release of ammonia into the shed, chicken injuries, taking the chickens off feed and water during the activity, and exposure to airborne pathogens.

Australian growers have developed methods that reduce these risks, including:

- avoiding tilling when close to peak density (especially between day 28 and small bird pickup)
- increasing shed ventilation during and after litter tilling to dilute and remove ammonia, airborne dust and pathogens, and evaporate more water
- using multiple staff to move chickens and keep them away from machinery.

### Benefits of litter tilling

- Breaks caked and clumpy litter into smaller pieces, improving friability and increasing surface area.
- Mixes wet and dry material so litter is dry enough that it doesn't stick together or compact.
  - Ideally, there will be dry litter beside or below damp or caked litter and it will all be mixed together.
  - Tilling wet litter alone will enable some rapid drying but is likely to result in rapid compaction and caking on the surface.
- Increased evaporation rate from caked litter:
  - 12 to 15 times more evaporation for 4 to 6 hours after tilling
  - 7 times more for up to 15 hours after tilling
  - 4 to 5 times more for up to 20 hours after tilling
  - The ongoing evaporation rate will be 3 times greater if litter stays friable.
- Increased evaporation rate from friable litter:
  - 4 to 5 times more evaporation for 4 to 6 hours after tilling
  - 2.5 times more for up to 15 hours after tilling
  - 1.5 times more for up to 20 hours after tilling
  - Evaporation returns to normal after 24 hours.



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## Management actions

### Pre-requisites for litter tilling

Minimising the amount of water added to the litter and increasing evaporation can reduce the need for interventions like litter tilling.

- Adjust drinker height and pressure to minimise spillage.
- Inspect drinkers for wear or leaks.
- Consider installing medium-flow drinker nipples if cake keeps forming under the drinkers.
- Pre-heat the shed, litter and floor for one or two days before placing chicks. Sheds with concrete floors need more pre-heating than those with earth floors.
- Use in-shed circulation fans to increase air speed at the litter surface to evaporate more water.
- Increase ventilation to reduce in-shed relative humidity to 50-60%.
- Temporarily exclude or move chickens from high density areas or other trouble spots (e.g. migration fences and along walls) to enable litter to dry.

### Assess litter conditions daily

- The litter underneath the drinkers is expected to be a bit damper than surrounding litter. However, if it is noticeably damper or if it sticks in a ball when you squeeze it, it is too damp and action is needed.
- Take action as soon as you observe the litter getting wetter and before it becomes too wet and caked.
- Record the litter condition on a shed card or litter record sheet. This will help you identify when litter conditions start to decline and may help you prevent issues in future batches. Comparing conditions with those in other sheds might reveal drinker or ventilation issues.

### Litter tilling

#### Managing ammonia

Tilling litter will release ammonia into the shed so the ventilation rate should be increased for 6 to 12 hours afterwards.

Schedule litter tilling so extra ventilation is not detrimental to the in-shed environment. Wet and caked litter will release more ammonia. Litter that is mostly dry or doesn't contain much manure (e.g. less than 21 days) may not require as much ventilation.

### Managing ammonia levels after tilling

- Measure the ammonia concentration an hour after litter tilling. This can be done with ammonia indicator strips, hand-held ammonia meters or installed in-shed sensors.
- If the ammonia concentration is above 15 ppm, continue with extra ventilation. If the ammonia concentration has fallen below 15 ppm it should be safe to resume normal ventilation.
- After adjusting ventilation rate, re-check the ammonia concentration after an hour and adjust ventilation if required.
- Consider maintaining extra ventilation for as long as possible (the rest of the afternoon and into the early evening) to evaporate as much water and remove as much ammonia as possible from the litter.

### Re-use litter

- Previous growers' experiences with re-use litter have mentioned that turning the litter 4 to 6 times before a batch can assist in reducing litter moisture and ammonia. This also reduces ammonia risks during the batch.

### Scheduling tilling

Many growers schedule litter tilling at weekly intervals after brooding and before day 28 (when increasing chicken density reduces room to operate machinery in the shed). They also till the litter straight after small-bird pickup while there is room in the shed.

Growers have reported that the litter often dries and recovers after small-bird pickup, which reduces the need for further tilling before the end of the batch.



Intervals between litter tilling will be influenced by:

- bedding/litter material, depth and dryness at the start of the batch
- type, size and effectiveness of tilling equipment
- weather
- season
- chicken age, density and health
- feed, nutrition and drinking water
- drinker type, adjustment and age
- the ventilation system's ability to remove water each day
- staff availability.

It is better to till while the litter is still in relatively good condition rather than waiting for it to be extensively caked. Also consider that there are times when it is less suitable to increase ventilation rate to exhaust released gases and water, due to colder air outside (depends on the time of the grow-out).

### Choosing the best time for tilling to reduce ammonia risks and maximise evaporation

- Till litter on fine, warm days when relative humidity is low.
- Litter tilling activities should be conducted in the mid to late morning to take advantage of the release of water from recently tilled litter.
- Avoid litter tilling late in the afternoon when there is only a short window of time to ventilate moisture and gases.
- Avoid litter tilling at night and in the early morning when the air outside is cooler and the potential for evaporation is lower. There are also a higher risk of odour impacts at these times.

#### Risks of litter tilling

- higher ammonia concentration
- injuries and scratches
- chickens taken off feed and water
- wet litter is brought to the surface
- increased ventilation may be detrimental
- possible release of extra odour during tilling.

#### Benefits of tilling

- litter returned to friable and working state
- chickens interact with litter and dust-bathe
- greater water evaporation keeps litter drier
- drier litter and aeration are likely to reduce odour concentration in the longer term.

#### Risks and benefits of litter tilling

#### Risks of not litter tilling

- chickens are in contact with caked litter
- litter may be damper
- caked litter will stay damp for longer and there will be more odour and ammonia production.

#### Benefits of not litter tilling

- chickens kept on feed and water
- chickens not disturbed
- ventilation based on chicken needs (not forced to increase)
- odour and ammonia diffuses slowly from the litter, especially if litter is caked or compacted.

Risks and benefits of litter tilling: If the risks of tilling the litter outweigh the benefits or the risks of not tilling, postpone tilling or take other actions to minimise the risks.

## Selecting tilling machinery

Growers use a variety of litter tilling equipment.

- **Hand-operated rakes** open and loosen the litter but are unlikely to completely chop or grind clumps or cake into friable material. These are most suited to small areas and for reducing compaction before the litter surface begins to cake.
- **Smaller and/or walk behind machines** (usually limited to 1 m wide) can be operated without lifting drinker or feed lines, but usually take more time than larger machines. They may not mix the wet litter with the dry litter beside it. Some growers combine this activity with daily shed walks. A single person can normally till litter with a small machine because they can keep the chickens away from it.
- **Mid-sized machinery** (1-2 m wide) require drinker and feeder lines to be lifted. Wider implements allow for better mixing of wet and dry litter; however, the design of some implements doesn't support a lot of sideways mixing. More power chops and grinds caked litter to return friability and spreads it evenly so it is level across the shed. Multiple staff are usually required.
- **Larger machines** (wider than 2 m) can till quickly but may be difficult to manoeuvre through the shed, especially when approaching peak chicken density. Wider implements allow for better mixing of wet and dry litter; however, the design of some implements doesn't support a lot of sideways mixing. Multiple staff are required.

## Grower experiences

The following is a snapshot of five growers who use different types of machinery. Some have developed or modified equipment to enhance their litter tilling operations and to help maintain dry and friable litter.

### Don, Southeast Queensland

*Grower's aim:* Complete and total sideways mixing of wet and dry litter. Move damp litter away from drinkers.

*How:* Don created a tractor attachment that uses augers to grind and completely mix litter before evenly spreading it at the back of the machine as it passes through the shed. Cake is completely broken down and mixed with the surrounding dry litter three times within the machine, ensuring complete mixing and friability of the final product. Litter is tilled about once a week or as required.

*Benefits:* Existing machines did not completely mix the litter and left damp litter under the drinker lines. Other machines do not completely break down and mix caked litter with surrounding friable litter. This machine rejuvenates the litter and spreads it out evenly and level.



### Ray, Southeast Queensland

*Grower's aim:* Proactively maintain litter conditions throughout the batch to keep litter dry and friable.

*How:* Three types of machinery are used. Two of the three are tractor attachments.

Between day 3 and 7, a small walk machine is used when required to disturb the litter and reduce caking under the drinker lines and other problem areas. It is also used throughout the batch if touch-ups are required, especially at peak density.

For the rest of the batch, when required, a purpose-built litter tiller is used across the whole shed as it is more effective in pulverizing cake and mixing the litter. If litter conditions require greater attention, Ray uses a power harrow with another tractor running in front of the litter tiller. Both tractors operate at the same time to minimise chicken disturbance, break down cake more thoroughly and mix the litter. He prefers to use the power harrow on its own after final bird pickup to aerate in preparation for litter reuse.

*Benefits:* Provides multiple tools for different situations, allowing the litter to be effectively worked in the required way.

## Anthony, Victoria

*Grower's aim:* Increased moveability and control when litter tilling.

*How:* An engineering company combined a pre-existing litter tilling attachment with a zero-turn machine. This machine offers the opportunity to till at any day within in the batch due to its size and manoeuvrability.

*Benefits:* The design allows more control and manoeuvrability throughout the shed compared to larger litter tilling machines. Benefits of this small to mid-size machine include:

- Full control of the machinery with the ability to see and avoid the birds.
- It doesn't require a second person working out front.
- It can weave in and out to mix wet and dry litter, rather than being restricted to straight lines like a tractor. It is quick and easy to make multiple passes if required.
- It is more effective than walk behind machines (wider and better at mixing).
- It is less exhausting for the worker and reduces exposure to dust and ammonia.



## Sothy, Southeast Queensland

*Grower's aim:* Keep the litter working and extend its friability.

*How:* For the first 2 to 3 weeks, a hand-pulled rake system is dragged through the shed during bird checks. Raking encourages the chickens to work the litter but doesn't grind up cake. If the floor becomes caked, a larger tractor-driven machine is used.

*Benefits:* This daily practice allows thin cake to be broken and opened, which encourages the birds to work the litter. It is a proactive approach to maintain the litter early before it goes off. If the litter becomes caked, a tractor operated litter tiller is used to condition the whole shed. This returns the litter to a friable state and increases evaporation of water. Litter conditions and climate determine the regularity of the tractor application: it is often only required one or two times per batch.





## Vince, South Australia

*Grower's aim:* Keep litter dry and working and reduce caking under the drinkers.

*How:* Drinker lines are raised and a custom-made V-shaped tool is dragged underneath using the tractor three-point linkage. This breaks up cake and moves moist litter sideways, away from the drinker lines. Vince lets the birds work the litter back under the drinkers. Because dry litter is lighter and more friable, the chickens move it more easily than the wet or caked litter.

A day or so later, Vince uses the rotary hoe to mix the wet and dry litter. This leaves the litter under the drinkers noticeably drier than before. The rotary hoe also leaves a level and smooth litter surface.

*Benefits:* This reduces caking under the drinker lines and provides an extra tool that reduces the need to rotary hoe constantly. This system works because the moist litter under the drinkers is moved to the side, where less water is added. This tool has been adopted by other growers in Vince's region.



## More resources

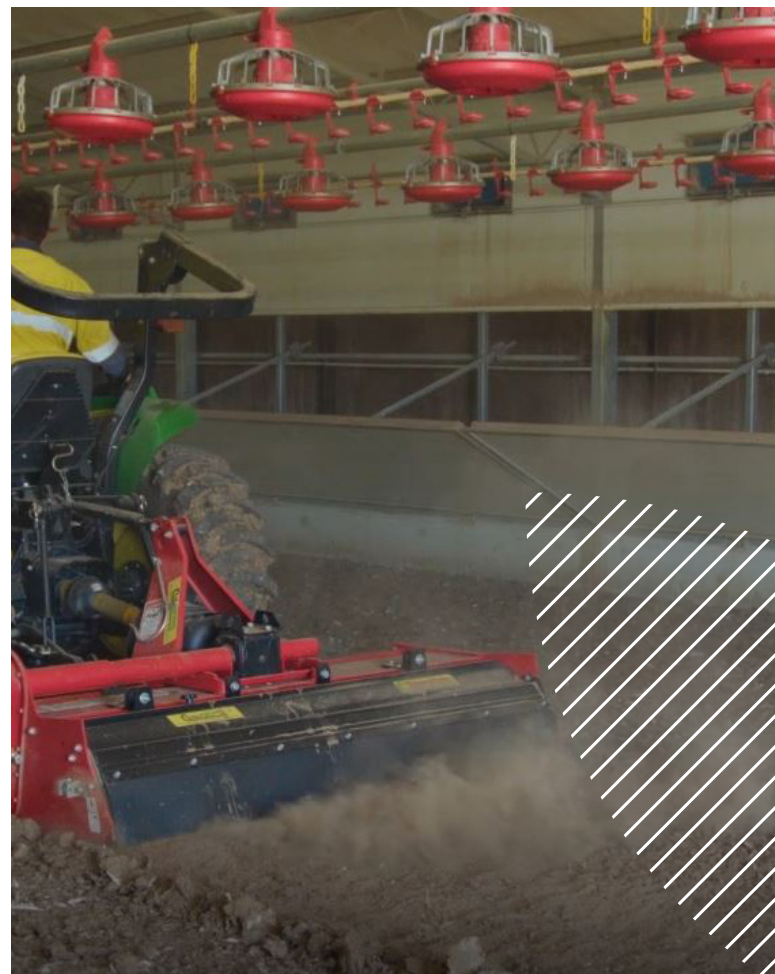
- An industry survey on litter management and re-use practices of Australian meat chicken growers. <https://doi.org/10.1071/AN21222>

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