

Grower storage and handling facilities - checklist

Philip Burrill DAF Qld. Senior Agronomist

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Name:

Property:

Contact details:

A. Storage site information - grain buyer & producer

Storage location:

- Location of main storage facility: (GPS -Lat. /Long.)
- Location other storage facility: (GPS -Lat. /Long.)

Map attached (optional): Storage complex map: identifying silos, sheds and bunkers locations on property and their ID numbers

Storage access:

- Wet weather "access to storages" on property roads, all-weather farm road & water crossings? Yes / No
- Public / main roads to property - wet weather access? Yes / No
- Any local truck size routes restriction – roads, bridges? Yes / No
- Property distance to closest town: name: / km
- Distance to nearest Bulk handling depot: / km
- Distance to nearest weighbridge : name: / km

Storage site details:

- Truck turning & tipping – firm & level site with turning room around storages for Semi., B-double, Road-train,
- Silo complex hazards: e.g location of overhead power lines near storages
- Loading speed (tonne/hr) / Augers / Belt conveyor./Overhead bin with weight cells?
- Power source (No power / Mains / Generator / Mains & generator backup)

Current: storage equipment & procedures

- **Silo identification & records:** (Y / N / F) Yes, No, Future, next 2 - 3 yrs.
 - a) Allocated a permanent number / code (silo ID) on individual storages ()
 - b) When filling silo, record: moisture content by truck load, quality details eg. protein etc, variety, season & any grain treatments ()
 - c) When out-loading silo / sales, record tonnes and signed by truck driver ()
 - d) Farm office has a “storages spread sheet record” with each silo’s grain details, monthly insect & quality check results & any grain treatments ()
 - e) At silos complex, a small note book to record monthly insect and grain quality checks. () Transfer this information to office storage records ()

- **Grain quality & insect monitoring equipment:**

Insect sieve () Insect ID photos () Grain temperature probe () Safe grain sample points top () and bottom () of storage. Safe silo ladders ()

Grain moisture meter () NIR protein testing unit () Truck sample stand ()

- **Storage Hygiene:**
 - a) Design of storages internal & external allows for easy access to clean, e.g. silo aeration ducting and grain residues inside the silo base ()
 - b) Storage / silo cleaning equipment: Long handle brooms () Vacuum ()
 - c) High pressure water is available for storage wash outs when required ()
 - d) Suitable waste grain site: dump & spread thin, burn, bury ()
 - e) Correct storage structural treatment products suitable for – cereal grains, pulses, oilseeds eg. DE dust – Dryacide® ()

- **Aeration cooling:**
 - a) Fans, ducting and venting combination for each silo provides appropriate cooling air flow rates of 2 – 4 L/s/t for all grains & canola ? () Tested? ()
 - b) Fans operation Manual () Time clock () Auto Controller ()
 - c) Recording aeration fan run hours each monthly in storage note book ()

- **Grain chemical protectant treatments:**
 - a) Before using grain treatments, checking with grain buyers or handler ()
 - b) Labels checked to ensure correct products used. Seek advise if unsure.()
 - c) Calibrate spray equipment prior to use. () Personnel protective gear ()

- **Fumigation:**
 - a) Sealable storages that may be used for fumigation are “pressure tested” to check gas tightness (no leaks) at least once per year. ()
 - b) Recirculation on large silos, > 150 t capacity (...) Ground level application ()
 - c) Fumigation safety gear () Safe storage of Fumigation products ()

Storage Facilities

| SILOS cone based | | | | | |
|-----------------------------|-------------------------------------|-------------------|-------------------------------|------------------------------------|---------|
| ID | Capacity tonnes / m ³ | Sealable Y / N | Date of last Pressure test | Aeration Y / N Auto Control X/✓ | Notes : |
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| SILOS flat base | | | | | |
| ID | Capacity tonnes / m ³ | Sealable Y/N | Date of last Pressure test | Aeration Y/N Auto Control X/✓ | Notes : |
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| Grain SHEDS | | | | | |
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| Grain PADS | | | | | |
| ID | Capacity tonnes / m ³ | | | | Notes: |
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| Other storage e.g. planting seed silos, silo bags, | | | | | |
| ID | Capacity tonnes/ m ³ | | | | Notes: |
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B. Best practice activities & records - grower checklist

Checklist for storage facility – Grain quality & pest control

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| Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec |
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| WINTER - May June | | | |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------|
| ✓ | Action | Notes | Date |
| | Monthly storage checks completed & recorded – visual & smell check grain quality, sieve grain from top & bottom, inspect probe traps, identify pests, record grain treatments | | |
| | Stock reconciliation – visual tonnage estimation, during grain inspection above | | |
| | Office “storage spread sheet” up-to-date – monthly checks on quality, insects, plus grain treatments / fumigation details recorded. Grain variety, season, screenings, protein, etc. CVD are up-to-date for grain sales | | |
| | Hygiene – storages & grain handling equipment clean up – cold winter temperatures suppress storage pest flying. Ideal time for grain residue clean up in all empty storages, equipment, headers. Once clean, apply DE treatment (e.g. Dryacide®) to internal surfaces | | |
| | Aeration cooling – when using auto controller to run aeration fans, do a monthly check on fan run hours for silo currently under aeration. (should be approx. 100 hrs / month) While taking grain storage samples to sieve for insect, also check grain temperature with a grain temp. probe. Aim for grain temps. of less than 15°C in winter. | | |
| | Fumigation – sealable silos - Pressure test sealable silos in morning before sun starts heating up silo roof & walls. Require sealable silo to pass a 3 minute half life test. A new sealable silo should meet Aust. Standard AS2628 – 5 min. half life test. | | |
| | R & M on storage facilities – maintenance on augers, belts, silos. Manual run check on all aeration fans electric faults.. Alterations to storages to allow easier clean out of grain residues. Birds and rodents - apply protective measures / traps to reduce risk of contamination of stored grain | | |
| | Augers & trucks - after handling fertilizer or fungicide treated planting seed , clean -wash out augers, bins, trucks to prevent cross contamination with bulk cereals, oilseeds, pulses. | | |
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| SPRING - Sept. Oct | | | |
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| ✓ | Action | Notes | Date |
| | Monthly storage checks completed & recorded – visual & smell check grain quality, sieve grain from top & bottom, inspect probe traps, identify pests, record grain treatments | | |
| | Stock reconciliation – visual tonnage estimation, during grain inspection above | | |
| | Office “storage spread sheet” up-to-date – monthly checks on quality, insects, plus grain treatments / fumigation details recorded. CVD are up-to-date for grain sales | | |
| | Hygiene – storages & grain handling equipment – clean out old grain residue from empty storages, equipment. Apply DE treatment (e.g. Dryacide®) to internal surfaces. For headers and augers that are difficult to clean out, consider a pre- harvest flush of 2 – 3 bags of grain which is disposed off. | | |
| | Grain quality testing – check grain testing equipment: moisture meter, protein testing, test weight, screening sieve, weighbridge, note book and recording spread sheet etc. | | |
| | Grain protectant spray – Check supplies of registered grain protectants (e.g. Conserve on Farm, K-Obiol). Check nozzle & calibration of spray application equipment - 1 L / tonne. Check with potential grain buyer / handlers before applying grain protectants. | | |
| | Harvest - truck loads checked for grain quality (variety, protein, mc, screenings, etc.) to segregate into storages. Each silo has a 20 L “silo quality drum” (with lid) to represent the grain quality for that storage. Take 15 -20 cupful’s per truck. When silo full, mix grain in drum, test grain quality and record details in office “storage spread sheet” | | |
| | Stock reconciliation – at end of harvest | | |
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| SUMMER - Jan. Feb. | | | |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------|
| ✓ | Action | Notes | Date |
| | Monthly storage checks completed & recorded – visual & smell check grain quality, sieve grain from top & bottom, inspect probe traps, identify pests, record grain treatments. | | |
| | Stock reconciliation – visual tonnage estimation, during grain inspection above | | |
| | Office “storage spread sheet” up-to-date – monthly checks on quality, insects, plus grain treatments / fumigation details recorded. CVD are up-to-date for grain sales | | |
| | Hygiene – storages & grain handling equipment – clean out old grain residue from empty storages, headers & equipment. Apply DE treatment (e.g. Dryacide®) to internal surfaces Take care with grain or planting seed gradings. They are very attractive to pests. | | |
| | Aeration cooling – when using auto controller for aeration fan operations, do a monthly check on fan run hours for silo under aeration. While taking monthly grain storage samples to sieve for insect, check grain temperature with a grain temp. probe. Include planting seed silos. Aim for less than 23°C in summer. | | |
| | Planting seed – your highest value grain. Careful sieving for insect pests and check grain temperature. Aeration should aim to maintain seed at less than 20°C grain temp. Consider taking samples for germination & vigour testing in late summer. | | |
| | Fumigation – check supplies of tins, bag chains, blankets of Phosphine. Protective gear in good order. A silo pressure test prior to fumigation will show any leak points (eg. Silo top lid, base outlet) that may cause fumigation to fail, by not holding gas concentrations for the time required (7 – 10 days) to kill all storage pests. | | |
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Monthly storage inspection - pests, grain quality, treatments

| Date | Storage type / ID | Pests nil or ID | Grain quality comment | Aeration fan run hrs. auto control | Grain treatments Notes: (dates treated and ready for outturn, product, WHP) |
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C. Summary - grain storage best practise

Web links:

1. **Stored Grain web site** www.storedgrain.com.au
2. **Monitor & record:** <http://storedgrain.com.au/monitoring-protects-grain/>
3. **Identify pests:** <http://storedgrain.com.au/stored-grain-pests-id-ns/>
4. **Hygiene:** <http://storedgrain.com.au/hygiene-structural-treatments/>
5. **Aeration :** <http://storedgrain.com.au/aerating-stored-grain/>
6. **Fumigation :** <http://storedgrain.com.au/fumigating-with-phosphine-and-ca/>
7. **Pressure test Silo :** <http://storedgrain.com.au/pressure-testing/>
8. **Grain Protectants :** <http://storedgrain.com.au/grain-protectants/>
9. **Economics of storage :** <http://storedgrain.com.au/economics-booklet/>
10. **Storage Facility design :** <http://storedgrain.com.au/grain-storage-facilities/>

Phone enquiries - grain storage specialists : 1800 weevil (1800 933 845)

Grain storage best practices

For storage pest control and grain quality maintenance, integrating the strategies listed below provides reliable results.

Hygiene – storages & equipment

Regular clean up of grain residues in sheltered sites like empty storages and grain handling equipment significantly reduces the number of pests breeding sites. Augers, hoppers, field bins, empty silos and any other sheltered sites where grain can collect are all important places to clean out when not in use.

A recent test found over 1000 lesser grain borers in the first 40 litres of freshly harvested wheat that passed through a combine header. Old sorghum residues inside the header from last harvest provided food and shelter for these insects to multiply.

Once a physical cleanout of residues is completed, a structural application with a product like diatomaceous earth (DE) e.g. Dryacide® (dust or slurry) will help kill any remaining pests inside silos or equipment.

DE structural treatments can also be used on empty storages that may hold pulses and oilseeds. It is however important to always check with potential grain buyers / handlers and read product labels carefully prior to application of any insecticides on grain or structures.

Silos that have had a pest infestation can be pressure washed out with water & allowed to dry. This will help remove insect pest eggs in the grain dust.

Old waste grain should never be left dumped in heaps around the property. Storage pests quickly turn these into breeding sites and can readily fly 2 or 3 kms back to your silos. Use, bury or burn waste grain so it does not breed pests.

For any grain held for more than 1 month, carry out monthly checks (sieve, insect trap) on storages and fumigate promptly when pests are detected. This includes planting seed and grain held for stock feed.

Site complex hygiene - Birds, rodents and other animals can also be of concern in various storage situations such as grain sheds, bunkers and grain bags. Apply barriers or use other protective measures to reduce risk of grain contamination.

Monitoring grain

Monitor: Never 'store and forget': Sieve grain samples and check insect traps in storages at least once per month. Identify pests and keep monthly records, including notes on any grain treatments or fumigations.

Take grain samples monthly from the silo base outlet and if safe, also sample from the top grain surface or use an insect probe trap. Sieve one litre samples on a wire mesh insect sieve with a white tray. Hold tray in sunlight

for 10 – 15 seconds to encourage insect movement. Identification of pests found is important as treatment action may differ for specific pests or other insects found.

Storage Choices

Many older silos were not designed to be gas-tight and would be difficult to retro seal for the purpose of fumigation. Fit these silos with aeration, do a thorough job with hygiene and monitor monthly. Aim to have at least two sealable, aerated silos on farm. This allows you to achieve an effective fumigation of infested grain.

When buying new silos, look for a quality design that is easy to clean out, fitted with aeration and is sealable to allow fumigation when pests are found. Ask the silo manufacturer if the silo meets the Australian Standard (AS 2628) for sealable silos. i.e. passes the silo pressure test.

Aeration

Fit aeration fans to storages to reduce grain temperatures. Cooling grain will either slow or stop the storage pest's breeding life cycle. Rust red flour beetle stops breeding at 20°C. Lesser grain borer stops at 18°C. All insects stop breeding below 15°C.

Aerate grain as soon as it is put into storage. For reliable results use a good quality automatic controller to run fans, as they select the best temperature and humidity air to use. Ensure silo venting is well designed.

Aim for grain temperatures of less than 23°C in summer and less than 15°C in winter. Field trials show this is achievable within a few days to one week. A grain temperature probe pushed 1 meter into grain and checked after 3 minutes will indicate grain temperatures achieved.

Fumigation

Firstly check you have a suitable gas tight – pressure tested, sealable storage. For effective phosphine fumigations we require a minimum of 300 ppm gas concentration for 7 days or 200 ppm for 10 days. A silo that is not properly sealed will not hold these gas concentrations for the required length of time.

Phosphine gas will leak out very quickly from unsealed storages. The result is only a partial kill of insect life cycle stages - eggs, larvae, pupae and adults. Resistant insect strains also increase with poor unsealed fumigations.

For silos that are greater than 150 tonnes capacity it is recommended that a gas recirculation system is fitted to speed up distribution of phosphine gas during fumigation. This may also enable ground level application of tablets.

If grain temperatures in storage are cool, in the 15 to 25°C range due to aeration cooling, the longer 10 day fumigation is required. (see phosphine label). Profume® fumigations are particularly sensitive to poor insect control results if grain temperatures are below 20°C.

When using phosphine tablets, hang trays in silo headspace, spread tablets out evenly. Label dose rate is 1.5 tablets per cubic metre of silo capacity. As a guide, a 100 tonne wheat capacity silo should always be dosed with 200 tablets, regardless of how much grain is in the silo.

For ease of handling, consider using phosphine “bag chains or belts”. These products are in a string of sachets rather than phosphine in tablet form. (eg. Rentokil - Gastion phosphine belts®, or United Phosphorus Ltd – QuickPhos® fumigation bags). No application trays are required and dust residue is contained in the sachets when the fumigation is completed.

As a general rule, only keep a silo sealed while conducting the fumigation (7 – 10 days). After fumigation is completed, vent the silo using the aeration fan for 1 day, then continue to store grain using aeration cooling to maintain uniform, cool grain conditions.

Harvest time grain management

After discussions with various grain buyers about market requirements, aim to segregate and store grain during harvest on quality specifications that offer the best returns. Take regular small samples (cups) from each truck load while augured into storages. Continue to test. Also have a 20 litre labelled, sealable bucket next to each silo to hold samples. This bucket will represent the quality of grain in the silo.

Regular harvest time testing of samples for protein, moisture content etc, helps ensure each truck load is put into the right silo segregation. Record details of approximate load weights, variety, protein, screenings, moisture content, test weight etc. Do stock reconciliation (tonnes) at the end of harvest

Grain management notes:

Cereal grains

As a guide, the combination of regular storage hygiene plus well managed aeration cooling deals with 70% of storage pest problems. Ensure sealable silos are available when a fumigation is required to treat an infestations.

The first grain harvested is often at greatest risk of early infestation due to headers, field bins, augers or silos harboring storage pests in old grain residues.

Without aeration in storage, freshly harvested grain usually has a temperature around 30°C, an ideal breeding temperature for storage pests. Always deal with any high moisture grain promptly, aerate, blend or dry.

Check stored grain monthly for pests, grain temperature and quality. Keep a monthly storage record of pests found and any grain treatments applied. Useful monitoring equipment includes an insect sieve, insect probe traps, insect ID photos, grain sample spear and a grain temperature probe (1.5 m long). Identify storage pests before selecting a treatment. Read labels carefully.

Before using grain treatments / pesticides, check with your potential grain buyers or bulk handler for market acceptability. When used, rotate chemical groups to reduce the development of resistance.

Planting Seed - held on farm (cereals - wheat, barley, oats)

Seed that is dry, cool and sound (e.g. not weather damaged) will maintain its germination longer in storage.

Grain moisture content (mc) should be below 12% for cereal grains. Grain temperature in storage has a major impact on germination and vigour. Use aeration (with auto control) on seed storages to aim for 20°C grain temperatures or lower. Locate small seed silos in the shade or paint them reflective white. Germination percentage should be above 95% after 6 months storage. Include a vigour test in lab tests.

Treating your planting seed with a grain protectant is recommended in combination with aeration cooling. Seed can be fumigated (sealable silo) with phosphine if required, as it has no detrimental effect on germination.

Pulse and oilseeds

Insect control options are very limited for stored pulses and oilseeds. Grain protectants are NOT registered for use. Phosphine fumigation and controlled atmosphere may be an option; check with end users / buyers. Performance of phosphine fumigation on oilseeds is often reduced due to phosphine gas sorption during treatment. Seek advice.

Most insecticide storage structural / surface treatments can not be used on storages to be used to hold oilseeds and pulses. If unregistered chemical residues are detected by grain buyers, there can be serious long term consequences for Australian domestic and export markets.

Diatomaceous earth (DE e.g. Dryacide[®]) is an option. Deposits of this naturally occurring amorphous silica with insecticidal properties are mined at various locations. It is applied as a dust or slurry spray onto internal surfaces of storages and equipment after old grain residues have been physically removed or washed out.

Some pyrethrin + piperonyl butoxide based products (eg. Rentokil's Pyrethum insecticide spray – mill special[®] or Webcot's S-Py natural pyrethrum Insecticide[®]) are registered for moth control in oilseed storage areas or storage sheds. They can be used as a structural surface spray or fogging / misting treatment. They are not to be applied as a grain treatment. Use only as labels direct.

With limited pest control options available for pulses and oilseeds, make full use of good hygiene and aeration cooling. Small seed size grains like canola may require upgraded aeration cooling fans on storages to overcome high working back pressures fan are working against.

Take care to store oilseeds and pulses at their safe, recommended grain moisture contents.
