Ground cover in the mid-Murrumbidgee catchment

What is ground cover?

Ground cover is any material found on or near the soil surface that protects the soil from the erosive action of wind and water (rain drop impact and overland flow). Materials such as loose surface stones and dung can provide an effective ground cover, but plant material (herbage ground cover), either alive or dead, is the most common and most important. The percentage ground cover is usually described as the opposite of per cent bare soil surface. It is assessed when viewed from vertically above the ground.

Why is ground cover important?

Maintaining adequate ground cover protects the soil from the erosive forces of wind and water. Soil, nutrients and organic matter are retained and siltation problems in dams and water ways are minimised by this reduction in erosion. Adequate ground cover reduces run off and so increases infiltration of rainfall into the soil, increasing soil moisture available for plant growth. Managing pastures and crops, and their residues, to maintain adequate levels of ground cover is an effective way of minimising erosion.

There are two important components of herbage ground cover:

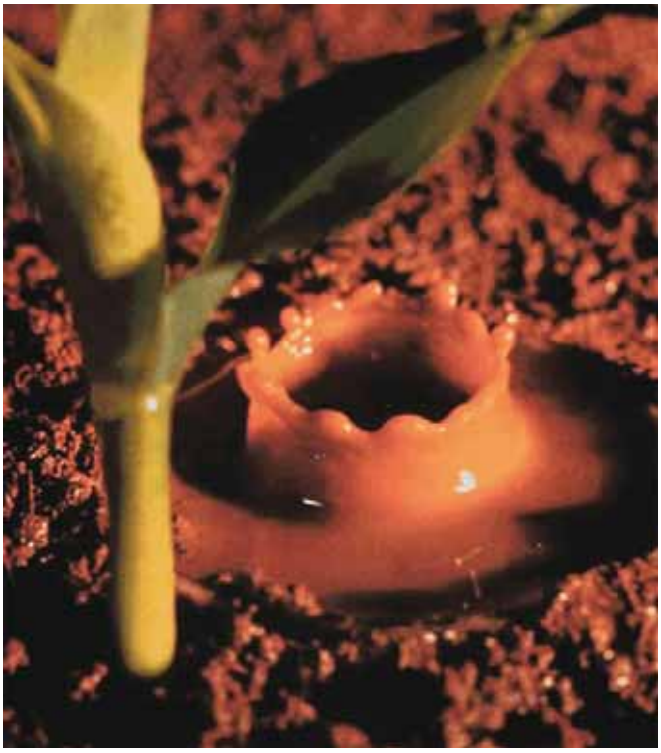
- Canopy cover is standing plants or their residues greater than 5 cm in height. The height of the cover and its horizontal profile can be important for minimizing wind erosion.
- Contact cover is herbage in contact with the soil and includes prostrate stems and leaves, litter and basal areas of plants. Attached plant material is more effective than detached material (litter) for run off and wind erosion control, as it is less able to be carried away.

Rain drop interception

The first role of ground cover is to intercept rain drops and reduce their impact on the soil surface. Falling rain drops possess energy that is dissipated on striking bare soil, breaking down soil structure and detaching soil particles. The detached particles typically form a surface seal that reduces the rate of infiltration of water and increases run off. The soil particles can also be washed

Key points

- Actively growing crops and pastures, and their residues, protect the soil surface from erosion by wind and water.
- Pasture ground cover of 40–65% is recommended on the gently sloping to flat lands of southern NSW to minimise water erosion.
- Wind erosion is minimised with 50% ground cover of prostrate plants, and with as little as 20–30% for upright plants and their residues (ie standing wheat stubble).
- Grazing management of dry residues of crop and pasture over summer/autumn in most years is critical in maintaining ground cover.



Raindrop impact on the soil surface.
Photo: South Dakota State University

away in surface run off. Plant cover protects the soil by intercepting drops and dissipating the associated energy. If soil structure is maintained, infiltration rates of water will also be maintained so more rain water will soak into the soil. Canopy and contact cover are both important in protecting the soil against rain drop impact.

Run off

The second role of ground cover is to impede and slow run off water to give it more time to infiltrate, and to allow deposition of sediment. Contact cover that is attached is critically important in controlling surface run off and promoting deposition of sediment. Detached contact cover or litter is effective only if it is not carried away in the run off. The effectiveness of litter is enhanced by the presence of some attached cover.

Some lucerne stands may not effectively impede surface run off and so may provide little protection against soil erosion. A stand of lucerne approaching flowering may have a canopy cover of about 75%, but erosion can occur as it may have little contact cover or litter because of grazing.

The importance of contact cover is greater on sloping country than on flatter country. Typical relationships between groundcover and run off and soil loss are given in Figure 1.

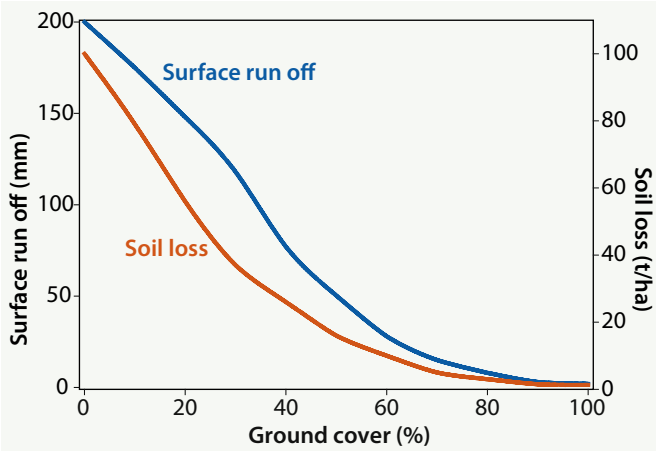


Figure 1 Typical relationships between annual run off of surface water, annual soil loss through erosion and ground cover (derived from Lang and Holmes 1995).

Wind erosion

Tall pastures and crops (> 30 cm), and their standing attached residues, are most effective in minimising wind erosion. If cereal stubble is standing (30-60 cm tall), 20 to 30% cover is required to reduce the risk of erosion, as the standing stalks greatly reduce the wind speed at the soil surface (Findlater and Riethmuller 2000). With prostrate stubble, about 50% of the surface should be covered to control wind erosion. This is approximately 750–1000 kg/ha cereal stubble and 1500 kg/ha lupin stubble (Carter 2002; Carter undated). Much higher levels are required for wind erosion control if plant residues are

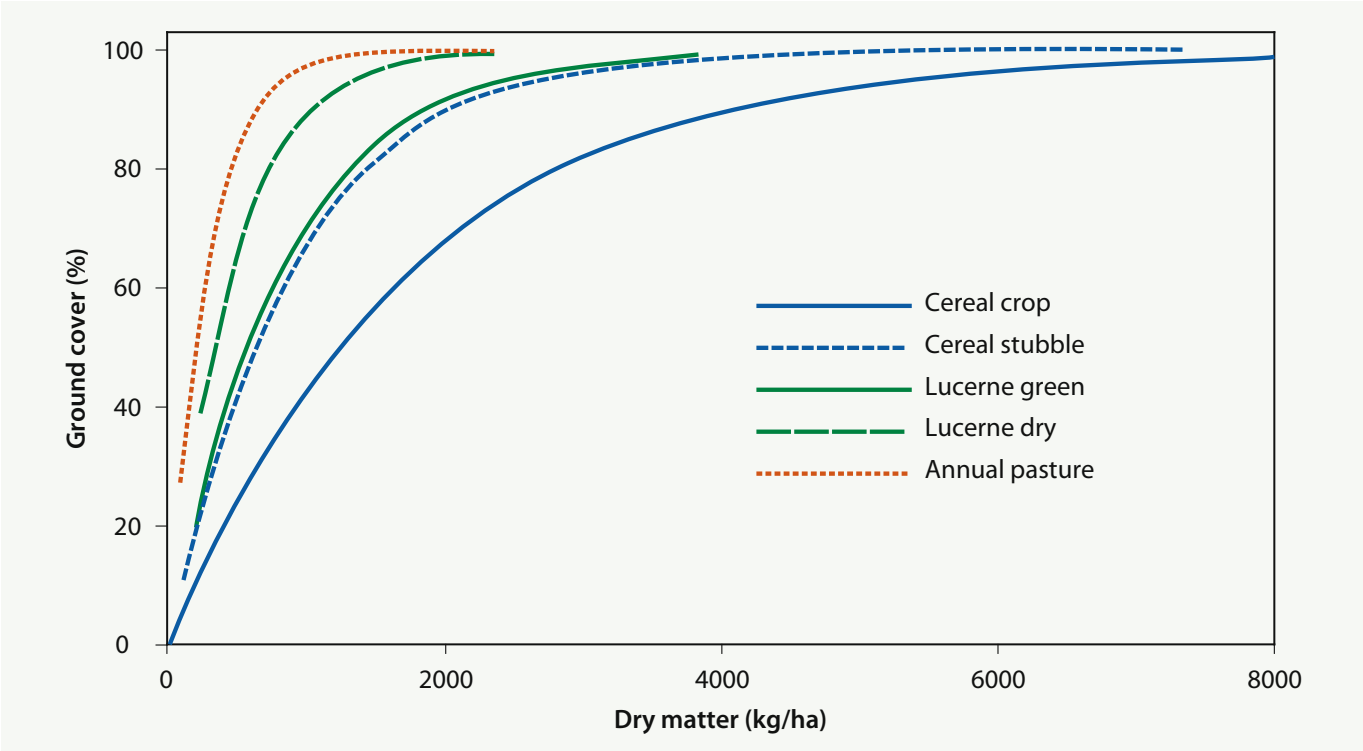


Figure 2 The relationship between ground cover and dry matter production for annual pasture (both green and dry), green lucerne, dry lucerne residue, growing cereal and cereal stubble in the Murrumbidgee catchment (derived from Bowman unpublished).

detached or easily blown by the wind (for example, field pea stubble).

With annual pastures, ground cover of 30 to 50% is required to minimise wind erosion, which can be achieved with as little as 500 kg/ha of dry matter (Carter undated). As minimum ground cover occurs in autumn in southern NSW, the values given would be the minimum required at that time of the year. Higher amounts would be needed in early summer as grazing and decomposition would reduce the ground cover over summer and into autumn.

Ground cover in the Murrumbidgee catchment

The development of ground cover is associated with the germination of annual pasture species and the sowing of crops, mainly cereals, following autumn/winter rains. This ground cover develops over winter and is at a maximum in late spring (October/November). Annual pastures develop ground cover more rapidly than cereal crops and lucerne (Figures 2 and 3). An annual pasture has ground cover of >95% with dry matter production of only about 500 kg/ha, while this ground cover is achieved with about 3000 kg/ha in lucerne pastures and about 5000 kg/ha in green cereal crops (Figure 2).

However, the grazing of these dry residues over summer and into autumn progressively reduces ground cover. Annual pastures and lucerne have minimal ground cover in autumn, with grazed lucerne generally having lower ground cover than annual pastures (Figure 3). Cereal crop stubbles are frequently burned in April/May leaving the soil surface exposed; retaining stubble offers greater protection of the soil.

In southern NSW the erosivity of rainfall is highest over summer as a result of intensive storms, and is minimal in winter (Figure 4). Heavy summer rainfall (January/February) can be damaging, but the soil surface is actually well protected due to the cover offered by matured annual pastures and crops. The time of highest erosion risk is late summer/early autumn as ground cover is minimal at this time, following the break down of dead plant material over summer, and before new plant growth with the autumn break. However, while the soil is most exposed, rainfall erosivity and intensity tend to be lower at this time of the year.

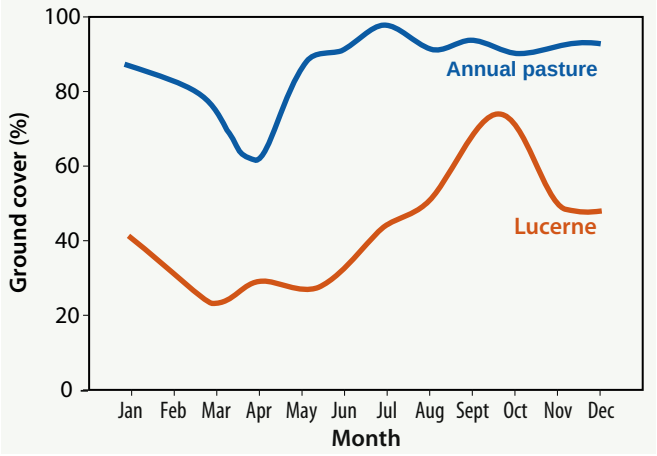


Figure 3 The changes in ground cover of grazed lucerne and annual pasture (averaged 2005 to April 2007) showing the minimal ground cover in autumn (March–May; derived from Bowman unpublished).

Erosion risk is increased in dry seasons or drought years, as pastures are grazed to low levels of ground cover and the soil can be exposed over summer and into autumn. This expands the "time window" of erosion risk. Similarly, where wild fire has destroyed ground cover during summer the risk of erosion is increased. Wind erosion may be reduced, in both these situations, by cultivating to produce a cloddy, rough soil surface.

Estimates of minimum ground cover required to control excessive erosion from run off in southern NSW for different soil erodibilities and slopes are given in Table 1.

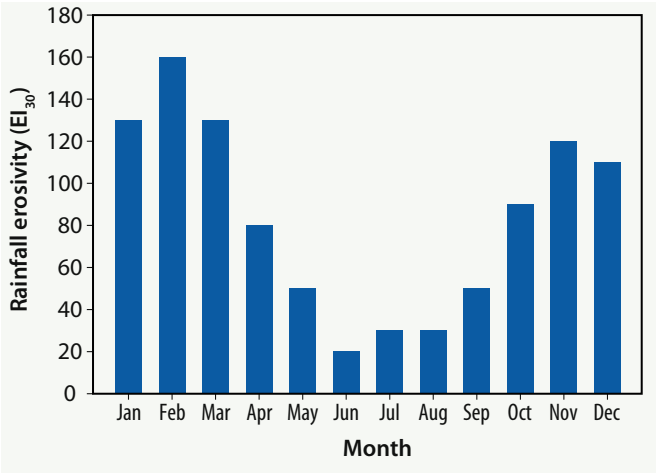


Figure 4 The approximate monthly erosivity of rainfall in the cropping areas of south western NSW. Erosivity is a measure of energy in rainfall and rainfall intensity. Actual erosion will depend on ground cover, slope and erodibility of the soil type (derived from Rosewell and Turner 1992).

Table 1 Estimates of minimum amount of ground cover (%) required to reduce excessive run off and erosion, and sustain productivity for a range of slope gradients and soil erodibility classes for the southern cropping areas of NSW (from Lang and McDonald 2005).

Erodibility class	Typical soil types	Paddock slope			
		Flat (<2%)	Gentle (2-10%)	Moderate (10-20%)	Steep (>20%)
Low	• Deep sands	60 (40)a	60	65	85
Low–moderate	• Sandy loams, light clays • Uniform clays (kraznozems and euchrozems (ferrosols))	60 (40)	60	70	90
Moderate–high	• Loams • Cracking clays (vertosols)	60 (40)	60	75	90
High	• Silts, fine sandy loams • Red-brown earths (chromosols) • Red and yellow earths (kandosols) • Sodic duplex soils (sodosols)	60 (40)	65	80	95
Low-high	• Drainage lines (all types)	100	100	100	100

a Ground cover values given in parentheses apply to the western margin where low annual rainfall may limit ability to consistently sustain higher values under profitable grazing systems.

Estimating ground cover

A simple method which gives an approximate estimate of ground cover involves standing in a representative part of the paddock with your feet half a metre apart. Visualise a square 0.5 × 0.5 m (a square quadrat) in front of your feet and look vertically into the pasture/crop to estimate the percentage of the area that is covered by plant material and litter. Do this, say, ten times across the paddock and average the results.

Inexperienced observers performed well compared to both experienced observers and objective measurements (Murphy and Lodge 2002), except that they tended to over estimate ground cover in the mid range. Accuracy may be improved by using photo guides of reference quadrats with known amounts of ground cover. Figures 5 to 7 give a set of standards for pasture and cereal stubble.

Managing ground cover

Pastures

Managing pastures is a compromise between production, animal health and environmental goals. However, in the Murrumbidgee catchment, grazing management during summer and into autumn is key to minimising erosion. Once 70% ground cover is evident, stock should be excluded from erosion prone areas such as water ways and slopes. Less sensitive areas can be grazed to lower ground cover levels, but continuing dry conditions may make it necessary to choose a small or "sacrifice" area on which to confine and feed stock. This is a common practice under drought conditions.

Cropping and stubble management

How much stubble do you have after harvest? First estimates can be made from grain yield. Stubble present after harvest is about 1.5 times the grain yield for grain yields of 0.5 to 4 t/ha in dryer areas. However in the eastern higher rainfall areas as grain yields increase this rule breaks down. An estimate of stubble amount from grain yield based on data over 27 years from Wagga Wagga is given in Figure 8.

Managing stubble is a compromise between protecting the soil surface with ground cover, and not having too much stubble by sowing the following season, which often causes difficulty when sowing a new crop. Common practice in southern NSW is to graze stubbles. This has the effect of stock tramping down stubble and consuming small amounts. During April/May, if stubble loads are too great to permit sowing it is generally burnt. This exposes the soil surface and is a potential window for erosion.

Farming systems that allow stubble retention are being developed and adopted. Straw spreaders on headers improve distribution of stubble and reduce the chance of clumps forming, blocking sowing machinery when sowing into the header windrows. Stubble can also be slashed or harrowed to produce shorter pieces, which flow through sowing machinery more easily. Precision agriculture systems also allow growers to sow through standing stubble using wider row spacings and inter-row sowing.

In dry or drought years the grazing of failed crops in spring, or the cutting of crops for hay, can seriously reduce ground cover as early as spring. Destocking or confining stock to smaller areas for hand feeding can reduce the erosion risk.

Annual pasture ground cover

Quadrat (1 m²) *Field view*

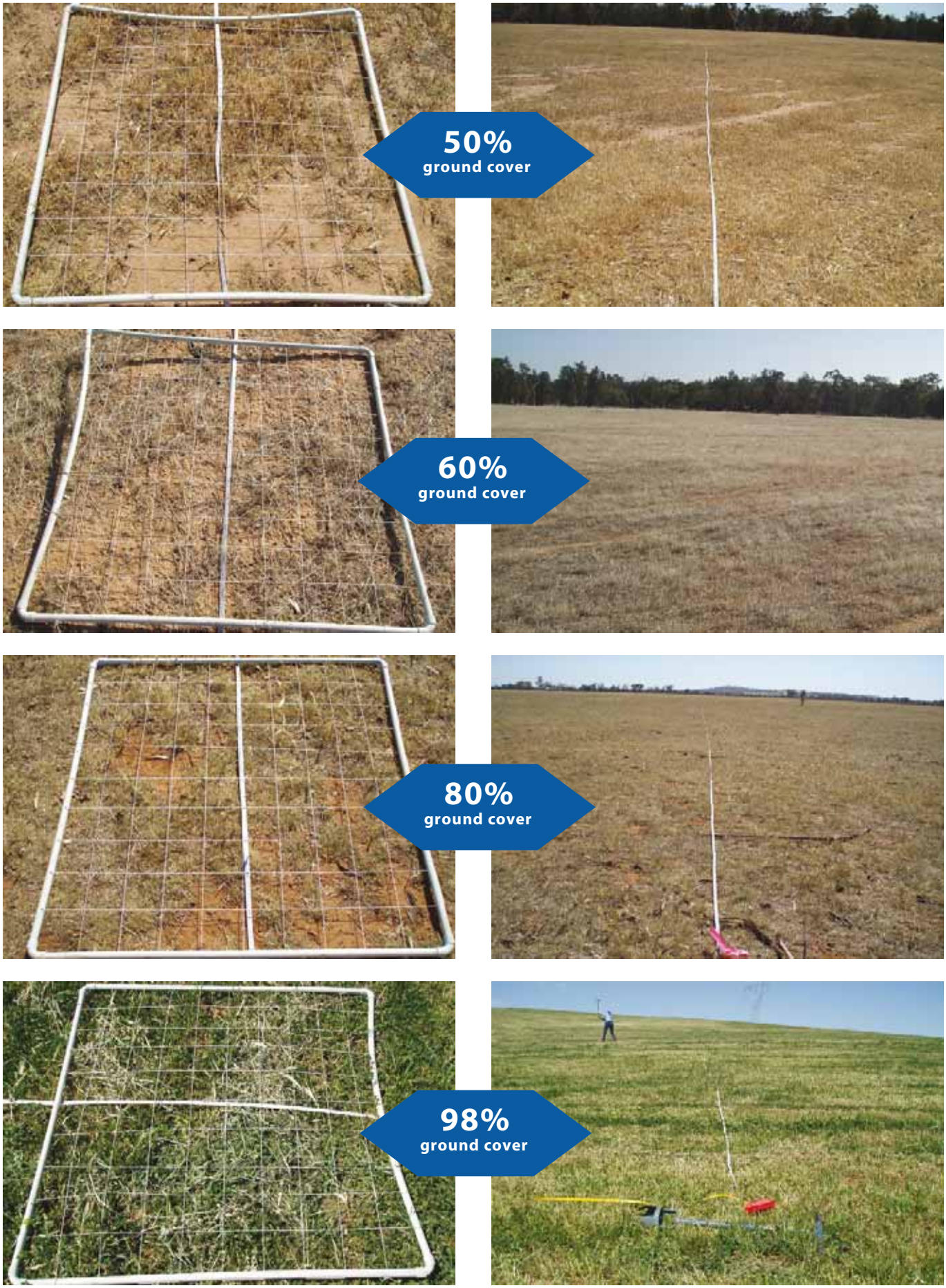


Figure 5 Estimating ground cover of grazed annual pastures.

Lucerne dominant pasture ground cover

Quadrat (1 m^2) *Field view*

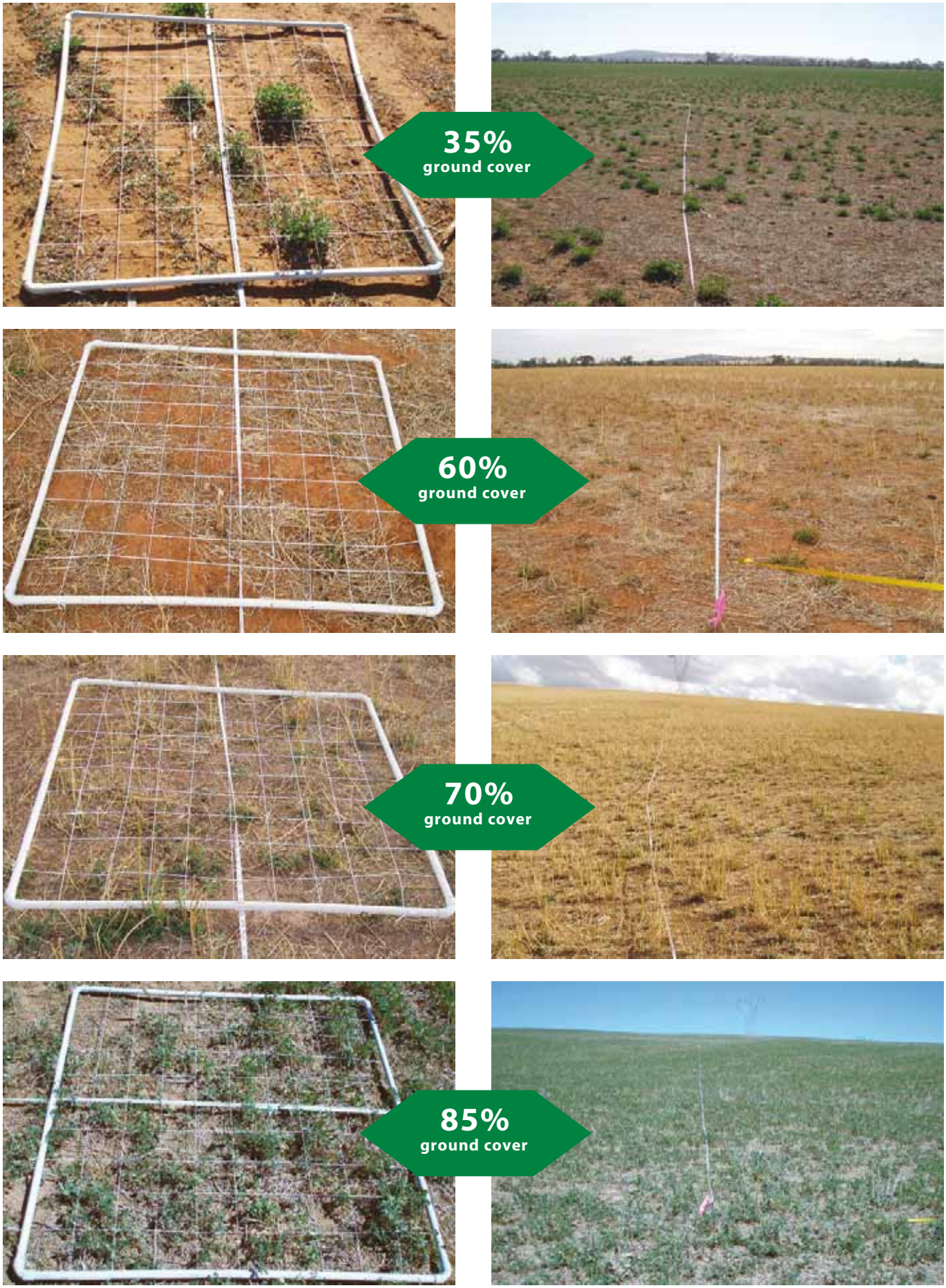


Figure 6 Estimating ground cover of grazed lucerne dominant pastures.

Cereal stubble ground cover

Quadrat (1 m²) *Field view*

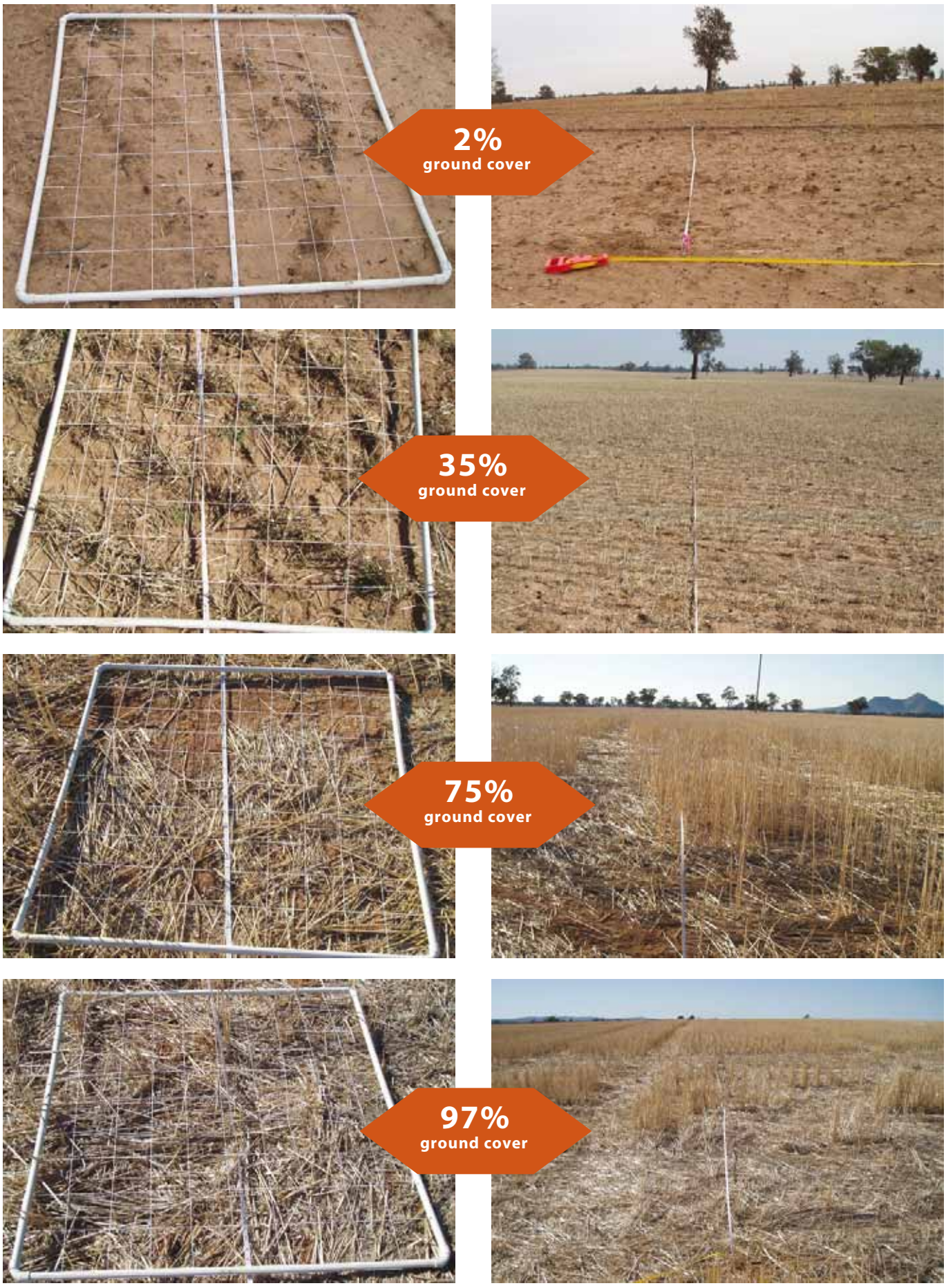


Figure 7 Estimating ground cover of cereal stubble.

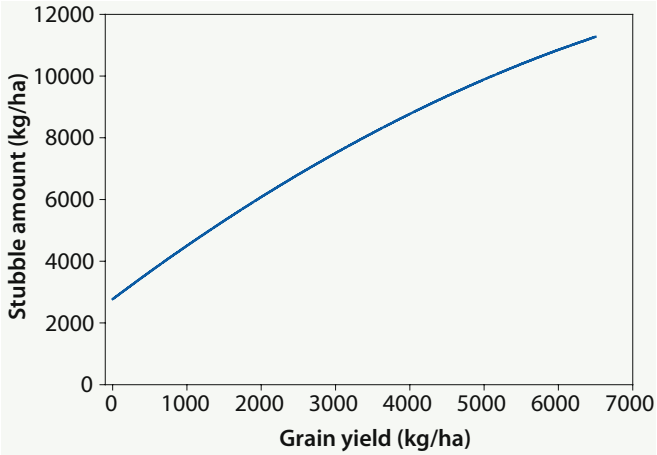


Figure 8 Relationship between grain yield and estimated amount of stubble after harvest for Wagga Wagga, southern NSW (derived from Heenan *et al* 1994, and MK Conyers *pers comm*).

Acknowledgements

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References and further reading

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Further information

www.murrumbidgee.cma.nsw.gov.au or
www.dpi.nsw.gov.au

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