Photo: Ben White

Effective weed control essential for long-term productivity

Key facts

- **Effective weed control will reduce competition for limited moisture and nutrients on sandy soils.**
- **Use a combination of chemical and non-chemical strategies to control weeds.**
- **Understand the attributes of important weed species to ensure control strategies are effective.**
- **Address the full range of factors that limit crop production (e.g. water repellence, subsoil compaction and low soil fertility), to maximise crop competition and weed control.**

Weeds can thrive in sandy soils if control measures are ineffective. Low organic matter (OM), organic carbon (OC) and clay contents combined with potential non-wetting characteristics and poor water-holding capacity can see crops suffer, while certain weeds proliferate.

Large yield losses can occur on sandy soils where weeds are poorly controlled due to the competition for limited resources (i.e. moisture and nutrients). Sub-optimal crop yields, combined with expensive chemical control measures, can result in a significant loss of income. Brome grass (*Bromus* spp.) alone is estimated to cost $19.7M annually across the GRDC Southern Region.

Understanding the specific challenges of controlling weeds on sandy soils, including which weed species are more adapted to these soils, and identifying cost-effective long-term control strategies will increase both profitability and sustainability (Table 3).

There are four specific issues that contribute to poor herbicide efficacy and weed control on sandy soils:

- **Low water-holding capacity** — Rainfall events move water and soluble herbicide products faster and deeper through sandy soils compared with clay soils, which can damage crops, reducing their ability to compete with weeds. Low levels of plant-available water within the soil profile also can cause significant moisture stress in shallow-rooted annual crops, while deep-rooted weed species, such as skeleton weed, can thrive.
- **High percentage of sand** — The low clay content of sandy soils means there are less binding sites for herbicide molecules as they move through the soil profile. The consequence is that a great amount of the active ingredient of a herbicide is available to control weeds, but exacerbates the risk of herbicide damage to the crop. This is particularly a problem where product selectivity is narrow and herbicide safety is derived from the physical separation of the crop seed and the herbicide.
- **Low organic matter** — Low OM levels present a similar challenge to the low clay content of a sandy soil — herbicides are less able to bind to particles within soil, which increases the potential for crop damage. Low OM levels also indirectly affect weed control as poor growth reduces the ability of crops to compete with weeds, due to low fertility and reduced potential for mineralisation.
- **Water repellence** — Water-repellent soils can restrict the emergence of weeds at sowing (reducing the efficacy of non-selective pre-sowing knockdown herbicide applications). Staggered weed and crop germination, and dry pockets of soils, can result in significant herbicide damage to crops when the soil 'wets up' and enables rapid uptake of product.

Management options

As with all weed species, preventing seed set over a number of consecutive seasons is necessary to reduce weed populations. Employ a range of strategies to avoid or delay herbicide resistance. Do not rely solely on herbicides, or a single group of herbicides, and remember "if it works, don't keep using it".

Table 3. Key weeds species, their impact and characteristics

Weed name	Impact	Characteristics allowing proliferation
Brome grass (*Bromus spp.*)	▪ Highly competitive on sand ▪ Root disease host	▪ High level of seed dormancy ▪ Prolific seed set under ideal conditions ▪ Few selective herbicide control options ▪ Has developed resistance to a number of key herbicide chemistries ▪ Can be difficult to remove from crop seed resulting in weed seed dispersal via sowing operation
Silver grass (*Vulpia spp.*)	▪ Well adapted to sandy soils ▪ Allopathic effect of grass residue can reduce emergence of subsequent crop or pasture ▪ Root disease host ▪ Potential for livestock skin contamination and carcase downgrades	▪ Control options vary in effectiveness and are often expensive
Wild radish (*Raphanus raphanistrum*)	▪ Well adapted to growing on sandy soil ▪ Toxic effect on retained crop seed if stored for extended periods ▪ Rapidly develops resistance to many key herbicide control groups ▪ Highly competitive ▪ Rapid growth, especially at northern latitudes (long daylight hours)	▪ Possesses a tap root, which can extract moisture from deep in the profile and penetrate compacted sandy soils better than cereal plants ▪ Extremely hard seeded, resulting in seed bank recruitment over a number of seasons following seed set. This also results in a number of germinations in the crop in any one season. ▪ Ability to set seed 12 months of the year
Skeleton weed (*Chondrilla juncea L.*)	▪ Very competitive in high numbers ▪ Can be expensive to control long term ▪ Prolific seed set when not controlled before or during harvest ▪ Potential to cause quality downgrades where green material is harvested with crop	▪ Perennial species extremely well-adapted to low-fertility sands due to tap root system and perennial nature (able to utilise out-of-season rainfall) ▪ Can grow and persists in low-rainfall environments due to extensive root system
Afghan (*Citrullus lanatus*) and paddy melons (*Cucumis myriocarpus*)	▪ Well adapted to sandy soils ▪ Problematic to sowing operation when larger in size due to fibrous runners ▪ Aggressive user of summer rainfall and mineralised nitrogen	▪ Very efficient at using water, enabling extremely effective moisture conversion to biomass ▪ Extremely long seed bank dormancy (>10 years) — multiple germinations across season utilising out-of-season rainfall

- Aim to stop all seed set. Use a range of weed seed control strategies, such as narrow windrow burning, chaff carts, chaff decks, seed destructors, hay cutting, weed wiping and spray topping.
- Grow a diverse range of crops and/or pastures in the rotation to allow a broader variety of control strategies to be used. Diverse crop and pasture rotations support a wider range of herbicide options and groups can be used and rotated, which is important for delaying the development of resistance.
- Utilise autonomous spot spraying control technology, such as WeedSeeker® and WEEDit® to identify and target weeds or patches with high rates of herbicide. A targeted approach can improve cost-effectiveness of control and is most applicable for summer-active species, such as skeleton weed.
- Control in-crop weeds, including those that escape control and have a staggered germination, with an effective selective herbicide, or a non-selective control measure (e.g. crop topping).
- Test weeds for herbicide resistance. It is essential to know which products will still effectively control weeds to develop a workable herbicide rotation strategy.
- Encourage crop competition (density and growth) by applying adequate nutrition, ameliorating hostile soil conditions, reducing row spacing and increasing sowing rates towards the upper level of district recommendations.

Further information

- **Guidelines to managing key weed species across low-rainfall regions of south-eastern Australia (Ag Excellence Alliance, 2016)**
  http://agex.org.au
- **Impact of weeds on Australian grain production, GRDC, 2016**
  https://grdc.com.au/ImpactOfWeeds
- **Hitting the right target — what are our most costly weeds? (GRDC Update Papers, 2015)**
  https://grdc.com.au/Research-and-Development/GRDC-Update-Papers/2015/02/Hitting-the-right-target
- **Weed resistance testing:**
  http://www.plantscienceconsulting.com.au/#
- **GRDC Integrated Weed Management (IWM) hub**
  http://www.grdc.com.au/Resources/IWMhub
- **Australian Herbicide Resistance Initiative**
  http://ahri.uwa.edu.au
- **Weed Seed Wizard**
  https://www.agric.wa.gov.au/weed-seed-wizard-0
- **WeedSmart**
  http://www.weedsmart.org.au