Implications of the 2002 drought for weed management

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The 2002 drought may have major implications for potential weed problems during the 2003 season, including management in fallows, pastures and crops. However, there is very little published information on the impact of drought on weed population dynamics. There is some information on the impact of weather (rainfall and temperature) on effectiveness of weed control methods. The 1982 and 1994 droughts provide some guidance on the consequences of a major drought on subsequent weed problems. The most likely impact of the drought on weeds is the incursion of new weed problems into districts via fodder, grain and seed.

Irrespective of the drought, the principles of best-bet or integrated management should be adhered to within sustainable farming rotations. Furthermore, the benefits of stubble retention for reducing soil erosion and weed management should be strongly promoted at this time.

Below are some comments on the potential impact of drought on weed problems and management.

Changes in weed seed banks

Species dominance

The weather influences the complex interaction of weed lifecycles, management practices and other organisms (such as pests, pathogens, large herbivores and competing plant species). Variation in weather affects crop/pasture competitive ability, weed growth and seed production, size of seed banks, and future weed densities. Erratic rainfall influences short-term changes in growth as well as long-term shifts in weed communities and species dominance. This is especially important for weed species on the edge of their geographic range and new weed incursions. Drought promotes the dominance of two types of weed species. Firstly, short-term annual species with rapid population turn over, shallow and wide spreading roots, plasticity in growth to exploit surface water and infrequent rainfall events (eg. shepherd's purse, fumitory, vulpia, hairy panic, wild radish), and secondly, drought-tolerant deep-rooted species, such as Paterson's curse.

Following the 2002 season

People assume that weed burdens will be higher than usual in 2003, due to poor weed control and poorly competitive crops in 2002. Is this really the case? Volunteer crops could be a problem in 2003 from unharvested crops in 2002. Where forage conservation was practiced in 2002 *fewer weeds* will result if cutting occurred before weed seed production.

Overgrazing of pastures during a drought will result in a shift to greater weed dominance, especially species like vulpia, and drought-tolerant Paterson's curse. This results from less perennial groundcover and persistence, poorly competitive annual species with low seed set, and more gaps for weed invasion.

During summer fallow

Soil conditions over summer will affect seed survival on and in the soil (from decay or predation), the breakage of dormancy and the amount of seed germinating after the autumn break. The effect of these factors will vary with species and is difficult to predict. The level

of stubble and the distribution of weed seeds in the soil profile will also influence seed survival. Movement of weed seed in summer rainfall run-off will influence seed banks and weed distribution in paddocks. It is therefore important to observe direction of flows to establish weed movement.

More weed seeds may remain on the soil surface after a dry hot summer because seed decay is less in dry soil than in moist warm conditions. High temperatures are likely to damage seeds and the benefits of solarisation for seed kill are known. Tramping stock may also destroy weed seeds on the soil surface. Seed predation by ants depends on temperature (> with high temperatures), weed species (> fumitory and annual ryegrass, cf. wild radish and wild oats) and seed size (> for small seeds).

Ants also play a role in seed burial, which will enhance survival in the soil in dry conditions. Seed dormancy is induced more in dry conditions but varies with weed species. If seeds fall down cracks, they may survive longer than if they remained on the soil surface.

Research is in progress to examine the impact of weather conditions on ryegrass and radish dormancy.

Benefits of stubble retention

This summer has clearly shown the benefits of stubble retention for reducing soil erosion, particularly the importance of minimising stock grazing and trampling of paddocks. Stubble retention also improves water conservation and soil structure and 'health' resulting in less energy requirements at sowing. It is often suggested that adoption of stubble retention by growers is limited due to perceptions of greater weed management problems and increased reliance on herbicides.

We know that changing to stubble retention systems influences weed population dynamics and the management options available. This includes increasing dominance of some species (eg. herbicide-resistant ryegrass and brome grass), while other species like wild radish and wild oats are problems in both conventional and stubble retention systems. But management options are available for these problems to reduce weed seed banks, including careful use of herbicides, seed sterilisation, crop competitive ability, seed capture or destruction at harvest, use of forage crops and green manures.

Crop establishment and competitive ability is often reduced, especially in canola and lupins following cereals. Considerable research over the last few years has identified ways to improve crop competitive ability, by choice of variety, good quality seed, and increased seeding rates. Current research is examining optimal planting arrangement and sowing equipment to sow into stubble at narrow row spacings to maintain crop competitiveness. In stubble retention systems, staggered germination and weed emergence can reduce the efficacy of non-selective herbicides, appropriate residual herbicides can reduce this problem.

Stubble retention may also provide new opportunities for better weed control, for example conditions which accelerate seed mortality, or induced dormancy through deep burial followed by minimal disturbance. With reduced tillage weed seeds are usually concentrated on or near the soil surface and strategic autumn burning can be a useful tool for some species like ryegrass and brome grass, but its ineffective for more dormant species like radish and wild oats. Crop residues can act as a physical barrier to weed emergence, exude suppressing allelochemicals, and enhance the soil biological activity and provide a habitat for seed predators. Research is in progress to examine this.

Emerging winter weeds in 2003

Germination of winter weeds depends on the timing and quantity of rainfall, depth of seed burial, weed species, level of stubble, and soil disturbance. Small seeded species are able to germinate and establish on less water than larger seeded ones. Weed establishment depends on favourable conditions for early growth and is reduced by competition from associated desirable crop or pasture species. Crop or pasture selection (rotation) should therefore be based on weed as well as disease considerations.

Costs of long-term weed management

Unfortunately, effective weed management strategies are expensive in the short-term, but over the long-term are economic because of the high future cost of uncontrolled higher weed densities. It is difficult to expect growers to adopt long-term sustainable weed management when they have little money following a drought. The *Kondinin Group* estimates that grower income was down 50% in 2002. This has serious implications for cash flow in 2003 for weed control. Careful planning can reduce the cost of weed management.

Below is a list of potential problems that are more likely following the drought. Also, some suggestions for better weed management during the 2003-growing season. Careful consideration of crop rotations is an essential component of integrated weed management strategies.

Problems and planning for 2003

New weed incursions
The probability of the importation of new weed species into a district in contaminated grain or forage is *very high* in a drought. Preventing a new weed incursion is much cheaper than managing it later. Incursions of species such as parthenium weed, musk weed, blue mustard, bedstraw, amsinkia, Chilean needle grass etc have already occurred. Wild radish was spread dramatically in contaminated fodder in southern NSW following the 1994 drought. More weeds are likely to be moved along roadsides by/in travelling stock (eg. in faeces, on wool), and from grain spills and hay.

Action required:
- check grain or forage for weed seed contamination
- get weed seed identified
- growers need to ask vendors about the source of the seed
- feed stock in a restricted area and keep record of location
- check for emergence of new weed species after the first significant rain and afterwards
- keep records of new incursions and establish a management strategy
- seek more training on weed identification

Fallow weed control
Summer-growing weeds will use scarce nutrients and soil water and should be controlled. It is important to maintain stubble for conservation of summer rains for next winter crop as well as reducing the risk of soil erosion. Stubble burning in autumn may be less effective for ryegrass control because of low stubble levels from 2002. Herbicide efficacy may be reduced due to stressed plants and stubble.
Benefits of moderate grazing some weed species in fallow should be considered, including spray grazing. What are the benefits and costs in fallow grazing? What is the nutritive value to stock, compared with the risks of soil erosion?

Action required:
- scout and record emerging weeds
- spray at early stage of growth (less herbicide required to kill small weeds)
- use glyphosate and follow up with paraquat or most economic mixture
- spray at night or early morning when plants are less stressed and less dust
- spray patches with residual compounds and watch plant-back times
- watch-out for stock poisoning with species such as heliotrope, panic, amaranthus, chenopodium

Herbicide residues

The risk of residues is high after a drought. This can be herbicides used in the 2002 growing season, or ones used for fallow weed control. Residue problems depend on: the herbicide type, rate of application, soil type (pH, texture etc.), timing and quantity of rainfall and temperatures since application, the crop or pasture species (and variety), and the time of sowing. Triazines and sulfonylureas (eg. Glean) are problems in high pH soils in dry conditions, whereas imidazolinones (eg. Spinnaker with canola) are more residual in low pH acid soil. Imidazolinones can present re-cropping limitations on alkaline soils where minimum rainfall requirements are not met. Other potential problems that need consideration are legumes after Lontrel, cereals after Tordon, and cereals after triazines. Are we sure about the accuracy of plant-back charts following a drought?

Action required:
- consult records for details of herbicide use in 2002, and rainfall records
- consult plant-back charts
- field bio-assays may be useful if problems are suspected

Seedbed preparation and sowing

Compacted, dry soil following drought when cultivated may stimulate germination of some species eg. Fumitory and ryegrass, while other species will have a variable response eg. wild radish and wild oats. Delay sowing to kill early germinations with non-selective herbicides (a tickle may stimulate germination of some species). Judicious use of pre-emergence herbicides is required in paddocks, which are likely to have heavy weed burdens.

Conditions could be cold and wet following the drought and increase the risk of herbicide damage to crops. Consider carefully weather conditions at the time of application (eg. frost, waterlogging etc as indicated on herbicide labels), especially with post-emergence herbicides to avoid crop damage. Strongly competitive crops and pastures are essential to reduce weed impacts. Re-sowing of pastures may be necessary.

Action required:
- consult records of paddock history and weed incidence and effectiveness of herbicides used in 2002, especially where herbicide resistance is a problem and limited choices of herbicide groups are available
- scout for weeds and record species and densities within paddocks
- plan weed management strategy for each paddock
- reduce seed bank prior to sowing
- use the most cost-effective herbicide mixture for species present
- use pre-emergence herbicides in paddocks with expected high weed seed banks
- consult herbicide labels and recommendations for sensitive varieties and adverse weather conditions at spraying, especially for post-emergence herbicides

- create a strongly competitive crop by: choice of a strongly competitive crop species (eg. barley, triticale) and vigorous variety, good quality seed ie. not pinched or shrivelled, and maintain narrow row spacing and higher seed rates (at least 100 kg/ha for wheat, aiming at 200 plants/m^2). Put poorly competitive pulses in paddocks likely to have low weed densities, especially if there are grass weeds
- plan forage legumes or green manures for paddocks that are expected to have large weed burdens
- consider re-sowing pastures: a bio-assay to test pasture seed bank could be useful