MANAGING WEEDS ON ROADS, CHANNELS AND WATER STORAGES

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The problem

Weeds on roads and irrigation structures are a problem because they:

- can be hosts for insects and diseases;
- are a source of weed seeds that contaminate cotton fields and add to the weed seed-bank;
- may restrict the flow of water, which in turn can reduce irrigation effectiveness, increase water logging, lead to blockages in irrigation channels, and can cause erosion and failure of banks;
- make access to channels and structures difficult and provide a habitat for snakes and other pests in areas where siphons are being set;
- can contaminate modules; and
- act as harbours for feral pigs.

Ownership and responsibility for weed management may be difficult to establish in some situations. Weeds may not be able to be managed on adjoining public land.

A very weedy water storage, dominated by sesbania and cumbungi. This storage is a source of weed seed to the cotton crop and a host for pests and diseases.

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Weed management options

The options for managing weeds on roads and irrigation structures are:

- chemical control with herbicides,
- mechanical control with cultivators, graders, excavators and hand hoeing, and
- burning.

A weed management plan should not rely solely on one weed management strategy, as heavy reliance on a single strategy will inevitably see the emergence of weeds that are able to tolerate that strategy. Over reliance on a single herbicide may result in the selection of weeds that are resistant to that herbicide. For more information, refer to Managing Weeds in Cotton and Managing Herbicide Resistance in Cotton section B2 and C2 in WEEDpak.

Weeds are not generally a big problem on roads, as weeds do not grow well on compacted areas and most weeds can be controlled with herbicides and mechanical removal. Weeds are far more difficult to manage on irrigation structures, where water movement, and the physical size, shape and location of the structures requires management with specialised equipment.

Weed management on adjoining private and public land can be a problem. Weeds growing on roadsides (such as this road between two cotton properties) can be a continual source of infestation. Photo: Sandra Williams.

Table 1. *Herbicides registered for controlling weeds on non-agricultural areas. A range of commercial formulations may be available for each active ingredient. Refer to the product label for specific directions regarding the use of a product.*

Herbicide active ingredient	Concentration and formulation	Application rate	Comments
amitrole + ammonium thyocianate	250 g/L AC 220 g/L	0.28 – 4.5 L/100 L water	Check the label for details. Controls a wide range of plants from seedling grasses, at low rates, to perennial grasses at high rates. Controls young broadleaf plants.
diuron	500 g/L SC 900 g/kg WG	72-144 L/ha (Qld) 20-40 L/ha (NSW) 22 kg/ha (Qld) 40 kg/ha (NSW)	Check the label for details. Weeds controlled: Annual and perennial grasses and broadleaf weeds (except Nutgrass, Bindweed and Russian knapweed). Do not use in water-logged areas. Do not use in irrigation channels or drains unless all irrigation tail water and rainfall can be captured and held on farm. Channels must be flushed after application.
glyphosate	360 g/L AC 500 g/L AC 510 g/L AC	2-9 L/ha 1.44-6.48 L/ha 2.1-6.3 kg/ha	Check label for details Controls most weeds. Lower rates for annual grasses. Higher rates for perennials and broadleaves. Reduction in effectiveness may result if more than ¼ of the above ground portion of the weed is submerged at treatment.
glyphosate	450 g/L AC 540 g/L AC 680 g/kg WG	1.6-7.2 L/ha 1.35-6 L/ha 1-4.5 kg/ha	Check label for details Controls most weeds. Lower rates for annual grasses. Higher rates for perennials and broadleaves. Do not apply to weeds growing in or over water. Do not allow water to return to dry channels and drains within 4 days of application.
pendimethalin	330 g/L EC 440 g/L EC 455 g/L	4.5-9 L/ha 3.4-6.75 L/ha 3.3-6.5 L/ha	Check the label for details. Do not apply where waterlogging is likely to occur. If 25-50 mm rain has not fallen within 14 days the channel should be filled with water and allowed to stand for 1 day. The water in the channel should then be drained off and used to pre-irrigate cotton fields.
2,2-DPA	740 g / kg WP	10-20 kg / ha	Controls annual and perennial grasses. Controls rush and sedge, cumbungi, water couch.

Herbicide options

A range of herbicides is registered for controlling weeds on non-agricultural areas, roads, drains, and irrigation structures, as shown in Table 1. Always refer to the product label for specific use directions.

Weeds can be very difficult to control on irrigation structures with herbicides as:

- The herbicides may not be safe to use on cotton or other crops, and so must be applied in conditions that preclude drift to crops or movement in water,
- Soil incorporated residual herbicides are difficult to incorporate to irrigation structures, and may wash into cotton fields,
- Residual herbicides may need to be applied at very high rates, which makes them very expensive to apply,
- Herbicides may need to be applied in the "off-season" when channels are empty. Channels may have to be flushed before use to dilute high rates of residual herbicides,
- Structures may be large enough to make it difficult to apply herbicide to all parts of the structure. Specially designed spray booms are often used for channels and irrigation structures.
- Plants growing in water can not be treated with residual herbicides,
- The constantly changing water level in some channels makes it difficult to treat all weeds at the same time. Some supply channels may remain wet throughout the cotton season, making them very difficult to manage with herbicides, and
- Residual herbicide (diuron) can only be applied where all irrigation tailwater and rainfall can be captured and held on farm.

In using herbicides to manage weeds in channels, head-ditches and storages during the cotton season, it is essential to prevent the movement of herbicides into the crop, either as drift or in water from irrigation or rainfall. The risk greatly diminishes at the end of the cotton season, when the crop is no longer as susceptible to the herbicides. Rotation crops and pastures, however, may also be susceptible to damage from these herbicides, so care must be taken all year round.

A purpose-built sprayer, designed for spraying irrigation channels. Photo by Sandra Williams.

Drift can be reduced by applying herbicides with low pressure and high water volume, through low-pressure nozzles, with air assisted sprays and as shielded sprays. Minimising release height, avoiding high ground speeds and using larger droplets will decrease the risk of drift. The overwhelming influence on drift, however, is to only apply herbicides under suitable environmental conditions. Windy and dead-calm conditions are equally unsuitable for spraying and must be avoided. Don't be fooled that a gentle breeze in the tractor cabin equates to similar conditions outside!!

Contact (non-residual) herbicides

Contact, or knockdown herbicides, kill plants that are growing at the time of application. They are generally very effective on seedlings and young plants, but may be less effective on mature and perennial plants.

Glyphosate is generally regarded as the safest, easiest to use knockdown herbicide option for roads, channels and storages where both grasses and broadleaf weeds are present. It is effective on most annual and perennial weeds, but has the potential to cause considerable damage to conventional cotton plants, alternative crops pastures and riparian areas if it is applied inappropriately. Relatively light rates are required to kill most grass weeds, while heavier rates are needed for many broad leaf and perennial weeds. Glyphosate is a slow-acting herbicide. Complete death of weeds may occur up to two to three weeks after application.

Some formulations of glyphosate should not be applied to water or to weeds standing in water. Where glyphosate is applied to dry drains, there may be a requirement that water not be returned to these drains for some period after herbicide application.

Some formulations, such as Roundup® Bioactive are registered for use on aquatic areas, for controlling emerged weeds that may be standing

in water. Always check the product label for specific directions on product use.

Roundup Ready Flex® cotton volunteer plants may be a problem along roadways and channels, as these plants have been modified to make them tolerant of glyphosate. Cotton varieties with the Roundup Ready Flex trait can not be controlled by glyphosate, and needs to be controlled using an alternative option, such as mechanical control or an alternative herbicide.

Repeated use of glyphosate to manage weeds over many years places high selection pressure on the weeds and will result in both species shift to weeds which are more tolerant of glyphosate and selection for resistance to glyphosate. It is essential to only rely on glyphosate as one of a range of tools for managing weeds in every situation, including roads, channels and water storages.

Selective grass herbicides may be very useful where grass weeds are the predominant weed problem along the edges of cotton fields. These herbicides are most effective against young, actively growing grass weeds. They may be ineffective when applied to mature or stressed grass weeds. Several of these herbicides are available, and are registered for use in cotton, so can be used without risk of damage to the cotton. Great care must be taken however, when using the grass herbicides near sensitive rotation crops such as sorghum, millet, and winter cereals.

The selective grass herbicides are also very prone to developing resistance and can only be used as an occasional management tool when supported by a range of other tools. See Section C, Herbicide Resistance in WEEDpak for more information on developing weed management systems that avoid herbicide resistance.

Residual herbicides

The residual herbicides provide longer-term control of weeds than the contact herbicides, but are difficult to apply to irrigation structures during the cotton season. They must be applied to dry soil. Residual herbicides are normally applied to irrigation structures in autumn after the final irrigation on the cotton. Channels must be flushed prior to the next irrigation to dilute any excessive levels of herbicide that may remain. Non-residual herbicides are generally used to control any weeds that emerge during the irrigation period.

For best results, the residual herbicides require either mechanical or water incorporation (rain or irrigation). Application and mechanical incorporation is easily undertaken on roadways, but may be very difficult to achieve on irrigation structures, and particularly on steep banks. Incorporation with irrigation is more easily achieved, but may wash much of the herbicide away from the target site.

Channels are regularly re-shaped and de-silted with excavators, graders, and delvers.

Mechanical control

Regular grading and upkeep of roadways and channels provides an effective, non-chemical means of weeds control. This may be combined with de-silting operations in channels when required. However, the silt may contain large numbers of weed seeds that will need later control. It is a useful strategy to leave the silt on roadways as much as possible, where emerging weeds can be more readily controlled.

Hand hoeing of channels is sometimes done where large weeds such as sesbania, bladder ketmia, the burrs or Roundup Ready Flex cotton volunteers need controlling in sensitive or inaccessible areas, or areas where spraying is not an option due to wind conditions.

Burning

In severe cases, where large weeds have grown out of control, burning has been used to remove the bulk of dead weed material. Burning may also kill many weed seeds, pests and diseases. Permits may be required for burning, particularly during the summer months.

Common weeds of roads and channels

Any weed can be a problem on roads and irrigation structures, but some species are more difficult to manage than are others. Among the more troublesome weeds are:

Brown beetle grass	*Leptochloa fusca*
Cumbungi	*Typha* spp.
Knotweed	*Perscaria* spp.
Nutgrass	*Cyperus rotundus*
Noogoora burr	*Xanthium occidentale*
Italian cocklebur	*Xanthium italicum*
Sesbania pea	*Sesbania cannabina*
Cowvine	*Ipomoea lonchophylla*
Bellvine	*Ipomoea plebeia*
Awnless barnyard grass	*Echinochloa colona*
Summer grass	*Digitaria ciliaris*
Caltrop	*Tribulus terrestris*
Spineless caltrop	*Tribulus micrococcus*
Couch	*Cynodon dactylon*
Downs nutgrass	*Cyperus bifax*
Volunteer cotton	

These weeds are generally problems because they;

- tolerate the herbicides normally used to control weeds on these areas, or
- grow in water, and so are difficult to treat with either contact or residual herbicides.

An irrigation channel heavily infested with brown beetle grass. The infestation has been sprayed with glyphosate and burned off, but will regrow.

Brown beetle grass is a major weed of irrigation channels and is increasingly becoming a problem in cotton where no residual herbicides are used. Plants produce a large amount of viable seed and can grow to form large tussocks that obstruct channels. Seeds from plants growing on channels are transported into fields in irrigation water and readily grow and establish in cotton fields.

Brown beetle grass is difficult to control on channels with most herbicides. Pendimethalin will control brown beetle grass, but is difficult to incorporate on irrigation structures. Brown beetle grass is easily controlled in-crop with the residual grass herbicides trifluralin, pendimethalin, metolachlor, and Zoliar. Brown beetle grass can be a problem in the furrows in fields where these products are applied in a band behind the planter, with no residual grass herbicide applied to the furrow.

Mechanical control is an option both in-channels and in-crop but this can be time consuming and expensive. Brown beetle grass is very difficult to control in-crop after crop canopy closure.

Brown beetle grass produces masses of seed that germinate and grow in moist places such as channels and irrigation furrows.

Cumbungi and knotweed are not generally problems in irrigation channels where the water level varies, but are more often problems in irrigation storages. Isolated plants are of little importance, but they are large plants, and can form dense mats that are almost impenetrable. They can be hosts to pests including feral pigs. Once established, they are very difficult to control with herbicides. When these weeds become a problem, they may need to be removed with excavators.

Cumbungi is a large plant that grows in water and is tolerant of glyphosate.

Knotweed can form an almost impenetrable mass.

Nutgrass is difficult to control with either herbicides or mechanical control, regardless of its location. It not as big a problem in channels as it is in cotton, but can restrict water flow and cause the build-up of silt, and is able to spread with machinery and water movement. Nutgrass spreads primarily by tubers, which can float and be moved around in water. Any nutgrass patch can act as a source in infestation to cotton fields.

Nutgrass thrives in wet conditions. Nutgrass tubers move in water and are a constant source of infestation to cotton fields.

The burrs, Noogoora burr and Italian cockleburr, are perennial problems where ever they occur. They can produce seed while very small, but can become very large plants, producing masses of seed. Their seed easily catches in clothing and cotton lint and can remain viable in the soil for many years.

The burrs are relatively easily controlled with herbicides, but their ability to germinate after every rainfall or irrigation event makes them a major nuisance. Burrs growing on irrigation structures may be a major source of seed infestation into cotton fields.

Italian cocklebur growing on the side of a channel. These plants are carrying a mass of seed, much of which may end up in the field. Note also the presence of sesbania and barnyard grass on the channel bank.

Sesbania is another potentially large weed that produces masses of seed. These seeds move in irrigation water and can easily move from irrigation channels into fields. Sesbania is relatively tolerant of glyphosate and difficult to control with residual herbicides on channels.

A heavy infestation of sesbania in a head-ditch. Sesbania was not common on this property, but seed has been introduced through the irrigation water. The weed will soon become established in the cotton field if it is not controlled.

Cowvine and **bellvine** are difficult to control in conventional cotton. Plants growing on channels and irrigation structures can be an important source of weed seed going into fields.

This channel bank is covered in cowvine plants. These plants are a source of weed seed for the cotton field.

Spread of seeds through irrigation water

Irrigation water can be an important source of weed infestation into cotton fields, and may include large numbers of weed seeds. When this water is being drawn from an external source, such as a river, the cotton grower has little control over the weed seed load in the water. Generally, however, the numbers of seeds introduced in irrigation water is not large in comparison with the numbers of seeds already present in the soil. A study on one field, heavily infested with cowvine, found that around 5500 cowvine seeds were introduced into the field from irrigation water over a single summer. However, this field already had approximately 2000 seeds/m^2, or 800 million cowvine seeds in the seedbank. The extra 5500 seeds per season are of little importance until the seedbank in the field is greatly reduced.

A study by David Hawkey found large numbers of grass seeds in irrigation water entering fields in the Macquarie Valley. Nevertheless, the introductions still amounted to only a small proportion of the total numbers of weed seeds already present in the fields.

Irrigation water is most important as a potential source of infestation of new weeds to a farm. In the example given above, 5500 seeds per season of a new weed species introduced to a field, would be a major problem and would soon see the weed well established in that field.

The problem of weed seed contamination in irrigation water is generally far worse when pumping floodwater. Some weed seeds are regularly falling into water from plants established on riverbanks etc., but most of these seeds move only a short distance. During a flood, there is the potential for weeds established away from the rivers to contribute large seed loads to the floodwater. Examples of this, were the introduction of velvetleaf to one property in the Gwydir watercourse country during the 1998 flood, and Downs nutgrass to a field on another property during the flood of February 2001, when flood water inundated a cotton field.

There are a number of factors that influence the number and species of seeds that are found in irrigation water. These factors include: soil type; cropping and weed control practices; drainage water return into the channel; distance from the river or main water source; the nature of the watershed; and the environment through which the irrigation channel passes. Weed management in and around channels is likely to influence the numbers and species of seeds that are introduced to fields in irrigation water. Studies have found that the length of time that weed seeds remain viable in fresh water may range from a few months to five or more years, depending on the species concerned.

Channels with poor weed control usually contribute the largest number of seeds to the irrigation water. As water moves through the channel system, the number of seeds in the water is likely to increase from plants growing along the channel banks, seeds blowing into open channels, and by return flows from irrigated fields. The greater the distance that water travels in channels, the longer the exposure to weedy banks. Irrigation is capable of carrying weed seeds over long distances and has the potential to introduce new weed species to a field and a region.

Only one viable seed is needed to start a weed infestation in a field. For this reason, the control of weeds in and around channels and drainage ways should receive as much attention as the weeds that occur in the paddock.

Summary

Weeds are undesirable on roads and irrigation structures, as they are a source of weed infestation for cotton fields and can negatively impact on the irrigation system. Control is equally important on channels and structures that may not be in use. All structures should be given the same importance as cotton fields.

A number of strategies can be used to reduce the movement of weed seeds into cotton fields.

1. Carefully monitor irrigation structures for the presence of weeds that are not commonly found on the farm. These species deserve special attention. Elimination of a single plant may remove the need to manage infested fields in later years.
2. Keep all irrigation water sourced from off-farm in a water storage for as long as possible before use (this is especially important with floodwater), in order to allow the weed seeds to sink during storage, effectively removing them from the irrigation water.
3. Flush dirty channels before use, removing most weed seeds into the water storage system.
4. Treat channels with a residual herbicide after the final irrigation.
5. Use non-residual herbicides as often as necessary to control weeds that emerge during the cotton season.