

BEST MANAGEMENT OF BLADDER KETMIA WHAT YOU CAN DO TO MAKE A DIFFERENCE

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Summary

Bladder ketmia (*Hibiscus trionum*) is an increasingly problematic weed in the Australian cotton industry. Two varieties of the weed exist, narrow leaf bladder ketmia that can emerge, grow and produce seeds throughout the year, and wide leaf bladder ketmia that only grows throughout the cotton season, producing seeds in summer and autumn. Successive seedling flushes of the weed produce seeds within 46-62 days respectively, depending on the type. Between 2500 and 5000 seeds are produced on medium sized plants.

Integrated weed management strategies for bladder ketmia need to focus on three key areas for best management. Firstly, management should be aimed at reducing and eliminating successive seedling flushes after rainfall and irrigation events. A wide range of management options can be used before cotton planting, in rotations and fallow crops, but only a restricted range of tools can be used post-planting including herbicides (broadacre and shielded), cultivation and chipping. The suite of management methods is similar for the second key area for management, removing plants in-crop before they set seed. This is a crucial step so that the problem is not perpetuated in future years. Thirdly, good farm hygiene is important to restrict the movement of the weeds both between fields and farms. In particular it is important to apply the message “*Come clean Go clean*” where ever these weeds occur, as well as removing plants from inside and around irrigation infrastructure, on fallow land and disturbed non-crop areas, and destroying them completely whenever possible.

Introduction

Weeds are an important problem in the Australian cotton industry, costing in excess of \$400/ha/yr when control costs and yield losses are considered (Taylor and Walker 2002). The high cost of weed management and often diverse range of weeds present on farm (Johnson and Hazlewood 2002) makes weed management difficult. Some weeds have more impact than others and weeds in the family Malvaceae appear to be increasing in importance. For example bladder ketmia (*Hibiscus trionum*) has been consistently noted as one of the most important weeds on cotton farms during the last 16 years (Charles 1991; Johnson *et al.* 2003b) with well over 85% of properties affected (Taylor and Inchbold 2001). While individual bladder ketmia plants are not overly competitive, localised yield losses will occur in dense stands. The weed is difficult to manage because successive flushes of seedlings appear following irrigation and rainfall. The weed also has prolific seed production and these seeds appear to have long persistence in the soil.

Past research has focussed on the distribution and spread (Johnson *et al.* 2002), and biology and lifecycle of bladder ketmia (Johnson 2003). A guide to the identification of the various types of bladder ketmia that occur throughout the Australian industry has been published (Johnson *et al.* 2003a) and the importance of recognising these differences outlined in a separate paper in the proceedings of this conference (Johnson *et al.* 2004). This paper outlines a short summary of research information relating to the biology, ecology and

lifecycle of narrow and wide bladder ketmia, (*H. trionum* var. *trionum* and *H. trionum* var. *vesicarius* respectively) and then uses this knowledge to discuss how best management outcomes for both weeds can be achieved.

General information on bladder ketmia

Narrow leaf bladder ketmia

Narrow leaf bladder ketmia can emerge, grow and produce seeds throughout the year. The weed appears to be easily spread by poor machinery and farm hygiene, and in water. It is therefore desirable to manage it in all situations when and where it occurs, for example in cotton crops, in winter and summer fallows, along irrigation systems and on uncultivated land. Plants can produce mature seed in 46 days or less, with an average of 5500 seeds produced per plant. Information from overseas suggests that seeds have a strong seed dormancy allowing the weed seeds to survive for many years in the soil. Studies are continuing in Australia to confirm this. Further details on the various aspects of the biology, ecology and lifecycle of narrow leaf bladder ketmia have been published elsewhere (Johnson 2003).

Wide leaf bladder ketmia

Both types of wide leaf bladder ketmia emerge and grow during spring, summer and autumn. In contrast to narrow leaf bladder ketmia, the wide leaf types of bladder ketmia appear to produce mature seeds in summer and autumn only. Again, seeds of the weed are easily spread when there is poor farm hygiene. Although it is important to manage wide leaf bladder ketmia in all situations, management is especially important to prevent seed production during summer and autumn. The yellow flower centre type of wide leaf bladder ketmia can produce seeds in 53 days or less, and 61 days or less in the case of the red flower centre type, with an average of 2500 seeds produced per plant. It would be sensible to assume that wide leaf bladder ketmia also has strong seed dormancy, although studies are continuing to confirm this. Further details on the various aspects of the biology, ecology and lifecycle of narrow leaf bladder ketmia have been published elsewhere (Johnson 2003).

How to best manage bladder ketmia

Integrated weed management (IWM) strategies for any variety or type of bladder ketmia need to have three specific aims. Management should be aimed at firstly reducing or eliminating the successive seedling flushes that occur after rainfall and irrigation events. Secondly, efforts should be directed at removing plants that escape in-crop management before seed set. Management of the weed when it is vegetative is desirable, both because herbicide efficacy is likely to be greater on vegetative plants and because competition from the weeds on cotton is likely to be less. However, the narrow window of 30-38 days before flowering occurs often makes this difficult. The third general means of management for bladder ketmia is good farm hygiene. This is particularly pertinent in areas or fields where bladder ketmia does not yet occur, or does so at low densities.

A discussion of how specific management practices fit with the three general management principles outlined above follows. The management information outlined below has been drawn from a variety of sources including herbicide labels and databases, from the Best Bet Management section in WEEDpak and from other anecdotal evidence from consultants, agronomists and growers. It is important to note that only those herbicides registered have been outlined below, and that the mention of such information does not imply that the action of the herbicide has been substantiated by this research.

Reducing and eliminating seedling flushes

Although there are a number of pre-plant management options to reduce or eliminate seedling flushes of bladder ketmia, the number of options to manage seedling flushes in-crop is somewhat limited.

Pre-plant and planting - both broadacre cultivation and herbicide applications should be considered to reduce seedling numbers pre-plant, whether that be in winter fallow fields or in the days immediately prior to cotton planting. Seedling flushes in summer fallows should also be treated the same way. Pre-irrigation to initiate a seedling flush is one management practice that should also be considered. Herbicides and mixtures containing glyphosate, glyphosate and oxyfluorfen, diuron, paraquat/diquat and 2,4-D amine are among the most effective, registered pre-plant options for control of this weed. Diuron and paraquat/diquat are effective registered herbicides that may be used at planting. Herbicides containing fluometuron/prometryn, or fluometuron alone, are not registered on bladder ketmia. Although the action of these herbicides on bladder ketmia is not clear, their use in fields that contain other weeds is strongly recommended.

Post-planting - the use of Roundup Ready herbicide® in Roundup Ready crops®, or glyphosate through shielded spray units in non-glyphosate resistant crops, appears to be one of the best means of management for treating successive seedling flushes of either variety of bladder ketmia early in-crop. There are currently product use limits on the amount of Roundup Ready herbicide® that can be used in Roundup Ready crops however. Inter-row cultivation and chipping are especially important on fields that have infestations of bladder ketmia.

Although the cotton industry has traditionally relied heavily on the use of residual herbicides before and at planting and one lay-by application in-crop, there may be situations where both an early and late lay-by application are needed to manage successive weed flushes (I. Taylor pers. comm.). To ensure that all weeds are controlled on 'dirty' fields, an early layby should be timed shortly after the windows for Roundup Ready® herbicide applications early season (four true leaves) and over-the-top applications of Staple® and/or Envoke® have closed (these latter two herbicides are not registered for bladder ketmia but may be for other weeds present), and when the cotton plants are large enough to receive a directed application. For bladder ketmia, an early layby should be timed to reduce the seedling flushes after the end of the Roundup Ready® window and before the start of the traditional standard layby window. This will help produce season-long management of the weed, assuming that very few weed seedlings emerge and produce viable seeds once the cotton canopy closes, or cotton plants become quite large. Both diuron and prometryn are effective registered lay-by herbicides that may be used to manage bladder ketmia as early lay-by applications. Label restrictions prevent the use of diuron more than once during the cotton season.

Finally, it is important to remember to practise good IWM, particularly considering the increased use of glyphosate both pre-plant and in-crop. All herbicide chemistry should be rotated to delay possible resistance buildup, and weed escapes controlled by alternative means before they set seed.

Rotation crops - bladder ketmia appears to be effectively controlled by the use of either atrazine or 2,4-D amine in sorghum crops. Although bladder ketmia is not a major weed during the winter cropping phase, control may be achieved in wheat crops by 2,4-D amine.

Effective control of bladder ketmia can also be achieved in other rotation crops. The reader is referred to the latest NSW Agriculture publication *Weed control in summer crops* and respective herbicide labels and company representatives for more specific advice on rates of application and plant-back periods.

Summer and winter fallows - there is a larger number of options for managing bladder ketmia in fallow situations and many of these have been outlined above. Leaving aside soil structural and moisture conservation concerns, shallow broadacre cultivation is also a very useful tool in managing the weed.

Removing plants in-crop

Competition between bladder ketmia and cotton will occur if weed seedlings are allowed to grow unchecked in-crop. There are three main means of removing bladder ketmia plants in cotton crops, the use of herbicides, cultivation and chipping. The successful management of this weed appears to decrease as individual plants become larger.

The most successful means of managing the weed in-crop is through the use of glyphosate whether over-the-top, directed or shielded, and increased over-the-top opportunities for glyphosate may be realised with the introduction of Roundup Flex®. Bayer CropScience intend to introduce glufosinate-ammonium cotton (Liberty Link®) in the future and while the action of this herbicide on bladder ketmia is currently under evaluation, another tool may well be added for the management of bladder ketmia in crop if registration is achieved.

It is pertinent to remember that both cultivation and chipping are still very useful tools in removing bladder ketmia plants in-crop. A combined program using both approaches is important, particularly to ensure that the weeds in the plant line are removed by chipping. These approaches should form a part of any IWM program for this weed.

Good farm hygiene

Though often overlooked, good farm hygiene is an integral part of IWM and in the management of bladder ketmia. Good farm hygiene needs to include the following:

1. Machinery and equipment needs to be cleaned of mud, soil and seed after working in a weedy field and before entering onto a clean field. To manage this weed effectively the message "*Come clean Go clean*" needs to be applied at a field level on farm.
2. Bladder ketmia plants need to be removed from inside storage walls, irrigation channels, head and tail water ditches and other irrigation system infrastructure. The seeds of bladder ketmia can float and will be spread in water.
3. Weeds in other non-crop on-farm areas need to be controlled so that spread does not occur to cropping areas. These areas not only include fallow country, but along roads and roadside edges, along fence lines and riverbanks, in pasture country and in other disturbed wasteland. Parking cultivation and other machinery on weedy wasteland is a sure way to spread weeds onto fields.
4. Removing dead plants from in the field and irrigation system areas is important, where practical. What appear to be immature green seed heads may actually produce mature seed if adult plants are pulled out and left to die.

How differences between narrow and wide leaf bladder ketmia can impact management

Many of the differences between narrow and wide leaf bladder ketmia have been outlined in a companion paper in this proceedings (Johnson 2004). While specific details can be found in that paper, several points should be highlighted for those who encounter mixed stands of bladder ketmia. Narrow leaf bladder ketmia has a faster vegetative and reproductive development than wide leaf bladder ketmia. This makes wide leaf bladder ketmia slightly easier to manage in order to prevent weed seed production because the window of opportunity is slightly larger. Again, wide leaf bladder ketmia is slightly easier to manage than the narrow leaf variety because mature seed production occurs later in summer and autumn only as opposed to all year round in narrow leaf bladder ketmia. Generally however persistence is the key in a successful IWM package for managing both varieties of this weed.

It is also important to note that because of the taxonomic confusion that has (and still does) exist around the identification of the different varieties of bladder ketmia, that no herbicide labels currently make the distinction between the different varieties. While such a distinction may not have been required in the past when active ingredients appear to have had similar action on both types, more recent research (Wallace 2001) and observations outlined in Johnson *et al.* (2004) indicate that similarity of herbicide action may not be valid in all cases, for example with glyphosate (an on-label registration) and bromoxynil and trioxysulfuron (both off-label, but examined in trials). Because of the large amount of variation identified between different varieties, types and even populations of bladder ketmia, further herbicide screening studies may be needed to elucidate the situation further.

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