

Roundup Ready to flex its muscles

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Since Roundup Ready cotton was introduced to Australia in 2000, it has been rapidly adopted by growers, and now accounts for over 70 per cent of all cotton planted. Roundup Ready technology has re-defined weed management in cotton production — facilitating better weed control, lowering costs and increasing productivity. Importantly, Roundup Ready cotton has allowed growers to lower the quantity of residual herbicides used on farm, reducing any risk posed to the environment.

Despite the high adoption of Roundup Ready technology, growers have always wanted to widen the window of over the top (OTT) application. So Monsanto began working on a new version of Roundup Ready in 1998 — Roundup Ready Flex cotton.

Monsanto Australia began work on Roundup Ready Flex in 2002, with a small amount of seed imported from the US and grown out in our research facility in Toowoomba. Over the past two seasons, Roundup Ready Flex has been comprehensively tested in the field, with data generated from these trials used to support submissions for commercial release currently being assessed by the Office of the Gene Technology Regulator (OGTR), Australian Pesticide and Veterinary Medicines Authority (APVMA) and Food Standards Australia New Zealand (FSANZ).



RR Flex has a wider window of application.

How Roundup Ready cotton works

The Roundup family of herbicides works on susceptible plants by inhibiting the production of certain proteins within the plant necessary for normal plant growth (Figure 1). Roundup herbicides block the production of the EPSPS enzyme.

The EPSPS enzyme facilitates the conversion of sugars produced in the plant (as a consequence of photosynthesis) into proteins that enable the plant to grow. With this process unable to proceed, normal plant function ceases, and the plant dies.

In Roundup Ready cotton, a gene (CP4-EPSPS) isolated from a naturally

occurring soil bacteria has been inserted into the plant. This modification provides an alternate way for the plant to produce the essential plant proteins in the presence of glyphosate. Roundup Ready cotton does not metabolise glyphosate. Instead it grows normally due to the presence of the enzyme produced by the CP4-EPSPS gene.

Roundup Ready cotton has a high degree of vegetative tolerance to glyphosate applications, but the CP4-EPSPS gene is not produced in the floral parts of Roundup Ready cotton. So it is susceptible to glyphosate injury during the reproductive phase.

OTT applications beyond the four-leaf stage can result in pollen sterility, fruit abortion and possible yield loss. So glyphosate contact with plant tissue must be avoided through the use of shielded or directed sprayers beyond this growth stage.

Roundup Ready Flex cotton

Roundup Ready Flex cotton however possesses both vegetative and reproductive tolerance to the Roundup family of herbicides. Roundup Ready Flex cotton utilises the same CP4-EPSPS gene sequence that codes for the CP4-EPSPS protein in the current Roundup Ready cotton, corn, canola and soybean products.

But Roundup Ready Flex cotton has two copies of the CP4-EPSPS gene. It also has a unique promoter sequence that allows for the expression of the CP4-EPSPS protein in the reproductive plant parts as well as vegetative plant tissue.

Unlike Roundup Ready cotton, applications beyond the four-leaf stage will not affect reproductive development in Roundup Ready Flex varieties. Results from several years of research both in Australia and the US have shown that Roundup Ready Flex cultivars are tolerant of glyphosate applications well into the flowering period.

Australian studies over the past two seasons have evaluated different timing and rates of glyphosate, assessing the growth and development, fruiting architecture, yield and fibre quality. Results from these trials have shown that none of these traits have been affected.

Roundup Ready Flex cotton can be safe-

FIGURE 1: Biochemical fate of glyphosate in susceptible and Roundup Ready crops

ly sprayed over the top from crop emergence right through the key window for controlling economically damaging weeds.

Benefits of Roundup Ready Flex

The high margin of crop safety exhibited by Roundup Ready Flex due to its tolerance to glyphosate during fruiting will offer growers increased flexibility and convenience when making weed control decisions. Growers will have more opportunity to control weeds if bad weather or mechanical breakdown delays spraying. The need for specialised spray equipment (such as shielded sprayers) may also be reduced, potentially leading to increased production efficiencies.

Growers will effectively be able to tailor their in-crop herbicide applications to weed development stage instead of the stage of cotton growth, potentially leading to better weed control. Herbicide applications will also be able to be customised to suit the appropriate environmental conditions, reducing the risk of off-target drift, and maximising product efficacy.

Weed management systems

Roundup Ready Flex cotton will incorporate the same integrated weed management (IWM) principles as currently recommended for Roundup Ready cotton. It will be accompanied by a robust crop management plan, designed to ensure the sustainable use of the technology.

The cotton production system incorporates a range of weed control methods. Cultivation, chipping and herbicides with multiple modes of action are features of the cotton weed control landscape, all of which have served to prevent the occurrence of weed resistance to any type of herbicide. It is anticipated that Roundup Ready Flex will provide growers with another option to consider within this system.

Weed systems trials conducted last season have demonstrated that a more flexible use pattern will not serve to increase the number of glyphosate applications required to achieve good weed control. Instead it will enable growers to more efficiently apply the herbicide when and where needed. These trials also showed the importance of lay-by herbicides in providing long-term weed control, especially when multiple germinations of certain weeds (for example, bladder ketmia) are present.

Roundup Ready Flex availability

This season a small amount of Roundup Ready Flex cotton is being grown under strict license conditions enforced by the OGTR. Currently FSANZ is considering the approval of Roundup



Ready Flex cotton seed in the food chain, along with the OGTR assessing a commercial release application for environmental health and safety. Simultaneously, the APVMA is considering an application for use of the herbicide over the crop.

Roundup Ready Flex technology will be licensed to both CSD and Deltapine. Both seed companies have been working with Roundup Ready Flex since 2003, and it is anticipated that both companies will incor-

porate the trait into Bollgard II varieties as well as stand-alone Roundup Ready Flex varieties.

The approval process for new biotechnology traits can take some time, but we anticipate that all three approval processes will be in place by the time commercial quantities of elite germplasm are available in 2006.

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