

Glyphosate use and *Fusarium* outbreaks: cause and effect?

In the past, claims have been made of a link between the use of genetically modified (GM) glyphosate-tolerant (marketed as Roundup Ready) crops, including cotton, canola and soybean, and an increase in the prevalence of *Fusarium* fungus attacks on these crops. The two GM crops of most interest in the Australian context are Roundup Ready cotton which has been commercially produced since 1996 and Roundup Ready canola which was commercially produced in some states of Australia for the first time in 2008.

This paper is a brief summary of the literature available relating to the influence of herbicides on soil-borne diseases, with emphasis on glyphosate and *Fusarium* interactions.

Based on a special report by Dr JL Huppatz, Former Science Advisor, Agrifood Awareness Australia Limited



Glyphosate

Glyphosate is a broad-spectrum herbicide which has been used commercially in agriculture for over 20 years. It is the most successful herbicide ever developed with a particularly low toxicity level and benign environmental impact.

Weeds cost the Australian grains industry alone around \$1.3 billion each year in control costs, lost production and poor quality grain. Growers use herbicides to control weeds that compete with their crops for soil nutrients, moisture and sunlight. In Australia, glyphosate is approved for the control of a wide range of annual, perennial, tree, brush and woody weeds and is used extensively in no/low-till agronomic systems.

Australian canola growers spend approximately \$72 million on herbicides to control weeds in their canola crops each year. Herbicides used in canola production typically include applications to the soil prior to the plants emerging (pre-emergent) plus applications to the target weeds detected throughout the canola growing season (post emergent).

Herbicide tolerant crops

Herbicide tolerant crops are not harmed by the herbicides applied to the weeds around them. In the case of Roundup Ready crops, the herbicide used is glyphosate. Australian farmers already have access to two herbicide tolerant canola varieties developed through conventional breeding — triazine tolerant (TT) and imidazolinone (IMI) tolerant canola. The introduction of new GM herbicide tolerant canola varieties, including GM glyphosate-tolerant varieties, aimed to provide growers with greater flexibility in weed control options.

Fusarium

Most *Fusarium* species are soil fungi and have a world-wide presence. Some are plant diseases causing root and stem rot, vascular wilt or fruit rot, while others cause storage rot. *Fusarium* causes major diseases in all Australia's dominant crops, including cotton and wheat. *Fusarium* Wilt is a concern for the Australian cotton industry, and has been for several years, prior to the introduction of GM glyphosate-tolerant cotton. *Fusarium* Head Blight and Crown Rot affect the Australian wheat industry.

The claims

It has been alleged that in North America glyphosate use on GM crops:

- promotes the growth of *Fusarium*
- makes plants more susceptible to infection and kills beneficial microorganisms in the soil
- inhibits the growth of fungi that compete with *Fusarium*
- can lead to an increase of *Fusarium* Head Blight in wheat the following year.

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The investigation

It is important to ask two questions when looking at this issue.

- 1 Has the introduction of GM crops resulted in an increased incidence of *Fusarium* diseases?
- 2 Is the use of glyphosate (independent of GM crops) responsible for an increased incidence of *Fusarium* diseases?

Are GM crops increasing the incidence of *Fusarium* diseases?

Scientific research has found that glyphosate-tolerant GM crops react no differently in their responses to disease than their non-GM counterparts.

Experiments involving glyphosate-tolerant soybean in the USA, both in the laboratory and in field trials, found that:

- while herbicides affected disease differently, there was no difference in the effect on glyphosate-tolerant GM and non-GM soybeans
- soybean cultivars, GM and parent non-GM lines, were identical in their response to disease
- all publicly and privately developed soybean cultivars and ancestral soybean breeding lines in the USA have been surveyed for resistance to Sudden Death Syndrome caused by *Fusarium*, and no difference between the GM glyphosate-tolerant and non-GM parent cultivars was found.

It has been suggested that changed agricultural practices in the way that herbicides are applied to herbicide-tolerant crops could increase infections by root pathogens because weeds are routinely sprayed at a later stage in herbicide-tolerant crops and this may allow plant pathogens the opportunity to multiply in the dying roots of weeds and affect the crop. While there is no scientific evidence to validate this claim, more research on the impact of changed agricultural practices on herbicide-fungal interactions is needed.

There is no convincing evidence to suggest that the growing of GM herbicide tolerant crops poses any greater risk in terms of disease outbreak than the use of other crop management systems.

Could glyphosate use be responsible for an increased incidence of *Fusarium* disease?

Treating crops with any pesticide, herbicide, fungicide or insecticide has the potential to alter soil microflora but the level of disturbance is usually low and not of agricultural significance.

However, research available in this area suggests that it is possible to link an increased use of glyphosate with increased presence of soil-borne fungal organisms such as *Fusarium*, depending on the frequency of herbicide use, agronomic factors and environmental conditions.

Although detrimental herbicide interactions may occur, the frequency and severity of disease outbreaks are the result of other factors. Recent research indicates that the effect of herbicide application, particularly glyphosate, on disease susceptibility is unlikely to be significant in the absence of other contributing factors, such as favourable environmental conditions and the agronomic systems used to grow the crop, including crop rotation practices. These factors are likely to vary widely in different geographic locations and soil types and for individual crops.

In conclusion

There has been no record of any fungal problems unique to the use of herbicides in herbicide tolerant crops in the past decade and there is no evidence that the growing of GM herbicide tolerant crops poses any greater risk in terms of disease outbreak than use of their non-GM counterparts.

It is clear from a number of studies in both the glasshouse and the field that GM herbicide tolerant crop varieties are no more susceptible to disease than their non-GM parents.

Although detrimental herbicide-disease interactions may occur, the frequency and severity of disease outbreaks are usually the result of other factors, and appropriate strategies should be in place to mitigate potential negative interactions. It is important to emphasise that the use of disease-tolerant cultivars is the most important element in reducing the incidence of soilborne fungal diseases.

For a number of reasons, including increased risk of weed resistance or of inducing a change in the weed spectrum, as well as possible implications for increased disease development, it is important that valuable herbicides such as glyphosate not be overused.



Further information

This paper was generated in response to an article which appeared in the *Weekly Times*. A copy of the original article, and a more scientific response based on the available literature can be obtained by contacting the Agricultural Biotechnology Council of Australia office on 02 6269 5620 or info@abca.com.au

