Glyphosate displays disease control activity in glyphosate resistant crops

Paul C.C. Feng, Frank C. Kohn, R. Douglas Sammons and Keith A. Kretzmer
Monsanto, 800 N. Lindbergh Blvd, St Louis, MO 63167, USA
Email: rdsamm@monsanto.com

Summary Glyphosate is a broad spectrum herbicide used world-wide. Recent studies showed that glyphosate has activities against some fungi that cause diseases in crops. Published studies have demonstrated activities of glyphosate against leaf and stripe rust in glyphosate-resistant wheat, and against Asian soybean rust (ASR) in glyphosate-resistant soybeans.

Past studies showed that glyphosate provided both preventive and curative activities against *Puccinia triticina* Erikss., and *Puccinia striiformis* Westend., which cause leaf and stripe rusts in wheat, respectively (Feng *et al*. 2005). Rust control was demonstrated at multiple plant growth stages with a glyphosate spray rate of 0.84 kg ha^{-1} which is the typical use rate for weed control. A field test under realistic stripe rust pressure confirmed the preventive and curative activities of glyphosate.

Greenhouse studies showed that glyphosate provides both preventive and curative activities against Asian soybean rust (ASR) caused by *Phakopsora pachyrhizi* H. Sydow Sydow, in glyphosate-resistant soybeans. Rates of 0.84 to 1.68 kg ha^{-1} of glyphosate were necessary to provide consistent activity, although the level of activity was equal to or less than that of fungicide standards. Application of glyphosate prior to rust inoculation delayed the onset of ASR for 14 to 21 days. Glyphosate also displayed curative activity when applied within 5–6 days after rust inoculation. Activity was attributed to systemic glyphosate that required plant absorption and translocation; little to no activity was observed with the surfactant system in a commercial glyphosate formulation.

Field studies conducted in Argentina, Brazil, South Africa and USA showed good translation of greenhouse data with reduction in field severity of ASR from application rates between 0.84 and 1.68 kg ha^{-1} of glyphosate; however in most cases current glyphosate products do not yet provide the same level of efficacy as commercial standard fungicides.

Glyphosate is a broad spectrum herbicide with very attractive environmental properties and has been used in glyphosate-resistant crops for efficacious control of weeds. Glyphosate inhibits 5-enolpyruvyl shikimate 3-phosphate synthase which is a key enzyme in the synthesis of aromatic amino acids in plants, fungi and bacteria. Our results with wheat and soybean rust suggest that disease control is through a direct action of glyphosate on the rust fungi. Leaf rust control by glyphosate was not mediated through induction of four common systemic acquired resistance genes. Studies with ASR demonstrated higher shikimate levels in infected leaves following treatment with glyphosate, providing additional evidence for direct inhibition of fungal EPSPS.

Our results indicate that glyphosate has activity against wheat rusts and ASR. Activity against additional plant diseases on soybean and diseases on other crops has been documented, demonstrating that incremental disease control benefits in glyphosate-resistant crops are possible.

Keywords Glyphosate, EPSPS, soybean, Asian soybean rust, wheat, leaf rust, stripe rust.

REFERENCE

Feng, P.P.C., Baley, G.J., Clinton, W.P., Bunkers, G.J., Alibhai, M.F., Paulitz, T.C. and Kidwell, K.K. (2005). Glyphosate inhibits rust diseases in glyphosate-resistant wheat and soybean. *Proceedings of the National Academy of Science USA* 102 (48), 17290-5.