**PROJECT CODE**

**BRE0901**

**TITLE**
**Developing Sulfentrazone Tolerance in Lentil**

**INVESTIGATORS**

Principal Investigator: F.A. Holm, Dept. of Plant Sciences, University of Saskatchewan
Co-Investigators: Albert Vandenberg, Crop Development Centre, University of Saskatchewan;
K.L. Sapsford, Dept. of Plant Sciences, University of Saskatchewan; and
Eric Johnson, Agriculture and Agri-Food Canada (Scott)

**STUDY FUNDER(S)**

Saskatchewan Pulse Growers

**TYPE OF STUDY**

**GENETIC IMPROVEMENT IN LENTIL – HERBICIDE TOLERANCE**

**OBJECTIVES**

This project has two main goals: investigating the potential for use of Group 14 herbicides in lentil cropping systems in Saskatchewan; and investigating the potential for breeding Group 14 tolerant lentil varieties.

**WHY STUDY NEEDED**

Diversified weed control systems and herbicide options are urgently needed for lentil production in Saskatchewan. Lentils are a poor competitor with weeds and yield can be reduced substantially if weeds are not adequately controlled. Weed control options are limited, with the shift in weed populations toward Group 2 herbicide resistance and a new threat in the form of the recent discovery of glyphosate resistant kochia in the western prairies. Use of Group 14 herbicides is increasing in many regions where weed populations have shifted towards resistance of some of the commonly used herbicide action modes. A review of literature indicated that since tolerance to Group 14 herbicides (Protoporphyrinogen oxidase inhibitors) like sulfentrazone (Authority®) exist in many legume species, it might be possible to develop tolerance in the lentil crop.

This project focused on evaluating the potential for identifying or developing sulfentrazone tolerance in lentil varieties, as well as identifying potential of other Group 14 herbicides such as fluthiacet-methyl.

**HYPOTHESIS**

This project tests the hypothesis that tolerance to sulfentrazone exists in lentil germplasm at a level sufficient to allow the development of lentil varieties tolerant to the herbicide.

## STUDY DESIGN

Following the previous observation that some lentil cultivars appeared to have a degree of tolerance to sulfentrazone, several experiments were planned to identify and increase this tolerance.

1. Several cultivars were grown at Scott and Saskatoon over two years, using a split-plot experimental design, to examine effects of injury by sulfentrazone (0, 70, 140, and 280 g active ingredient per hectare).
2. Another study evaluated re-cropping injury on lentils 12 months after sulfentrazone application. The first crop was chickpeas, then several cultivars of lentils were grown in the next year, using a split-plot experimental design.
3. A greenhouse study was used to investigate whether CDC Improve and CDC Impala exhibited similar responses to fluthiacet-methyl, another group 14 herbicide which is used post-emergent. Cross-tolerance would allow use of this herbicide both for selecting new cultivars, and allow the breeding of lines with high tolerance to fluthiacet-methyl (Cadet).
4. A field trial with fluthiacet-methyl followed the greenhouse trial, using a split-plot design with seven cultivars and comparing fluthiacet-methyl to sulfentrazone, at Saskatoon and Scott in 2011.
5. Earlier tests spraying large sets of lentil varieties had identified a few with a higher degree of tolerance. These survivors were incorporated into the crossing block immediately for crossing and multiplication, while the tests were repeated with more varieties. Crosses were made involving elite lines of all market classes of lentils. Progeny from these crosses were put out in the field (Saskatoon) in 2010 and treated with sulfentrazone again. Some of the best-looking plants were used immediately in crossing. In 2011 further progeny were field-tested using fluthiacet-methyl.

## FINDINGS

1. Some cultivars such as CDC Improve and CDC Impower showed less injury from sulfentrazone, and recovered better, although plant stands of all cultivars were reduced somewhat. In the Saskatoon 2011 trial, herbicide injury was seen but in some cultivars the plants recovered better and in one cultivar, CDC Improve, there was no yield loss at the lowest level of sulfentrazone. The Saskatoon 2010 site was extremely wet and lentil plots were very poor, although some differences were still apparent. Sulfentrazone is a soil-active herbicide and in the Scott 2011 site, which started with a long dry period, there was little injury and no yield loss. In the Scott 2010 site, in a very wet year, weeds could not be controlled by other means and the consequence was that in some cultivars, yield was higher in the presence of the herbicide.
2. When lentil cultivars were grown after sulfentrazone-treated chickpeas, injury

ratings on the lentil re-crop were low and yield appeared unaffected. This may have been influenced by the very wet first year, which maximized sulfentrazone breakdown.

3. The greenhouse study with fluthiacet-methyl showed that there were differences in biomass accumulation among cultivars, suggesting that this herbicide has potential for use in selection.
4. In the follow-up field trial, the visible injury caused by the two herbicides was inconsistent; at Saskatoon, sulfentrazone injury was greater while at Scott fluthiacet-methyl injury was greater. At both sites, though, the lentils recovered well from fluthiacet-methyl and little to no yield loss was seen. Some cultivar differences were seen. This herbicide may become a useful addition for lentil growers.
5. The lines which were crossed and repeatedly tested with sulfentrazone, then fluthiacet-methyl, were analysed and lines with best maturity and least injury were selected. There was a wide range of yield. The search for improved tolerance and how it is transmitted is continuing in further research projects, and is expected to lead to the release of good quality Group 14-tolerant lentil cultivars, some of which may have the Clearfield® tolerance as well.

**SIGNIFICANCE OF STUDY**

The results from the field trials, despite some inconsistencies, showed that there are tolerance differences to Group 14 herbicides within the narrow range of germplasm tested. When a wide range of lines was treated, the rare survivors used in crossing transmit their tolerance to some progeny. Such crosses are expected to lead to new cultivars with good tolerance to sulfentrazone. A second Group 14 herbicide, fluthiacet-methyl, worked well as a selection agent, leading to the possibility that other Group 14 herbicides may work well for lentil growers.

**PUBLICATIONS, PRESENTATIONS, EDUCATIONAL MATERIALS PRODUCED**

Sulfentrazone resistant lentil varieties would be released to growers through the SPG variety release program. Information on the new varieties and the accompanying herbicide package would be disseminated through normal extension channels including SPG communication vehicles, pulse crop field days and workshops, and the farm media. It is expected that both BASF (imidazolinone herbicides) and FMC/Nufarm (sulfentrazone) would actively promote the use of the varieties and the herbicide package to lentil producers.

**Presentations**

Preliminary field data were presented at the NAPIA meeting in Puerto Rico in October 2011.

Selected results from this research were presented at the International Conference on Legume Genetics and Genomics to be held in Hyderabad, India, October 2012 and at the Canadian Pulse Research Workshop, Niagara Falls, November 2012.

**VALUE TO PRODUCERS**

Kochia is a major weed problem throughout the lentil production area of Saskatchewan. Kochia plants are highly competitive, especially against lentil, and most are resistant to Group 2 herbicides. This greatly reduces the utility of the Clearfield® trait in current Clearfield® lentil varieties. Being able to use sulfentrazone or other Group 14 herbicides in combination with imidazolinone herbicides on lentils would provide control of a wide range of broadleaved weeds, which would provide improved weed control options, increase lentil yields, and reduce harvesting problems.