New Strategies for the Integrated Pest Management in Dry Edible Beans to Manage Risk and to Enhance Economic Viability

Final Report

Mr. C.L. Gillard
Ridgetown College, University of Guelph
120 Main Street East, Ridgetown Ontario N0P 2C0
(519) 674-1632, fax (519) 674-1600
cgillard@ridgetownc.uoguelph.ca

Research Co-operators:
Dr. Peter Sikkema
Ridgetown College, University of Guelph
Telephone: (519) 674-1603
Facsimile: (519) 674-1600
Email: psikkema@ridgetownc.uoguelph.ca

Dr. Art Schaafsma
Ridgetown College, University of Guelph
Telephone: (519) 674-1624
Facsimile: (519) 674-1555
Email: aschaafsma@ridgetownc.uoguelph.ca

Canadapt Project #:564

Project Coordinator: Mr. Lucas Thacker

Presented to the Agricultural Adaptation Council and the Ontario Coloured Bean Growers Association, January 31, 2004
# Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive Summary</td>
<td>3</td>
</tr>
<tr>
<td>Project Objectives and Project Input</td>
<td>4</td>
</tr>
<tr>
<td>Funding Activities</td>
<td>5</td>
</tr>
<tr>
<td>Research Results</td>
<td>5</td>
</tr>
<tr>
<td>Reach and Communication</td>
<td>18</td>
</tr>
</tbody>
</table>
EXECUTIVE SUMMARY

The primary focus of this project is the integrated management of two pests in dry beans; the potato leafhopper and weed control strategies. A minor focus of the project is the management of several other dry bean pests, including wireworm, bean leaf beetle, seed corn maggot, anthracnose, white mold, root rot and tarnished plant bug. Dry bean growers rely almost entirely on the weed management research funded by this project to provide them with new weed control strategies. Compared to other field crops, dry bean acreage is simply too small to attract significant funding from private industry. Furthermore, this problem is compounded by the fragmentation of the dry bean industry, with a number of different market classes grown, each with it’s own response to new weed management strategies. This raises potential product liability issues for private companies, which limits their interest in the crop even more.

Several effective control strategies were found for the following problem weeds in white and kidney beans; lamb’s-quarters, red root pigweed, common ragweed, proso millet, green foxtail, green smartweed and wormseed mustard. Each of these weeds is a major concern in at least part of the dry bean production region in Ontario.

Field studies evaluated the response of 6 market classes (black, pinto, Berna, cranberry, kidney and yellow eye) to four potential new herbicide options. Of the 24 possible combinations of herbicide and market class, 10 combinations were found to provide an adequate level of crop safety, and an URMULE submission will be made to the PMRA. Eight combinations were found to provide an unacceptable level of crop safety, and additional data is required for 6 combinations. As well, 5 preplant incorporated herbicides, 5 preemergence herbicides and 6 postemergence herbicides were evaluated in otebo and adjuki market classes. Twelve URMULE submissions will be made to the PMRA, while 10 combinations provide an unacceptable level of crop safety, and additional data is required for 8 combinations. These results demonstrate the need to continue this research. This research needs to be expanded to cover off other dry bean market classes. There are no herbicides currently registered for use in two dry bean market classes grown in Ontario (otebo and kintoki), which seriously jeopardizes current and future markets for Ontario dry bean growers.

The potato leafhopper (PLH) is the most serious insect pest facing Ontario growers. Damage from this pest exceeds $3 M each year. This figure can be reduced by developing new control strategies, by developing a better understanding of the pest and pest thresholds, and through the education of dry bean growers. This project has identified three new seed treatment control strategies, and four new foliar control strategies. These strategies are effective, economical and provide a positive environmental impact, compared to current control strategies. Pest threshold research has measured the impact that PLH has at various stages of crop development, and measured the impact that various control strategies have on the pest and the crop. For instance, the new seed treatment control strategies provide an effective control of PLH for 4-6 weeks. This is considered season long control in some years, but not in others. The development of pest thresholds in combination with this seed treatment technology will allow growers to select the most appropriate foliar control measure, and apply them only when they are needed to adequately control the pest. A final area of research has developed a better understanding of the interaction between PLH and dry beans. It has shown that PLH are attracted to dry beans based on leaf colour. There is some potential to use this information, along with new control strategies, to develop a trap cropping system that will reduce damage from the pest, and reduce the need for
repeated application of foliar insecticides by dry bean growers. The control of minor dry bean pests has focused on the development of new seed treatment control strategies to replace existing seed treatment combinations. For Ontario produced seed, the current seed treatment is DCT. This product is effective and inexpensive, but it is difficult to apply, it has problems with ‘dust off’, and it has very little impact on several key pests. For seed that is imported from the U.S., the current seed treatment contains streptomycin, which will soon be deregistered for use in Canada, and lorosban, which is under review by the PMRA and the EPA for removal from the marketplace. Research in this project supported the recent registration of Apron Maxx RTA, which provides dry bean growers with a new level of control for early season root rot. Root rot is considered by many in the industry to be the Achilles heel in dry bean production. Registration is pending on new insecticide seed treatments that will provide excellent control of wireworm, seed corn maggot and bean leaf beetle, as well as the potato leafhopper, as discussed above. Anthracnose seems to be the fly in the ointment. None of the products evaluated, including Apron Maxx, provide a level of control that is equivalent to DCT. This seed borne disease is a sporadic, yet serious problem in dry bean production that is getting worse every year. The winning seed treatment control strategy must provide adequate control of anthracnose, to be given the ‘thumb’s up’ by growers.

PROJECT OBJECTIVES AND GOALS

Goal: To re-tool integrated management of pests in edible beans to be more economically viable, more effective, more efficient and safer.
Objectives: To adapt several new pest control strategies to manage a number of specific weed, disease and insect pests in dry edible beans on the basis of efficacy, crop tolerance, ease of delivery, and economy.
Deliverables: Knowledge of the specific pests each strategy controls. Assess the ease of delivery for each pest control strategy. Assess the adoption by growers to each pest control product. Assess the economic feasibility of each strategy for the grower, compared to other existing control measures in the marketplace. Assess the impact each strategy will have on the environment.
Results to Date: New pest control strategies have been identified for the potato leafhopper, anthracnose, problem weeds, white mold and root rot that meet the goals and objectives above. As these strategies become available to growers, the economic feasibility and adoption will be assessed. A positive environmental impact is expected for each strategy, as this was a core objective for this project.

Goal: To determine how pest control strategies fit across a number of cultivars in each of the major edible bean market classes.
Deliverables: Knowledge of crop tolerance for each pest control strategy, for several popular cultivars in each of the major market classes of dry beans. The development of a set of production guidelines, for growers to use as a risk management tool.
Results to Date: Pest control strategies have been evaluated in a number of dry bean market classes. Essentially no crop tolerance issues have been identified for the insect or disease control strategies. However, efficacy and crop tolerance has been found to be particularly important for the weed control strategies being assessed. Further research has been proposed in this area.
Goal: To integrate non-chemical alternative methods of pest control in dry edible beans, including cultural and trap cropping strategies.
Deliverables: Knowledge of which specific pests can be effectively controlled by each alternative method. Knowledge of the crop tolerance for each alternative control method, for several popular cultivars in each of the major market classes of dry edible beans. Assess the adoption by growers to each alternative method of pest control. Assess the ease of delivery for each alternative method. Assess the economic feasibility of each alternative method. Assess the impact each alternative method of pest control will have on the environment.
Results to Date: A trap cropping system was evaluated in small plot studies. This research has shown some promise. Before large scale studies are initiated, some field scale research will be performed to monitor the movement of PLH. Alternative technologies were evaluated for the control of early season root rot and the foliar control of PLH. None were found to be as effective as the control strategies currently in use.

Goal: To develop a better understanding of the interaction between potato leafhopper and the edible bean plant, including the mode of attraction between the pest and major market classes of edible beans, and the movement of potato leafhoppers from other susceptible crops in to an edible bean crop.
Deliverables: Knowledge of why the potato leafhopper prefer certain market classes of dry edible beans over others. Knowledge of the movement of potato leafhoppers between dry edible beans and other susceptible crops. Knowledge of the movement of potato leafhoppers within a dry edible bean crop.
Results to Date: This research has found that PLH are attracted to certain dry bean market classes over others based on colour. This research will assist in explaining the differences growers often see in PLH populations between dry bean cultivars and between dry bean market classes. This knowledge could be used as a selection tool in a breeding program to select PLH tolerant dry bean breeding lines.

**FUNDING ACTIVITIES**

All of the external funding has been received from each of the four partners in the project. An invoice has been sent to the AAC from the Office of Research at the University of Guelph (see copy attached), to access the AAC funding committed to the project for both years.

**RESEARCH RESULTS**

**Potato Leafhopper (PLH) Attraction to Dry Bean Cultivars, and the Evaluation of Trap Cropping Systems**

E. Bullas defended her M.Sc. thesis on July 29, 2003. Two articles have been submitted to the Canadian Journal of Plant Science from her thesis, and both have been accepted with minor revisions. She conducted a series of experiments to determine the mode of attraction between the potato leafhopper (PLH) and dry edible beans. PLH nymphs did not show a preference for any one of three dry bean cultivars, based on olfactory cues (smell). Colour based preferences were
found to exist, with adult PLH selecting Berna leaf sections more than 2:1 over the white pea and EMP 419 cultivars. 

The aggregative tendencies of the potato leafhopper were investigated in a trap cropping simulation, which involved different arrangements of Berna interplanted amongst rows of Navigator white bean. The results suggest that a trap crop system may be possible. There is concern, however, that Berna is not sufficiently attractive to draw PLH from more than several rows away. Some additional research will be performed in 2004, to evaluate the trap cropping system on a field scale. It is hypothesized that low to moderate PLH populations can be controlled, particularly those insects that are migrating into a field from surrounding areas.

**Evaluation of New Foliar Insecticides for Potato Leafhopper (PLH) Control**

A total of 10 new foliar insecticides were evaluated in three dry beans market classes, and compared to Cygon for PLH control. The new insecticides represent new insecticide technology that has less environmental and user exposure concerns, as well as alternative products (e.g. kaolin clay). Four of the 10 insecticides evaluated are effective, and should be an option that is economical for growers. Syngenta is currently pursuing the registration of one product, and my staff will pursue a User Requested Minor Use Label Expansion (URMULE) for at least one product in 2004. The registration of these products will provide growers with meaningful alternatives to Cygon, which is the only foliar control for PLH that is currently registered.

**Evaluation of New Seed Treatments to Control Insect Pests in Dry Beans**

Three new systemic insecticide seed treatments were evaluated for the control of PLH, seed corn maggot and wireworm pests in dry beans. Each of the products were found to be effective against the pests. For example, a moderate rate of Gaucho was found to give 4 weeks control for PLH, while the same rate of Poncho or Cruiser gives 6 weeks control. Syngenta and Gustafson are currently pursuing the registration of these products. Once registered, these products will start a new era in early season pest management in dry beans.

**Evaluation of New PLH Thresholds in Dry Beans**

A standard threshold has been used for years as a guideline for the control of PLH in dry beans. This threshold was compared to three new early thresholds (with a reduction in the adult/nymph thresholds at unifoliate and 2nd trifoliate stages) and two late thresholds (with a reduction in the nymph thresholds at first bloom and early pod fill stages) in three dry bean cultivars. Over the last two years, PLH populations increased very quickly each spring, and it was very difficult to accurately hit the thresholds points early in the growing season. Given the mobility of this pest, it may not be possible to provide growers with surgical precision in early thresholds during the first part of the growing season. In 2002, PLH populations stayed at very high levels well into August, which allowed us to evaluate the effectiveness of the two new late thresholds, compared to a standard threshold. In 2003, PLH populations crashed very early in the growing season, which resulted in very little useful information. With only one good year’s data (2002), it is suggested that this work continue for 2004, in order to develop some solid conclusions.

**Evaluation of New PLH Thresholds, in Combination with Systemic Seed Treatments**

New systemic seed treatments have been evaluated for the control of PLH, and they provide up to 6 weeks control of the pest. This will provide season long control of PLH in some years, but not in others. Growers need to know more about PLH damage to their crop once this 6 week
control period is up. A standard threshold, used as a guideline for the control of PLH in dry beans, was compared to one early threshold (with a reduction in the nymph thresholds at the 2nd trifoliate stages) and two late thresholds (with a reduction in the nymph thresholds at first bloom and early pod fill stages) to answer these questions. In 2002, PLH populations were very strong for the entire growing season, and some excellent threshold responses were recorded. In 2003, the PLH populations built up very quickly for the first 3 weeks after planting, but dropped off quickly after that point and never rebounded. Essentially no useful information was gathered in 2003. This study will be repeated in 2004, to confirm or refute the results from 2002.

**Evaluation of Repeated Applications of Cygon at Various Rates on White Beans**

Three rates of Cygon (25, 50 and 100% of the label rate) were applied three times to OAC Thunder white beans. Insecticide application was done every two weeks for a six week period, with a standard PLH nymph threshold being used to initiate the timing of the first insecticide application. No differences in yield, maturity or seed weight were recorded. This suggests that repeated applications of Cygon, even at the full label rate, have a minimal effect on yield. This work will be repeated in 2004, to confirm these findings.

**Control of White Mold in Dry Edible Beans with Foliar Fungicides**

Several experimental products were compared to the standard white mold product Ronilan for white mold control. In both years of the study, different methods were used to achieve good disease pressure. Disease pressure was present in most of the studies, but not at a level that would achieve good separation between treatments. This research will continue in 2004, as funding permits.

**Biological Control of Seeding Root Rot in Dry Edible Beans**

A number of biological compounds have been evaluated for their ability to control early season root rot in dry beans. Most of the products contained *Bacillus subtilis*, as the active ingredient. After conducting more than 20 studies over four years, it is felt that these products will only control a mild root rot infection. In side by side comparisons, nitrogen fertilizer was found to be a more effective control for root rot. The bottom line is that the economics of using a biological organism to control root rot in dry edible beans will have to be weighed against the cost and the benefits of other control measures, such as nitrogen fertilizer.

**Chemical Control of Root Rot in Dry Edible Beans with Seed Treatments**

A series of chemical seed treatments were evaluated for their ability to control early season root rot in dry beans. At least two products have been identified as effective control agents. Syngenta has received registration on one of those products (Apron Maxx RTA) and it will be available to dry bean growers, starting in 2004. This research will continue in 2004, as funding permits.

**Control of Anthracnose Disease Pressure in Dry Edible Beans with Seed Treatments**

A number of commercial and experimental seed treatments were compared to DCT for the control of anthracnose, a serious seed borne disease in dry beans. Excellent field studies in 2002 and 2003 have determined that none of the products evaluated can achieve the level of control that DCT offers. Given the serious nature of this pest, research will continue in 2004 to find an effective solution. Recently, this study has been expanded to include foliar fungicide compounds. Two products were recently registered for use in controlling anthracnose in dry beans. Growers need to be educated on the proper use of these products, as well as other control measures.
Problem Weed Control

Weed Control in White and Kidney Beans with Reduced Rates of Pursuit plus Frontier Applied Preplant Incorporated.

The preplant incorporated rate of Pursuit required to provide at least 90% of the following weeds is in brackets: lamb’s-quarters (75 mL/ac), redroot pigweed (75 mL/ac), green smartweed (75 mL/ac), common ragweed (100 mL/ac), wormseed mustard (75 mL/ac), proso millet (100 mL/ac) and green foxtail (100 mL/ac). When Pursuit was applied alone, white and kidney bean yields were maximized at a Pursuit rate of 75 and 100 mL/ac, respectively.

When tankmixed with Frontier at 440 mL/ac and applied preplant incorporated the rate of Pursuit required to provide at least 90% of the following weeds is in brackets: lamb’s-quarters (50 mL/ac), redroot pigweed (25 mL/ac), green smartweed (25 mL/ac), common ragweed (100 mL/ac), wormseed mustard (25 mL/ac), proso millet (25 mL/ac) and green foxtail (25 mL/ac). When tankmixed with Frontier the rate of Pursuit required for maximum yield in white and kidney beans was 50 mL/ac.

Weed Control in White and Kidney Beans with Reduced Rates of Pursuit plus Treflan Applied Preplant Incorporated.

The preplant incorporated rate of Pursuit required to provide at least 90% of the following weeds is in brackets: lamb’s-quarters (75 mL/ac), redroot pigweed (75 mL/ac), common ragweed (100 mL/ac), proso millet (100 mL/ac) and green foxtail (> 125 mL/ac). When Pursuit was applied alone, white and kidney bean yields were maximized at a Pursuit rate of 75 mL/ac.

When tankmixed with Treflan at 500 mL/ac and applied preplant incorporated the rate of Pursuit required to provide at least 90% of the following weeds is in brackets: lamb’s-quarters (50 mL/ac), redroot pigweed (50 mL/ac), common ragweed (100 mL/ac), proso millet (25 mL/ac) and green foxtail (25 mL/ac). When tankmixed with Treflan the rate of Pursuit required for maximum yield in white and kidney beans was 75 and 125 mL/ac, respectively.

Weed Control in White Beans with Reduced Rates of Pursuit plus Frontier Applied Preemergence.

The preemergence rate of Pursuit required to provide at least 90% of the following weeds is in brackets: lamb’s-quarters (75 mL/ac), redroot pigweed (50 mL/ac), green smartweed (50 mL/ac), common ragweed (125 mL/ac), proso millet (100 mL/ac) and green foxtail (> 125 mL/ac). When Pursuit was applied alone, white and kidney bean yields were maximized at a Pursuit rate of 100 and 75 mL/ac, respectively.

When tankmixed with Frontier at 440 mL/ac and applied preemergence the rate of Pursuit required to provide at least 90% of the following weeds is in brackets: lamb’s-quarters (75 mL/ac), redroot pigweed (25 mL/ac), green smartweed (25 mL/ac), common ragweed (100 mL/ac), proso millet (25 mL/ac) and green foxtail (25 mL/ac). When tankmixed with Frontier and applied preemergence the rate of Pursuit required for maximum yield in white and kidney beans was 50 mL/ac.

Dry Bean Market Class Tolerance to New Weed Control Strategies

Tolerance of Otebo Beans to Preplant Incorporated Herbicides.

EPTAM. There was 1, 2 and 3% visual crop injury at 7, 14 and 28 days after emergence (DAE) respectively, a decrease in height of 8%, a decrease in dry weight of 1% and no negative effect
on yield at the label rate of Eptam. At twice the label rate, there was 1, 2 and 2% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 6%, a decrease in dry weight of 2% and no negative effect on yield. Based on this preliminary research there is an adequate margin of crop safety in Otebo beans to support the registration of Eptam applied preplant incorporated. These results will be confirmed in trials planned for 2004. An URMULE submission will be prepared based on this data.

Treflan. There was 1, 1 and 0% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 3%, a decrease in dry weight of 4% and a decrease in yield of 3% at the label rate of Treflan. At twice the label rate, there was 0, 0 and 0% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 2%, no negative effect on dry weight and a decrease in yield of 4%. Based on this preliminary research there is an adequate margin of crop safety in Otebo beans to support the registration of Treflan applied preplant incorporated. These results will be confirmed in trials planned for 2004. No URMULE submission will be prepared based on this data until the PMRA lifts the moratorium on new registrations with Treflan.

Frontier. There was 3, 2 and 2% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 10%, a decrease in dry weight of 19% and a decrease in yield of 10% at the label rate of Frontier. At twice the label rate, there was 1, 3 and 4% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 12%, a decrease in dry weight of 4% and a decrease in yield of 9%. This is not a large enough data set to determine if there is an adequate margin of crop safety in Otebo beans to the preplant incorporated application of Frontier.

Dual Magnum. There was 1, 1 and 0% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 3%, a decrease in dry weight of 1% and no negative effect on yield at the label rate of Dual Magnum. At twice the label rate, there was 1, 1 and 0% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 1%, no negative effect on dry weight and a decrease in yield of 1%. Based on this preliminary research there is an adequate margin of crop safety in Otebo beans to support the registration of Dual Magnum applied preplant incorporated. These results will be confirmed in trials planned for 2004. An URMULE submission will be prepared based on this data.

Pursuit. There was 1, 2 and 6% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 14%, a decrease in dry weight of 16% and a decrease in yield of 13% at the label rate of Pursuit. At twice the label rate, there was 1, 3 and 20% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 23%, a decrease in dry weight of 34% and a decrease in yield of 32%. This is not a large enough data set to determine if there is an adequate margin of crop safety in Otebo beans to the preplant incorporated application of Pursuit.

Tolerance of Otebo Beans to Preemergence Herbicides.

Frontier. There was 2, 2 and 1% visual crop injury at 7, 14 and 28 DAE respectively, and no negative effect on plant height, dry weight or yield at the label rate of Frontier. At twice the label rate, there was 3, 3 and 2% visual crop injury at 7, 14 and 28 DAE respectively, and no negative effect on height, dry weight or yield. Based on this preliminary research there is an adequate margin of crop safety in Otebo beans to support the registration of Frontier applied preemergence. These results will be confirmed in trials planned for 2004. An URMULE submission will be prepared based on this data.

Dual Magnum. There was 2, 1 and 1% visual crop injury at 7, 14 and 28 DAE respectively, and no decrease in height, dry weight or yield at the label rate of Dual Magnum. At twice the label rate, there was 4, 2 and 1% visual crop injury at 7, 14 and 28 DAE respectively, and no decrease
in height, dry weight or yield. Based on this preliminary research there is an adequate margin of crop safety in Otebo beans to support the registration of Dual Magnum applied preemergence. These results will be confirmed in trials planned for 2004. An URME submission will be prepared based on this data.

**Command.** There was 5, 4 and 3% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 4%, a decrease in dry weight of 9% and no decrease in yield at the label rate of Command. At twice the label rate, there was 9, 9 and 11% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 13%, a decrease in dry weight of 20% and a no decrease in yield. This is not a large enough data set to determine if there is an adequate margin of crop safety in Otebo beans to the preemergence application of Command.

**Pursuit.** There was 0, 1 and 7% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 5%, a decrease in dry weight of 8% and a decrease in yield of 10% at the label rate of Pursuit. At twice the label rate, there was 0, 2 and 19% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 18%, a decrease in dry weight of 30% and a decrease in yield of 9%. This is not a large enough data set to determine if there is an adequate margin of crop safety in Otebo beans to the preemergence application of Pursuit.

**Lorox.** There was 4, 10 and 6% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 12%, a decrease in dry weight of 29% and a decrease in yield of 11% at the label rate of Lorox. At twice the label rate, there was 15, 39 and 42% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 35%, a decrease in dry weight of 79% and a decrease in yield of 56%. There is not an adequate margin of crop safety in Otebo beans to the preemergence application of Lorox.

**Tolerance of Otebo Beans to Postemergence Herbicides.**

**Basagran Forte.** There was 4, 1 and 0% visual crop injury at 7, 14 and 28 DAA respectively, a decrease in height of 1%, a decrease in dry weight of 17% and no decrease in yield at the label rate of Basagran Forte. At twice the label rate, there was 8, 5, and 3% visual crop injury at 7, 14 and 28 DAA respectively, a decrease in height of 5%, a decrease in dry weight of 15% and no decrease in yield. Based on this preliminary research there is an adequate margin of crop safety in Otebo beans to support the registration of Basagran Forte applied postemergence. These results will be confirmed in trials planned for 2004. An URMULE submission will be prepared based on this data.

**Reflex.** There was 2, 2 and 1% visual crop injury at 7, 14 and 28 DAA respectively, a decrease in height of 2%, a decrease in dry weight of 15% and a decrease in yield of 4% at the label rate of Reflex. At twice the label rate, there was 4, 3, and 1% visual crop injury at 7, 14 and 28 DAA respectively, a decrease in height of 3%, a decrease in dry weight of 4% and a decrease in yield of 2%. Based on this preliminary research there is an adequate margin of crop safety in Otebo beans to support the registration of Reflex applied postemergence. These results will be confirmed in trials planned for 2004. An URMULE submission will be prepared based on this data.

**Basagran Forte plus Reflex.** There was 3, 2 and 1% visual crop injury at 7, 14 and 28 DAA respectively, a decrease in height of 4%, no decrease in dry weight and a decrease in yield of 8% at the label rate of Basagran Forte plus Reflex. At twice the label rate, there was 6, 4, and 2% visual crop injury at 7, 14 and 28 DAA respectively, a decrease in height of 10%, a decrease in dry weight of 8% and a decrease in yield of 10%. This is not a large enough data set to determine if there is an adequate margin of crop safety in Otebo beans to the postemergence application of
Basagran Forte plus Reflex.  
**Poast Ultra.** There was 1, 1 and 0% visual crop injury at 7, 14 and 28 DAA respectively, no decrease in height, a decrease in dry weight of 4% and no decrease in yield at the label rate of Poast Ultra. At twice the label rate, there was 1, 1, and 1% visual crop injury at 7, 14 and 28 DAA respectively, no decrease in height, a decrease in dry weight of 3% and no decrease in yield. Based on this preliminary research there is an adequate margin of crop safety in Otebo beans to support the registration of Poast Ultra applied postemergence. These results will be confirmed in trials planned for 2004. An URMULE submission will be prepared based on this data.

**Assure II.** There was 5, 3 and 1% visual crop injury at 7, 14 and 28 DAA respectively, a decrease in height of 2%, a decrease in dry weight of 11% and no decrease in yield at the label rate of Assure II. At twice the label rate, there was 10, 6, and 2% visual crop injury at 7, 14 and 28 DAA respectively, a decrease in height of 2%, a decrease in dry weight of 15% and no decrease in yield. Based on this preliminary research there is an adequate margin of crop safety in Otebo beans to support the registration of Assure II applied postemergence. These results will be confirmed in trials planned for 2004. An URMULE submission will be prepared based on this data.

**Viper.** There was 4, 2 and 2% visual crop injury at 7, 14 and 28 DAA respectively, a decrease in height of 4%, a decrease in dry weight of 23% and a decrease in yield of 6% at the label rate of Viper. At twice the label rate, there was 10, 7, and 5% visual crop injury at 7, 14 and 28 DAA respectively, a decrease in height of 11%, a decrease in dry weight of 24% and a decrease in yield of 12%. This is not a large enough data set to determine if there is an adequate margin of crop safety in Otebo beans to the postemergence application of Viper. In addition, BASF has decided that Viper will no longer be sold in Canada.

**Meridian Plus.** There was 4, 1 and 1% visual crop injury at 7, 14 and 28 DAA respectively, a decrease in height of 8%, a decrease in dry weight of 13% and no decrease in yield at the label rate of Meridian Plus. At twice the label rate, there was 7, 4, and 1% visual crop injury at 7, 14 and 28 DAA respectively, a decrease in height of 8%, a decrease in dry weight of 23% and no decrease in yield. Based on this preliminary research there is an adequate margin of crop safety in Otebo beans to support the registration of Meridian Plus applied postemergence. These results will be confirmed in trials planned for 2004. An URMULE submission will be prepared based on this data.

Tolerance of Adzuki Beans to Preplant Incorporated Herbicides.  
**EPTAM.** There was 13, 15 and 22% visual crop injury at 7, 14 and 28 days after emergence (DAE) respectively, a decrease in height of 25%, a decrease in dry weight of 55% and a decrease in yield of 20% at the label rate of Eptam. At twice the label rate, there was 18, 22 and 39% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 30%, a decrease in dry weight of 46% and a decrease in yield of 31%. The preplant incorporated application of Eptam in adzuki beans results in unacceptable crop injury.

**Treflan.** There was 3, 4 and 2% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 13%, a decrease in dry weight of 21% and a decrease in yield of 7% at the label rate of Treflan. At twice the label rate, there was 5, 5 and 2% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 6%, a decrease in dry weight of 17% and no decrease in yield. Based on this preliminary research there is an adequate margin of crop safety in Adzuki beans to support the registration of Treflan applied preplant incorporated. These results will be
confirmed in trials planned for 2004. No URMULE submission will be prepared based on this data until the PMRA lifts the moratorium on new registrations with Treflan.

**Frontier.** There was 11, 10 and 10% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 25%, a decrease in dry weight of 46% and a decrease in yield of 23% at the label rate of Frontier. At twice the label rate, there was 16, 18 and 11% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 32%, a decrease in dry weight of 38% and a decrease in yield of 16%. The preplant incorporated application of Frontier in adzuki beans results in unacceptable crop injury.

**Dual Magnum.** There was 8, 6 and 3% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 12%, a decrease in dry weight of 28% and a decrease in yield of 4% at the label rate of Dual Magnum. At twice the label rate, there was 9, 6 and 2% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 19%, a decrease in dry weight of 31% and a decrease in yield of 17%. This is not a large enough data set to determine if there is an adequate margin of crop safety in adzuki beans to the preplant incorporated application of Dual Magnum.

**Pursuit.** There was 2, 2 and 3% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 12%, a decrease in dry weight of 15% and a decrease in yield of 1% at the label rate of Pursuit. At twice the label rate, there was 5, 4 and 7% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 21%, a decrease in dry weight of 35% and a decrease in yield of 5%. Based on this preliminary research there is an adequate margin of crop safety in adzuki beans to support the registration of Pursuit applied preplant incorporated. These results will be confirmed in trials planned for 2004. An URMULE submission will be prepared based on this data.

**Tolerance of Adzuki Beans to Preemergence Herbicides.**

**Frontier.** There was 9, 11 and 13% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 10%, a decrease in dry weight of 32% and a decrease in yield of 22% at the label rate of Frontier. At twice the label rate, there was 20, 24 and 32% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 9%, a decrease in dry weight of 45% and a decrease in yield of 41%. The preemergence application of Frontier in adzuki beans results in unacceptable crop injury.

**Dual Magnum.** There was 9, 10 and 8% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 5%, a decrease in dry weight of 6% and a decrease in yield of 17% at the label rate of Dual Magnum. At twice the label rate, there was 17, 20 and 25% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 15%, a decrease in dry weight of 41% and a decrease in yield of 39%. The preemergence application of Dual Magnum in adzuki beans results in unacceptable crop injury.

**Command.** There was 9, 11 and 27% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 10%, a decrease in dry weight of 29% and a decrease in yield of 34% at the label rate of Command. At twice the label rate, there was 12, 23 and 46% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 31%, a decrease in dry weight of 48% and a decrease in yield of 67%. The preemergence application of Command in adzuki beans results in unacceptable crop injury.

**Pursuit.** There was 1, 1 and 2% visual crop injury at 7, 14 and 28 DAE respectively, no decrease in height, a decrease in dry weight of 7% and no decrease in yield at the label rate of Pursuit. At twice the label rate, there was 3, 3 and 5% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 3%, a decrease in dry weight of 14% and a decrease in yield of 4%. The
preemergence application of Pursuit is registered for use on adzuki beans.

Tolerance of Adzuki Beans to Postemergence Herbicides.

**Basagran Forte.** There was 34, 34 and 34% visual crop injury at 7, 14 and 28 DAA respectively, a decrease in height of 36%, a decrease in dry weight of 63% and a decrease in yield of 57% at the label rate of Basagran Forte. At twice the label rate, there was 40, 44, and 42% visual crop injury at 7, 14 and 28 DAA respectively, a decrease in height of 40%, a decrease in dry weight of 68% and a decrease in yield of 66%. The postemergence application of Basagran Forte in adzuki beans results in unacceptable crop injury.

**Reflex.** There was 6, 3 and 2% visual crop injury at 7, 14 and 28 DAA respectively, a decrease in height of 5%, a decrease in dry weight of 3% and a decrease in yield of 12% at the label rate of Reflex. At twice the label rate, there was 8, 7, and 5% visual crop injury at 7, 14 and 28 DAA respectively, a decrease in height of 12%, a decrease in dry weight of 17% and a decrease in yield of 12%. This is not a large enough data set to determine if there is an adequate margin of crop safety in adzuki beans to the postemergence application of Reflex.

**Poast Ultra.** There was 3, 2 and 1% visual crop injury at 7, 14 and 28 DAA respectively, no decrease in height, a decrease in dry weight of 13% and a decrease in yield of 3% at the label rate of Poast Ultra. At twice the label rate, there was 4, 4, and 2% visual crop injury at 7, 14 and 28 DAA respectively, a decrease in height of 5%, a decrease in dry weight of 6% and a decrease in yield of 12%. The postemergence application of Poast Ultra is registered for use on adzuki beans.

**Assure II.** There was 2, 2 and 1% visual crop injury at 7, 14 and 28 DAA respectively, no decrease in height, a decrease in dry weight of 7% and no decrease in yield at the label rate of Assure II. At twice the label rate, there was 3, 3, and 2% visual crop injury at 7, 14 and 28 DAA respectively, a decrease in height of 6%, a decrease in dry weight of 26% and a decrease in yield of 2%. The postemergence application of Assure II is registered for use on adzuki beans.

**Viper.** There was 6, 3 and 2% visual crop injury at 7, 14 and 28 DAA respectively, a decrease in height of 6%, a decrease in dry weight of 17% and no decrease in yield at the label rate of Viper. At twice the label rate, there was 9, 8, and 4% visual crop injury at 7, 14 and 28 DAA respectively, a decrease in height of 8%, a decrease in dry weight of 15% and no decrease in yield. Although there is an adequate margin of crop safety in adzuki beans to the postemergence application of Viper it will not be submitted for registration since BASF has decided to discontinue the co-pack in Canada.

**Meridian Plus.** There was 19, 14 and 14% visual crop injury at 7, 14 and 28 DAA respectively, a decrease in height of 25%, a decrease in dry weight of 35% and a decrease in yield of 25% at the label rate of Meridian Plus. At twice the label rate, there was 31, 29, and 27% visual crop injury at 7, 14 and 28 DAA respectively, a decrease in height of 35%, a decrease in dry weight of 59% and a decrease in yield of 44%. The postemergence application of Meridian Plus in adzuki beans results in unacceptable crop injury.

**Herbicide Tolerance in White Beans.**

**Pursuit.** The application of Pursuit applied at 42, 84, 126 and 252 mL/ac resulted in 1, 2, 2, and 6% visual crop injury 28 DAE, a decrease in height of 0, 1, 7 and 10% 28 DAE, a decrease in shoot dry weight of 7, 8, 20 and 34% 28 DAE, a decrease in root dry weight of 1, 4, 16 and 24% 28 DAE and a decrease in yield of 0, 0, 4 and 7%, respectively in studies conducted by C. Gillard, C. Swanton and P. Sikkema.
Lorox. There was 6, 7 and 8% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 10%, a decrease in dry weight of 17% and a decrease in yield of 1% at the label rate of Lorox. At twice the label rate, there was 18, 34 and 41% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 29%, a decrease in dry weight of 68% and a decrease in yield of 24%. There is not an adequate margin of crop safety in white beans to the preemergence application of Lorox.

Command. There was 6, 7 and 3% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 4%, a decrease in dry weight of 10 and no decrease in yield at the label rate of Command. At twice the label rate, there was 15, 21 and 18% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 17%, a decrease in dry weight of 30% and a decrease in yield of 1%. This is not a large enough data set to determine if there is an adequate margin of crop safety in white beans to the preemergence application of Command.

Basagran Forte plus Reflex. There was 2, 2 and 0% visual crop injury at 7, 14 and 28 DAA respectively, a decrease in height of 1%, no decrease in dry weight and a decrease in yield of 4% at the label rate of Basagran Forte plus Reflex. At twice the label rate, there was 5, 3, and 3% visual crop injury at 7, 14 and 28 DAA respectively, a decrease in height of 11%, a decrease in dry weight of 5% and no decrease in yield. This is not a large enough data set to determine if there is an adequate margin of crop safety in white beans to the postemergence application of Basagran Forte plus Reflex.

Meridian Plus. There was 1, 1 and 0% visual crop injury at 7, 14 and 28 DAA respectively, no decrease in height, a decrease in dry weight of 3% and a decrease in yield of 2% at the label rate of Meridian Plus. At twice the label rate, there was 3, 2, and 1% visual crop injury at 7, 14 and 28 DAA respectively, a decrease in height of 4%, a decrease in dry weight of 5% and a decrease in yield of 10%. Based on this preliminary research there is an adequate margin of crop safety in white beans to support the registration of Meridian Plus applied postemergence. These results will be confirmed in trials planned for 2004. An URMULE submission will be prepared based on this data.

**Tolerance of Coloured Beans to Lorox Applied Preemergence.**

**AC Harblack Black Beans.** There was 1, 3 and 3% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 1%, no decrease in dry weight and a decrease in yield of 15% at the label rate of Lorox. At twice the label rate, there was 6, 21 and 24% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 18%, a decrease in dry weight of 41% and a decrease in yield of 32%. The preemergence application of Lorox results in unacceptable crop injury in black beans.

**GTS 900 Pinto Beans.** There was 1, 2 and 0% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 3%, a decrease in dry weight of 9% and no decrease in yield at the label rate of Lorox. At twice the label rate, there was 7, 16 and 19% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 17%, a decrease in dry weight of 35% and no decrease in yield. Based on this preliminary research there is an adequate margin of crop safety in pinto beans to support the registration of Lorox applied preemergence. These results will be confirmed in trials planned for 2004. An URMULE submission will be prepared based on this data.

**Berna Brown Beans.** There was 1, 3 and 3% visual crop injury at 7, 14 and 28 DAE respectively, and no decrease in height, dry weight and yield at the label rate of Lorox. At twice the label rate, there was 2, 13 and 13% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in
height of 10%, a decrease in dry weight of 15% and a decrease in yield of 5%. Based on this preliminary research there is an adequate margin of crop safety in brown beans to support the registration of Lorox applied preemergence. These results will be confirmed in trials planned for 2004. An URMULE submission will be prepared based on this data.

Hooter Cranberry Beans. There was 0, 2 and 1% visual crop injury at 7, 14 and 28 DAE respectively, no decrease in height, a decrease in dry weight of 9% and no decrease in yield at the label rate of Lorox. At twice the label rate, there was 1, 9 and 12% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 9%, a decrease in dry weight of 19% and no decrease in yield. Based on this preliminary research there is an adequate margin of crop safety in cranberry beans to support the registration of Lorox applied preemergence. These results will be confirmed in trials planned for 2004. An URMULE submission will be prepared based on this data.

Montcalm Kidney Beans. There was 1, 3 and 2% visual crop injury at 7, 14 and 28 DAE respectively, no decrease in height and dry weight and a decrease in yield of 1% at the label rate of Lorox. At twice the label rate, there was 2, 15 and 18% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 1%, a decrease in dry weight of 33% and a decrease in yield of 17%. The preemergence application of Lorox results in unacceptable crop injury in kidney beans.

GTS 1701 Yellow Eye Beans. There was 0, 2 and 2% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 2%, a decrease in dry weight of 17% and no decrease in yield at the label rate of Lorox. At twice the label rate, there was 1, 13 and 15% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 8%, a decrease in dry weight of 30% and a decrease in yield of 10%. The preemergence application of Lorox results in unacceptable crop injury in yellow eye beans.

Tolerance of Coloured Beans to Command Applied Preemergence.

AC Harblack Black Beans. There was 5, 6 and 2% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 4%, and no decrease in dry weight and yield at the label rate of Command. At twice the label rate, there was 13, 20 and 12% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 15%, a decrease in dry weight of 9% and a decrease in yield of 13%. The preemergence application of Command results in unacceptable crop injury in black beans.

GTS 900 Pinto Beans. There was 8, 10 and 5% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 11%, a decrease in dry weight of 8% and a decrease in yield of 2% at the label rate of Command. At twice the label rate, there was 16, 23 and 25% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 26%, a decrease in dry weight of 28% and no decrease in yield. Based on this preliminary research there is an adequate margin of crop safety in pinto beans to support the registration of Command applied preemergence. These results will be confirmed in trials planned for 2004. An URMULE submission will be prepared based on this data.

Berna Brown Beans. There was 5, 5 and 2% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 7%, a decrease in dry weight of 14% and a decrease in yield of 3% at the label rate of Command. At twice the label rate, there was 13, 17 and 9% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 9%, a decrease in dry weight of 7% and a decrease in yield of 7%. Based on this preliminary research there is an adequate margin of crop safety in brown beans to support the registration of Command applied preemergence. These
results will be confirmed in trials planned for 2004. An URMULE submission will be prepared based on this data.

**Hooter Cranberry Beans.** There was 7, 9 and 2% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 4%, a decrease in dry weight of 8% and no decrease in yield at the label rate of Command. At twice the label rate, there was 14, 20 and 12% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 16%, a decrease in dry weight of 33% and a decrease in yield of 9%. Based on this preliminary research there is an adequate margin of crop safety in cranberry beans to support the registration of Command applied preemergence. These results will be confirmed in trials planned for 2004. An URMULE submission will be prepared based on this data.

**Montcalm Kidney Beans.** There was 7, 10 and 3% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 5%, a decrease in dry weight of 2% and a decrease in yield of 8% at the label rate of Command. At twice the label rate, there was 12, 18 and 12% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 12%, a decrease in dry weight of 32% and a decrease in yield of 11%. The results from this research have been variable. Additional research needs to be conducted to determine if there is an adequate margin of crop safety in kidney beans to support the registration of Command applied preemergence.

**GTS 1701 Yellow Eye Beans.** There was 10, 12 and 3% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 3%, a decrease in dry weight of 13% and no decrease in yield at the label rate of Command. At twice the label rate, there was 16, 22 and 13% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 22%, a decrease in dry weight of 43% and a decrease in yield of 4%. Based on this preliminary research there is an adequate margin of crop safety in yellow eye beans to support the registration of Command applied preemergence. These results will be confirmed in trials planned for 2004. An URMULE submission will be prepared based on this data.

**Tolerance of Coloured Beans to Basagran Forte plus Reflex Applied Preemergence.**

**AC Harblack Black Beans.** There was 3, 3 and 1% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 5%, a decrease in dry weight of 1% and a decrease in yield of 6% at the label rate of Basagran Forte plus Reflex. At twice the label rate, there was 6, 4 and 2% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 6%, a decrease in dry weight of 13% and a decrease in yield of 2%. Based on this preliminary research there is an adequate margin of crop safety in black beans to support the registration of Basagran Forte plus Reflex applied postemergence. These results will be confirmed in trials planned for 2004. An URMULE submission will be prepared based on this data.

**GTS 900 Pinto Beans.** There was 2, 1 and 0% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 6%, and no decrease in dry weight and yield at the label rate of Basagran Forte plus Reflex. At twice the label rate, there was 5, 4 and 3% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 14%, a decrease in dry weight of 18% and a decrease in yield of 12%. The postemergence application of Basagran Forte plus Reflex results in unacceptable crop injury in pinto beans.

**Berna Brown Beans.** There was 4, 1 and 1% visual crop injury at 7, 14 and 28 DAE respectively, no decrease in height and dry weight and a decrease in yield of 1% at the label rate of Basagran Forte plus Reflex. At twice the label rate, there was 8, 3 and 2% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 8%, a decrease in dry weight of 18% and a decrease in yield of 4%. The results from this research have been variable. Additional research needs to be
conducted to determine if there is an adequate margin of crop safety in brown beans to support the registration of Basagran Forte plus Reflex applied postemergence.

**Hooter Cranberry Beans.** There was 3, 3 and 2% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 3%, a decrease in dry weight of 17% and a decrease in yield of 3% at the label rate of Basagran Forte plus Reflex. At twice the label rate, there was 6, 5 and 4% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 5%, a decrease in dry weight of 9% and a decrease in yield of 4%. The results from this research have been variable. Additional research needs to be conducted to determine if there is an adequate margin of crop safety in cranberry beans to support the registration of Basagran Forte plus Reflex applied postemergence.

**Montcalm Kidney Beans.** There was 4, 2 and 1% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 2%, a decrease in dry weight of 10% and no decrease in yield at the label rate of Basagran Forte plus Reflex. At twice the label rate, there was 6, 4 and 3% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 4%, a decrease in dry weight of 4% and a decrease in yield of 3%. The results from this research have been variable. Additional research needs to be conducted to determine if there is an adequate margin of crop safety in kidney beans to support the registration of Basagran Forte plus Reflex applied postemergence.

**GTS 1701 Yellow Eye Beans.** There was 4, 4 and 2% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 6%, a decrease in dry weight of 2% and a decrease in yield of 4% at the label rate of Basagran Forte plus Reflex. At twice the label rate, there was 8, 6 and 4% visual crop injury at 7, 14 and 28 DAE respectively, no decrease in height, a decrease in dry weight of 9% and a decrease in yield of 2%. The results from this research have been variable. Additional research needs to be conducted to determine if there is an adequate margin of crop safety in yellow eye beans to support the registration of Basagran Forte plus Reflex applied postemergence.

**Tolerance of Coloured Beans to Meridian Plus Applied Preemergence.**

**AC Harblack Black Beans.** There was 2, 1 and 0% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 1%, a decrease in dry weight of 5% and no decrease in yield at the label rate of Meridian Plus. At twice the label rate, there was 3, 3 and 1% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 7%, a decrease in dry weight of 11% and a decrease in yield of 10%. The results from this research have been variable. Additional research needs to be conducted to determine if there is an adequate margin of crop safety in black beans to support the registration of Meridian Plus applied postemergence.

**GTS 900 Pinto Beans.** There was 1, 1 and 0% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 2%, and no decrease in dry weight and yield at the label rate of Meridian Plus. At twice the label rate, there was 2, 2 and 1% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 8%, a decrease in dry weight of 7% and a decrease in yield of 6%. Based on this preliminary research there is an adequate margin of crop safety in pinto beans to support the registration of Meridian Plus applied postemergence. These results will be confirmed in trials planned for 2004. An URMULE submission will be prepared based on this data.

**Berna Brown Beans.** There was 1, 0 and 0% visual crop injury at 7, 14 and 28 DAE respectively, no decrease in height, a decrease in dry weight of 3% and a decrease in yield of 6% at the label rate of Meridian Plus. At twice the label rate, there was 4, 3 and 2% visual crop injury at 7, 14
and 28 DAE respectively, no decrease in height, a decrease in dry weight of 5% and a decrease in yield of 6%. The results from this research have been variable. Additional research needs to be conducted to determine if there is an adequate margin of crop safety in brown beans to support the registration of Meridian Plus applied postemergence.

Hooter Cranberry Beans. There was 3, 2 and 1% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 5%, no decrease in dry weight and a decrease in yield of 6% at the label rate of Meridian Plus. At twice the label rate, there was 6, 4 and 3% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 10%, a decrease in dry weight of 2% and a decrease in yield of 16%. The postemergence application of Meridian Plus results in unacceptable crop injury in cranberry beans.

Montcalm Kidney Beans. There was 2, 2 and 1% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 4%, a decrease in dry weight of 5% and no decrease in yield at the label rate of Meridian Plus. At twice the label rate, there was 4, 3 and 3% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 7%, a decrease in dry weight of 8% and a decrease in yield of 14%. The postemergence application of Meridian Plus results in unacceptable crop injury in kidney beans.

GTS 1701 Yellow Eye Beans. There was 3, 3 and 1% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 3%, a decrease in dry weight of 8% and a decrease in yield of 7% at the label rate of Meridian Plus. At twice the label rate, there was 7, 6 and 5% visual crop injury at 7, 14 and 28 DAE respectively, a decrease in height of 7%, a decrease in dry weight of 2% and a decrease in yield of 18%. The postemergence application of Meridian Plus results in unacceptable crop injury in yellow eye beans.

Weed Control in White and Kidney Beans with Reduced Rates of Pursuit plus Frontier Applied Preplant Incorporated.

The preplant incorporated rate of Pursuit required to provide at least 90% of the following weeds is in brackets: lamb’s-quarters (75 mL/ac), redroot pigweed (75 mL/ac), green smartweed (75 mL/ac), common ragweed (100 mL/ac), wormseed mustard (75 mL/ac), proso millet (100 mL/ac) and green foxtail (100 mL/ac). When Pursuit was applied alone, white and kidney bean yields were maximized at a Pursuit rate of 75 and 100 mL/ac, respectively.

When tankmixed with Frontier at 440 mL/ac and applied preplant incorporated the rate of Pursuit required to provide at least 90% of the following weeds is in brackets: lamb’s-quarters (50 mL/ac), redroot pigweed (25 mL/ac), green smartweed (25 mL/ac), common ragweed (100 mL/ac), wormseed mustard (25 mL/ac), proso millet (25 mL/ac) and green foxtail (25 mL/ac). When tankmixed with Frontier the rate of Pursuit required for maximum yield in white and kidney beans was 50 mL/ac.

REACH AND COMMUNICATION

This project targets the 1500 dry edible bean producers in Ontario, and each grower will benefit from this work. The fact that this project deals with the evaluation of new control strategies and new integrated pest management approaches in dry edible beans means that it impacts dry bean processors, consumers and society in general.

To date, well over 1500 people have been reached by this project. This would include members of dry bean grower organizations in Ontario and other production regions in North America and the world, as well as a number of public and private researchers. Research results have been
presented at 3 scientific conferences and 19 grower and industry meetings. Nine scientific papers have been submitted and/or accepted for publication in the Canadian Journal of Plant Science and Weed Technology. A total of 24 URMULE submissions have been made to the Pest Management Regulatory Agency (PMRA) for new weed control strategies. Thirteen of the 24 URMULEs have been registered. Nine popular press articles have been published in grower publications, 3 articles have been published in scientific conference proceedings, and 8 technical reports have been circulated by hard copy and via the Internet.

Scientific Publications

Popular Press Articles/Conference Proceedings


**Oral Presentations**


**Nov. 2003** Assessing Leafhopper Varietal Choices in Dry Beans Based on Visual Cues. Poster presentation at the Bean Improvement Cooperative Conference, Sacramento CA.

**Aug. 2003** Research Tour at the Huron Research Station for the directors and staff of the Ontario White Bean Producers’ Board and the Ontario Coloured Bean Growers Association.

**July 2003** Legume Pests: Potato Leafhoppers and Alfalfa Weevil. Diagnostic Days, Ridgetown College, Ridgetown ON.


**Mar. 2003** What’s Bugging Your Beans? Great Canadian Bean Company grower meeting, Ailsa Craig ON.

Feb. 2003  Presentation of research results at the Ontario Coloured Bean Growers Association Directors Meeting
Jan. 2003  Cinderella Edibles - Production Tips. Southwest Agriculture Conference, Ridgetown College, Ridgetown ON.
Nov. 2002  The Evaluation of Three Systemic Seed Treatment Compounds for the Control of Potato Leafhopper (Empoasca fabae Harris) in Dry Beans. Canadian Pulse Crop Research Workshop, Edmonton AB.
Aug. 2002  Research Tour at the Huron Research Station for the directors and staff of the Ontario White Bean Producers’ Board and the Ontario Coloured Bean Growers Association
July 2002  Potato Leafhoppers and Root Rot in Dry Beans. Diagnostic Days, Ridgetown College, Ridgetown ON.
April 2002  Presentation of research results at the Ontario Bean Producers’ Marketing Board Research Committee Meetings.
Feb. 2002  Edible Bean Production Tips. W.G. Thompson grower meetings in Ridgetown, Almonte and Ponty Poole ON.

Internet
The pest management results are put on the Ridgetown College web site at:
http://www.ridgetownc.on.ca/research/Subject/ediblebeans.cfm.
The weed management results are put on the Ridgetown College weed science web page:
www.ridgetownc.on.ca/weeds.

Technical Reports


**URMULEs Submitted to the PMRA (Pest Management Regulatory Agency)**

<table>
<thead>
<tr>
<th>URMULE Number</th>
<th>Crop</th>
<th>Herbicide</th>
<th>Timing</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001-1164</td>
<td>Beans, Adzuki fomesafen</td>
<td>post</td>
<td></td>
<td>residue trials from 5 sites are required</td>
</tr>
<tr>
<td>2001-1111</td>
<td>Beans, Adzuki-metolachlor</td>
<td>pre</td>
<td></td>
<td>2 additional tolerance data points</td>
</tr>
<tr>
<td>2001-0169</td>
<td>Beans, Adzuki-metolachlor</td>
<td>pre</td>
<td></td>
<td>2 additional tolerance data points</td>
</tr>
<tr>
<td>2002-0500</td>
<td>Beans, Edible imazethapyr</td>
<td>ppi</td>
<td></td>
<td>add cranberry and kidney beans to the label</td>
</tr>
<tr>
<td>2003-0834</td>
<td>Beans, Edible s-metolachlor</td>
<td>ppi</td>
<td></td>
<td>new tankmix</td>
</tr>
<tr>
<td>2002-1165</td>
<td>Beans, Edible s-metolachlor</td>
<td>+ imazethapyr</td>
<td></td>
<td>add cranberry and kidney beans to the label</td>
</tr>
<tr>
<td></td>
<td>Sent to PMRA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Beans, Edible s-metolachlor</td>
<td>pre</td>
<td></td>
<td>new tankmix</td>
</tr>
<tr>
<td></td>
<td>+ imazethapyr</td>
<td></td>
<td></td>
<td>add cranberry and kidney beans to the label</td>
</tr>
<tr>
<td></td>
<td>Sent to PMRA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Beans, Edible bentazon (Forte)</td>
<td>post</td>
<td></td>
<td>add cranberry and black beans to the label</td>
</tr>
<tr>
<td></td>
<td>Sent to PMRA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Beans, Edible bentazon (Forte)</td>
<td>post</td>
<td></td>
<td>add dry common beans to the label</td>
</tr>
<tr>
<td></td>
<td>+ fomesafen</td>
<td></td>
<td></td>
<td>data has been sent to BASF and Syngenta</td>
</tr>
</tbody>
</table>

**Registered in 2003**

<table>
<thead>
<tr>
<th>URMULE Number</th>
<th>Crop</th>
<th>Herbicide</th>
<th>Timing</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002-1009</td>
<td>Beans, Edible s-metolachlor</td>
<td>ppi</td>
<td></td>
<td>add black and cranberry beans to the label</td>
</tr>
<tr>
<td>2002-3395</td>
<td>Beans, Edible s-metolachlor</td>
<td>ppi</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2001-1109</td>
<td>Beans, Edible s-metolachlor</td>
<td>pre</td>
<td></td>
<td>new application timing for cranberry and kidney beans</td>
</tr>
<tr>
<td>2001-0170</td>
<td>Beans, Edible s-metolachlor</td>
<td>pre</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2003-0834</td>
<td>Beans, Edible s-metolachlor</td>
<td>ppi</td>
<td></td>
<td>new tankmix for broad spectrum weed control in cranberry and kidney beans</td>
</tr>
<tr>
<td>2002-1165</td>
<td>Beans, Edible s-metolachlor</td>
<td>+ imazethapyr</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Registered in 2002

<table>
<thead>
<tr>
<th>URMULE Number</th>
<th>Crop, Common</th>
<th>Herbicide</th>
<th>Timing</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001-1518</td>
<td>Beans, Adzuki</td>
<td>quizalofop-ethyl</td>
<td>post</td>
<td>added adzuki beans to the label</td>
</tr>
<tr>
<td>2001-1520</td>
<td>Beans, Mung</td>
<td>quizalofop-ethyl</td>
<td>post</td>
<td>added mung beans to the label</td>
</tr>
<tr>
<td>2001-1552</td>
<td>Beans, Dry</td>
<td>quizalofop-ethyl</td>
<td>post</td>
<td>added black, brown, cranberry, yellow eye, white and red kidney and white beans to the label</td>
</tr>
</tbody>
</table>

### Registered in 2001

<table>
<thead>
<tr>
<th>URMULE Number</th>
<th>Crop, Dry Common</th>
<th>Herbicide</th>
<th>Timing</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999-0343</td>
<td>Beans, Adzuki</td>
<td>imazethapyr</td>
<td>pre</td>
<td>added adzuki beans to the label</td>
</tr>
<tr>
<td>1999-0342</td>
<td>Beans, Dry</td>
<td>imazethapyr</td>
<td>pre</td>
<td>added black, brown, cranberry and yellow eye beans to the label</td>
</tr>
<tr>
<td>2000-0836</td>
<td>Beans, White</td>
<td>imazethapyr</td>
<td>ppi</td>
<td>new application timing</td>
</tr>
<tr>
<td>2000-0725</td>
<td>Beans, White</td>
<td>imazethapyr +</td>
<td>ppi</td>
<td>new tankmix for broadspectrum weed control</td>
</tr>
<tr>
<td></td>
<td></td>
<td>trifluralin</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>