

**WEED CONTROL IN PROCESSING
VEGETABLES**

RESEARCH RESULTS – 2023

**PREPARED FOR:
THE ONTARIO PROCESSING VEGETABLE
GROWERS**

ACKNOWLEDGEMENTS

Purpose Of This Booklet

This booklet is provided as a guide to the 2023 processing vegetable weed control research control plots. The experiments outlined in this booklet are located at Ridgetown Campus. We appreciate the funding, cooperation and assistance provided by the Ontario Processing Vegetable Growers and the Ontario Food Processors Association. As well, we would like to thank the chemical companies and their representatives, Ag Extension personnel, and other research scientists for their ideas, plant material and herbicide samples that were used in these trials. Funding for the 2023 research program was provided by:

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We trust that the information provided by this research will further the science of weed control by assisting with the registration of herbicides through the minor use system. We also hope this information will be of use in the extension of proper herbicide recommendations, thereby enabling growers to achieve consistent, broad spectrum weed control with a minimum of crop damage.

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Trial 1: Tolerance of Lima Bean to Reflex Applied at Various Timings

Objective: To examine the tolerance of two lima bean varieties (Improved Kingston and Cypress) to Reflex + Agral 90 applied at four growth stages, unifoliolate, 1-2 trifoliolate, 3-4 trifoliolate, and early flower.

Materials & Methods:

Crop: Lima bean

Variety: Improved Kingston Planting date: May 16, 2023
Planting rate: 266, 667 seeds/ha Depth: 5 cm
Row spacing: 75cm Plant spacing: 9.5 cm
Emergence date: May 30, 2023
Harvest date: September 6, 2023

Crop: Lima bean

Variety: Cypress Planting date: May 16, 2023
Planting rate: 266, 667 seeds/ha Depth: 5 cm
Row spacing: 75cm Plant spacing: 9.5 cm
Emergence date: May 30, 2023
Harvest date: September 6, 2023

Design: Randomized Complete Block Design

Plot width: 1.5m Plot length: 8 m
Reps: 4

Field Preparation: Field was fertilized on May 16 with 19-19-19 to ensure trial received 60 kg/ha actual K, based on OMAFRA recommendations.

Soil Description:

Sand: 51.6% OM: 4.3% Texture: Sandy Clay Loam
Silt: 24.4% pH: 7.3 Soil: Watford/Brady Series
Clay: 24% CEC 12.3

Application Information:

| Date | Jun-2-2023 | Jun-13-2023 | Jun-22-2023 | Jul-7-2023 |
|------------------------|-------------|-------------|-------------|-------------|
| Start Time | 7:00 AM | 8:45 AM | 8:20 AM | 8:20 AM |
| Method | CO2 SPRAY | CO2 SPRAY | CO2 SPRAY | CO2 SPRAY |
| Timing | UNIFOLIATE | 1-2 TRI | 3-4 TRI | FLOWER |
| Placement | FOLIAR | FOLIAR | FOLIAR | FOLIAR |
| Air Temperature | 25.1 C | 16.3 C | 20.8 C | 20 C |
| Wind Velocity+Dirt | 1.1 KPH, NW | 6.2 KPH, SW | 8.2 KPH, SE | 4.8 KPH, SE |
| Wet Leaves (Y/N) | Y, yes | N, no | N, no | N, no |
| Soil Temperature | 28 C | 18 C | 24 C | 24 C |
| Soil Moisture | DRY | MOIST | NORMAL | SLIWET |
| Soil Surface Condition | FINE | FINE | FINE | FINE |
| % Cloud Cover | 20 | 100 | 100 | 25 |
| Time to First Moisture | | 4.0 HR | | |

Spray Equipment:

Application Method: CO2 Backpack
Nozzle Type: Air Induction
Nozzle Spacing: 50 cm (20")
Spray Volume: 200 L/ha (20 GAL/AC)

Pressure: 207 KPA (30 PSI)
Nozzle Size: ULD120-02
Boom Width: 1.5 m (60")

Table 1.1. Effect of Reflex application timing on lima bean visual injury 7, 14 and 28 days after application (DAA).

| Herbicide* | Timing | Visual Injury (%) | | |
|-------------------|-----------------|-------------------|--------|--------|
| | | 7 DAA | 14 DAA | 28 DAA |
| Untreated Control | | 0 c | 0 b | 0 c |
| Reflex | Unifoliate | 12 b | 14 a | 9 a |
| Reflex | 1-2 trifoliate | 18 a | 14 a | 8 ab |
| Reflex | 3-4 trifoliate | 18 a | 14 a | 6 b |
| Reflex | Early flowering | 13 b | 14 a | 9 a |
| LSD (P <0.05) | | 2 | 3 | 3 |

*Reflex was applied at 400 ml/ac + Agral 90 at 5L/1000L for all application timings.

Note: Means followed by the same letter are not significantly different (P=0.05, LSD).

Table 1.2. Effect of Reflex application timing on lima bean height, dry biomass and yield.

| Herbicide* | Timing | Height | Dry Biomass | Yield |
|-------------------|-----------------|-------------|-------------|--------|
| | | (% control) | (g) | (T/AC) |
| | | 28 DAA | 14 DAA | |
| Untreated Control | | 100 a | 225 a | 0.93 a |
| Reflex | Unifoliate | 84 b | 226 a | 0.75 b |
| Reflex | 1-2 trifoliate | 92 ab | 188 a | 0.72 b |
| Reflex | 3-4 trifoliate | 93 ab | 197 a | 0.78 b |
| Reflex | Early flowering | 97 a | 211 a | 0.78 b |
| LSD (P <0.05) | | 10 | 36 | 0.15 |

*Reflex was applied at 400 ml/ac + Agral 90 at 5L/1000L for all application timings.

Note: Means followed by the same letter are not significantly different (P=0.05, LSD).

Conclusions:

This trial was kept weed-free to test for the effect of Reflex applied at four different timings on visual injury, height, dry weight and lima bean yield. There was no variety effect observed, therefore only the application treatment effect, across varieties, is shown.

While the degree of visual injury decreased over the three visual injury rating dates (7, 14, and 28 days after Reflex application), all timing applications, at all three evaluation dates, significantly injured lima bean. When Reflex was applied at the unifoliate stage plant height was decreased but there was no difference in plant dry biomass versus the untreated control.

Regardless of application timing or variety, Reflex applications decreased yield compared to the untreated control in 2023.

Trial 2: Tolerance of Lima Bean to Reflex plus Various Adjuvants Applied at 1-2 trifoliolate

Objective: To examine the tolerance of lima bean to Reflex applied at 1-2 trifoliolate (recommended application stage) with three different adjuvants (Turbocharge, Agral 90, and MSO).

Materials & Methods:

Crop: Lima bean

Variety: Cypress Planting date: May 16, 2023

Planting rate: 266, 667 seeds/ha Depth: 5 cm

Row spacing: 75cm Plant spacing: 9.5 cm

Emergence date: May 30, 2023

Harvest date: September 6, 2023

Design: Randomized Complete Block Design

Plot width: 1.5m Plot length: 8 m

Reps: 4

Field Preparation: Field was fertilized on May 16 with 19-19-19 to ensure trial received 60 kg/ha actual K, based on OMAFRA recommendations.

Soil Description:

Sand: 51.6%

OM: 4.3%

Texture: Sandy Clay Loam

Silt: 24.4%

pH: 7.3

Soil: Watford/Brady Series

Clay: 24%

CEC 12.3

Application Information:

| | |
|------------------------|-------------|
| | A |
| Date | Jun-13-2023 |
| Start Time | 9:10 AM |
| Method | CO2 SPRAY |
| Timing | 1-2 TRI |
| Placement | FOLIAR |
| Air Temperature | 16.3 C |
| Wind Velocity+Dir. | 6.2 KPH, SW |
| Wet Leaves (Y/N) | N, no |
| Soil Temperature | 18 C |
| Soil Moisture | MOIST |
| Soil Surface Condition | FINE |
| % Cloud Cover | 100 |
| Time to First Moisture | 4.0 HR |

Spray Equipment:

Application Method: CO2 Backpack

Pressure: 207 KPA (30 PSI)

Nozzle Type: Air Induction

Nozzle Size: ULD120-02

Nozzle Spacing: 50 cm (20")

Boom Width: 1.5 m (60")

Spray Volume: 200 L/ha (20 GAL/AC)

Table 2.1. Effect of Reflex plus Turbocharge, Agral 90, or MSO adjuvant on lima bean visual injury 7, 14 and 28 days after application (DAA), dry weight at 28 days and yield.

| Herbicide* | Rate | Visual Injury (%) | | | Biomass (g) 28 DAA | Yield (T/AC) |
|-------------------|-----------|-------------------|--------|--------|-----------------------|-----------------|
| | | 7 DAA | 14 DAA | 28 DAA | | |
| Untreated Control | | 0 c | 0 b | 0 b | 158 a | 0.77 a |
| Reflex | 400 ml/ac | 16 a | 12 a | 5 a | 132 a | 0.71 a |
| Turbocharge | 5L/1000L | | | | | |
| Reflex | 400 ml/ac | 12 b | 8 a | 6 a | 156 a | 0.67 a |
| Agral 90 | 5L/1000L | | | | | |
| Reflex | 400 ml/ac | 16 a | 11 a | 5 a | 159 a | 0.65 a |
| MSO | 5L/1000L | | | | | |
| LSD (P <0.05) | | 3 | 4 | 3 | 39 | 0.25 |

Note: Means followed by the same letter are not significantly different (P=0.05, LSD).

Conclusions:

This trial was kept weed-free to test for the effect of Reflex plus Turbocharge, Agral 90, or MSO as the adjuvant, applied at 1-2 trifoliolate, on visual injury, dry weight and lima bean yield.

All herbicide treatments, regardless of adjuvant used caused significant lima bean injury at the 7, 14, and 28 DAA rating, compared to the untreated control. However, by the 28 DAA evaluation lima bean injury was below 10% for all treatments. The use of Agral 90 as an adjuvant with Reflex resulted in lower injury symptoms at 7 DAA versus Turbocharge or MSO treatments, however by the 14 and 28 DAA evaluations all three adjuvants resulted in similar injury levels.

Despite observed injury for all herbicide treatments there was no significant reduction of plant dry biomass at 28 DAA or lima bean yield compared to the untreated control.

Trial 3: Tolerance of Lima Bean to Tough

Objective: Determine the tolerance of lima bean to PRE and POST applications of Tough.

Materials & Methods:

Crop: Lima bean

Variety: Cypress Planting date: May 16, 2023

Planting rate: 266, 667 seeds/ha Depth: 5 cm

Row spacing: 75cm Plant spacing: 9.5 cm

Emergence date: May 30, 2023

Harvest date: September 6, 2023

Design: Randomized Complete Block Design

Plot width: 1.5m Plot length: 8 m

Reps: 4

Field Preparation: Field was fertilized on May 16 with 19-19-19 to ensure trial received 60 kg/ha actual K, based on OMAFRA recommendations.

Soil Description:

Sand: 51.6%

OM: 4.3%

Texture: Sandy Clay Loam

Silt: 24.4%

pH: 7.3

Soil: Watford/Brady Series

Clay: 24%

CEC 12.3

Application Information:

| | A | B |
|------------------------|-------------|-------------|
| Date | May-18-2023 | Jun-13-2023 |
| Start Time | 7:00 AM | 9:00 AM |
| Method | CO2 SPRAY | CO2 SPRAY |
| Timing | PRE | 1-2 TRI |
| Placement | SOIL | FOLIAR |
| Air Temperature | 7 C | 16.3C |
| Wind Velocity+Dir | 1 KPH, NE | 6.2 KPH, SW |
| Wet Leaves (Y/N) | Y, yes | N, no |
| Soil Temperature | 13 C | 18 C |
| Soil Moisture | NORMAL | MOIST |
| Soil Surface Condition | | FINE |
| % Cloud Cover | 0 | 100 |
| Time to First Moisture | | 4.0 HR |

Spray Equipment:

Application Method: CO2 Backpack

Pressure: 207 KPA (30 PSI)

Nozzle Type: Air Induction

Nozzle Size: ULD120-02

Nozzle Spacing: 50 cm (20")

Boom Width: 1.5 m (60")

Spray Volume: 200 L/ha (20 GAL/AC)

Table 3.1. Effect of Tough on lima bean visual injury 7, 14 and 28 days after emergence/application, dry weight at 14 days and yield.

| Herbicide* | Rate | Visual Injury (%) | | | Biomass (g) | Yield |
|-------------------|-----------|-------------------|--------|--------|-------------|--------|
| | | 7 DAA | 14 DAA | 28 DAA | 14 DAA | (T/AC) |
| Untreated Control | | 0 c | 0 c | 0 b | 50 a | 0.77 a |
| Tough--PRE | 304 ml/ac | 0 c | 0 c | 0 b | 42 a | 0.56 a |
| Tough--PRE | 608 ml/ac | 1 c | 0 c | 0 b | 44 a | 0.59 a |
| Tough--POST | 304 ml/ac | 12 b | 8 b | 3 ab | 46 a | 0.71 a |
| Tough--POST | 608 ml/ac | 19 a | 11 a | 4 a | 44 a | 0.68 a |
| LSD (P <0.05) | | 2 | 2 | 3 | 15 | 0.28 |

Note: Means followed by the same letter are not significantly different (P=0.05, LSD).

Conclusions:

This trial was kept weed-free to test for the effect of preemergence and postemergence applications of Tough on visual injury, dry weight and yield of lima bean.

The POST applications of Tough resulted in increased lima bean injury compared to the untreated control and PRE applications of Tough at 7 and 14 DAA. However, by the 28 DAA evaluation only the 2x (608 ml/ac) rate of Tough caused increased injury compared to the untreated control; the injury was less than 5% though.

No application rate or timing of Tough affected lima bean dry biomass at 14 DAA and all treatment yields were similar to the untreated control despite early season injury.

Trial 4: Preemergence Weed Management Strategies in Tomato

Objective: To examine potential processing tomato tankmix combinations with respects to tolerance and weed management.

Materials & Methods:

Crop: Processing Tomato

Variety: N 3306 Planting date: May 23, 2023

Planting rate: 39 167 plants/ha Depth: 6 cm

Row spacing: 1.5 m Plant spacing: 34 cm

Harvest date: August 21, 2023

Design: Randomized Complete Block Design

Plot width: 1.5 m Plot length: 8 m

Reps: 4

Field Preparation: Fertilizer applied on May 10, 2023 at a rate of 594 kg/ha of a blend containing 30.31% total N, 6.4% total P, 9.46% total K, and 3.62% total S. Fertilizer was incorporated within 2 hours of application with an S-tine cultivator.

Soil Description:

Sand: 49.6%

OM: 4.1%

Texture: Loam

Silt: 28.4%

pH: 6.2

Soil: Watford/Brady

Clay: 22%

CEC 12.4

Application Information:

A
Application Date: May 21, 2023
Time of Day: 4:20 PM
Application Method: CO2 SPRAY
Application Timing: PRE-TRANS
Application Placement: SOIL
Air Temperature, Unit: 23.2
% Relative Humidity: 42.5
Wind Velocity, Unit: 9.4 KPH
Wind Direction: SW
Dew Presence (Y/N): Y.yes
Soil Temperature, Unit: 27.0 C
Soil Moisture: MOIST
% Cloud Cover: 25

Spray Equipment:

Application Method: CO2 Backpack

Pressure: 207 KPA (30 PSI)

Nozzle Type: Air Induction

Nozzle Size: ULD120-02

Nozzle Spacing: 50 cm (20")

Boom Width: 1.5 m (60")

Spray Volume: 200 L/ha (20 GAL/AC)

Table 4.1. Effect of herbicide tankmix combinations on processing tomato visual injury 7, 14 and 28 days after transplant (DAE), and dry biomass at 28 DAE.

| Herbicide | Rate (ml/ac) | Visual Injury (%) | | | Dry Biomass (g) |
|-------------------|-----------------|-------------------|--------|--------|--------------------|
| | | 7 DAE | 14 DAE | 28 DAE | |
| Untreated Control | | 0 a | 0 b | 0 a | 20 a |
| Authority | 117 | 0 a | 0 b | 2 a | 17 a |
| Authority Supreme | 240 | 1 a | 3 a | 2 a | 16 a |
| Dual II Magnum | 700 | 0 a | 0 b | 1 a | 19 a |
| Sencor 480 | 600 | | | | |
| Dual II Magnum | 700 | 1 a | 1 b | 3 a | 18 a |
| Sencor 480 | 600 | | | | |
| Prowl H2O | 890 | | | | |
| Dual II Magnum | 700 | 0 a | 1 b | 1 a | 18 a |
| Authority | 117 | | | | |
| Prowl H2O | 890 | | | | |
| Dual II Magnum | 700 | 2 a | 3 a | 2 a | 16 a |
| Authority Supreme | 240 | | | | |
| Prowl H2O | 890 | | | | |
| Dual II Magnum | 700 | 0 a | 0 b | 0 a | 19 a |
| Sencor 480 | 600 | | | | |
| Authority | 117 | | | | |
| Prowl H2O | 890 | | | | |
| LSD (P <0.05) | | 2 | 1 | 3 | 5 |

Note: Means followed by the same letter are not significantly different (P=0.05, LSD).

Table 4.2. Effect of herbicide tankmix combinations on processing tomato redroot pigweed (AMARE), common lambsquarters (CHEAL), and green foxtail (SETVI) control at days after transplant (DAE), and red fruit tomato yield.

| Herbicide | Rate (ml/ac) | Control 28 DAE (%) | | | Red Yield (T/AC) |
|-------------------|-----------------|--------------------|-------|-------|---------------------|
| | | AMARE | CHEAL | SETVI | |
| Untreated Control | | 0 d | 0 d | 0 a | 26.94 a |
| Authority | 117 | 39 abc | 55 a | 5 a | 24.56 a |
| Authority Supreme | 240 | 21 cd | 68 a | 19 a | 26.65 a |
| Dual II Magnum | 700 | 38 abc | 34 ab | 13 a | 31.72 a |
| Sencor 480 | 600 | | | | |
| Dual II Magnum | 700 | 58 ab | 49 a | 19 a | 27.61 a |
| Sencor 480 | 600 | | | | |
| Prowl H2O | 890 | | | | |
| Dual II Magnum | 700 | 43 abc | 66 a | 19 a | 33.04 a |
| Authority | 117 | | | | |
| Prowl H2O | 890 | | | | |
| Dual II Magnum | 700 | 35 bc | 68 a | 26 a | 30.04 a |
| Authority Supreme | 240 | | | | |
| Prowl H2O | 890 | | | | |
| Dual II Magnum | 700 | 59 a | 51 a | 29 a | 33.91 a |
| Sencor 480 | 600 | | | | |
| Authority | 117 | | | | |
| Prowl H2O | 890 | | | | |
| LSD (P <0.05) | | 23 | 37 | 25 | 7.4 |

Note: Means followed by the same letter are not significantly different (P=0.05, LSD).

Conclusions:

This trial had front halves and back halves, where the back half was kept weed-free to test for the effect of the tankmix applications on visual injury, dry biomass and tomato yield. The weedy front halves were evaluated for weed control. It should also be noted that there was very little rain following PRE herbicide application, so weed control was very poor in 2023.

At 28 days after transplant redroot pigweed and lambsquarters control was improved for most treatments versus the untreated control. The 4-way herbicide combination of Dual II Magnum + Sencor 480 + Authority + Prowl H2O showed similar levels of tomato injury and redroot pigweed, lambsquarters, and green foxtail control as the Dual II Magnum + Sencor 480, Dual II Magnum + Sencor 480 + Prowl H2O, and Dual II Magnum + Authority + Prowl H2O treatments.

No herbicide treatment reduced red yield versus the untreated control. Additionally, there was no increase in green tomato yield for any treatment, indicating that tomato maturity was not impacted (data not shown).

Trial 5: Tolerance of Preemergence Tankmixes in Cucumber

Objective: Determine the tolerance of cucumber to preemergence applications of Sandea, Dual II Magnum, and Prowl H20.

Materials & Methods:

Crop: Cucumber

Variety: Vlasstar

Planting rate: 87 500 seeds/ha

Row spacing: 75 cm

Planting date: May 30, 2023

Depth: 4 cm

Emergence date: June 6, 2023

Harvest date: July 24, 2023

Design: Randomized Complete Block Design

Plot width: 2.0 m

Plot length: 8 m

Reps: 4

Field Preparation: Fertilized with 19-19-19 to ensure trial area had 110 kg/ha actual N. Fertilizer was incorporated using an S-tine cultivator.

Soil Description:

Sand: 49.6%

Silt: 28.4%

Clay: 22.0%

OM: 4.1%

pH: 6.2

CEC: 12.4

Texture: Loam

Soil: Watford/Brady Series

Application Information:

| | |
|------------------|-------------|
| APPLICATION DATE | A June 1 |
| TIME OF DAY | 10:00 AM |
| TIMING | PRE |
| AIR TEMP (c) | 30.1 |
| RH (%) | 48.6 |
| WIND SPEED (KPH) | 5.5 |
| SOIL TEMP (c) | 28 |
| CLOUD COVER (%) | 15 |

Spray Equipment:

Application Method: CO2 Backpack
Nozzle Type: AIR INDUCTION
Nozzle Spacing: 50 cm (20")
Spray Volume: 200 L/ha (20 GAL/AC)

Pressure: 207 KPA (30 PSI)
Nozzle Size: ULD120-02
Boom Width: 2.0 m (79")

Table 5.1. Effect of herbicide treatment on 'Vlasstar' cucumber visual injury 7, 14 and 28 days after emergence (DAE) and stand count.

| Herbicide | Rate | Visual Injury (%) | | | Plant Stand #/4 m |
|-------------------|-----------|-------------------|--------|--------|----------------------|
| | | 7 DAE | 14 DAE | 28 DAE | |
| Untreated Control | | 0 a | 0 c | 0 b | 47 a |
| Sandea | 20 g/ac | 0 a | 1 c | 5 b | 46 a |
| Prowl H2O | 890 ml/ac | | | | |
| Sandea | 20 g/ac | 0 a | 10 b | 4 b | 49 a |
| Dual II Magnum | 700 ml/ac | | | | |
| Prowl H2O | 890 ml/ac | 0 a | 12 b | 8 b | 51 a |
| Dual II Magnum | 700 ml/ac | | | | |
| Sandea | 20 g/ac | 0 a | 16 a | 23 a | 48 a |
| Prowl H2O | 890 ml/ac | | | | |
| Dual II Magnum | 700 ml/ac | | | | |
| LSD (P <0.05) | | 0 | 3 | 8 | 7 |

Note: Means followed by the same letter are not significantly different (P=0.05, LSD).

Table 5.2. Effect of herbicide treatment on 'Vlasstar' cucumber yield.

| Herbicide | Rate | Yield (T/AC) | | | | | Total |
|-------------------|-----------|--------------|------------|------------|------------|------------|--------|
| | | Grade 1 | Grade 2 | Grade 3 | Grade 4 | Grade 5 | |
| Untreated Control | | 0.57 a | 0.83 a | 3.95 a | 3.33 a | 0.61 a | 9.29 a |
| Sandea | 20 g/ac | 0.84 a | 0.77 a | 3.86 a | 3.15 a | 1.17 a | 9.78 a |
| Prowl H2O | 890 ml/ac | | | | | | |
| Sandea | 20 g/ac | 0.56 a | 0.82 a | 4.22 a | 3.01 a | 0.79 a | 9.39 a |
| Dual II Magnum | 700 ml/ac | | | | | | |
| Prowl H2O | 890 ml/ac | 0.59 a | 0.86 a | 3.50 a | 2.19 ab | 0.64 a | 7.79 a |
| Dual II Magnum | 700 ml/ac | | | | | | |
| Sandea | 20 g/ac | 0.78 a | 0.82 a | 2.40 a | 1.23 b | 0.17 a | 5.40 a |
| Prowl H2O | 890 ml/ac | | | | | | |
| Dual II Magnum | 700 ml/ac | | | | | | |
| LSD (P <0.05) | | 0.25 | 0.35 | 1.66 | 1.34 | 0.77 | 3.15 |

Conclusions:

This trial was kept weed-free to test for the effect of preemergence Sandea, Prowl H2O, and Dual II Magnum applications on cucumber visual injury, plant stand and yield.

The 3-way combination of Sandea, Prowl H2O, and Dual II Magnum caused increased injury, compared to the untreated control, at 14 and 28 DAE. While the increased injury did not result in a decreased cucumber stand or statistically reduced total cucumber yield, there was a numerical reduction of total yield, which combined with the observed injury could be concerning.

The observed visual injury noted at 14 DAE for the 2-way tankmix of Sandea + Dual II Magnum and Prowl H2O + Dual II Magnum was greater or equal to the commercially accepted injury level of 10%, and was also greater than the untreated control. However, by 28 DAE the observed injury for these two tankmix combinations had decreased and was similar to the untreated control. No 2-way tankmix decreased plant stand or yield compared to the untreated control.

Trial 6: Tolerance of Preemergence Herbicides in Carrot

Objective: Determine the tolerance of carrot to various preemergence herbicides

Materials & Methods:

Crop: Carrot

Variety: Belgrado

Planting rate: 590,625 plants/ha

Row spacing: 38 cm

Planting date: May 31, 2023

Depth: 4 cm

Emergence date: June 26, 2023

Harvest date: August 18, 2023

Design: Randomized Complete Block Design

Plot width: 1.5 m

Plot length: 8 m

Reps: 4

Field Preparation: Trial was cultivated two times with an S-tine cultivator and irrigation tape laid along the center row of each plot (3 row beds). At the time of planting there was little moisture in soil. Once carrot emerged and established irrigation was no longer used.

Soil Description:

Sand: 68.2%

Silt: 22.9%

Clay: 8.9%

OM: 2.93%

pH: 6.4

Texture: Sandy Loam

Soil: Fox

Application Information:

| | |
|------------------|---------|
| | A |
| APPLICATION DATE | MAY 11 |
| TIME OF DAY | 9:00 AM |
| TIMING | PRE |
| AIR TEMP (c) | 22.7 |
| RH (%) | 48 |
| WIND SPEED (KPH) | 1.4 |
| SOIL TEMP (c) | 22 |
| CLOUD COVER (%) | 5 |

Spray Equipment:

Application Method: CO2 Backpack

Nozzle Type: AIR INDUCTION

Nozzle Spacing: 50 cm (20")

Spray Volume: 200 L/ha (20 GAL/AC)

Pressure: 207 KPA (30 PSI)

Nozzle Size: ULD120-02

Boom Width: 2.0 m (79")

Table 6.1. Effect of preemergence herbicides on carrot: visual injury, plant stand and yield.

| Herbicide | Rate mL/ac | Visual Injury (%) | | Plant Stand 28 DAE | Yield T/AC |
|--|--------------------|-------------------|--------|-----------------------|---------------|
| | | 7 DAE | 28 DAE | | |
| Untreated Control | | 0 d | 0 d | 151 ab | 10.44 abc |
| Nortron | 1350 | 5 d | 1 d | 183 a | 13.38 a |
| Nortron Prowl H2O | 1350 890 | 11 cd | 6 cd | 124 bc | 12.08 ab |
| Nortron Zidua | 1350 80 | 65 b | 69 ab | 38 ef | 2.42 ef |
| Nortron Dual II Magnum | 1350 525 | 16 cd | 18 cd | 90 cd | 7.06 cd |
| Nortron Prowl H2O Zidua | 1350 890 80 | 53 b | 64 b | 29 ef | 3.44 ef |
| Nortron Prowl H2O Dual II Magnum | 1350 890 525 | 31 c | 23 c | 61 de | 5.23 de |
| Nortron Zidua Dual II Magnum | 1350 80 525 | 89 a | 89 a | 13 f | 0.99 f |
| Tough | 304 | 10 d | 10 cd | 118 bc | 8.82 bc |
| LSD (P <0.05) | | 21 | 21 | 48 | 4 |

Note: Means followed by the same letter are not significantly different (P=0.05, LSD).

Conclusions:

This trial was kept weed-free to determine the tolerance of carrot to preemergence applications of Nortron and Nortron tankmixes.

Nortron applied on its own did not increase visual injury at either the early or late rating (7 DAE and 28 DAE, respectively) compared to the untreated control. Similarly, the number of carrots per plot and carrot yield was not affected by Nortron applied alone.

The 2-way combination of Nortron + Zidua significantly increased carrot injury compared to the untreated control and this injury also impacted carrot number and yield. Applications of Nortron + Prowl H2O did not significantly increase visual injury compared to the untreated control and the resulting yield was similarly not impacted.

All of the 3-way combinations, Nortron + Prowl H2O + Zidua, Nortron + Prowl H2O + Dual II Magnum, and Nortron + Zidua + Dual II Magnum resulted in significant carrot injury which resulted in decreased carrot number and yield. Plots treated with Zidua, either as a 2-way or 3-way application had the lowest yields and greatest injury, suggesting that Zidua is not a viable option for carrot.

Plots treated with Tough had statistically similar levels of visual injury, carrot number and yield compared to the untreated control.

Trial 7: Tolerance and Weed Control of Zidua Tank-mixes on Processing Pea

Objective: Determine weed control and tolerance of processing pea to Zidua alone and in combination with various PRE herbicides.

Materials & Methods:

Crop: Pea

Variety: Welland

Planting rate: 300 kg/ha

Row spacing: 18 cm

Planting date: Apr 13, 2023

Depth: 8 cm

Emergence date: May 5, 2023

Harvest date: June 29, 2023

Design: Randomized Complete Block Design

Plot width: 3.0 m

Plot length: 8 m

Reps: 4

Field Preparation: Worked the field twice with S-tine cultivator prior to planting. 40 kg/ha of actual K (19-19-19) was applied to the area and worked in with the S-tine cultivator on April 13, 2023.

Soil Description:

Sand: 51.6%

Silt: 24.4%

Clay: 24.0%

OM: 4.3%

pH: 7.3

CEC 12.3

Texture: Sandy Clay Loam

Soil: WATFORD/BRADY

Application Information:

| | |
|------------------|---------------------|
| APPLICATION DATE | A April 19, 2023 |
| TIME OF DAY | 3:30 PM |
| TIMING | PRE |
| AIR TEMP (c) | 10.3 |
| RH (%) | 62 |
| WIND SPEED (KPH) | 4.4 |
| SOIL TEMP (c) | 18.5 |
| CLOUD COVER (%) | 35 |

Spray Equipment:

Application Method: CO2 Backpack

Nozzle Type: AIR INDUCTION

Nozzle Spacing: 50 cm (20")

Spray Volume: 200 L/ha (20 GAL/AC)

Pressure: 207 KPA (30 PSI)

Nozzle Size: ULD120-02

Boom Width: 2.0 m (79")

Table 7.1. Effect of herbicide treatment on 'Welland' pea visual injury 7, 14 and 28 days after emergence (DAE).

| HERBICIDE | RATE | VISUAL INJURY | | |
|-------------------|-----------|---------------|--------|--------|
| | | 7 DAE | 14 DAE | 28 DAE |
| Untreated Control | | 0 b | 0 b | 0 a |
| Zidua | 80 mL/ac | 0 b | 0 b | 0 a |
| Zidua | 80 mL/ac | 0 b | 0 b | 1 a |
| Pursuit | 126 mL/ac | | | |
| Zidua | 80 mL/ac | 0 b | 1 b | 1 a |
| Dual II Magnum | 0.7 L/ac | | | |
| Zidua | 80 mL/ac | 1 b | 0 b | 0 a |
| Prowl H2O | 0.89 L/ac | | | |
| Zidua | 80 mL/ac | 2 a | 4 a | 1 a |
| Sandea | 20 g/ac | | | |
| LSD (P <0.05) | | 1 | 2 | 1.5 |

Note: Means followed by the same letter are not significantly different (P=0.05, LSD).

Table 7.2. Effect of herbicide treatment on velvetleaf (ABUTH), common ragweed (AMBEL), common lambsquarters (CHEAL) and green foxtail (SETVI) control 42 days after application.

| HERBICIDE | RATE | ABUTH | AMBEL | CHEAL | SETVI |
|-------------------|-----------|-------|-------|-------|-------|
| Untreated Control | | 0 c | 0 c | 0 c | 0 c |
| Zidua | 80 mL/ac | 88 b | 49 b | 81 b | 70 b |
| Zidua | 80 mL/ac | 100 a | 90 a | 100 a | 71 b |
| Pursuit | 126 mL/ac | | | | |
| Zidua | 80 mL/ac | 89 ab | 65 ab | 96 a | 88 a |
| Dual II Magnum | 0.7 L/ac | | | | |
| Zidua | 80 mL/ac | 96 ab | 89 a | 99 a | 65 b |
| Prowl H2O | 0.89 L/ac | | | | |
| Zidua | 80 mL/ac | 100 a | 100 a | 100 a | 74 ab |
| Sandea | 20 g/ac | | | | |
| LSD (P <0.05) | | 12 | 37 | 6 | 17 |

Note: Means followed by the same letter are not significantly different (P=0.05, LSD).

Table 7.3. Effect of herbicide treatment on 'Welland' pea tenderness and yield.

| HERBICIDE | RATE | TENDEROMETER READING (PSI) | YIELD T/AC |
|-------------------|-----------|-------------------------------|---------------|
| Untreated Control | | 87 a | 2.72 c |
| Zidua | 80 mL/ac | 89 a | 3.70 ab |
| Zidua | 80 mL/ac | 84 a | 4.33 a |
| Pursuit | 126 mL/ac | | |
| Zidua | 80 mL/ac | 80 a | 4.27 a |
| Dual II Magnum | 0.7 L/ac | | |
| Zidua | 80 mL/ac | 86 a | 3.80 ab |
| Prowl H2O | 0.89 L/ac | | |
| Zidua | 80 mL/ac | 84 a | 3.40 bc |
| Sandea | 20 g/ac | | |
| LSD (P <0.05) | | 7 | 1 |

Note: Means followed by the same letter are not significantly different (P=0.05, LSD).

Conclusions:

This trial was established to determine the tolerance of processing pea to preemergent Zidua (pyroxasulfone) tankmixes and to explore the efficacy of those tankmix combinations on weed control. Only the Zidua + Sandea tankmix combination caused significant injury, compared to the untreated control, at the 7 and 14 days after emergence (DAE) evaluation. By 28 DAE, there was no difference in visual injury for the Zidua + Sandea treatment and the untreated control. While there was no significant visual injury noted by 28 DAE for the Zidua + Sandea treatment a yield reduction was still observed. The Zidua + Sandea pea yield was significantly lower than plots treated with either Zidua + Pursuit or Zidua + Dual II Magnum. Yield from plots treated with Zidua + Sandea were similar to yield from the untreated control. Yield was similar between plots treated with Zidua alone, Zidua + Pursuit, Zidua + Dual II Magnum, and Zidua + Prowl H2O. No treatment affected pea maturity.

The addition of a tankmix partner to Zidua often significantly improved weed control compared to Zidua applied alone. Zidua + Pursuit provided excellent velvetleaf, common ragweed, and common lambsquarters control. The addition of Pursuit to Zidua did not improve green foxtail control. Zidua + Dual II Magnum provided good velvetleaf, common lambsquarters, and green foxtail control, but only fair common ragweed control. Zidua + Prowl H2O provided excellent velvetleaf and common lambsquarters control, good ragweed control, but only fair green foxtail control. Velvetleaf, common lambsquarters, and ragweed control was excellent for the Zidua + Sandea tankmix, but green foxtail control was only fair. Green foxtail density in this trial was fairly high in 2023 with density counts of over 100 plants per meter.