

Incorporating Roundup-Ready Sugarbeets into a Sustainable Weed Control Program at Scottsbluff, Nebraska during the 2009 Growing Season.

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Objective: 1) Determine the best strategies for using Roundup for weed control in sugarbeets.
2) Select the most effective traditional herbicides to utilize with Roundup to address Roundup-tolerant weeds.

Problem Addressed: Roundup-Ready sugarbeets have been planted in western Nebraska for the past two growing seasons. The use of glyphosate for postemergence weed control in sugarbeets has dramatically improved the growers' ability to manage weeds. This has also been the case for soybean, corn, and cotton growers in other sections of the US. A few soybean growers in Nebraska have been continuously utilizing only glyphosate for weed control for the past 13 years. As we move to western Nebraska the predominant use of glyphosate has been in corn with some growers continuously utilizing only glyphosate for weed control for 7 years. With 130 million acres of corn and soybeans treated with glyphosate in the US in 2008, it is not surprising that weed shifts have occurred and some weed species have developed tolerance to glyphosate.

As glyphosate gains popularity for weed control in sugarbeets it would be prudent to examine some of the experiences that corn and soybean growers have had with glyphosate so we can sustain glyphosate efficacy in sugarbeets. Once corn and soybean growers switch to a glyphosate-resistant crop they usually want to continue using glyphosate. If weed shifts or tolerant weeds have developed they have addressed problem weeds by applying a preemergence herbicide at planting or tank mixing another postemergence herbicide with glyphosate. Many growers in the Western Sugar growing region have used Roundup-Ready crops sparingly, so initially there should be very few problems with glyphosate performance. The objective of this experiment is to give growers backup information so in future years, if glyphosate-tolerant weeds develop, there will already be control tactics tested and available for growers to utilize.

Procedure: A field study was initiated near Scottsbluff, Nebraska to compare the effectiveness of various herbicides for weed control in Roundup-Ready sugarbeets. The experimental design was a randomized complete block with four replications. Plots were 11 feet wide by 45 feet long and were located on a loamy sand with 0.9% organic matter and a pH of 8.1. Sugarbeet 'BTS66RR70' were planted on April 24. The plot area was irrigated on May 6, May 17, and May 21 for seed germination and early season plant growth. Herbicide application began on April 27 three days after planting. Sugarbeets were in the cotyledon growth stage by May 18 when postemergence herbicide application was initiated. Row closure occurred on July 7 when the last set of postemergence treatments were applied. Herbicides were applied with a tractor-mounted sprayer calibrated to deliver 20 gallons of water per acre at 32-psi pressure with Spraying Systems 11002 VS nozzles. Environmental conditions following herbicide application and weed growth stages at the time of herbicide application are given in Table 1.

Results: Crop injury from herbicides was evaluated on June 10 (Table 2). Crop injury was greatest in areas treated with a conventional weed control program of Nortron applied at

planting followed postemergence by four applications of Betamix plus Upbeet plus Stinger plus methylated seed oil (Scoil). Crop injury was also observed from a postemergence application of Betamix plus Upbeet plus Stinger plus Scoil at the cotyledon, four true-leaf, and six true-leaf growth stages plus Roundup Original Max at the two true-leaf and 10 true-leaf growth stages. Crop stand and weed density were determined by counting sugarbeets and weeds in a 440 sq ft area in the center of each plot. The weed population consisted of common lambsquarters, common purslane, redroot pigweed, hairy nightshade, and stinkgrass at densities of 1349, 31, 57, 218, and 11 plants per 440 sq ft, respectively. Common lambsquarters was the dominate weed in the study area. All the herbicide treatments provided 97% or more common lambsquarters and 90% or more hairy nightshade control (Table 2). Redroot pigweed control was excellent with all treatments except two applications of Roundup Original Max. With the removal of common lambsquarters, hairy nightshade, and redroot pigweed there was space available for common purslane and stinkgrass which began growth in June and continued to emerge until canopy closure. Nortron applied preemergence followed by Roundup Original Max at the two true-leaf stage and Roundup Original Max plus either Dual Magnum or Outlook at the four true-leaf stage with a followup of Roundup Original Max at the 10 true-leaf growth stage provided excellent control of early and late season weeds.

The conventional weed control program of Nortron followed postemergence by Betamix plus Upbeet plus Stinger caused early season crop injury and a sugarbeet root yield of 41.2 tons/acre while three applications of Roundup Original Max at 0.75 lb/acre caused no early season crop injury and sugarbeet root yield was 47.0 tons/acre even though weed control was similar with both treatments (Table 2). This would suggest that the early season crop injury observed with the conventional herbicide program reduced root yield 12% compared to three applications of Roundup Original Max. Two applications of Roundup Original Max provided reduced control of redroot pigweed and hairy nightshade and a sugarbeet root yield of 38.7 tons/acre which was reduced compared to the other weed control programs.

Table 1. Environmental Conditions at the Time of Herbicide Application.

| Date | Air temperature | Humidity | Wind speed & direction | Time of day | Crop growth stage | Weed heights | | | | |
|----------|-----------------|----------|------------------------|-------------|-------------------|----------------------|------|------|------|------|
| | | | | | | Colq | Copu | Rrpw | Hans | Stgr |
| | (F) | (%) | (mph) | | | ----- (inches) ----- | | | | |
| April 27 | 44 | 49 | 2 NE | 1:00 PM | Pre | | | | | |
| May 18 | 88 | 17 | 2 SW | 11:00 PM | Cot | 1 | -- | 0.5 | 0.75 | -- |
| May 22 | 74 | 45 | 3 SE | 2:00 PM | 2TL | 2 | -- | 0.75 | 1.5 | -- |
| June 1 | 59 | 86 | Calm | 9:00 AM | 4TL | 3 | -- | 1 | 3 | -- |
| June 8 | 61 | 52 | 2 SW | 1:00 PM | 6TL | 10 | 1.5 | 6 | 10 | -- |
| June 15 | 81 | 30 | 4 SW | 11:00 AM | 8TL | 17 | 2 | 10 | 12 | -- |
| June 22 | 82 | 37 | 1 NE | 11:00 AM | 10TL | 24 | 4 | 13 | 14 | 1 |
| July 7 | 67 | 70 | 1 NW | 9:00 AM | Canopy | 36 | 6 | 30 | 20 | 5 |

Table 2. Incorporating Roundup-Ready Sugarbeets into a Sustainable Weed Control Program.

| Herbicide treatment | Rate | Time of application | Sugarbeet | | | | |
|---|---------------------|---------------------|---------------|-------|-------|---------|-----|
| | | | Visual Injury | Stand | Yield | Sucrose | SLM |
| | | | 6/10 | 6/10 | 10/7 | | |
| (lb/acre) | (%) | (plants/acre) | (tons/acre) | (%) | | | |
| Nontreated | -- | -- | 0 | 41100 | -- | -- | -- |
| Nortron | 1.0 | Pre | | | | | |
| Betamix + Upbeet + Stinger + Scoil | 0.08 + 0.004 + 0.02 | Cot | | | | | |
| Betamix + Upbeet + Stinger + Scoil | 0.08 + 0.004 + 0.02 | 2TL | | | | | |
| Betamix + Upbeet + Stinger + Scoil | 0.08 + 0.004 + 0.02 | 4TL | | | | | |
| Betamix + Upbeet + Stinger + Scoil | 0.08 + 0.004 + 0.02 | 6TL | 13 | 49200 | 41.2 | 13.7 | 1.6 |
| Roundup Original Max + AMS | 0.75 | 2TL | | | | | |
| Roundup Original Max + AMS | 0.75 | 6TL | | | | | |
| Roundup Original Max + AMS | 0.75 | Canopy closure | 0 | 48000 | 47.0 | 14.0 | 1.6 |
| Nortron | 1.0 | Pre | | | | | |
| Roundup Original Max + AMS | 0.75 | 2TL | | | | | |
| Roundup Original Max + AMS | 0.75 | 6TL | | | | | |
| Roundup Original Max + AMS | 0.75 | Canopy closure | 0 | 46900 | 44.2 | 14.0 | 1.6 |
| Roundup Original Max + AMS | 0.75 | 2TL | | | | | |
| Roundup Original Max + Progress + AMS | 0.75 + 0.25 | 4TL | | | | | |
| Roundup Original Max + Progress + AMS | 0.75 + 0.33 | 8TL | 2 | 45200 | 44.4 | 14.3 | 1.6 |
| Roundup Original Max + Upbeet + AMS + Scoil | 0.75 + 0.016 | 2TL | | | | | |
| Roundup Original Max + Upbeet + AMS + Scoil | 0.75 + 0.016 | 6TL | | | | | |
| Roundup Original Max + AMS | 0.75 | Canopy closure | 0 | 48200 | 45.8 | 13.8 | 1.7 |
| Roundup Original Max + Stinger + AMS | 0.75 + 0.02 | 2TL | | | | | |
| Roundup Original Max + Stinger + AMS | 0.75 + 0.02 | 6TL | | | | | |
| Roundup Original Max + AMS | 0.75 | Canopy closure | 0 | 45700 | 45.0 | 14.2 | 1.6 |
| Norton | 1.0 | Pre | | | | | |
| Roundup Original Max + AMS | 0.75 | Cot | | | | | |
| Roundup Original Max + Progress + AMS | 0.75 + 0.25 | 4TL | | | | | |
| Progress | 0.33 | 6TL | | | | | |
| Roundup Original Max + AMS | 0.75 | Canopy closure | 3 | 45400 | 46.1 | 14.0 | 1.7 |
| Roundup Original Max + AMS | 1.12 | 2TL | | | | | |
| Roundup Original Max + AMS | 1.12 | 6TL | | | | | |
| Roundup Original Max + AMS | 1.12 | 10TL | 0 | 46900 | 44.3 | 13.9 | 1.7 |

Table 2. Incorporating Roundup-Ready Sugarbeets into a Sustainable Weed Control Program – Continued.

| Herbicide treatment | Rate | Time of application | Sugarbeet | | | | |
|--|---------------------|---------------------|-----------------------|---------------|---------------|---------|-----|
| | | | Visual Injury 6/10 | Stand 6/10 | Yield 10/7 | Sucrose | SLM |
| | (lb/acre) | | (%) | (plants/acre) | (tons/acre) | (%) | |
| Nortron | 1.0 | Pre | | | | | |
| Roundup Original Max + AMS | 0.75 | 2TL | | | | | |
| Roundup Original Max + Dual Magnum + AMS | 0.75 + 1.0 | 4TL | | | | | |
| Roundup Original Max + AMS | 1.12 | 10TL | 3 | 45600 | 46.9 | 13.9 | 1.7 |
| Roundup Original Max + AMS | 0.75 | 2TL | | | | | |
| Roundup Original Max + AMS | 0.75 | 6TL | 0 | 46600 | 38.7 | 14.7 | 1.5 |
| Nortron | 1.0 | Pre | | | | | |
| Roundup Original Max + AMS | 0.75 | 2TL | | | | | |
| Roundup Original Max + Outlook + AMS | 0.75 + 0.66 | 4TL | | | | | |
| Roundup Original Max + AMS | 1.12 | 10TL | 1 | 45100 | 44.5 | 14.1 | 1.6 |
| Betamix + Upbeet + Stinger + Scoil | 0.08 + 0.004 + 0.02 | Cot | | | | | |
| Roundup Original Max + AMS | 0.75 | 2TL | | | | | |
| Betamix + Upbeet + Stinger + Scoil | 0.08 + 0.004 + 0.02 | 4TL | | | | | |
| Betamix + Upbeet + Stinger + Scoil | 0.08 + 0.004 + 0.02 | 6TL | | | | | |
| Roundup Original Max + AMS | 1.12 | 10TL | 7 | 46100 | 44.6 | 13.8 | 1.7 |
| Roundup Original Max + AMS | 0.75 | 2TL | | | | | |
| Roundup Original Max + Dual Magnum + AMS | 0.75 + 1.0 | 4TL | | | | | |
| Roundup Original Max + Dual Magnum + AMS | 0.75 + 1.0 | 8TL | 0 | 44500 | 44.8 | 14.3 | 1.5 |
| LSD at 0.05 | -- | -- | 3 | NS | 3.1 | NS | NS |

Table 2. Incorporating Roundup-Ready Sugarbeets into a Sustainable Weed Control Program - Continued.

| Herbicide treatment | Rate (lb/acre) | Time of application | Percent weed control 7/10 | | | | | Average |
|---|---------------------|------------------------|---------------------------|------|------|------|------|---------|
| | | | Colq | Copu | Rrpw | Hans | Stgr | |
| Nontreated | -- | -- | 0 | 0 | 0 | 0 | 0 | 0 |
| Nortron | 1.0 | Pre | | | | | | |
| Betamix + Upbeet + Stinger + Scoil | 0.08 + 0.004 + 0.02 | Cot | | | | | | |
| Betamix + Upbeet + Stinger + Scoil | 0.08 + 0.004 + 0.02 | 2TL | | | | | | |
| Betamix + Upbeet + Stinger + Scoil | 0.08 + 0.004 + 0.02 | 4TL | | | | | | |
| Betamix + Upbeet + Stinger + Scoil | 0.08 + 0.004 + 0.02 | 6TL | 97 | 62 | 96 | 97 | 27 | 75 |
| Roundup Original Max + AMS | 0.75 | 2TL | | | | | | |
| Roundup Original Max + AMS | 0.75 | 6TL | | | | | | |
| Roundup Original Max + AMS | 0.75 | Canopy closure | 98 | 0 | 98 | 96 | 33 | 65 |
| Nortron | 1.0 | Pre | | | | | | |
| Roundup Original Max + AMS | 0.75 | 2TL | | | | | | |
| Roundup Original Max + AMS | 0.75 | 6TL | | | | | | |
| Roundup Original Max + AMS | 0.75 | Canopy closure | 99 | 88 | 97 | 97 | 62 | 88 |
| Roundup Original Max + AMS | 0.75 | 2TL | | | | | | |
| Roundup Original Max + Progress + AMS | 0.75 + 0.25 | 4TL | | | | | | |
| Roundup Original Max + Progress + AMS | 0.75 + 0.33 | 8TL | 98 | 91 | 98 | 94 | 95 | 95 |
| Roundup Original Max + Upbeet + AMS + Scoil | 0.75 + 0.016 | 2TL | | | | | | |
| Roundup Original Max + Upbeet + AMS + Scoil | 0.75 + 0.016 | 6TL | | | | | | |
| Roundup Original Max + AMS | 0.75 | Canopy closure | 97 | 31 | 97 | 98 | 58 | 76 |
| Roundup Original Max + Stinger + AMS | 0.75 + 0.02 | 2TL | | | | | | |
| Roundup Original Max + Stinger + AMS | 0.75 + 0.02 | 6TL | | | | | | |
| Roundup Original Max + AMS | 0.75 | Canopy closure | 99 | 18 | 99 | 98 | 41 | 71 |
| Norton | 1.0 | Pre | | | | | | |
| Roundup Original Max + AMS | 0.75 | Cot | | | | | | |
| Roundup Original Max + Progress + AMS | 0.75 + 0.25 | 4TL | | | | | | |
| Progress | 0.33 | 6TL | | | | | | |
| Roundup Original Max + AMS | 0.75 | Canopy closure | 99 | 91 | 99 | 98 | 78 | 93 |
| Roundup Original Max + AMS | 1.12 | 2TL | | | | | | |
| Roundup Original Max + AMS | 1.12 | 6TL | | | | | | |
| Roundup Original Max + AMS | 1.12 | 10TL | 99 | 48 | 96 | 99 | 75 | 83 |

Table 2. Incorporating Roundup-Ready Sugarbeets into a Sustainable Weed Control Program – Continued.

| Herbicide treatment | Rate (lb/acre) | Time of application | Percent weed control 7/10 | | | | | Average |
|--|---------------------|------------------------|---------------------------|------|------|------|------|---------|
| | | | Colq | Copu | Rrpw | Hans | Stgr | |
| Nortron | 1.0 | Pre | | | | | | |
| Roundup Original Max + AMS | 0.75 | 2TL | | | | | | |
| Roundup Original Max + Dual Magnum + AMS | 0.75 + 1.0 | 4TL | | | | | | |
| Roundup Original Max + AMS | 1.12 | 10TL | 99 | 98 | 99 | 99 | 99 | 98 |
| Roundup Original Max + AMS | 0.75 | 2TL | | | | | | |
| Roundup Original Max + AMS | 0.75 | 6TL | 97 | 0 | 82 | 90 | 42 | 62 |
| Nortron | 1.0 | Pre | | | | | | |
| Roundup Original Max + AMS | 0.75 | 2TL | | | | | | |
| Roundup Original Max + Outlook + AMS | 0.75 + 0.66 | 4TL | | | | | | |
| Roundup Original Max + AMS | 1.12 | 10TL | 99 | 95 | 99 | 99 | 99 | 98 |
| Betamix + Upbeet + Stinger + Scoil | 0.08 + 0.004 + 0.02 | Cot | | | | | | |
| Roundup Original Max + AMS | 0.75 | 2TL | | | | | | |
| Betamix + Upbeet + Stinger + Scoil | 0.08 + 0.004 + 0.02 | 4TL | | | | | | |
| Betamix + Upbeet + Stinger + Scoil | 0.08 + 0.004 + 0.02 | 6TL | | | | | | |
| Roundup Original Max + AMS | 1.12 | 10TL | 99 | 90 | 96 | 99 | 87 | 94 |
| Roundup Original Max + AMS | 0.75 | 2TL | | | | | | |
| Roundup Original Max + Dual Magnum + AMS | 0.75 + 1.0 | 4TL | | | | | | |
| Roundup Original Max + Dual Magnum + AMS | 0.75 + 1.0 | 8TL | 99 | 98 | 99 | 99 | 99 | 98 |
| LSD at 0.05 | -- | -- | 1 | 25 | 3 | 3 | 40 | |