# BETAMIX®, PROGRESS®, AND BETANEX® FORMULATIONS FOR WEED CONTROL IN SUGAR BEET

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## Introduction

Pressure from the U.S. Environmental Protection Agency to remove one of the carriers from the current formulations of Betamix, Progress, and Betanex has lead Aventis to produce formulations of these products that use a plant-based oil as a carrier. These oil-based formulations need to be compared to current formulations to determine if sugar beet tolerance and weed control efficacy are similar.

## Methods

Experimental oil-based formulations of Progress (AE B049913), Betamix (AE B038584), and Betanex (AE B038107) were compared to commercial formulations for sugar beet tolerance and weed control efficacy.

This trial was established at the Malheur Experiment Station under furrow irrigation on April 8, 2002. Sugar beets (Hilleshog 'PM-21') were planted in 22-inch rows at a 2-inch seed spacing. After planting, the trial was corrugated and Counter 20 CR was applied in a 7-inch band over the row at 6 oz/1,000 ft of row. Sugar beets were thinned to 8-inch spacings on May 6 and 7. Plots were sidedressed on May 22 with 150 lb N/acre as urea. All plots were treated with Roundup (0.75 lb ai/acre) prior to sugar beet emergence. On May 13, Temik 15G (10 lb/acre) was applied for sugar beet root maggot control. For powdery mildew control, Super-Six liquid sulfur was applied on June 20 and August 14, sulfur dust (30 lb/acre) was applied July 23, and Laredo fungicide was applied on July 11. All fungicide treatments were applied by air. Herbicide treatments were broadcast applied with a $CO_2$-pressurized backpack sprayer calibrated to deliver 20 gal/acre at 30 psi. Plots were four rows wide and 27 ft long and treatments were arranged in a randomized complete block design with four replicates.

Experimental and commercial formulations of Progress, Betamix, and Betanex were applied alone at 4.0 oz ai/acre and in a micro-rate at 1.28 oz ai/acre with UpBeet (0.063 oz ai/acre), Stinger (0.5 oz ai/acre), and Scoil (methylated seed oil) (1.5 percent v/v). The experimental and commercial formulations were applied alone three times with the first application to cotyledon beets, the second to two-leaf beets, and the third to six-leaf beets. The applications were made on April 22, May 2, and May 13. The micro-rate treatments were applied four times with the first application to cotyledon beets on April 22, two-leaf beets on April 29, four-leaf beets on May 4, and six-leaf beets on May 13.

Sugar beet injury and weed control were evaluated throughout the season. Sugar beet yields were determined by harvesting the center two rows of each plot on October 8 and 9. Root yields were adjusted to account for a 5 percent tare. One sample of 16 beets was taken from each plot for quality analysis. The samples were coded and sent to Hilleshog Mono-Hy Research Station in Nyssa, Oregon, to determine beet pulp sucrose content and purity. Sucrose content and recoverable sucrose were estimated using empirical equations. Data were analyzed using analysis of variance procedures and means were separated using protected LSD at the 95 percent confidence interval (P = 0.05).

## Results and Discussion

Sugar beet injury ranging from 23 to 31 percent was observed on May 10 prior to the last herbicide application for both the micro-rate and standard-rate programs (Table 2). On May 20 (7 days after treatment [DAT]), the commercial formulation of Betamix provided greater crop injury compared with both the commercial and experimental Progress formulations applied as a micro-rate, Betamix applied as a micro-rate, Betanex applied alone as a standard, and both the commercial and experimental Betanex formulations applied as a micro-rate. The experimental formulation of Betamix applied three times at standard rates provided greater crop injury 18 DAT than micro-rate treatments including either the commercial or experimental formulations of Progress or Betanex. The experimental formulations displayed similar injury compared to their respective commercial formulations when applied in a micro-rate with UpBeet, Stinger, and Scoil or when applied three times at standard rates. Sugar beet injury was not significant on June 24.

Pigweed species (i.e., Powell amaranth and redroot pigweed) and common lambsquarters control was similar between the commercial and experimental formulations whether applied alone or in the micro-rate treatment (Table 1). Hairy nightshade control was significantly greater with the commercial Betamix formulation compared to the experimental formulation. Kochia control was significantly (P = 0.1) greater with the commercial Progress and Betanex formulations, providing 19 and 21 percent greater kochia control than their respective experimental formulations.

Sugar beet root yields were similar with the experimental oil-based formulations compared to their respective commercial formulations (Table 2). Sugar beet root yields ranged from a low of 23 ton/acre with the experimental oil-based formulation of Progress applied alone to a high of 39.1 ton/acre with the micro-rate treatment containing the experimental Betanex formulation. Root yield with the experimental Betanex formulation was 9.2 ton/acre less than the commercial Betanex formulation. This difference in root yield is most likely due to decreased kochia control received from this treatment (Table 1).

Table 1. Sugar beet injury and yield with experimental and commercial Progress, Betamix, and Betanex formulations, Malheur Experiment Station, Oregon State University, Ontario, OR, 2002.

| Treatment* | Rate | Timing† | Sugar beet injury 5-10 | 5-20 | 6-01 | 6-24 | Sugar beet stand | Sugar beet yield |
|---|---|---|---|---|---|---|---|---|
| | oz ai/acre | Crop stage | % | | | | 1,000/acre | ton/acre |
| Exp. Progress<br>Exp. Progress<br>Exp. Progress | 4.0<br>5.2<br>5.2 | Cot<br>2-leaf<br>6-leaf | 26 | 24 | 15 | 3 | 38.9 | 23.0 |
| Progress<br>Progress<br>Progress | 4.0<br>5.2<br>5.2 | Cot<br>2-leaf<br>6-leaf | 25 | 26 | 14 | 6 | 36.6 | 27.7 |
| Exp. Progress + UpBeet + Stinger + Scoil | 1.28 + 0.063 + 0.5 + 1.5% v/v | Cot, 2, 4, 6-leaf | 25 | 21 | 8 | 0 | 39.4 | 36.2 |
| Progress + UpBeet + Stinger + Scoil | 1.28 + 0.063 + 0.5 + 1.5% v/v | Cot, 2, 4, 6-leaf | 26 | 20 | 3 | 0 | 41.0 | 36.4 |
| Exp. Betamix<br>Exp. Betamix<br>Exp. Betamix | 4.0<br>5.2<br>5.2 | Cot<br>2-leaf<br>6-leaf | 31 | 25 | 17 | 6 | 40.0 | 25.7 |
| Betamix<br>Betamix<br>Betamix | 4.0<br>5.2<br>5.2 | Cot<br>2-leaf<br>6-leaf | 29 | 29 | 15 | 7 | 39.7 | 30.4 |
| Exp. Betamix + UpBeet + Stinger + Scoil | 1.28 + 0.063 + 0.5 + 1.5% v/v | Cot, 2, 4, 6-leaf | 25 | 23 | 14 | 3 | 40.0 | 35.2 |
| Betamix + UpBeet + Stinger + Scoil | 1.28 + 0.063 + 0.5 + 1.5% v/v | Cot, 2, 4, 6-leaf | 23 | 20 | 8 | 3 | 38.9 | 36.5 |
| Exp. Betanex<br>Exp. Betanex<br>Exp. Betanex | 4.0<br>5.2<br>5.2 | Cot<br>2-leaf<br>6-leaf | 28 | 23 | 16 | 5 | 39.5 | 25.6 |
| Betanex<br>Betanex<br>Betanex | 4.0<br>5.2<br>5.2 | Cot<br>2-leaf<br>6-leaf | 25 | 19 | 11 | 5 | 40.6 | 34.8 |
| Exp. Betanex + UpBeet + Stinger + Scoil | 1.28 + 0.063 + 0.5 + 1.5% v/v | Cot, 2, 4, 6-leaf | 26 | 21 | 6 | 2 | 40.0 | 39.1 |
| Betanex + UpBeet + Stinger + Scoil | 1.28 + 0.063 + 0.5 + 1.5 % v/v | Cot, 2, 4, 6-leaf | 25 | 21 | 6 | 1 | 40.5 | 37.2 |
| Untreated control | -- | -- | 0 | 0 | 0 | 0 | 33.0 | 1.8 |
| LSD (0.05) | | | 7 | 7 | 9 | NS | 3.4 | 7.5 |

*Experimental Progress, Betamix, and Betanex formulations are oil-based.

†Micro-rate applications were applied to cotyledon (Cot) sugar beets on April 22, two-leaf (2-leaf) beets on April 29, four-leaf (4-leaf) beets on May 4, and to six-leaf (6-leaf) sugar beets on May 13, 2002. Standard-rate applications were made on April 22, May 2, and May 13 to cotyledon, two-leaf, and six-leaf sugar beets, respectively.

Table 2. Weed control with experimental and commercial Progress, Betamix, and Betanex formulations, Malheur Experiment Station, Oregon State University, Ontario, OR, 2002.

| | | | Weed control[§] | | | |
|---|---|---|---|---|---|---|
| | | | Pigweed spp.[‡] | Common lambsquarters | Hairy nightshade | Kochia |
| Treatment* | Rate | Timing[†] | 41 DAT | | | |
| | oz ai/acre | Crop stage | % | | | |
| Exp. Progress<br>Exp. Progress<br>Exp. Progress | 4.0<br>5.2<br>5.2 | Cot<br>2-leaf<br>6-leaf | 77 fg | 93 | 90 bc | 72 c |
| Progress<br>Progress<br>Progress | 4.0<br>5.2<br>5.2 | Cot<br>2-leaf<br>6-leaf | 73 g | 90 | 90 bc | 91 abc |
| Exp. Progress + UpBeet + Stinger + Scoil | 1.28 + 0.063 + 0.5 + 1.5% v/v | Cot, 2, 4, 6-leaf | 88 bcd | 90 | 93 abc | 95 ab |
| Progress + UpBeet + Stinger + Scoil | 1.28 + 0.063 + 0.5 + 1.5% v/v | Cot, 2, 4, 6-leaf | 88 cde | 91 | 90 bc | 94 ab |
| Exp. Betamix<br>Exp. Betamix<br>Exp. Betamix | 4.0<br>5.2<br>5.2 | Cot<br>2-leaf<br>6-leaf | 81 efg | 93 | 75 d | 87 abc |
| Betamix<br>Betamix<br>Betamix | 4.0<br>5.2<br>5.2 | Cot<br>2-leaf<br>6-leaf | 84 def | 94 | 89 bc | 95 ab |
| Exp. Betamix + UpBeet + Stinger + Scoil | 1.28 + 0.063 + 0.5 + 1.5% v/v | Cot, 2, 4, 6-leaf | 92 abc | 98 | 97 a | 85 abc |
| Betamix + UpBeet + Stinger + Scoil | 1.28 + 0.063 + 0.5 + 1.5% v/v | Cot, 2, 4, 6-leaf | 87 cde | 93 | 93 abc | 98 a |
| Exp. Betanex<br>Exp. Betanex<br>Exp. Betanex | 4.0<br>5.2<br>5.2 | Cot<br>2-leaf<br>6-leaf | 88 cde | 98 | 84 cd | 73 bc |
| Betanex<br>Betanex<br>Betanex | 4.0<br>5.2<br>5.2 | Cot<br>2-leaf<br>6-leaf | 92 abc | 92 | 86 c | 94 abc |
| Exp. Betanex + UpBeet + Stinger + Scoil | 1.28 + 0.063 + 0.5 + 1.5% v/v | Cot, 2, 4, 6-leaf | 94 ab | 95 | 95 ab | 96 ab |
| Betanex + UpBeet + Stinger + Scoil | 1.28 + 0.063 + 0.5 + 1.5 % v/v | Cot, 2, 4, 6-leaf | 94 a | 93 | 96 a | 91 ab |
| Untreated control | -- | -- | 0 h | 0 | 0 e | 0 d |
| LSD (0.05) | | | -- | 8 | -- | -- |

*Experimental Progress, Betamix, and Betanex formulations are oil-based.
[†]Micro-rate applications were applied to cotyledon (Cot) sugar beets on April 22, two-leaf (2-leaf) beets on April 29, four-leaf (4-leaf) beets on May 4, and to six-leaf (6-leaf) sugar beets on May 13, 2002. Standard-rate applications were made on April 22, May 2, and May 13, to cotyledon, two-leaf, and six-leaf sugar beets, respectively.
[‡]Pigweed species were predominantly Powell amaranth mixed with some redroot pigweed.
[§]Where letter designations occur the ANOVA was performed on arcsine square root percent transformed data. Transformed mean separation applied to non-transformed data.