

**2017 Final Report**

**Evaluation of Integrated Strategies to Manage Herbicide Resistant Weeds in Soybean**

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**Palmer Amaranth Trials**

Herbicide trials for residual control of Palmer amaranth were conducted at two locations in Southern Maryland, one in Charles County near the town of Newburg and the second in St. Mary’s County near the town of Mechanicsville. Both sites had a heavy infestation of glyphosate and ALS resistant Palmer amaranth the preceding crop year. Fifteen treatments were evaluated in the trial as represented by the chart below. Each location utilized a complete block randomized design with four replications. The plot treatment area consisted of 12 rows (15 feet) by 30 feet long. Counts of Palmer amaranth were taken from the middle 4 rows of each plot, which represented an actual area of 150 square feet (5 feet by 30 feet). The number of emerged Palmer plants was recorded from individual plots starting 10 days after treatment and every 7 days thereafter. The average height of the five tallest Palmer amaranth plants in each plot was also recorded. Data was analyzed using an ANOVA and t-test for significant differences at the 0.05 confidence level.

The Charles County site was planted as full season soybeans on May 9 using a no-till planter on 15 inch rows with Asgrow AG47X6 Roundup Ready2 Xtend seed. The preceding crop was corn with a heavy infestation of Palmer amaranth. The soil type was Dodon fine sandy loam. Gramoxone SL was applied at 2 pints/acre on May 10th to terminate all existing vegetation and residual products were applied May 11th. A delayed post residual application of Dual was made to selected plots on May 31st. All plots received an application of glyphosate on May 31st. A rescue application of Xtendimaxx was applied July 13th to all plots to terminate Palmer amaranth and reduce seed pressure for the next year.

The St. Mary’s County site was planted in double crop soybeans following wheat on June 29th using a no-till planter on 15 inch rows with Asgrow AG47X6 Roundup Ready2 Xtend seed. The preceding crop was corn with a heavy infestation of Palmer amaranth. The soil type was Othello silt loam. Gramoxone SL was applied at 2 pints/acre June 30th to terminate all existing vegetation and residual products were applied July 1. A delayed post-emergence residual application of Dual was made to selected plots on July 24th. All plots received an application of glyphosate on July 24th as well. A rescue application of Xtendimaxx was applied September 25th to all plots to terminate Palmer amaranth and reduce seed pressure for the next year.

Table 1: Herbicide Treatments

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| **Treatment #** | **Treatment and Rate** | **Common Name** | **Equivalent To** |
| 1 | Control |  |  No herbicide applied |
| 2 | 4 oz Canopy | (metribuzin + chlorimuron) | 3.43 ozs metribuzin 75DF1.71 ozs Classic |
| 3 | 3 oz Valor SX +1.33 pts Dual Magnum(Off Label-Research use only) | (flumioxazin + s-metachlor) | 3 oz Valor SX1.33 pts Dual Magnum |
| 4 | 3 oz Valor SX | (flumioxazin) | 3 oz Valor SX |
| 5 | 4 oz Authority XL | (sulfentrazone + chlorimuron) | 5 oz Spartan 1.25 ozs Classic |
| 6 | 25 oz BroadAxe XC | (sulfentrazone + s-metolachlor) | 5.5 oz Spartan 1.47 pts Dual Magnum |
| 7 | 1.25 pts Boundary | (s-metolachlor + metribuzin) | .82 pints Dual Magnum4.2 ozs Metribuzin 75DF |
| 8 | 4 oz Dimetric | (metribuzin) | 4.0 ozs Metribuzin 75DF |
| 9 | 1.5 pts Prowl H2O | Pendimethalin | 1.5 pts Prowl H2O |
| 10 | 3.75 oz Fierce | (flumioxazin + pyroxasulfone) | 2.5 oz Valor SX 1.9 ozs Zidua |
| 11 | 4 oz Fierce XLT | (flumioxazin + pyroxasulfone + chlorimuron) | 1.91 oz Valor SX 1.49 ozs Zidua1.06 oz Classic |
| 12 | 25 oz BroadAxe XC(1.33 pts Dual 21 Days Post) | (sulfentrazone + s-metolachlor) | 5.5 oz Spartan 1.47 pts Dual Magnum |
| 13 | 3.75 oz Fierce(1.33 pts Dual 21 Days Post) | (flumioxazin + pyroxasulfone) | 2.5 oz Valor SX 1.9 ozs Zidua |
| 14 | 1.25 pts Boundary Pre(1.33 pts Dual 21 Days Post) | (s-metolachlor + metribuzin) | .82 pints Dual Magnum4.2 ozs Metribuzin 75DF |
| 15 | 1.5 pts Prowl H2O + 4 oz Dimetric(1.33 pts Dual 21 Days Post) | (pendimethalin + metribuzin) | 1.5 pints Prowl H2O4 ozs Metribuzin 75DF |

Results from the 2017 trial are consistent with findings in 2015 and 2016. The trials indicate significantly better control of Palmer amaranth with the use of any residual product when compared to a non-treated control. Prowl, Dimetric, and Prowl plus Dimetric provided 1-2 weeks of control, Boundary and Canopy provided 2-3 weeks of control and Fierce, Fierce XLT, Authority XL, and BroadAxe XC provided 3-5 weeks of control. The trial did not show significant differences between treatments that received an additional post-emergence application of the residual herbicide Dual. Results are shown in Figures 1 and 2.

The use of residual products also provided a longer time-frame for the timely and thus effective application of post-emergent herbicides. The trials show that a post-emergent herbicide treatment needs to be applied within 28 days of planting to achieve reliable control. Waiting beyond 28 days will result in emerged Palmer amaranth plants that are larger than the 3-4 inch height limit for post-emergent herbicides. If no residual herbicide is used, the post-emergent treatments need to be applied within 14 days, and season long control is very unlikely.

**Common Ragweed Trials**

An herbicide trial for evaluating residual pre-emergent herbicides for control of common ragweed was established near the town of Chaptico in St. Mary’s County. The trial was conducted at a location with a heavy infestation of ALS and Glyphosate resistant common ragweed the previous year. Seven treatments with potential activity on common ragweed were evaluated including the herbicides Linex, Command, Dimetric, Valor, and combinations thereof, as illustrated in Table 2. The trial utilized a complete block randomized design with four replications. The plot treatment area consisted of 6 rows 30 inches wide (15 feet) by 30 feet long. Counts of common ragweed were taken from the middle 2 rows of each plot which represented an actual area of 150 square feet (5 feet by 30 feet). The number of emerged common ragweed plants was recorded from individual plots starting 14 days after treatment and every 7 days thereafter. The average height of the five tallest ragweed plants in each plot was also recorded. Data was analyzed using an ANOVA and t-test for significant differences at the 0.05 confidence level.

The field was planted as full season soybeans on June 9th using a no-till planter on 30 inch rows with Roundup Ready 2 Yield seed. The soil type was Woodstown sandy loam. The preceding crop was full season soybeans with a heavy infestation of ALS and Glyphosate resistant common ragweed. The cover crop was terminated on April 15th with an application 1 quart of glyphosate and 1 pint of 2,4-D. Gramoxone SL was applied May 15th as a final burndown before planting. Extended rains and wet soil conditions prevented planting until June. Gramoxone SL was applied again at 3 pints/acre on June 9th to terminate all existing vegetation and residual products were applied June 10th.

Results are presented in Figure 3. The trial indicates significantly better control of common ragweed with the use of any residual product when compared to a non-treated control. Treatments that utilized more than one effective mode of action provided better control then single mode of action treatments. Products containing the active ingredients linuron, metribuzin, and flumioxazin performed best. Command (clomazone) performed significantly better than the control, but was not as effective as other products. There was some plant stunting and phytotoxicity observed on plots treated with Linex plus Dimetric.

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| Table 2: 2017 Ragweed Pre-emergent Herbicide Trial |
| **Treatment #** | **Treatment and Rate** | **Common Name** | **Equivalent To** |
| 1 | Control |  |  No herbicide applied |
| 2 | 1.5 pts Linex 4L | (linuron) | 1.5 pts Linex 4L |
| 3 | 4 oz Dimetric | (metribuzin) | 4.0 ozs Metribuzin 75DF |
| 4 | 3 oz Valor SX | (flumioxazin) | 3 oz Valor SX |
| 5 | 2.66 pts Command | (clomazone) | 2.66 pts Command |
| 6 | 2.66 pts Command plus 4 oz Dimetric | (clomazone + metribuzin) | 2.66 pts Command4.0 ozs Metribuzin 75DF |
| 7 | 2.66 pts Command plus 1.5 pts Linex 4L | (clomazone + linuron) | 2.66 pts Command1.5 pts Linex 4L |
| 8 | .75 pts Linex 4L plus 4 oz Dimetric | (linuron + metribuzin) | .75 pts Linex 4L4.0 ozs Metribuzin 75DF |
| 9 | 3 oz Valor SX plus4 oz Dimetric | (flumioxazin + metribuzin) | 3 oz Valor SX4.0 ozs Metribuzin 75DF |
| 10 | 3.75 oz Fierce | (flumioxazin + pyroxasulfone) | 2.5 oz Valor SX 1.9 ozs Zidua |

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Sample Abstract:

 Herbicide resistance continues to be a major concern for Maryland soybean growers, particularly with ALS and Glyphosate herbicide resistant Palmer amaranth (*Amaranthus palmeri*), common ragweed (*Ambrosia artemisiifolia*) and marestail (*Conyza canadensis*). On-farm replicated research trials conducted at two locations during the 2015, 2016, and 2017 seasons evaluated the efficacy of fifteen pre-emergent herbicide treatments for control of Palmer amaranth. A complete block randomized design with four replications was utilized on a field location with a heavy infestation of glyphosate and ALS resistant Palmer amaranth the preceding crop year. The number of emerged Palmer plants was recorded from individual plots starting 10 days after treatment and every 7 days thereafter. Height data from the 5 largest Palmer plants in each plot was also recorded. Data was analyzed using an ANOVA and t-test for significant differences at the 0.05 confidence level. Results indicate significantly better control of Palmer amaranth with the use of any residual product when compared to a non-treated control. Residual products varied in the length of control provided from two to six weeks. Products with the active ingredient flumioxazin including premixes of Fierce or Fierce XLT or products with the active ingredient sulfentrazone including premixes such as Broadaxe or Authority XL provided the most consistent control. Residual herbicides also resulted in significant differences in weed height over the length of the season. This is especially advantageous in that it provides a longer time-frame for the timely and thus effective application of post-emergent herbicides. Field demonstration days were conducted each year at the trial locations to demonstrate trial results, weed identification and management techniques.