

SUGAR BEET RESPONSE TO DUAL MAGNUM[®] AND EPTAM[®] APPLIED EARLY FALL (OF THE YEAR PRECEDING SUGAR BEET) IN REDUCED TILLAGE FIELDS TO CONTROL YELLOW NUTSEDGE

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Introduction

Weed control is an important component of sugar beet production. One of the most problematic weeds in some Treasure Valley fields is yellow nutsedge. Yellow nutsedge presents a production challenge particularly if not effectively managed in all crops grown in a rotation. The current Dual Magnum (*s*-metolachlor) herbicide label allows only post emergence application after sugar beets are at the first true leaf stage, and at that time yellow nutsedge may have already emerged. However, Dual Magnum being a pre-emergence herbicide does not control weeds that have already emerged including yellow nutsedge. Therefore, the use of Dual Magnum and Outlook (dimethenamid-p) as post emergence herbicides tank mixed with glyphosate has largely failed to reduce yellow nutsedge in sugar beet fields.

Additionally, some growers in eastern Oregon and southwestern Idaho have moved to exclude moldboard plowing for fields intended for sugar beet production as a measure to minimize soil erosion, improve soil structure and reduce field operations. The trend is to disk the fields coming out of wheat, fumigate, and form beds at an appropriate time during fall. Removal of moldboard plowing could result in increased buildup of yellow nutsedge.

The study evaluated the response of sugar beet and the level of yellow nutsedge control when Dual Magnum alone or tank-mixed with Eptam (EPTC) herbicide is applied in reduced tillage conditions during the fall preceding sugar beet.

Materials and Methods

A three-year field study was initiated during fall 2019 and repeated in 2020 and 2021 with sugar beet seeded during spring of the following year. During each fall, the wheat stubble was flailed, the field irrigated, and after drying several disk passes were made, and the field groundhugged to create a seedbed favorable for sugar beet growth. In all years the fields were furrow irrigated after herbicides were applied and disked as needed for particular treatments. Fertilizer was broadcasted during the previous fall and during spring of the crop season based on soil test results. The study area was fumigated using Telone C-35 at 13 gal/acre during fall 2019, 2020, and 2021.

Fall fertilizer was broadcast applied as determined by soil tests to supply deficient nutrients (N, P, K, Zn, and B). Important field operations are presented in Table 1. Plant stand counts, yellow nutsedge control (0-100% scale) were conducted on the dates shown in Table 2. Other production practices followed local recommended practices.

Data were subjected to analysis of variance and the treatment means were compared using protected LSD at the 0.05% level of confidence.

Table 1. Design and methodology quick facts.

| Operation | 2019/2020 | 2020/2021 | 2021/2022 |
|-------------------------------|------------|--------------------|------------|
| Disk, groundhog, plow, beds | 9/6/2019 | 10/9 to 10/12/2020 | 9/13/2021 |
| Fall Herbicides applied | 9/6/2019 | 9/24/2020 | 9/27/2021 |
| Fumigated | 10/22/2019 | 10/25/2020 | 11/29/2021 |
| Sugar beet BTS 251 RR planted | 4/8/2020 | 4/5/2021 | 4/8/2022 |
| Herbicide sprays | | | |
| Pre-emergence treatments | 4/9/2020 | 4/9/2021 | 4/20/2022 |
| 2-leaf stage | 5/1/2020 | 5/12/2021 | 5/13/2022 |
| 6- to 8-leaf stage | 6/3/2020 | 6/7/2021 | 6/6/2022 |
| Harvested | 9/24/2020 | 9/24/2021 | 9/19/2022 |

Results and Conclusions

2019/2020 study. After all field operation during fall 2019, a considerable amount of wheat residue was still visible on the soil surface. As a result, there was staggered sugar beet emergence during spring 2020 with different cohorts appearing overtime (Figure 1). On May 6, 2020, plant stand ranged from 38,235 to 41,428 plants/acre across Dual Magnum or Dual Magnum + Eptam herbicide treatments, compared to 40,091 plants/acre for fumigation alone or 38,903 plants/acre for Roundup + Outlook herbicides (Table 2). In the end, plant stand was similar across the treatments and ranged from 43,655 to 47,144 plants/acre. No visible sugar beet injury was observed from Dual Magnum herbicide applied the previous fall or prior to emergence (data not shown). Yellow nutsedge control was >91% across herbicide treatments (Table 2). Root yield ranged from 48.2 to 52.7 tons/acre across herbicide treatments compared to 36.2 tons/acre for the fumigation only and 51.1 tons/acre for Roundup + Outlook treatments. Sugar content was similar across treatments and ranged from 14.05 to 14.42% across fall-applied Dual Magnum treatments compared to 13.58% for fumigation only. Similarly, the estimated recoverable sugar (ERS) and conductivity were not affected by fall-applied herbicides. These results suggested effective yellow nutsedge control with Dual Magnum applied the previous fall. However, the influence of prevailing weather during winter and spring 2020 could not be discounted.

2020/2021 study. The weather during winter 2020 and spring 2021 was characterized by dry and warm conditions. Consequently, the soil was considerably dry at the time of sugar beet seeding during spring 2021. Because of dry soil conditions at planting time and water yet to being

released in the irrigation ditches, the study area was immediately drip irrigated using water from a nearby well in order to facilitate sugar beet seed germination and emergence. This was a complete departure from normal local production practices. Though not statistically different, sugar beet plant stand on May 11, 2021 was considerably variable in some herbicide treatments and overall lower than our targeted population (Table 3). Sugar beet emergence was sparse and reduced in some treatments but eventually plants filled the rows. On May 11, the average plant stand ranged from 35,213 to 40,473 plants/acre across Dual Magnum treatments compared to 35,128 plants/acre for the grower standard of Roundup + Outlook at the 2-leaf stage and 37,334 plants/acre with fumigation only (Table 3). Yellow nutsedge control on September 9 was >81% across fall applied Dual Magnum treatments compared to 78% for the grower standard and 0% for fumigation only. Root yield ranged from 42.6 to 52 tons/acre across fall and PRE applied Dual Magnum herbicide treatments compared to 37.1 tons/acre for the fumigation only and 52.3 tons/acre for the grower standard. However, fall applied Dual Magnum at 1.33 pt/acre reduced yield by 18% compared to the grower standard (52.3 tons/acre). In turn, the reduction in yield culminated to lower ERS for fall applied Dual Magnum at 1.33 pt/acre (Table 3). Percent sugar content was similar across all herbicide treatments. These results suggested effective yellow nutsedge control with Dual Magnum applied the previous fall. It was not clear why yield was reduced with Dual Magnum at 1.33 pt/acre and not at 2 pt/acre. Additionally, the influence of prevailing weather during winter 2020 and spring 2021 may have played a role in the observed results.

2021/2022 study. In 2022, sugar beet plant stand ranged from 55,049 to 59,999 plants/acre (Table 4). The lowest stand (55,049 plants/acre) was in plots treated with Dual Magnum at 2 pt/acre during the preceding fall. This treatment resulted in reduced plant stand in two of the three years (2021 and 2022). The common factor between the two years is dry conditions during the preceding winter and dry soil conditions at planting during spring 2021 and 2022. The 2021/2022 field area had a low yellow nutsedge population. In turn, all treatments provided ≥85% yellow nutsedge control (Table 4). There was no difference in root yield across fall applied Dual Magnum treatments and the grower standard of Roundup + Outlook when plants were at the 2-leaf stage. Yield for fumigation only treatment was 8 tons/acre compared to 47.6 to 50.9 tons/acre for fall- and PRE-applied Dual Magnum treatments. Similarly, the sugar content was 13.85% to 14.49% across fall-applied Dual Magnum treatments, compared to 12.71% for fumigation only. The lowest percent sugar content among the fall-applied treatments was when Dual Magnum at 0.5 pt/acre was applied PRE followed by Dual Magnum at 1 pt/acre + Roundup at 2 pt/acre at 2-leaf stage (13.85%). This treatment resulted in reduced percent sugar, which incidentally was similar to the grower standard of Roundup at 32 fl oz/acre tank-mixed with Outlook at 21 fl oz/acre at 2-leaf stage (Table 4). In turn, the ERS was reduced when Dual Magnum 0.5 pt/acre PRE was followed by an in-season Dual Magnum at 1 pt/acre at the 2-leaf stage (224.2 lb/ton) compared to 229.7 to 237.7 lb/ton for the other fall applied Dual Magnum treatments. It is not clear why PRE application of Dual Magnum at 0.5 pt/acre followed by POST at 1 pt/acre affected the percent sugar content and ERS while PRE application of Dual Magnum at 1.33 pt/acre did not. It is possible the low solubility for Dual Magnum played a role in these results with PRE at 1.33 pt/acre not completely dissolved in the soil by the time sugar beet emerged and the roots grew below the treated soil layer.

Conclusions

- Fall-applied Dual Magnum in reduced till conditions did not result in sugar beet injury and improved yellow control compared to in-season Roundup + Outlook herbicides.
- Results for fall-applied Dual Magnum varied by year and was possibly influenced by the weather conditions during the preceding winter and the spring of sugar beet seeding year. Given the recent trend of mild winters, warm and reduced precipitation during spring, fall-applied Dual Magnum at rates higher than 1 pt/acre could result in reduced yield in some years.
- These results apply only to medium textured soils (silt loam), and the response of sugar beet planted in lighter soil fields is not known.

Acknowledgements

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Figure 1. Field appearance and sugar beet plant stand on April 29, 2020 (top) in a reduced tillage field at Malheur Experiment Station, Ontario, OR, 2020. Note emergence variability in the bottom picture (bottom).

Table 2. Sugar beet response and yellow nutsedge control in response to Dual Magnum and EPTAM applied the preceding fall at the Malheur Experiment Station, Ontario, OR 2019-2020.

| Treatment ^a | Rate Unit | Growth ^{bc} | Plant population ^d | | Yellow nutsedge control ^d | | | Yield tons/acre | Sugar % | ERS lbs/acre | Nitrate ppm | Conductivity mmhos |
|------------------------|---------------|----------------------|-------------------------------------|-----------|--------------------------------------|-----------|----------|--------------------|------------|-----------------|----------------|-----------------------|
| | | | 5/6/2020 ----- plants/acre ----- | 5/19/2020 | 5/6/2020 | 5/20/2020 | 9/8/2020 | | | | | |
| Fumigation only | | | 40,091 ab | 46773 a | 0 c | 0 d | 0 d | 36.2 b | 13.58 b | 8,036.2 b | 393.32 b | 0.93 a |
| Dual Magnum | 1.0 pt/acre | FALL | 38,235 b | 44397 a | 99 a | 98 ab | 100 a | 48.2 a | 14.14 a | 11,099.2 a | 376.04 b | 0.96 a |
| Dual Magnum | 1.33 pt/acre | FALL | 41,353 a | 47144 a | 100 a | 99 ab | 100 a | 52.2 a | 14.14 a | 12,094.8 a | 552.02 a | 0.93 a |
| Dual Magnum | 2 pt/acre | FALL | 41,428 a | 43655 a | 100 a | 100 a | 100 a | 50.1 a | 14.22 a | 11,716.6 a | 326.97 b | 0.90 a |
| Dual Magnum | 1.33 pt/acre | FALL | 41,131 ab | 46328 a | 93 ab | 95 abc | 99 ab | 52.4 a | 14.09 a | 12,391.7 a | 445.57 ab | 0.78 a |
| Eptam | 7 pt/acre | FALL | | | | | | | | | | |
| Dual Magnum | 0.5 pt/acre | FALL | 40,982 ab | 46847 a | 83 b | 89 c | 98 ab | 49.5 a | 14.05 a | 11,481.8 a | 405.64 ab | 0.88 a |
| Eptam | 7 pt/acre | FALL | | | | | | | | | | |
| Dual Magnum | 1.0 pt/acre | POST 2LF | | | | | | | | | | |
| Dual Magnum | 1.0 pt/acre | FALL | 39,349 ab | 47144 a | 93 ab | 95 abc | 98 ab | 50.1 a | 14.30 a | 11,916.5 a | 341.86 b | 0.85 a |
| Eptam | 7 pt/acre | FALL | | | | | | | | | | |
| Dual Magnum | 0.5 pt/acre | PRE | 38,606 ab | 46551 a | 93 ab | 92 bc | 91 c | 52.7 a | 14.14 a | 12,096.9 a | 427.97 ab | 0.99 a |
| Dual Magnum | 1.0 pt/acre | POST 2LF | | | | | | | | | | |
| Dual Magnum | 1.33 pt/acre | PRE | 40,314 ab | 45660 a | 83 b | 92 bc | 97 b | 51.0 a | 14.42 a | 11,988.1 a | 390.71 b | 1.00 a |
| Outlook | 21 fl oz/acre | 2-leaf | 38,903 ab | 45066 a | 95 ab | 98 ab | 98 ab | 51.1 a | 14.23 a | 12,151.6 a | 349.54 b | 0.80 a |
| Roundup PowerMax | 32 fl oz/acre | 2-leaf | | | | | | | | | | |
| LSD (P = 0.05) | | | 2,923 | NS | 13 | 7 | 3 | 5.1 | 0.44 | 1,569.8 | 153.12 | 0.23 |
| Treatment Prob>F | | | 0.0232 | 0.0832 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0610 | 0.0003 | 0.1929 | 0.6848 |

^a All treatments (except the fumigated only) were sprayed with Roundup PowerMax 32 fl oz/acre (glyphosate 1.12 lb ae/acre) plus Class Act NG 48 fl oz/acre when sugar beet plants were at the 2- and 6- to 8-leaf stages.

^b Operations for treatments 2 to 5 = disk the stubble/groundhog/remake furrows/spray herbicides/disk/irrigate. Treatments 6 and 7= disk the stubble/groundhog/remake furrows/disk/spray herbicides/disk/irrigate.

^c Fall treatments were applied 9/6/2019; PRE = Preemergence on 5/1/2020; POST 2-leaf on 5/13/2020; and 6- to 8-leaf on 6/8/2020.

^d Means within a column followed by the same letter are not significantly different (P = 0.05, LSD).

^e Abbreviations: ERS = Estimated Recoverable Sugar; ppm = parts per million; mmhos = root conductivity in millimhos per centimeter.

Table 3. Sugar beet response and yellow nutsedge control in response to Dual Magnum and EPTAM applied the preceding fall (2020) at the Malheur Experiment Station, Ontario, OR 2020-2021.

| Treatment ^a | Rate | Unit | Timing ^{bc} | Plant population plants/acre | Yellow nutsedge control ^d | | | Yield tons/acre | Sugar % | ERS lbs/acre | Nitrate ppm | Conductivity mmhos |
|------------------------|------|------------|----------------------|---------------------------------|--------------------------------------|-----------|----------|--------------------|------------|-----------------|----------------|-----------------------|
| | | | | | 5/2/2021 | 5/26/2021 | 9/8/2021 | | | | | |
| Fumigation only | | | | 37,334 a | 0 g | 0 e | 0 f | 37.1 c | 13.88 a | 8,078.5 d | 477.50 a | 1.16 ab |
| Dual Magnum | 1.0 | pt/acre | FALL | 35,213 a | 75 cd | 78 bc | 78 cd | 47.3 ab | 13.65 a | 9,354.5 bcd | 389.85 a | 1.57 a |
| Dual Magnum | 1.33 | pt/acre | FALL | 35,806 a | 74 de | 78 bc | 79 bcd | 42.6 bc | 13.61 a | 9,024.8 cd | 459.98 a | 1.20 ab |
| Dual Magnum | 2 | pt/acre | FALL | 33,176 a | 90 a | 89 a | 94 a | 49.5 ab | 13.50 a | 10,508.9 abc | 511.25 a | 1.17 ab |
| Dual Magnum | 1.33 | pt/acre | FALL | 37,419 a | 81 b | 81 b | 85 b | 52.0 a | 13.37 a | 10,637.9 abc | 481.09 a | 1.31 ab |
| Eptam | 7 | pt/acre | FALL | | | | | | | | | |
| Dual Magnum | 0.5 | pt/acre | FALL | 36,570 a | 68 f | 71 d | 69 e | 47.9 ab | 13.46 a | 10,045.9 a-d | 394.08 a | 1.20 ab |
| Eptam | 7 | pt/acre | FALL | | | | | | | | | |
| Dual Magnum | 1.0 | pt/acre | POST 2LF | | | | | | | | | |
| Dual Magnum | 1.0 | pt/acre | FALL | 35,891 a | 76 cd | 80 bc | 81 bc | 48.7 ab | 13.50 a | 10,422.7 abc | 449.28 a | 1.13 b |
| Eptam | 7 | pt/acre | FALL | | | | | | | | | |
| Dual Magnum | 0.5 | pt/acre | PRE | 40,049 a | 79 bc | 83 b | 74 de | 50.6 a | 13.54 a | 10,669.6 abc | 493.68 a | 1.20 ab |
| Dual Magnum | 1.0 | pt/acre | POST 2LF | | | | | | | | | |
| Dual Magnum | 1.33 | pt/acre | PRE | 40,473 a | 78 bcd | 79 bc | 81 bc | 51.6 a | 13.99 a | 11,384.8 a | 389.79 a | 1.14 ab |
| Outlook | 21 | fl oz/acre | 2-leaf | 35,128 a | 70 ef | 75 cd | 78 cd | 52.3 a | 13.36 a | 11,064.4 ab | 441.88 a | 1.12 b |
| Roundup PowerMax | 32 | fl oz/acre | 2-leaf | | | | | | | | | |
| LSD (P = 0.05) | | | | 11998.4 | 4 | 5 | 7 | 7.9 | 0.75 | 2002.19 | 174.738 | 0.431 |
| Treatment Prob>F | | | | 0.9709 | 0.0001 | 0.0001 | 0.0001 | 0.0116 | 0.7479 | 0.0588 | 0.8258 | 0.0423 |

^a All treatments (except the fumigated only) were sprayed with Roundup PowerMax 32 fl oz/acre (glyphosate 1.12 lb ae/acre) plus Class Act NG 48 fl oz/acre when sugar beet plants were at the 2- and 6- to 8-leaf stages.

^b Operations for treatments 2 to 5 = disk the stubble/groundhog/remake furrows/spray herbicides/disk/irrigate. Treatments 6 and 7 = disk the stubble/groundhog/remake furrows/disk/spray herbicides/disk/irrigate.

^c Fall treatments were applied 9/24/2020; PRE = Preemergence on 4/9/2021; POST 2-leaf on 5/12/2021; and 6- to 8-leaf on 6/7/2021.

^d Means within a column followed by the same letter are not significantly difference (P = 0.05, LSD).

^e Abbreviations: ERS = Estimated Recoverable Sugar; ppm = parts per million; mmhos = root conductivity in millimhos per centimeter.

Table 4. Sugar beet performance and yellow nutsedge control in response to Dual Magnum and EPTAM applied the preceding fall (2021) at the Malheur Experiment Station, Ontario, OR 2021-2022.

| Treatment ^a | Rate | Unit | Timing ^{bc} | Plant population plants/acre | Yellow nutsedge control ^d | | Yield tons/acre | Sugar % | ERS lbs/ton | ERS lbs/acre | Nitrate ppm | Conductivity mmhos |
|------------------------|---------------|------|----------------------|---------------------------------|--------------------------------------|---------------------------|--------------------|------------|----------------|-----------------|----------------|-----------------------|
| | | | | | 6/15/2022 ----- % ----- | 9/7/2022 ----- % ----- | | | | | | |
| Fumigation only | | | | 58,910 ab | 0 d | 0 c | 8.0 b | 12.71 c | 203.5 c | 1,625.8 b | 411.5 a | 1.04 a |
| Dual Magnum | 1.0 pt/acre | | FALL | 59,306 ab | 100 a | 100 a | 48.8 a | 14.49 a | 237.1 a | 11,541.2 a | 346.5 a | 0.95 ab |
| Dual Magnum | 1.33 pt/acre | | FALL | 56,435 ab | 100 a | 100 a | 48.7 a | 14.20 ab | 231.7 ab | 11,291.7 a | 344.5 a | 0.96 ab |
| Dual Magnum | 2 pt/acre | | FALL | 55,049 b | 100 a | 100 a | 47.6 a | 14.11 ab | 229.7 ab | 10,910.6 a | 360.5 a | 0.97 ab |
| Dual Magnum | 1.33 pt/acre | | FALL | 58,217 ab | 100 a | 100 a | 49.0 a | 14.12 ab | 230.0 ab | 11,281.0 a | 427.3 a | 0.97 ab |
| Eptam | 7 pt/acre | | FALL | | | | | | | | | |
| Dual Magnum | 0.5 pt/acre | | FALL | 59,999 a | 100 a | 100 a | 48.9 a | 13.96 ab | 228.7 ab | 11,201.7 a | 353.3 a | 0.93 ab |
| Eptam | 7 pt/acre | | FALL | | | | | | | | | |
| Dual Magnum | 1.0 pt/acre | | POST 2LF | | | | | | | | | |
| Dual Magnum | 1.0 pt/acre | | FALL | 57,722 ab | 100 a | 100 a | 50.9 a | 14.14 ab | 231.2 ab | 11,766.5 a | 434.3 a | 0.95 ab |
| Eptam | 7 pt/acre | | FALL | | | | | | | | | |
| Dual Magnum | 0.5 pt/acre | | PRE | 57,623 ab | 95 b | 98 a | 50.8 a | 13.85 b | 224.3 b | 11,374.1 a | 415.8 a | 0.99 ab |
| Dual Magnum | 1.0 pt/acre | | POST 2LF | | | | | | | | | |
| Dual Magnum | 1.33 pt/acre | | PRE | 59,405 ab | 98 ab | 99 a | 47.3 a | 14.43 ab | 237.7 a | 11,252.1 a | 367.8 a | 0.90 b |
| Outlook | 21 fl oz/acre | | 2-leaf | 59,504 ab | 88 c | 85 b | 50.5 a | 13.94 ab | 226.3 ab | 11,446.3 a | 399.8 a | 0.99 ab |
| Roundup PowerMax | 32 fl oz/acre | | 2-leaf | | | | | | | | | |
| LSD (P = 0.05) | | | | 4,791 | 4.6 | 4.8 | 4.4 | 0.611 | 12.2 | 1,039.9 | 128.7 | 0.11 |
| Treatment Prob>F | | | | 0.0219 | 0.0001 | 0.0001 | 0.0001 | 0.0002 | 0.0004 | 0.0001 | 0.7644 | 0.4961 |

^a All treatments (except the fumigated only) were sprayed with Roundup PowerMax 32 fl oz/acre (glyphosate 1.12 lb ae/acre) plus Class Act NG 48 fl oz/acre when sugar beet plants were at the 2- and 6- to 8-leaf stages.

^b Operations for treatments 2 to 5 = disk the stubble/groundhog/remake furrows/spray herbicides/disk/irrigate. Treatments 6 and 7= disk the stubble/groundhog/remake furrows/disk/spray herbicides/disk/irrigate.

^c Fall treatments were applied 9/27/2021; PRE = Preemergence on 4/20/2022; POST 2-leaf on 5/13/2022; and 6- to 8-leaf on 6/8/2022.

^d Means within a column followed by the same letter are not significantly difference (P = 0.05, LSD).

^e Abbreviations: ERS = Estimated Recoverable Sugar; ppm = parts per million; mmhos = root conductivity in millimhos per centimeter.