# Evaluation of Preemergent Herbicides for Newly Planted Blackberries

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**Public Abstract**

Weed management in blackberry (*Rubus* subspecies *Rubus*) is vitally important to maintain fruit quality and yields. Due to the sensitivity of blackberry to many postemergent herbicides, it is common to rely on preemergent herbicides to prevent weed emergence near blackberry plants. Thus, this study was designed to investigate the response of newly planted blackberries to a selection of preemergent herbicides. Field studies were conducted using 'Ouchita' blackberries transplanted in Fayetteville, AR and in Clarksville, AR. Herbicide treatments included mesotrione (2.25 oz ai/A), flumioxazin (3 oz ai/A), napropamide (4 lb ai/A), *S*-metolachlor (1.42 lb ai/A), pendimethalin (3 lb ai/A), and oryzalin (2.4 lb ai/A). Visual injury ratings indicated that flumioxazin and mesotrione caused injury at 14 and 28 days after treatment (DAT) and that mesotrione was the only herbicide to cause significant injury at 56 and 84 DAT. A significant reduction in blackberry plant heights was observed in plants treated with mesotrione at 56 and 84 DAT. Initially, leaf chlorophyll content was reduced by mesotrione, likely due to the bleaching symptoms of that HPPD-inhibiting herbicide; but the reduction in leaf chlorophyll content was no longer apparent by 84 DAT. Despite no restrictions on the federal label for mesotrione on newly planted blackberries, the level of injury and stunting observed would be unacceptable for commercial production. Repeated applications and yield data from 2022 will compliment the current data set to determine whether yield reduction will result from any herbicide treatments.

**Objectives:**

1. To determine the effect of preemergent herbicide applications on establishment and growth of newly transplanted blackberry plants in AR.
2. To generate data on weed control and crop response that can be utilized for regional recommendations and applications for supplemental labels for herbicides for blackberries grown in the southern region.

**Introduction**

Weeds compete directly with blackberries for water, nutrients, and light. Additionally, weeds may harbor insect pests or prevent air flow, favoring the development of foliar diseases. Current recommendations advise growing blackberries in a weed-free strip at least 4-ft wide to prevent yield loss from completive weeds (Mitchem & Jennings 2020). Weed-free strips allow blackberry plants to grow more vigorously, producing more primocanes and floricanes, and ultimately higher yields and fruit quality (Basinger et al. 2017; Meyers et al. 2014). Weed-free strips are typically maintained through the use of selective herbicides, dormant applications of nonselective herbicides, and preemergent herbicides to prevent weed emergence near blackberry plants. This weed management strategy is

reliable for established blackberry plants; however, very few preeemergent herbicides are registered for use on first year blackberry plantings. The majority of preemergent herbicides are restricted to plants that have been established for more than 1 year (Table 1). New blackberry plantings, where plants are smallest and most vulnerable to weed interference, have the fewest options for chemical weed control. Thus, this proposal is designed to assess tolerance of newly established blackberry plants to several preemergent herbicides.

**Table 1. List of commercially available preemergent herbicides for use in blackberry.**

| Common name | Trade name | WSSA MOA | Label restrictions for application |
|---|---|---|---|
| Dichlobenil | Casoron | 20 | Established plants only |
| Diuron | Karmex | 7 | Established plants only |
| Flumioxazin | Chateau | 14 | No restrictions[1] |
| Halosulfuron | Sandea | 2 | Washington and Oregon only |
| Indaziflam | Alion | 29 | Established plants only |
| Isoxaben | Trellis | 21 | Nonbearing trees/vines |
| Isoxaben + Trifluralin | Snapshot | 21 + 3 | Nonbearing trees/vines |
| Mesotrione | Callisto | 27 | No restrictions[1] |
| Napropamide | Devrinol | 15 | New plantings |
| Norflurazon | Solicam | 12 | Established plants only |
| Oryzalin | Surflan | 3 | Nonbearing trees/vines |
| Pendimethalin | Prowl H2O | 3 | New plantings |
| Rimsulfuron | Grapple | 2 | Established plants only |
| Simazine | Princep | 5 | New plantings |
| S-metolachlor | Dual Magnum | 15 | New plantings[2] |
| Sulfentrazone | Zeus XC | 14 | Established plants only (3 years or more) |
| Sulfentrazone + carfentrazone | Zeus Prime XC | 14 + 14 | Established plants only (2 years or more) |
| Terbacil | Sinbar | 5 | Established plants only |

In perennial cropping systems, preemergent herbicides are used to prevent the germination of weed seeds, ideally causing no negative effects on the established crop. Industry and university research have demonstrated the safety of many preemergent herbicides in established blackberry plantings (Meyers et al. 2015; Peachey et al. 2012). Unfortunately, very little research is available assessing the effects of preemergent herbicides on newly planted blackberries. Thus, there is a critical need to

[1] *Label has no restrictions for 1st year plantings (Anonymous 2018, 2019). Though recommendations are to apply only to plantings established 1 year or more (Mitchem and Jennings 2020).*

[2] *S-metolachlor is registered for use only in Washington and North Carolina, under 24(c) special local needs labels, not available in Arkansas and many other states.*

investigate tolerances of newly planted (i.e. 1st year) blackberries to a selection of herbicides that may be safe for use and merit supplemental labeling.

**Materials and Methods**

Tissue cultured 'Ouchita' blackberries were planted in the spring of 2021 at the Milo J Shult (MJS) Research and Extension Center in Fayetteville, AR, and at the Fruit Research Station (FRS) in Clarksville, AR. Experimental plots measured 8-ft in length with four blackberry plants at 24-inch spacing with a 36-inch gap between plots (in-row) and 8 ft centers (between rows). Six preemegent herbicide treatments were replicated 4 times at each of two locations. Herbicide treatments include oryzalin, pendimethalin, *S*-metolachlor, flumioxazin, napropamide, and mesotrione. Preemergent herbicide applications were made using a $CO_2$-powered backpack sprayer (8002 EVS flat fan nozzles), calibrated to deliver 20 gallons per acre covering a 40-inch swath on each side of the plot. Treatments were applied within 72 hours after planting. Treatments will be repeated in early Spring 2022 on the same plots to assess the cumulative effect of repeat herbicide. Presumably, injury levels will be reduced with larger plants, which will be in the second year of growth, but the cumulative effect of injury will be quantified with yield data.

In the first year, data collected included weed control, crop injury, and primocane and floricane diameters. Crop injury ratings will be assessed relative to a weed-free plot. Weed control ratings of each herbicide were assessed visually by comparing treated plots to the untreated checks. In the second year, data will be collected on fruit number, fruit weight by harvest, and overall fruit weight across two harvests. Season-long weed control is not expected from any of the selected preemergent herbicides. To ensure plantings are not overrun by weeds before the end of the season, row middles were mowed regularly. Once preemergent herbicides have degraded, blanket applications of selected herbicides (e.g., paraquat, fluazifop) were sprayed uniformly on all plots. Weed control ratings will discontinue following blanket applications; however, crop injury ratings will still be assessed.

Blackberry plants were maintained similarly to commercial production regarding fertility and cultural practices. A vertical trellis was be installed for plantings at each site to maintain plant architecture. Pruning occured as commercially practiced to ensure development of lateral buds (Fernandez et al. 2016; Strik et al. 2012). Insecticides and fungicides were applied as needed, following regional recommendations.

Results from this study will be used to guide recommendations for herbicide in new blackberry plantings, including the University of Arkansas Recommended Chemicals for Weed and Brush Control and the Southeast Regional Caneberries Integrated Management Guide (Barber et al. 2020; Mitchem and Jennings 2020). Data will also be used to solicit supplemental labels and 24(c) registrations for promising herbicides in the southern region.

**Results**

*Injury ratings*

Five of the seven selected preemergent herbicides caused little to know visual injury to blackberries, across all rating dates (Table 2). Flumioxazin and mesotrione exhibited minor injury at both locations at 7 and 14 DAT. Flumioxazin symptoms were characterized by necrotic lesions on leaf surfaces, and mesotrione symptoms were primarily comprised of bleached foliage. Flumioxazin symptoms began to subside by 28 DAT and was undistinguishable from the nontreated plants after 42 DAT. In contrast, mesotrione injury became more apparent as time passed. The initial bleaching symptoms subsided after about 4 weeks, but plants remained stunted and had an overall reduced canopy size. Thus, visual symptoms shifted from acute herbicide symptoms to a general reduction ain plant stature, which was corroborated by plant height data (Table 3).

*Plant height and leaf chlorophyll content*

Significant effects of herbicides on blackberry plant heights were detected 14 DAT, but it was not a particularly substantial effect (plants varied by < 2 cm), and no significant herbicide effect at 28 DAT (Table 3). At 56 DAT, blackberry plant heights were significantly reduced in plots treated with mesotrione; no other herbicides had an effect on plant heights at that rating date. At 84 DAT, treatment with mesotrione resulted in the shortest plants at both MJS and FRS. It is worth noting that flumioxazin, *S*-metolachlor, and oryzalin applied in MJS reduced blackberry plant heights relative to the untreated control. The only herbicide that caused any reduction in leaf chlrophyll content was mesotrione (Table 3). At both locations, mesotrione caused significant reductions in leaf chlorophyll content at 14, 28, and 56 DAT. By 84 DAT, no herbicide treatments caused any significant difference in leaf chlorophyll content.

**Discussion**

First year data indicate that mesotrione may not be suitable for application on first year plantings of blackberries, due to extensive crop injury, reduced leaf chlorophyll content and reduced plant height. This aligns with regional recommendations (Mitchem and Jennings 2020), though there are no restrictions on the Callisto® label for first year blackberry plantings (Anonymous 2018). Flumioxazin is another potentially problematic herbicide due to the severity of herbicide symptoms on small plants. Despite the lack of injury symptoms at later evaluation dates, it is likely that the observed injury would be unacceptable for newly planted blackberries. This could be overcome by ensuring that flumioxazin does not come into contact with plant foliage, which would require additional investment in shielded applications or grow tubes. More promising are the results with *S*-metolachlor, napropamide, oryzalin, and pendimethalin, none of which exhibited any crop injury above 5% in the entire trial. It was expected that napropamide and oryzalin would cause little to no injury because these products are already labeled for use in newly planted blackberries. It is promising that no injury was observed in response to *S*-metolachlor, which does not currently have a 24(c) registration for use in blackberries in Arkansas. Lastly, it is encouraging that plants treated with pendimethalin exhibited no injury symptoms. Pendimethalin would be a very valuable new herbicide for registration in blackberries, particularly with the periodic difficulties in acquiring oryzalin in some years.

**Table 2. Summary of visual injury of blackberries treated with preemergent applications of several herbicides applied in Fayetteville, AR and in Clarksville, AR.[z]**

| | Injury rating | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 7 DAT | | 14 DAT | | 28 DAT | | 42 DAT | 56 DAT | 84 DAT | |
| Herbicide[y] | FRS | MJS | FRS | MJS | FRS | MJS | Both | Both | FRS | MJS |
| | % | | | | | | | | | |
| Mesotrione | 6.3 b | 5.0 b | 13.8 a | 10.0 a | 12.5 a | 31.3 a | 55.6 a | 41.3 a | 28.8 a | 57.5 a |
| Flumioxazin | 10.0 a | 10.0 a | 15.0 a | 7.8 ab | 2.5 b | 12.5 b | 2.5 b | 4.4 b | 0.0 b | 2.5 b |
| Napropamide | 0.0 c | 0.0 d | 0.0 b | 0.0 d | 0.0 b | 0.0 c | 0.0 b | 0.6 b | 0.0 b | 1.3 b |
| *S*-metolachlor | 0.0 c | 5.0 b | 0.0 b | 0.0 d | 0.8 b | 0.0 c | 0.0 b | 0.6 b | 0.0 b | 1.3 b |
| Pendimethalin | 0.0 c | 1.3 cd | 1.5 b | 1.3 cd | 0.0 b | 2.5 c | 0.0 b | 0.0 b | 0.0 b | 0.0 b |
| Oryzalin | 0.0 c | 2.5 c | 0.0 b | 4.5 bc | 0.0 b | 5.0 c | 0.6 b | 0.6 b | 0.0 b | 3.8 b |
| Factor | *P value* | | | | | | | | | |
| Herbicide (H) | <.0001 | <.0001 | <.0001 | <.0001 | 0.0011 | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 |
| Location (L) | - | - | - | - | - | - | 0.4820 | 0.4606 | - | - |
| H × L | 0.0004 | | 0.0053 | | 0.0005 | | 0.5279 | 0.4756 | 0.0013 | |

[z]Abbreviations: DAT = days after treatment, FRS = Fruit Research Station (Clarksville, AR), MJS = Milo J. Shult Research and Extension Center (Fayetteville, AR).

[y]Herbicide rates: mesotrione (2.25 oz ai/A), flumioxazin (3 oz ai/A), napropamide (4 lb ai/A), *S*-metolachlor (1.42 lb ai/A), pendimethalin (3 lb ai/A), and oryzalin (2.4 lb ai/A)

**Table 3. Summary of blackberry plant heights and leaf chlorophyll content in response to preemergent herbicides applied in Fayetteville, AR and in Clarksville, AR.[z]**

| | Plant height | | | | | Leaf chlorophyll content | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Herbicide[y] | 14 DAT[z] | 28 DAT | 56 DAT | 84 DAT | | 14 DAT | 28 DAT | 56 DAT | | 84 DAT |
| | Both | Both | Both | FRS | MJS | Both | Both | FRS | MJS | Both |
| | cm | | | | | SPAD | | | | |
| Mesotrione | 11.0 a | 11.7 | 20.6 b | 59.9 b | 78.8 d | 33.38 b | 34.81 b | 35.62 b | 41.93 b | 49.57 |
| Flumioxazin | 9.3 b | 11.9 | 34.4 a | 117.9 a | 132.5 c | 42.23 a | 45.97 a | 44.19 a | 45.01 a | 51.85 |
| Napropamide | 10.9 ab | 13.0 | 39.1 a | 108.4 a | 156.3 ab | 42.87 a | 47.48 a | 46.34 a | 47.33 a | 52.28 |
| *S*-metolachlor | 11.1 a | 19.3 | 39.4 a | 109.8 a | 141.8 bc | 43.30 a | 48.02 a | 44.25 a | 45.18 a | 50.78 |
| Pendimethalin | 11.6 a | 13.3 | 35.9 a | 105.9 a | 147.0 abc | 42.58 a | 48.43 a | 46.13 a | 45.80 a | 51.43 |
| Oryzalin | 11.1 a | 13.6 | 35.4 a | 109.1 a | 134.8 bc | 42.36 a | 50.23 a | 46.48 a | 45.81 a | 52.42 |
| Untreated | 10.9 ab | 12.6 | 35.4 a | 104.1 a | 165.4 a | 43.23 a | 45.89 a | 46.86 a | 47.74 a | 50.59 |
| Factor | *P value* | | | | | | | | | |
| Herbicide (H) | 0.0042 | 0.3748 | <.0001 | 0.0001 | <.0001 | <.0001 | <.0001 | <.0001 | 0.0118 | 0.4224 |
| Location (L) | 0.0158 | 0.2439 | 0.6185 | - | - | 0.2113 | 0.1240 | - | - | 0.0046 |
| H × L | 0.6085 | 0.3995 | 0.3015 | 0.0455 | | 0.9233 | 0.1882 | 0.0452 | | 0.3691 |

[z]Abbreviations: DAT = days after treatment, FRS = Fruit Research Station (Clarksville, AR), MJS = Milo J. Shult Research and Extension Center (Fayetteville, AR).

[y]Herbicide rates: mesotrione (2.25 oz ai/A), flumioxazin (3 oz ai/A), napropamide (4 lb ai/A), *S*-metolachlor (1.42 lb ai/A), pendimethalin (3 lb ai/A), and oryzalin (2.4 lb ai/A)

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