North American Bramble Growers Research Foundation

Grit Weeding to Efficiently Control Weed Populations in Primocane-Fruiting Raspberries

Principal Investigators: Steve Poppe[1], Mary Rogers[2], Frank Forcella[3], Andy Petran[2]

[1] West Central Research and Outreach Center, University of Minnesota, 46352 State Hwy 329, Morris, MN 56267. **Email**: poppesr@umn.edu **Phone:** 320-589-1711 ext. 2121 **Fax:** (320) 589-4870
[2]Department of Horticultural Science, University of Minnesota. 1970 Folwell Avenue, St Paul, MN 55108. **Email:** roge0168@umn.edu (Mary Rogers), petra057@umn.edu (Andrew Petran) **Phone:** 612-624-8871 **Fax:** 612-624-4941
[3]USDA North Central Soil Conservation Research Laboratory, 803 Iowa Avenue, Morris, MN 56267. **Email**: frankforcella@ars.usda.gov **Phone:** 320-585 8427

The demand for organic products in the United States is continuing to increase. According to the 2014 Organic Survey the United States sold a total of $5.5 billion in organic products in 2014, up 72% since 2008. Many organic small fruit and vegetable farms generate high yields and revenue on relatively small parcels of land. For example, national production of organic raspberries totaled only 608 acres of land in 2014, but that land produced 4.8 million lbs. of raspberries generating over $14 million in revenue (USDA, 2015).

The majority of raspberry production takes place in California, Oregon and Washington, but local raspberry growers can be found throughout the United States, utilizing a wide variety of cultural practices that reflect the diversity of environments in which they live. However, a commonality throughout these environments is the need for proper weed control, especially within the crop row. Despite rapid increases in national production and sales of organic horticultural crops, there is a scarcity of published research on organic weed control in these systems. Research has focused primarily on herbicide-based management. While herbicidal management can be effective, there are concerns about cost, environmental effects, and efficacy of sprays that are organically approved. Most herbicides are not labeled for organic use, and those that can be used are often not recommended on young plantings when crops are most vulnerable to weed pressure. Thus organic growers are typically forced to rely on manual within-row weeding, which is time consuming, labor intensive, and expensive.

Despite the prevalence of national production, there is a lack of published research on weed control in raspberry and other bramble crops, especially within-row weed control, which is challenging for all producers. Lawson & Wiseman demonstrated the negative effect of within-row weeds on cane growth and mortality, and since then there has been relatively little work, which focused mainly on herbicide-based management.

To address these issues, we investigated grit weeding as an alternative weed management strategy in fall-bearing organic raspberry production. Grit weeding is a practice in which a soft,

abrasive substrate (e.g., corn cob grit) is propelled via compressed air towards weed seedlings for within-row weed control. Since the practice utilizes decomposable agricultural waste it is cost effective and can be used on organic systems. Grit weeding has demonstrated effective weed control in corn, soybean, tomato and pepper without negatively affecting yields and was shown to control weed populations without damaging crop seedlings.

The rate and frequency of grit application for effective weed control has been investigated, but never applied for use in brambles. In 2017 we investigated the application of grit on weeds and raspberry primocanes within the plant row compared to traditional hand weeding techniques. We measured weed population, time to hand weed, and raspberry plant growth, (dry weight of the entire plant above ground) in a 1st and 2nd year raspberry planting.

The field study took place at the University of Minnesota West Central Research and Outreach Center in Morris, MN (45.5919° N, 95.9189° W) on a prairie mollisol soil on USDA organically certified land. The experiment was split into two blocks, based on age of raspberry plants. The first block consisted of two 76' rows of 1st year fall-bearing 'Himbo Top' raspberries, and the second block consisted of one 76' row of 2nd year 'Himbo Top' plants. Four replications of three treatments (hand weeded, grit weeded, non-weeded check) were completely randomized within the 1st year block, and three replications of two treatments (grit weeded and non-weeded check) were completely randomized within the 2nd year block to trial the effectiveness and efficiency of grit weeding for within-row weed management (Figure 1). Grit weeding was performed using a modified air compressor and blasting corncob grit towards the base of raspberry canes.

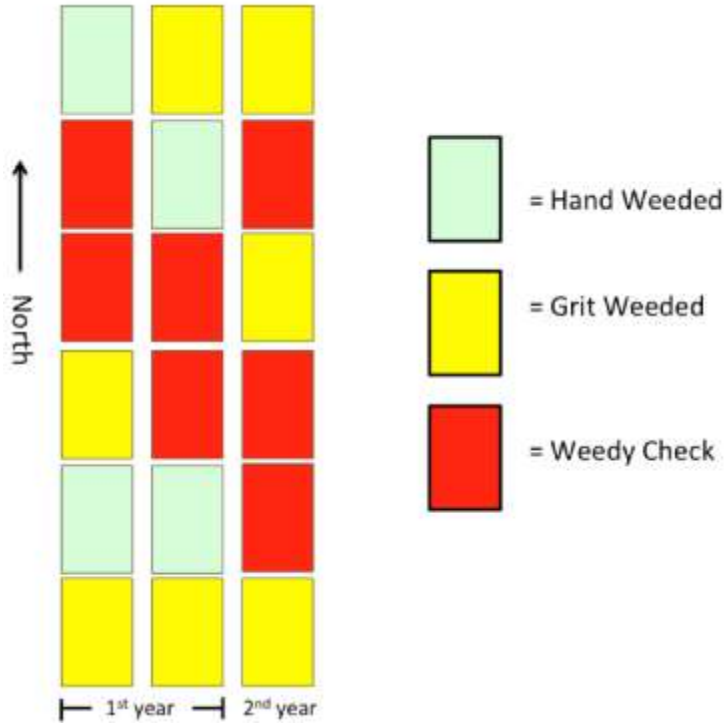

Figure 1. Two-block experimental design of grit-weeding project, Morris, MN 2017.

In both plantings, six 12’ plots were established in each 76’ row, and treatments were assigned randomly to these plots. Data collection also included total time for grit weeding and hand-weeding dedicated in each treatment replicate. Hand weeding and grit weeding began on June 2, 2017 as weed seedlings begin to emerge. Grit weeding continued throughout June and early July.

Results and Analysis: All of the annual broadleaf and grass plants succumbed nicely to the grit application in each block (Pictures 1 & 2). The most abundant weeds were common lambsquarters and redroot pigweed (Picture 3). These plants were eliminated by both hand- and grit-weeding. A troublesome “weed” that remained in the grit-weeding treatment was bluegrass, which was used for planting between the raspberry rows and crept into the within-row areas. The bluegrass may look delicate, but it withstood grit abrasion quite well. Grit weeding applications were performed 7 times between June 2 and July 12, 2017 (Picture 1). Hand weeding was performed 6 times between June 12 and July 12, 2017 (Picture 2).

Picture 1
1st-Year Raspberry
Grit-weeded
12 July 2017
Note tufts of bluegrass (*Poa pratensis*) within plot.

Picture 2
1st-Year Raspberry
Hand-weeded
12 July 2017
Note bluegrass (*Poa pratensis*) alleys around plot.

Picture 3. 1st-year raspberry **weedy check** 18 July 2017.

Within the 1st year planting block, hand- and grit-weeded treatments had similarly low amounts of average weed dry weight, and considerably less than the weedy check (Figure 2). This shows

that for our experiment, grit weeding was as effective as hand weeding at suppressing within-row weed pressure. However, average total weeding time was higher in the grit weeded treatments than hand weeded (Figure 3). While this implies that grit weeding may be a more labor-intensive technique than hand weeding, we believe that a simple design alteration may considerably reduce grit-weeding times. As mentioned above, the majority of grit weeding time was spent on control of bluegrass whose light-weight seeds had dispersed at sowing from the between-row walkways into the within-row bramble areas. Thus, we advise not to sow bluegrass at or close to the time of primocane transplantation. A single manual hoeing can eliminate the bluegrass.

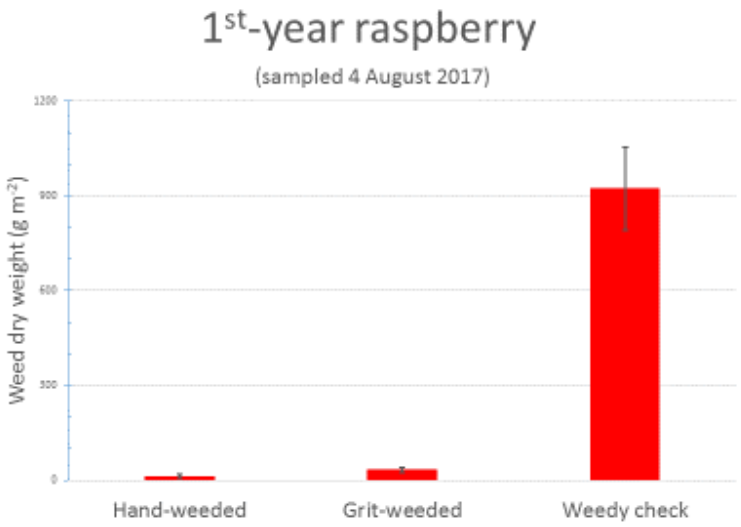

Figure 2. Average dry weight of each treatment within 1st year planting block.

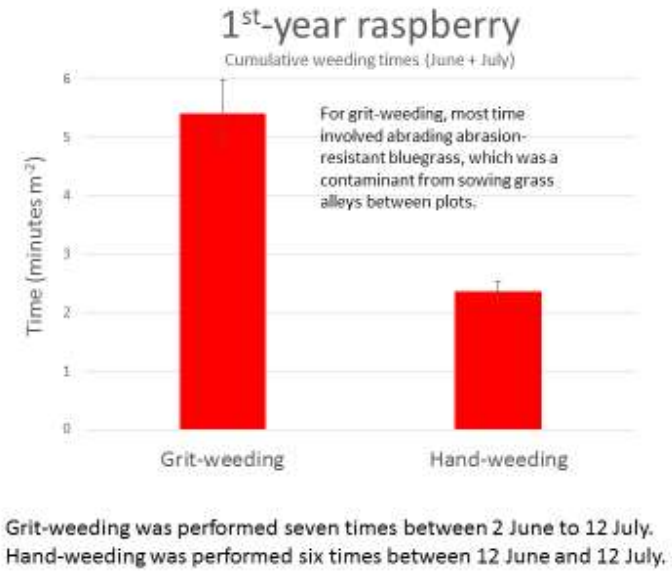

Figure 3. Average weeding time of hand- grit-weeded treatments within 1st year planting block.

In the 2nd year planting block, block size limited the number of treatments to only grit-weeding and a weedy check (three plots for each). Weed emergence began much earlier in this experiment and included winter annuals such as field pennycress. Consequently, grit applications commenced earlier than in the previous experiment, but also had to cease earlier to avoid injury to the rapidly developing raspberry plants. A total of two applications were made between late April and late May. Average weed dry weights of the grit and weedy check treatments of the 2nd year block were recorded in mid June, about two weeks after the cessation of grit-weeding. All aboveground weed growth within each plot was cut and collected. Some weed regrowth occurred, which was cut and harvested near the end of the growing seaon in August. Early grit-weeding greatly reduced weed biomass (Figure 4) in the 2nd-year planting, which effectively eliminated early-season weed-raspberry competition. By August regrowth of weeds had occurred in both treatments, but raspberry plants were so large by that time that the presence of weeds was not easily noticeable in either treatment.

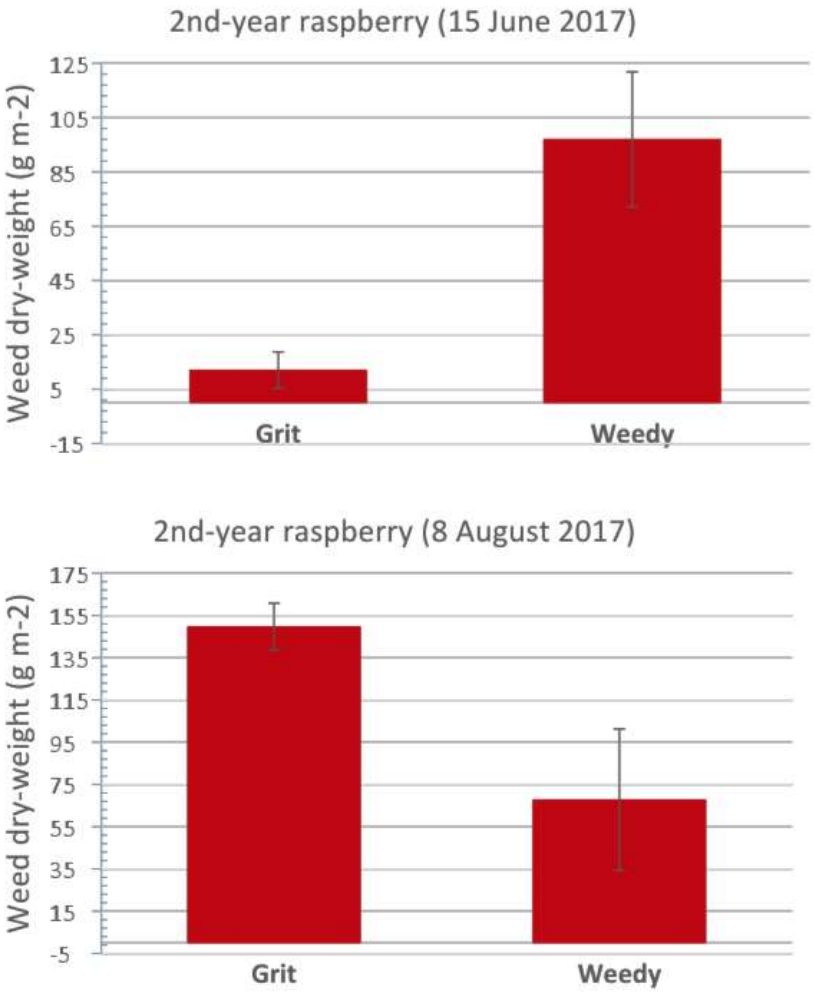

Figure 4. Average weed dry weight of weedy and grit-weeded treatments within the 2nd year planting block at two sampling dates, 2017.

In the 1st-year planting, raspberry dry weight within the hand- and grit-weeded treatments were similar, while plants within the weedy check had lower dry weights (Figure 5). This showed that grit weeding and hand weeding were equally effective at increasing raspberry plant vigor via reducing weed competition.

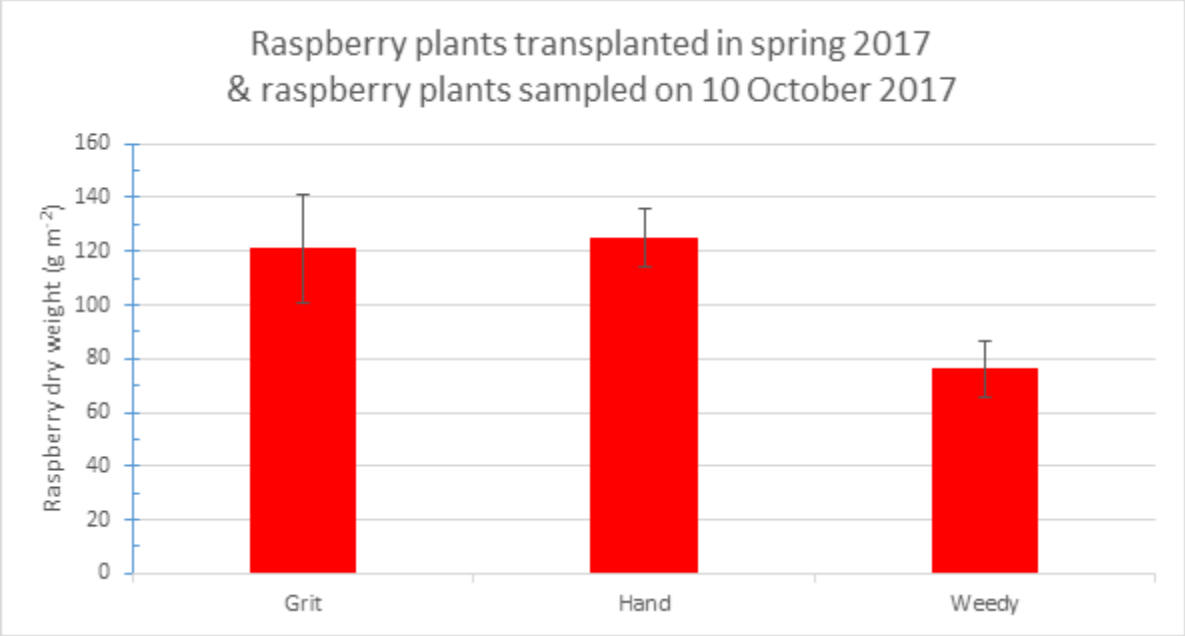

Figure 5. Average dry weight of raspberry plants in each treatment.

In this project we demonstrated that grit weeding displays similar effectiveness at reducing weed pressure and increasing raspberry vigor as hand weeding. We maintain that careful choice of walkway material in future experiments will likely reduce grit weeding time, possibly at or below average hand weeding times. However, even using our observed weeding time averages, growers may still prefer grit weeding over hand weeding techniques. This is because grit weeding is a more mechanized technique that is less stressful on the grower, requiring little to no bending or crawling. The physical ease of grit weeding may be preferable to growers, even if it may take more time to conduct. We recommend that future experiments analyze the use of grit weeding in plots with walkway covers that are not naturally resistant to abrasion (i.e., not turf grasses), and also the potential of granular fertilizers to be incorporated into grit mixtures. This 'ferti-weeding' may build plant-available fertility while simultaneously reducing weed pressure.

References

Lawson, H and J Wiseman. 1976. Weed competion in spring-planted raspberries. Weed Res 16(3), 155-162.

2014 Organic Survey, https://www.agcensus.usda.gov/publications/organic_survey/

Three-second sequence showing the abrasion and destruction of two pigweed seedlings in the WCROC raspberry experiments.

Portable grit applicator in use in transplanted raspberry at WCROC. Photo taken in early June 2017.