Integrating Flame-Weeding for Early Season Palmer amaranth control in Soybean

Kurt Vollmer, Alan Leslie, Dwayne Joseph, Jadon Cook, and Ellie Rogers

Introduction

- Starting clean or weed-free is the key to any good weed control program, and it is an essential tool for managing Palmer amaranth.
- Many soil-active (residual) herbicides are available to prevent and/or reduce weed emergence.
- Control is more complicated in organic systems where:
  1) residual herbicides are not an option, and
  2) there is continuous germination throughout the growing season.
- Flame-weeding is a non-chemical tactic that has been evaluated to control emerged grass and broadleaf weed species.
- Previous research has shown that post-dispersal flaming can destroy redroot pigweed seed.
- Small seeds of Palmer amaranth and redroot pigweed germinate from shallower depths in the soil profile and may be affected by surface flaming.
- In this study we hypothesized:
  1) that early season flame-weeding may help to reduce weed emergence, and
  2) this tactic can be integrated with cultivation to provide effect postemergence control of emerged Palmer amaranth.

Methods and Materials

- Two studies were conducted in 2023 at the UMD research greenhouse and in a grower field in Greensboro, MD.
- The greenhouse study consisted of smooth pigweed seeded in aluminum trays at 0, 0.5, 1, and 1.5 inches (in.) below the soil surface and flamed at speeds of 1, 2, and 3 miles per hour. A non-flamed control was included for each soil depth.
- The field study evaluated flame-weeding as an integrated tactic for early season weed control using combinations of flame-weeding and/or cultivation (Fig. 1, 3).
- All treatments were conventionally tilled prior to soybean planting on June 23, 2023 and were flamed prior to crop and weed emergence (F^{PRE}) at speeds of 1 or 2 miles per hour (mph).
- Postemergence treatments were made 1 and 2 weeks after planting (WAP, Table 1).

Table 1. Postemergence flame-weeding tactics. *All control tactics repeated at 1 mph and 2 mph respectively.*

Postemergence Control Tactic	Application (WAP)
One additional postemergence flaming (F^{+1})	1
Two additional postemergence flamings (F^{+2})	1, 2
Cultivation followed by one additional flaming (F^{+1} fb C^{+1})	1, 2
Two additional cultivations (C^{+2})	1, 2

Acknowledgments

- Maryland Soybean Board
- Adam Chaffinch

Figure 1. Demonstration using Inferno Flame Weeder.

Figure 2. Effect of flame weeding on large (bottom) vs small (top) pigweed.

Figure 3. Demonstration using Inferno Flame Weeder.

Figure 4. Palmer amaranth damage after flame-weeding.

Figure 5. Example plot layout depicting untreated (left) and application tactic (right) divided by soybean row.

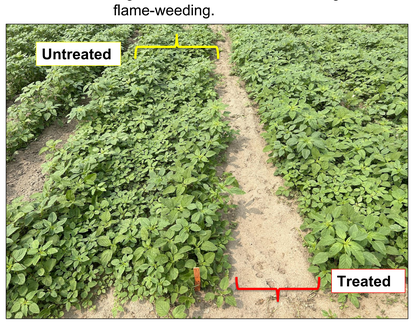


Figure 6. Two additional cultivations (C^{+2}) *right;* untreated *left.*

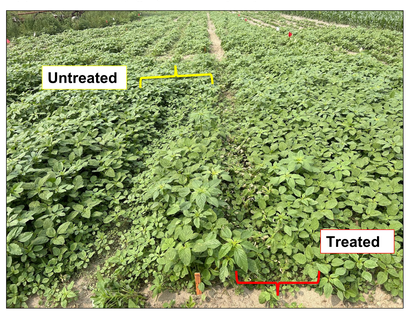


Figure 7. Cultivation followed by one additional flaming (F^{+1}) *right* untreated *left.*

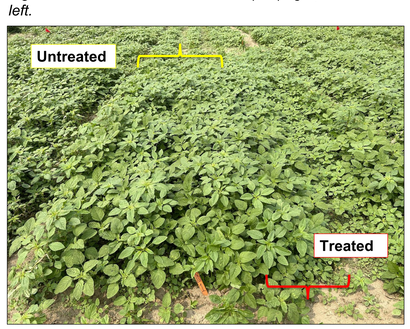


Figure 8.Two additional postemergence flaming (F^{+2}); untreated *left.*

Results and Discussion

- In the greenhouse study, only burial depth had an effect on weed emergence, with fewer weeds emerging at the 1 and 1.5 in. depths (Fig. 9).
- In the field study, flaming prior to emergence did not significantly reduce weed density compared to other flame-weeding treatments (Fig. 10).
- Multiple cultivations were needed to significantly reduce weed emergence compared to untreated areas (Fig. 6,10).
- Postemergence flaming treatments only resulted in an 18% reduction in weed density (Fig. 10).
- Although injury was observed with flame-weeded treatments, control declined with increasing weed height and weed density (Fig. 2,4,7,8).
- Overall, these results show that flame-weeding alone is not a viable tactic for managing large populations of Palmer amaranth.

Figure 9. Smooth pigweed emergence from 4 burial depths.

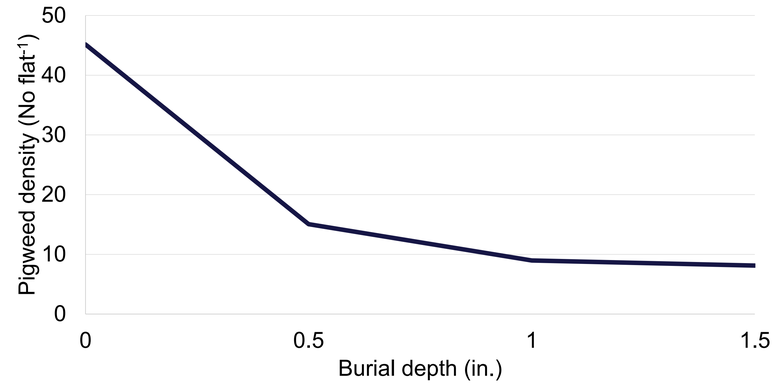
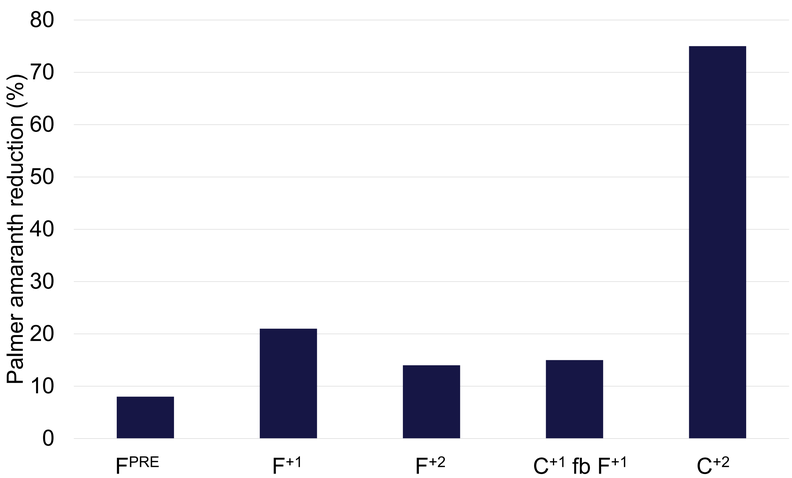


Figure 10. Percent reduction in Palmer amaranth 3 weeks after planting.



* Abbreviations: F^{PRE}: preemergence flaming; F^{+1}: one additional postemergence flaming; F^{+2}: two additional postemergence flamings; fb: followed by; C^{+1}: one postemergence cultivation; C^{+2}: two postemergence cultivations.