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Controlling Palmer Amaranth with Early-Post-emergence Herbicides in Central Arizona Cotton System

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Introduction

Palmer amaranth (*Amaranthus palmeri*) remains one of the most problematic and yield-limiting weeds in cotton production systems across central Arizona. Its rapid growth rate, high fecundity, and widespread herbicide resistance make timely and effective management critical, particularly during early crop establishment. Early post-emergence (EPOST) (when Palmers are 1-4 inches tall) herbicide applications play a vital role in integrated weed management by targeting weeds at vulnerable growth stages and reducing early-season competition. This study evaluated the efficacy of selected EPOST herbicide programs, including combinations of glyphosate, acetochlor, diuron, pendimethalin, and pyroxasulfone, under field conditions at the Maricopa Agricultural Center to provide practical guidance for growers and stakeholders. Weed (Palmer amaranth) density was measured in a one-square-meter quadrant for each treatment, with four replications. More details on study design and methodology can be found in our sister study (Mukherjee et al., 2026).

Results and Discussions

All early post-emergence herbicide treatments numerically reduced Palmer amaranth (*Amaranthus palmeri*) infestation and improved visual control ratings relative to the untreated check across evaluation timings; however, because statistical comparisons among treatments were not observed in this study, the differences reported here should be interpreted as descriptive trends rather than confirmed treatment effects. Across all rating dates, the three-way tank mixture of glyphosate + acetochlor + diuron (PowerMax3 + Warrant + Direx 4L) produced the most consistent suppression of Palmer amaranth, a pattern plausibly attributable to the simultaneous delivery of foliar (systemic) and soil-residual activity across multiple complementary modes of action. In contrast, single-active-ingredient treatments, pendimethalin (Prowl H2O) and pyroxasulfone (Zidua SC), appeared to provide more variable control across timings, a pattern consistent with the documented sensitivity of soil-residual herbicide performance to weed density,

Table 1: Details of Early-post emergence treatments in Cotton at Maricopa Agricultural Center, Maricopa, AZ

Trade Name	Active Ingredients	Site of Action Group	Application Rate	Application Timing
PowerMax® Warrant®+ Direx 4L®	Glyphosate, Acetochlor, Diuron	9,15,7	30 fl oz/acre + 3 pts/ acre + 32 fl oz/acre	Early post-emergence
Prowl H20®	Pendimethalin	3	3 pints/acre	Early post-emergence
Zidua SC®	Pyroxasulfone	15	2 pts/acre	Early post-emergence

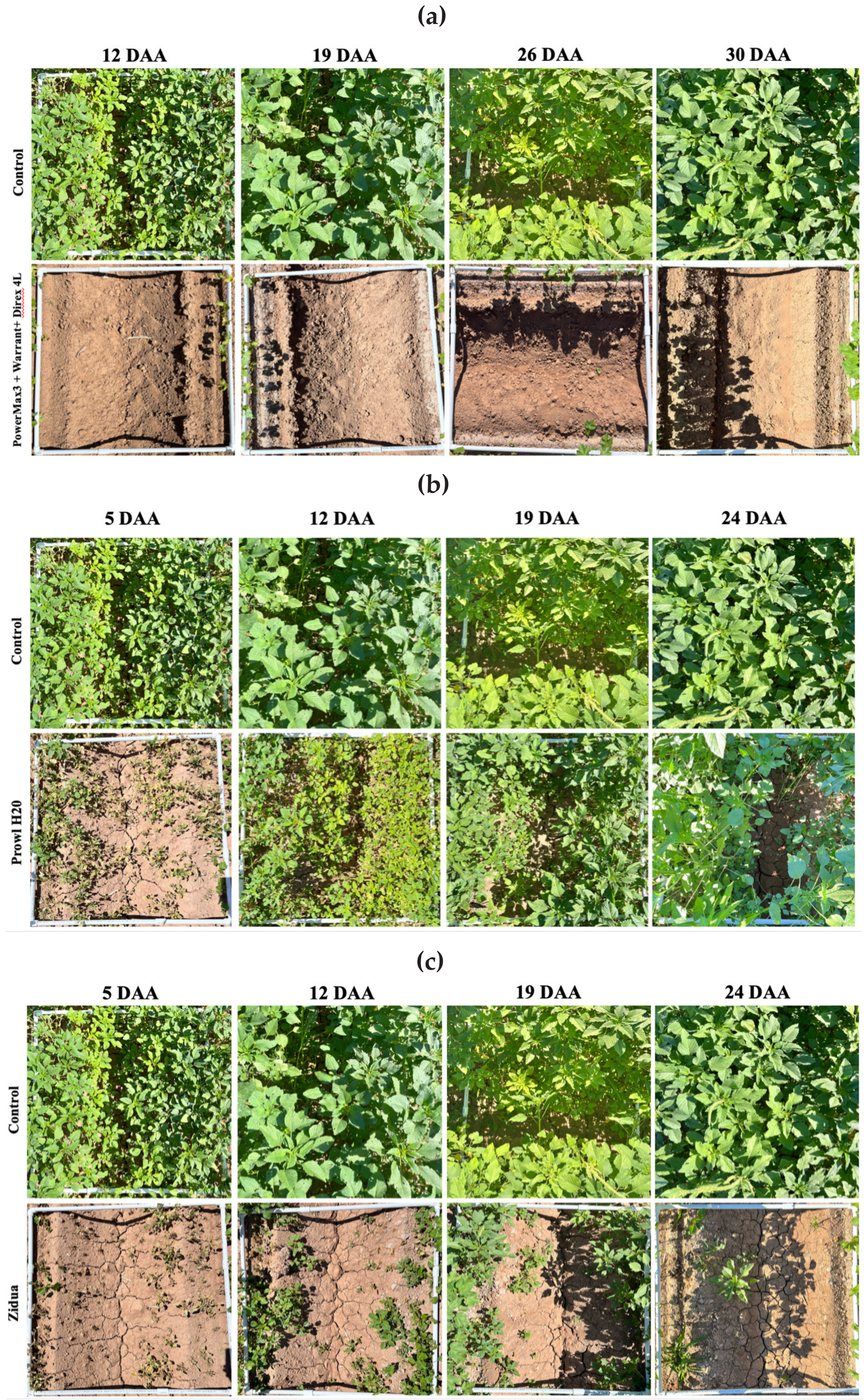

Figure 1. Visual comparison (in one square meter quadrant) between untreated check (UTC) and treated (early post-emergence application with (a) PowerMax+Warrant+Direx 4L, (b) Prowl H2O, (c) Zidua SC at multiple days after application (DAA) (*Image credit: Avik Mukherjee*)

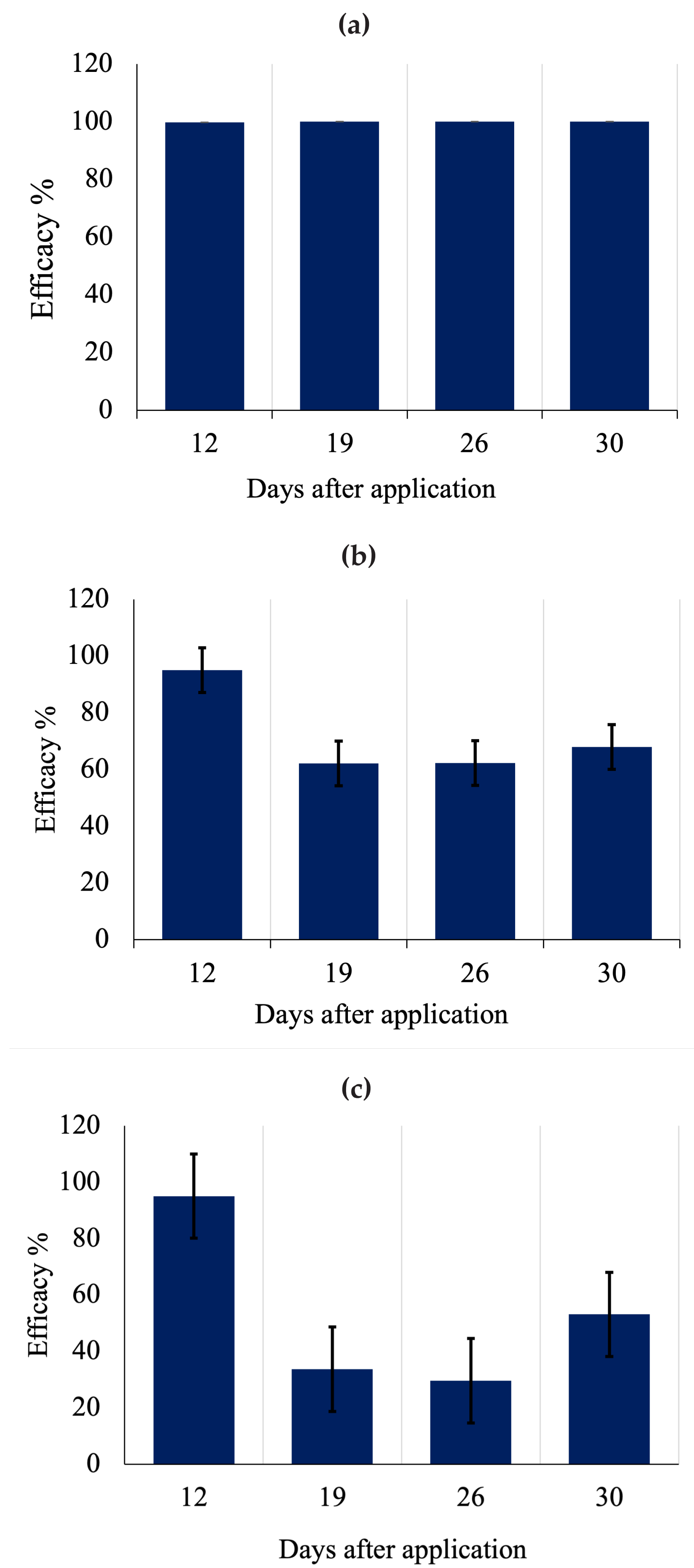

Figure 2. The efficacy trends of early post-emergence herbicides (a) PowerMax+Warrant+Direx 4L, (b) Prowl H2O, (c) Zidua SC at multiple days after application (DAA). Each black line represents the standard deviation of the sample mean.

soil moisture at and after application, and prevailing environmental conditions. These results are based on a one-year field trial and motivate a statistically powered follow-up trial in 2026 to permit formal inference on treatment differences and on the interaction between herbicide program and environmental drivers.

Variability in herbicide performance could be attributed to factors such as initial weed density, weed pressure gradient in the field, environmental conditions during application, and the precise timing of herbicide application relative to weed growth stage. Under high weed pressure, reliance on a single mode of action may be insufficient for sustained control (Beckie 2006, Powles et al., 2010), underscoring the importance of diversified herbicide programs. Sustained adoption of such integrated programs is essential to preserving the efficacy of remaining effective chemistries and to maintaining the long-term agronomic and economic viability of cotton production in Arizona.

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Disclaimer

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