

Influence of preharvest herbicide applications on color retention of canned black beans



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Introduction

- Michigan is the top black bean producing state in the U.S., with most varieties being of Type II upright architecture, which is essential for direct harvest.
- To effectively direct harvest black beans, preharvest herbicide applications are used to provide uniform dry down by desiccating green tissue and weeds (Figure 1).
- Recently, the dry bean canning industry has observed a loss of 'black' color after canning, which is an important aspect for consumer acceptance.
- Several factors may influence the loss of color in the canning process of black beans and some of these factors are thought to be part of external production practices.
- Potential influences may include black bean variety selection, seasonal growing conditions, and possibly preharvest herbicide selection and/or timing of application.

Objective

- Evaluate the effects of preharvest herbicide treatments on canned black bean color of three black bean varieties.

Materials and Methods

Experiment design

- A field trial was conducted at the Saginaw Valley Research and Extension Center near Richville, MI in 2013
- Two planting dates: June 13 and June 26, 2013
 - Different seasonal growing conditions
- Split-split plot design, 4 replications
- Main plot: three Type II black bean varieties
 - 'Zenith' - new Michigan State University variety
 - 'Zorro' - standard Michigan grown variety
 - 'Eclipse' - standard ND and MN grown variety
- Sub-plot: application timing
- Sub-sub plot: preharvest herbicide

Preharvest herbicide treatments

- Two application timings
 - Early: 50% of pods were yellow
 - Representing worse case scenario of uneven dry down within a field
 - Standard: 80% of pods were yellow
- Three herbicide treatments
 - Paraquat (0.56 kg ha⁻¹) + NIS (0.25% v/v)
 - Saflufenacil (0.05 kg ha⁻¹) + MSO (1% v/v) + AMS (2% w/w)
 - Glyphosate (0.84 kg a.e. ha⁻¹) + AMS (2% w/w)

Data collection and analysis

- Desiccation was evaluated 3, 7, and 14 DAT
- Beans were direct harvested, adjusted to 18% moisture, and canned using a small scale protocol
- Color after canning was assessed by a trained panel of 22 evaluators using a scale from 1 (poor) to 5 (excellent)
- Color was also evaluated by measuring luminosity (L) with a colorimeter, using a scale from 0 (black) to 100 (white)
- Data were analyzed using PROC MIXED in SAS and means were separated using Fisher's protected LSD_(0.05)

Results and Discussion

Uneven maturity



Figure 1. Example of uneven maturity in a Michigan black bean field prior to preharvest herbicide application.

- Dried black bean color was similar for the three varieties after harvest.
- For both planting dates, preharvest herbicide treatments applied at the standard timing did not affect black bean color after canning (*data not shown*).
- The main effect of black bean variety was always significant for color after canning, regardless of planting date, application timing, or preharvest treatment for luminosity readings and panel assessments (Figure 2).
 - 'Zenith' had the darkest color, followed by 'Zorro', while 'Eclipse' had the lightest color after canning.
- The main effect of preharvest herbicide treatment applied early resulted in differences in black bean luminosity for both planting dates (Figure 3).
 - Each herbicide treatment resulted in higher luminosity values (lighter color) compared with the untreated control.
 - Early applications of glyphosate resulted in the greatest reduction in black color after canning (Figure 4).
- Panel assessments resulted in differences between planting dates for the early application timing. Interactions between herbicide treatment and variety were observed (Figure 5).
 - As with the luminosity ratings, applications of glyphosate in 5 of the 6 variety by treatment interactions resulted in overall poorer dark color. The only time this did not occur was due to the overall poorer color with Eclipse for the second planting date.

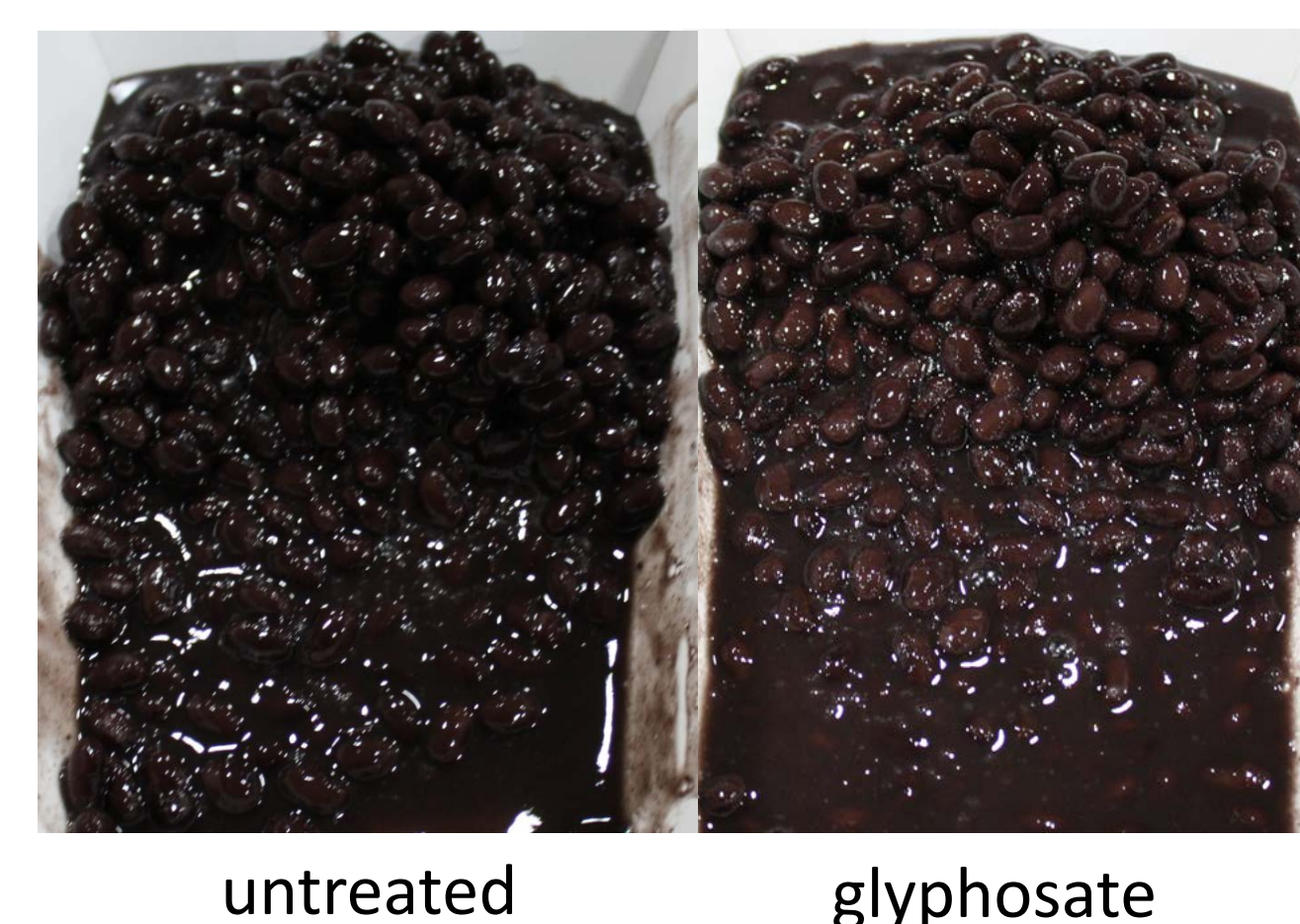


Figure 4. Differences in black bean color after canning for an early application of glyphosate compared with the control.

Color difference between varieties



Figure 2. Variety differences in black bean color after canning.

Luminosity for preharvest treatments

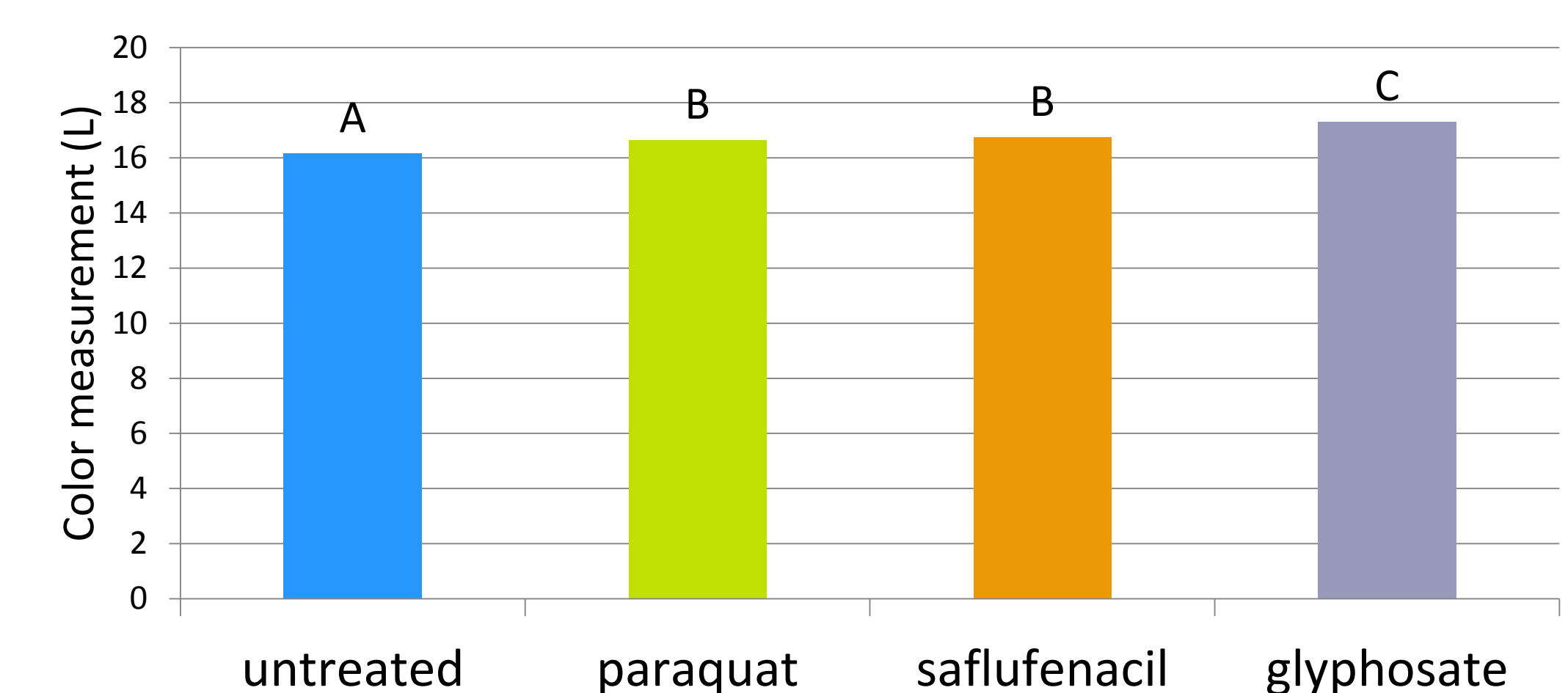


Figure 3. Main effect of herbicide on black bean luminosity for the early application timing combined over both planting dates.

Panel assessment for black bean color

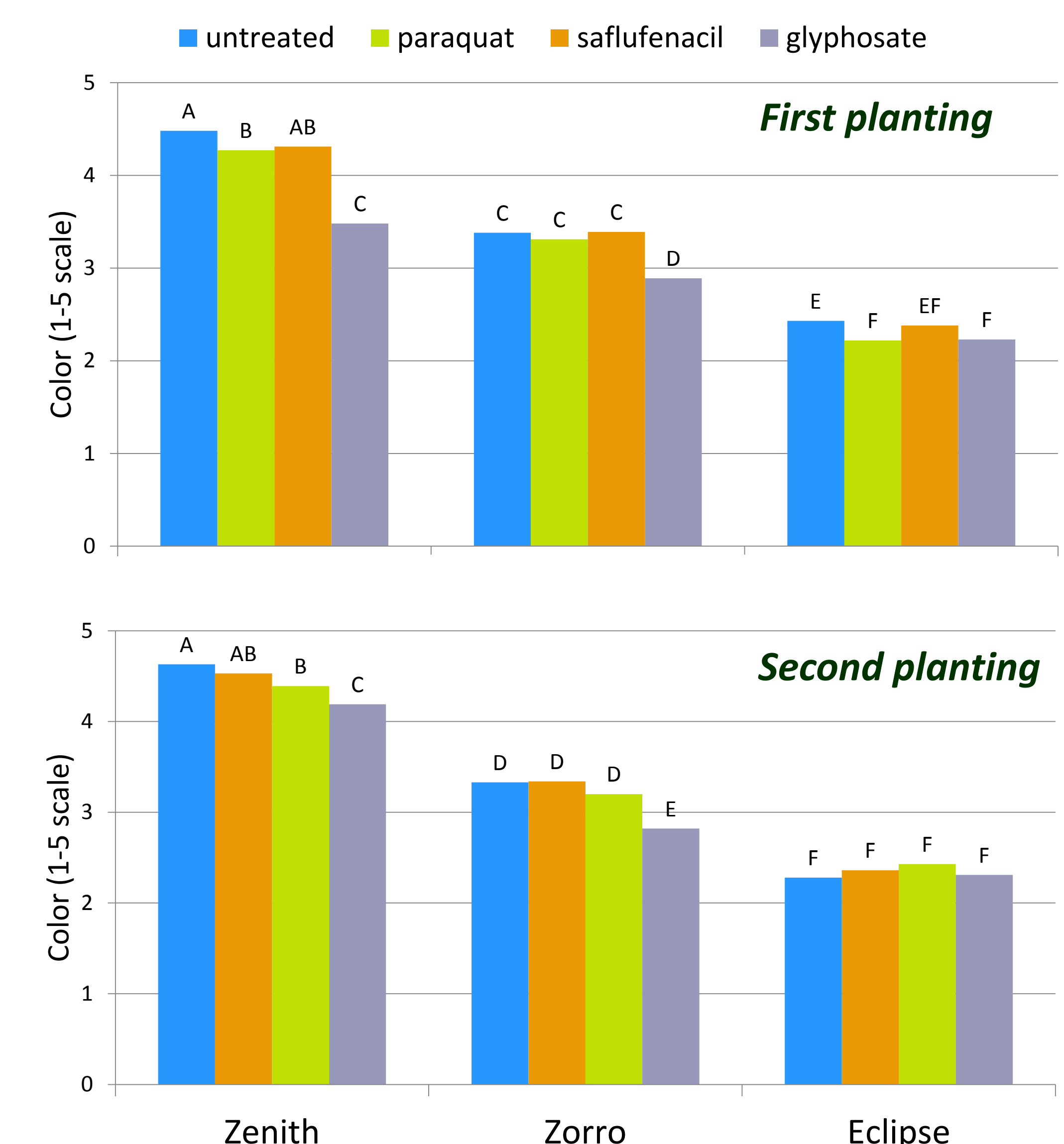


Figure 5. Panel assessment of color differences of three black bean varieties and three preharvest herbicide treatments applied at the early application timing.

Conclusions

- External factors outside the canning process resulted in differences in black bean color.
- Variety selection played the greatest role in color retention after canning.
- Black bean color was also affected when preharvest herbicide applications that were made too early (areas in the field that are greener). This was more apparent when glyphosate was applied.
- To avoid issues with the loss of the dark color that consumers desire in canned black beans, the canning industry should work with growers on variety selection and the appropriate timing of preharvest herbicide applications and product selection.

Acknowledgements

