Integrating Perennial Groundcover: Species and Suppression Effects on Maize Growth

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Abstract

Conventional maize production maximizes yield through intense management but can degrade soil and ecosystem health. Perennial groundcover (PGC) based cropping systems offer a potential sustainable alternative to reduce environmental impacts while maintaining productivity. This study evaluated the effect of the PGC species and suppression methods on maize growth, yield, resource competition; and whether early suppression or summer dormancy traits can reduce interspecific competition. A field trial was conducted in Boone, Iowa during 2025.

Key Results:
Suppression increased Red: far-red (R:FR) light ratios, maize height, and grain yield compared to unsuppressed PGC. Summer-dormant cultivars performed closer to the control.

Conclusion:
Early-season suppression and use of summer-dormant PGCs effectively reduced competition, resulting in maize yields comparable to those of the conventional cropping system.

Background

- PGC systems interplant a cool-season perennial grass with the main crop to provide continuous soil cover. This approach offers potential to mitigate the environmental impact of conventional farming while sustaining yield and economic feasibility by improving soil stability, increasing soil carbon, utilizing excess nutrients, and providing weed suppression.
- Interspecific competition for water, sunlight, and nutrients remains a major challenge in PGC systems, often limiting crop growth and yield. Restricting competition early in the maize life cycle will reduce competitive pressure and improve system performance.

Hypotheses

- Maize grown with PGC exhibiting summer dormancy will have a higher yield than maize grown with non-dormant PGC species.
- Chemically suppressed plots will result in greater maize yield than unsuppressed plots due to reduced early-season competition.
- Combining summer-dormant PGC species with suppression will maintain maize yields comparable to the conventional control.

Fig. 1: Maize ('P1185' hybrid) interplanted with 'FNKY' Tall fescue. Picture taken on 07/9/2024.

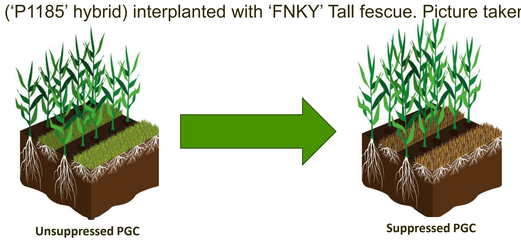

Fig. 2: Illustration of PGC-based maize production and result of early-season suppression. Suppression reduces PGC growth, turning their green color to brown.

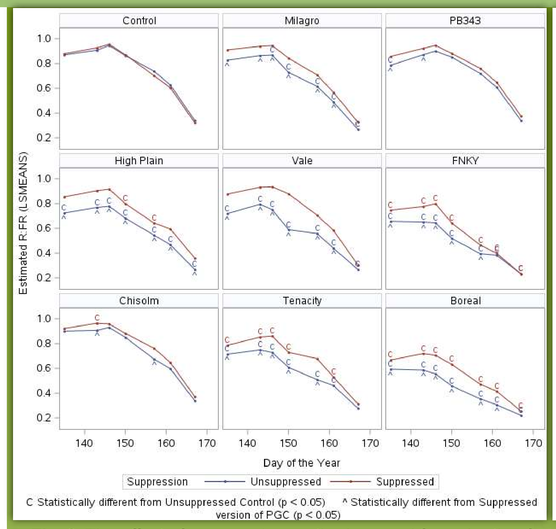

Fig. 3: The effect of suppression methods on red:far red ratio of reflective light for different PGCs.

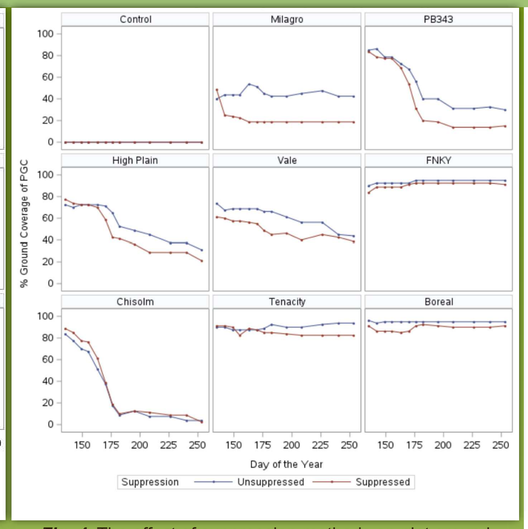

Fig. 4: The effect of suppression methods on plot ground coverage for different PGCs.

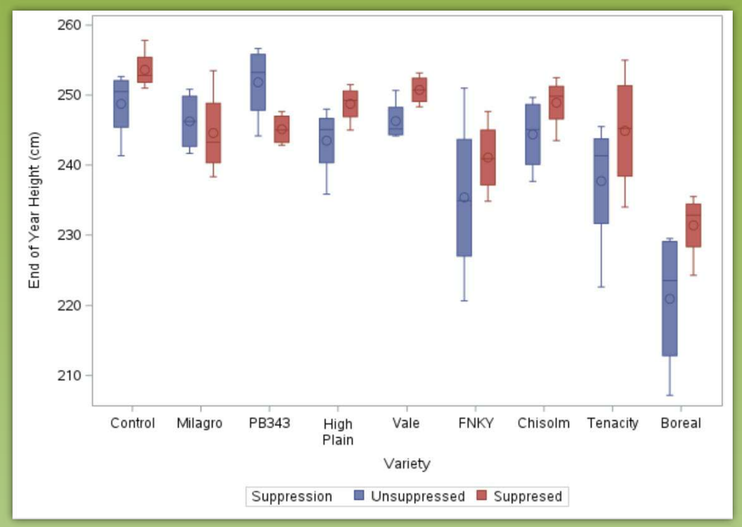

Fig. 5: The effect of suppression method on end of season maize plant heights for different PGCs.

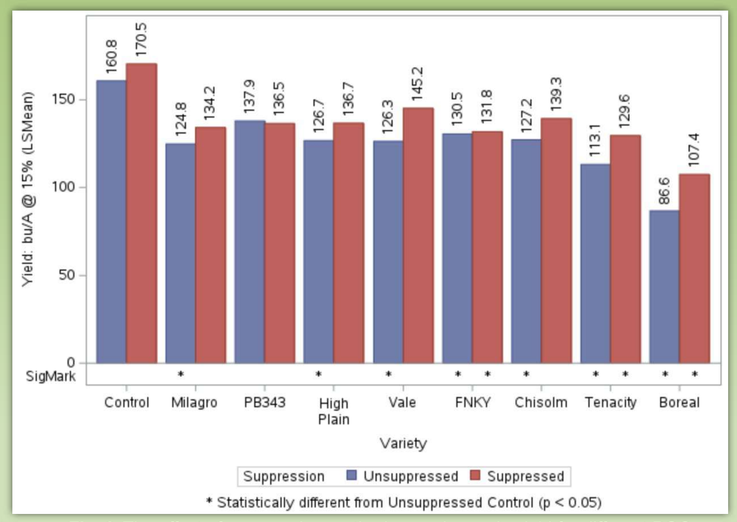

Fig. 6: The effect of suppression method on maize grain yield for different PGCs.

Materials and Methods

- Experiment is a split-block design with four replications. The main plot factor is management practice consisting of two treatments: unsuppressed and Liberty-suppressed (32 oz acre^{-1}). The sub plot factor includes eight PGC cultivars of four different species and one control treatment of conventionally grown maize.
- Maize is planted at 76 cm row spacing into 30 cm strips-till zones in plots containing pre-established PGC. Chemical suppression is applied two days after maize emergence. Banded fertilizer was applied prior to strip-tillage following standard local recommendations.

Data collection:

- Light quality (LI-COR180) – R:FR light ratio of reflected light wavelengths influencing maize's Shade Avoidance Response (SAR).
- Maize staging and plant height.
- Grain yield – Combine harvest at approximately 15% moisture.
- Groundcover estimates – percent coverage, weed density, and greenness.
- Other – Soil moisture (TDR 350), SPAD (SPAD 502), Drone and AI Images;

- Data is being analyzed using the MIXED procedure for repeated analysis, and GLM procedure for single measurements in SAS 9.4, with suppression and PGC as fixed effects, and block and block interactions being treated as random. Means were separated using pairwise comparisons (PDIFF) at $\alpha = 0.05$.

Results

- Suppression and PGC cultivar influenced maize growth, reflected light quality, coverage ability, and grain yield.
- Suppression increased R:FR light ratios (Fig. 3), indicating a decrease in competition for light and a lower likelihood of triggering SAR in maize. Plots with Summer-dormant PGC ('Milagro', 'PB343', 'High Plain', 'Vale') were closer to the control under suppression than non-dormant PGC ('FNKY', 'Tenacity', 'Boreal').
- Suppression decreased early-season ground coverage (Fig. 4) in most PGC types. Summer-dormant PGC had lower ground coverage throughout the growing season.
- Suppression of PGC resulted in taller maize plants at the end of the season (Fig. 5) in most PGC cultivars, except 'PB343'.
- Suppression of PGC resulted in higher maize grain yield (Fig. 6) with most PGC cultivars, except 'PB343'. Plots with summer-dormant PGC ('Milagro', 'PB343', 'High Plain', 'Vale') performed closer to the control under suppression than non-dormant PGC ('FNKY', 'Tenacity', 'Boreal').

Conclusions

- Suppression reduced early interspecific competition between maize and PGC.
- Combining suppression and summer-dormant PGC minimizes negative impacts on maize growth and yield.
- Long-term data will help evaluate differences in persistence among PGC cultivars and impact of suppression on PGC persistence.

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