Impact of integrative crop and livestock production on pest and beneficial arthropods

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INTRODUCTION

Both corn grain production and forage-based beef production are major industries in the Western Corn Belt of the United States. The amount of forage available for grazing and haying has declined in the last decade, leading to a greater need for nutritious forage for livestock. In Nebraska, many growers have adopted the practice of grazing their cattle herds on the corn stalks that remain in their crop fields post-harvest. Cattle will remain feeding and living in these corn fields until the spring. This practice is an alternative to baling or otherwise mechanically removing corn residue. Winter grazing by cattle in a crop field could have implications for soil-dwelling and epigeal arthropods by impacting agroecosystem properties, such as plant residue, soil health, and nutrient cycling.

METHODS

This experiment was located in western Nebraska at a no-till, sprinkler irrigated, continuous corn field. Two replicates (~6.5 ha each) of the following 4 treatments have been imposed since 2009 (Fig. 1A):

1) Residue removal by baling
2) Heavy winter cattle grazing (0.8 AUM/ha)
3) Light winter cattle grazing (0.4 AUM/ha)
4) No residue removal

Sampling was conducted during the 2014 field season to obtain the following data on pest and beneficial arthropods:

- Emergence of adult western corn rootworm (WCRW) using 2 single-plant cages per plot (Fig. 1C)
- Activity-density of epigeal arthropods using 2 pitfall traps filled with propylene glycol per plot

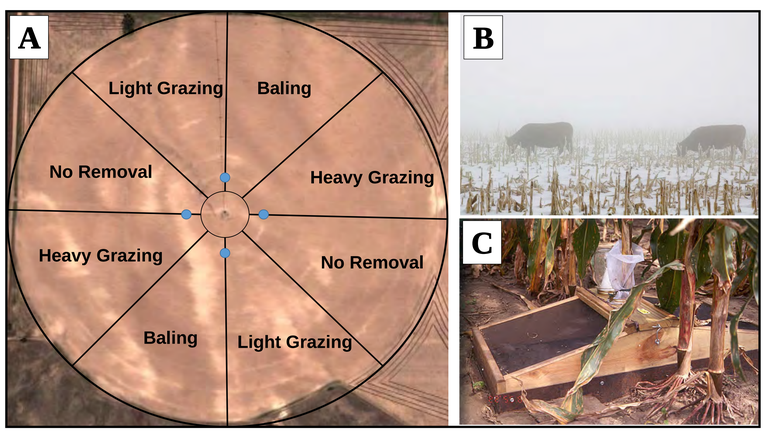

Figure 1. A) Field plot design; B) Cattle grazing corn stalks during the winter; C) Emergence cage for capturing WCRW.

RESULTS

Table 1. Western corn rootworm adult emergence across treatments

	Cumulative WCRW Beetles Emerged (Mean ± SEM)
Baling	12.8 ± 5.3[a]
Heavy Grazing	1.0 ± 0.7[b]
Light Grazing	20.3 ± 12.0[a]
No Removal	2.5 ± 0.9[b]

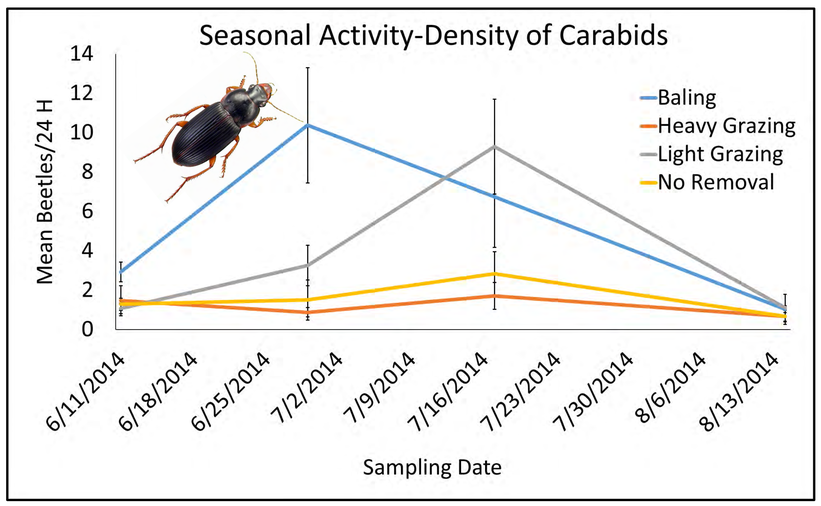

Figure 2. Ground beetle (Carabidae) activity-density across the season

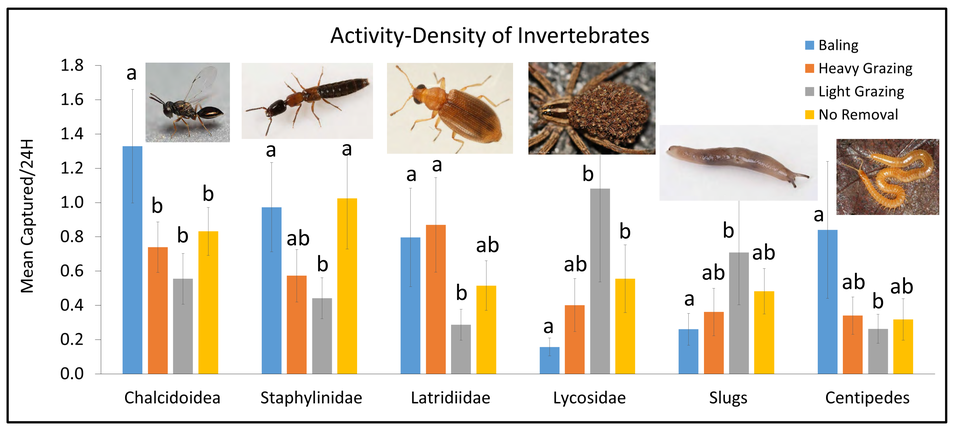

Figure 3. Invertebrate activity-density measured using pitfall traps.

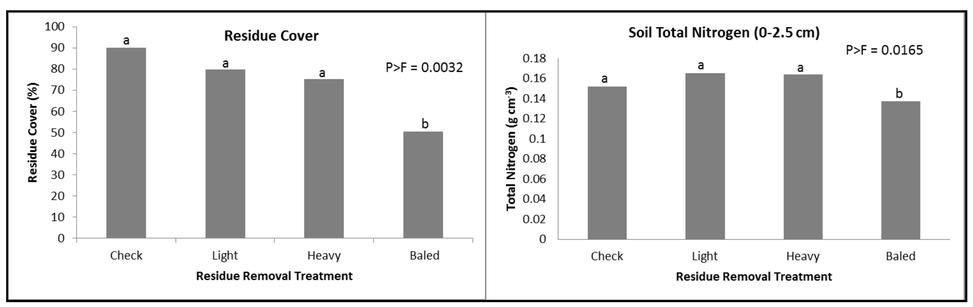

Figure 4. Measurements of A) residue cover and B) soil total nitrogen.

Figure 5. Contents of a pitfall trap.

RESULTS SUMMARY

- WCRW adult emergence was higher in the Baling and Light Grazing treatments (Table 1)
- Carabid beetle activity-density peaked in July and was highest in Baling and Light Grazing plots (Fig. 2)
- Significant differences in activity-density were found for Chalcidoidea (parasitoid wasps), Staphylinidae (rove beetles), Latridiidae (minute brown scavenger beetles), Lycosidae (wolf spiders), Gastropoda (slugs), and Chilopoda (centipedes) (Fig. 3)
- No significant differences were found for: Acari (mites), Nitidulidae (sap beetles), Diptera (flies), Gryllidae (crickets), and 81 other arthropod families
- The Baling treatment had less crop residue and lower total nitrogen at the soil surface (Fig. 4)
- Yield was not significantly different based on treatment

DISCUSSION

Crop residue and cattle grazing impacted populations of pest and beneficial arthropods, although not in expected ways. Further work is needed to understand why western corn rootworm emergence was enhanced by residue removal and light grazing. Lower winter mortality or lower natural enemy pressure in these plots may have facilitated these results. Both the presence of crop residue and cattle manure may influence prey abundance and therefore the activity-density of carabid beetles, wolf spiders, and other epigeal generalist predators. We seek to better understand how these common agronomic practices impact arthropods in the agroecosystem. These types of integrative systems that seek to maximize the sustainable production of both crops and livestock could provide benefits to agricultural productivity.

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