Plant Growth Parameters: Influence of No-Till Cover Crops

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INTRODUCTION

Governments, industry, scientists, and farmers are faced with the challenge of providing food, feed, and fiber for the increasing global human population. During previous centuries, increases in food productivity was achieved by deforestation, plowing prairies and virgin fields, and draining wetlands. However, due to the environmental consequences of these practices, and the non-renewable nature of soils, land management practices are being implemented to optimize crop productivity while reducing environmental ramifications. One of these practices is the inclusion of cover crops (CC) into crop rotation systems.

Cover crops are planted during 'fallow' periods to prime the soil by reducing soil bulk density, increasing water infiltration, and reducing surface water runoff (Haruna et al., 2022). Further, leguminous CCs can fix atmospheric N while non-leguminous CCs can scavenge and recycle excess N (Adetunji et al., 2020), thus increasing crop productivity and environmental sustainability.

OBJECTIVES AND HYPOTHESES

The aim of this study was to answer the following questions:

a. How does a suite of CCs influence soil NO_3-N, soil organic carbon (SOC), and in situ measured volumetric water content (VWC).

b. How does CC influence plant height (PH), leaf length (LL) and width (LW), chlorophyll content (ChlorC), yield, and moisture content of corn (*Zea mays*) seeds.

It is hypothesized that:

a. Cover crops will increase NO_3-N, SOC, and in situ measured VWC due to surface biomass.

b. Cover crops will increase measured plant growth parameters.

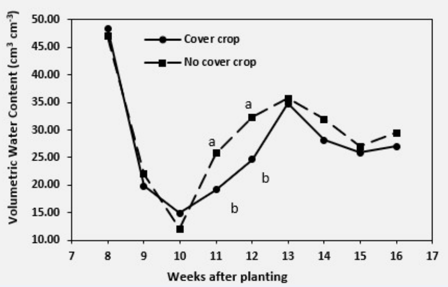

Figure 1: Management effects on *in situ* measured water content

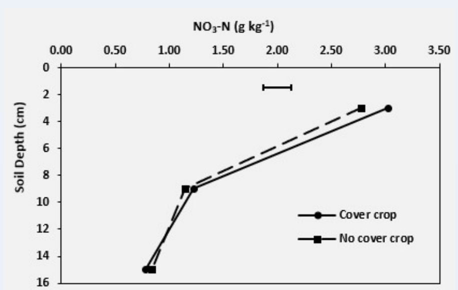

Figure 2: Management effects on nitrate nitrogen (NO_3-N) with depth

MATERIALS & METHODS

- The experimental design was randomized complete block design.
- Treatments were cover crops (CC) vs no cover crop (NC).
- The CCs included hairy vetch (*Vicia villosa* Roth), crimson clover (*Trifolium incarnatum* L.), winter wheat (*Triticum aestivum* L.), winter peas (*Lathyrus hirsutus* L.), oats (*Avena sativa*), triticale (*Triticale hexaploide* Lart.), barley (*Hordeum vulgare* L.), and flax (*Linum ustatissimum* L.).
- About 190 kg N ha^{-1} was applied in split application (pre-planting and side-dress).
- Soil nitrate-nitrogen (NO_3-N) and SOC were measured on samples collected at 0-6, 6-12, and 12-18 cm depths 8 weeks after planting using the combustion method.
- *In situ* VWC was measured using time-domain reflectometry method (FieldScout® TDR 300).
- The PH, LL, LW, and ChlorC were measured each week, beginning 8 weeks after planting.
- The PH, LL, and LW were measured using a tape measure.
- Leaf area was calculated using the Montgomery equation (Montgomery, 1911) as LL x LW x M_f; where M_f is the Montgomery factor (0.75).
- The ChlorC was measured using a SPAD meter and converted to chlorophyll concentration for corn using the method of Markwell et al. (1995).

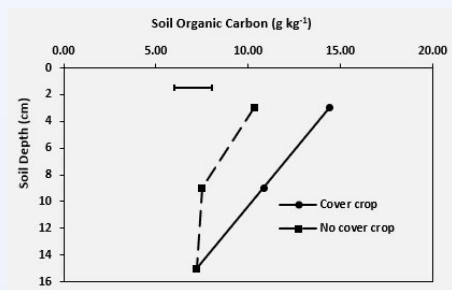

Figure 3: Management effects on soil organic carbon with depth

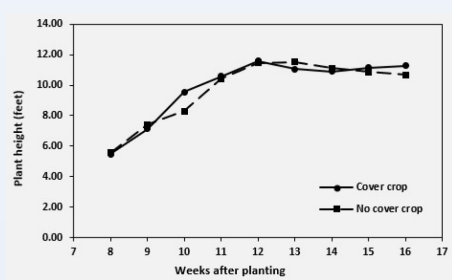

Figure 4: Plant height as influenced by cover crop management

RESULTS

- After a rainfall event, NC management had higher VWC (Fig. 1).
- At the top 6 cm depth, NO_3-N was higher under CC compared with NC, suggesting that CCs can add and recycle N within the soil (Fig. 2).
- Cover crop residues left on the soil surface is probably responsible for higher SOC at 0-6 and 6-12 cm depths (Fig. 3).
- Plant height was similar between CC and NC management (Fig. 4).
- During most of the study period, corn leaf area was higher under NC compared with CC (Fig. 5) which resulted in higher chlorophyll concentration (Fig. 6) and yield.
- As a result, seed count (yield) was slightly higher under NC compared with CC (Table 1).
- Results support the need to delay the harvest of corn until late summer.
- Seed with higher moisture content have been reported to perish at lower temperature, while seed with low moisture content survive significant temperature variability (Tangney et al., 2018).
- Significantly higher seed water content percentage suggests that NC can lead to increased seed mortality in a variable atmospheric climate condition.

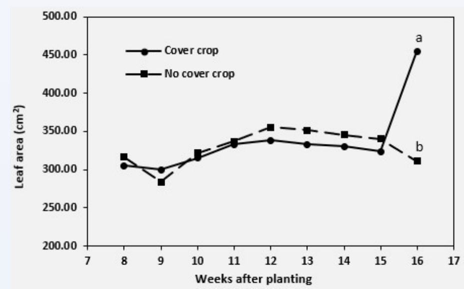

Figure 5: Effects of cover crop management on corn leaf area

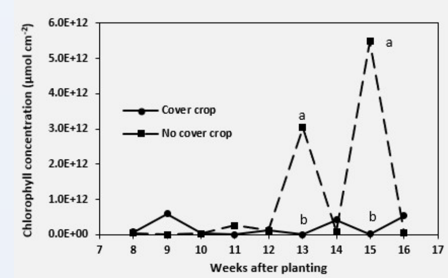

Figure 6: Management effects on the chlorophyll concentration of corn leaves.

Table 1: Effects of cover crop on corn yield

	Root Count	Biomass Water Content	Seed Count per cobb (yield)	Seed Water Content
		%		%
Cover Crop	27.00	227.31	571.33	47.47
No Cover Crop	26.00	241.37	622.33	52.71
	ANOVA *P > F*			
Treatment	0.988	0.602	0.289	0.041

CONCLUSIONS

- Cover crops can reduce out-of-pocket NO_3-N cost for producers.
- Cover crop management can improve SOC at the top 12 cm soil depth.
- No cover crop management can increase corn leaf area and chlorophyll concentration.
- Cover crops can ensure the survivability of corn seeds during growing season temperature variation, potentially leading to more yield.

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