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# Effects of Double Cropped on Yield and Biomass Accumulation of Cover Crops in Kansas

George Y. Mahama, Kraig Roozeboom, David B. Mengel, and P.V.Vara Prasad
Department of Agronomy, Kansas State University, Manhattan, KS 66506

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## Introduction

- The contribution of nitrogen (N) by cover crops is an important component of sustainable agriculture and alternative source of N. Legume summer and winter cover crops can decrease inorganic N fertilizer requirements and production costs through symbiotic $N_2$ fixation. Moreover, N accumulation in the plant biomass can provide large amounts of mineralized N if the entire growth is returned to the soil as green manure. It is also vital to make maximum use of the available land during the growing season. Hence, double cropping is an option to increase grain production from a unit of land, improving cash flow, spreading risk, more efficient use of equipment, and achieving greater net returns on investment. Soil erosion, as a result of wind and water, can also be reduced as the ground is covered, essentially on a year-round basis. However, summer crop yields may be decreased due to shortened length of growing season and risk of water shortage.

## Objectives

- To evaluate the performance of double cropped soybean and grain sorghum yield following winter wheat.
- To determine total biomass production, N and Carbon accumulation of various cover crops following winter wheat.

## Materials and Methods

- Field experiments were conducted at two locations, Ashland Bottoms and North Farm both in Riley county, Kansas in 2012.
- The experimental design was a randomized complete block design. Five crops, cowpea [*Vigna unguiculata* (L.) Walp], sunn hemp (*Crotolaria juncea*), pigeon pea [*Cajanus cajan* (L.) Millsp], soybean [*Glycine max* (L.) Merr.], and grain sorghum [*Sorghum bicolor* (L.) Moench] were randomly assigned to experimental units. Plot size was 4.5 x 9 m. There were 6 rows per plot spaced at 0.75 m with four replications.
- Soil samples at a depth of 0–5 cm and 0–60 cm were taken before planting and analyzed for chemical properties (Table 1). Planting was done on June 19 and July 3 at Ashland Bottoms and North Farm, respectively.
- Data on physiological, growth and yield traits were measured and analyzed using SAS version 9.1.3 with GLM at an alpha level of 0.05. For significant variables, mean separation was accomplished using LSD test.

**Photo: Growth of sunn hemp and cowpea at vegetative stage.**

**Table1. Chemical characteristics of soils at experimental sites.**

| Location | pH | Mehlich 3 P | k | OM | $Cl^-$ | S | $NH_4^+$ N | $NO_3^-$ N |
|---|---|---|---|---|---|---|---|---|
| | | ppm | ppm | % | ppm | ppm | ppm | ppm |
| Ashland Bottoms | 5.6 | 60.7 | 349 | 1.8 | 2.0 | 3.6 | 2.8 | 3.2 |
| North Farm | 5.0 | 64.8 | 249 | 3.6 | 3.8 | 4.8 | 7.2 | 9.6 |

## Results and Discussion

- July and August precipitation was 28mm below normal and temperature was 1.35°C above normal (Fig. 1).

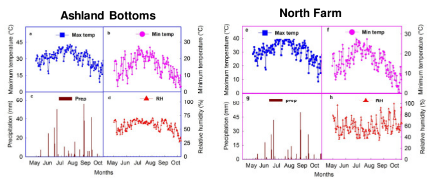


**Figure 1. Daily maximum temperature, minimum temperature, precipitation, and relative humidity during crop growing season.**

- There were significant interactions between crop and location for most physiological, growth and yield traits.

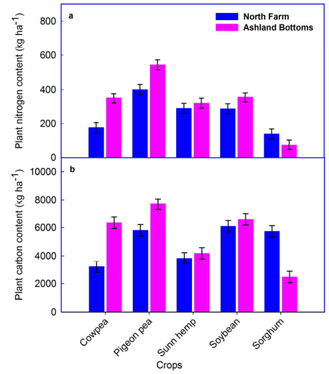


**Figure 2. Effect of location by crop interaction on plant N (a) and plant carbon accumulation.**

- Averaged across both locations, pigeon pea recorded the greatest plant nitrogen and carbon accumulation. While sorghum and sunn hemp recorded the least (Fig. 2).

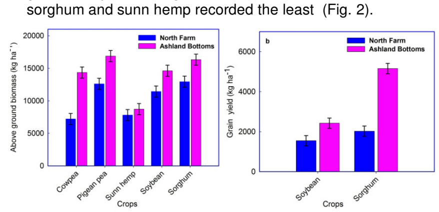


**Figure 3. Effect of location by crop interaction on (a) above ground biomass, and (b) grain yield at Ashland Bottoms and North Farm.**

- Among the various crops, pigeon pea produced the most above ground biomass when compared to sorghum, soybean and cowpea, and sunn hemp produced the least biomass at both locations (Fig. 3a).

## Results and Discussion cont.

- Although the interaction between location and crop was significant, sorghum produced the greatest grain yield than soybean at both locations (Fig. 3b).

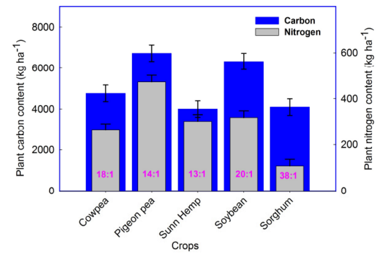


**Figure 4. Carbon and nitrogen accumulation plus C:N ratio of various crops both at Ashland Bottoms and North Farm combined.**

- C:N ratio was significantly greater for sorghum. Pigeon pea and sunn hemp recorded the smallest C:N at both locations (Fig. 4).
- Across both locations and crops, relationship between above ground biomass as a function of plant carbon content was significant, linear and positive ($R^2 = 0.94$, P = 0.0001) (Fig. 5a).
- Similar response was observed for the relation between above ground biomass and plant nitrogen content ($R^2 = 0.64$, P= 0.0001) (Fig. 5b).

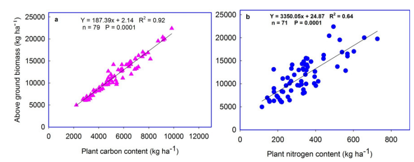


**Figure 5. Relationship between above ground biomass and (a) plant carbon content (b) plant nitrogen content across both locations.**

## Conclusions

- At both locations, grain sorghum produced more grain yield than soybean.
- Above ground biomass was greater for pigeon pea, followed by sorghum, cowpea, soybean and sunn hemp.
- Pigeon pea accumulated the most plant nitrogen and carbon, followed by soybean, cowpea, sunn hemp and sorghum.
- Overall, there was strong positive linear relationship between above ground biomass and plant nitrogen and carbon accumulation.

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