Crotalaria juncea GREEN MANURE BIOMASS AND SEED YIELD PRODUCTIVITY IN AN ORGANIC SYSTEM AS AFFECTED BY TIME OF APICAL CUTTING AND PLANTING DENSITY

Jacqueline Halbrendt[1], J. Pablo Morales-Payan[1], Sonia Martinez Garrastazu[1,2], Bryan Brunner [1,2], Luisa Flores-Lopez[2], and Juan A. Toro-Santiago[2], Department of Crops and Agro-Environmental Sciences[1] and Agricultural Experiment Station-Lajas[2], University of Puerto Rico-Mayagüez
Carlene Chase[3] and Rosalie Koenig[4], University of Florida, Departments of Horticultural Sciences[3] and Agronomy[4] Gainesville, Florida, and Brad Morris[5] USDA-ARS, Griffin, Georgia.

INTRODUCTION

◆ *Crotalaria juncea* is regarded as a plant with great potential for 'green manure' and soil amendment in the tropics. Increasing interest in organic and ecological production in PR, as well as possible use of this plant in conventional systems, has prompted research on increasing its productivity of seeds (for propagation) and biomass (for soil incorporation).

◆ Relatively low planting rates (10 lb/A) and higher rates (40 lb/A) have been recommended for establishment of *C. juncea* for seed production and green manure, respectively. Currently, there are no research results that support the recommendation of those planting rates in Puerto Rico.

◆ It has been hypothesized that apical removal may increase branching and possibly total biomass and/or seed production in *C. juncea*, and possibly on its ability to suppress weeds under its canopy. Again, there is no experimental support for the beneficial effect of apical removal in *C. juncea* weed suppression, biomass and/or seed yield in the conditions of PR.

◆ The objective of this research was to determine the effect of planting density and apical removal at various times after plant emergence on the shoot biomass and seed yields of *C. juncea* in southern Puerto Rico.

MATERIALS AND METHODS

◆ Field experiments in 2008 and 2009 at the Ag Experiment Station of the University of Puerto Rico-Mayaguez in Lajas (18° 03' 07"N, 67° 03' 35")

◆ A South African accession ('Tai-yang-ma') was direct seeded in the field in June of 2008 and April of 2009. Plants were grown organically. To encourage root nodulation, seeds were inoculated with *Rhizobium* (Nitragen EL®, EMD Crop BioScience, Milwaukee, WI). To aid in the establishment of the sunn hemp transplants, we provided overhead irrigation (2008) or drip irrigation (2009) during the first 3 weeks after planting. Azadirachtin (Gowan, Yuma, AZ) and the insecticide/miticide Ecotrol® (EcoSMART Technologies, Inc., Franklin, TN) were used to manage the leaf-eating beetles *Ceratoma* spp and *Diabrotica balteata*, and the pod borers *Utetheisa bella* L. and *Utetheisa ornatrix* L.

◆ The experiment was planted in tilled beds using 25x6 ft (7.62x1.82 m) plots, with an 8 ft (2.43 m) buffer between plots. The seeds were inoculated with *Rhizobium spp.* (Nitragen EL®, EMD Crop BioScience, Milwaukee, WI) on planting day to improve root nodule formation

◆ The treatments were three planting densities (10, 25, and 40 lbs *C. juncea* seed per acre), and four apical cutting treatments (manually removing the top 1-2 inches from the primary stem of each plant in the plot at 3, 4, and 5 weeks after planting, and a no-cutting treatment). For simplification purposes, these treatments will hereinafter be referred to as NC (no cut), 3W, 4W, and 5W. We used a complete randomized block design with a split-split plot arrangement (time of assessment x density x apical removal).

◆ We determined *C. juncea* shoot height and width (taken at 2, 3, 4, and 5 months after planting, MAP). Weed data was collected on one occasion in 2008 (2.5 MAP) and on two occasions in 2009 (1 and 2 MAP). Pods were harvested at the 'rattle stage' from one row in each plot. Soot biomass was collected two times during each year, once during flowering and again after pod harvest. On each occasion, four representative plants were cut at soil level and oven dried before they were weighed. Resulting data was submitted to ANOVA and Duncan multiple range test (α=0.05) when appropriate.

RESULTS

➤ there was a significant interaction between planting density and apical cutting and, as expected, a significant difference in height over time in both 2008 and 2009.

➤ Apical removal did not cause significant differences in height among the 3 planting densities at both 2 and 5 MAP

➤ The most prevalent height differences occurred during 3 and 4 MAP (Figure 1).

➤ Note that the 2 MAP assessment occurred shortly after the final apical cuttings were performed, which may partially account for the lack of differences at that point in time.

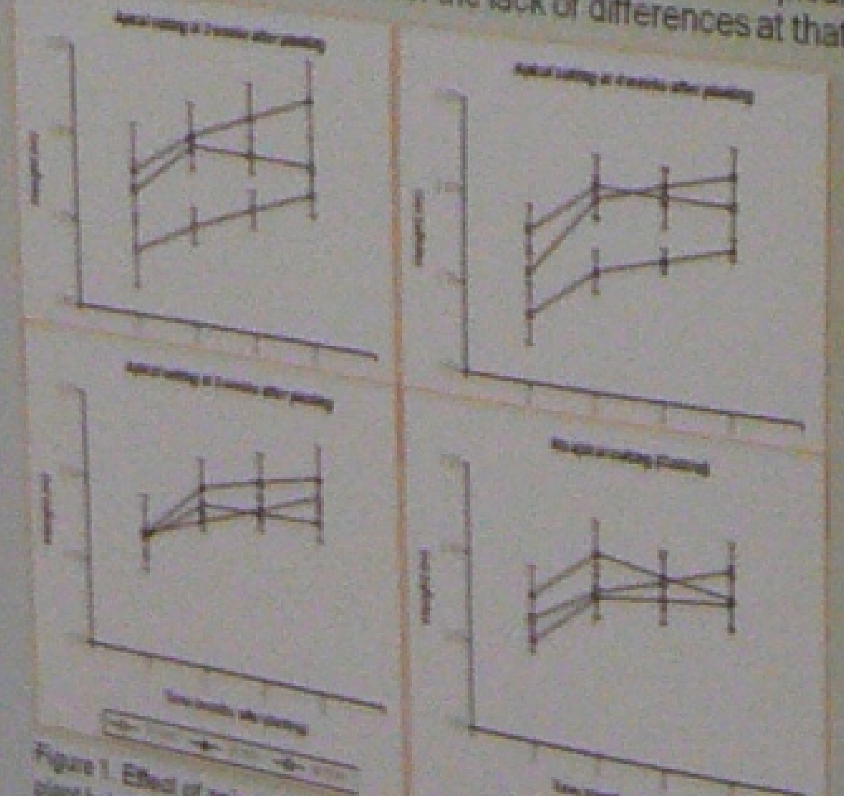

Figure 1. Effect of apical cutting treatment and planting density in *C. juncea* on plant height over time in Lajas, Puerto Rico (2008).

➤ In 2009, there were significant interactions between apical cutting and planting density (Figure 2). Plant heights at 2 MAP were similar across treatments. However, beginning at 3 MAP, differences were evident. With apical cutting at 3 W, plants in the 10 lb/A density were significantly shorter than in the 25 lb/A (at 4 MAP) and 40 lb/A (at 5 MAP). In 2008 and 2009, this effect was reversed in the 4W treatments, where 25 lb/A became the density with the least height (at 3 and 4 MAP). Also, as in 2008, the density of 10 lb/A with a 3W treatment presented among the lowest values, along with 40 lb/A-4W.

➤ Overall, there was a greater change in growth through the duration of the experiment in 2009 than in 2008. Since the two experiments were planted during different seasons (June in 2008 and April in 2009), several environmental factors which may have played a role in causing these changes, including photoperiod, precipitation, and ambient air temperature, among others.

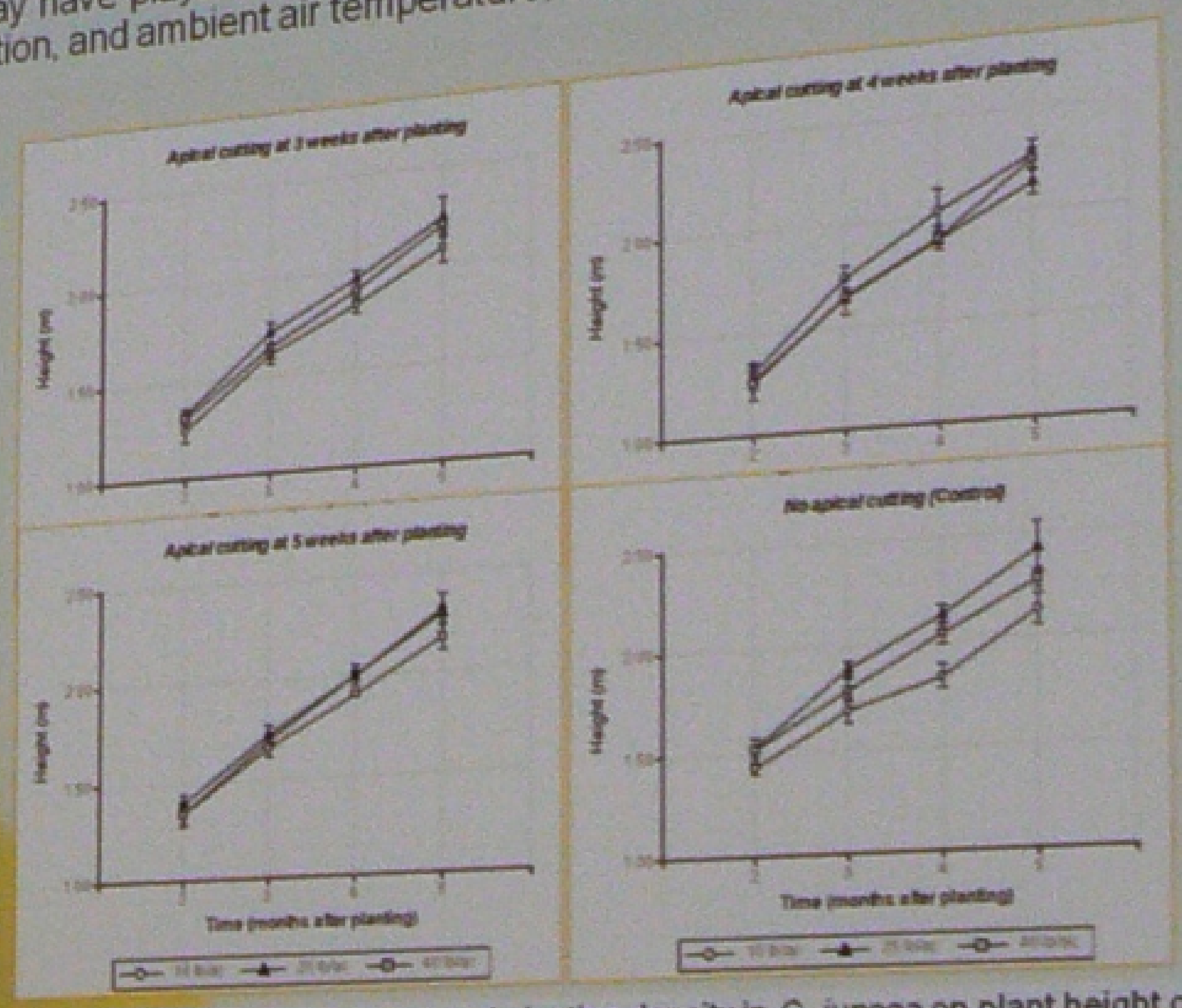

Figure 2. Effect of apical cutting treatment and planting density in *C. juncea* on plant height over time in Lajas, Puerto Rico (2009).

➤ There was a significant effect of planting density in both years, but no effect of apical cutting (Figure 3). In spite of the yield differences between the two years, both reflect significantly less biomass production at the 10 lb/A density, as compared with the 25 and 40 lb/A densities, which were not found to be statistically distinct from one another. Average biomass production in 2008 for the 25 and 40 lb/ac densities were, respectively 30,000 and 29,000 kg/ha at flowering, and 41,500 and 48,000 kg/ha post-harvest. For the same treatments, the values were nearly 4 times lower in 2009. Hence, planting in June at 25 lb/A would be best for biomass production.

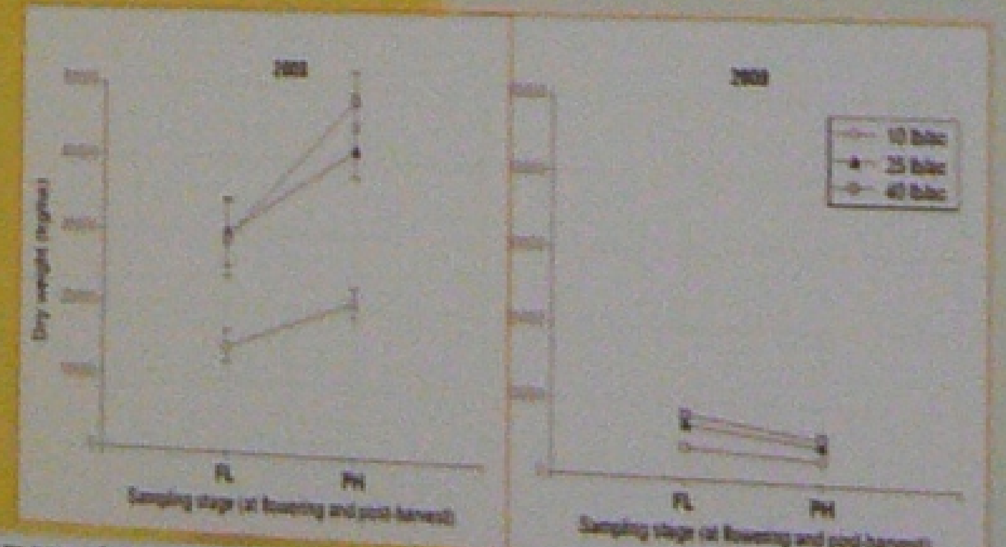

Figure 3. Shoot biomass yield of *C. juncea* as affected by planting density in Lajas, PR, 2008 and 2009.

➤ Apical removal did not affect seed yield, but density did. Both years, putative pollinators (honey bee, *Apis mellifera*, and carpenter bee, *Xylocopidae mordax*) were abundant. The stark differences in seed yield between 2008 and 2009 (Figure 4) were likely a result of the change in planting season (June in 2008, April in 2009) and stronger pest pressure in 2009 than in 2008.

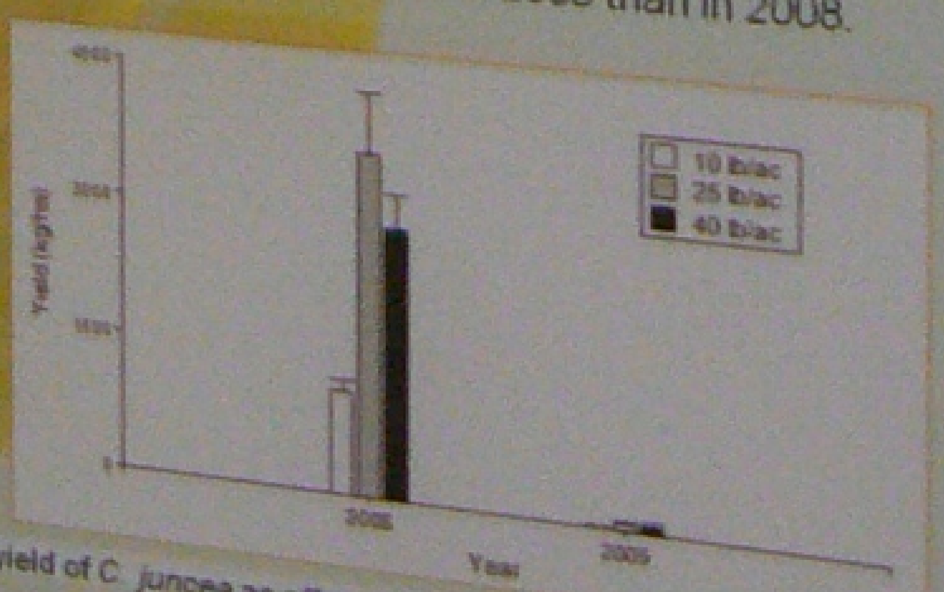

Figure 4. Seed yield of *C. juncea* as affected by planting density in Lajas, PR, 2008 and 2009.

CONCLUSION

➤ The best treatment for both biomass and seed productivity was planting at 25 lb/A with no apical cut.

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