Multifunctional Intercropping as a Cultural Strategy to Reduce Weed Pressure for Small-Scale Organic Vegetable Production

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Introduction

- Crop rotations involving cover crops and intercropping with smother crops have been shown to reduce weed emergence, but much less attention has been given to the latter.
- The extent of competitive interactions between cash crops and weeds is dependent upon factors such as crop geometry, canopy architecture, planting density, and crop growth rate (Isik et al., 2008).
- Agroecosystems that incorporate crops with different growth forms create a more complex multi-layer system that more closely mimic natural ecosystems and may potentially optimize those competitive interactions (Buhler, 2003).
- The ability of a multi-layer system to suppress weed growth is typically owed to a reduction of light transmittance due to an increase in canopy density

Objectives

- *To evaluate the ability of architecturally complex intercropping systems to suppress weed growth*
- *To examine the relationship between weed biomass and leaf area index (LAI)*

Methods and Treatments

- A two-year field study was initiated in 2011 using 5 crop species (Table 1) and 3 replicates.
- Plots measuring 20 m^2 were established with crops planted on 4 m long double rows on 1.5 m wide raised beds and plants spaced 30.5 cm apart.
- In 2011, peanut was direct seeded on August 1st followed by watermelon on August 7th, okra and cowpea on August 14th and 15th and 3-inch tall pepper transplants on August 18th
- Due to over-competition by watermelon in year 1, planting dates were altered and plants were direct seeded earlier in the season in year 2 (Peanut and okra on June 21st and 22nd, cowpea on June 27th, pepper transplants on July 3rd and watermelon on July 12th).
- Five controls of each species in monocrop were used. The six treatments used were: **a within-row intercropping system of peanut and watermelon (W_{pw}), peanut, watermelon, and okra (W_{pwo}), peanut, watermelon, okra, and cowpea (W_{pwoc}), and all 5 control species (W_{all}) and a strip intercropping system of peanut and watermelon consisting of alternating single rows (S_{pw}).**
- LAI , or the total one-side leaf are per unit of ground surface area (Lombardini, 2006), was measured 33 (not shown), 43, and 63 days after last planting (DALP) in year 2 of the study

Table 1. Component crops and their primary and secondary contributions and plant growth habit

Crop	Variety	Family	Function	Architecture
Peanut	Tamspan 90	Fabaceae	nitrogen fixation, smother crop	low/ mid growth form
Watermelon	*TAMU mini	Cucurbitaceae	smother crop, shading	low growth form
Okra	Clemson spineless	Malvaceae	pollinator attractant, structural support	tall growth form
Cowpea	Texas pinkeye	Fabaceae	nitrogen fixation, pollinator attractant	mid growth form
Pepper	Jalapeño/Serrano	Solanaceae	pest barrier	mid growth form

*Unreleased variety

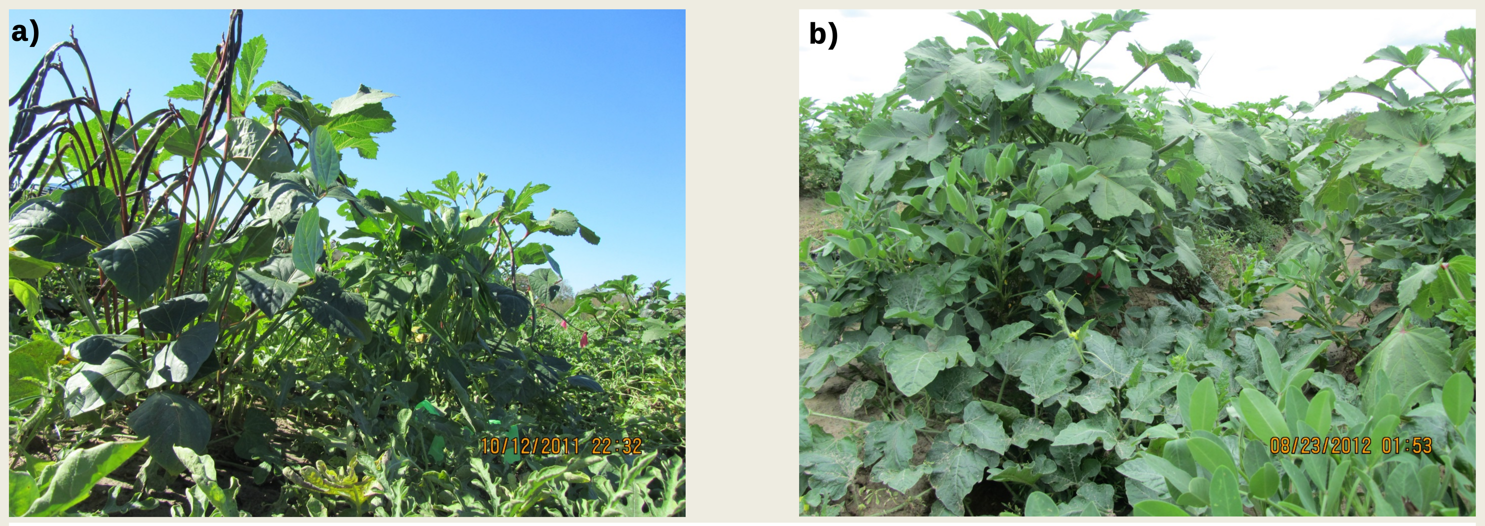

Fig 1. Intercropped peanut, watermelon, okra, cowpea and pepper highlighting the variable growth form of component crops in an architecturally complex system in (a) year 1 and (b) year 2.

Acknowledgements

The authors would like to thank the USDA, Southern SARE and TWRI for funding this research. They would also like to thank Brady Grimes, TAMU Howdy Farm, Romeo Montalvo, Dominique Conrad, and Kyle Harrison for their assistance in the field.

Results

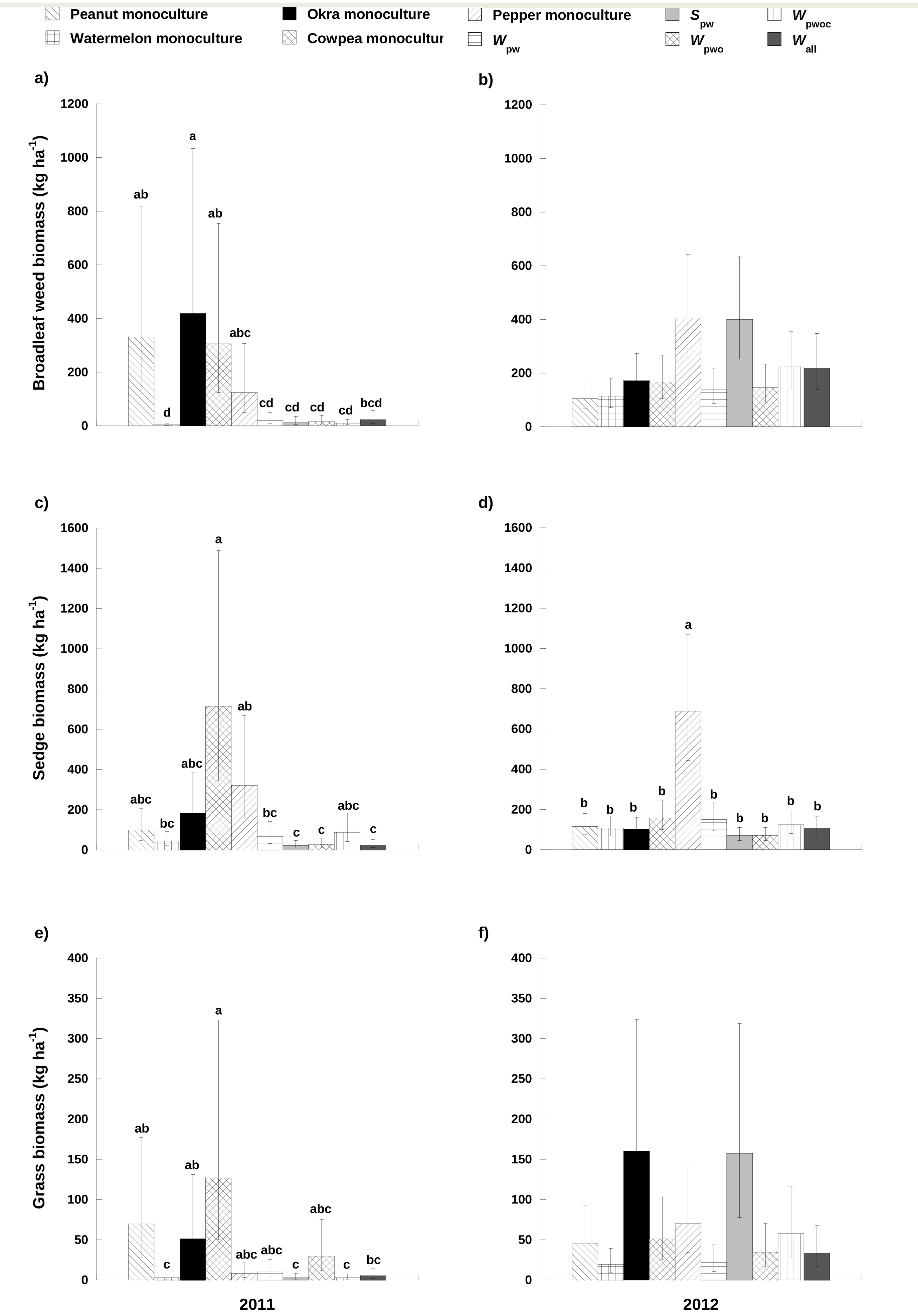

Fig 2. Least square means and standard errors of the mean of (a)(b) broadleaf, (c)(d) sedge, and (e)(f) grass weed biomass (kg ha^{-1}) for each monoculture and intercropping combination in year 1 and year 2, respectively. Different letters indicate statistically significant differences (P ≤ 0.05) between means within years according to Tukey's LSD test.

Fig 3. (a) Nutsedge infestation in a cowpea monoculture and (b) watermelon's effectiveness as a smother crop in a peanut-watermelon-okra (W_{pwo}) intercropping system in year 1.

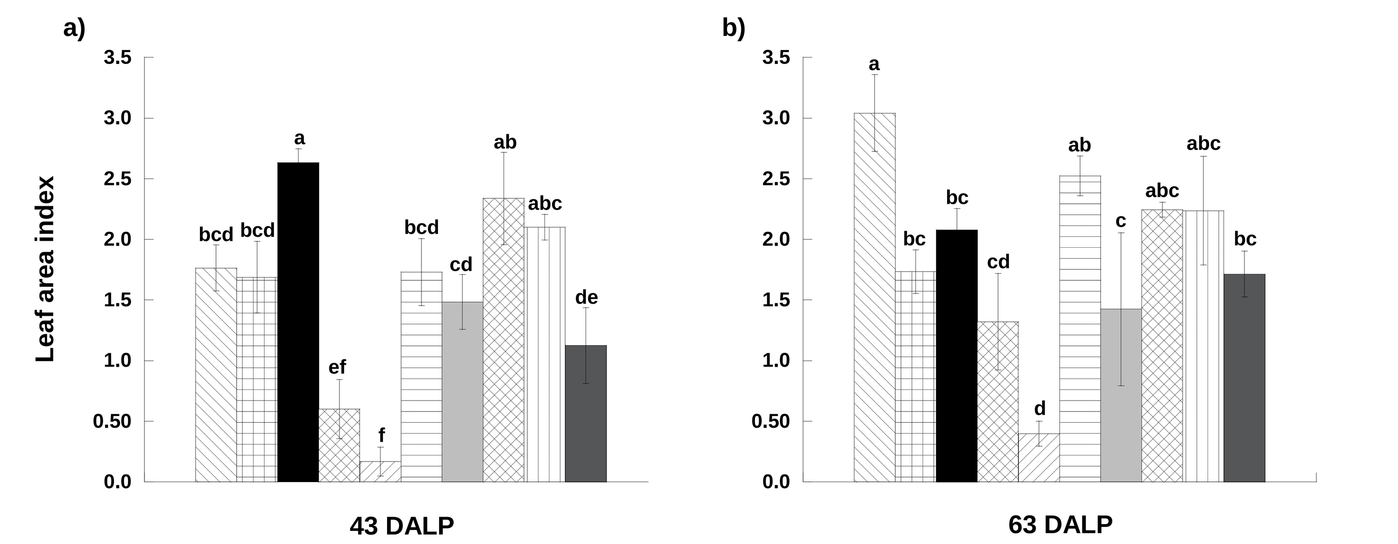

Fig 4. Leaf area index (LAI) of monoculture controls and intercropping treatments taken (a) 43 and (b) 63 days after last planting (DALP) in year 2. Treatments are given in Figure 1. Different letters indicate statistically significant differences (P ≤ 0.05) between means within years according to Tukey's LSD test.

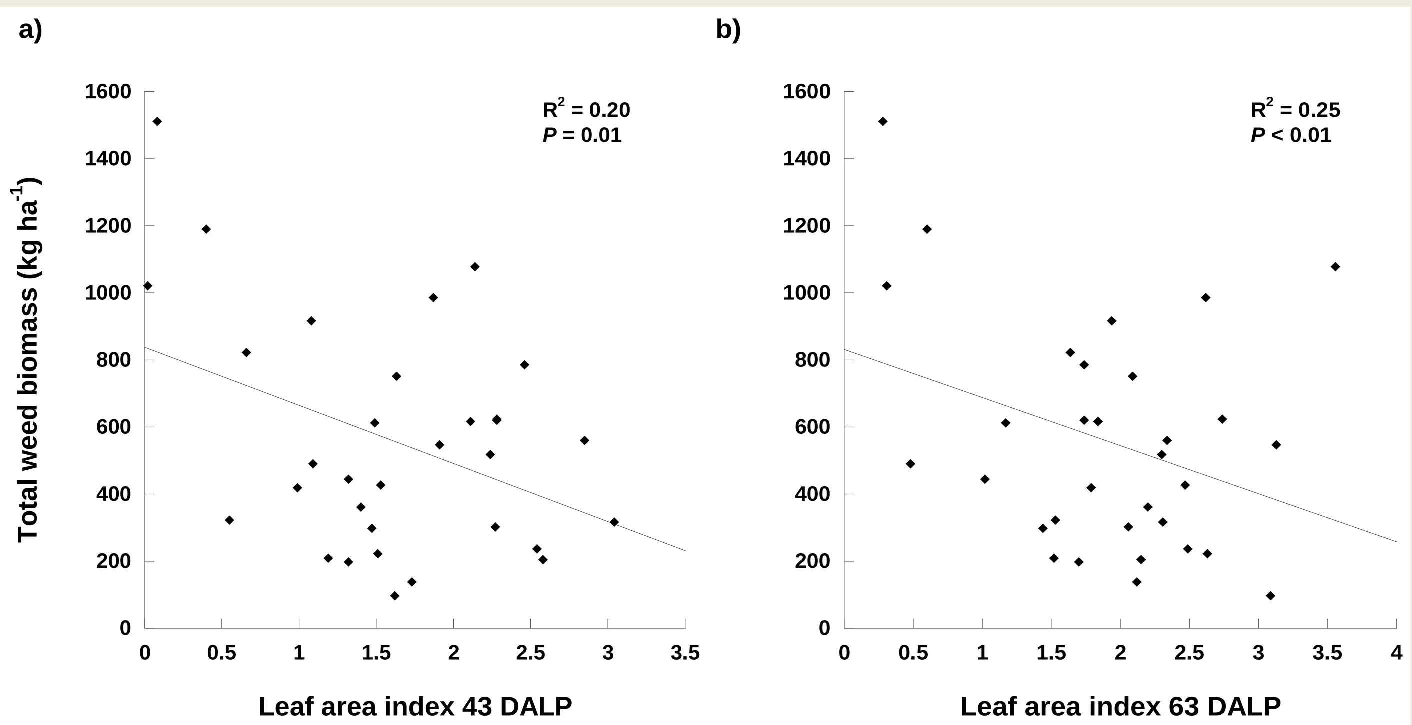

Fig 5. Relationship between leaf area index (LAI) and total weed biomass (kg ha^{-1}) (a) 43 and (b) 63 days after last planting (DALP). There were significant (P ≤ 0.05) negative linear relationships between LAI and total weed biomass with this relationship stronger later in the growing season.

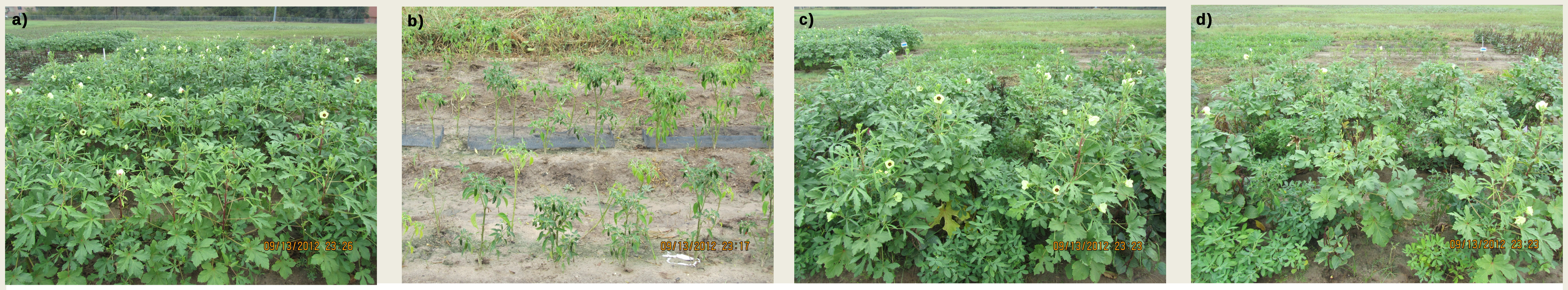

Fig 6. Images of (a) okra grown in monoculture (b) pepper monoculture , (b) peanut-watermelon-okra-cowpea (W_{pwoc}) and peanut-watermelon-okra-cowpea-pepper (W_{all}) 63 DALP in year 2. Large canopy gaps were evident in pepper monoculture and small gaps began to form with the addition of pepper in the W_{all} intercropping scheme.

Summary and Discussion

- All intercropping combinations effectively suppressed broadleaved weeds, nutsedges, and grasses in year 1 (Fig. 2), suggesting watermelon performed well as a smother crop
- Only nutsedges were suppressed in year 2 in pepper monoculture in part due to changes to relative planting dates that altered species dominance patterns and reduced watermelon biomass
- Crops with small leaf area such as pepper (Fig. 4) benefited from multifunctional intercropping with regards to weed suppression (without sacrificing overall plot yields (Franco et al., 2015))
- Leaf area index accounted for 25% of the variability in total weed biomass 63 DALP in year 2 (Fig. 5), suggesting an architecturally complex intercropping system has the potential to effectively increase canopy density, utilizing more of available solar radiation, and reduce weed pressure
- This may offer organic producers another management tool for the control of hard-to-control perennial weeds such as purple and yellow nutsedge

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