

Introduction

Cover crops can be an effective means to provide agroecological services such as promoting soil health, suppressing weeds, and enhancing soil organic matter. Recently there has been increasing interest in improving cropping system diversity by using cover crop mixtures. In our previous trials in north-central Florida, evaluations of 4-component mixes containing various proportions of sunn hemp (*Crotalaria juncea* cv. Tropic Sun), slenderleaf rattlebox (*C. ochroleuca*), hairy indigo (*Indigofera hirsuta*), and American jointvetch (*Aeschynomene americana*) seed resulted in cover crop mixtures that were dominated by sunn hemp. In an effort to ensure greater representation of the other species in the mixture, a smaller stature sunn hemp cultivar, AU Golden, was selected to replace 'Tropic Sun' in the 2017 study. The objective of the study was to compare 4-component mixtures with monocultures of the component species to determine whether mixtures are capable of providing equivalent or superior biomass production and weed suppression.

Materials and Methods

- **Study locations:** University of Florida Plant Science Research and Education Unit, Citra, FL and Rosie's Organic Farm, Gainesville, FL.
- **Experimental design:** Randomized complete block design with four replications. Plot size was 15 ft by 15 ft with 5-ft alleys between plots.
- **Treatments:** Monocultures and 4-way mixtures of *Aeschynomene americana*, *Crotalaria juncea* cv. AU Golden, *C. ochroleuca*, *Indigofera hirsuta* (Table 1) and a weedy control (WC). Seeds were broadcast by hand and the cover cropping period was 8 weeks.
- **Data collection and analysis:** Photosynthetically active radiation (PAR) penetrating the canopy was measured using an AccuPAR ceptometer at 2, 4, 6, and 8 weeks after planting (WAP). Weed density, weed biomass, and cover crop biomass were collected using two randomly placed 0.5 m x 0.5 m quadrats per plot at 4 and 8 WAP. Weeds were counted and categorized as broadleaf, sedge, and grass. Weed and cover crop samples were oven-dried and weighed. Data were analyzed using the GLIMMIX and MIXED procedures of the SAS statistical software package for Windows (version 9.2 SAS Institute Inc., Cary, NC).

Table 1. Species and seeding rates of monoculture and mixtures.

Cover Crop Treatment	Seeding Rate (lb/ac)
<i>Aeschynomene americana</i> (AA)	20
<i>Crotalaria juncea</i> (CJ)	40
<i>Crotalaria ochroleuca</i> (CO)	20
<i>Indigofera hirsuta</i> (IH)	20
Mix 1 (1:1:1:1)	CO 6, AA 6, CJ 6, IH 6
Mix 2 (1:2:1:2)	CO 6, AA 12, CJ 6, IH 12
Mix 3 (2:1:1:1)	CO 12, AA 6, CJ 6, IH 6
Mix 4 (2:2:1:3)	CO 12, AA 12, CJ 6, IH 18



Figure 1. Cover crop monocultures at 8 weeks after planting: *Aeschynomene americana* (A), *Crotalaria juncea* (cv. AU Golden) (B), *C. ochroleuca* (C), and *Indigofera hirsuta* (D).

Results

Table 2. Weed density in response to cover crop monocultures and 4-way mixtures of *Aeschynomene americana* (AA), *Crotalaria juncea* cv. AU Golden (CJ), *C. ochroleuca* (CO), *Indigofera hirsuta* (IH) at 8 weeks after planting (WAP).

Treatment	Citra				Rosie's			
	BL ^z	Grass	Sedge	Total	BL	Grass	Sedge	Total
	plants m ⁻² (8 WAP)							
WC	485	562	300 a	1347	16	63	16 cd	96
AA	423	498	175 bc	1096	30	89	63 ab	182
CJ	610	657	160 c	1427	19	60	95 a	175
CO	709	783	295 a	1788	16	87	32 bcd	136
IH	307	366	206 bc	880	2	58	48 bc	108
Mix-1	339	424	257 ab	1020	13	67	19 cd	99
Mix-2	412	536	206 bc	1154	25	88	37 bcd	150
Mix-3	550	666	229 abc	1445	49	40	9 d	98
Mix-4	291	374	194 bc	860	3	65	34 bcd	103
<i>P</i> -value	0.1	0.11	0.01	0.09	0.14	0.72	0.0003	0.35

^z BL – Broadleaf weeds

Table 3. Weed biomass in response to cover crop monocultures and 4-way mixtures of *Aeschynomene americana* (AA), *Crotalaria juncea* cv. AU Golden (CJ), *C. ochroleuca* (CO), *Indigofera hirsuta* (IH) at 8 weeks after planting (WAP).

Treatment	Citra				Rosie's			
	BL	Grass	Sedge	Total	BL	Grass	Sedge	Total
	kg ha ⁻¹ (8 WAP)							
WC	868 ab	215	776 a	1859 a	59 a	3591 a	142	3791 a
AA	893 a	171	414 bcd	1478 bc	27 abc	2236 bc	198	2461 bc
CJ	511 d	58	147 d	716 f	31 abc	1219 cd	384	1635 bc
CO	852 abc	164	678 ab	1695 ab	48 ab	2361 b	165	2574 b
IH	434 d	174	617 abc	1226 cde	3 c	132 d	332	1467 c
Mix-1	589 cd	129	667 ab	1385 bcd	0 c	1844 bcd	160	2004 bc
Mix-2	596 bcd	231	278 d	1105 de	9 bc	2391 b	135	2536 b
Mix-3	588 cd	279	322 cd	1190 cde	10 bc	1451 bcd	107	1568 bc
Mix-4	378 d	174	401 bcd	953 ef	4 c	1390 bcd	159	1553 bc
<i>P</i> -value	0.0011	0.18	0.0006	<0.0001	0.04	0.0002	0.11	0.0006

^z BL – Broadleaf weeds

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Figure 2. Cover crop mixture treatments at 8 weeks after planting: Mix 1 (A), Mix 2 (B), Mix 3 (C), Mix 4 (D).

Table 4. Cover crop biomass accumulation at 8 weeks after planting (WAP).

Treatment	Citra		Rosie's	
	kg ha ⁻¹ (8 WAP)			
<i>Aeschynomene americana</i> (AA)	220 c	584 c		
<i>Crotalaria juncea</i> (CJ)	2208 a	3655 a		
<i>Crotalaria ochroleuca</i> (CO)	540 c	758 c		
<i>Indigofera hirsuta</i> (IH)	1447 b	1743 b		
Mix-1	1710 ab	2265 b		
Mix-2	1429 b	1891 b		
Mix-3	1610 b	2093 b		
Mix-4	1946 ab	2389 b		
<i>P</i> -value	<0.0001	<0.0001		

Table 5. Percent photosynthetically active radiation penetrating the cover canopy measured at two-week intervals after planting.^z

WAP	CJ	CO	AA	IH	Mix-1	Mix-2	Mix-3	Mix-4
2	91	97	98	97	97	97	95	96
4	67	87	83	73	76	71	75	74
6	22	34	41	22	25	22	29	17
8	56	54	68	47	52	52	59	47
LC	***	***	***	***	***	***	***	***
QC	***	***	***	***	***	***	***	***

^z PAR at both locations was averaged as there was no significant interaction between crop and location. WAP – Weeks after planting; LC and QC indicate linear and quadratic contrasts, respectively. *** Data significant at P < 0.001.

Conclusions

- The only significant decrease in weed density relative to the weedy control occurred with the *C. juncea* monoculture in Citra.
- Total weed biomass was lowest with *C. juncea* at 8 WAP in Citra, which was not significantly different from Mix 4. *I. hirsuta* produced the lowest weed biomass at Rosie's which was not significantly different from *C. juncea* and Mixes 1, 3, and 4.
- At Rosie's the *C. juncea* produced the highest cover crop biomass; whereas at Citra, *C. juncea* biomass was highest but not significantly different from Mix 1, 2, and 3 by 8 WAP.
- By 6 WAP *C. juncea* and all mixes had decreased PAR penetrating the canopy to less than 30%.
- Mixes outperformed monocultures of *A. americana* and *C. ochroleuca*, but not *C. juncea* and *I. hirsuta* monocultures.