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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 location:** University of Florida, IFAS Plant Science Research and Education Unit, Citra, 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 on June 1, 2017 and the cover cropping period was 8 weeks.
- **Data collection and analysis:** Photosynthetically active radiation 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 by 0.5 m quadrats per plot at 4 and 8 weeks after planting. Weeds were counted and categorized as broadleaf, sedges, and grasses. 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 Cary NC). Means in columns followed by the same letter are not significantly different according to the Tukey test or the DIFF option of the LSmeans statement, respectively ($P < 0.05$).

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

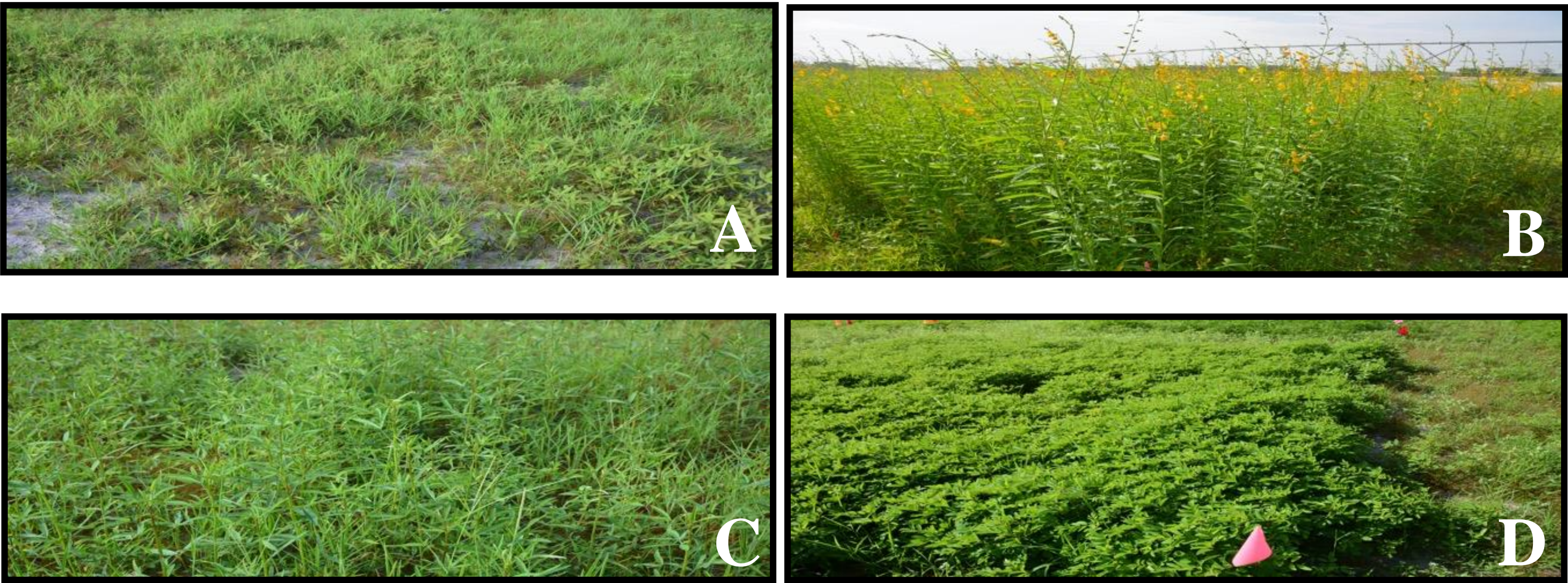


Figure 1. Cover crop monocultures at 8 weeks after planting: *Aeschynomene americana* (A), *Crotalaria juncea* (cv. AU Golden) (B), *C. ochroleuca* (C), and *Indigofera hirsuta* (D).

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 4 and 8 weeks after planting (WAP).

Treatment	4 WAP				8 WAP			
	Broadleaf	Grass	Sedge	Total	Broadleaf	Grass	Sedge	Total
	(plants m ⁻²)							
WC	582	64	333 ab	980	485	562	300 a	1347
AA	452	85	285 ab	823	423	498	175 ab	1096
CJ	642	52	182 b	877	610	657	160 b	1427
CO	561	84	432 a	1078	709	783	295 ab	1788
IH	357	44	291 ab	692	307	366	206 ab	880
Mix-1	355	54	382 ab	792	339	424	257 ab	1020
Mix-2	412	68	223 ab	703	412	536	206 ab	1154
Mix-3	546	78	326 ab	950	550	666	229 ab	1445
Mix-4	281	71	278 ab	631	291	374	194 ab	860
P-value	0.15	0.63	0.01	0.22	0.1	0.11	0.01	0.09

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 4 and 8 weeks after planting (WAP).

Treatment	4 WAP				8 WAP			
	Broadleaf	Grass	Sedge	Total	Broadleaf	Grass	Sedge	Total
	(kg ha ⁻¹)							
WC	338 ab	45	171 ab	554 ab	868 a	215	776 a	1859 a
AA	260 ab	30	118 ab	409 ab	893 a	171	414 abc	1478 abc
CJ	269 ab	44	91 b	404 b	611 ab	68	181 c	860 d
CO	358 a	52	231 a	641 a	852 a	164	678 ab	1695 ab
IH	184 b	62	197 ab	444 ab	434 b	174	617 abc	1226 bcd
Mix-1	290 ab	37	170 ab	497 ab	589 ab	129	667 ab	1385 abcd
Mix-2	289 ab	60	148 ab	497 ab	596 ab	231	278 bc	1105 cd
Mix-3	287 ab	72	204 ab	563 ab	588 ab	279	322 abc	1190 bcd
Mix-4	185 b	61	186 ab	433 ab	378 b	174	401 abc	953 cd
P-value	0.01	0.51	0.02	0.02	0.0004	0.22	0.0011	<0.0001

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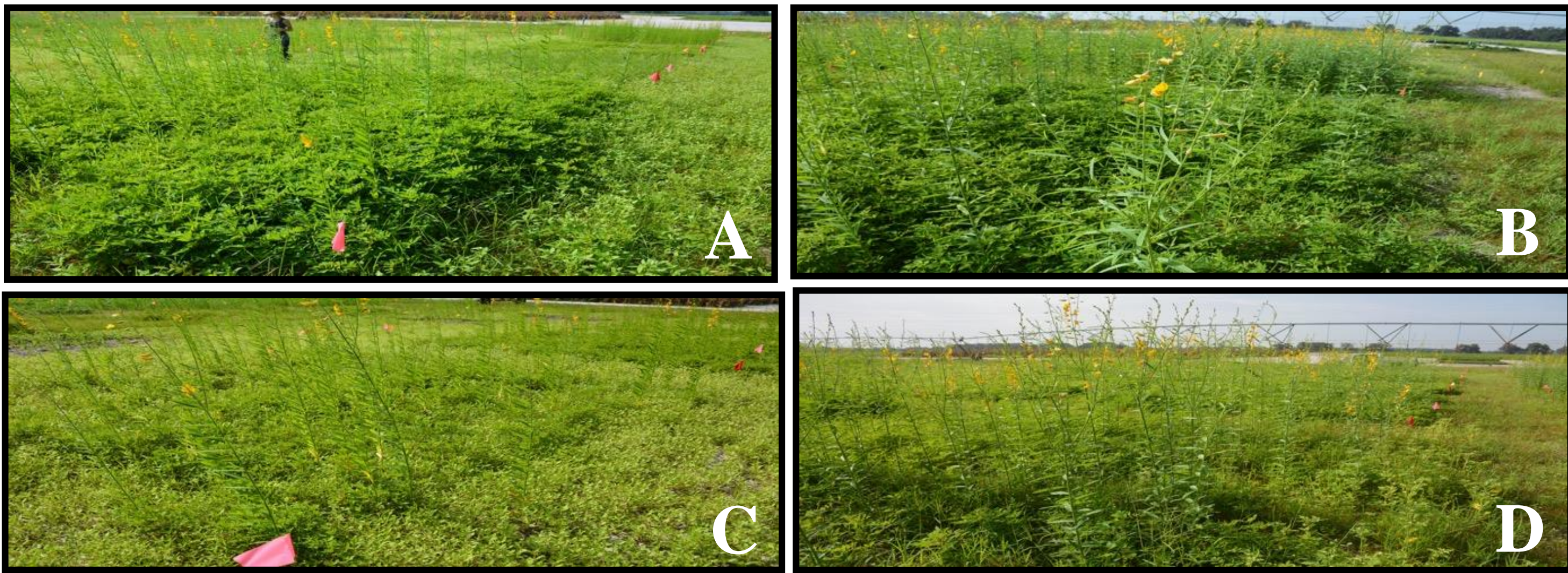


Figure 2. Cover crop mixture treatments at 8 weeks after planting: Mix 1 (A), Mix 2 (B), Mix 3 (C), Mix 4 (D).

Table 4. Cover crop biomass accumulation at four and eight weeks after planting.

Treatment	4 WAP	8 WAP
	kg ha ⁻¹	
<i>Aeschynomene americana</i> (AA)	49 de	220 c
<i>Crotalaria juncea</i> (CJ)	301 ab	2208 a
<i>Crotalaria ochroleuca</i> (CO)	84 cde	540 bc
<i>Indigofera hirsuta</i> (IH)	187 bcd	1447 ab
Mix-1	254 abc	1710 a
Mix-2	236 abc	1429 ab
Mix-3	210 bcd	1610 a
Mix-4	401 a	1946 a
P-value	<0.0001	<0.0001

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

WAP	CJ	CO	AA	IH	Mix-1	Mix-2	Mix-3	Mix-4
2	90 a	98 a	98 a	99 a	98 a	98 a	97 a	98 a
4	70 b	89 a	90 a	89 a	91 a	88 a	83 a	84 b
6	22 c	43 b	61 b	28 b	34 c	31 b	37 b	20 d
8	49 d	51 b	66 b	31 b	47 b	33 b	54 b	31 c
P-value	<0.0001	<0.0001	0.0006	<0.0001	<0.0001	<0.0001	0.0002	<0.0001

Conclusions

- The only significant decrease in weed density relative to the weedy control occurred with the *Crotalaria juncea* monoculture (*C. juncea*).
- Total weed biomass was lowest with *C. juncea* at 8 WAP, which was not significantly different from that with *I. hirsuta* or Mixes 1, 2, 3, and 4.
- Total cover crop biomass was highest with Mix 4 by 4 WAP, but this was not significantly different from that with *C. juncea*, Mix 1, and Mix 2.
- Mix 4 and *C. juncea* resulted in significant decreases in PAR penetrating the canopy by 4 WAP, which indicated more rapid canopy closure.
- Under the high weed pressure conditions of this trial only Mix 4, which contained the highest proportion of *I. hirsuta* seed, performed comparably to *C. juncea*.