

Addressing Some Constraints of ‘Tropic Sun’ Sunn Hemp and ‘Iron Clay’ Cowpea

Introduction

- Cover crops can contribute to more sustainable cropping systems by providing agroecosystem services such as improved soil health, and suppression of weeds and plant-parasitic nematodes. However, some commonly used cover crop cultivars also exhibit undesirable traits.
- The sunn hemp (*Crotalaria juncea*) cultivar Tropic Sun is unable to consistently set seed within the continental US. Whereas, the day neutral cultivar ‘AU Golden’, which can set seed, is considered to have low biomass production that may compromise weed suppression. ‘Iron Clay’ cowpea (*Vigna unguiculata*) produces hard seed that can cause volunteer plants to emerge in subsequent cash crops.
- Therefore, the objective of the study was to compare the biomass production and weed and plant-parasitic nematode suppression of commercial and alternative germplasm lines of sunn hemp and cowpea. A commercially available slenderleaf rattlebox (*C. ochroleuca*) genotype and a USDA accession were also evaluated.

Materials and Methods

- **Study locations:** Trials were conducted at the Plant Science Research and Education Unit, Citra, FL and at 3 north-central Florida organic farms: Frog Song Organics, Rosie’s Organic Farm, and Siembra Farm.
- **Treatments:** Commercially available and alternative germplasm of sunn hemp, cowpea, and slenderleaf rattlebox were evaluated (Table 1) and compared with no cover crop or weedy control (WC). Seeds were broadcast by hand in May-June 2018 at all 4 locations.
- **Experimental design:** Randomized complete block with 4 replications.
- **Data collection:** Data were collected on cover crop and weed shoot biomass using two randomly placed quadrats 0.5 m × 0.5 m per plot at 8 weeks after planting (WAP). A composite soil sample from each plot was collected by using a soil sampler at 6-inch depth to determine nematode infestation before planting and at 8 weeks after planting.
- **Statistical analysis:** Data were analyzed using the GLIMMIX procedure of SAS (version 9.2 SAS Institute, Cary, NC) and least squares means were separated using the DIFF option of the LSmeans statement at $P \leq 0.05$. Least squares means followed by different lowercase and uppercase letters indicate differences within locations and across locations, respectively. NS indicates no significant difference.

Table 1. Cover crop germplasm and seeding rates evaluated.

Cover crop	Germplasm type	Seeding rate (lb/acre) ^a
‘AU Golden’	Commercial	40
‘Tropic Sun’	Commercial	40
Sanni	Alternative	40
‘Iron Clay’	Commercial	68
US 1136	Alternative	140
US 1137	Alternative	130
US 1138	Alternative	90
Red Hemp	Commercial	20
PI 274767	Alternative	20

^aSeeding rates for cowpea cultivar and germplasm lines in lb/acre are equivalent to 75 seeds/m².



Figure 1. Slenderleaf rattle box (*Crotalaria ochroleuca*) cover crops at eight weeks after planting.

Results

Table 2. Cover crop biomass accumulation at eight weeks after planting.

Cover Crop	Citra	Siembra	Frog Song	Rosie’s	Sig.
Biomass (kg ha ⁻¹)					
Sanni	2251 a (B)	5812 a (A)	5205 ab (A)	2097 abc (B)	*
‘AU Golden’	1600 abc (C)	6027 a (A)	4644 ab (B)	2130 ab (C)	*
‘Tropic Sun’	1811 ab (B)	5061 ab (A)	5711 a (A)	2546 a (B)	*
US 1136	1157 bcd (B)	5355 a (A)	3988 bc (A)	1370 cd (B)	*
US 1137	740 d (C)	4686 ab (A)	2314 de (B)	1799 bcd (B)	*
US 1138	931 cd (C)	4633 ab (A)	3236 cd (B)	1755 bcd (C)	*
‘Iron Clay’	883 cd (C)	3685 b (A)	2013 de (B)	1219 d (BC)	*
Red Hemp	802 d (AB)	560 c (BC)	1249 e (A)	296 e (C)	*
PI 274767	554 d (B)	-	1277 e (A)	-	*
Significance	*	*	*	*	*

- ❖ Sanni shoot biomass production was not significantly different from that with ‘Tropic Sun’ and ‘AU Golden’ at all four locations.
- ❖ Cowpea biomass was equivalent to or greater than ‘Iron Clay’.
- ❖ PI 274767 produced similar biomass to Red Hemp.

Table 3. Effect of cover crop on weed biomass at eight weeks after planting.

Cover Crop	Citra	Siembra	Frog Song	Rosie’s	Sig.
Biomass (kg ha ⁻¹)					
Sanni	532 bc (BC)	181 c (C)	826 bc (A)	1151 cd (A)	*
‘AU Golden’	450 bc (B)	116 c (B)	574 cde (B)	1915 b (A)	*
‘Tropic Sun’	364 bc (C)	190 c (C)	707 cd (B)	2172 ab (A)	*
US 1136	353 bc (B)	0 c (C)	112 f (BC)	752 d (A)	*
US 1137	451 bc (AB)	8 c (C)	218 ef (BC)	739 d (A)	*
US 1138	264 c (BC)	71 c (C)	395 def (B)	814 cd (A)	*
‘Iron Clay’	273 c (B)	344 c (B)	1224 ab (A)	1350 c (A)	*
Red Hemp	424 bc (C)	1940 b (AB)	1309 a (BC)	2672 a (A)	*
PI 274767	677 ab (B)	-	1632 a (A)	-	*
WC	936 a (B)	3832 a (A)	1563 a (B)	2413 ab (AB)	*
Significance	*	*	*	*	*

- ❖ Weed biomass suppression with Sanni sunn hemp was as effective as with the commercial cultivars at Citra, Siembra, and Frog Song and better than the commercial cultivars at Rosie’s.
- ❖ The three cowpea germplasm lines resulted in either lower or similar weed biomass than ‘Iron Clay’ cowpea at all locations.
- ❖ Red Hemp & PI 274767 did not suppress weeds effectively at Frog Song. At Citra Red Hemp suppressed weed biomass to less than the weedy control but PI 274767 did not provide significant weed suppression.

Table 4. Effect of cover crops on root-knot and ring nematode populations.

Treatment	Root-knot nematode			Ring nematode		
	Pi ^a	Pf ^b	Rf ^c	Pi ^a	Pf ^b	Rf ^c
Sanni	17.2	2.8	0.2	8.7	3.7	0.4
‘AU Golden’	24.8	4.1	0.2	8.9	9.0	1.0
‘Tropic Sun’	26.4	4.1	0.2	14.6	7.4	0.5
US 1136	16.5	7.6	0.5	10.0	6.1	0.6
US 1137	18.8	4.8	0.3	8.9	7.1	0.8
US 1138	18.5	6.6	0.3	9.5	7.1	0.7
‘Iron Clay’	22.1	5.5	0.2	8.0	5.3	0.6
Red Hemp	15.3	3.6	0.2	13.1	7.1	0.5
PI 274767	31.1	6.2	0.2	10.8	9.7	0.9
WC	15.8	4.4	0.3	7.5	5.7	0.7
Significance	NS ^d	NS	NS	NS	NS	NS

^aPi = Initial population density; ^bPf = Final population density; ^cRf = Reproduction factor (Pf/Pi). Data for all locations were pooled.

- ❖ No proliferation of plant-pathogenic nematodes occurred with either the cover crops or the weedy control.

Conclusions

- Alternative germplasm of sunn hemp and cowpea provided equivalent or better cover crop biomass accumulation and weed suppression than their respective commercial cultivars.
- The lower shoot biomass accumulation with Red Hemp and PI 274767 provided less effective weed suppression.
- Sanni and the three cowpea cultivars US 1136, US 1137, and US 1138 appear to be viable replacements for ‘Tropic Sun’ and ‘Iron Clay’ cowpea, respectively.
- Nematode host status should be assessed at higher populations.



Figure 2. Sunn hemp (*Crotalaria juncea*) and cowpea (*Vigna unguiculata*) cover crops at eight weeks after planting.

Acknowledgements

- This material is based upon work that is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under award number 2015-38640-23780 through the Southern Sustainable Agriculture Research and Education program, under subaward number LS16-270. USDA is an equal opportunity employer and service provider. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.
- We thank the cooperating farmers at Frog Song Organics, Rosie’s Organic Farm, and Siembra Farm for their willingness to engage in on-farm research.