

Size Matters: Sunn Hemp Cultivar Choice Influences Companion Species Biomass Production in a Cover Crop Mixture

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Adding Diversity with Cover Crops

Increasing the cover crop options for annual hill production of organic strawberry (*Fragaria ×ananassa*) can increase cropping system diversity while providing agroecosystem services. In summer 2013, sunn hemp (*Crotalaria juncea* cv. Tropic Sun) and hairy indigo (*Indigofera hirsuta*) were the best performing of four leguminous cover crops. The cover crops had been selected for evaluation due to their potential for off-season suppression of weeds and plant-pathogenic nematodes and as a source of green manure. Stakeholder evaluation of the research encouraged the evaluation of mixtures. As a result, a 2014 study compared the sunn hemp and hairy indigo performance with that of a 4-way mix (Table 1).

Table 1. Species and seeding rates of cover crops used in monoculture and mixture in summer 2014 prior to organic strawberry. The 4-way mixture was evaluated at only 1 of the 4 locations.

Cover Crop	Rate
Sunn hemp	40 lb/ac
Hairy indigo	20 lb/ac
4-way mixture	Sunn hemp, hairy indigo, short-flower rattlebox, American jointvetch (12 lb, 12 lb, 6 lb, and 6 lb/ac)
Weedy	No cover crop

2014 Study Results:

- The 4-way mixture produced less biomass than the sunn hemp monoculture
- No significant difference in total weed biomass between the sunn hemp monoculture and the 4-way mix
- 80% of the biomass consisted of sunn hemp.

Seeking More Evenness of Species in the Mix

The objective of the 2015 study was to determine the optimal proportions for the components of a 4-species cover crop mixture that provide a diverse, weed-suppressive canopy. We replaced the short-flower rattlebox (*C. breviflora*) with slenderleaf rattlebox (*C. ochroleuca*) since the latter was resistant to the sting nematode (*Belonolaimus longicaudatus*) – a key pathogen of strawberry.

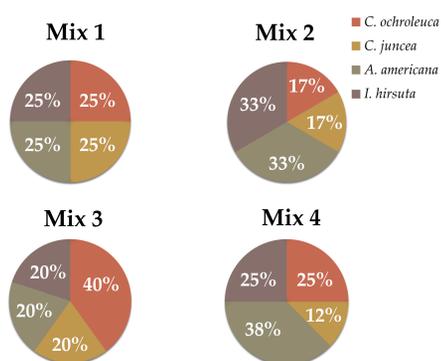


Figure 1. Seed composition of 4-way mixes of *Crotalaria juncea* cv. Tropic Sun, *C. ochroleuca*, *Aeschynomene americana*, and *Indigofera hirsuta* in 2015 trials.



Figure 2. Cover crop mixtures at Citra, FL at 10 weeks after planting (WAP).

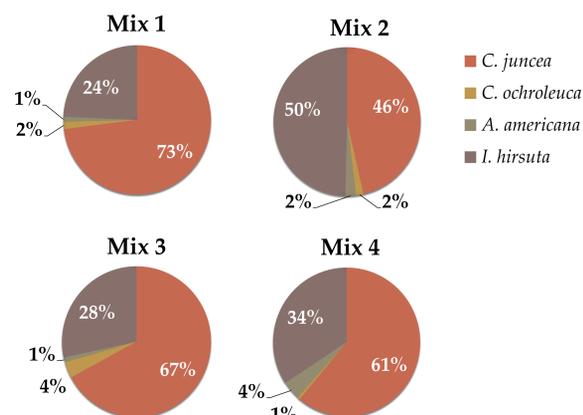


Figure 3: Sunn hemp (*C. juncea*) produced 46% to 73% of the biomass at Citra (shown above in chart) and 80 to 90% at Rosie's Organic Farm (not shown). Hairy indigo (*I. hirsuta*) was the only other species that produced more than 24% to 50% shoot biomass.

2015 Study Results:

- Despite decreasing sunn hemp proportion in the mix to 25% or less by seed weight, sunn hemp continued to dominate mixes.
- Cover crop mixtures had no significant effect on weed biomass.
- 'Tropic Sun' sunn hemp appeared to be too competitive and may have suppressed the establishment of companion species.

Substituting 'AU Golden' for 'Tropic Sun'

In a summer 2016 trial in Citra, FL, we used 'AU Golden', a day-neutral, shorter stature sunn hemp cultivar than the short-day 'Tropic Sun'. We compared a 4-way mix treatment comprised of sunn hemp, slenderleaf rattlebox, hairy indigo, and American jointvetch in the proportions 2:2:1:1 by seed weight with monocultures of 'Tropic Sun' sunn hemp and hairy indigo, and a weedy control.

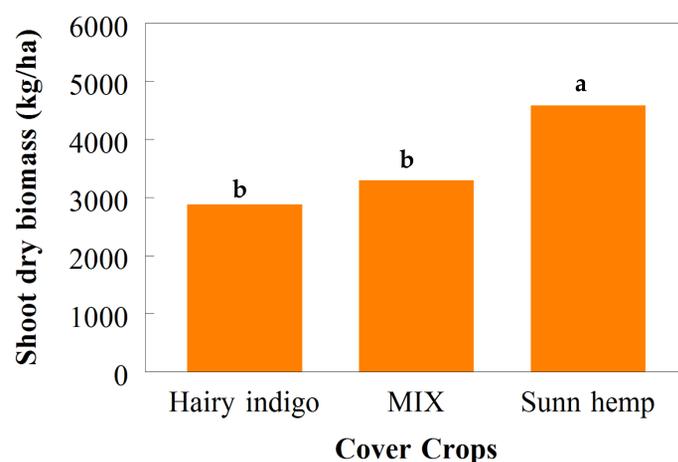


Figure 4. 'Tropic Sun' sunn hemp at 40 lb/ac resulted in higher shoot biomass than the 4-way mix containing 'AU Golden' and the hairy indigo monoculture at 8 WAP.

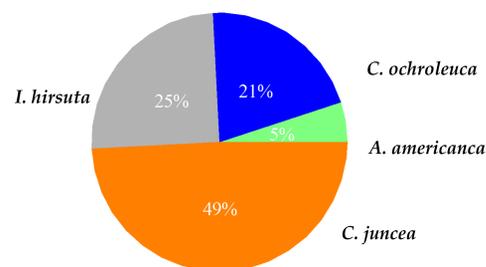


Figure 5. By 8 WAP, 'AU Golden' sunn hemp biomass was 49% with 25%, 21%, and 5% occurring with hairy indigo, slenderleaf rattlebox, and American jointvetch, respectively. In 2017 the percentages were 54%, 37%, 2%, and 7%, respectively, likely affected by poor quality slenderleaf rattlebox seed.

In summer 2017 trials, the seed proportions used for mixes in Figure 1 were reevaluated with 'AU Golden' as the sunn hemp cultivar. We also included monocultures of the component species of the mixes.

Table 2. Cover crop biomass, total weed biomass, and total weed density at 8 WAP in Citra, FL (summer 2017).

Treatment	Cover Crop Biomass (kg/ha)	Total Weed biomass (kg/ha)	Total Weed Density (plants/m ²)
Weedy control	---	1859 a	1347
<i>A. americana</i>	220 c	1478 abc	1096
<i>C. juncea</i>	2208 a	860 d	1427
<i>C. ochroleuca</i>	540 bc	1695 ab	1788
<i>I. hirsuta</i>	1447 ab	1226 bcd	880
Mix-1	1710 a	1385 abcd	1020
Mix-2	1429 ab	1105 cd	1154
Mix-3	1610 a	1190 bcd	1445
Mix-4	1946 a	953 cd	860
P-value	<0.0001	<0.0001	0.09

2017 Mix/Monoculture Comparison Results:

- The weed infestation was very high in the organic field used.
- Cover crop biomass was highest with the sunn hemp monoculture, but not significantly different from hairy indigo and all 4 mixes.
- The best weed biomass suppression occurred with the sunn hemp monoculture, but was not significantly different from hairy indigo and the 4 mixes.
- The smaller stature 'AU Golden' appears to have good potential for use in mixes that are as effective in producing biomass and weed suppression as the monoculture.

Conclusions

- The shoot biomass of 4-way legume mixes that contain 'Tropic Sun' sunn hemp tend to be dominated by the contribution from sunn hemp.
- Replacing 'Tropic Sun' with the smaller stature 'AU Golden' increased the percentage of the companion species in mixes.
- The 4-way mix with 'AU Golden' resulted in less biomass production than a 'Tropic Sun' monoculture.
- The smaller stature 'AU Golden' is better suited to mixtures that include shorter and/or slower growing companion species than the taller 'Tropic Sun'.

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