Reduced tillage termination of cover crop systems in the tropics

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Introduction:
Cover crop (CC) use is increasing around the world and their use is considered a valued component of sustainable agricultural production systems. Cover crops provide a range of agricultural and ecosystem benefits which range from soil protection and improvement to pest reduction. Low external input farmers rely heavily on farm-derived resources such as cover crops for soil and pest management. Tropical agroecosystems require cover crop management strategies to be modified to meet environmental and cultural conditions and the use of reduced tillage practices have been promoted to increase soil conservation and reduce on farm expenses.

Conventional cover crop management strategies were developed for temperate climates where plant senescence is timed with seasonal transition for effective CC termination. Mechanical cutting followed by full incorporations of CCs in the tropics has been the accepted practice for CC termination. While an effective termination tool, this method relies on conventional soil tillage that can result in decreased soil conservation. The alternative method of rolling/crimping CCs to produce surface sheet mulch has gained attention as a progressive practice that reduces tillage and provides additional agroecosystem benefits. However, tropical environments have a 365 days warm growing cycle which promotes regrowth capabilities of many indeterminate CCs through potential crown and bud meristematic activity. Assessment of different mechanical CC termination methods is needed to avoid having CCs become weed pests. A CC termination study was conducted on St. Croix in the U.S. Virgin Islands to test 4 mechanical termination methods and their effects on CC regrowth, as well as deleterious and grass weed suppression.

Objectives:
To evaluate sunn hemp (Crotalaria juncea cv. IAC-1) SH and lablab (Lathyrus purpureus cv. Rongai LL) as CCs and their ability to suppress weeds.

To evaluate 4 different types of mechanical CC termination and their effect on CC regrowth and weed development.

To monitor the physical and chemical decomposition of SH and LL residue.

Materials and Methods:
At the University of the Virgin Islands in St. Croix, sunn hemp and lablab were planted on October 3, 2012, evaluated as CCs, and then terminated 120 days after planting. No additional external inputs were applied to the fields.

Termination treatments tested consisted of:
1) Full incorporation with a disc harrow (3 passes),
2) Minimum incorporation with a disc-harrow (1 pass),
3) Mowing with a rotary brush mower (1 pass),
4) Roll down with a roller-crimper (1 pass).

Cover crop and weed biomass were determined prior to termination and subsequent CC regrowth and weed biomass was determined at 6, 9, and 12 weeks post-termination. Weed species were separated by weed class and designated either a grass or broadleaf, no weeds were encountered in this trial. Letter bags containing either SH or LL crop residue were placed in treatments 1 and 2 at day 1 after termination and were collected at 6, 9, and 63 days after termination and analyzed for plant chemical properties.

Results and Discussion:
Sunn hemp yielded the highest amount of CC biomass at termination with 6,800 ± 684 kg/ha compared to LL at 3,126 ± 683 (p<0.002). Lablab had greater plant tissue nitrogen (N) content than SH at 2.5% ± 0.1 compared to 1.7 ± 0.1, respectively. However, due to the greater SH biomass, total estimated N contribution was greater for SH (117 kg/ha ± 15) than for LL (70 kg/ha ± 15) (p<0.05). At 6 weeks after termination, SH had 0 regrowth across all treatments compared to LL which had the greatest measured regrowth from treatment 2 (2.1 ± 0.18) and similar regrowth in treatments 3, 4, and 5 (11 ± 19, 91 ± 19, and 498 ± 196 respectively, p<0.05). At 9 and 12 weeks after termination, SH regrowth was effectively controlled in all termination treatments with the only measurable regrowth occurring in plots terminated with the roller-crimper (Table 2). In contrast, LL had higher levels of regrowth across all treatments for all three post-termination harvests and termination treatments 1, 3, and 4 resulted in similar LL regrowth for each respective post-termination harvest date. Results indicate that SH has a favorable response to all reduced tillage termination methods tested compared to LL, thus, SH may be better suited for use as a CC in reduced tillage tropical agroecosystems.

Sunn hemp controlled grass weeds in treatments 1, 2, and 4 through week 9 which had similar biomass accumulation of grass weeds at week 9 with 0, 8, and 196 ± 127 kg/ha. At 12 weeks after SH termination, broadleaf and grass weed levels exceeding 1800 kg/ha in all treatments except for treatment 1 which had the lowest levels at 631 ± 260 kg/ha and 44 ± 260 kg/ha, respectively (p<0.05). Therefore, full incorporation with 3 passes with the disc harrow resulted in the most effective termination and weed suppression method for SH.