Coimbatore 3 (CO3 - *Pennisetum perpureum* X *Pennisetum americarnum*) grass as an intercrop under coconut (*Cocos nucifera*)

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Abstract. The effect of cultivation of Coimbatore 3 (CO3; *Pennisetum perpureum x Pennisetum americarnum*) grass under coconut has not been researched in Sri Lanka. We examined the effect of different levels of nitrogen fertilizer and the spread of CO3 roots in the soil. CO3 root slips were cultivated under coconut in two rows with 1x2 m within and between row spacing in a Randomized Complete Block Design with three replicates. Treatments were four Nitrogen (N) levels- 0, 14, 21 and 35 kg N/ha/year. There were sixteen effective palms per treatment. CO3 bushes were harvested at 15 cm height from ground level at 6 monthly intervals. Application of 21 and 35 kg of N/ha/year gave the highest (P>0.05) dry matter yield (DM) of 216 and 225 kg per ha per year respectively compared to other treatments. An average nut yield of 55, 53 and 56 nuts per tree per year were observed in plots receiving 14, 21 and 35 kg N/ha/year respectively. CO3 roots were spread in an area of 0.94 m (width) and 0.65 m (depth). Application of 21 kg of N/ha/year was determined as the best rate of nitrogen to be applied after each pruning of CO3 cultivated under coconut. It is advisable to cultivate only 3 rows of CO3 within a coconut square to avoid CO3 roots invading into the manure circle of the coconut palm.

Keywords: Pasture under coconut, coconut yield, intercropping, nitrogen fertilization.

Introduction

Coimbatore 3 (CO3), the Hybrid of *Pennisetum perpureum x Pennisetum americarnum* was developed by the Tamil Nadu Agricultural University, Coimbatore, India in 1997. It was introduced to Sri Lanka in 1999. CO3 is a vigorously growing bush with high tillering capacity, green forage yield, regeneration capacity, leaf to stem ratio, crude protein content and resistant to pest and diseases (Premaratne and Premalal 2006b). Therefore, the Department of Animal Production and Health, Sri Lanka encouraged livestock farmers to cultivate this fodder as it supplies quality fodder for dairy cows.

Normally, coconut (*Cocos nucifera*) palms are cultivated at a spacing of 8x8 m (coconut square) leaving 75% of the space between palms available for other activities such as cultivation of intercrops and management of livestock. Coconut livestock farming systems provide a steady income with less risk than intercrops. This farming system has several advantages. It provides products such as coconuts and related products; milk, meat, eggs and live animals. In addition, livestock feed on weeds and add manure to coconut palms in the form of dung and urine.

Milk production under the extensive system in the Coconut Triangle (Premaratne and Premalal 2006a) of Sri Lanka is low and amounts to less than 3 liters per day per cow (Somasiri and Gunathilake 2009). However, under an intensive management system that includes feeding quality forage and available concentrates such as coconut poonac and rice bran, milk yield can be increased by up to 9 liters per day per cow (Somasiri and Gunathilake 2009). The major constraint faced by livestock farmers in the coconut triangle and dry zone of Sri Lanka is the lack of quality feeds during the dry season. As a result, the potential milk yield is not obtained. Therefore, preserved feeds and high quality fodders such as tree legumes and fodder grasses are vital during this season.

Many livestock farmers started to cultivate CO3 under coconut as a feed for livestock. Considering its vigorous growth pattern CO3 may be a threat to coconut palms if cultivated as an intercrop without much emphasis on the spacing and application of fertilizer. Research was carried out in 2006 to 2009 at the Coconut Research Institute, Sri Lanka to study the growth pattern of CO3 under coconut as this has not been explored to date. The objectives of this research were to select the best nitrogen fertilizer level to be applied after each cutting of CO3 bushes and to study the pattern of CO3 roots distributed in the soil at the end of the experiment.

Methods

Experimental site

This experiment was carried out at Coconut Research Institute (CRI), Bandirippuwa Estate, Lunuwila in the Intermediate Zone Low Country (IL_1), Sri Lanka. The soil type was Boralu series and land suitability class was S_4 (moderately suitable). Coconut palms were a stand of mixed varieties (Tall, Snadramn and Tall x Snadramn) established in 1976.

Experimental design and treatments

There were four Nitrogen treatments applied namely, T_1- Control (0 kg N/ha/year); T_2- 14 kg N/ha/year; T_3- 21 kg N/ha/year and T_4- 35 kg N/ha/year. Treatments were arranged in a Randomized Complete Block Design (RCBD) with three replicates (plots) per treatment. Treatment plots were spread in a 0.8 ha area and each plot was separated by a guard row of coconut palms. There were sixteen effective palms per treatment.

Land preparation and field establishment

The coconut land was ploughed and then harrowed in September, 2006. Two planting rows were prepared within the coconut square. CO3 root slips were established in October (*maha* season), 2006 with inter and intra row spacing of 2 m and 1 m respectively giving 160 plants per ha (Liyanage *et al.* 1985).

A basal fertilizer mixture (Veterinary Research Institute, Sri Lanka recommendation of Urea – 200 kg/ha/year, Triple Super Phosphate – 120 kg/ha/year and Muriate of Potash – 100 kg/ha/year) was applied at the start and applied annually until the end of the experiment. Periodically goat manure was also applied at a rate of one kg per plant as a source of nitrogen, phosphorous and potassium (Tennakoon and Bandara 2003).

Coconut palms were fertilized annually with the Adult Palm Mixture (APM) recommended by CRI, Lunuwila, Sri Lanka (Circular 2008) at a rate of 12-6-32 of nitrogen, phosphorous and potassium respectively broadcast in a 2 m radius around the coconut palm (Liyange 1999). The field was weeded periodically by mechanical slashing. Plants were not irrigated during the dry season and off-rainy seasons.

Application of treatments

Treatments were applied at the onset of each rainy season (*maha season:* October to January and *yala season:* March to June).

Harvesting

CO3 bushes were harvested by cutting to a height of 15 cm height using a hand sickle every six months. Bushes were weighed at the field to obtain the fresh matter yield and a representative random sample of one kg was obtained to determine dry matter (DM). At the end of the experiment a representative sample of CO3 bushes was uprooted gently from each treatment.

The roots were separated from stem and washed with care and the height and width of roots measured to determine the spread of CO3 roots in the field. Nut yield recordings of the effective palms were also carried out every two months in the period of 2006-2009.

Analysis of data

Data were statistically analyzed by an Analysis of Variance using General Linear Model Procedure in Statistical Analytical Systems (SAS 1999). Least significant difference (LSD) was used to compare the difference between treatments.

Results and Discussion

Average dry matter yield

According to Table 1, T4 had given the highest (P>0.05) average dry matter yield per ha per year compared to the other treatments. However, towards year three, annual average DM yield tend to decrease in all treatments except in T3 though it was not significant. In contrast, Manyawu *et al.* (2003) observed that the DM yields of hybrid *Pennisetums* decreased with frequent cutting intervals (two to four weeks) but were higher at longer cutting intervals (six to ten weeks). Our objective was to see the effect of nitrogen fertilizer on the growth of CO3. Therefore, the cutting frequency used in this experiment was six months. However, with the use of organic manure such as farm yard manure and/or vermin compost and nitrogen fertilizer with coir pith as a moisture absorbent have provided considerably higher CO3 yields in an experiment carried out in India (Subramanian *et al.* 2007).

Average coconut yield

According to Table 2, T2 and T4 had recorded the highest average coconut yield per tree per year whereas, lowest nut yield was recorded in the T1 (P>0.05). According to the results in Table 1 and Table 2, application of Nitrogen increased CO3 yield but did not have any adverse affects on coconut yield. However, further research is needed to see the effect of CO3 on coconut yield.

Root distribution pattern of CO3 plants

Height and width of CO3 roots were measured irrespective of the treatments after the completion of the experiment and this data was used to estimate the maximum number of CO3 rows that can be established within a coconut square using information from Liyange (1999). In the present experiment, CO3 roots had been spread in an area of 0.94

Table 1. Average dry matter (DM) yield of CO3 (Mean ± s.e.).

Treatment (N kg/ha/year)	Dry matter yield kg/ha			Average dry matter yield kg/ha/year
	Year 1	Year 2	Year 3	
T1 (0)	144 ± 47	148 ± 52	81 ± 40	124 ± 43
T2 (14)	216 ± 47	206 ± 52	135 ± 40	186 ± 43
T3 (21)	258 ± 47	190 ± 52	200 ± 40	216 ± 43
T4 (35)	244 ± 47	234 ± 52	196 ± 40	225 ± 43

Table 2. Average coconut yield per tree per year (Mean ± s.e.).

Treatment (N kg/ha/year)	Coconut yield nuts/tree/year			Average coconut yield nuts/tree/year
	Year 1	Year 2	Year 3	
T1 (0)	49 ± 7	60 ± 3	36 ± 4	48 ± 4
T2 (14)	57 ± 7	67 ± 3	41 ± 4	55 ± 4
T3 (21)	52 ± 7	65 ± 3	42 ± 4	53 ± 4
T4 (35)	60 ± 7	67 ± 3	40 ± 4	56 ± 4

m (width) and 0.65 m (depth). While the space between palms is 8x8 m within a coconut square, the manure circle, which has a 2 m radius from the base of the coconut stem, should be left uncultivated with no intercrop. Coconut roots spread into this area even though the coconut roots effectively use only 25% of the total space available in a coconut square (Liyange 1999).

Generally, 80% of the coconut roots are spread to a depth of 80 cm (Liyange 1999) and a width of two meters from the base of the coconut palm. Therefore, within a coconut square only 4 m area is left for cultivation of intercrops. There is a possibility of CO3 roots invading into the manure circle of the coconut palm if planted in more than four rows (1 m x 1 m intra and between row spacing), and there will be competition for soil nutrients and moisture between CO3 roots and coconut roots. Hence, it is advisable to cultivate only three rows of CO3 within a square at a spacing of 1 m x 1 m. Then management practices under coconut such as plucking and collection of nuts, application of fertilizers, and weeding would be unhindered.

Conclusion

Considering the above results, application of 21 kg of N/ha/year is the best rate of nitrogen fertilizer with respect to DM yield of CO3 and coconut yield. Considering the spread of CO3 roots it is suitable to cultivate maximum of three CO3 rows under coconut as an intercrop.

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