Research article

Peanut Yield and Changes of Soil properties by Intercropping in Upland Cropping Systems of Southeast Cambodia

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Abstract Successive monocropping with cassava in upland areas of Cambodia has led to a progressive decline in soil fertility. The aim of the present study was to investigate the change of soil properties and examine the growth and yield of peanut in intercropping cultivation in the upland cropping systems of Cambodia. Seven intercropping treatments were studied: T1 (cassava + mungbean + fertilizer rotation with fallowing); T2 (cassava + peanut + fertilizer rotation with fallowing); T3 (cassava + fertilizer rotation with fallowing); T4 (cassava + no fertilizer); T5 (mungbean + fertilizer rotation with cassava + mungbean + no fertilizer); T6 (peanut + fertilizer rotation with cassava + peanut + no fertilizer) and T7 (stylo + fertilizer rotation with cassava + no fertilizer) were designed and conducted in the fields of farmers in Prey Veng and Svay Rieng provinces. Field data indicated that peanut yield increased in the order of: T2 > T7 > T1 > T6 > T5 > T3 > T4. Analysis revealed there were significant differences in peanut yield among all seven treatments, with the yield of T4 being significantly lower than that of T2 and T7. The mean of the peanut yields were greater than 2.1t h^{-1} for all treatments. The total N, K and phosphate of the pre-treatment analysis did not significantly differ from those of the post-treatment analysis. This study suggests that intercropping cultivation could provide a sustainable harvestable yield of peanut in the upland cropping system in Cambodia.

Keywords peanut, intercropping, upland cropping system, Cambodia

INTRODUCTION

The challenges of farmers in improving upland farming systems in Cambodia were identified, in which soil fertility was one of the main challenges in agricultural production systems in Cambodia (Chan et al., 2009). Soil factors affecting crop suitability for upland crops in Cambodia have been documented (Seng et al., 2009). Previous studies revealed that upland areas are widespread throughout Cambodia, thus there was a considerable scope in developing upland crops and cropping technologies in Cambodia (Seng et al., 2011). The continuous mono-cropping particularly with cassava in upland areas

has led to a progressive decline in soil fertility. There is an urgent need to identify alternative agricultural production options capable of economically improving both the soils and production, while at the same time improve the incomes of rural households, which are almost 100% dependent on agriculture. Important upland crops in Cambodia are maize, rubber, soybean, mungbean, cassava, sesame, peanut and sugarcane (Bell et al. 2005). Inter-cropping is one of the options available for more sustainable agricultural production systems. Most farmers in the provinces of Prey Veng and Svay Rieng have tried to intensify agricultural production through mono-cropping of cassava, reflecting the high demand for this crop in commercial markets. However, this cropping intensification has been done with little knowledge of procedures or technologies for maintaining soil fertility.

Some farmers have reported that soil fertility shown a significant decline in areas with a history of cassava cropping because smallholder producers like them are unable to afford commercial fertilizers to replace the nutrients removed by successive cassava cultivation. In this study, a number of different 'systems of production' are being evaluated on the Prey Khmer soils in Prey Veng and Svay Rieng provinces. Crop growth and yield performance, together with issues of soil fertility sustainability, from different combinations of maize and cassava with selected legumes were investigated.

OBJECTIVE

The objectives of the present study are to (1) examine growth and yield of peanut in intercropping cultivation in the upland cropping system of Cambodia and (2) investigate the changes in soil chemical and physical properties after intercropping cultivation.

METHODOLOGY

This study was carried out in Prey Veng and Svay Rieng provinces which are located in the Southeastern Cambodia (Fig. 1). Prey Veng is located on the east bank of the Mekong River and is one of the largest rice producing regions in Cambodia and other crops while Svay Rieng is located on Cambodia's South-Eastern border with Vietnam, 125km from Phnom Penh capital.

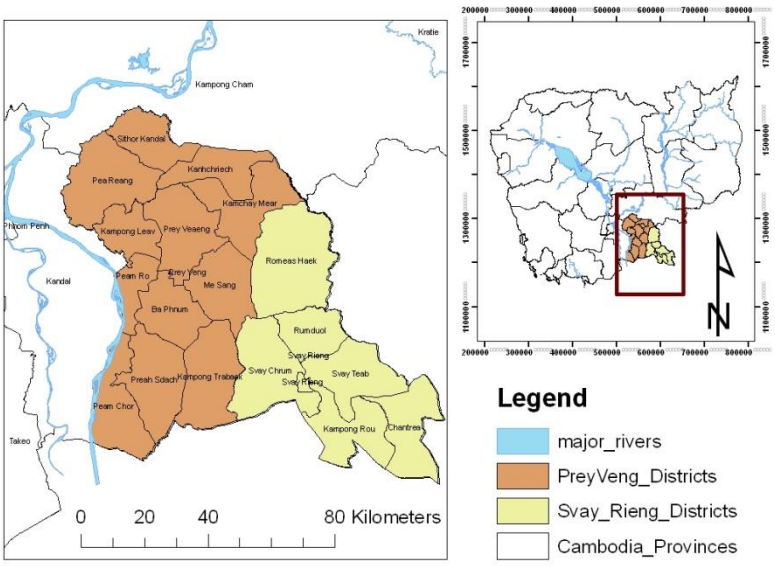

Fig. 1 Map of the study areas

Field trials of intercropping cultivation of peanut were conducted in eight basic production systems (7m × 10m) of farmers in the study areas of Prey Veng (n = 4) and Svay Rieng (n = 4) provinces. The detailed design of field trials is presented in Table 1. The plant height (cm), weight per hill (g), number of fruit per hill, grain weight per 100 seeds (g), peanut yield per hectare (t h^{-1}) were determined. Concurrently, soil samples were collected before and after each treatment, to determine soil properties and the changes in total C, organic C, N, P_2O_5, Ca, Mg, Na, K and exchangeable acidity (pH_{KCl}) and actual acidity (pH_{H2O}).

Table 1 Summary of intercropping of peanut cultivation in the upland cropping system in Prey Veng and Svay Rieng provinces

Treatment	2014		2015	
	EWS	LWS	EWS	LWS
T1	CS+MB+F	–	PN+F	–
T2	CS+PN+F	–	PN+F	–
T3	CS+F	–	PN+F	–
T4	CS-F	–	PN+F	–
T5	MB+F	CS+MB-F	PN+F	–
T6	PN+F	CS+PN-F	PN+F	–
T7	Stylo+F	CS-F	PN+F	–

EWS, early wet season; LWS, late wet season; MZ, maize; SB, soybean; MB, mung bean; CS, cassava; PN, peanut; +F, fertilizer application; -F, No fertilizer application

All statistical data analyses were employed using SPSS for Windows (Version 16.0). One-way ANOVA test was applied to verify the differences in plant height, weight per hill, number of fruit per hill, peanut yield among all treatments. Paired samples *t* testing was performed to certify the differences in soil pH, total C, organic C, total N, P_2O_5, K, Ca, Mg and Na between pre-treatment and post-treatment of each treatment. Significance is considered in a circumstance where $p < 0.05$.

RESULTS AND DISCUSSION

Peanut Yield

A summary of growth and yield of intercropping cultivation of peanut are presented in Table 2. The comparisons revealed that there were no significant difference in plant height at flowering and harvesting stages among all treatments (One-way ANOVA, $p > 0.05$). However, there were significant differences in weight per hill of peanut among all treatment (One-way ANOVA, $p < 0.05$). The weight per hill of T2 was significantly higher than that of T3, T4, T5 and T6 using post hoc Tukey HSD test ($p < 0.05$). Likewise, the number of fruit per hill significantly differed among all treatments (One-way ANOVA, $p < 0.05$). The post hoc Tukey HSD test revealed that number of fruit per hill of T2 was significantly greater than that of T3, T4, T5 and T6 ($p < 0.05$). Grain weights per 100 seeds were significantly different among all treatment (One-way ANOVA, $p < 0.05$). A previous study on field crop productivity in relation to soil properties revealed that peanut was the most reliable crop with successful establishment in the early wet season and harvestable yield at 80% of sites (Seng et al., 2011). The present study showed that peanut yield increased in an order of T2 > T7 > T1 > T6 > T5 > T3 > T4. A comparison revealed that there were significant differences in peanut yield among all treatments (One-way ANOVA, $F(6, 49) = 3.18$, $p = 0.01$). Post hoc Tukey HSD test indicated that peanut yield of T4 was significantly lower than that of T2 and T7 ($p < 0.05$). According to Seng et al (2011), peanut yield was between 2.1 to 3.4t h^{-1} on Kampong Siem soils. Peanut yield of the present