Developing Conservation Agriculture Production Systems in the Philippines

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Introduction

Uplands in tropical countries face high erosion rates brought about by intense cultivation and heavy rainfall. This largely contributes to the decline in crop productivity and to the increase use of farm fertilizers to produce same amount of farm output. Conservation agriculture with trees (CAT) offers solution to this pressing problem through following 5 key principles: Minimum soil disturbance, continuous mulch, maintaining diverse crop species, integrated pests and nutrient management. CAT is very important in soil and water conservation, enhancing agri-diversity, improving farm carbon sequestration potential, maximization of land area usage in the Philippines as well as the reversal of soil degradation thus improving food and nutritional security of the upland dwellers.

Methodology

Five promising conservation agriculture production systems (CAPS) were evaluated in comparison with conventional maize tillage system (Table 1) in Claveria, Misamis, Philippines (8°38'39", 124°55'49") on a sloping land of 26%. Two weeks before planting, the weeds were sprayed with glyphosate (Round up) following the standard recommendation rate. Treatments 1-4 used dibble method in planting maize seeds as well as the associated crops. All treatments were subjected to low (F1 = 0-30-0 $NP_2O_5K_2O$) and moderate (F2 = 60-30-30 $NP_2O_5K_2O$) fertility levels. Due to poor performance of F1 during the first year, it was modified to high fertility level with 120-60-60 $NP_2O_5K_2O$, during the subsequent year. All P and K were applied as basal. N was applied in split at 15 and 30 days after emergence. Turn around period was reduced by immediately planting the crop after each harvest except with treatments having a fallow period (T2).

Figure 1. Degraded agricultural landscapes are expanding in the Philippines due to improper tillage and water –induced soil erosion on sloping lands causing low farm productivity, malnutrition and poverty

Objectives

The objective is to assess crop yields from conservation agriculture production system (CAPS) and to compare them from conventional plow-based system in the Philippines.

Treatment	Description
T1 - Maize + *Arachis pintoi*	Maize seeds were dibble planted using stick spaced at 70 cm x 20 cm making 72,000 plants per hectare. The *Arachis pintoi* cuttings were planted single row in the middle of maize rows spaced at 25 meters apart.
T2 - Maize + Stylosanthes – Stylosanthes fallow	The maize was established and managed similar to T1. The *Stylosanthes guianensis* seeds were drilled in between rows of maize and thinned 10-15 plants per linear meter.
T3 - Maize + Cowpea – Upland rice + Cowpea	The maize was established in double rows at 35 cm spacing and 20 cm between plants making 72,000 plants per hectare followed by 2 rows of cowpea at 35 cm spacing with 10-15 plants per linear meter. After cowpea harvest, upland rice was subsequently planted. After maize harvest, cowpea was subsequently planted.
T4 - Maize + Rice bean	The maize was established similar to T1. Rice bean was established 2 weeks prior to maize harvest.
T5 - Cassava + Stylosanthes	Furrows were spaced at 100 cm and cassava cuttings were planted 50 cm apart making 20,000 plants per hectare. *Stylosanthes guianensis* seeds were drilled in between rows of cassava and thinned 10-15 plants per linear meter.
T6 - Maize – Maize (conventional plow base)	Two plowings using animal drawn mould board plow; two harrowing using animal drawn spike-toothed harrow, and furrowed by animal drawn mould board plow.

Figure 2. Conservation agriculture with tree (CAT) with principles of minimal soil disturbance, continuous ground cover, diverse crop species, integrated pests and nutrients management and integration of trees provides alternative option.

Results and Discussions

Figure 3 shows the comparison of total aboveground biomass (a) and grain yield (b) as influenced by different conservation agriculture production system (CAPS) in year 2010. The conventional maize system yielded better in total biomass and grain yield compared with other CAPS. Maize with rice bean yielded lowest across all cropping patterns. The moderate fertility level (60-30-30) had higher yield across all CAPS compared to low fertility level (0-30-0). The first harvest of T5 (Cassava+Stylo) was in the following year.

In year 2011 (Figure 3), Cassava + Stylo had the highest total biomass (a) which constitutes 1st crop of cassava and 3 prunnings of Stylo, it was followed by Maize + *Arachis pintoi* and Maize + Stylo rank third. The remaining cropping patterns were comparable in total biomass. In Figure 3b, root yield of cassava was high. In grain yield comparison, Maize + Rice bean yielded highest and the remaining cropping patterns were comparable in grain yield.

Similar trend was observed in year 2012. Still cassava rank 1st in total biomass (Figure 3) and the rest of cropping patterns were comparable except for traditional monoculture maize. The root yield of cassava was higher compared to the previous cropping. Grain yield of T3 (Maize+Cowpea-Upland rice) was also better.

Conclusion

We found out that Cassava + Stylo showed higher total system productivity across all CAPS treatments. Maize + *Arachis pintoi* showed higher total biomass and grain yield among CAPS treatments with maize in the subsequent years. This might be due to higher N-fixing capacity of *Arachis pintoi* that supplemented additional N to the soil which provided N benefits both to maize and to the legume. Conventional maize monocropping system productivity declines during the subsequent years

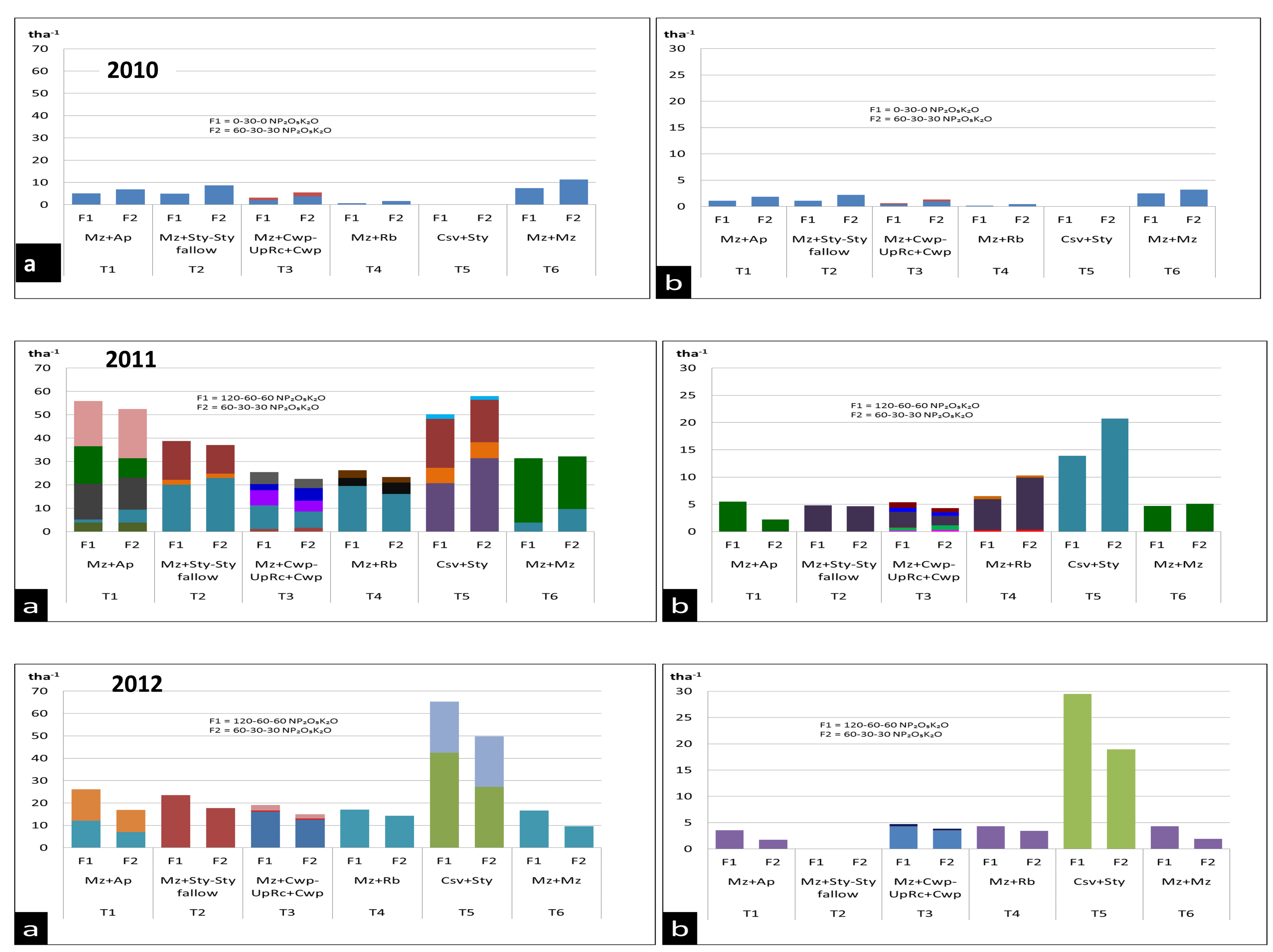

Figure 3 . Annual total dry matter yield (a) and total grain yield (b) of different CAPS evaluated in 3 years on acid upland soil. Claveria, Misamis Oriental, Philippines

This project was made possible through support provided by the United States Agency for International Development (USAID) and the generous support of the American people for the Sustainable Agriculture and Natural Resources Management Collaborative Research Support Program under terms of Cooperative Agreement Award No.EPP-A-00-04-00013-00 to the Office of International Research and Development at Virginia Tech.