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CLIMATE-SMART AGRICULTURE: INCREASING CROP YIELDS ON-FARM THROUGH USE OF SUNNHEMP (*Crotalaria juncea* L.) PHASE 2. RESIDUAL EFFECTS OF SUNNHEMP ON SUCCEEDING MAIZE CROP

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ABSTRACT

Agriculture in Swaziland, like elsewhere in the region, faces a number of challenges like stagnant agricultural yields, land degradation and poor access to farm inputs. Climate-smart agriculture is an approach to developing the technical, policy and investment conditions to achieve sustainable agricultural development for food security under climate change. A field experiment was established in the 2015/2016 cropping and was continued in the 2016/2017 cropping season. The main objective of the study was to increase crop production on-farm by using green manure crops instead of commercial fertilisers, whose manufacturing process contribute to climate change and climate variability, through the emission of greenhouse gases. The treatments in the 2016/2017 season were; (1) Maize monocrop; no fertiliser. (2) Sunnhemp monocrop at 80 kg/ha. (3) Maize monocrop with fertiliser; applied 300 kg/ha of 2-3-2 (22) and 200 kg/ha of LAN (4) Maize and sunnhemp intercropped, no fertiliser to maize, sunnhemp seed rate is 40 kg/ha; both crops allowed to mature and crop residue are returned to the soil after harvest (5) Maize and sunnhemp intercropped, no fertiliser to maize, sunnhemp seed rate is 60 kg/ha; both crops allowed to mature and crop residue are returned to the soil after harvest. The results show that sunnhemp in monoculture was significantly ($P < 0.05$) higher in dry mass with 4391 kg/ha at 10 weeks after planting while sunnhemp intercropped with maize was lowest with 2764 kg/ha. The results also show that sunnhemp yield was not significantly different among the different treatments. Maize grown in monoculture with the application of synthetic fertilisers yielded significantly ($P < 0.05$) higher with 3800 kg/ha. Maize grown in monoculture without fertiliser followed with 3367 kg/ha while maize intercropped with 40 kg/ha of sunnhemp was lowest with 1067 kg/ha. The land equivalent ratio in this experiment was positive at 1.58. It is concluded that the residual effects of a previous sunnhemp crop did not contribute significantly to maize performance in the current season. It is recommended that the experiment be continued on a long term basis as benefits of green manures need progressive cropping seasons.

INTRODUCTION

Climate-smart agriculture (CSA) may be explained as a set of farming principles and practices that increase productivity (increase per unit of resource used) in an environmentally sustainable way, through adaptation. Climate-smart agriculture as presented by the Food and Agriculture Organization (FAO, 2010) at the Hague Conference on Agriculture, Food Security and Climate Change in 2010, is composed of three pillars that contribute to the achievement of sustainable development goals. It integrates the three dimensions of sustainable development (economic, social and environmental) by jointly addressing food security and climate challenges. It is composed of three main pillars: (1) increasing agricultural productivity and incomes in a sustainable manner, (2) adapting and building resilience to climate change, and (3) reducing and/or removing greenhouse gases emissions, where possible.

The magnitude, urgency and broad scope of the effects of climate change on agricultural systems create a compelling need to ensure comprehensive integration of these effects into national agricultural planning, investments and programmes. The CSA approach is designed to identify and operationalise sustainable agricultural development within the parameters of climate change.

PROBLEM STATEMENT

Swaziland, like most countries in the Southern African Development Community (SADC) countries, has not been able to meet its annual maize requirement of about 130,000 to 140,000 tonnes per annum (NMC, 2015). Factors contributing to the shortage include climate change and climate variability brought about by greenhouse gases such as carbon dioxide and methane, among others. The high cost of commercial fertilisers has also contributed to low maize and other crop yields. One possible means of addressing the problem of low crop yields due to climate change and associated factors such as the manufacture of commercial fertilisers whose production contribute to climate change is the use of green manure crops such as sunnhemp, hence this proposal.

OBJECTIVES

The general objective is to increase crop production on-farm by using green manure crops instead of commercial fertilisers, whose manufacture contribute to climate change and climate variability, through the emission of greenhouse gases.

The specific objective of the proposal is to determine the residual effects of sunnhemp on soil physical and chemical properties of a succeeding maize crop (Zea mays L.) grown in monoculture or as an intercrop with sunnhemp.

MATERIALS AND METHODS

A field experiment was established during the 2015/2016 cropping season near Dalcrue Farm of the University of Swaziland. Phase 2 followed in the 2016/2017 cropping season (Table 1).

Table 1. Treatment description of the experiment in 2016/2017.

Treatment code	Field Code	Treatment description
1	A	Maize monocrop; No fertliser, Maize stover returned to the soil
2	B	Sunnhemp monoculture; planted at seed rate of 80kg/ha. Sunnhemp allowed to mature, seeds harvested and crop residue returned to the plot
3	C	Maize monocrop with fertilizer; apply 300 kg/ha of 2-3-2 (22) and 200 kg/ha of limestone ammonium nitrate
4	D	Maize and sunnhemp intercropped, no fertilizer to maize, sunnhemp seed rate is 40 kg/ha; both crops allowed to mature and crop residue are returned to the soil after harvest
5	E	Maize and sunnhemp intercropped, no fertilizer to maize, sunnhemp seed rate is 60 kg/ha; both crops allowed to mature and crop residue are returned to the soil after harvest

Data collected on maize

Leaf area, Leaf area index, Number of days to full tasselling, Number of days to full silking, Yield components (number of cobs/plant, number of rows/cob, cob length, cob diameter, dry mass of a 100 seeds, shelling percentage and harvest index), Seed yield (kg/ha) at 12.5% moisture content.

Data collected on sunnhemp

Plant height, Number of days to full flowering, Biomass of leaves and stems, Seed yield (kg/ha) at 10.0% moisture content.

RESULTS AND DISCUSSION

Sunnhemp yield

Sunnhemp planted at 40 kg/ha and grown in association with maize had the highest yield of 551 kg/ha. Sunnhemp grown in monoculture and planted at 80 kg/ha had the lowest yield with 425 kg/ha. However, all these differences were not significant (Figure 1). It is worth noting that intercropping maize and sunnhemp did not lead to reduction in sunnhemp yield. This may be attributed to the fact that sunnhemp grew taller than maize and outcompeted the maize. Also, maize was already dry when sunnhemp was still at pod-filling stage hence did not provide competition for the sunnhemp. It is also worth noting that planting sunnhemp at different densities did not have a negative influence in yield. This may be due to the fact that sunnhemp planted at lower densities had more space to exploit while crowded sunnhemp suffered from inter-plant competition.

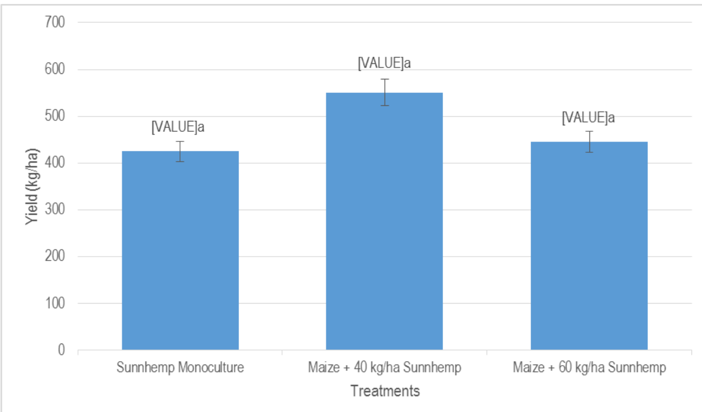

Figure 1. Sunnhemp yield at harvesting

Maize grain yield

Maize grown with synthetic fertilisers yielded significantly (P < 0.01) higher than maize grown in association with sunnhemp. It had a yield of 3800 kg/ha while maize grown in monoculture and without fertilisers followed with 3367 kg/ha. Maize grown in association with 40 kg/ha of sunnhemp was lowest with 1067 kg/ha (Figure 2). Maize grown with synthetic fertilisers yielded significantly (P < 0.01) higher than maize grown in association with sunnhemp. In a similar study, Nndwambi (2015) found that growing maize in association with pigeonpeas reduced maize yield by 20.5%. Similar results were also reported by Edje and Mabuza (2014) who reported that maize grown in monoculture yielded significantly (P < 0.05) higher than maize grown in mixed stand with sunnhemp.

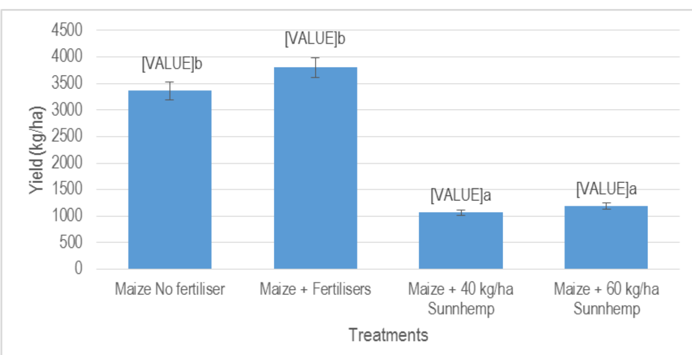

Figure 2. Maize grain yield

CONCLUSION

It is concluded that intercropping maize and sunnhemp up to maturity significantly ($P < 0.05$) reduce maize yields while sunnhemp yield is not affected. Intercropping maize and sunnhemp gives a higher LER since sunnhemp yield is not reduced.

RECOMMENDATIONS

It is recommended that sunnhemp and maize be grown successively with sunnhemp as the first crop to reduce competition. It is also recommended that the experiment be done for a long period of time to realise the benefits of sunnhemp residues.

AKNOWLEDGEMENTS

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