N2Africa - Putting nitrogen fixation to work for smallholder farmers in Africa

Maize-grain legume intercropping: Ecological intensification to enhance resource use and production efficiency for smallholder farmers in northern Ghana

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Introduction

Maize-legume intercropping is practised by many smallholder farmers in the Guinea savanna agroecological zone (AEZ) in northern Ghana for household food and income security; and as a buffer for the single cropping season and unpredictable rainfall. Different maize-legume intercropping patterns have been studied in this AEZ. However, knowledge on performance of within-row maize-legume intercropping system is lacking. Effect of soil fertility level on the efficiency and productivity of the intercrop systems has not been studied. The objective of this study was to assess the effects of different spatial arrangement of maize-grain legume intercrops on resource use efficiency and productivity under different soil fertility types in this AEZ in northern Ghana.

Materials and methods

The trials were conducted in 2013 and 2014 seasons at Kpataribogu and Bundunia in the Southern and Northern Guinea savanna AEZ respectively. High (HF), medium (MF) and low (LF) soil fertility fields were used in each AEZ. Treatment tested were maize-legume within-row; 1:1 and 2:2 distinct rows of maize-legume and their sole crops. Cowpea (CP), soybean (SB) and groundnut (GN) were the legumes (LG) used. A randomised complete block design was used. Each maize-legume system had the five treatments replicated four times per fertility level. Photosynthetically active radiation (PAR) was measured with AccuPAR LP-80 Ceptometer. Intercrop productivity was assessed with land equivalent ratio (LER) and monetary advantage index (MAI). Statistical analysis was done with GenStat.

Results

Intercropping significantly improved PAR interception relative to sole maize but not sole legume (Fig. 1, data not shown for soybean and groundnut). LER indicates intercrops were relatively efficient and productive than sole crops (Table 1). LER was higher in low fertility fields than fields high in fertility (significant in Bundunia but not in Kpataribogu). Within-row system significantly intercepted more PAR (mostly at mid to late pod-filling stage of legumes); had higher LER and in Kpataribogu, significantly higher MAI than 1:1 and 2:2 systems (Fig. 2). Intercrop grain yields (data not shown) followed similar trend as IPAR, LER and MAI with highest yields (cowpea–2.06; soybean–1.79; groundnut–0.82; maize–3.07 t ha^{-1}) achieved with within-row system.

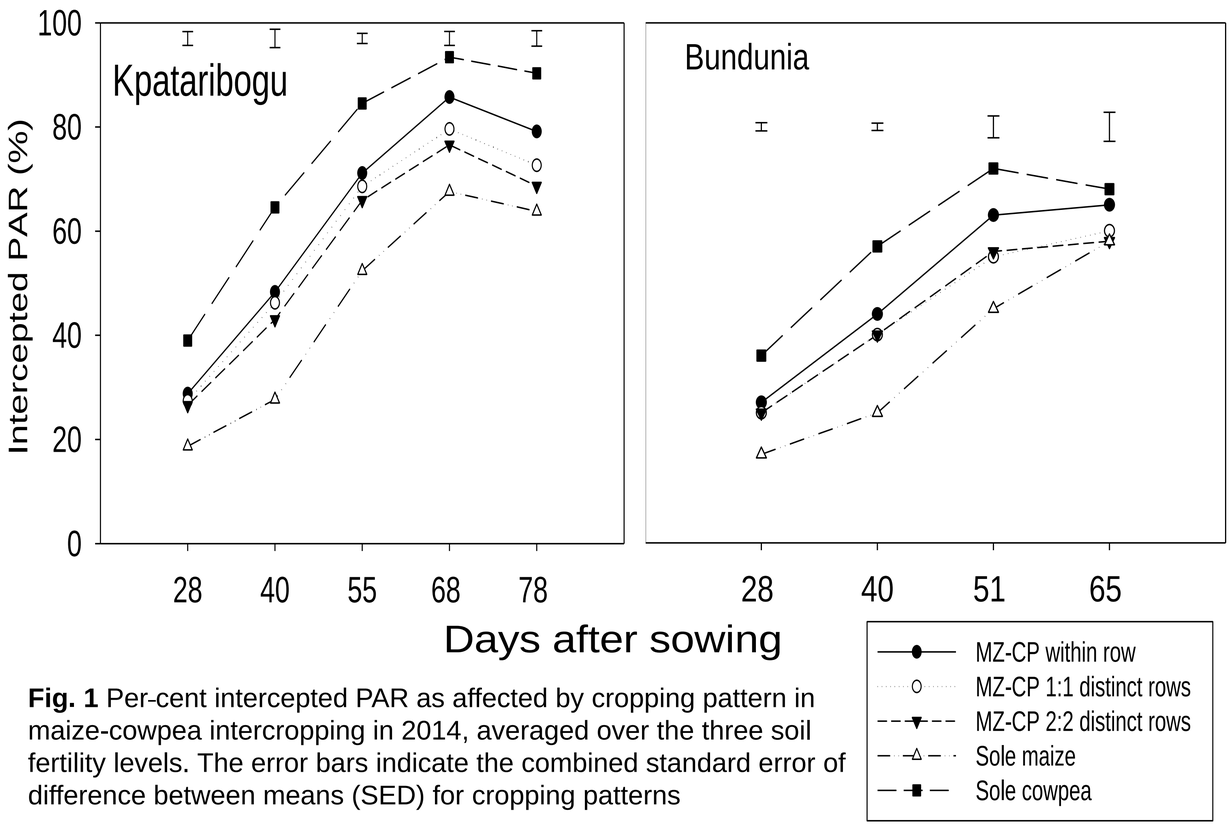

Fig. 1 Per-cent intercepted PAR as affected by cropping pattern in maize-cowpea intercropping in 2014, averaged over the three soil fertility levels. The error bars indicate the combined standard error of difference between means (SED) for cropping patterns

Table 1 LER of maize-legume intercropped patterns at different fertility levels, averaged over both seasons. The SED shows the combined standard error of difference between means for either intercropping arrangements or soil fertility levels.

Intercropping arrangement	Kpataribogu				Bundunia			
	HF	MF	LF	Mean	HF	MF	LF	Mean
MZ-CP within-row	1.4	1.7	1.6	1.5	1.5	1.5	1.8	1.6
MZ-CP 1:1 rows	1.2	1.3	1.4	1.3	1.2	1.4	1.8	1.4
MZ-CP 2:2 rows	1.1	1.2	1.2	1.2	1.2	1.3	1.5	1.3
Mean	1.2	1.4	1.4		1.3	1.4	1.7	
SED$_{arrangement}$				0.1				
SED$_{fertility}$								0.1
MZ-SB within-row	1.3	1.7	1.3	1.4	1.5	1.5	1.7	1.6
MZ-SB 1:1 rows	1.2	1.3	1.2	1.2	1.2	1.4	1.6	1.4
MZ-SB 2:2 rows	1.1	1.2	1.1	1.1	1.2	1.4	1.6	1.4
Mean	1.2	1.4	1.2		1.3	1.4	1.6	
SED$_{arrangement}$				0.1				
SED$_{fertility}$								0.1
MZ-GN within-row	1.5	1.4	1.5	1.4	1.5	1.6	1.8	1.6
MZ-GN 1:1 rows	1.3	1.3	1.2	1.3	1.3	1.3	1.6	1.4
MZ-GN 2:2 rows	1.2	1.3	1.3	1.3	1.3	1.3	1.7	1.4
Mean	1.3	1.3	1.3		1.4	1.4	1.7	
SED$_{arrangement}$				0.04				
SED$_{fertility}$								0.1

Fig. 2 MAI of different maize-legume intercrop arrangements, averaged over both seasons and fertility levels. Error bars show the combined SED for intercropping arrangements.

Conclusions

- Intercropping improved resource use efficiency and productivity relative to sole crops. Within-row system was generally more efficient and productive than distinct-rows.
- With maize-legume intercropping, we can achieve higher LER, for that matter higher resource use efficiency and grain productivity in poor fertility fields, safeguarding household food and income security for resource poor smallholders.

Acknowledgements

We are grateful to N2Africa project and NUFFIC for funding support and to CSIR-SARI, Tamale for the use of its facilities for conducting this work. To the farmers in Kpataribogu and Bundunia, we appreciate your generous efforts.

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