Journal of
Current Opinion in Crop Science
Journal homepage:: www.jcocs.com

SHORT COMMUNICATION

Identification of Relatively More Efficient and Productive Cropping System in Varying Potential Agro-ecologies of Central Tanzania

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Article history:

Received: March 24, 2021
Accepted: April 30, 2021
Published: June 24, 2021

Citation:

Wabwire, S., Chilagane, L. A., & Msuya, D. G. (2021). Identification of relatively more efficient and productive cropping system in varying potential agro-ecologies of central Tanzania. *Journal of Current Opinion in Crop Science, 2*(2), 243-246.

ABSTRACT

The experiment was conducted in the varying potential sub agro-ecologies of Kongwa and Kiteto districts in Central Tanzania during the 2019-2020 cropping season to identify the relatively more efficient and productive cropping system. Results showed that in the high sub ecology, Pigeon pea - Sorghum intercrop had the highest Land Equivalent Ratio (LER) of 1.59. In the moderate, Pigeon pea - Groundnut highest LER value was 1.65, and in the low sub ecology, Pigeon pea - Pearl millet highest LER value was 2.36 compared to LER values of 1.00 for the respective sole crops, which indicated the superiority of intercropping over monoculture. The above findings revealed that increased productivity could be achieved through intercropping. Therefore, it could be concluded that Pigeon pea- Sorghum, Pigeon pea- Groundnut and Pigeon pea- Pearl millet are the more efficient and productive cropping systems in the high, moderate and low sub ecologies, respectively.

Keywords: Intercropping systems; Land equivalent ratio; Grain yield

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INTRODUCTION

When compared to monoculture, cereal and grain legume intercropping increases the use of resources for crop growth and often results in higher productivity per unit area (Saxena et al., 2018). Continuous solo cropping systems, such as maize, yielded less than one tonne per hectare on average, compared to intercropping systems, which yielded maize yields of up to 1.5 tonnes per hectare (Njira et al., 2013; Latati et al., 2016).

The Doubled-up Legumes Rotation (DLR) system was supported by Njira et al. (2013). Pigeon pea intercropped with peanut or soybean and subsequently rotated with maize generated the best returns on land and labour spent in the DLR method, resulting in very high fertiliser use efficiency (Njira et al., 2013; Smith et al., 2016). As a result, the goal of this research is to find a more efficient and productive farming system in Central Tanzania's various potential agro-ecological zones.

MATERIALS AND METHODS

The present study was conducted at the Central zone of Tanzania in three sub agro-ecologies i.e., (i) high potential zone (Manyusi and Mlali villages in Kongwa district) which receives ≥500mm of rainfall; (ii) moderate potential zone (Njoro-1 and Njoro-2 villages in Kiteto district) which receives ≥ 400-500mm of rainfall, and (iii) low potential zone (Laikala and Moleti villages in Kongwa district) which receives ≤ 350mm of rainfall (Hoeschle-Zeledon, 2019). Kongwa district lies between latitudes 5° 30' to 6° 00' S and longitudes 36°15' to 36°00' E with altitude stretching between 900 and 1000 masl while Kiteto district lies between latitudes 05°52'00'S and longitudes 36°51'00'E with altitude stretching between 500 and 1200 masl (URT, 2016; PO-RALG, 2018). A total of 4 crops (groundnut, pigeon pea, sorghum and pearl millet) were evaluated. The pigeon pea - groundnut intercrop versus pigeon pea and groundnut sole crops experiment was laid down in the high and moderate potential zones; pigeon pea - sorghum intercrop versus pigeon pea and sorghum sole crop experiment laid in all the potential zones i.e., high, moderate and low while the pigeon pea - pearl millet versus pigeon pea and pearl millet sole crops were laid in the low potential sub ecological zone. Three central rows of each plot (12 m^2) were harvested to determine grain yield per hectare i.e., weight of grains $plot^{-1}$(kg) was converted to hectare (10000 m^2) to determine grain yield in kg ha^{-1}

RESULTS AND DISCUSSION

In the high potential agro-ecology, the highest LER value (1.59) was obtained from Pigeon pea - Sorghum intercrop at Mlali village showing a yield advantage of 59% over monoculture (Table 1). For the Pigeon pea - Groundnut intercrop, LER value of 1.44 was obtained in Mlali village. The findings agree with previous reports of Kermah et al. (2017) and Smith et al. (2016). Nevertheless, the legume - cereal intercrops (Pigeon pea - Sorghum) performed better than the Doubled-up legumes (Pigeon pea - Groundnut) intercropping systems.

Table 1. Effects of different intercropping systems on grain yield & LERs

Villages	Treatments	Intercrop yield (kg ha^{-1})		Sole crop yield (kg ha^{-1})		Partial LER		Total LER
	Cropping systems	Crop 1	Crop 2	Crop 1	Crop 2	Crop 1	Crop 2	
High								
Manyusi	PP-GN	761.90	476.19	2428.57	682.54	0.31	0.70	1.01
	PP-SG	1206.35	746.03	1984.13	1428.57	0.61	0.52	1.13
Mlali	PP-GN	535.71	714.29	940.48	821.43	0.57	0.87	1.44
	PP-SG	483.33	1845.24	1228.57	1535.71	0.39	1.20	1.59
Moderate								
Njoro 1	PP-GN	984.13	873.02	2142.86	968.25	0.46	0.90	1.36
	PP-SG	1619.05	1539.68	2000.00	1888.89	0.81	0.82	1.63
Njoro 2	PP-GN	412.70	603.17	1206.35	460.32	0.34	1.31	1.65
	PP-SG	396.83	1761.90	1142.86	2444.44	0.35	0.72	1.07
Low								
Laikala	PP-SG	523.81	1761.90	1365.08	1666.67	0.38	1.06	1.44
	PP-PM	714.29	476.19	1031.75	285.71	0.69	1.67	2.36
Moleti	PP-SG	297.62	750.00	571.43	773.81	0.52	0.97	1.49
	PP-PM	511.90	678.57	654.76	571.43	0.78	1.19	1.97

Note: Crop 1= Pigeon pea (PP); Crop 2= Groundnut (GN), Sorghum (SG), Pearl millet (PM)

In the moderate potential agro-ecology, results of the study showed the highest LER value of 1.65 obtained from Pigeon pea - Groundnut intercrop at Njoro 2 village. For the Pigeon pea - Sorghum intercrop, there was almost no yield advantage as the LER was low (1.07). In Njoro-1 village results showed that Pigeon pea - Sorghum intercrop had a LER value of 1.63 while Pigeon pea - Groundnut intercrop recorded a LER value of 1.36. The above findings revealed that intercrop systems generally increased productivity as they had higher LER compared to their respective monocrops. Khan et al. (2017) reported similar findings that intercropping systems had superior yields compared to the monocrops. Dahmardeh et al. (2010), also observed higher LER of intercropping systems and therefore concluded that intercropping was more beneficial compared to monoculture.

In the low potential agro-ecology, results from the study showed that Pigeon pea - Pearl millet in Laikala village had the highest LER value of 2.36 and Pigeon pea - Sorghum had a LER value of 1.44. On the other hand, in Moleti village Pigeon pea - Pearl millet had a LER of 1.97 and Pigeon pea - Sorghum had a LER value of 1.49. It was observed that the Pigeon pea - Pearl millet intercrop system outperformed the Pigeon pea - Sorghum intercrop in the low potential agro-ecology.

CONCLUSION

The present study concluded that, increased farm productivity is fetched through practicing the intercropping at the high, moderate and low potential agro-ecological zones of Central Tanzania. Small farm holds of these regions can adopt this technology over the existing sole cropping system.

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