Integrated technologies for sorghum-legume production system to improve livelihood and adaptation to climate change in Gedarif State, Sudan

By

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Abstract

Sorghum is grown as a single crop especially by the large scale farmers and sometimes intercropped with legumes such as cowpea, groundnuts, green gram, and lablab bean by small scale farmers to provide the protein that supplement the carbohydrates and starch from sorghum. Rural families invariably derive food, animal feed, and cash, together with spill-over benefits to their farmlands for example in improving soil fertility through in situ decay of root residues and legume leaves. Fields works were conducted at 6 locations on farmers fields at different environmental zones, viz., Northern (Dray areas), Central (semi-dray area) and Southern (wet area) Gedarif State during 2011/2012 and 2012/2013 to Enhance utilization of sustainable sorghum-legume system technologies and innovations by smallholder farmers in the semi-arid areas of Eastern Sudan (Gedarif State). Production technologies were evaluated in packages consisting of (1) improved sorghum variety (AG8 for low rainfall areas and Wad Ahmed for relatively high rainfall areas), (2) intercropping with legume (cowpea for low rainfall areas and groundnuts for relatively high rainfall areas), (3) water harvesting by cross ridging against the slope and tied the ridges every 10 m (4) low micro dose of nitrogen fertilizer (15 kg urea/ha. applied with the seeds at sowing). This improved production package was compared with the farmer practice and showed excellent performance on grain yield and forage. The package was improving productivity of the whole system in the semi arid environment. Results revealed that the improved production technologies were superior to the farmers' practices in the overall production and increasing sorghum, cow pea and groundnuts productivity. Sorghum grain yield increased to 2500 kg/ ha. In southern area compared with traditional farmers (500 kg/ha.). In the central area sorghum productivity increased to 1728 kg/ha. in compare with traditional farmers production (225 kg/ha.). However, in the northern area the productivity of sorghum crop increased from 180 kg/ha. to 1080 kg/ha. Data recorded on sorghum Stover yield significantly different between production technologies and traditional farmer's practices (17.5, 10.8 and 6.7 ton/ha.) in southern, central and northern areas, respectively. Groundnuts and cowpea recorded the highest yield compared to traditional farmers yied (1500 and 1152 kg/ha.) and 500 and 432 kg/ha., respectively.

Keywords: sorghum, technologies, adaptation, cowpea, groundnuts, traditional, livelihood, climate change and intercropping.

Introduction

The tropical drylands are changing rapidly, and the challenges to ensure sustainable livelihood are increasingly mounting. Increasingly-recognized environmental threats such as climate change, land degradation and biodiversity loss have added new dimensions to the ongoing challenges such as drought, increasing population pressure, and rising costs of food and inputs in the dry tropics {1}. These challenges continue to make the arid and semi arid tropics the home to the deepest pockets of poverty, malnutrition and food insecurity on earth {2}. The incidence of poverty is highest in rural areas, where agriculture is the main occupation. Most of the inhabitants of the dryland areas struggle to wrest a meagre living from agriculture using subsistence cultivation methods {3}. Tragically, they are missing out on large potential productivity gains that are biologically possible given the soils, crops and climates of these areas, as proven by decades of research across a wide range of dryland locations {1}. The importance of sorghum is largely based on the hardiness and adaptation of the crop to harsh climates that characterizes some areas in the country. Sorghum Stover is a significant source of dry season fodder for livestock and it has good grain mould resistance and thus has a lower risk of contamination by mycotoxins {4}. In addition to food and feed it is used for a wide range of industrial purposes, including lager beer, starch for fermentation and bio-energy. The grain, apart from providing food, can be used to formulate feed for the livestock. Sorghum is grown as a single crop especially by the large scale farmers and is often intercropped with legumes such as cowpea, groundnuts, and lablab bean by small scale farmers to provide the protein that supplement the carbohydrates and starch from sorghum {5}. Rural families invariably derive food, animal feed, and cash, together with spill-over benefits to their farmlands for example in improving soil fertility through in situ decay of root residues and legume leaves {6}. In addition, because the legume grain is widely traded out of the major production areas, it provides income and serves as a cheap and nutritious food for the relatively poor sections of urban communities {5}. The objective of this study was to enhance utilization of sustainable sorghum-legume system technologies and innovations by smallholder farmers in the semi-arid areas to improve livelihood and adaptation to climate change in Gedarif State, Sudan.

Materials and Methods

Fields works were conducted at 6 locations on farmers fields at different environmental zones, viz., Northern (Dray areas), Central (semi-dray area) and Southern (wet area) Gedarif State during 2011/2012 and 2012/2013. Production technologies were evaluated in packages consisting of (1) improved sorghum variety (AG8 for low rainfall areas and Wad Ahmed for relatively high rainfall areas), (2) intercropping with legume (cowpea for low rainfall areas and groundnuts for relatively high rainfall areas), (3) water harvesting by cross ridging against the slope and tied the ridges every 10 m (4) low micro dose of nitrogen fertilizer (15 kg urea/ha. applied with the seeds at sowing). This improved production package was compared with the farmer practice.

Nine feddans (3.8 ha.) in three areas were selected in the Northern area, viz., Gadambalia Eljabal, Gadambalia Tirfa and Abu-Kashma. Selected areas were cultivated with sorghum variety AG8 and intercropping with cow pea (Local variety), early in July, 15th. 2011. Also we choose three locations in the central area of Gedarif State in both Wad-Elhori and Zerega-Eldonki. And also three locations were selected in Seraf Saeed, Umkhraiit and Allam to represent the southern area which was planted in sorghum variety Wad Ahmed and inter cropped with groundnuts in July, 10^{th}. 2011. All selected areas in different locations were also sown with the same variety and same package in season 2012/2013. All cultural practices adopted as per ARC standards.

The data was analyzed after transformation by using the software MSTAT program. ANOVA was used for significant differences of the treatments and Duncan's Multiple Range Test (DMRT) for mean separation.

Results and Discussions

Results revealed that the improved production technologies were superior to the farmers' practices in the overall production and increasing sorghum, cow pea and groundnuts productivity. Sorghum grain yield increased to 2500 kg/ ha. In southern area compared with traditional farmers (500 kg/ha.). In the central area sorghum productivity increased to 1728 kg/ha. in compare with traditional farmers production (225 kg/ha.). However, in the northern area the productivity of sorghum crop increased from 180 kg/ha. to 1080 kg/ha.

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