Agricultural Sciences and Resource Management in the Tropics and Subtropics

UNIVERSITÄT BONN

RHEINISCHE FRIEDRICH – WILHELMS -UNIVERSITÄT BONN

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Faculty of Agriculture

Institute of Crop Science and Resource conservation

Water Use Efficiency of different Sorghum cultivars and supplementary irrigation in Mali

A Comparative Participatory Research at the CCAFS Climate Smart Village Cinzana

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Submitted by:

Manuel Müller

from

Germany

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1st Examinant: Dr. Thomas Gaiser

2nd Examinant: Dr. Michael Frei

Abstract

Extreme rainfall events and more intraseasonal drought spells of 7 days within the 19 years of the new millennium than the 50 years before are strong climate change indicators and require a rethinking in Mali's agriculture of the Sudano - Sahelian zone.

To become self-sustaining and feed a growing population (3 % per year), climate smart agricultural practices as supplementary irrigation in rainfed agriculture; the dominant agricultural practice in sub-Saharan Africa was evaluated. In this research, soil moisture under local, improved water stress tolerant and sensitive Sorghum bicolore (L.) cultivars were monitored with and without post rain season supplementary irrigation in the Climate Smart Village Cinzana in Mali in the rainy season of 2019. Soil properties were identified in profiles of 2 meter depths and soil moisture in upper soil layers was monitored up to 60 cm depths during the growing season. The calciferric Vertisols received 1088mm precipitation and 100kg ha^{-1} NPK broadcasting + 18kg ha^{-1} micro dosing NPK and 50kg ha^{-1} urea.

Sorghum tolerated 16 days of flood and 33 days of water logging as saturated soil from 23rd August to 25th September. During grain filling, two times 20 l m^{-2} were applied with bucket irrigation in half of the plots as supplementary irrigation (SI) compared to plots without irrigation (NI).

.Without supplementary (NI) irrigation, there was no significant difference in yield and total aboveground biomass production between the three cultivars. Under supplementary irrigation (SI), "Jakumbè" as an improved cultivar did not perform significantly higher than the others. The yield effect of supplementary irrigation was +0.33 t ha^{-1} (not significant)for "Jakumbè" (2.06 t ha^{-1} with no irrigation NI) while there was a not significant negative trend when applying SI for "Gnofing" (2.05 t ha^{-1} under NI). The same applies for Water use efficiency (WUE) based on grain yield divided by the sum of precipitation and soil water balance. Significant differences occurred in above ground biomass(AGB) production where "Gnofing" performed best. "Jakumbè" and "Gnofing" reached plant heights of 4 m which is 200 % of "Jakumbè's" catalogue value while the maximum height of the cultivar "PR3009B"s" was closer (+ 45 % NI,+ 37 % SI) to a normal height of 1.85 m. Fertilizer effects in comparisons with no fertilizer -control plots were stronger while relative irrigation effects without fertilizer were higher. Water Use efficiency is depended on several soil characteristics as soil fertility water holding capacity and surface conditions. The outcome of this research is to keep focus on soil fertility as a strong factor on water use efficiency while introducing climate smart water harvesting agricultural practices. Increased water uptake by growth and reduced soil evaporation by shading reduce water losses.

Based on literature data from Burkina Faso, local irrigation reservoirs with investment costs of 429,500 CFA and micro dose fertilizer application (9 g N, 4 g P, 4 g K) can generate profit within 2 years based on yield data of this research.

Supplementary irrigation is a contextualized practice for the professional well diggers of the CSV N'Gakoro but has not yet proven to be economical feasible.