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POLICY BRIEF

Growth and Yield Response of Tomato Cultivars to Nitrogen Fertilizer and Organic Amendments and Modelling Climate Impact

Executive summary

Tomato production in The Gambia is ranked second after onion in terms of production acreage and highly consumed. An agronomic trial was conducted in 2021 and 2022 at Horticulture unit in Yundum. The main objective was to enhance tomato production in The Gambia through determination of effects of organic and inorganic fertilizers as well as model climate impact on the performance of Mongal F1 and Thorgal F1 tomato varieties. The design of the experiment was split-plot design with three replications and four treatments such as Leucaena leaves, Poultry bedding, Nitrogen fertilizer and Leucaena leaves + Poultry bedding. Constant increase in temperature, wind and decrease in rainfall, an unpredictable rainfall pattern and prolonged drought are effects causing severe dropping of flowers and rotting of tomato fruits. Use of synthetic pesticide, planting of trees and fertilizers are use as adaptation strategies. Mongal F1 tomato variety had performed better than Thorgal F1. Poultry bedding and Leucaena leaves has increased soil fertility than Leucaena leaves + poultry bedding and Nitrogen. Response to growth and yield, Leucaena leaves and poultry bedding performed better than Nitrogen and Leucaena leaves +poultry bedding. The results from DSSAT (CROPGRO) model shows the existence of climate change such as unpredictable and erratic rainfall, higher temperatures etc. The model indicated that, highest amount of rainfall was recorded in September, and the lowest was in July, contrary both temperature's solar radiations were very high in July and declined in September. In addition, days after start of simulations for tomato growth, and yield, treatments did not impacted well due to their longterm effects.

Introduction /Overview of the research problem

The production and utilization of tomato has increased over the years in The Gambia. However, demand for the crop exceeds supply owing to its economic importance and increasing popularity as a result of economic gains and consumption. Tomato production in The Gambia is ranked second after onion in terms of production acreage among vegetables. The crop is high in vitamin AB and C and also contain good amount of potassium, iron and phosphorus. Fresh tomatoes and canned types such as concentrates puree and paste are increasingly in demand in West Africa where they form an essential part of the diet (Costa, 2018). Soil fertility in the Gambia today is generally regarded as low, which is the unfortunate result of rapid population growth and poor agricultural management practices. Plant nutrient depletion rate is considered moderate and the loss of soil through erosion is estimated at 12.5 tons per hectare per year and these has affected tomato production in the Gambia as not meeting the demand (Agriculture and Natural Resources, The Gambia, 2009). The Gambia is listed among the top 100 countries most vulnerable to climate change (IPCC, 2020), and is also one of the 10 nations in the world most vulnerable to coastline erosion and sea level rise. (Gomez, Adelagun, *et al.,* 2020). Drought, flooding, coastal erosion, windstorms, high temperatures, and heavy and irregular rainfalls have all become more frequent and intense in the nation in recent years. The country's efforts to eradicate poverty and develop sustainably are greatly hampered by these extreme weather phenomena, especially the drought.

Overall Objective

To enhance tomato production in The Gambia through determination of effects of inorganic and organic fertilizers as well as modelling climate impact on the performance of Mongal F1 and Thorgal F1 tomato cultivars.

Approaches

A field survey, soil sample collections, research experiment and modelling climate impact on to tomato varieties. Key informant interviews and focus group discussions was used and established survey results. The design of the experiment was a split-plot design with three replications and four treatments. Mongal F1 and Thorgal F1 were the tomato cultivars used and fertilizer options applied were Leucaena leucocephala leaves (5kg/plot), Poultry bedding (5kg/plot) leucocephala leaves + Poultry bedding (5kg/plot) which means half of five kilos each and Nitrogen fertilizer (0.05kg/plot). Adapting the DSSAT crop simulation model for most commonly used tomato cultivars at nitrogen fertilizer and different organic amendment levels in The Gambia.

Findings

Table: 2: Climate Change Challenges and Adaptation Strategies for Tomatoes

Variables	Frequency	Percentage
Effects of climate change on tomatoes		
Dropping of flowers by rain and wind	10	20
Fallen of tomato plant due to heavy wind	5	10
Introduction of pests	8	16
Low yielding due to continues rain and heavy winds	1	2
Severe discoloration of leaves	6	12
Severe rotting of tomato fruits	14	28
Stunted growth due to high temperatures	6	12
Adaptation Strategies		
Application of large quantity of fertilizers	12	24
Planting of trees (wind Breakers)	7	14
Practice of staking	3	6
Use of synthetic Pesticide	28	56

Table 1: Results Obtained from the Individual Treatment Soil Samples for the Chemical Parameters

Treatments	BASES ECHANGEABLES(meq/100g)					
	C (%)	Azote (%)	Ca	Na	Mg	K
Leucaena Leaves	0,43	0,04	6,94	0,04	2,06	2.90
Poultry Bedding + Leucaena Leaves	0,53	0,05	7,37	0,04	2,06	3.08
Poultry Bedding	0,55	0,05	6,81	0,04	2,12	3,04
Nitrogen	0.33	0,05	6,93	0,04	2,62	3.17

Table 3: Influence of Tomato Varieties to Agronomic Traits and Fertilizers

Agronomic Traits	PH@4W	SG	PB	TPP	50%Flower
Tomato Cultivars					
Mongal	38.32	1.45	5.58		36
Thorgal	33.56	1.25	4.66		32
Treatments					
Leucaena Leaves	37.63	1.33	6.00	9.83	
Poultry Bedding + Leucaena	35.43	1.15	5.16	9.66	
Nitrogen Leaves	32.06	1.20	4.00	7.33	
Poultry Bedding	38.65	1.30	5.33	11.00	

Conclusions

Generally, tomato farmers are aware and also strongly believed that climate change is existing where constant increase in temperature and decrease in rainfall, an unpredictable rainfall pattern and prolonged drought were mentioned to have been experienced as climate change effects for more than five years while minority indicated about 5-10years. These effects were known to tomato growers through personal experience. Climate change is causing severe dropping of flowers by rain and wind and rotting of tomato fruits as well as disease attack at the reproductive stage. For the case of adaptation strategies, great numbers of the farmers are using synthetic pesticide to control disease e.g. red spider mites, planting of trees (wind breakers) to reduce heavy wind speed and application of large quantity of fertilizers to improve the soil fertility. Mongal F1 tomato variety had performed better than Thorgal F1 for both growth and yield parameters. However, among the treatments, poultry bedding has increased soil fertility level followed by Leucaena leaves and the lowest mean values were observed from Leucaena leaves + poultry bedding and Nitrogen. For the case of treatments response to growth and yield parameters, such as (stem girth, primary branches, fruit length) Leucaena leaves recorded the highest mean values seconded by poultry bedding and the lowest values were resulted from Nitrogen and Leucaena leaves +poultry bedding, except for number of trusses per plant, poultry bedding performed better than all the rest.

Recommendations

1. The research is recommending for further study on the same topic in different agro-ecological zone using local and improved tomato varieties.

2. The study is also recommending investigations of comparing the performance of leucaena and gliricidial leaves on tomatoes and soil fertility.