RESPONSE OF ROSELLE (*HIBISCUS SABDARIFFA*) TO THE APPLICATION OF DIFFERENT RATES OF NPK (10:10:10) FERTILIZER IN NORTHERN GUINEA SAVANNA ZONE OF NIGERIA

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ABSTRACT
The response of roselle (*Hibiscus sabdariffa*) to application of NPK (10:10:10) was investigated at the research farm of the Plateau State College of Agriculture, Garkawa (Latitude 10^0 11' longitude 8^0 21'E) in the northern guinea savanna ecological zone during the 2012 and 2013 seasons. Treatments consisted of NPK (10:10:10) fertilizer applied at the rate of 0, 90, 180 and 270kg/ha. The experiment was laid out in a randomized complete block design (RCBD), replicated 3 times. Results obtained showed a significant ($p<0.05$) increase in plant height, number of leaves per hectare, calyx yield and seed yield with increase in fertilizer rates. There was however, no significant difference in roselle growth and yield parameters when NPK fertilizer (10:10:10) was applied at the rate of 180kg/ha and 270kg/ha. The study recommends application of NPK (10:10:10) at 180 kg/ha for optimum growth and yield of roselle in the study area.
Key words: Roselle, NPK (10:10:10), growth, yield

Introduction

Roselle (*Hibiscus sabdarifa*) is of the family malvacea (Babatunde and Zachariah, 2001). It is a woody annual herb growing about 2.0 -2.5 metres tall (Bakers, 1970) the leaves are deep, three to five lobed, arranged alternately on stem. The flowers are white or yellow in colour with a dark red spot at base of the petal.

The crop is normally cultivated for its leaves, calyx or jute in Nigeria, Indian and America (Shotton, 1968). The cultivation of Roselle is on the increase in northern Nigeria due to the utilization of its calyx for production of liquid beverage popularly known as "Zobo". Better still, the leaves are utilized as vegetables in soup or in making a condiment popularly known as "Kodo". The seed is used in the production of a local condiment called "*dad dawa*" (Schippers, 2000), because of its high content of vitamin C which is believed to reduce cholesterol in human body (Tindal, 1983). The dried stem which is burn into ashes are use to produce local liquid potash, used in cooking soup and in the production of black soap, locally used as antiseptic.

Many farmers would apply fertilizer on cereals and legumes in anticipation of optimum yield, but not on roselle a vegetable that is regarded as seemingly "little crop". This is due to lack of adequate knowledge on the contribution of roselle to food security of the nation.

Unless there is efficient production and emphasis on fertilization of roselle and other vegetables, the tropics cannot achieve its sufficiency. Lack of adequate fertilization or improper usage of fertilizer could be responsible for the high level of food insecurity, better still consumption of vegetables help the poor to meet their daily protein needs.
In view of the above, this research work is aimed at:

i. determining the response of NPK compound fertilizer (10:10:10) on the growth and yield of roselle and
ii. to determine the most appropriate rate of NPK (10:10:10) fertilizer application to roselle.

MATERIALS AND METHODS

The experiment was conducted at the experimental site of the Plateau State College of Agriculture, Garkawa during the 2012 and 2013 wet seasons, Garkawa is located at $10^0$11'N and longitude 8^0 21'E with maximum average temperature of 30^0C.There were four treatments used as dosages of fertilizer applications at 0, 90, 180 and 270Kg/ha. Treatments were assigned to plots using picking from a hat without replacement method. The treatments were replicated 3 times and laid out in a randomized complete block design (RCBD). The land was ploughed to obtain a fine tilth, it was then marked out into 12 plots of $15m^2$ (5m x 5m) each with a spacing1.5m between blocks and 1.0 between plot. Three seeds were sown in rows at a pacing of 20cm x 20cm between stands. The plants were thinned to two plants/stand at two 2 weeks after sowing (WAS).

Weeds were controlled manually by hoe weeding at 2 and 4. Spraying was done against pests using *Lamda cyhalothrin* at 1 litre per hectre. The NPK (10:10:10) fertilizer was applied at 2 WAS. Data on rainfall, temperature, and relative humidity during the experimental period were recorded and presented as Table 1. Similarly, data on physico-chemical properties of the soil at the study site is presented in Table 2.

Plant heights of five randomly selected plants in the inner rows were measured using a metre rule from the base to the apex of the middle leaflet. The number of leaves was obtained by physical counting of leaves of the five randomly selected plants. Weight of calyx (Kg) per hectare and seed weight (Kg) per hectare was taken from the five randomly selected plants in the inner rows. Data was analyzed using fishers test as described by Snedecor and Cochran (1967). Significant means were separated using the least significant difference (LSD).

Results and Discussion

The meteorological data and the physico-chemical properties of the soil at the experimental site are presented in Tables 1 and 2. The site recorded a mean annual rainfall of 1438.3mm with a temperature range of between 17 – 39.5^{o}C and an average RH of 67.7%. The rainfall, temperature and soil conditions of the study area were typical of the tropical climate adequate for the production of any temperate crop such as roselle.

The result of this study indicated a significant differences ($p<0.05$) in plant height measured due to the application of NPK (10:10:10) at 0, 90, 180, 270 kg/ha (Table 3). There was a general increase in plant height due to increase in dosage of fertilizer from 0 to 270kg/ha application. This result is in conformity with the findings of Babatunde and Zachariah, 2001 who reported that increase in nitrogen application favors increase in growth of roselle. This is due to the fact that nitrogen is a major nutrient needed for growth of plants.

The mean number of leaves differed significantly at both 4 and 6 WAS (Table 4). Continuous increase in the application of NPK (10:10:10) significantly increase mean number of leaves. There was however, no significant difference when the fertilizer was increased from 180kg/ha to 270kg/ha. A possible explanation to this would be that nitrogen supply natural flushed to the plants at onset of the wet seasons which compensated for the total nitrogen need of the crop. Better still, a little application of fertilizer is just enough to sustain roselle throughout its life cycle, as vegetables do not need much NPK compared to cereals. The result is in conformity with the work of Shotton (1968) who reported a significant increase in number of leaves of vegetables with the application of NPK (10:10:10).

Similarly, a significant increase in calyx weight was obtained with increase in the rate of NPK application from 0-180kg/ha; but a decrease was recorded when the fertilizer was increase to 270kg/ha (Table 5). This showed that application of NPK (10:10:10) beyond 180kg/ha is not economic. The calyx as part of the fruit of roselle requires phosphorus and potassium for flowering and fruit development, but little is enough to provide for its development. Tindal (1983) reported the usefulness of NPK fertilization to horticultural vegetables for growth and development.

Seed weight (kg/ha) of roselle was significantly ($p< 0.05$) influenced by application of NPK (Table 6). Application of NPK (10:10:10) favors seed yield of roselle. This is due to the ability of the roselle to get the needed primary nutrients for proper seed maturity. Grubben (1977) reported that maximum seed weight was attained due to application of NPK fertilizers.

Summary and Conclusion

A field experiment was conducted at the Plateau State College of Agriculture in the northern guinea savanna during the 2012 and 2013 wet seasons to determine the response of roselle to NPK (15:15:15) at (0,90,180,270kg/ha). The experiment was laid out in a RCBD and replicated three times. Results obtained showed a significant increase in plant height, number of leaves, weight of calyx and seed weight (kg/ha) with increase in the quantity of the fertilizer; but growth and yield parameters did not differed significantly when the fertilizer rate was increase from 180kg/ha to 270kg/ha. Application of NPK (15:15:15) at 180kg/ha favors optimum yield of roselle in the study area.

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Table 1: Average Meteorological data for 2012 and 2013 at the experimental site

Month	Rainfall(min)	Temperature (max)	Temperature (min)	Relative humidity
January	0.0	39.5	26.8	54.0
February	0.0	39.1	25.0	56.0
March	0.0	39.0	25.6	53.0
April	75.0	37.5	27.1	63.0
May	116.3	34.1	25.6	76.0
June	125.0	32.5	24.7	80.0
July	382.0	30.5	23.5	74.0
August	230.3	30.12	23.5	86.0
September	312.3	30.5	23.5	85.0
October	177.4	31.8	23.8	81.0
November	20.0	35.0	22.8	68.0
December	0.0	36.5	17.3	36.0

NIMET (2012 and 2013)

Table 2: Physical and Chemical Characteristics at the experimental site

Mechanical Properties

Clay (%) ---------- 9.0
Silt (%) ---------- 13.0
Fine sand (%) ---------- 30.0
Coarse sand (%) ------- 48.0
Textural class – Sandy Clay (SL)

Exchangeable bases (Meq/100g)

Na---------- 0.25
K ---------- 0.23
Ca---------- 1.16
Mg ---------- 1.00
CEL----------12.00
P(ppm)---------- 2.80

Chemical Properties

PH in H_20 ---------- 6.1
PH in Hcl ---------- 5.5
Organic Malter
Carbon (%) ---------- 0.23
Nitrogen (%) ---------- 0.056

Table 3: Mean plant height (cm) of Roselle at 4 and 6 WAS*

	2012		2013	
NPK Kg/ha	4WAS	6WAS	4WAS	6WAS
0	18.80	19.81	41.20	42.21
90	19.73	20.70	47.56	47.50
180	22.16	22.17	74.28	74.30
270	26.72	26.74	76.39	77.40
LSD (P<0.05)	5.888	5.888	3.190	3.888

WAS= weeks after sowing

Table 4: Number of leaves of roselle at 4 and 6 WAS

	2012		2013	
NPK (kg/ha)	4WAS	6WAS	4WAS	6WAS
0	31.33	32.30	91.30	92.33
90	33.67	34.60	96.47	97.04
180	35.57	35.60	98.47	98.41
270	37.40	38.41	102.13	102.15
LSD (0.05)	2.01	4.07	4.21	5.06

WAS= weeks after sowing

Table 5: Effects of NPK fertilizer (10-10-10) on calyx weight of roselle plant (kg/ ha)

NPK kg/ha	Weight of calyx (Kg)	
	2012	**2013**
0	24.4	25.5
90	41.0	42.2
180	56.0	57.2
270	50.0	51.3
LSD($p<0.05$)	10.92	10.92

Table 6: Effects of NPK fertilizer (10-10-10) on seed weight (kg/ha)

NPK kg/ha	Seed weight (kg/ha)	
	2012	**2013**
0	40.6	41.7
90	120.92	122.90
180	250.00	253.00
270	183.56	189.56
LSD($p<0.05$)	25.99	25.99