



ORIGINAL RESEARCH ARTICLE

Effect of Sowing Date and Nitrogen Fertilizer on the Growth and Yield of Roselle (*Hibiscus sabdariffa* L.) in Mubi North, Guinea Savannah Nigeria

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ABSTRACT

The field experiment was conducted during 2024 rain fed cropping season at the Teaching and Research Farm of the Department of Crop Science, Adamawa State University, Mubi to determine the most suitable sowing date and nitrogen level that can give optimum growth and yield of roselle (*Hibiscus sabdariffa* L.) in Mubi Northern Guinea Savannah. The treatments consisted of three (3) different sowing dates of ten (10) days interval: SD₁ (21/07/2024), SD₂ (31/07/2024) and SD₃ (10/08/2024) and four levels of nitrogen fertilizer: N₁ (0 kg N/ha), N₂ (50 kg N/ha), N₃ (100 kg N/ha) and N₄ (150 kg N/ha) respectively. The experiment was laid out in a split plot design replicated three times. Sowing date was allocated to main plots and nitrogen levels to sub-plots. Data were taken on plant height, number of branches, days to first flowering, days to 50 % flowering, fresh calyx weight, dry calyx weight and dry seed weight. Data collected were subjected to analysis of variance (ANOVA) and mean were separated using Duncan Multiple Range Test at 5 % level of probability. Result obtained shows that effect of sowing date was significant ($p \leq 0.05$) on the parameters measured except on number of branches and days to flowering (first and 50 %). Similarly, nitrogen levels were also significant ($p \leq 0.05$) on the parameters measured except on number of days to flowering and dry calyx weight. Sowing on 21/07/2024 (SD₁) was found to be the best for fresh calyx weight (125.6 g), dry calyx weight (23.30 g) and dry seed weight (18.23 g) per plant. Similarly, application of 150 kg N/ha (N₄) produced better fresh calyx weight (169.97 g) and dry seed weight (26.95 g) per plant. Based on the result of the study, early sowing (SD₁) and 150 kg N/ha (N₄) gave optimum performance and seed yields (27.80 g) and are hereby recommended for the study area.

Introduction

Sowing date is an important factor in crop production as it can positively or negatively affect crop performance and yield. Roselle (*Hibiscus sabdariffa* L.) a tropical annual shrub, whose fruit like structures containing edible pigment belongs to the malvaceae family, (Ghazali, 1999). Roselle is tolerant to a wide

range of environmental conditions, particularly well-suited to cultivation in hot, dry regions on a wide range of soils. Some cultivars will also give economic yields in wet, humid areas although optimum rainfall is 18 cm to 20 cm distributed over 3 to 4 months. Roselle is sensitive to day length, requiring a short day of 12 to 13 hours (Tindali, 1983).

Depending on the variety, it matures from 12 – 16 weeks from sowing where diseases and pest are rarely serious. Rain or high humidity during the harvest time and drying can downgrade the quality of the calyces and reduce the yield. In Nigeria, its production is mainly in the Guinea and Sudan Savanna zones of the country where the red calyx genotypes are prevalent and the green calyx type is mainly found in the south western part of the country (Alegbejo, 2000).

Schipper (2000) observed that, roselle is now considered one of the competitive beverages in the world. In Nigeria, roselle has become an important source of raw material for a beverage drink called “Zobo” in Northern Nigeria. This drink is a hot water extract of roselle calyx locally processed with sweeteners, spices and flavor such as ginger, vanilla, straw berry and pineapple (Arrowosoge, 2002). Nutritionally, the calyx is reported by Bake and Futuless (2011) to have significant quantities of vitamin A, C, phosphorus, iron, and calcium, but low in protein. The young leaves are also known to be rich in digestible protein and the oil content of roselle seeds vary from 25 to 30% and has similar properties with cotton seed oil.

Roselle, in spite of its food and medicinal value, is been classified as a minor crop. Farmers in Nigeria plant it without due consideration for appropriate sowing date which can affect its yield and quality of the produce (calyx). Consumer acceptability, based on calyx quality in terms of color, taste, calyx size, aroma and yield is an important factor. Among the various constraints limiting the production of roselle in Nigeria, nitrogen fertilizer also appears to be one of the most important because it influences calyx and yield production (Oyewole and Mera, 2010).

The objectives of the study were to determine the optimum sowing date for the growth and yield of roselle, to evaluate the effect of

nitrogen fertilizer on the growth and yield of roselle and to determine the best interaction of sowing date and nitrogen levels that can give optimum growth and yield of roselle in the study area.

Materials and Methods

Experimental Site

Field experiment was conducted at the Department of Crop Science, Food and Agricultural Organization/Tree Crop Program (FAO/TCP) Teaching and Research Farm, Adamawa State University, Mubi, under rain fed condition in 2024 cropping season. Mubi, located in the Northern Guinea Savannah zone of Nigeria is situated between latitude 10° 11' and 10° 30' North of the Equator and between longitude 13° 10' and 13° 30' East of the Greenwich meridian and at an altitude of 969 m above mean sea level (MSL). The mean annual rainfall of Mubi is 900 mm, a minimum temperature of 18°C during harmattan period and 40°C as maximum in April (Adebayo, 2020).

Treatments and Experimental Design

The treatments consisted of three (3) different sowing dates SD₁ (21/7/2024), SD₂ (31/7/2024), and SD₃ (10/8/2024) and four nitrogen levels: N₁ (0 kg N/ha), N₂ (50 kg N/ha), N₃ (100 kg N/ha) and N₄ (150 kg N/ha). The experiment was laid out in a split plot design replicated three times. Sowing date was assigned to main plots and nitrogen levels to sub plots.

Source of seed and Sowing Method

The seed used in the research was obtained from the local farmers in the study area. The land for the trial was ploughed using tractor and leveled manually to get a fine tilt before sowing. Sowing was done manually through dibbling. Seeds were sown at a depth of 3 cm – 4 cm with 6 – 8 seeds per/hole at the spacing of 60 cm between rows and 45 cm between stands which was later thinned to 2 plants per stand at two Weeks After Sowing (WAS).

Fertilizer Application

Phosphorus (P) and potassium (K) fertilizers were applied at the rate of 30 kg P₂O₅ and K₂O respectively, while nitrogen (N) was applied based on its treatment. Both P and K were applied at land preparation while nitrogen fertilizer was applied in two split doses for those treatments receiving nitrogen. First dosage was applied at 3 WAS and the remaining dosage at 6 WAS.

Data Collection

Data were collected on the following parameters:

1. Plant Height (cm)

Ten plants were randomly selected and tagged properly within the net plot, plant heights were measured at 4, 8 and 12 WAS using meter rule and the average height were determined and recorded.

2. Number of Branches

This was done by counting the number of branches of the ten tagged plants at 4, 8 and 12 WAS and their average mean was calculated and recorded.

3. Days to First Flowering

Number of days taken from sowing to the appearance of first flower in a plot was recorded as number of days to first flowering.

4. Days to 50 % flowering

Days to 50 % flowering was recorded as number of days from sowing to the date when 50 % of plants showed at least one flower fully opened.

5. Weight of Fresh Calyx

Fresh calyx weight was determined by measuring the calyx from ten uprooted plants in each net plot using electronic (sensitive) scale and mean was computed and expressed in grams.

6. Weight of Dry Calyx

The calyx from the ten plants were oven dried at 65°C in an air dry oven until constant weight was obtained.

Average dry weight of calyx per plant was computed and expressed in grams.

7. Dry Seed Weight per Plant

Dry seed weight was determined by harvesting and threshing of fruits from the ten sampled plants in each net plot, the seeds were weighted using electronic (sensitive) scale and their mean was computed and expressed in grams.

Results

Effects of Sowing Date and Nitrogen Levels on Plant Height (cm) of Roselle (Hibiscus Sabdariffa L.)

The result of the effects of sowing date and nitrogen levels on plant height of roselle is presented in Table 1. Effect of sowing date was not significant ($P>0.05$) on plant height at 4 WAS, but significant ($P\leq 0.05$) at 8 and 12 WAS. SD₁ produced significantly tallest plants (36.40 cm and 59.72 cm), followed by SD₂ (30.35 cm and 55.01 cm) while SD₃ recorded the shortest plants (27.32 cm and 53.27 cm) at 8 and 12 WAS respectively.

Similarly, Effect of nitrogen levels was not significant ($P>0.05$) on plant height at 4 WAS, but significant ($P\leq 0.05$) at 8 and 12 WAS. Application of 150 kg N ha⁻¹ produced significantly tallest plants (56.35 cm and 63.50 cm), followed by 100 kg N ha⁻¹ (31.05 cm and 60.05 cm) while control treatment (0 kg N ha⁻¹) recorded the shortest plants (24.77 cm and 47.05 cm) at 8 and 12 WAS respectively. There was no significant ($P>0.05$) interaction between the sowing date and nitrogen levels on plant height during the period of the research.

Effects of Sowing Date and Nitrogen Levels on Number of Branches of Roselle (Hibiscus Sabdariffa L.)

The result of the effects of sowing date and nitrogen levels on number of branches per plant of roselle is presented in Table 1. Effect of sowing date was not significant ($P>0.05$) on

number of branches per plant of roselle. However, nitrogen levels were significant ($P \leq 0.05$) on number of branches per plant of roselle at all the sampled period. Application of 150 kg N ha⁻¹ produced significantly highest number of branches (7.16, 8.79 and 17.86) at 4, 8 and 12 WAS respectively, while control treatments (0 kg N ha⁻¹) recorded the least number of branches (3.50, 5.03 and 10.24) per plant at 4, 8 and 12 WAS respectively.

There was no significant ($P > 0.05$) interaction between the sowing date and nitrogen levels on number of branches per plant of roselle during the period of the research.

Effects of Sowing Date and Nitrogen Levels on Number of Days to First Flowering of Roselle (Hibiscus Sabdariffa L.)

The result of the effects of sowing date and nitrogen levels on number of days to first flowering of roselle is presented in Table 1. Effects of both sowing date and nitrogen levels were not significant ($P > 0.05$) on number of days to first flowering of roselle during the period of the study. And there was no significant ($P > 0.05$) interaction between the sowing date and nitrogen levels on number of days to first flowering of roselle during the period of the research.

Effects of Sowing Date and Nitrogen Levels on Number of Days to 50 % Flowering of Roselle (Hibiscus Sabdariffa L.)

The result of the effects of sowing date and nitrogen levels on number of days to 50 % flowering of roselle is presented in Table 1. Effect of both sowing date and nitrogen levels were not significant ($P > 0.05$) on number of days to 50 % flowering of roselle during the period of the study. And there was no significant ($P > 0.05$) interaction between the sowing date and nitrogen levels on number of days to 50 % flowering of roselle during the period of the research.

Effects of Sowing Date and Nitrogen Levels on Fresh Calyx Weight of Roselle (Hibiscus Sabdariffa L.)

The result of the effects of sowing date and nitrogen fertilizer on fresh calyx weight of roselle is presented in Table 1. Sowing date significantly ($P \leq 0.05$) influences fresh calyx weight. Early sowing (SD₁) recorded the highest weight of fresh calyx (125.60 g), followed by SD₂ (113.30 g) while SD₃ had the least weight of fresh calyx (96.80 g) per plant of roselle. Similarly, effect of nitrogen levels was significant ($P \leq 0.05$) on fresh calyx weight. Application of 150 kg N ha⁻¹ produced the highest fresh calyx weight (169.97 g) per plant, followed by 100 kg N ha⁻¹ (104.50 g) while control (0 kg N ha⁻¹) produces the least fresh calyx weight (81.50 g) per plant respectively. There was no significant ($P > 0.05$) interaction between the sowing date and nitrogen levels on fresh calyx weight per plant of roselle during the period of the research.

Effects of Sowing Date and Nitrogen Levels on Dry Calyx Weight of Roselle (Hibiscus Sabdariffa L.)

The result of the dry matter weight of roselle as effected by different sowing date and nitrogen levels is presented in Table 1. Sowing date significantly ($P \leq 0.05$) influences dry calyx weight. Early sowing (SD₁) recorded the highest weight of dry calyx (23.30 g), followed by SD₂ (19.88 g), while SD₃ had the least weight of dry calyx (17.99 g) per plant of roselle. However, effect of nitrogen levels was not significant ($P > 0.05$) on dry calyx weight per plant of roselle. And there was no significant ($P > 0.05$) interaction between the sowing date and nitrogen levels on dry calyx weight per plant of roselle during the period of the research.

Table 1: Effects of Sowing Date and Nitrogen Levels on the Performance of Roselle (*Hibiscus sabdariffa* L.) in Mubi during 2024 Growing Season

Treatments	Plant Height (cm)			Number of Branches			Days to Flowering		Fresh Calyx Weight (g)	Dry Calyx Weight (g)	Dry Seed Weight (g)
	4 WAS	8WAS	12 WAS	4 WAS	8 WAS	12 WAS	First	50 %			
Sowing Date											
SD ₁	22.83	36.40 ^a	59.72 ^a	5.80	7.92	14.10	96.03	99.10	125.60 ^a	23.30 ^a	18.23 ^a
SD ₂	20.55	30.35 ^b	55.01 ^b	5.02	6.91	13.47	105.08	105.15	113.30 ^b	19.88 ^{bc}	14.81 ^b
SD ₃	18.93	27.32 ^c	53.27 ^c	5.04	6.73	13.64	108.15	105.00	96.80 ^c	17.99 ^c	14.00 ^c
Level of Sign.	ns	*	*	ns	ns	ns	Ns	ns	*	*	*
Nitrogen (kg/ha)											
0	16.97	24.77 ^d	47.05 ^d	3.50 ^d	5.03 ^d	10.24 ^d	108.87	108.87 ^a	81.50 ^d	11.951	9.52 ^c
50	13.94	27.94 ^c	54.75 ^c	4.72 ^c	6.23 ^c	10.24 ^d	104.59	104.59 ^b	80.80 ^c	12.113	10.25 ^c
100	22.91	31.05 ^b	60.05 ^b	6.94 ^b	7.31 ^b	14.44 ^b	101.89	101.89 ^c	104.50 ^b	12.867	12.03 ^b
150	24.24	56.35 ^a	63.50 ^a	7.16 ^a	8.79 ^a	17.86 ^a	96.97	96.97 ^d	169.97 ^a	12.671	26.95 ^a
Level of Sign.	ns	*	*	*	*	*	ns	ns	*	ns	*
Inter. SD x N	ns	ns	Ns	Ns	Ns	Ns	ns	Ns	ns	ns	*

Mean with the same letter were not significantly deference at 0.05, WAS = Weeks after sowing, LSD = Least significant deference, NS = not significant at 0.05, * = significant at 0.05.

Effects of Sowing Date and Nitrogen Levels on Dry Seed Weight of Roselle (Hibiscus Sabdariffa L.)

The result of the effects of sowing date and nitrogen fertilizer on dry seed weight of roselle is presented in Table 1. Sowing date significantly ($P \leq 0.05$) influences dry seed weight per plant of roselle. Early sowing (SD_1) recorded the highest dry seed weight (18.23 g), followed by SD_2 (14.81 g), while SD_3 had the least weight of dry seed (14.00 g) per plant of roselle. Similarly, effect of nitrogen levels was significant ($P \leq 0.05$) on dry seed weight of roselle. Application of 150 kg N ha⁻¹ produced the highest dry seed weight (26.95 g) per plant, followed by 100 kg N ha⁻¹ (12.03 g), while control (0 kg N ha⁻¹) recorded the least weight of dry seed (9.52 g). There was significant ($P \leq 0.05$) interaction between the sowing date and nitrogen levels on dry seed weight per plant of roselle. Highest dry seed weight (27.80 g) was obtained from early sowing (SD_1) with the application of 150 kg N ha⁻¹, while late sowing (SD_3) with 0 kg N ha⁻¹ (control) produced the least dry seed weight per plant of roselle (9.70 g).

Discussion

Effects of Sowing Date and Nitrogen Levels on the Performance of Roselle (Hibiscus Sabdariffa L.)

The significant increase in plant height, fresh calyx weight, dry calyx weight and dry seed weight of roselle with early sowing (SD_1) performing better than the other sowing dates could be due to the facts that the plants attained highest of number of days from sowing to the harvest time. The yield superiority of SD_1 might be attributable to the production of longer calyx in relation to other sowing dates. This result agreed with the findings of Pfeiffer and Harris (1998) who also recorded higher values on these parameters from early sowing date than middle and late planting dates. Twain *et al.* (2001) also observed that early planting of roselle (SD_1) has the possibility of performing better in

terms of plant height, number of branches, fresh and dry seed weight, but in contrast to this research, number of days to first and fifty percent flowering were also significantly influenced by sowing date.

The significant increase in plant height, number of branches, fresh calyx weight and dry seed weight of roselle with 150 kg N/ha performing better than the other treatments confirmed the role of nitrogen in promoting vegetative growth of crops. Udoh *et al.* (2005) reported that nitrogen has been observed to elongate the juvenile stage in plant, thus delaying crop maturity, increase in time to the efficient flowering with increase in application of nitrogen fertilizer.

This result is in line with the findings of Alegbejo (2000) and Ndapko (1997) who also reported a significant increase in plant height, number of branches and flowering of roselle with increase in levels of nitrogen from 50 – 150 kg N/ha. Similarly, Alegbejo (2000) reported a progressive increase in the height of roselle varieties at different N rates. Crop productivity in rain fed agriculture is limited mainly by low availability of mineral nutrients especially nitrogen fertilizer at planting or at vegetative stage of the plant development or at both stages. This finding is supported by Bake and Futuless (2011) who observed that improved agricultural productivity could be achieved by the use of fertilizers especially N. This result also corroborates the findings of Okusanya *et al.* (2002) who observed that roselle plant responds favorably to nitrogen fertilizer at different levels.

The significant increase from the interaction of 150 kg N/ha and SD_1 on dry seed weight explained the important of early sowing and optimum application of N fertilizer on the grains yield of a crop. These results are in tandem with Akanbi *et al.* (2009) who reported that sowing date increase seed yield in roselle plant. Akanbi *et al.* (2009) also reported that,

roselle plants respond favourably to nitrogen fertilizer application. Increased in calyx weight as observed by Okusanya *et al.* (1999); Okosun (2000) and Babatunde (2001) supported the present finding on seed weight. The result indicated that early sowing (21/07/2024) with 150 kg/N/ha fertilizer level gave the highest seed weight. This result is in conformity with Akanbi (2009) who similarly observed that, application of nitrogen fertilizer significantly influenced the number of pods produced per plants and number of seeds in roselle. From these result, it was observed that for every increase in nitrogen fertilizer level, there was a clear significant difference in fresh and dry weight. This implies that, higher application of nitrogen could further improve these parameters with a desirable improvement. This result corroborates with that of Bake and Futuless (2011) who suggested the need to apply fertilizer to replenish depleted soil nutrient.

Conclusion and Recommendations

The findings of the study showed that, performance of roselle is significantly influenced by sowing date and nitrogen levels. And it can be concluded that increased in nitrogen level up to 150 kg N/ha significantly increase the growth and seed yield of roselle together with early sowing date (21/07/2024). Based on the result obtained from the study, treatment combination of 150 kg N/ha with first sowing date (21/07/2024) is hereby recommended for the study area because of its high performance on the growth and seed yield of roselle.

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