



## Effects of Accession and Nutrients sources of Rosselle Production (*Hibiscus Sabdariffa L.*) in Savanna Agro-ecological zone, Nigeria

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### Abstract

The experiment aimed to evaluate the effect of Accession and nutrient sources on the growth and yield of sorrel grown at Makurdi during the 2023 Rainy Season. The treatments used were Accession (NG001, NG002 and NG003), Organic source (Poultry dropping, Cow dung, Goat manure and control) was used. The experiment is a 3 by 4 experiment laid in a randomized complete block design with three replications. The spacing of 20 x 75 cm was adapted for the work. During the investigation, some physiological variables, such as growth, plant height, the number of leaves, number of branches, number of flowers, days of maturity were measured. Other characters like number of calyx per plant, number of calyx per plant, calyx weight, plant weight and dry calyx weight and yield were also recorded. The results of the investigation revealed that sorrel generally responded to both varietal and nutrient source. All the parameters studies have significantly ( $P \leq 0.05$ ) responded to NG001, where it was observed to perform higher in both growth character such as plant height (60.23), the number of leaves (80.23), number of branches (7.81), number of flower (74.12), number of calyx per plant (54.63), number of seed per calyx (9.83), calyx weight (258.12), plant weight (582.50) and dry calyx (147.63) weight and yield (6.83) while NG003 had (130.00). On nutrient source poultry droppings was superior in both growth and yield related character such as, plant height (68.91), the number of leaves (88.31), number of branches (7.61), number of flower (73.23), number of calyx per plant (53.83), number of seed per calyx (8.03), calyx weight (257.23), plant weight (582.41) and dry calyx (146.83) weight and yield (6.03) while control plots had (135.22) days of maturity. Based on the results obtained it can be suggested that the use NG001 and poultry dropping will lead to optimum yield for roselle farmers in the study location.

**Keywords:** Sorrel, Organic nutrient and Variety.

### Introduction

Roselle (*Hibiscus sabdariffa*) is a versatile tropical plant known for its economic and nutritional benefits, particularly its edible calyxes and seeds. In recent years, the cultivation of Roselle has gained popularity in Nigeria due to its potential for both local consumption and export. However, achieving optimal growth and yield remains a challenge, largely influenced by genetic factors and soil fertility. Koenig and Johnson (1999).

In Makurdi, Nigeria, the use of organic manure as a soil amendment has emerged as a sustainable practice to enhance agricultural productivity. Organic manures, such as poultry droppings, goat manure, and cow dung, are rich in essential nutrients and improve soil structure, water retention, and microbial activity. These benefits can lead to increased growth rates, higher yields, and improved quality of crops, making organic fertilizers a vital component in modern farming practices. Madina et al (2023). Organic production of Roselle (*Hibiscus sabdariffa*) has gained traction as an environmentally friendly and sustainable agricultural practice. This method emphasizes the use of natural inputs and techniques that enhance soil health, conserve biodiversity, and reduce chemical residues in food products. The increasing demand for organic products, combined with Roselle's nutritional and economic value, makes organic cultivation a promising venture. One of the key components of organic Roselle production is effective soil fertility management.

Organic fertilizers, such as compost, poultry manure, goat manure, and green manures, provide essential nutrients to the plants while improving soil structure and microbial activity. These inputs not only enhance nutrient availability but also promote a healthy ecosystem that supports plant growth (Talpur *et al.*, 2013). Organic production relies on natural pest management strategies. Techniques such as intercropping, the use of beneficial insects, and organic pesticides derived from natural sources help manage pests and diseases without harming the environment. Regular monitoring of plants for signs of infestation enables timely intervention, reducing the reliance on synthetic chemicals. Selecting the right accessions or varieties is critical for successful organic Roselle production. Different varieties may exhibit varying levels of resistance to pests, diseases, and environmental stresses Adebayo and Akoun (2002). Organic farmers often choose local or heirloom varieties that are well-adapted to their specific conditions and have a proven track record of performance. Harvesting Roselle requires careful timing to ensure the calyxes are picked at their peak ripeness for optimal flavor and quality. Post-harvest handling practices, such as proper drying and storage, are essential to maintain the quality of the calyxes, which are used in beverages, culinary dishes, and herbal remedies. Implementing organic standards during harvesting and processing helps ensure that the final product meets consumer expectations for organic certification FAO (2007). The organic market for Roselle is expanding, driven by increasing consumer awareness of health benefits and the desire for chemical-free products. Farmers engaged in organic production can tap into premium markets, offering their products at higher prices. Participation in certification programs can further enhance marketability and consumer trust.

Organic production of Roselle presents a sustainable alternative to conventional farming methods. By focusing on soil health, natural pest management, and careful variety selection, farmers can enhance both the quality and yield of Roselle. This approach not only supports the environment but also meets the growing demand for organic products, contributing to improved livelihoods for farmers and healthier food options for consumers. Consumers tend to use organic products continuously, and this has become a global trend. In response to consumer demand, organic food products are quickly growing (Peng, 2019). All countries around the world report a trend of continual growth in the organic food and beverage market (Golijan and Dimitrijević, 2018). The demand for organic products has been reported to be increasing in both local and international markets (Declaro-Ruedas, 2019), and is expected to continue growing, especially in developed countries, while the supply of organic products is limited and still cannot produce enough organic products to meet the market demand.

Roselle (*Hibiscus sabdariffa*) is widely cultivated in Nigeria, where various varieties and accessions have been developed to enhance productivity, nutritional value, and adaptability to local conditions. Each varieties and accession has its strengths, making them suitable for different farming strategies and market demands. Farmers can select varieties and accessions based on their specific growing conditions and market preferences, contributing to sustainable agricultural practices and improved livelihoods. Continued research and development efforts are essential to further optimize these accessions and expand their cultivation across the region Akanbi *et al* (2015). This study aims to investigate the effects of various organic manure sources and Roselle accessions on growth and yield-related parameters in Makurdi.

## Material and methods

The experiment was carried out in Makurdi Benue State. At (7°44'0"N 8° 32' 0").The experiment aimed to evaluate the effect of residuals species on the growth and yield of rosselle grown at Makurdi during the 2023 Rainy Season. The treatments used were Accessions (NG001, NG002 and NG003), Organic source (Poultry dropping, Cow dung, Goat manure and control) was used. Poultry dropping applied at the rate of 10 tones/ha and poultry dropping (85% Dry Matter, Organic Material 55%, Total Nitrogen 5.0%, Total Phosphorus 1.31% and Total Potassium 2.12%), Cow dung 10t/ha (Dry matter 10%, Organic Material 10%, Total Nitrogen 12.0%, Total Phosphorus 0.3% and Total Potassium 0.6%) and Goat manure 10t/ha (dry matter 45%, Organic material 30%, Total Nitrogen 9.2%, Total Phosphorus 0.5%, Total Potassium 1.40%). all kept under intensive care and was allowed to undergo partial decomposition for five months following the recommendation of Yusuf and Paul (2015) before it was used for the experiment, and control as check. A 2 by 4 experiment was laid in a randomized complete block design (RCBD) with three replicates, a 4m<sup>2</sup> plot was laid out with 1m between plots and 01m between blocks. There were 12 plots each within a block which gave the total number of 36 plots for the study, an inter-row and intra-row spacing of 20cm x 75cm was adopted for the research, Agronomic practice such as weeding was done manually at 2 and 6 weeks after planting to ensure weed free plots, all the data were collected within the net plot of 4m<sup>2</sup> where a total of 5 plants were tagged for data collection within each net plot. During the investigation, some physiological variables, such as growth, plant height (as taken with the aid of measuring tape from the base of the plant to the tip), the number of leaves (were counted), number of branches (were counted), number of flowering (were counted), and days of maturity were measured (were counted). Other characters like number of calyx (were counted), length of calyx (were measured with a tap), calyx weight (weight with digital weighing scale), plant weight (weight with digital weighing scale) and dry calyx weight (weight with digital weighing scale) were also recorded. All data collected were subjected to analysis of variance (ANOVA) version 17, while least significant difference (LSD) at 5% level of probability was used in separating the means.

**Table\_1: Main Effect of Accession and nutrient source on plant height of rossel grown in Makurdi, Nigeria**

	Weeks after planting (WAP)					
	2	4	6	8	10	12
<b>Accession (A)</b>						
NG001	4.23	7.72	14.53	39.53	54.02	60.23
NG002	3.14	6.02	13.82	34.62	57.23	56.43
NG003	3.00	5.67	13.00	33.02	40.23	50.33
F-LSD (0.05)	0.06	0.20	0.63	2.03	3.01	2.23
<b>Nutrient (N)</b>						
Poultry dropping	4.43	8.73	14.51	38.83	62.23	68.91
Goat manure	3.62	7.63	13.73	35.91	55.23	57.91
Cow dung	3.01	7.00	12.89	30.21	52.32	55.43
Control	2.30	5.53	10.12	28.62	48.12	50.23
F-LSD (0.05)	0.08	0.31	1.03	2.14	3.00	2.92
<b>Interaction</b>						
VXA	NS	NS	NS	NS	NS	NS

LSD= Least Significant Differences at 5% Level of Probability

This study investigates the main effects of variety and nutrient source on the plant height of Roselle (*Hibiscus sabdariffa*) grown in Makurdi, Nigeria, over a 12-week period. Three Accession (NG001, NG002, and NG003) were evaluated alongside four nutrient treatments: poultry droppings, goat manure, cow dung, and a control group. Results indicate significant differences in plant height across both **Accession** and nutrient sources, with the poultry droppings treatment yielding the tallest plants at all measured weeks after planting (WAP). Specifically, this not far from the fact that nutrients play an important role in plant vegetative growth, this work is supported by the finding of Palet and Meshram (2004) who reported that organic source of nutrient gotten from poultry manure do not only encourages soil microorganism activities and save for consumption but also increases vegetative growth which later translate to crop yield. Ndubuaku et al. (2015) started that the increase in vegetative or floral part of plant is determine by the amount of nutrients applied to it which also affect the overall yield in crop., NG001 consistently exhibited superior growth, reaching a maximum height of 60.23 cm at 12 WAP corroborate with work of Nathe (2020) who reported that most variability in plant height is caused by inherent genetic make-up of the variety/ accession, he added that varietal difference can affect both vegetative and reproductive stage of plant positively On the other hand, the control group resulted in the shortest plants, underscoring the importance of nutrient application for optimal growth. The study found no significant interaction effects between variety and nutrient source. These findings highlight the potential of specific varieties and organic fertilizers to enhance Roselle growth, providing insights for improved cultivation practices in the region.

**Table\_2: Effect of Accession and nutrient source on Number of leaves of rossel grown in Makurdi, Nigeria**

	Weeks after planting (WAP)					
	2	4	6	8	10	12
<b>Accession (A)</b>						
NG001	3.23	4.12	10.50	29.83	45.52	80.21
NG002	2.00	3.32	8.81	27.72	43.13	78.73
NG003	2.01	3.00	7.54	25.23	40.98	65.4
F-LSD (0.05)	0.02	0.20	0.41	1.03	2.01	3.13
<b>Nutrient (N)</b>						
Poultry dropping	2.43	4.13	11.41	30.53	46.43	88.31
Goat manure	2.62	3.23	9.23	28.31	43.13	73.51
Cow dung	2.00	3.00	8.03	26.54	41.23	60.54
Control	1.00	2.13	6.82	23.12	38.62	55.13
F-LSD (0.05)	0.08	1.11	1.13	1.24	1.00	2.02
<b>Interaction</b>						
VXA	NS	NS	NS	NS	NS	NS

LSD= Least Significant Differences at 5% Level of Probability

This research examines the effects of **Accession** and nutrient source on the number of leaves in Roselle (*Hibiscus sabdariffa*) cultivated in Makurdi, Nigeria, over a 12-week period. Three **Accession**—NG001, NG002, and NG003 were tested with four nutrient treatments: poultry droppings, goat manure, cow dung, and a control group. The findings reveal

significant differences in leaf production associated with both the variety and the nutrient source. Notably, NG001 exhibited the highest leaf count, achieving a maximum of 60.21 leaves at 12 weeks after planting (WAP) Jilani *et al.* (2010), Nyam *et al.* (2021), and Iorliam and Ugoo (2023) have reported findings similar to this study, focusing on roselle, onion, lettuce, and okra, respectively, and citing varietal variations in crop performance mostly caused by environmental and genetic factors. Poultry droppings significantly enhanced leaf development across all sampling periods, with a peak of 68.31 leaves at 12 WAP. Conversely, the control group yielded the fewest leaves, emphasizing the critical role of nutrient application in promoting leaf growth. This research provides important information for sustainable farming practices by highlighting the potential of organic nutrient sources, especially chicken manure, to improve leaf production in roselle according to a previous study by Nyam *et al.* (2021). No significant interaction effects were observed between variety and nutrient source. These results provide valuable insights for optimizing Roselle cultivation, indicating that specific varieties and organic fertilizers can substantially improve leaf yield.

**Table\_3: Effect of Accession and nutrient source on Number of branches of rossel grown in Makurdi, Nigeria**

	Weeks after planting (WAP)				
	4	6	8	10	12
<b>Accession (A)</b>					
NG001	1.12	2.50	4.63	6.82	7.81
NG002	1.32	1.81	3.32	5.33	6.13
NG003	1.01	1.32	3.00	5.00	5.23
F-LSD (0.05)	0.02	0.11	0.23	0.30	0.11
<b>Nutrient (N)</b>					
Poultry dropping	1.23	2.41	3.83	6.03	7.61
Goat manure	1.13	1.43	2.61	5.43	6.11
Cow dung	1.03	1.22	2.32	4.23	5.00
Control	1.03	1.22	2.02	3.12	4.23
F-LSD (0.05)	0.01	0.03	0.14	1.00	1.02
<b>Interaction</b>					
VXA	NS	NS	NS	NS	NS

LSD= Least Significant Differences at 5% Level of Probability

This study evaluates the effects of **Accession** and nutrient source on the number of branches in Roselle (*Hibiscus sabdariffa*) grown in Makurdi, Nigeria, over a 12-week period. Three **Accession**—NG001, NG002, and NG003 were assessed in conjunction with four nutrient treatments: poultry droppings, goat manure, cow dung, and a control group, this could be related to adoptability of the crop, cultural practice and inherent ability of the accession as reported by Adeyemi (2008). The results demonstrated significant variation in branching patterns associated with both the variety and nutrient source. NG001 consistently exhibited the highest branch counts, reaching 7.81 branches at 12 weeks after planting (WAP) this could be attributed to the increase in plant height, number of leaves as reported in table 1 and 2 which agrees with the finding of Madina *et al.*, 2024 who reported that cultural practice, rainfall pattern, genetic make-up and ability of the plant to acclimatize to the growing environment plays a vital role in such variation. Among the nutrient treatments, poultry droppings also promoted superior branching, culminating in 7.61 branches at 12 WAP.

Conversely, the control group showed the least branching, highlighting the necessity of nutrient application for optimal growth. No significant interaction effects were detected between variety and nutrient source. These findings underscore the importance of selecting appropriate varieties and nutrient sources to enhance branch development in Roselle cultivation, contributing to improved agronomic practices in the region.

**Table\_4: Effect of Accession and nutrient source on yield related parameters of rossel grown in Makurdi, Nigeria**

<b>Accession (A)</b>	Number of flower	Days to maturity	Number of calyx/plant	Number of seed per capsule
NG001	74.12	120.50	54.63	9.82
NG002	62.32	125.81	47.32	8.33
NG003	50.00	130.01	43.00	7.21
F-LSD (0.05)	7.02	3.11	3.03	0.41
<b>Nutrient (N)</b>				
Poultry dropping	73.23	127.41	53.83	8.03
Goat manure	61.13	128.43	42.61	7.43
Cow dung	50.23	130.21	40.12	7.00

Control	42.03	135.22	32.02	6.12
F-LSD (0.05)	7.01	3.03	1.04	0.24
<b>Interaction</b>				
VXA	NS	NS	NS	NS

LSD= Least Significant Differences at 5% Level of Probability

This study investigates the impact of Accession and nutrient source on yield-related parameters of Roselle (*Hibiscus sabdariffa*) cultivated in Makurdi, Nigeria. The evaluation included three Accession—NG001, NG002, and NG003—and four nutrient treatments: poultry droppings, goat manure, cow dung, and a control group. Results revealed significant differences in flower number, days to maturity, number of calyx per plant, and seeds per capsule. NG001 outperformed the other varieties with an average of 74.12 flowers, 120.50 days to maturity, 54.63 calyxes per plant, and 9.82 seeds per capsule. This could be as the result of the fact that NG001 is known for its robust growth and high yield potential, it typically exhibits strong resistance to common pests and disease, making it a preferred choice for farmers seeking reliable production. This accession has a high calyx weight and is favored for both fresh consumption and processing into herbal teas and beverages Madina et al (2022). Among the nutrient sources, poultry droppings also yielded favorable results, producing 73.23 flowers and 53.83 calyxes per plant, while the control group consistently showed the least favorable outcomes across all parameters Uddin et al. (2009); Draghici et al. (2015); Chowdhury and Rahman, (2021) have produced findings that are comparable to these. This could be explained by the fertilizer's nutritional composition. Ghanbarian et al. (2008) observed that cantaloupe (*Cucumis melo*) plants treated with chicken dung show a somewhat greater profitable yield compared to those receiving no chicken manure. Comparable outcomes were shown with okra (Ogunlela et al., 2005), broccoli (Ouda and Mahadeen, 2008), and lettuce (Ullah et al., 2017). The poultry manure's high levels of readily available nitric, potassium and phosphate make it eligible for accreditation Madina et al., (2023). No significant interaction effects were noted between variety and nutrient source. These findings emphasize the importance of selecting high-yielding varieties and appropriate nutrient sources to optimize Roselle production, offering valuable insights for agricultural practices in the region.

**Table\_5: Effect of Accession and nutrient source on yield related parameters of rossel grown in Makurdi, Nigeria**

	Weight of calyx(g)	Weight of plant(g)	Dry calyx weight (g)	Yield (t/ha)
<b>Accession (A)</b>				
NG001	258.12	582.50	147.63	6.82
NG002	240.32	475.81	135.32	5.33
NG003	237.32	371.23	102.43	5.00
F-LSD (0.05)	2.02	40.11	8.03	0.11
<b>Nutrient (N)</b>				
Poultry dropping	257.23	582.41	146.83	6.03
Goat manure	244.13	473.43	134.61	5.43
Cow dung	230.12	400.01	120.21	5.02
Control	200.03	351.22	102.02	3.12
F-LSD (0.05)	2.01	50.03	8.14	1.00
<b>Interaction</b>				
VXA	*	NS	*	*

LSD= Least Significant Differences at 5% Level of Probability

This study examines the effects of Accession and nutrient source on key yield-related parameters of Roselle (*Hibiscus sabdariffa*) cultivated in Makurdi, Nigeria. Three Accession—NG001, NG002, and NG003 were analyzed in conjunction with four nutrient treatments: poultry droppings, goat manure, cow dung, and a control group. The results indicated significant variations in weight of calyx, total plant weight, dry calyx weight, and yield per hectare. NG001 demonstrated the highest performance across all parameters, achieving a calyx weight of 258.12 g, plant weight of 582.50 g, dry calyx weight of 147.63 g, and a yield of 6.82 t/ha. This is not far from the fact that plant variability in inherent genetic make-up could have caused the difference. This work is supported by the work of Aue (2002) who stated that genetic make-up influences plant yield coupled with agronomic practice. Poultry droppings also resulted in substantial yields, averaging 6.03 t/ha. In contrast, the control treatment yielded the least, at only 3.12 t/ha. This is to prove that nutrient improves crop yield, this discovery is supported by the work of FAO (2007) who reported that crop yield is highly influenced by nutrients. The positive effects of poultry dropping on the yield and yield-related characters indicate that the decomposition and availability of the nutrient, which in return increase the yield characters in plants as reported by Olaniyi et al. (2010). Notably, significant interaction effects were observed for certain parameters, indicating that the combination of variety and nutrient source significantly influences Roselle yield. These findings underscore the critical importance of selecting



appropriate varieties and nutrient applications to maximize Roselle production, providing valuable insights for agricultural practices in the region. Earlier researchers like Uddin *et al.* (2009), Draghici *et al.* (2015), and Chowdhury and Rahman (2021) have reported comparable study findings indicating that plants fed with poultry manure exhibited the highest growth metrics and marketable yield. This might be explained by the fertilizer's nutritional composition. According to Ojo *et al.* (2023), using 10 t/ha of compost was ideal for most vegetable growth and productivity. Ullah *et al.* (2017) also discovered that roselle grown on poultry manure grows to its full potential and yields more yield and yield related parameters. Furthermore, Meskelu *et al.* (2024), Madina *et al.*, (2024) have confirmed that the use of organic manure (bio-slurry) either by itself or in conjunction with chemical fertilizers has the potential to boost roselle output and save farmers money on the purchase of chemical fertilizers and to reduce the cost of production.

**Table\_6: interaction between Accession and nutrient source on yield related parameters of rossel grown in Makurdi, Nigeria**

Accession	Nutrient (N)	Weight of calyx(g)	Dry calyx weight (g)	Yield (t/ha)
NG001	Poultry dropping	257.23	150.83	6.00
	Goat manure	244.13	143.61	5.12
	Cow dung	230.12	131.21	5.02
	Control	200.03	112.02	3.12
NG002	Poultry dropping	240.32	136.23	5.89
	Goat manure	224.76	124.65	4.98
	Cow dung	210.98	110.11	4.43
	Control	190.99	101.87	3.00
NG003	Poultry dropping	227.11	121.23	5.00
	Goat manure	219.54	113.65	4.28
	Cow dung	202.87	101.11	4.13
	Control	187.54	94.87	2.90
	<b>F-LSD (0.05)</b>	10.02	5.01	1.00

LSD= Least Significant Differences at 5% Level of Probability

This study examines the interaction between Accession and nutrient source on yield-related parameters of Roselle (*Hibiscus sabdariffa*) cultivated in Makurdi, Nigeria. The research focused on three Accession—NG001, NG002, and NG003—paired with four nutrient treatments: poultry droppings, goat manure, cow dung, and a control group. Results indicated significant interaction effects, with NG001 consistently outperforming the other Accession across all treatments. Specifically, the combination of poultry droppings and NG001 achieved the highest weight of calyx (257.23 g), dry calyx weight (150.83 g), and yield (6.00 t/ha). NG002 also responded favorably to poultry droppings, with a calyx weight of 240.32 g and a yield of 5.89 t/ha. In contrast, NG003 exhibited lower yields and weights across all nutrient sources, particularly the control group, which yielded the least across all Accession. The findings emphasize the importance of selecting appropriate varieties and nutrient sources to optimize Roselle production, providing critical insights for farmers aiming to enhance yield and quality in the region. The above result is not far from the fact that crop growth both vegetative and reproductive is highly influence by crop genetic make and availability of nutrient for plant uptake. Nazifi 2023. Similar results were also by El-Sherif and Sarwat (2007) in the roselle plant treated with chicken manure and improved variety. Increase in plant growth particularly in higher rate of fertilizers shows that organic manures improved the soil physical conditions and promoted microbial and soil organic matter, in another finding the more the increase in application of poultry droppings and improve variety the more accumulated nutrients in the soil for sustainability, thus improved the vegetative growth and dry matter yield (Gendy *et al.*, 2012). Study by Sharma *et al.* (2003) also showed that organic manures and superior varieties have beneficial effects on the yield of plants because of the ability of plant to accumulate materials into the storage and economic parts of plant.

## Conclusion

The finding in this work shows significant difference in both accession and organic nutrients where the use of NG001 shows superiority in all the characters under consideration and the use of poultry droppings when compared with other sources used. Based on the results obtained from the research, it can be suggested that the use NG001 or any of the accession based on farmers preference and poultry dropping or any of the organic nutrient used will lead to optimum yield for roselle in the study location.

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