



Research Paper

Lettuce Cultivars Response to NPK 15:15: 15 Fertilizer Management Practices N Southern Nigeria

AGBA. O. A

Department of Agronomy, Cross River University of Technology, Agriculture and Forestry Faculty, Obubra, Cross River State, South – Nigeria

ABSTRACT

Field studies were conducted to determine the response of Lettuce (*Lactuca sativa*) cultivars to Npk 15;15:15 fertilizer management practices in 2020 and 2021 seasons in Cross River University of Technology, Teaching and Research Farm, Agronomy Department, Faculty of Agriculture Obubra, Cross River State, Nigeria. The experimental design was 2 x5 factorial of two lettuce cultivars (Great Lake and Baby leaf mix) and 5 fertilizer RATES (0, 50, 100, 150, and 200)Kg/ha, ten treatment combination laid out in randomized complete block design with three replications. Results shown that the 2 lettuce varied significantly in their growth and yield. Baby leaf mix had taller plants, more leaves and dry matter per plant than Great lake cultivar. Higher leaf number values (44.32, and 46.13) and plant height (15.57 and 16.11) cm were recorded at 200 kg/ha fertilizer at 12 weeks after planting in 2020 and 2021 seasons respectively. Lettuce cultivars varied in their growth and yield. Baby leaf mix higher growth and yield than Great lake. The highest fresh leaf yield (232.38 and 251.77)g per plant and (4.235 and 4.352) t/ha were produced in plots treated with 150 k/ha NPK 15;15;15 at 16 WAP in 2020 and 2021 seasons respectively. Farmers and researchers are advise to apply 150 or 200kg/ha NPK 15:15:15 fertilizer in cultivating Baby leaf mix Lettuce cultivar for maximum growth and fruit yield in the tropics.

KEY WORDS: Lettuce, Cultivars NPK fertilizer, Growth, Yield

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I. INTRODUCTION

Lettuce (*Lactuca sativa*) is one of leafy vegetables cultivated for its leaves that are used for food and medication. The plant has high nutritive value, rich in vitamins (A, carotene, C, ascorbic acid and minerals especially calcium and iron (VILLAGRA, *et al.* 2012, Amanda and Ahundeniya, 2012).

The leaves are used in salad, dishes like soups, stews, and cheese. The antioxidants present in Lettuce is used in medication against some diseases (Ananda and Ahundeniya, 2012). Spain, China, United States of America, India, Egypt are among the largest world producers of lettuce (Food and Agricultural Organization (FAO, 2013).

Commercial production/cultivation of lettuce in Nigeria is restricted to Northern parts. This could partially be due to climatic, weather and soil conditions that are more suitable in the North than southern Nigeria. Lettuce is commonly cultivated in southern Nigeria where there is high demand and high cost of the produce.

Adverse weather condition and low soil fertility among others are the constraints to high commercial scale cultivation of lettuce in Cross River State South- South Nigeria. NPK fertilizers supply the nitrogen, phosphorus and potassium which are major determinants for high crop (lettuce) yield and quality (Lenamaria *et al.* 2016..)

In commercial vegetable cultivation especially lettuce, the application of NPK fertilizers is important for profitable cultivation. This is because, these nutrients play a vital role in chlorophyll synthesis, process of photosynthesis and carbon dioxide assimilation (QIU *et al.* ;2014).

Literature shows that application of NPK fertilizers promotes vigorous growth (leaves, branches and plant height), also increases uptake of other essential plant nutrients, transpiration rate and improves stomatal conductance (QIU, *et al.*, 2014, Lenamaria *et al.*¹; 2016.).

Earlier researchers have reported that crops cultivars shown significant variations in growth, form, size, color, leaf shape, color, taste and yield quality. Lettuce cultivars performance is affected by genotype and environmental conditions. The ability to select the right cultivar contribute highly to realization of increase growth and yield.

There is paucity of literature information on the lettuce cultivars that is suitable for increase growth in Cross River, Southern Nigeria. Therefore, this study aimed to determine the appropriate lettuce cultivar and NPK 15:15:15 fertilizer rate require for optimum growth and yield in Cross River, South –South Nigeria.

II. MATERIALS AND METHODS

The experiments were conducted in 2020 and 2021 rainy season at Teaching and Research Farm, Faculty of Agriculture and Forestry, Cross River University of Technology Obubra, Agronomy Department, Cross River State. The area is located within Longitude 08^o 6'' E and latitude 05^o 59''N in a derived savannah zone of Nigeria. The mean monthly temperature ranged between 24^oc and 32^oc. The rainfall pattern is bimodal with peaks in months of July and September.

Experimental design

The experiment was a 2X5 factorial of 2 lettuce cultivars (Great lake and Baby leaf mix) and 5 NPK 15:15:15 rates: 0; 50, 100, and 200kg/h) with ten treatment combinations laid out in Randomized complete block Design with three replications.

Land preparation

The experimental field was cleared, packed, ploughed and harrowed manually, divided into three blocks. Each block was divided into ten plots of 4x2m (8m²). Blocks were separated with 1.0m and pot with 0.5m from adjoining plot. Soil samples were taken at random using soil urger at depth of 0 – 15cm. These were bulk together mixed thoroughly from where a composite soil sample was collected for laboratory analysis to determine the physical and chemical properties of the site.

Nursery Techniques

Lettuce seeds of the two cultivars were collected from certified source sown in two separated well prepare nursery beds using drilling method. Beds were mulched with dry grass water regularly with watering can. Mulching materials were removed four days after seedlings germination and rearranged between drills – rows of the germinated or emerged seedlings.

They were given intensive care for 4 weeks before transplanting to main beds. Seedlings were harden for two weeks before transplanting by reducing the frequency of watering to once in two days.

They were transplanted in the evening at spacing of 40x30cm inter and intra row respectively. Plot size was 4mx3m (12m²).

Seedlings were watered (irrigated) immediately after transplanting.

Fertilizer Application

NPK 15,15, 15 was applied according to the schedule treatments (0, 50, 100, 150 and 200kg/hg) in two splits, half during one week after transplanting and other half at 4 weeks after transplanting.

Cultural Practices

Weed Control

Weeding was done manually using small hole at 5, 15 weeks after planting as the need arose.

Harvesting

Harvesting was done at physiological maturity when the leaves were fresh, green before seed formation. It was done manually by cutting Lecture leaves at 7, 9 and 12 weeks after planting (WAP).

Data Collecting

At the beginning of data collection, four plants were tag at the middle row for measurement of growth and yield parameters on per plant bases. Data were collected on number of leaves per plant. Plant height. Girth (stem diameter).

STATISTICAL ANALYSIS

Data collected were statistically analyzed using Analysis of Variance (ANOVA) procedures as outlined by Gomez and Gomez, (1986). Treatments means that showed significant differences were separated using Fishers Least Significant difference (LSD) at 0.05 probability level according to Obi, 2002.

III. RESULTS AND DISCUSSION

Results of the Laboratory analysis of the soil of experimental site before planting shows that the soil was sandy loam, acidic, and low in organic matter, carbon, total nitrogen which could be attributed to leaching, and uptake of nutrients by plants (Table 1). Agba, *et al*; (2018) worked in similar location, they observed low soil nutrients in the area and recommended that inorganic NPK fertilizer be added to the soil to improved crop growth and yield.

The low nutrients content of the study site soil especially nitrogen(0.073 % in 2020 and 0.069 % in 2021) that is lower than the critical value of 1,00% reported by KARIMAEI, *et al*;(2004) for soil of humid tropical regions could be due to leaching and heavy rains associated with humid areas of Southern Nigeria .

Lettuce growth parameters were improved by application of mineral NPK fertilizer. Plant height and leaves numbers increased significantly with successive increment in the rate of NPK 15;15;15 fertilizer (Table 2). At all periods of measurements (7, 9, 12 Week After Planting) the fertilizer rate of 200kg/ ha recorded the highest plant height , numbers of leaves per plant, and girth (stem diameter) in 2020 and 2021 cropping seasons respectively.

Ichi, *et al* (2018) reported that the application of NPK fertilizers is highly require for most soils that are low in nutrients so as to supply those essential nutrients needed by the crops but are lacking in the soil.

The two lettuce cultivars response significantly to NPK 15:15:15 fertilizer treatments with Baby Leaves Mix cultivar showing taller plant height, more number of leaves and dry matter of plant fractions than Great Lake cultivar of Lettuce (Table 3). Dry weight of leaves, stem and root were significantly affected in the two cultivars of Lettuce by fertilizer application (table3). Plots without NPK 15:15:15 fertilizer recorded the lowest dry matter of plant fractions. While 200k/ha of NPK 15:15:15 fertilizer gave the highest dry matter yield of leaves and roots per plant in the two cropping seasons respectively.

Results Lettuce yield as affected by NPK fertilizer and cultivars shown in Table 4 revealed that leaf fresh weight per plant increased with incremental rate of NPK 15;15;15 fertilizer at the early stage up to 12 WAP .However, beyond this stage ,at 16 WAP, fresh leaf yield per hectare increases up to 150 kg/ha NPK 15;15;15, beyond this fertilizer rate, yield of Lettuce decreases with increase in fertilizer application.

This increased in Lettuce fresh leaves weight as NPK 15;15;15 rate increase up the of 150 kg/ha and began to decrease at fertilizer rate beyond 200kg/ha observed in this study collaborate with the findings of Ichi, *et al* (2018) who obtained similar results in lettuce cultivated with nitrogen fertilizer in Kaduna Sudan savannah. This may also be attributed to an increase in photosynthetic leaf area of Lettuce due high vegetative growth as a result of the effects of NPK 15;15;15 fertilizer.

IV. CONCLUSION

Based on the result of this study, farmers and researchers should apply 150 or 200kg/ha NPK 15;15;15 fertilizer in cultivating Baby Leaves Mix cultivar of Lettuce for optimum growth and yield in Obubra central Cross River state South-South Nigeria humid tropical condition.

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Table 1. Soil physical and chemical properties of the study site before planting

Characteristics	Value	
Physical properties	2020	2021
Sand %	76.13	78
Slit (%)	18.34	16.5
Clay (%)	14.42	13.29
Textural class	SANDY loam	SANDY loam
Chemical properties		
Ph in H ₂ O(1:2.5)	5.42	5.37
PH in CaCl ₂ (0.01)	4.27	4.34
Total nitrogen (%)	0.073	0.069
Potassium (cmol/kg)	0.87	0.76
Organic carbon (%)	1.46	1.38
Organic matter (%)	2.17	2.53
Exchangeable Bases(cmol/kg/kg)	Exchangeable Bases(cmol/kg/kg)	Exchangeable Bases(cmol/kg/kg)
change all the values below	change all the values below	change all the values below
Calcium (cmol/kg)	3.75	3.19
Magnesium (cmol/kg)	1.05	1.03
Sodium	0.01	0.12
Hydrogen (cmol/kg)	0.42	0.12
Aluminum (cmol/kg)	1.42	1.51

Table 2. Effects of NPK 15; 15; 15 fertilizer and lettuce cultivars on plant height, number of leaves per plant and girth {mm} on lettuce' in 2020 and 2021 cropping seasons

Treatments	Plant Height(cm)				Numbers of Leaves per plant						Girth (Stem Diameter) (mm)							
	7WAP		9WAP		12WAP		7WAP		9WAP		12WAP		7wap		9WAP		12WAP	
	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
NPK 15:15:15 Fertilizer(kg/ha)																		
O	3.14	3.20	5.21	5.13	6.16	6.24	7.31	7.14	10.31	10.22	17.32	18.13	2.24	2.13	5.22	4.58	8.24	12.36
50	4.23	4.19	6.48	6.35	8.21	8.33	7.14	9.23	13.42	14.11	22.24	23.12	4.35	4.25	8.34	7.69	11.32	15.78
100	4.67	4.58	7.36	7.43	9.33	9.41	12.25	11.44	17.15	16.31	28.23	29.31	7.15	6.23	10.23	10.14	13.15	19.34
150	5.12	5.22	8.42	8.36	12.12	13.26	14.11	14.23	40.24	21.72	34.41	32.14	8.23	8.14	12.34	12.43	16.16	23.17
200	5.31	5.43	9.56	9.61	15.57	16.11	15.22	15.14	25.12	27.15	44.32	46.13	10.12	10.23	14.17	15.21	20.34	27.24
LSD(0.05)	0.01	0.01	0.03	0.02	0.01	0.02	0.01	0.02	0.03	0.02	0.04	0.01	0.02	0.03	1.12	0.01	0.02	0.03
Lettuce Cultivars																		
Great Lake 3.13			5.32	4.59	6.48	6.43	6.23	16.23	12.16	13.34	20.21	22.12	2.45	2.37	6.44	6.35	15.63	16.24
Baby leaf mix4.22			6.25	7.246	10.74	14.16	8.44	8.44	16.324	17.16	43.14	44.21	3.33	3.33	9.35	9.47	21.35	23.26
LSD(0.05)			0.01	0.01	0.02	0.03	0.04	0.02	0.03	0.12	0.11	0.03	0.04	0.02	0.03	0.04	0.21	0.14

Table3. Effects of N.P.K 15;15;15 Fertilizer and cultivars on dry matter weight and growth rate of leaf and root of Lettuce in 2020 and 2021.

Treats	Leaf dry weight per plant(g)						Leaf Growth Rate (g/m ² /day)						Root Growth Rate (g/m ² /day)					
	7WAP		9WAP		12WP		4-7WAP		7-9WAP		9-12WAP		4-7WAP		7-9WAP		9-12WAP	
NPK 15;15;15 Fertilizer(kg/ha)	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
0	4.38	4.27	7.46	7.54	12.1	11.9	0.03	0.03	1.21	1.31	2.01	2.03	0.00	0.00	0.021	0.025	1.0112	1.0133
50	6.72	5.98	10.2	11.3	20.4	21.3	0.05	0.05	2.34	2.35	3.14	3.25	0.00	0.00	0.0764	0.0791	1.8457	1.7563
100	8.45	9.13	13.6	13.7	25.8	24.4	0.09	0.09	3.14	3.23	4.25	4.31	0.00	0.00	0.0982	0.0975	2.0453	2.0524
150	11.17	12.4	18.5	17.9	32.3	33.2	0.11	0.11	4.01	4.12	5.04	5.06	0.00	0.00	0.1216	0.1243	2.876	2.795
200	15.56	15.9	23.2	21.8	43.6	45.5	0.13	0.15	5.14	5.2	6.46	6.39	0.02	0.02	0.3247	0.3512	3.1248	3.137
Mean																		
LSD(0.05)	0.52	0.54	0.92	0.94	1.11	1.23	0.00	0.00	0.32	0.31	0.41	0.40	0.00	0.00	0.02	0.02	0.01	0.02
Lettuce Cultivars																		
Great Lake	5.12	6.23	11.4	10.8	26.3	24.2	0.04	0.04	0.15	0.18	1.45	1.48	0.00	0.07	0.445	0.452	0.897	0.7545
Baby Leaf Mix	8.51	8.79	14.6	13.9	41.4	40.1	0.08	0.08	0.32	0.41	2.76	2.83	0.00	0.09	0.6514	0.723	1.457	1.536
LSD(0.05)	0.61	0.70	0.31	0.42	1.31	1.33	0.00	0.00	0.00	0.00	0.04	0.13	0.02	0.00	0.04	0.03	0.012	0.013

Table 4. Effects of N.P.K 15;15;15 Fertilizer and cultivars on the yield of Lettuce in 2020 and 2021.

Treats	Leaves fresh weight per plant(g)						Leaves fresh weight per hectare(t/ha)						Total vegetative yield (t/ha)	
	9WAP		12WAP		16 WP		9WAP		12WAP		16WAP		2020	2021
NPK 15;15;15 Fertilizer(kg/ha)	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
0	18.87	20.13	46.75	45.81	60.26	61.37	0.413	0.422	0.632	0.634	0.701	0.712	0.312	0.312
50	24.39	27.85	75.91	77.26	95.41	98.52	0.722	0.785	1.345	1.346	2.124	2.251	0.0579	0.583
100	32.18	35.23	91.42	93.58	151.6	152.4	0.956	0.978	2.211	2.323	3.057	3.076	0.805	0.814
150	51.52	53.14	113.5	121.7	232.3	251.7	1.289	1.295	3.056	3.067	4.235	4.352	0.978	0.985
200	63.12	65.56	141.3	145.4	201.5	212.8	1.903	0.998	2.105	2.431	3.213	3.402	0.716	0.727
LSD(0.05)	1.1	1.2	2.1	2.3	3.2	3.1	0.001	0.001	0.02	0.02	0.01	0.01	0.002	0.001
Lettuce Cultivars														
Great Lake	37.87	43.16	139.5	145.1	253.6	278.1	0.328	0.569	2.312	2.459	4.786	4.898	0.898	0.934
Baby Leaf Mix	34.25	39.38	116.1	135.1	201.3	224.2	0.243	0.437	1.423	1.511	3.332	3.456	0.734	0.789
Lsd(0.05)	1.3	1.2	2.3	2.1	3.4	3.2	0.001	0.001	0.01	0.01	0.02	0.02	0.001	0.001
Interaction Cultivars	64.73	66.46	145.6	148.3	272.1	285.2	1.175	1.234	2.59	2.78	5.129	5.279	1.123	1.136

Table 5. Effects of N.P.K 15:15:15 Fertilizer and cultivars on the yield of Lettuce in 2020 and 2021.

NPK 15;15;15 Fertilizer(kg/ha)	Leaves fresh weight per plant(g)						Leaves fresh weight per hectare (t/ha)						Total vegetative yield (t/ha)	
	9WAP		12W AP		16W AP		9WAP		12W AP		16W AP		2020	2021

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	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
0	18.87	20.13	46.75	45.81	60.26	61.37	0.413	0.422	0.632	0.634	0.701	0.712	0.312	0.312
50	24.39	27.85	75.91	77.26	95.41	98.52	0.7221	0.785	1.345	1.346	2.124	2.251	0.0579	0.583
100	32.18	35.23	91.42	93.58	151.62	152.41	0.956	0.978	2.211	2.323	3.057	3.076	0.805	0.814
150	51.52	53.14	113.51	121.73	232.38	251.77	1.289	1.295	3.056	3.067	4.235	4.352	0.978	0.985
200	63.12	65.56	141.36	145.46	201.53	212.81	1.903	0.998	2.105	2.431	3.213	3.402	0.716	0.727
LSD(0.05)	0.23	0.31	2.4	2.5	3.2	3.6	0.001	0.001	0.02	0.03	0.03	0.02	0.001	0.001
Lettuce Cultivars														
Great Lake	33.15	37.14	68.75	96.25	112.68	131.39	0.987	0.985	2.431	2.371	3.274	3.314	0.916	0.983
Baby Leaf Mix	61.23	62.18	128.49	132.71	241.51	247.38	2.42	2.311	2.472	3.267	5.342	5.481	0.957	0.946
LSD(0.05)	1.12	1.11	2.31	2.41	3.23	3.11	0.01	0.01	0.001	0.001	0.23	0.21	0.0001	0.0001