Original Research Article

Influence of N:K Ratios in Soils on Growth, Nutrient Availability and Yield of Maize (*Zea mays L.*) in Southern Nigeria.

ABSTRACT

This study was undertaken to determine the influence of N:K ratios applied to soils and the availability of N, K on yield of maize in two distinct ecological zones of Edo state of Nigeria. The sites used were Rubber Research Institute of Nigeria (RRIN) Iyanomo (Forest) and the Teaching and Research Farm of Ambrose Alli University, Emaudo, Ekpoma (Derived Savanna). The soils of the two experimental sites were analyzed for both physical and chemical properties before the commencement of the experiments. The experiments were carried out as pot experiments in the screen house and field experiments. Each of the experiments had ten treatments (adjusted ratios) that were fitted into randomized complete block design and replicated three times. Maize was used as the test crop. Results from the screen house revealed that N/K ratio 4:1 had the highest dry matter yield for both locations, (RRIN; 2.60 g/pot and Emaudo; 2.75 g/pot) but these values were not significantly different (P < 0.05) from what were obtained from N/K ratio 3:1 and 2:1, respectively. The N:K ratio in soil had influence on the availability of N and K. Under field conditions, N/K ratio 4:1 had the highest grain yield for both locations (RRIN; 3.46 ton/ha and Emaudo; 3.33 ton/ha), and the highest cob field weight (RRIN; 9.92 ton/ha and Emaudo; 9.33 ton/ha), hence its recommendation.

Keywords: N:K ratios, Nutrient availability, Growth, Maize, yYeld, Soils.

Introduction

Chemical fertilizers are essential components of any system in which the aim is to maintain good yield in the absence of organic manure [1]. However, the rate of application and dosage has a greater influence on both crop yield and its environment [2]. Excessive application of fertilizer as opined by [3] does not really enhance sustainability, crop nutrient uptake nor significantly increase yields but tends to encourage economic waste and damage to the environment. Inadequate application, on the other hand, can retard growth and lower yield in short term and in the long run jeopardizes sustainability through soil mining and erosion. This precarious tilt between "excessive" and "inadequate" is the major challenge of fertilizer recommendation efforts and can only be effectively bridged when nutrients are applied at the right ratios.

Soil nutrient leaching and low level of soil organic matter has made nitrogen a limiting nutrient to maize production in Nigeria [4;5]. However, high supply of N is frequently associated with acidification and accumulation of ammonia in the rhizosphere [6]. Increases in N availability may also lead to strong P and K shortage which might exclude some plant species through vitality [7].

Potassium is known to play a major role in osmoregulation, enzyme activation and carbohydrate translocation [8]. The release and fixation of K is as a function of fertilizer application rate and soil parent material [9]. Furthermore, K supply might affect N uptake in leaves, photosynthetic activity and water use efficiency [10].

Majority of tropical soils are fragile and low in plant nutrients [11; 12] and with climate that is characterised by high rainfall and insolation which are however not evenly distributed in the various ecological zones. Hence, variation in the performance of crops, the soil condition and nutrient status are expected among the ecological zones.

The study was however performed in a screenhouse house and field to determine the variation of N:K Ratio in soils, growth, nutrient availability and mield of maize (*Zea mays L.*). To better understand the variations in N:K ratios, an examination of the growth responses, nutrient concentrations in earleaf at silk and crop yield for the best combination of N:K ratios in soils were carried out in the locations.

Materials and Methods

The experiment was performed in two locations, viz; Rubber Research Institute of Nigeria (RRIN) Iyanomo (rain forest). The soils are derived from the coastal plain sand parent material and the second location was the Teaching and Research Farm of Ambrose Alli University, Emaudo annex, Ekpoma (derive savanna), the soils are from the transition zone between the coastal plain and basement complex, both in Edo state, Nigeria. Soils from RRIN used for the study are Inceptisols, classified as Typic Dystrudept and specifically located at latitude 6^{o} 09' and 6^{o} 85' N and longitude 5^{o} 35' and 5^{o} 58' E [13], while soils from Emaudo are Ultisols, classified as Rhodic paleudults and located at latitude 6^{o} 18' and 6^{o} $46^{,}$ E and longitude of 6^{0} $^{o}00^{,}$ and 6^{o} $40^{,}$ N [14]. The experiment was carried out in two stages: Pot experiment in the screen house (screen house ionic experiment) and field experiment (field ionic experiment). Surface soil samples taken from each of the experimental sites, were air dried, sieved and analyzed for both physical and chemical properties, 1500g each were weighed and placed in 2 liter plastic cups, based on the soil test values, using the following adjusted ratios: 0:0, (Control) 1:1, 2:1, 3:1, 4:1, 5:1, 1:2, 1:3, 1:4 and 1:5 N:K treatments (Table 1). The experiments were fitted into a randomized complete block design (RCBD) and replicated three times. Nitrogen was applied as urea, and potassium as muriate of potash. Maize was used as the test crop, distilled water was used for irrigation. The above ground portions of maize plant were harvested six weeks after planting (WAP). The experiment was repeated in the field as a follow up of the screen house work. The field ionic studies were conducted in two locations, RRIN and Emaudo, respectively. The experiment was a randomized complete block design. N:P:K ratio trials were laid out consisting of 10 treatments, based on the soil test values, using the following adjusted ratios: 0:0, (Control) 1:1, 2:1, 3:1, 4:1, 5:1, 1:2, 1:3,

Table 1.Adjusted N:K ratios in the soil before planting in the screen house

Ecological Zone	Location	Trt No	NK Ratio in Soil	Soil adjusted Nutrients (g/pot)	
				N	K
		1	0 : 0	-	-
		2	1 : 1	0.12	0.12
		3	1 : 2	0.12	0.24
Derived		4	1 : 3	0.12	0.36
Savanna	Emuado	5	1: 4	0.12	0.48
		6	1 : 5	0.12	0.60
		7	2 : 1	0.24	0.12
		8	3 : 1	0.36	0.12
		9	4 : 1	0.48	0.12
		10	5 : 1	0.60	0.12
		1	0 : 0	-	-
		2	1 : 1	0.12	0.12
		3	1 : 2	0.12	0.24
Forest	RRIN	4	1 : 3	0.12	0.36
		5	1: 4	0.12	0.48
		6	1 : 5	0.12	0.60
		7	2 : 1	0.24	0.12
		8	3 : 1	0.36	0.12
		9	4 : 1	0.48	0.12
		10	5 : 1	0.60	0.12

1:4 and 1:5 for N:K (Table 2) randomized among the plots within the block. Each plot size was 2.5m x 2.0m and the planting distance adopted was 75 x 25cm with a space of 50 cm between plots and 80 cm between blocks. N:K treatments were applied 2 weeks after planting (WAP) Agronomic growth traits were measured at 4 and 8 WAP. Two ear leaf samples were randomly selected from the centre row of each plot at silking stage and were analyzed for their nutrient contents of N and K. Three plants in each plot (middle row) were harvested from 15 plants in each plot to eliminate the effect of cross feeding. The harvested maize cobs were dried and dehusked, the dry weight (yield) noted. All data obtained from laboratory, screen house and field studies were subjected to statistical analysis (SARS).

Soils/plant tissue analysis

Soil pH was measured in 1:1 soil water suspension [15]. Exchange acidity (Al^{3+}, H^{+}) was extracted with 1NKCl [16]. Organic carbon was determined by wet dichromate acid oxidation method [17]. Available phosphorus was extracted with Bray P1 solution and measured by the molybdenum blue method on a technicon auto analyzer as modified BY [18]. Exchangeable cations (Ca, Mg, K and Na) were extracted with 1N NH_4OAC at pH 7.0. Potassium and Na were determined with a flame emission photometer while Ca and Mg were determined with absorption

Table 2. Adjusted N:K ratios in the soil before planting in the field atomic

Ecological Zone	Location	Trt No	NK Ratio in Soil	Soil adjusted nutrients (kg/ha) N	K
		1	0 : 0	-	-
		2	1 : 1	56.16	56.16
		3	1 : 2	56.16	56.16
Derived		4	1 : 3	56.16	56.16
Savanna	Emuado	5	1: 4	56.16	56.16
		6	1 : 5	56.16	56.16
		7	2 : 1	112.36	112.36
		8	3 : 1	168.48	168.48
		9	4 : 1	224.64	224.64
		10	5 : 1	280.80	280.80
		1	0 : 0	-	-
		2	1 : 1	56.16	56.16
		3	1 : 2	56.16	112.36
Forest	RRIN	4	1 : 3	56.16	168.48
		5	1: 4	56.16	224.64
		6	1 : 5	56.16	280.80
		7	2 : 1	112.36	56.16
		8	3 : 1	168.48	56.16
		9	4 : 1	224.64	56.16
		10	5 : 1	280.80	56.16

spectrophotometer [19]. Effective cation exchange capacity (ECEC) was calculated by the summation of exchangeable bases and exchange acidity [19]. Particle size distribution was determined by the hydrometer method according to [20]. Plant samples were oven dried at 70 ^{o}C for 72 hours, milled and sieved through 0.5 mm mesh sieve. Nitrogen was determined using the macro-kjedahl method [19], potassium was determined by flame photometer; and phosphorus was determined using Bray P I method and measured by the molybdenum blue method [18].

Results and Discussion

The physical and chemical properties of the soils used for the experiments are presented on Table 3. The Soils from the two sites were acidic in nature and had low electrical conductivity, total nitrogen, organic carbon, exchangeable potassium and sodium and are below the critical

Table 3. Physical and chemical properties of experimental sites.

Parameter	RRIN	Emaudo
pH	5.30	5.36
Organic Carbon (g/kg)	8.0	7.7
Organic matter (g/kg)	13.8	13.3
Available P (mg/kg)	4.37	4.78
Total Nitrogen (N) (g/kg)	0.72	0.58
Exchangeable Ca (Cmol/kg)	2.48	1.60
Exchangeable Na (Cmol/kg)	0.63	0.15
Exchangeable k (Cmol/kg)	0.16	0.18
Hydrogen (H^+) Cmol/kg	0.50	0.80
Aluminum (Al^{3+}) Cmol/kg	0.10	0.20
ECEC Cmol/kg	3.72	3.33
Clay (g/kg)	149.70	40.40
Silt (g/kg)	89.50	59.50
Sand (g/kg)	760.80	900.10
Textural class	Sandy Loam	Sand

nutrient element levels given for most crops of this region [21; 22; 23; 24]. The textural classes were sandy loam and sand.

Variations in N:K ratios on plant nutrient concentrations, uptake and dry matter yield in the screen house for both soils of RRIN and Emaudo are presented on Table 4, the concentration of N increased with increase in N application. N:K ratio experiment in the screen house work showed significant effect of applied ratios on DMY with N:K ratio 4:1 having the highest DMY in both soils. There was a positive and significant correlation between and uptake of N and K (r < 0.977**) in soils of RRIN (Table 5) as a result of the applied N/K ratios while in the soils of Emaudo, there was a positive correlation between the uptake of N and K (r < 0.512) although not significant. This was a probably indication of synergistic relationship, and is in agreement with the findings of [25].

Higher application of nitrogen significantly affected the maize plant growth rate with N:K applied ratios 4:1 having the highest growth rate in terms of maize plant height, stem girth, leaf area and number of leaves at 4 and 8 weeks after planting (WAP) for both Experimental sites.

Table 4. Variations in N:K ratios on plant nutrient concentrations, uptake and D.M.Y. of maize in the screen house at RRIN and Emaudo

Location	Adjusted N:K ratios in soils	D.M.Y (g/pot)	Conc of nuterients in plant (%)		uptake of nutrients (mg/kg)	
			N (conc)	K (conc)	N (uptak)	K (uptak)
	0 : 0	0.54	1.71	1.61	9.21	9.74
	1 : 1	1.17	1.72	1.65	20.11	21.69
	1 : 2	1.09	1.782	1.91	21.92	23.47
	1 : 3	0.95	1.84	1.94	22.82	24.04
	1: 4	0.70	1.99	2.05	26.45	27.20
RRIN	1 : 5	0.53	1.92	2.17	49.72	56.32
	2 : 1	1.24	1.92	1.95	20.93	20.13
	3 : 1	1.33	2.87	1.81	21.54	16.05
	4 : 1	2.60	2.93	1.72	16.10	11.00
	5 : 1	1.23	3.54	1.31	13.46	6.94
	SE (P < 0.05)	ns	ns	ns	ns	ns
	0 : 0	1.13	1.49	1.65	17.88	22.20
	1 : 1	1.57	1.50	1.87	23.55	29.36
Emaudo	1 : 2	1.52	1.54	2.10	16.94	23.10
	1 : 3	1.29	1.69	2.14	46.14	28.42
	1: 4	1.28	1.74	2.29	22.62	29.77
	1 : 5	1.20	1.77	28.85	28.85	39.61
	2 : 1	1.76	2.13	1.61	24.07	18.19
	3 : 1	1.80	3.15	1.51	38.70	27.18
	4 : 1	2.75	3.18	1.24	33.35	18.97
	5 : 1	1.20	3.32	1.17	37.12	18.72
	SE (P < 0.05)	ns	ns	ns	ns	ns

SE: Standard Error, ns: not significant, D. M. Y. : Dry matter yield

Table 5. Correlation coefficient matrix showing the effect of applied N:K ratios in soils on the relationship between nutrient concentrations, uptake and DMY of maize in the screen house

Location		D.M.Y	N conc (%)	N Uptake	K conc (%)	K conc (%)
	D. M. Y.	1				
	N conc (%)	-0.340	1			
RRIN	N Uptake	0.983**	-0.172	1		

	K conc (%)	0.789**	-0.755*	0.701*	1	
	K Uptake	0.998**	-0.368	0.977**	0.810**	**1**
	D. M. Y.	1				
	N conc (%)	0.048	1			
Emaudo	N Uptake	0.870**	0.528	1		
	K conc (%)	0.088	-0.749*	-0.303	1	
	K Uptake	0.835**	-0.376	0.512	0.618	**1**

D. M. Y. : Dry matter yield; *, **- significant at 5 and 1 respectively

The higher the application rate, the higher the vegetative growth rate and agreed with the findings of [5] that high application of N in maize triggers complex array of morphophysiological responses. In the N:K ratio experiment, there was an effect of applied ratio on earleaf DMY in both soils of RRIN and Emaudo. DMY and concentrations of N and K were highest at N/K ratio 4:1 in both soils. [26] observed that fertilizer fortified with Nitrogen increases the concentrations of nitrogen and phosphorus as well as potassium concentration in plant tissue. This could be the probable reason while K concentration in the plant tissue was high

Table 6. Variations in N:K ratio on maize mean plant height, stem girth, leaf area and number of leaves at 4 week after palnting at Emaudo.

Adjusted NK ratios in soil	Plant height (cm)	Stem girth (cm)	Leaf area (cm^2)	Number of leaves
0 : 0	17.10^{b}	0.83^{ab}	72.80	7.67
1 : 1	22.77^{ab}	1.20^{ab}	106.38	8.67
1 : 2	19.03^{ab}	0.97^{ab}	79.59	8.00
1 : 3	17.60^{b}	0.77^{b}	68.85	7.67
1: 4	17.97^{b}	0.93^{ab}	78.18	7.67
1 : 5	15.97^{b}	0.77^{b}	67.25	7.33
2 : 1	21.13^{ab}	1.10^{ab}	87.33	8.33
3 : 1	21.13^{ab}	1.20^{a}	106.38	8.67
4 : 1	22.77^{a}	1.20^{a}	108.27	8.67
5 : 1	25.77^{ab}	0.80^{ab}	73.59	7.33
SE. ($P < 0.05$)	2.29	0.13	ns	ns

Means within the same column having the same letter(s) are not significantly different from each other, SE: Standard Error, ns: non significant difference

Table 7:.Variations in N:K ratios on maize mean plant height, stem girth, leaf area and number of leaves at 8 weeks after planting at Emaudo.

Adjusted NK ratios in soils	Plant Height (cm)	Stem Girth (cm)	Leaf Area (cm^2)	Number of Leaves
0 : 0	46.67^{c}	1.20^{c}	188.89^{b}	13.67
1 : 1	83.25^{ab}	1.73^{ab}	380.46^{a}	14.33
1 : 2	73.77^{bc}	1.67^{ab}	395.67^{a}	15.00

1 : 3	73.60^{bc}	1.73^{ab}	429.05^{a}	14.33
1: 4	72.30^{bc}	1.73^{ab}	362.05^{a}	13.67
1 : 5	57.37^{ab}	1.67^{ab}	391.26^{a}	15.00
2 : 1	83.27^{ab}	1.67^{ab}	391.26^{a}	15.00
3 : 1	90.13^{ab}	1.67^{ab}	424.15^{a}	15.00
4 : 1	107.13^{a}	1.77^{a}	466.70^{a}	15.00
5 : 1	64.27^{cd}	1.43^{bc}	301.31^{ab}	15.00
SE. (P < 0.05)	11.14	0.10	56.2	ns

Means within the same column having the same letter(s) are not significantly different from each other, SE: Standard Error, ns: non significant difference

with higher N application (Table 10). Nitrogen/potassium application of varying ratios affected maize vegetative growth significantly in some stages of growth. However, [27] found at carimagua that the crop did not respond to N unless K was applied in the right proportion. In both soils, the concentration of N in the ear leaf increased with increase in N application. The highest N concentration was obtained from applied N:K ratio 4:1, this was

Table 8. variations in N:K ratios on maize mean plant height, stem girth, leaf area and number of leaves at 4 week after planting at RRIN.

Adjusted NK ratios in Soils	Plant height (cm)	Stem girth (cm)	Leaf area (cm^2)	Number of leaves
0 : 0	24.00^{b}	0.73^{c}	170.4^{c}	6.33
1 : 1	27.33^{ab}	0.87^{abc}	207.4^{bc}	7.67
1 : 2	27.00^{ab}	0.82^{abc}	203.6^{bc}	7.00
1 : 3	27.00^{ab}	0.79^{bc}	198.0^{bc}	7.67
1: 4	24.67^{b}	0.79^{bc}	194.3^{c}	7.67
1 : 5	24.67^{b}	0.79^{bc}	174.7^{c}	6.67
2 : 1	29.67^{ab}	0.90^{ab}	222.8^{bc}	7.67
3 : 1	30.00^{ab}	0.92^{ab}	259.4^{ab}	7.67
4 : 1	32.33^{a}	0.96^{a}	282.7^{a}	8.00
5 : 1	28.00^{ab}.	0.80^{ab}	218.2^{bc}	7.33
SE. (P<0.05)	2.22	0.13	19.17	Ns

Means within the same column having the same letter(s) are not significantly different from each other, SE: Standard Error, ns: non significant difference

Table 9. Variations in N:K ratios on maize mean plant height, stem girth, leaf area and number of leaves at 8 week after planting at RRIN.

Adjusted NK ratios in soil	Plant height (cm)	Stem girth (cm)	Leaf area (cm^2)	Number of leaves
0 : 0	102.0^{e}	1.03	385.4^{b}	11.00^{c}
1 : 1	159.0^{bcd}	1.40	525.9^{ab}	12.33^{abc}
1 : 2	159.0^{bcd}	1.40	486.3^{ab}	12.33^{abc}
1 : 3	151.0^{cd}	1.37	481.0^{ab}	12.00^{abc}
1: 4	146.3^{cd}	1.27	470.2^{ab}	12.00^{abc}

1 : 5	138.7^{d}	1.03	456.8^{ab}	11.33^{bc}
2 : 1	169.0^{abc}	1.47	560.8^{ab}	12.67^{ab}
3 : 1	178.3^{ab}	1.53	575.3^{ab}	13.00^{a}
4 : 1	184.7^{a}	1.60	587.0^{a}	13.33^{a}
5 : 1	160.7^{abcd}	1.43	537.7^{ab}	12.67^{ab}
SE. (P < 0.05)	7.66	Ns	58.3	0.49

Means within the same column having the same letter(s) are not significantly different from each other. SE: Standard Error, ns: non significant difference

closely followed by 3:1 and 2:1, respectively. The highest K concentration was obtained from applied N: K ratio 1:5. The highest N uptake was from applied N: K ratio 1:5. The highest K uptake was also obtained from applied N: K 1:5. [26] observed that fertilizer fortified with Nitrogen increases the concentrations of nitrogen and phosphorus as well as potassium concentration in plant tissue. This could be the probable reason while K concentration in the plant tissue was high with higher N application.

Table 10. Variations in N:K ratios on plant nutrient concentrations, uptake and d.m.y. of maize at silking at RRIN and Emaudo.

Location	Adjusted N:K ratios in soils	D.M.Y (g/pot)	Conc of nuterients in plant (%)		uptake of nutrients (mg/kg)	
			N (conc)	K (conc)	N (uptak)	K (uptak)
	0 : 0	162.38	1.59	1.03	2.58	0.40
	1 : 1	179.46	1.64	1.61	2.90	0.54
	1 : 2	178.32	1.57	1.91	3.27	0.77
RRIN	1 : 3	175.05	1.55	1.99	4.03	1.44
	1: 4	166.78	1.53	2.08	4.23	1.75
	1 : 5	210.82	1.51	2.12	4.65	2.02
	2 : 1	263.37	1.74	1.75	3.12	0.54
	3 : 1	280.45	2.98	2.15	3.71	0.47
	4 : 1	283.65	3.22	2.36	3.89	0.47
	5 : 1	184.95	2.51	1.31	4.19	0.42
	SE (P < 0.05)	ns	Ns	ns	ns	ns
	0 : 0	143.75	1.32	1.65	3.41	2.43
	1 : 1	207.32	1.73	1.67	3.83	3.76
	1 : 2	204.11	1.64	1.73	3.76	3.74
	1 : 3	188.00	1.55	1.89	3.65	4.45
Emaudo	1 : 4	159.29	1.02	2.03	2.68	5.33
	1 : 5	151.36	2.44	2.18	5.56	4.42
	2 : 1	224.86	2.83	2.38	5.44	2.66
	3 : 1	234.26	3.11	2.37	5.79	2.56
	4 : 1	275.91	3.59	2.31	6.41	2.33
	1 : 5	175.29	3.72	2.12	6.27	1.89
	SE (P < 0.05)	ns	ns	ns	ns	ns

Means within the same column having the same letter(s) are not significantly different from each other. DMY = --- SE: Standard Error, ns: non significant difference.

Nitrogen/potassium application of varying ratios affected maize vegetative growth significantly in some stages. Nitrogen and potassium concentrations in the earleaf at silk at this particular N/K ratio application level were within the sufficiency ranges based on values given by Jones and [27]. The positive and significant correlation between the uptake of N and K in both soils is indication of synergistic relationship (Table 11), with 'r' values of 0.676* for RRIN soils and 'r' values of 0.662* for Emaudo, respectively.

Table 11. Correlation coefficient matrix showing the effect of applied N:K ratios in soils on the relationship between nutrient concentrations, uptake and earleaf dmy of maize in soils of Emaudo

Location		D.M.Y	N conc (%)	N Uptake	K conc (%)	K conc (%)
RRIN	D. M. Y.	1				
	N conc (%)	-0.547	1			
	N Uptake	0.648*	0.281	1		
	K conc (%)	0.726*	-0.881**	0.0290	1	
	K Uptake	0.986**	-0.505	0.676*	0.720*	**1**
Emaudo	D. M. Y.	1				
	N conc (%)	-0.792**	1			
	N Uptake	-0.581	0.948**	1		
	K conc (%)	0.611	-0.706*	-0.611	1	
	K Uptake	0.890**	-0.824**	0.662*	0.901**	**1**

D. M. Y. : Dry matter yield; *, ** =significant at 5% and 1% respectively

With grain yield (Table 12), applied N/K ratio 4:1 recorded the highest in both soils of RRIN and Emaudo for both locations (RRIN; 3.46 ton/ha and Emaudo; 3.33 ton/ha) although not significant, and the highest cob field weight (RRIN; 9.92 ton/ha and Emaudo; 9.33 ton/ha). The highest cob yield was also obtained from the same applied ratio 4:1 in both soils.

Since majority of tropical soils are fragile and low in plant nutrients [Carsky and Iwuafor, 1995; Juo and Wilding, 1996] and with climate that is characterised by high rainfall and insolation which are however not evenly distributed in the various ecological zones, these applications seems not to have any variation in the two distinct soils (Ultisols and Inseptisols).

Gething (1993) of the international potash institute stated that in Asia the N: K ratio usage approaches 10: 1 compared with around 2: 1 in Europe and North America and some other parts of the world. This implies that with soils of RRIN and Emaudo, N:K ratios 4:1 could probably be the best ratio suggested for maize production in these locality.

Table 12.Effect of soil N:K ratios on the mean yield of maize (cobs and grains) in soils of RRIN and Emaudo

Adjusted N:K Ratios in Soil	RRIN		Emaudo	
	Cob field weight (ton/ha)	Grain yield (ton/ha)	Cob field weight (ton/ha)	Grain yield (ton/ha)
0 : 0	6.11[d]	2.16	5.12[c]	2.07
1 : 1	7.46[b]	3.06	7.62[b]	3.01
1 : 2	7.46[b]	2.60	7.61[b]	2.71
1 : 3	7.32[c]	2.45	6.81[c]	2.62
1: 4	6.47[c]	2.34	6.35[c]	2.33
1 : 5	6.14[d]	2.28	6.11[c]	2.21
2 : 1	8.22[a]	3.12	7.71[b]	3.07
3 : 1	8.63[a]	3.37	8.71[a]	3.11
4 : 1	9.92[a]	3.46	9.33[a]	3.33
5 : 1	6.79[c]	2.36	6.52[c]	2.46
SE. (P < 0.05)	0.011	ns	0.049	ns

SE: Standard Error, Means within the same column having the same letter are not significantly different from each other.

Conclusion

In the field N:K ratio experiment, there was a significant effect of applied ratio on ear leaf DMY in both soils of RRIN and Emaudo. The DMY and concentration of N and K where highest at N:K ratio 1:4 in both soils. With grain yield, applied N:K ratio 4:1 recorded the highest in both soils of RRIN and Emaudo although not significant. The highest cob yield was also obtained from the same applied ratio in both soils. This implies that with soils of RRIN and Emaudo, N:K ratios 4:1 could probably be the best ratio suggested for maize production.

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