Education & Science Journal of
Policy Review and Curriculum Development
Hard Print: 2315-8425 Online: 2354-1660
November, 2016
Vol. 6, No. 1

Yield Characteristics of Nerica – 3 (O.Sativa × O.Glaberrima) as affected by Cowdung and Nitrogen Rates in Mubi, Adamawa State. Nigeria

[1]**D. A. Aremu,**
[2]**A. A. Sajo &**
[3]**B. B. Jakusko**
[12&3]*Department of Agric. Tech., Federal Polytechnic, Mubi*
Department of Crop Production and Horticulture, MAUTECH Yola

Keywords:
NERICA,
Cowdung,
Nitrogen,
Yield,
Fertilizer.

Corresponding Author:
D. A. Aremu

Abstract

Field trials were conducted at the Teaching and Research Farm of the Department of Agricultural Technology, Federal Polytechnic, Mubi, Adamawa State Nigeria, during cropping seasons of 2011 and 2012. The design of the experiments in both seasons were split-plot in a Randomized Complete Block Design (RCBD) in which cowdung (0, 1, 2 and 3 t/ha) constitute the main plot and subplots as four (4) levels of nitrogen (0, 60, 120 and 180 kg N/ha) in three replications. Data were collected on soils of the experimental site, number of spikes per plot, number of spikelets per spike, number of seeds per plant, weight of seeds per plant, 1000-grain weight and total grain yield per plant and in kg/ha. Data collected were subject to analysis of variance (ANOVA) and means were separated using Duncan's Multiple range Test (DMRT) at 5% level of significant. The results showed that in 2011 and 2012, the soils were sandy loam. All the characters measured in both seasons were higher from application of nitrogen at the rate of 120 kg N/ha compared to other treatments. Non application of nitrogen (0 kg N/ha) resulted in decrease in all the characters considered. Application of cowdung at higher rate (2 t/ha) given higher result in most of the characters measured. Across the years, the interaction between application at 120 kg N/ha and 2 t/ha gave the highest total grain yield in kg/ha (5,139 kg/ha). The interaction between application at 0 kg N/ha and 0 t/ha resulted in lowest yield (1,169 kg/ha). It could be concluded that NERICA-3 rice could be produced in Mubi with yields above Nigerian average of 2000 kg/ha. From the findings, application of nitrogen and cowdung at the rate of 120 kg N/ha and 2t/ha appeared to be suitable for NERICA-3 in Mubi for optimum yield.

Background to the Study

New Rice for Africa (NERICA) is an interspecific culture of rice developed by West Africa Rice Development Association (WARDA) to improved the yield of African varieties (Dingkuhn, Jones, Johnson & Sow,1998). Nigeria being the most populous country in Africa with over 140 million people (Preliminary Census, 2006), struggle for food is expected to have increased with the increase in its inhabitants, and the demand for rice has since being rising steadily at about 14% annually (Erenstein, Lancon, Osimane & Kebbeb, 2003). Although 240 million people in West Africa rely on rice as the primary source of food (Sarla & Mallikarjuna, 2005) energy and protein in their diet, the majority of this rice is imported at a cost of $1 billion (Watanabe, Fitakuchi & Johns, 2006). Therefore self-sufficiency in domestic rice production would improve food security and aid economic development in the region (Kijima, Serun Kuuma & Otsuka, 2006a).

Upland rice is grown annually on about 17 million ha of land area worldwide, and this represents about 10.5 million ha in Asia, 3.7 million ha in Latin America and 2.8 million in Africa (Fageria, 2001). Average grown yields of upland rice are generally less than 2000 kg/ha in most of the upland rice producing regions due to many environmental stresses and use of low inputs by farmers (International Rice Research Institution, 1999). The annual rice production in Nigeria is about 4 million metric tons (Food & Agriculture Organisation, 2008). Nigeria has emerged as a major importer of rice (Anonymous, 2009). This is because, rice production in the country is characterized by low yield probably due to high weed infestation, lack of fertilizer application and cultivation of low yielding varieties while total crop failure may occur due to lack of fertilizer application, especially nitrogen which is the most limiting nutrient in the Nigeria soils and cultivation of poor yield varieties Africa Rice Centre (WARDA, 2008). According to Anonymous (2009), the production of rice eaters is increasing at an exceptional fast rate and will probably double by the year 2020. Kang, Seo, Ohishi, Vijarnson & Ishii (2006) found out that manure (animal manure) second essential for high yield in dry year, but in wet years, commercial fertilizer alone seemed sufficient. The application of inorganic and organic manure has the aim of increasing soil, fertility, and thus, productivity, but the effect of this addition depends partly on the existing fertility of the soil. According to Gupta, Kumar & Tripath, (2004), the effect varies according to the inherent physical and chemical properties of the soil. They also found that yield of rice was significantly influenced by organic matter, cation exchange capacity and P^H of soil and mean annual minimum temperature as a result of cowdung incorporated. The interaction between inorganic and organic fertilizer has been proved to increase yield significantly (Rayer, 1986). When N was applied in combination with cowdung, its utilization by the plant was increase by 32%, resulting in higher crop yield than when N and cowdung were applied separately (Bokhtiar, Sakwai, Islam & Mohammed, 2006). Yadev & Prassad (1992) reported that combination of cowdung at 2 t/ha and 1 t/ha with 5 kg N/ha minimized production in yield from successive rice cropping.

According to Matsushima (2005), the number of grain/panicle was found to be directly proportional to the nitrogen content of the plant during the period in which spikelet number was mostly determined. Seed weight was also found to increase with increasing nitrogen content in the plant during the ripening stage (Matsuo, 2000). Top dressing nitrogen at the ripening stage helped to promote synthesis and mobilization of the nutrients to the developing grain. Khatua & Sahoo (2003) reported 76 kg N/ha for high yielding, short duration cultivars, maturing in 75 to 104 days.

Despite the fact that there have been a tremendous effort towards rice production by the farmers in Nigeria in general and Mubi in particular, the expected targeted yield is yet to be achieved because of lack of inputs such as fertilizers improved varieties etc. There is a need therefore for serious concern on how the farmer will produce higher yield of rice, especially the improved varieties such as NERICA.

Materials and Methods

The experiments were conducted at the Teaching and Research Farm of Agricultural Technology Department, Federal Polytechnic, Mubi during the 2011 and 2012 cropping seasons. Mubi is located in the Northern Guinea Savannah belt of Nigeria's vegetation zones, between latitude 13° 14 and longitude 13° 16' with land area of 50,640 km^2 and population size of 759,045 with a density of 160.5 per square kilometer (Adamawa State, Agricultural Development Programme (2009), (Preliminary Census, 2006).

The land used in each year were cleared of all debris, gathered and burnt after which the land was ploughed and harrowed to obtain fine tilt, there after marked into plots. The designed used for the experiments in both seasons (2011 and 2012) was split plot in a randomized complete block design (RCBD) in which cowdung (0, 1, 2 and 3 t/ha) constitute the main plot while the four levels of nitrogen (0, 60, 120 and 180 kg N/ha) as subplot in three replications given a total of forty eight (48) subplots. Each subplot size was measured 4 m x 3 m (12 m^2) and the measurement of each main plot was 19 m x 3 m (57 m^2) each main and subplot as well as replication was separated by 1 m wide path.

Basal application of cowdung at the rate given above was applied to each main plot before sowing of seeds were sown two weeks after cowdung application. The spacing adopted in both seasons was 25 cm by 25 cm, seven seeds were sown per hole which was later thinned to five (5) plants per stand at three weeks after sowing. The following data were collected on some yield characteristics: number of spikes per plot, spikelets per spike, number of seeds per plant, weight of seeds per plant, 1000-grain weight and total grain yield (kg/ha). The data were subjected to analysis of variance (ANOVA) as described by Gomez & Gomez (1984) using mixed model procedure of statistical analysis system. Means were separated using Duncan's multiple range test (DMRT) at 5% level of significance (Duncan, 1955).

Result and Discussion

The results of composite soil samples for the two cropping seasons used in determining the physicochemical properties of the experimental sites as well as rainfall data for two seasons are presented in Table 1. In Table 2, there were significant (P=0.01) effects of nitrogen and cowdung on all the parameters measured except weight of seeds per plant in 2011 season. In both seasons (2011 and 2012), the highest number of spikes per plot (115.42 and 183.2) respectively were obtained from the application of nitrogen at the rate of 120 kg N/ha while the lowest were recorded from 0 kg N/ha (78.00 and 82.5) respectively. The production of more spikes from 120 kg N/kg in this study could therefore be attributed to efficient supply of nitrogen. Ajayi & Ayotade (1985) also reported that efficient utilization of nitrogen fertilizer by rice crop is determined among other factors by the nature of the soil variety, season, intensity of cultivation and fertilizer attributes and modifications.

With the application of cowdung, at the rate of 2 t/ha the higher number of spikes per plot was recorded in both seasons (116.83 and 158.0) respectively from 2 t/ha while least were recorded from 0 t/ha (74.42 and 121.9) in both seasons. The number of spikes per plot were increased with an increase in cowdung application. This is similar to the report of Vanlauwe, Wendt & Diels (2001) that long term manuring increased aggregate stability, pore space, bulk density and available water range.

Application of nitrogen and cowdung were observed to be highly significant (P=0.01) on number of spikelets per spike in 2012 season. However, it vary significantly (P=0.05) on number of spikelets per spike in 2011 season. The application of nitrogen at the rate of 120 kg N/ha gave the highest number of spikelets per spike in both seasons (18.25 and 18.25) respectively. Production of higher number of spikelets from 120 kg N/ha was not uncommon since 0 kg N/ha had fewer or lower number of tiller per plant. The fewer the tillers in rice, the more spikelets are produced (Cornell International Institute for Food Agriculture Development, 2009), the same trend was observed in 120 kg N/ha where it was observed that the more tillers were produced the crop tend to make a compensation on the number of spikelets per spike because potentially a high tillering rice plant tend to “feed” more than the low tillering one (Chang & Liu 1992).

With the application of cowdung in 2012 season the highest number of spikelets per spike was obtained from 2 t/ha (18.50), while the least was obtained from 15.17 t/ha. The application of cowdung at the rate of 2 t/ha produced higher number of spikelets per spike while control (0 t/ha) recorded the least. This could be as a result of increase in soil organic matter content derived from the incorporated cowdung coupled with enough rainfall especially in 2012 season.

The mean number of seeds per plant, were all highly significant (P=0.01) with the application of nitrogen and cowdung in both seasons (2011 and 2012) (Table 2). Application of nitrogen at the rate 120 kg N/ha produced higher (206.0 and 209.1) number of seeds per plant in both seasons. Number of seeds per plant and weight of seeds per plant may likely depend on the number of tillers. This result corroborate with the report of Africa Rice Centre (WARDA, 2003) that most upland varieties were equally bred for improved yield by utilizing the little amount of inputs likely moisture and fertilizer than the land race varieties (Hossner & Juo, 1999), Consultative Group on International Agricultural Research & Africa Rice Center (2003). Seed weight was also found to increase with increasing nitrogen content in the plant during the ripening stage (Matsuo, 2005).

The highest number and weight of seeds per plant were observed from application of cowdung at the rate of 2 t/ha in both seasons while the least were obtained from 0 t/ha. In this study number of seeds per plant decreased with increase in application of cowdung where as weight of seeds per plant increased with increase in application of cowdung. This is in line with the report of Yadev & Prasad (1992) that combination of application of cowdung at 2 t/ha and 1 t/ha minimized production in yield from excessive rice cropping.

Application of nitrogen and cowdung were observed to be significantly higher on 1000-grain weight in both seasons (2011 and 2012). Application at the rate of 120 kg N/ha and 2 t/ha was observed to produce higher 1000-grain weight than control (0 kg N/ha and 0 t/ha respectively) throughout the study period. This could be due to the former having more translocation of assimilates to the sink. The low weight with the control (0 kg N/ha and 0 t/ha) could be as a result of the moisture stress at the end of the season which resulted in the seeds not filling fully.

Total grain yield per plot and total grain yield in kg/ha were both influenced by nitrogen application. The highest total grain yield were recorded from application at the rate of 120 kg N/ha in both seasons, while the lowest were recorded from 0 kg N/ha. Jashin, Ahmed & Ahmed, (2004) found that applying 120 kg N/ha to an upland cultivar BR9 produced the highest paddy yield. In India, Kumar & Sharma (2000) also reported 120 kg N/ha as being the economic optimum level for an early maturing rainfed rice cultivar, of which NERICA-3 is among. Also in Philippines, farmers have been reported to apply 120 kg N/ha to traditional uplands which results to about 3 tons of paddy (Dedatta & Ross, 2005).

Total grain yield per plot and grain yield in kg/ha were both influenced by cowdung application. The highest total grain yield was recorded from application of cowdung at the rate of 2 t/ha while the lowest was recorded from control (0 t/ha). This is because cowdung has been reported to increase the efficiency of mineral fertilizers by improving properties of the soil (Vanlauwe, Vanlauwe, Vendt & Diets 2001). Gupta, Kumar & Tripath (2004) also found that yield of rice was significantly influenced by organic matter, cation exchange capacity and P^H of soil and mean annual minimum temperature as a result of cowdung incorporated. However the interaction between cowdung and nitrogen has been proved to increase yield significacntly (Rayer, 1986). The present report also lends support from the work of Garba (2006) who reported similar trend during anthesis and grain filing in groundnut.

Conclusion

In conclusion, the study indicated that NERICA-3 rice could be produced in Mubi successfully which could result in high yield above the Nigerian average of less than 2000 kg/ha. Result showed that application at the rate 120 kg N/ha could give a yield of 5139 kg/ha. Further research should be conducted on other varieties of NERICA rice with the same combination of nitrogen and cowdung.

Recommendations

Based on the findings of the study, it could be recommended that the combination of nitrogen and cowdung at the rate of 120kg N/ha and 2 t/ha respectively was found to produce the highest yield thus this farmers in Mubi and its environs could benefit from application.

References

Adamawa State, Agricultural Development Programme (AD, ADP) (2009). *Annual Report*.

Africa Rice Centre (WARDA) (2008). *2007 Africa rice trends editions.* Pp8-9.

Anonymous, (2009). Biotechnology can boast agriculture in Nigeria. In New Nigerian Newspaper of April, 13:25-26.

Bokhtiar, S.M, Sakwai, K, Islam, N.F. & Mohammed R. (2006). *Effect of organic manure and nitrogen manure and inorganic fertilizer on soil fertility and the productivity of sugar cane in Bangladesh*. Proceeding of International symposium on sustainable and sugar reduction technology. Nanning Guagxl China pp 199-204.

Consultative Group on International Agricultural Research and Africa Rice Centre (WARDA 2003). *NERICA on the move. A symbol of hope for rice farmers in Africa*, Abidjan, Cote d'Ivoire 5 pp.

Chang, F.C. & Liu, D.J. (1992). Physiological studies of rice tillers. *J. Agric Res China.* 41 (4). 311-316.

Cornell International Institute for Food Agriculture and Development (2009). The system of rice intensification. A collaborative effort of association of tefy saina, Antananarivo, Madagascar, and the Cornell International Institute for food Agriculture and Development *http//:ciifad.cornell.edu/sri/index/html*

Dedatta, S.K. & Ross, V.E. (2005). *Cultural practices for upland rice*. In IRRI. Major Research in upland, Rice. Los Benos, Philippines, pp 160-163.

Dingkhin, M. Jones, M.P., Johnson., D.E. & Sow A. (1998). Growth and yield potential of *oryza sativa* and *o.Glaberrima* upland rice cultivars and their interspecific progenies field crops research 57:57-69.

Duncan, D.B. (1955). Multiple range and multiple F. Test. *Biometric* 2:1-4. Duncan M.G. and J.D. Hasketh (1968): Net Photosynthesis rates, relative growth rate and leaf number of 22 cases of maize and eight temperatures. *Crop Science* 8(11) 670-674.

Erenstein O; Lancon, F., Osimane, A, & Kebbeb, M. (2003). *Operationalizing the strategic fram work for rice revitalization in Nigeria. In the Nigerian rice Economy in a competitive world, constraints, opportunities and strategies choices*. A report by USAID fund project implemented by West Africa Development Association (WARDA). The African rice centre, Abidjan, Cote d'Ivoire 38 p.

Fagaria, N.K. (2001). Nutrient Management for improving upland rice productivity and sustainability. *Common soil science and plant Analysis* 32, 2603-2629.

Food and Agriculture Organisation (2008). F.A.O. Statistical database. Available at: http://www.faostat.faorg (verified) 15 Dec, 2010.

Garba, A (2006). Effect of variety and seed position within the pod the growth and yield of groundnut (*Arachis hypogeal*) paper presented in the biological and environmental science journal for the tropics (BEST) Bayero University, Kano Nigeria.

Gomez, K.A. & Gomez K.A. (1984). Statistical procedure for Agricultural Research, 680.

Gupta, R. Kumar, R. & Tripath, S.K. (2004). *Study on Agronoclimatic condition and productivity pattern of Sugarcane in India*. Sugar Tech. 6 (3): 141-149.

Hossner, R.L., & Juo, S.R.A (1999). Soil nutrient management sustainable food crop production in upland farming systems, in the tropics. Food and Fertilizer Technology centre (FFTC) Extension bulletin 417: 1-19 *http://www.fao.org/documents* 2004.

Katyal, J.C; Biyal, S., Sharima, V.K & Craswel E.T (2005*). Efficiency of some modified urea fertilizers of wet land rice grown on preamble soil fer*t. Res 8:137-140.

International Rice Research Institute (1999). *Program report for 1998*. International Rice Research Institute. *Los Banos Philippines,* 1999.

Jashin, C Ahmed, U. & Ahmed, K.U. (2004). *Response of rice varieties to applied nitrogen in saline soils*. In: Rice Res. *New 9* (5):22.

Kang, D.J., Seo, Y.J; Ohishi, H., Futacuchi, K., Vijarnson P. & Ishii, K. (2006). Studies on the acid soil tolerance of NERICA III grain yield of acid tolerant NERICAS under acid sulphate soil conditions. *Japanese Journal of Crop Science* 25 (Extra issue 1): 214-215.

Khatua, K & Sahoo, B. (2003). Response of early varieties of rice to nitrogen under rainfed conditions. *Indian Tnt of Agron* 28 (4): 4. Sp – 4.6p.

Kijima, Y., Serun Kuuma, D & Otsuka, K (2006). *How revolutionary is the NERICA revolution? evidence from Uganda*. The developing Economic Africaine (Speical issue): 1-16.

Kumar; S.D. & Sharma, H.C. (2000). Responded of direct sown rice to levels of nitrogen under rainfed conditions. *Indian J. Agron* 25 (4): 717-718.

Matsuo, T. (2005). *Variety responded to nitrogen and spacing. In IRRI, the mineral nutrition of rice plant*. John Hopkins press, Baltimore, pp 437-448.

Matsushima, S. (2005). *Nitrogen requirements at different stages of growth. In the mineral nutrition of the rice plant*. The John Hoplains press, Baltimore, Maryland, 219-241.

Muckherjee, R.K., & Probhaker B.S. (2000). Effect of gibberellins on rice yield response to nitrogen applied at heading and quality of seeds, plant and soil, 55: 153-156.

Oikeh, S.O., Nwilene, F. Diatta, S., Osimane, O., Toure, A. & Okhindiecbie, P. (2006). *Agro Physiological responses upland NERICA rice to nitrogen and phosphorus fertilization in the forest agro ecology of West Africa.* paper presented at the ASACSSA-SSSA 2006 International Meetings, Indianapolis, USA, 12-16 November, 2006.

Preliminary Census (2006*). Nigerian's economy contrivers, National Population Commission of Nigeria bbc*.co.uk BBC News 14 December, 2005.

Rayer, A.J. (1986). Response of groundnut (*Arachis hypogeal*) to application of FYM. Nitrogen and Phosphorus on light steady laom savannah soil Northern Nigeria. International *Journal of Tropical Agriculture* 12 (1): 46-54.

Reddy, G.R.S & Reddy, K.A. (1987*). Effect of different forms of urea at various level of nitrogen for lowland rice, Abst*. Trop. Agric. 12.

Sarla, N. & Mallikarjuna B.P. (2005). *Oryza glaberrima*. A source for the improve of *oryza sativa* current science 89 (6): 955-963.

Singh C, Singh, P and Singh R. (2003). *Modern techniques of raising field crops*. Oxford and IBH Publishing Co. PVT Ltd. New Delhi 478 pp.

Vanlauwe, B., Wendt, J.W. & Diels, J. (2001). Combined application of organic matter and fertilizer. *Journal of American Society of Agronomy 50(* 247-279).

WARDA (2003). Strategy for rice sector revitalization in Nigeria, In: the Nigerian Rice Economy in a competitive world; constraints, opportunities and strategies choices. *A report by USAID funded project implementation by West Africa Rice Development Association (WARDA*). The African Rice Centre Abidjan, Cote d'Ivoire 38 pp

Watanabe, H, Fitakuchi, K. & Johns, M.P. (2006). *Grain quality traits of NERICA rice*, Expert bulletin for International Cooperation of Agriculture and Forestry 1:12-23.

Yadev, R.L & Prasad, S.K. (1992). Conserving the organic matter content of the soil to sustain sugar cane yield. *Experimental Agriculture.* (280): 57-62.

Yanami, I Emtery, O., Dinguing, L & Grip, H. (1997). Effect of organic manure and chemical fertilizer on nitrogen uptake and nitrate leaching in a Eumarthi eanthrosolsprofile. *Nutrient cycling Agro Eco-Systems*. 4*8*:225-229.

Appendix
Table 1: Soil Physicochemical Properties and Monthly Rainfall of the Experimental Site During the 2011 and 2012 Cropping Seasons.

Soil Properties	**2011**	**2012**
Soil P^H ($CaCl_2$)	5.65	5.92
Organic Carbon (%)	0.48	0.41
Bulk Density (g/cm^3)	1.45	1.26
Total N (%)	0.29	1.53
Available P (ppm)	0.02	0.05
C.E.C. (cmol kg/ha)	4.90	4.91
Exchangeable Ca (cmol kg/ha)	0.16	0.92
Exchangeable Mg (cmol kg/ha)	0.86	0.64
Exchangeable K (cmol kg/ha)	0.87	1.79
Exchangeable Na (cmol kg/ha)	0.22	0.15
Textural Class	Sandy Loam	Sandy Loam
Monthly Rainfall (mm)		
April	7.9	65.4
May	67.0	133.0
June	93.9	187.0
July	140.0	201.8
August	195.0	331.5
September	182.3	314.5
October	83.7	109.7
Total	**769.8**	**1342.9**
Mean	**109.97**	**191.84**

Source: Adamawa State University

Table 2: The Effect of Cowdung and Nitrogen on some yield characters of NERICA Rice in 2011 and 2012 Cropping seasons at Mubi.

Treatment	Number of spikes per plot			Number of Spikelet per spike			Number of seeds per plant			Weight of seeds per plant (g)		
	2011	2012	Mean	2011	2012	Mean	2011	2012	Mean	2011	2012	Mean
Nitrogen (Kg N/ha)												
0	78.00	82.50	80.25	16.75	13.42	15.085	189.50	162.40	175.95	49.25	48.24	48.835
60	81.75	160.40	121.08	15.25	16.92	16.09	168.00	186.20	177.10	50.75	53.25	52.00
120	115.42	183.20	149.31	18.25	18.25	18.25	206.00	209.10	207.55	51.75	54.42	53.09
180	109.67	173.40	141.535	17.50	17.50	17.50	182.0	193.9	187.95	52.00	52.75	52.375
LSD	6.45	4.37	5.41	0.97	0.98	0.97	2.32	2.41	2.37	1.75	1.75	1.75
Prob of F	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	Ns	0.001	0.001
Cowdung (t/ha)												
0	74.42	121.90	98.16	15.50	15.17	15.415	177.50	166.20	171.85	48.25	47.17	47.71
1	109.08	146.20	127.64	18.25	15.33	16.71	198.80	195.70	197.25	50.00	51.83	50.915
2	116.83	158.00	137.415	18.50	18.50	17.91	195.00	191.60	193.30	52.00	54.00	53.00
3	84.50	173.30	128.90	15.50	17.33	17.00	175.00	198.20	186.60	53.50	53.83	53.665
LSD	0.81	0.85	0.83	1.10	0.13	0.17	2.32	2.62	2.46	0.94	0.91	0.92
Prob of F	0.001	0.001	0.05	0.001	0.001	0.001	0.001	0.001	0.001	0.05	0.001	0.001

Table 3: Mean effect of cowdung and nitrogen on some yield characters of NERICA rice 2011 and 2012 cropping seasons at Mubi.

Treatment	1000-grain weight (g)			Total Grain Yield per plot (Kg)			Total grain yield in kg/ha		
	2011	2012	Mean	2011	2012	Mean	2011	2012	Mean
Nitrogen (kg N/ha)									
0	4.25	4.08	4.17	2.08	2.13	2.11	1635	1597	1616.00
60	3.50	4.71	4.11	2.75	3.25	3.00	2292	2705	2498.50
120	5.00	5.38	5.19	3.49	5.62	4.56	2910	4681	3795.50
180	4.50	5.13	4.81	3.14	5.28	4.21	2686	4396	3541.00
LSD	0.43	0.81	0.52	0.14	0.15	0.14	12.37	12.21	12.25
Prob of F	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Cowdung (t/ha)									
0	3.50	4.38	4.07	2.23	3.53	2.88	1760	2937	2348.50
1	4.25	4.63	4.44	2.61	3.91	3.26	2174	3257	2715.50
2	5.00	5.00	5.00	3.15	4.45	3.80	2699	3478	3088.50
3	4.50	5.29	4.90	3.47	4.39	3.93	2889	3705	3297
LSD	0.89	0.73	0.71	0.81	0.73	0.75	11.45	11.29	11.41
Prob of F	0.05	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001