

## EVALUATION OF FURFURAL UREA AS A SLOW RELEASE NITROGEN FERTILIZER IN AN ALFISOL IN SAMARU, ZARIA

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### ABSTRACT

*In this work, greenhouse studies were conducted to evaluate the effects of Furfural Urea as a slow release Fertilizer in an Alfisol of Nigerian savannah. In the greenhouse studies, treatments evaluated include four N levels each of urea and furfural urea, three complementary treatments of urea and furfural urea and absolute control. These bring the number of treatments to 21. The design was completely randomized design with three repetitions respectively. Observations taken included plant height and plant girth .In the greenhouse, at 12 WAP, complementary application of furfural urea and urea in the proportion of 75% Fu + 25% U significantly increased plant height by 69.6% over the absolute control. When furfural urea and urea were combined and applied at 150kg N/ha in the proportion of 50% Fu + 50% U at 6,9 and 12 WAP highest plant girth was obtained than in other treatments . The re-evaluation of these combinations at various rates is recommended for further research and multi-location trials.*

**KEYWORDS:** Greenhouse, Alfisol, WAP, Complementary, Absolute control

### INTRODUCTION

The Nigerian Savanna covers about three quarters of the country's total land area (Kowal and Knabe, 1972). The soils of the area are derived mainly from Aeolian deposits (Jones and Wild, 1993) and Kaolinite is dominant in the clay fraction (Ojanuga, 1979). The soils of the Nigerian guinea savanna are predominantly Alfisol. These soils are inherently low in organic matter (OM), cation exchange capacity (CEC), deficient in Nitrogen (N) and phosphorus (P) and are largely coarse textured. This low level of OM has made the savanna soil susceptible to major chemical, physical and biological limitations which reduce crop yields (Jones and Wild, 1993). The soils are exposed to true high temperature and rainfall over a period of five months of the year. A prolonged use of chemical fertilizers especially N fertilizers gives rise to residual soil acidity and cation depletion (Jones, 1989). Under intensive agriculture now commonly practiced, soil fertility declines rapidly after a few years of continuous cultivation. Therefore, fertilizer amendments is a pre-requisite to increasing and maintaining crop yields to feed the teeming population.

The overall objective of the research is to maximize the efficiency of plant use of applied nitrogen. This will determine the agronomic and economic value of fertilizer. It will also conserve energy and raw material needed to make the N fertilizer and minimize possible adverse effects on the environment (nitrate pollutants) that may result from the inefficient N use (Bremer and Hauk, 1988).

Farmers in the Nigerian savanna have higher preference for urea among other single nitrogen sources such as ammonium sulphate (AS) and calcium ammonium nitrate (CAN) for cereals Production because of its cost per unit of N. Unfortunately, these fertilizers are susceptible to various forms of losses in the soil. These include dissolution volatilization in the form of NH<sub>3</sub>, N<sub>2</sub>O, N<sub>2</sub> and denitrification losses .The

magnitude of losses is tremendous in the savanna zone largely due to the sandy nature of most soils and low OM content.

Cereal crops largely grown in the savanna region of Nigeria require high dose of nitrogen on a continuous basis. Due to the problem encountered with already established fertilizers (Idris, 1997), other sources are being explored for more efficient N fertilization. Attention is being directed towards slow release compounds. The controlled or slow availability supplies N continuously over an extended period, thus avoiding the need for repeated application of conventional water- soluble fertilizers. They also reduce N losses and reduce the hazard of seedling injury from over population (Allen et. al., 1991; Beaton et. al., 1987). There is the need to identify a slow release nitrogen fertilizers as a means of reducing these losses. Incidentally, crop residues such as maize cob, cowpea shell, rice husk; etc when combined contain pentosan active ingredients that can physically change urea fertilizer to furfural urea fertilizer (Cheng, 1987). The development of cost effective and environmentally friendly technology for controlling nitrogen loss from applied urea will surely benefit the resource poor farmers in the northern guinea savanna (NGS). The aim of this study was to examine the effectiveness of using furfural urea and urea in the savanna.

### MATERIALS AND METHODS

#### Sampling for Green House Study

Soil sample was taken from the site where the field experiment was conducted using a wheel barrow. The sampling depth was restricted to 0-15cm. The bulk soil was crushed, air-dried and sieved through a 2mm sieve after removal of foreign materials. Treatments for the greenhouse study consisted of four nitrogen levels each of urea and furfural urea, 3 complementary treatments of urea and furfural urea and absolute control (Table 1), these bring the number of treatment to 21.

The design was completely randomized design with three repetitions, respectively.

### Greenhouse Techniques

5kg of the soil was weighed into 7 litre capacity containers. The containers were labeled with the treatment task. The appropriate fertilizer was added and then thoroughly mixed. Some quantity of water was added to bring the soil to

field capacity. Any drained water was collected in a lid placed at the bottom of the containers and returned to the pots. Four maize seeds were planted symmetrically in the pots and thinned to two plants per pot a week after planting. The pots were maintained at field capacity through regular watering. Any drained water in each receiver was returned to the appropriate pots.

**Table 1: Treatments used for the greenhouse evaluation**

Treatment number	Treatment combination
1	50kgN/ha urea
2	100kgN/ha urea
3	150kgN/ha urea
4	200kg N/ha urea
5	50kg N/ha Furfural
6	100kg N/ha Furfural
7	150kg N/has Furfural
8	200kg N/ha Furfura
9	Absolute control (no fertilizer)
Complementary treat. 50	25% Furfural urea + 75% Urea 50% Furfural urea +50%Urea 75% Furfural urea +25%Urea
100	25% Furfural urea + 75% Urea 50% Furfural urea +50%Urea 75% Furfural urea +25%Urea
150	25% Furfural urea + 75% Urea 50% Furfural urea +50%Urea 75% Furfural urea +25%Urea
200	25% Furfural urea + 75% Urea 50% Furfural urea +50%Urea 75% Furfural urea +25%Urea

### Plant height and plant girth

Plant height measurements were taken. The measurement was taken from the base of the plant to the last open leaf. The girth of the plant was also taken. Plant height and plant girth were taken weekly.

## RESULTS AND DISCUSSIONS

### Effects of Application of Furfural Urea, Urea and their Combination on Plant Height (cm) in the Greenhouse

The effect of the application of urea, furfural urea and their combination on plant height in the greenhouse is shown in Table 2. Where furfural urea was applied at 150kgN/ha, plant height was significantly higher for all treatments at 3 WAP. These were followed by the rest of the treatments. In the complementary treatments, 200kgN/ha applied in the proportion 25%fu + 75%u gave the highest plant height. At 6 WAP, only the application of furfural urea at 200kgN/ha significantly promoted maize growth than other treatments. When urea and Furfural urea were combined at 150 kg/N in the proportion of 50% Fu + 50% urea tallest plant height was obtained. These were followed by the rest of the treatments at 9 WAP. At 12 WAP, added urea and furfural urea in the proportion

75% Fu + 25% U significantly increased plant height by 69.6% over the absolute control. It could be seen that the absolute control treatment produces the lowest plant height due to the low inherent fertility status of the soil used for the experimentation (Jones, 1989).

The soils are generally acidic and poorly buffered with respect to most nutrients (Jones and Wild, 1993, Heathcote and Stockinger, 1990, Greenland, 1999).

### Effect of the Application of Furfural urea, urea and their Combinations on Maize Girth (cm) in the Greenhouse

The effects of the application of furfural urea, urea and their combination on maize girth in the greenhouse are shown in Table 3. At 3 WAP, combining furfural urea and urea at 50 kg N/ha in the proportion of 25% Fu + 75% U gave the highest plant girth than all other treatments. When furfural urea and urea were combined and applied at 150 kg N/ha in the proportion of 50% Fu + 50% U at 6, 9 and 12 WAP highest plant girth was obtained than in other treatments. However, the rest of the treatment gave no significant different in their girth. The absolute control treatment gave the lowest plant girth.

These could be because of the availability of N to the maize crops in plots that received complemented furfural urea and urea. The urea provides immediate N supply to the crops, while the furfural urea through mineralization release its N slowly.

#### SUMMARY AND CONCLUSION

Plant height and plant girth in the greenhouse trial were observed to be positively effected by different fertilizers, but their effects were more serious when the two fertilizers (Furfural urea and Urea ) were combined. In assessing soil and recommended fertilizer levels (Urea and Furfural urea), crop yield have been used to assess plant response to N fertilizer (Tsiates and Maslaries, 2008). However, these study confirms that application of the recommended fertilizers rates

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results in increased maize yield and these also promoted vegetative growth, Paradkar and Shanma, 1993.

#### CONCLUSION

- The application of Furfural Urea, Urea and their combination on maize parameter in the greenhouse increased most plant growth parameters. The combinations of furfural urea and urea generally gave higher yields compared to their separate application. The best combinations were 75% Fu and 25% U in 2002 and 25% Fu and 75% U in 2003.
- The re-evaluation of these combinations at various rates is recommended for further research and multi-location trials.

APPENDIX

Table 2: Effects of Application of Furfural Urea, urea and their Combinations on Maize Plant Height (cm) in the Greenhouse.

Treat(kgN/ha Urea level)	3WAP	6WAP	9WAP	12WAP	
50	43.2ab	45.7ab	61.4bf	63.3ce	
100	45.2ab	51.1ab	72.9ae	76.2ae	
150	44.7ab	53.0ab	73.8ae	79.1ad	
200	45.8ab	56.2ab	73.4ae	73.6be	
Furfural urea level					
50	39.9ab	47.0ab	65.5bf	65.6be	
100	39.1ab	48.7ab	57.2df	60.3be	
150	51.1a	44.1ab	58.2cf	62.8ce	
200	44.1ab	60.0a	73.3ac	83.3ac	
<u>Complementary treat.</u>					
Rate	Combination				
50	25%Fu + 75%U	381ab	52.4ab	70.2bf	75.1be
	50%Fu + 50%U	40.2ab	45.5ab	54.9ef	69.5be
	75%Fu + 25%U	40.9ab	49.8ab	63.9bf	71.1be
100	25%Fu + 25%U	38.9ab	47.0ab	63.0bf	67.6be
	50%Fu + 50%	42.8ab	52.4ab	66.7bf	70.2be
	75%Fu + 25%U	40.8ab	50.9ab	68.8bf	72.7be
150	25%Fu + 75%U	41.7ab	54.6ab	75.0ae	77.0ae
	50%Fu + 50%U	47.0ab	58.8ab	92.7a	97.0a
	75%Fu + 25%U	44.0ab	57.3ab	79.1ad	85.5ab
200	25%Fu + 75%U	502ab	57.6ab	82.1ab	86.9ab
	50%Fu + 50%U	47.3ab	58.5ab	80.5ac	83.3ac
	75%Fu + 25%U	44.0ab	49.1ab	68.0bf	69.6be
Absolute control	35.3b	41.3b	49.2f	59.9e	
Mean	43.1	51.5	68.9	73.6	
CV	16.7	17.1	16.5	14.8	
R-square	0.35	0.38	0.6	0.56	
F-ratio	0.93*	1.1*	2.4*	2.5*	

Means with the same letter in the same column are not significantly different at 5 percent level of significance using DMTR

**Table 3: Effects of Application of Furfural Urea, urea and their Combinations on Maize Plant Girth (cm) in the Greenhouse.**

Treat (kgN/ha <sup>1</sup> )		3WAP	6WAP	9WAP	12W AP
Urea level					
50		3.7a-f	4.4c-e	3.7de	3.6e-g
100		3.9a-f	4.4c-e	4.1 b-e	4.1b-g
150		4.1a-d	4.3c-e	4.1 b-e	4.0b-g
200		4.1a-d	4.7b-d	4.5ab	4.4 b-d
furfural urea level					
50		3.7a-f	3.9c-f	3.7ce	3.7d-g
100		3.8 a-f	4.1b-f	3.9b-e	3.9c-g
150		4.0a-f	4.2b-f	4.3b-e	4.2b-e
200		3.7a-f	4.5b-e	4.4a-d	4.3b-e
Complementary treat.					
Rate	Combination				
50	25%Fu + 75% U	4.3a	4.5b-e	4.6ab	4.2b-f
	50%fu + 50%u	3.5f	3.9d-f	3.9d-f	3.9b-g
	75%fu + 25%u	3.5f	5.9d-f	3.6e	3.6fg
100	25%fu + 75%u	3.7b-f	4.1c-f	4.1b-e	3.9c-g
	50%fu + 50% u	4.0a-f	4.6b-e	4.2b-e	4.1b-g
	75%fu + 25%u	4.2ab	4.5b-e	4.3b-e	4.2b-g
150	25%fu + 75%u	4.2ab	4.6 b-e	4.5a-c	4.5a-c
	50%fu + 50%u	4.1a-c	5.5a	5.1a	5.1a
	75%fu + 25%u	4.1a-c	4.4h-e	4.4a-c	4.2b-f
200	25%fu + 75%u	4.1a-c	4.9ab	4.5ab	4.6ab
	50%fu + 50%u	4.0a-f	4.9ab	4.4a-d	4.5a-c
	75%fu + 25% u	4.1a-f	4.7bc	4.5a-c	4.5a-e
Absolute control ( no fertilizer)		3.6d-f	3.5f	3.5e	3.4g
Mean		3.9	4.4	4.2	4.1
CV		6.9	8.9	9.2	9.1
R-square		0.56	0.65	0.60	0.62
F-ratio		2.40*	3.61 *	3.04*	3.30*

Means with the same letter(s) within the same column are not significantly different at 5 percent level of significance using DMRT