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RESPONSES OF MELON (*Collocynthis citrullus*) AND SOIL CHEMICAL PROPERTIES TO DIFFERENT N - SOURCES IN ADO – EKITI, SOUTHWESTERN NIGERIA

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ABSTRACT

A two – year field experiment was conducted at the Teaching and Research Farm of the University of Ado – Ekiti, Ekiti State, Nigeria, during 2008 and 2009 cropping seasons to determine the effects of different N – sources on soil nutrient status and yield of melon (*Collocynthis citrullus*). The experiment was laid out in a Randomized Complete Block Design with three replicates. The different sources of N were: Calcium ammonium nitrate (CAN), Ammonium sulphate (AS), Urea (U), NPK 15 – 15 – 15 and control i.e. no fertilizer (NF). The results indicated that there were significant (P = 0.05) differences among the various N – sources with respect to their effects on soil nutrient status and yield of melon. The percentage decreases in soil organic carbon (SOC) after cropping were 58, 39, 49, 28 and 21 for NF, CAN, AS, U and N P K, respectively. Similarly, application of the different N – sources resulted in decreases in total nitrogen after cropping by 48, 26, 40, 14 and 7% for NF, CAN, AS, U and NPK 15 – 15 – 15, respectively. Averaged over two – years of experimentation, values of melon seed yields were 0.37, 0.61, 0.85, 1.22 and 1.15 t ha^{-1} for NF, U, CAN, NPK and AS, respectively.

Key words: Chemical properties, N – sources, fertility, yield, melon.

INTRODUCTION

Low soil nitrogen has been reported to be a limiting factor to crop production in many parts of the world (Harriz, 2006; Been *et al*., 2011). Nitrogen plays key roles in the growth and development of crops. It influences the yields mainly through leaf area expansion, which in turn, increases the amount of solar radiation intercepted, and dry matter production (Cam, 2009; Brader, 2011).

In many parts of the world, sources of nitrogen commonly used include Di-ammonium phosphate (DAP), Calcium ammonium nitrate (CAN), Sulphate of Ammonia (SA) or Ammonium sulphate (AS) and compound fertilizers, such as NPK 15 – 15 – 15; 20 – 20 – 20 (Kurtz, 2004; Sas, 2006). Other sources of N include; urea and ammonium nitrate, depending on their local availability (Kurtz; 2004). However, the use of sulphate of ammonia is discouraged due to its high residual acidity (Sas, 2006).

Previous studies had demonstrated significant effects of different N – sources on the growth and yield of melon (Adeuya, 2008; Cern, 2010; Mucido, 2010). In all these studies, significant differences among N – sources with respect to their effects on growth and yield attributes of melon were reported. Similarly, significant effects of N sources on major soil nutrients had been demonstrated by Fessil (2009); Cheng (2009); Handra (2011).

Elsewhere in the tropics, few studies had been conducted on the growth and yield of melon, as affected by different sources of N. In view of the paucity of published work on different

N sources on melon performance, this study sought to investigate the effects of different sources of N on soil nutrient status and melon performance.

MATERIALS AND METHODS

Study site: A two – year field experiment was carried out at the Teaching and Research Farm of the University of Ado – Ekiti, Ekiti State, Nigeria, during 2008 and 2009 cropping seasons. The soil of the study site is an Alfisol (SSS, 2003) of the basement complex, highly leached, and with low to medium organic matter content. The site of study had earlier been cultivated to certain arable crops, among which were maize, melon, cassava before it was left to fallow for some years prior to the commencement of this study. The fallow vegetation was manually slashed and thereafter, the land was ploughed and harrowed.

Collection and analysis of soil samples*:* Prior to planting, ten core soil samples, randomly collected from 0 – 15 cm top – soil , were bulked to form a composite, which was analyzed for physical and chemical properties. At the end of the second cropping season, another set of soil samples was collected and analyzed. The soil samples were analyzed in accordance with the procedures outlined by IITA (1989).

Experimental design and treatments: The experiment was laid out in a Randomized Complete Block Design with three replicates. The N – sources were: Calcium ammonium nitrate (CAN), Ammonium sulphate (AS), Urea (U), NPK 15 – 15 – 15 and control i. e. no fertilizer (NF). All the different N – sources fertilizers were applied at the rate of 200 kg ha^{-1} (Fondufe, 1995) in two split doses, at four and six weeks after planting (WAP).

Planting and weeding: Planting was done on March 12 and March 20 in the respective 2008 and 2009 cropping seasons. Two melon seeds were planted per stand at a spacing of 1 m x 1 m, but later thinned to one plant per stand (10,000 plants $ha\text{-}^{1}$), three weeks after planting. Weeding was carried out manually at 3 and 6 WAP, using a hand hoe.

Collection and analysis of data**:** At harvest, data were collected on yield and yield components of melon. All the data collected were subjected to analysis of variance (ANOVA), and treatment means were compared, using the Duncan Multiple Range Test (DMRT) at 5% level of probability.

RESULTS

The physical and chemical properties of soil in the study site before cropping are presented in Table 1.

Table 1: The physical and chemical properties of soil in the study site before cropping

Parameters	**Values**
pH	5.6
Organic carbon (g kg^{-1})	0.95
Total nitrogen (g kg^{-1})	0.58
Available phosphorus (mg kg^{-1})	0.86
Exchangeable bases (cmol kg^{-1})	
Potassium	0.44
Calcium	0.40
Magnesium	0.60
Sodium	0.51
Acidity	0.32
ECEC	2.27
Texture (g kg^{-1})	
Sand	680
Silt	200
Clay	120

Changes in soil nutrient status after cropping

Table 2 shows the soil nutrient status as affected by N – sources at the end of the experiment.

CAN resulted in 18% increase in soil pH after cropping, while contrasting decreases of 18, 32,29 and 46% for NF, AS, U and NPK, respectively. The percentage decreases in soil organic carbon (SOC) after cropping were 58, 39, 49, 28 and 21 for NF, CAN, AS, U and NPK, respectively. Similarly, the percentage decreases in total nitrogen after cropping were 48, 26, 40, 14 and 7 for the respective NF, CAN, AS, U and NPK. N – sources decreased available P after cropping by 47, 38, 28, 21 and 13% for NF, CAN, AS, U and NPK 15 – 15 – 15, respectively. Similarly, decreases in exchangeable K were 59, 43, 18, 32 and 9% for NF, CAN, AS, U and NPK, respectively. Application of CAN resulted in 40% increase in exchangeable Ca, compared to decreases of 33, 15, 3, and 13 % for NF, AS, U and NPK, respectively. In addition, decreases in exchangeable Mg were 57, 45, 20, 32 and 43% for NF, CAN, AS, U and NPK and for Na, decreases were 65, 51, 26, 39 and 14% for NF, CAN, AS, U and NPK, respectively.

Table 2: Soil nutrient Status as affected by different N – sources after cropping

Treatments (N-sources)	pH	Org. C ($g\ kg^{-1}$)	Total N ($g\ kg^{-1}$)	Av. P ($mg\ kg^{-1}$)	Exchangeable bases ($cmol\ kg^{-1}$) K	Ca	Mg	Na
Control	4.6b	0.40e	0.30e	0.46e	0.18e	0.27d	0.26d	0.18e
CAN	6.3a	0.58c	0.43c	0.53d	0.25d	0.56a	0.33c	0.25d
AS	3.8c	0.48d	0.35d	0.62c	0.36b	0.34c	0.48a	0.38b
Urea	4.0c	0.68b	0.50b	0.68b	0.30c	0.39b	0.41b	0.31c
NPK	3.0d	0.75a	0.54a	0.75a	0.40a	0.35c	0.34c	0.44a

Mean values in the same column followed by the same letter are not significantly different at P=0.05

Seed yield, and yield components of melon

Table 3 shows the effects of N – sources on seed yield, number of fruits per plant and average fruit weight of melon at harvest.

On the two – year average, values of melon seed yield were 0.37, 0.66, 0.85, 1.22 and 1.15 t ha^{-1} for NF, U, CAN, NPK and AS, respectively. Similarly, values of number of fruits per plant were 4.3, 6.1, 7.9, 10.4 and 9.0 for NF, U, CAN, NPK and AS, respectively. Values of average fruit weight were 0.54, 0.70, 0.87, 1.10 and 0.97 kg for NF, U, CAN, NPK and AS, respectively.

Table 3: Seed yield, number of fruits per plant and average fruit weight of melon as affected by different N – sources at harvest

Treatments	Melon seed yield ($t\ ha^{-1}$)			Number of fruits per plant			Average fruit weight (kg)		
(N-sources)	2008	2009	Mean	2008	2009	Mean	2008	2009	Mean
Contrtol	0.40e	0.33e	0.37	4.6e	4.0e	4.3	0.56e	0.51e	0.54
Urea	0.64d	0.58d	0.61	6.3d	5.9d	6.1	0.71d	0.68d	0.70
CAN	0.89c	0.81c	0.85	8.0c	7.8c	7.9	0.90c	0.83c	0.87
NPK	1.25a	1.19a	1.22	10.6a	10.1a	10.4	1.12a	1.07a	1.10
AS	1.18b	1.11b	1.15	9.1b	8.8b	9.0	1.00b	0.93a	0.97

Mean values in the same column followed by the same letter are not significantly different at P=0.05

DISCUSSION

In this study, the decreases in the soil organic carbon (SOC) after cropping, observed in all the plots where different N – sources fertilizers were applied agree with the findings of Kowal

(2009) and Idah (2011), who obtained significant decreases in soil organic matter (SOM), at termination of experiments involving mineral fertilizer application. This the addition of the synthetic fertilizers may have resulted in the provision of favourable soil conditions for the soil microbes with resultant stimulated organic matter decomposition. In view of the decline in SOM, associated with inorganic fertilization, the addition of organic fertilizers (plants and animal remains) to inorganic fertilizers – treated soils is strongly recommended.

The decreases in virtually all the nutrients after cropping, observed in the plots where N – sources fertilizers were not applied (i.e. control) can be ascribed to uptake by melon as well as leaching losses. Similarly, the decreases in the soil pH in the control plots after cropping can be attributed to decreases in the exchangeable bases, due perhaps, to leaching and /or melon uptake. The increase in soil pH after cropping, associated with application of CAN can be adduced to the increase in the value of exchangeable Ca, as CAN contains Calcium ions (Ca^{2+}). The decrease in available P and exchangeable K, Mg and Na can be attributed to melon uptake, as P is indispensable in the formation of good root system, flowering and seed production in plants. The decrease in soil pH (i. e. increased acidity), observed in the plots where ammonium sulphate [$(NH_4)_2SO_4$] fertilizer was applied can be adduced to the acidifying effects of ammonium sulphate due to hydrogen ions (H^+), resulting from oxidation of the ammonium ion (NH_4^+). Besides, this observation can be attributed to the decreases in the exchangeable bases, associated with ammonium sulphate application.

The decreases in N value after cropping, obtained in plots where CAN, ammonium sulphate and urea were applied can be attributed to melon uptake, leaching and ammonia volatilization, since these three fertilizers contain ammonium ions (NH_4^+), which are readily reduced to ammonia gas (NH_3) in the soil. Although, differences were obtained in the quantity of N lost through ammonia volatilization from these fertilizers, properties. For instance, in CAN, half of the N is in form of NH_4^+, while the rest half is in form of nitrate (NO_3^-) . So, only half of the applied N (i.e. NH_4^+ form) is therefore vulnerable to volatilization, which is a distinct advantage over the other ammonium – containing fertilizers. The decreases in N, P and K values after cropping, despite the addition of NPK fertilizer, implies that these nutrient elements were absorbed and utilized by melon.

The significantly higher value of melon seed yield for CAN than that of urea agrees with the findings of Adeuya (2008); Cern (2010); Mucido (2011). This observation points to the superiority of CAN to urea, as far as nitrogen nutrition of melon is concerned. The superiority of CAN stems from its ability to supply N in the forms of NH_4^+ and NO_3^-, compared with urea, that can only supply N in the form of NH_4^+. Thus, the presence of NH_4^+ and NO_3^- in CAN accounts for the higher yield performance of melon in CAN than the urea (Osaki *et al*; 1995). Besides, CAN has Calcium ions (Ca^{2+}) which is an extremely important element in the maintenance of cell membrane integrity, as well as cell division, hence, stimulating growth and development in plants. Also, the calcium element helps in the neutralization of soil acidity, hence, enhancing availability of certain nutrient element in the soil (Kurtz, 2004).

Much as the significant difference in melon seed yield between CAN and urea can be ascribed to the aforementioned factors, however, another factor that can be implicated for the significant differences between CAN and urea in melon seed yield performance is the difference between CAN and urea. This is in the respect to the amount of N lost in the form of an ammonia gas through volatilization from these two N – sources. This is because the amount of N lost in CAN through volatilization is not as high as that of N lost in urea.

The higher value of melon seed yield for ammonium sulphate than that for urea and CAN can be attributed to the presence of sulphur in the ammonium sulphate fertilizer, as sulphur has been reported as one of the essential nutrient elements needed for satisfactory growth and development of crop plants (Osaki *et al;* 1995). The highest melon seed yield value consistently recorded for NPK fertilizer treatment can be ascribed to the complementary roles of P and K in the nutrition of melon. Therefore, for a good melon performance, the recommendation of a judicious and balanced combination of these three nutrient elements is imperative.

CONCLUSION

Application of nitrogen from different N – fertilizer sources resulted in significant decreases in soil organic carbon, total N, available P and exchangeable bases at the end of each year experiment. The increases in seed yield and yield components of melon under different N – sources can be ranked as: control < urea < CAN < AS < NPK.

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