Agro-Science Journal of Tropical Agriculture, Food, Environment and Extension
Volume 7 Number 1 January 2008 pp. 78 -84
ISSN 1119-7455

COMPARATIVE STUDY OF THE PERFORMANCE OF JUTE PLANT (*CORCHORUS OLITORIUS* L.) ON HOME GARDEN SOIL, FARMLAND AND COCOA PLANTATION SOILS AS INFLUENCED BY VARYING LEVELS OF N- FERTILIZER

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ABSTRACT
This experiment was carried out in the green house at the College of Agricultural Sciences, Olabisi Onabanjo University, Yewa Campus, to assess the performance of jute plant (Corchorus olitorius L.) on three soil-use types (viz; farmland soil, cocoa plantation soil ~~and~~ residential or home garden soil) treated with five nitrogen (N) levels: 0, 25, 50, 75, and 100 kg/ha respectively. The trial was laid out in a split-plot design arranged in a randomized complete block format with three replications. Data collected were analyzed using Analysis of Variance (ANOVA) and the significant means were compared with Least Significant Difference (LSD) and Duncan's Multiple Range Test (DMRT) at 1 or 5% probability. The results of the investigation showed that jute plant (Corchorus olitorius L.) performed best in cocoa plantation soil, with application of 50 kg/ha N. Among the interaction effects, combined application of 50kg/ha of N- fertilizer on cocoa plantation soil gave the best vegetative growth and dry matter yield.

Key words: N- fertilizer, Jute plant (*Corchorus olitorius* L.), Farmland soil, Cocoa plantation soil, Home garden soil.

INTRODUCTION

Jute plant (*Corchorus olitorius L.)* is a leafy vegetable, grown in Nigeria and in many other tropical countries for its nutritious leaves. It is used for soup and eaten with starchy staple foods, especially in Southwestern Nigeria (Epenhuijsen, 1974; Fayemi, 1999 and Schrippers, 2000). According to Asomani-Boateng *et al* (1996), it is a common vegetable grown in the urban cities of Western Nigeria by house wives. Sometimes, it is grown around the riverside for commercial reasons.

As a result of intensive cultivation, most home garden soils are largely deficient in major soil nutrients, consequently resulting to low crop yields. However, adequate fertilization of the soils with organic and inorganic fertilizers will rejuvenate the soils for optimum productivity of crops (Agboola and Sobulo, 1981; Keit, 1983; Dudal and Byrnes, 1983). AVRDC, (1991) and Fayemi, (1999) reported that leafy vegetables such as *Corchorus olitorius and Celosia agentia* performed best on well-drained alluvial soils with adequate reserve of organic matter and soil moisture. Leafy vegetables have been found to perform well in peat soils, very rich in organic matter (Siemonsma, 1991). They require a lot of nitrogen for protein synthesis in the leaves (Akanbi and Togun, 2002).

The present study was aimed at comparing the growth of jute plant (*Corchorus olitorius L.)* on a home garden soil and two other agricultural soils at different levels of nitrogen fertilizer.

MATERIALS AND METHODS

Experimental site

The experiment was conducted in the green house at the college of Agricultural Sciences, Olabisi Onabanjo University, Yewa Campus, located on latitude $6^0 55'$ W and longitude $3^0 45'$ E. The site is situated in the humid forest zone of Western Nigeria with soils developed from sedimentary rocks. The major soil type in the area is classified as Oxic Paleustalf of Iwo series.

Soil sampling and analysis

Soil samples were randomly collected from 0 – 15 cm depth, from different portions of each of the selected soil-use types (farmland, cocoa plantation and residential or home garden) in Ago-Iwoye, Ogun state. The soil samples from each soil-use type were mixed together to get a representative sample. One kilogram of each of the three samples was air-dried and crushed to pass through a 2mm sieve and was taken to the laboratory for physical and chemical analyses. The samples were analyzed for pH (1:2 soil: water ratio), particle size distribution (Gee and Bauder, 1986), total N using the micro-kjeldahl method (Bremner and Molvaney, 1982) and exchangeable cations (K, Ca, Mg and Na). After extraction with 1N NH_4OAC (pH 7), K in the filtered extracts was determined with a flame photometer, whereas Ca, Mg and Na were determined with an atomic absorption spectrophotometer. Available P (Bray - 1-P) was determined by colorimetry using Bray 1 method (Bray and Kurtz, 1945). The results of the soil analyses are shown in Table 1.

The experimental design was a split-plot design, arranged in randomized complete block format, with three replicates. The main-plot factor was land-use types (Farmland, cocoa plantation and home garden soils) while the sub-plot consisted of the five nitrogen levels (O, 25, 50, 75 and 100 kgha^{-1}). Five kilograms (5kg) of each soil sample were placed in 5 litre- plastic buckets (nursery buckets) and moistened to field capacity. Seeds of jute plant (*Corchorus olitorius*), (NHCO-2 cultivar collected from the National Horticultural Research Institute, (NIHORT), Ibadan), were tied in a clean cloth, steeped into boiling water for about 5 – 10 seconds (to break dormancy) and were later sown in the nursery buckets to germinate. One hundred and eighty black polythene bags, each containing 5 kg of soil, were arranged in three batches, each representing a replicate. Each replicate consisted of sixty bags, twenty of which represented a soil type. Each of the five levels of urea (46% N) fertilizer was applied to four bags in the batch of twenty bags representing a soil type.

Two weeks after sowing (WAS), at three to four leaf emergence stage, the seedlings were transplanted into the pots at the rate of two seedlings/pot. At three weeks after transplanting (WAT), urea fertilizer was applied at the rates stated above.

Table 1: Physico-chemical properties of the soil-use types (SUT)

Soil property	*SUT I	*SUT 2	*SUT 3	Mean	Standard deviation	LSD (P=0.05)
pH (H_2O)	6.00	5.30	6.30	5.89	0.51	1.48
Organic carbon gkg^{-1}	8.40	14.40	4.20	9.00	5.13	14.97
Total N gkg^{-1}	1.19	0.72	0.44	0.78	0.38	1.10
C: N ratio	7.06	20.0	9.55	12.20	2.14	2.86
Available P mg kg^{-1}	13.60	0.10	4.50	6.01	6.89	20.12
Exchangeable cation C mol kg^{-1}						
Ca	3.50	6.30	10.00	6.60	3.26	9.51
Mg	0.80	1.40	2.50	1.57	0.86	2.51
K	0.10	0.20	0.20	0.17	0.06	0.17
Na	2.00	0.10	0.40	0.83	1.02	2.98
Extractable micronutrients mg kg^{-1}						
Cu	5.20	5.30	4.40	4.97	0.49	1.43
Zn	6.70	1.00	3.30	3.67	2.87	8.38
Mn	69.90	28.90	53.80	50.87	20.66	60.32
Fe	27.60	26.60	66.40	40.20	22.69	66.25
Extractable acidity C mol kg^{-1}	0.30	0.50	0.20	0.33	0.19	0.44
Texture	Sandy clay	Sandy loam	Sand			

**SUT1: Farmland soil, SUT2: Cocoa plantation soil SUT3: Hom garden soil*

Parameters measured

The following parameters were measured per plant; plant height (cm), number of leaves and leaf area (cm^2) at 3, 4 and 5 WAT. At maturity, plant samples were carefully uprooted and the fresh leaf weights as well as the total dry matter were measured. All data collected were statistically analyzed using Statistical Analysis Systems (SAS) with PROC GLM procedure (SAS Institute, 1996).

RESULTS

Soil type and growth parameters

The result of the soil chemical analysis in Table 1 showed that cocoa plantation soil had the highest value of C:N ratio (20.0) and least values of micronutrients (5.30 mg/kg Cu, 1.00 mg/kg Zn, 28.90 mg/kg Mn and 26.60 mg/kg Fe respectively). The farmland soil had the highest values of available P and Na (13.60 mg/kg P and 2.0 Cmol/kg Na). The home garden soil had the highest values of Ca and Mg (10.0 Cmol/kg and 2.50 Cmol/kg) followed by the cocoa plantation soil (6.30 Cmol/kg and 1.40 Cmol/kg); while the two soil–use types had equal levels of K (0.20 Cmol/kg each). There were significant differences (P< 0.05) in the levels of the different elements in the three soil-use types. The soil texture of the farmland soil was sandy clay while that of the cocoa plantation soil was sandy loam and sandy for the home garden soil.

Jute plant *(Corchorus olitorius L.)* recorded the best performance in cocoa plantation soil in terms of stem height, leaf number, leaf area, total fresh leaf yield and total dry matter yield (Figs. 1-4). Soil- use types had significant effect (P<0.05) on the morphological growth parameters and the dry matter yield. The crop differed significantly (P< 0.05) in the three land-use types in terms of stem height and leaf number (Figs. 1 and 2). There were no significant differences (P> 0.05) in the leaf area, total fresh leaf and dry matter yields in cocoa plantation and farmland soils but the performance differed significantly (P< 0.05) between the aforementioned land-use types and residential or home garden soil. Generally, soil from cocoa plantation gave the best performance in all the parameters followed by the farmland soil.

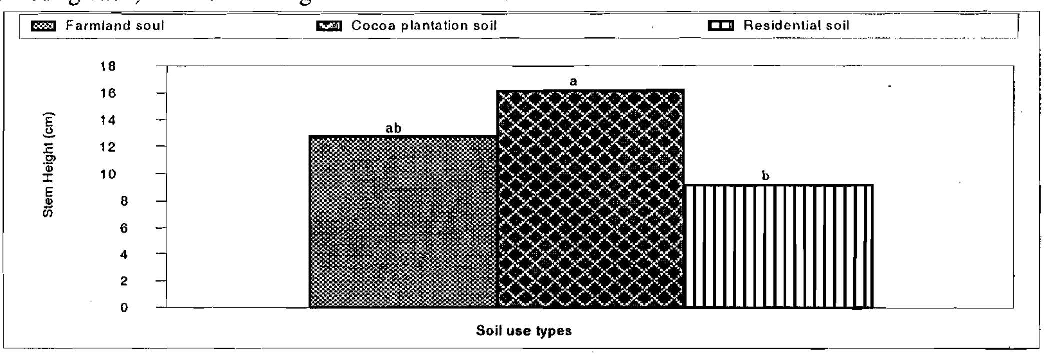


Fig. 1: Height (cm) of *Corchorus olitorius* as influenced by three soil- use types. Means with the same letter are not significantly (P> 0.05) different

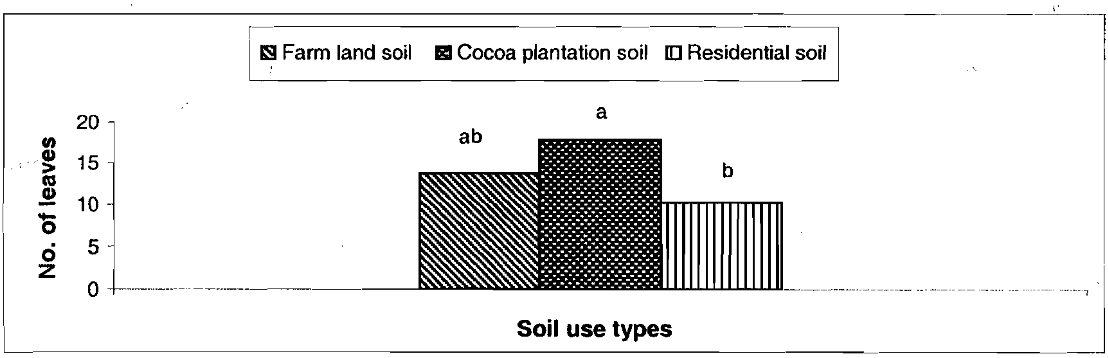


Fig. 2: Number of leaves of *Corchorus olitorius* as influenced by three soil-use types. Means with the same letter are not

significantly (P> 0.05) different.

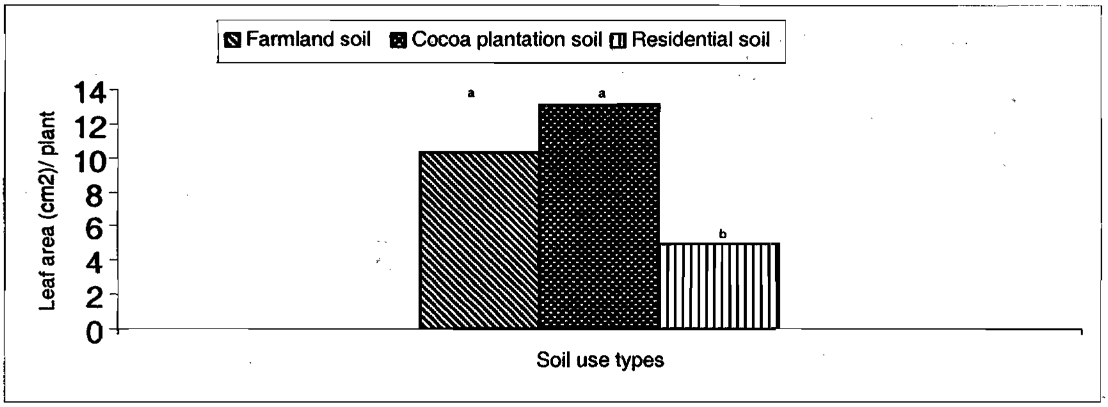


Fig. 3: Leaf area (cm[3]) of *Corchorus olitorius* as influenced by three soil-use types. Means with the same letter are not significantly (P> 0.05) different.

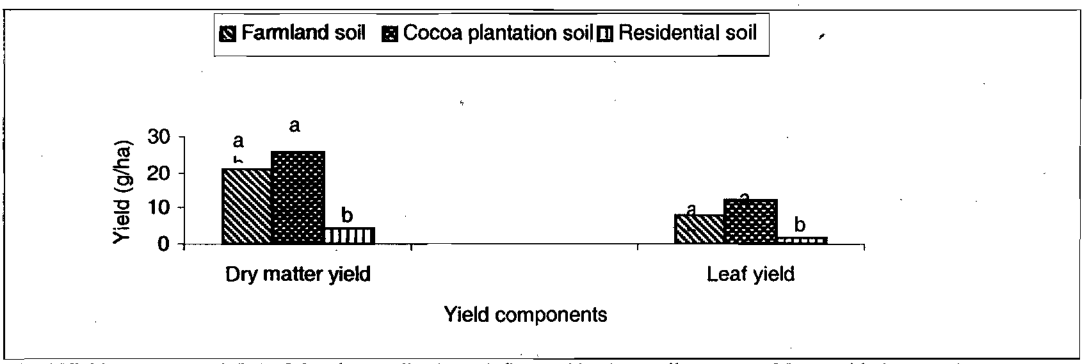


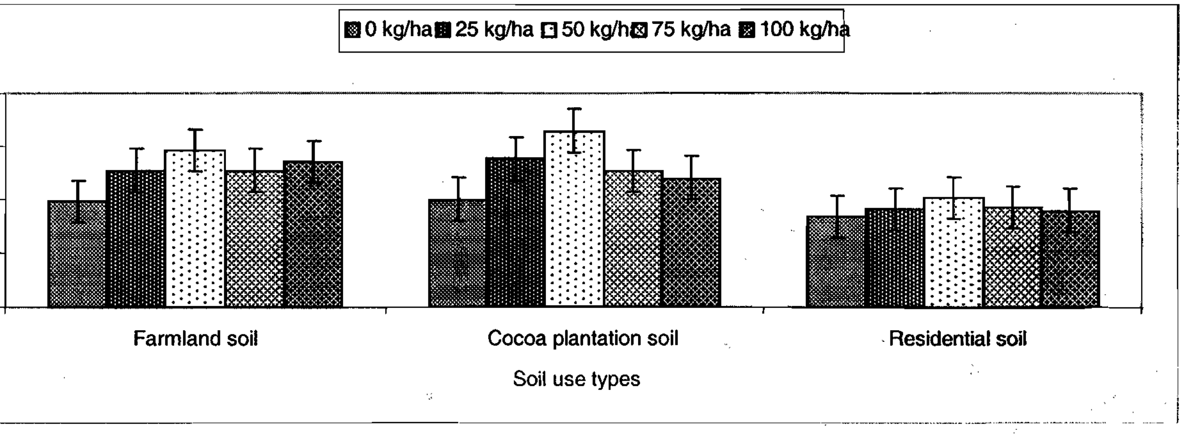
Fig. 4 Yield components (g/ha) of *Corchorus olitorius* as influenced by three soil-use types. Means with the same letter are not significantly (P> 0.05) different

Nitrogen level and growth parameters

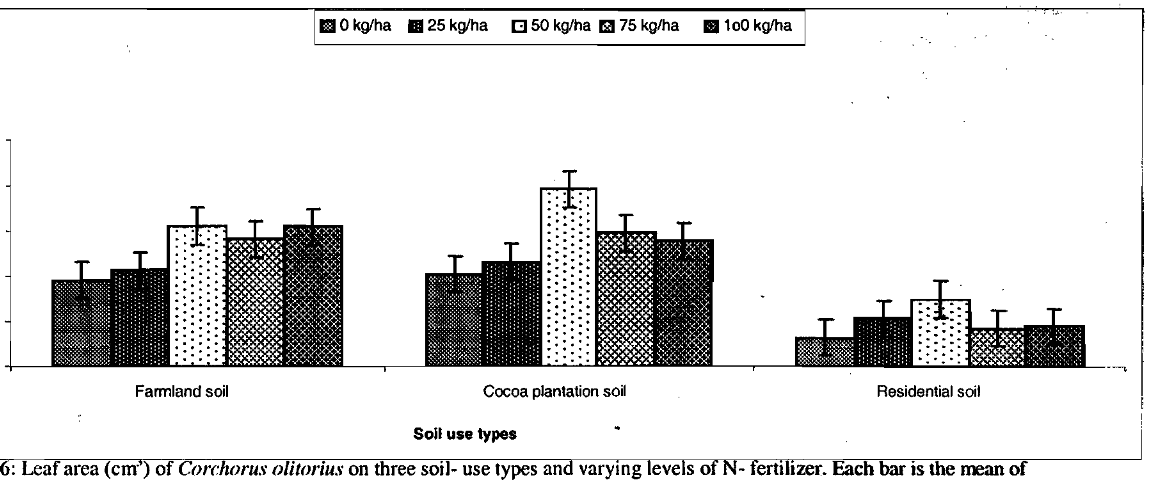
Application of 50 kg/ha of N – fertilizer gave the best performance in stem height, leaf area and number of leaves. Other levels like 25, 75 and 100 kg/ha N also enhanced the stem height while 75 and 100 kg/ha N gave considerable increase in the leaf area of the plant. However, there was no significant difference (P> 0.05) in the morphological growth of the plant in all the fertilizer levels.

Interaction effects of land-use types and different levels of fertilizer on growth parameters of jute plant (*Corchorus olitorius L.)*

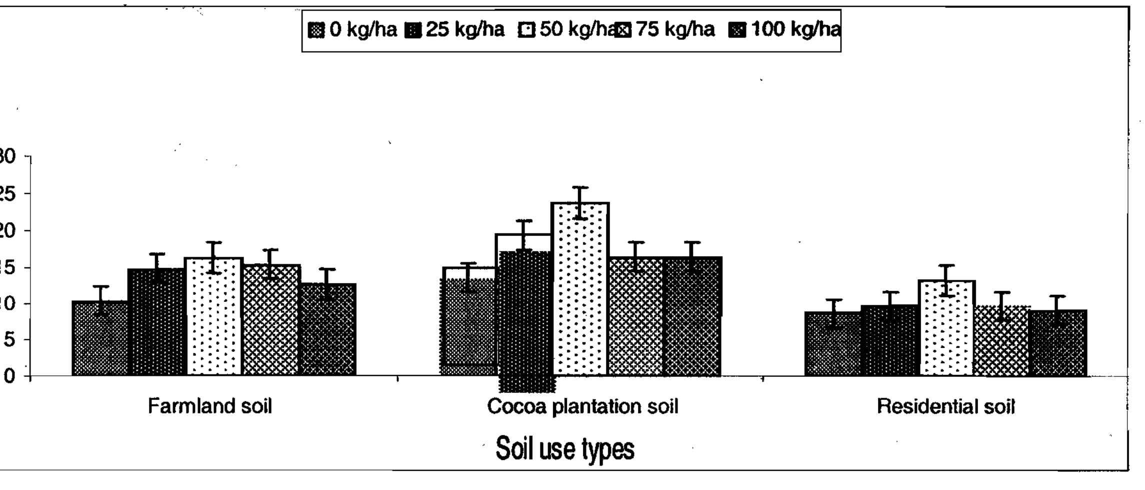
The application of 50 $kgha^{-1}$ N- fertilizer gave the highest increase in the plant stem height, leaf area number of leaves and total fresh leaf yield in the three land-use types. The control treatment (0kg/ha N) gave the least values of all the parameters in the soils. Cocoa plantation soil treated with 50 kg/ha N recorded the greatest values of the growth parameters, followed by farmland soil treated with 50 kg/ha N. Other levels, such as 25, 75 and 100 kg/ha, applied to both cocoa plantation and farmland soils also increased the growth considerably. Amongst the three land- use types, all the fertilizer levels applied to the residential or home garden soil recorded the least values in all the growth measures (Figs 5-8).



Height (cm) of *Corchorus olitorius* on three soil-use types and varying levels of N- fertilizer. Each bar is the mean of three replicates ± the standard error.



6: Leaf area (cm²) of *Corchorus olitorius* on three soil- use types and varying levels of N- fertilizer. Each bar is the mean of three replicates ± the standard error.



7: Number of leaves of *Corchorus olitorius* on three soil-use types and varying levels of N- fertilizer. Each bar is the mean of three replicates ± the standard error.

Fig. 8: Fresh leaf yield (g/ha) of *Corchorus olitorius* on three soil-use types and varying levels of N- fertilizer. Each bar is the mean of three replicates ± the standard error.

DISCUSSION

The poor performance of jute plant (*Corchorus olitorius L.)* on residential or home garden soil is quite expected; i. because of the sandy nature of the soil and ii. most of the residential or home garden soils are mixed with pebbles, stones, sand, cement and paint. Combination of these materials may destroy the original structure of the soil and to some extent have an inhibitory effect on plant growth. The pebbles, stones and sand would have caused excessive drainage, of the soil, which would lead to leaching of the soil nutrients, and the applied fertilizers, to the subsoil. They could also cause obstruction to free proliferation of plant roots to soil water level for adequate moisture absorption. Cocoa plantation soil (at 0-15cm) is usually rich in organic matter as a result of decomposition of the high deposits of leaf litter on the plantation bed, thus the excellent performance of the vegetable in this soil. Combination of high organic matter content and availability of adequate macronutrients in the soil enhanced vegetative growth and increased total fresh leaf and dry matter yields in cocoa plantation soil. This was in accordance with the findings of Siemonsma (1991) who observed that high level of organic matter in combination with other essential soil nutrients increased vegetative growth for maximum leaf yield in okra. The farmland had been cultivated for many years but was still reasonably sufficient in essential nutrients, thus it recorded second in its ability to sustain the plants. Siemonsma (1991) observed a high positive correlation and linear relationship between nutrient availability in the soil and photosynthate accumulation and partitioning from the leaves to the storage organs (source to sink).

The better performance of fertilized plants over the control suggested the need for fertilization of the soils for optimum yield. It also suggests that most of our agricultural soils are impoverished because of intensive cultivation and use as indicated by Akanbi and Togun (2002). Shortage or unavailability of nitrogen may have pronounced negative influence on most physiological processes such as production of certain organic compounds like protein, nucleic acids, phenol as also pointed out by Akanbi and Togun (2002).

The interaction effect of land-use type and N- fertilizer application revealed that addition of 50 kgha^{-1} N on the cocoa plantation soil, gave the best performance in terms of morphological growth parameters and optimum fresh leaf and dry

soil which enhanced the efficient use of N-fertilizer by the plant as suggested by Nyamangra *et al.* (2003).

CONCLUSION

This study revealed that, of the three soil-use types, jute plant (*Corchorus olitorius L.)* performed best in cocoa plantation soil with application of 50 kgha^{-1} N- fertilizer because of the high organic matter content. Production of vegetables in the urban cities will require soils rich in organic matter. Use of organic manures or fertilizers will be the best option.

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