Data Article

Data on the vegetative response of cowpea to fertilizer application on three selected benchmark soils of the Upper West region of Ghana

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A B S T R A C T

Declining soil fertility among smallholder farmers in the Savannah zones of Ghana, among other issues, is triggered by continuous cultivation, low fertilizer use and low soil organic matter content. The area is faced with insufficient domestic production, food insecurity and poverty, all of which constitute major constraints to national development. Continuous cultivation leads to low soil organic matter levels. To build up the soil organic matter levels, residue incorporation is a major factor to be considered. Cowpea is grown in these areas for the grain yield while the residue is incorporated into the soil to gain maximum benefits of the nitrogen fixation. We present the physical and chemical properties of three benchmark soils in the Savannah zones of Ghana as well as their vegetative response to NPK fertilizer application. The FAO soil classification also helps in the thorough understanding of the soil and an appropriate management option for optimal productivity is recommended.

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Specifications table

| Subject                      | Agriculture                                      |
|------------------------------|--------------------------------------------------|
| Specific subject area        | Soil classification, plant nutrition, fertilizer use |
| Type of data                 | Table, Graph and Figure                         |
| How data were acquired       | Ten fertilizer treatments were applied on cowpea to determine the effect on vegetative yield of cowpea. The plot size was 24 m² with 4 replications giving a total of 40 plots per soil type. Data were collected and analyzed using Genstat 11th edition. Soil classification was based on FAO WRB (2014) [1]. |
| Data format                  | Raw, analyzed.                                   |
| Parameters for data collection | Soil profile characterization, as well as standard laboratory protocols, was used for soil chemical and physical analysis. Vegetative growth data (height, number of leaves and leaf area) was collected at two, four and six weeks after sowing using a tape measure and leaf area meter |
| Description of data collection | 10 random representative crop stands for each treatment were selected for the collection of plant height, the number of leaves and leaf area. The profile pits were classified by determining the parent material, drainage class, horizon distinction and depth of horizons, soil consistency and color through field observation. Munsell color chart was used to determine the soil color. |
| Data source location         | City/Town/Region: Dondori- Lawra, Upper West region |
|                             | Country: Ghana                                   |
|                             | Coordinates (Latitude and longitude) for sampling location: N 10° 40’ 13.3” W 002° 51’ 14.8” |
|                             | City/Town/Region: Kojopere- Nadowli, Upper West region |
|                             | Country: Ghana                                   |
|                             | Coordinates (Latitude and longitude) for sampling location: N 10° 20’ 40.6” W 002° 13’ 44.7” |
|                             | City/Town/Region: Nyoli - Wa West, Upper West region |
|                             | Country: Ghana                                   |
|                             | Coordinates (Latitude and longitude) for sampling location: N 09° 46’ 16.0” W 002° 30’ 52.1” |
| Data accessibility          | Raw data were deposited at repository Mendeley data; Dec 18, 2019 |
|                             | Direct URL to data: http://dx.doi.org/10.17632/xmxkt726vs.1 |

Value of the data

- This dataset will be valuable for researchers, extension workers and farmers in choosing appropriate soil management practices for optimal and sustainable crop production in the Upper West region of Ghana.
- The data will allow researchers and farmers to determine the suitability of the soil to support the production of cowpea and other legumes in general. The information may also be used by the Government to formulate an appropriate policy and intervention strategies for increased food production for the growing population.
- The data provide insight on the effect of fertilizer treatments and soil types on the vegetative growth of cowpea. Cowpea requires balanced nutrition of nitrogen, phosphorus and potassium for vegetative growth. The vegetative part of the crop forms the biomass that is returned to the soil which helps in the buildup of soil organic carbon.
- This data will be a guide to farmers in the investigated areas on the best fertilizer combination for optimum performance of cowpea. It will also be a guide for long term investigation into soil nutrient dynamics for sustainable cowpea production in the investigated regions.
Table 1.
Soil profile Pit characterization of Dondori - Lawra.

| Horizon | Depth (cm) | Descriptions |
|---------|------------|--------------|
| Ap      | 0 - 15     | Strong brown (7.5Yr 4/6); sandy loam; few quartz stones; weak granular; occasional ironstone concretions; many very fine and fine roots; clear and smooth boundary. |
| BA      | 15 - 32    | Brown (7.5Yr 5/4); sandy loam; few quartz gravels and stones; weak crumbs; frequent ironstones and MnO₂ concretions; few fine roots; clear and smooth boundary. |
| Btcs₁   | 32 - 91    | Yellowish red (5Yr 4/6); dark red (2.5Yr 3/6) mottled; sandy clay loam; frequent quartz gravels sandstones; moderately medium sub-angular blocky; frequent ironstone concretions; very few fine roots; animal burrow; clear and smooth boundary. |
| Btcs₂   | 91 - 133   | Yellowish red (5Yr 5/6) dark red (2.5Yr 4/8) mottled; sandy clay loam; common quartz gravels and stones; moderately medium sub-angular blocky; frequent ironstones and MnO₂ concretions; clear and smooth boundary. |
| Btcs₃   | 133 - 180  | Yellowish red (5Yr 5/6); dark red (2.5Yr 4/8) mottled; clay loam; common quartz gravels and stones; moderately medium sub-angular blocky; common ironstone and MnO₂ concretions. |

Coordinates N 10° 40’ 13.3” W 002° 51’ 14.8”
Series: Dorimon
Location: Dondori- Lawra
Vegetation: Sudan Savanna
Site: Middle Slope
Parent Material: Lower Birrimian Rock
Drainage: Moderately Well Drained
Classification: Ferric Lixisol

2. Data description

The data are from 40 experimental plots in each of the 3 sites located in each of the investigated soil types. This was collected from three benchmark soils of the Upper West region of Ghana, West Africa. This region is of utmost importance as it is part of the “breadbasket” region of Ghana. The soil profile differentiations and characteristics observed in the field for the three soils (Dondori, Kojokpere and Nyoli) are presented in Tables 1–3, respectively. It shows the horizon descriptions, depth, drainage and FAO classification of each soil. The physical and chemical properties of the soil profile pit at different depths for each location are presented in Table 4. The Horizon depths for Kojokpere was 0–19, 19–44, 44–88, 88–121 and 121–172 cm. That of Dondori was 0–15, 15–32, 32–91, 91–133, 133–180 cm while Nyoli was 0–12, 12–32, 32–65, 65–82, 82–120. The effect of fertilizer treatments on cowpea height, leaf area and the number of leaves at Dondori are presented in Figs. 1–3, respectively. Figs. 4–6 show the fertilizer treatments effects on cowpea height, leaf area and the number of leaves at Nyoli. The treatment effects on cowpea height, leaf area and the number of leaves at Kojokpere are presented in Figs. 7–9, respectively. The data are available in the repository [2].

3. Experimental design, materials, and methods

Soil profile pits were dug for the soil classification. The different layers were identified and soil samples collected from each layer for laboratory analysis. The soil color was determined using the Munsell color chart. The soil samples from the different layers were analyzed in the laboratory using standard laboratory protocols. Soil pH was determined using a glass electrode pH meter in a 1:1 soil to distilled water (soil: water) ratio, available P by the Bray and Kurtz (Bray P-1) method [3] while the modified Walkley and Black procedure as described by Nelson and Sommers [4] was used to determine organic carbon. Total nitrogen was determined using
Table 2.
Soil profile Pit characterization of Kojokpere - Nadowli.

| Horizon | Depth (cm) | Description |
|---------|------------|-------------|
| Ap      | 0 - 19     | Dark brown (10Yr 3/3); coarse sandy loam; few quartz gravels and stones; weak crumbs; occasional ironstone and MnO₂ concretions; many very fine and common coarse roots; clear and smooth boundary. |
| AB      | 19 - 44    | Dark yellowish brown (10Yr 3/4); coarse sandy loam; common quartz gravels and stones; weak crumbs; frequent ironstones and MnO₂ concretions; many fine and common coarse roots; clear and smooth boundary. |
| Btcs₁   | 44 - 88    | Brown (7.5Yr 4/4); coarse sandy loam; common quartz gravels and few quartz stones; moderately medium sub-angular blocky; frequent ironstone and MnO₂ concretions; many fine and common coarse roots; clear and smooth boundary. |
| Btcs₂   | 88 - 121   | Strong brown (7.5Yr 4/6); coarse sandy loam; common quartz gravels and stones; loose; abundant ironstones and MnO₂ concretions; few fine and few coarse roots; clear and smooth boundary. |
| Btcs₃   | 121 - 172  | Brown (7.5Yr 5/4); clay loam; abundant quartz gravels and many quartz stones; loose; abundant iron and MnO₂ concretions; few coarse roots. |

Series: Kologu
Coordinates N 10° 20' 40.6" W 002° 13' 44.7"
Location: Kojokpere - Nadowli
Vegetation: Guinea Savanna
Site: Middle Slope
Parent Material: Cape Coast Granite
Drainage: Well Drained
Classification: Chromic Luvisol

Table 3.
Soil profile Pit characterization of Nyoli - Wa West.

| Horizon | Depth (cm) | Description |
|---------|------------|-------------|
| Ap      | 0 - 12     | Dark brown (10Yr 3/3); fine sandy loam; few quartz gravels and very few quartz stones; weak granular; few ironstones and MnO₂ concretions; abundant very fine many fine common medium and few coarse roots; clear and smooth boundary. |
| AB      | 12 - 32    | Dark yellowish brown (10Yr 3/6); fine sandy clay loam; few quartz gravels and stones; moderately medium sub-angular blocky; frequent ironstone and MnO₂ concretions; many very fine many fine common medium and common coarse roots; clear and smooth boundary. |
| Btcs    | 32 - 65    | Strong brown (7.5Yr 4/6); light olive brown (2.5Yr 5/6) mottle; clay loam; few quartz gravels and very few quartz stones; moderately medium sub-angular blocky; abundant ironstone and MnO₂ concretions; very few very fine fine and few medium roots; clear and smooth boundary. |
| Btcs₁   | 65 - 82    | Strong brown (7.5Yr 4/6); olive-yellow (2.5Yr 6/6) mottle; clay loam; very few quartz gravels and stones; moderately medium sub-angular blocky; abundant ironstones and MnO₂ concretions; few fine and few coarse roots; clear and smooth boundary. |
| Btcs₂   | 82 - 120   | Brown (7.5Yr 5/4) dark red (2.5Yr 4/8) mottle; clay loam; very few quartz gravels and stones; moderately medium sub-angular blocky; abundant ironstones and MnO₂ concretions; very few medium roots. |

Series: Varempere
Coordinates N 09° 46' 16.0" W 002° 30' 52.1"
Location: Nyoli - Wa West
Vegetation: Guinea Savanna
Site: Upper Slope
Parent Material: Cape Coast Granite
Drainage: Moderately Well Drained
Classification: Ferric Luvisol
Table 4.
Physical and chemical analysis of the soil profile pit.

| Lab. No. Site | Horizon (cm) | pH    | Org. C % | Total N % | Available p mg/kg | Exchangeable Cations cmol/kg | T.E.B Exch. Acidity cmol/kg | E.C.E.C cmol/kg % | Base Sat | Particle - Size Analysis | Particle - Size Analysis |
|---------------|-------------|-------|----------|-----------|-------------------|-----------------------------|-----------------------------|-------------------|----------|---------------------------|---------------------------|
|               |             |       |          |           |                   |                             |                             |                   |           | Sand (%) Silt (%) Clay (%) | Texture                   |
| 1             | Kojokpere   | 0 - 19| 6.7      | 1.19      | 0.10              | 3.95                        | 5.61                        | 1.34              | 0.37     | 0.04                      | Sandy Loam                |
| 2             | "           | 19 - 44| 6.51     | 0.5       | 0.04              | 0.88                        | 3.6                         | 0.67              | 0.16     | 0.05                      | Loamy Sand                |
| 3             | "           | 44 - 88| 6.5      | 0.19      | 0.02              | 0.15                        | 2.67                        | 0.53              | 0.10     | 0.04                      | Loamy Sand                |
| 4             | "           | 88 - 121| 6.32    | 0.15      | 0.01              | 0.56                        | 2.4                         | 0.27              | 0.12     | 0.07                      | Loamy Sand                |
| 5             | "           | 121 - 172| 6.33    | 0.11      | 0.01              | 0.11                        | 4.81                        | 1.34              | 0.18     | 0.17                      | Loamy Sand                |
| 6             | Dondori     | 0 - 15| 5.75     | 0.3       | 0.03              | 2.31                        | 1.6                         | 0.27              | 0.08     | 0.02                      | Sandy Loam                |
| 7             | "           | 15 - 32| 5.47     | 0.23      | 0.02              | 1.7                         | 1.34                        | 0.4               | 0.05     | 0.03                      | Sandy Loam                |
| 8             | "           | 32 - 91| 5.95     | 0.19      | 0.02              | 1.23                        | 3.2                         | 1.07              | 0.13     | 0.06                      | Loamy Loam                |
| 9             | "           | 91 - 133| 5.48   | 0.19      | 0.02              | 0.56                        | 3.2                         | 1.07              | 0.13     | 0.07                      | Loamy Silty               |
| 10            | "           | 133 - 180| 5.54   | 0.11      | 0.01              | 0.15                        | 3.47                        | 1.60              | 0.19     | 0.07                      | Loam Silty                |
| 11            | Nyoli       | 0 - 12| 6.03     | 1.22      | 0.11              | 13.95                       | 8.81                        | 0.80              | 0.23     | 0.08                      | Loam Silty                |
| 12            | "           | 12 - 32| 6.49     | 0.73      | 0.06              | 6.69                        | 5.07                        | 2.40              | 0.13     | 0.07                      | Loam Silty                |
| 13            | "           | 32 - 65| 6.22     | 0.57      | 0.05              | 2.94                        | 5.87                        | 1.20              | 0.19     | 0.08                      | Loam Silty                |
| 14            | "           | 65 - 82| 5.93     | 0.42      | 0.04              | 0.88                        | 6.14                        | 2.27              | 0.26     | 0.1                       | Loam Silty                |
| 15            | "           | 82 - 120| 6.07    | 0.3       | 0.03              | 0.82                        | 7.34                        | 3.87              | 0.34     | 0.09                      | Loam Silty                |

C – Carbon, N – Nitrogen, P – Phosphorus, Ca – Calcium, Mg – Magnesium, K – Potassium, Na – Sodium, TEB – Total exchangeable bases, ECEC – Effective cation exchange capacity, sat – saturation.
Fig. 1. Fertilizer treatment effects on the height of cowpea at Dondori. Bars represent LSD values, WAS – Weeks after sowing.

Fig. 2. Fertilizer treatment effects on leaf area of cowpea at Dondori. Bars represent LSD values, WAS – Weeks after sowing.

the macro Kjeldahl method [5] and 1.0 N ammonium acetate (NH₄OAc) extract was used for exchangeable bases. Exchangeable acidity (hydrogen and aluminium) was determined in 1.0 N potassium chloride (KCl) extract [6]. Exchangeable bases were extracted using 1.0 N ammonium acetate. Potassium and sodium in the soil extract were determined by flame photometry using standard solutions. Effective cation exchange capacity was calculated by the sum of exchangeable bases (Ca, Mg, K, and Na) and exchangeable acidity (Al and H). Percent base saturation was calculated from the sum of exchangeable bases as a percent of the ECEC of the soil.
3.1. Field experiment

The plot size was 24 m², with a planting distance of 60 cm × 20 cm. Asontem cowpea variety obtained from the Crop Research Institute, Kumasi Ghana was used. It was a fractional factorial experiment laid out in a Randomized Complete Block Design (RCBD) with ten treatments and four replications giving a total of 40 plots. The treatments were as follows: N-P₂O₅-K₂O (Kg ha⁻¹) corresponding to: 0 – 0 – 0 (control), 0 – 60 – 60, 15 – 60 – 60, 30 – 60 – 60, 60 – 60 – 60, 60 – 0 – 60, 60 – 30 – 60, 60 – 60 – 0, 60 – 60 – 30, 45 – 60 – 60.

The fertilizer was spot applied at sowing using urea, triple superphosphate and muriate of potash. Glyphosate and hand weeding were deployed for weed control. Data were taken at 2-
Fig. 5. Fertilizer treatment effects on leaf area of cowpea at Nyoli. Bars represent LSD values, WAS – Weeks after sowing.

Fig. 6. Fertilizer treatment effects on the number of leaves of cowpea at Nyoli. Bars represent LSD values, WAS – Weeks after sowing.

week intervals from the second week after sowing (WAS) until the sixth WAS and was stopped after flowering.
Fig. 7. Fertilizer treatment effects on the height of cowpea at Kojokpere. Bars represent LSD values, WAS – Weeks after sowing.

Fig. 8. Fertilizer treatment effects on leaf area of cowpea at Kojokpere. Bars represent LSD values, WAS – Weeks after sowing.

Conflict of Interest

The authors declare no competing interest.
Fig. 9. Fertilizer treatment effects on the number of leaves of cowpea at Kojokpere. Bars represent LSD values, WAS – Weeks after sowing.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.dib.2020.105590.

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