



Data Article

Data on the response of *Zea Mays* L. and soil moisture content to tillage and soil amendments in the sub-humid tropics



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ABSTRACT

The datasets presented were collected from Chuka and Kandara on-station trials sites in Kenya, conducted for two consecutive years. The main aim of the data collection was to evaluate the soil amendments and tillage influence on *Zea Mays* L. (maize) crop performance and soil moisture content, as reported by Kiboi et al. [1]. Rainfall data were collected using a manual rain gauge installed within the trial site. A non-destructive sampling of four maize plants next to each other on the centre row in each plot was conducted at the 6th and 10th leaf phase to determine crop growth dynamics. Maize grain and stover were harvested at maturity from net plots of 21 m² in Chuka and 15 m² in Kandara. The net plot was derived by excluding the first, the last (guard) rows, and the first and last maize plants in each plot. The net plot approach aimed to minimize the edge effect. For soil moisture content determination, a Polyvinyl Chloride access tube was installed at the centre of each plot. Crop phenology was observed and recorded at 50 and 100% stages per treat-

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ment. The datasets presented are supplementary materials to the research article by Kiboi et al. [1]. For statistical analysis, the data were subjected to analysis of variance (ANOVA). The datasets under consideration include daily rainfall, relative chlorophyll content- SPAD values and plant heights, grain yields and stover yields, and periodic soil moisture content.

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Specifications Table

| | |
|--------------------------------|--|
| Subject | Agricultural sciences |
| Specific subject area | Agronomy and Crop Science, Soil Science, and plant nutrition |
| Type of data | Tables |
| How data were acquired | An on-station field experiment was laid in 2016 in two on-station sites, Chuka and Kandara. Fourteen treatments were replicated four times, with tillage as the main factor while soil amendments were the sub-factors. Data acquisition was through field observations and measurements. |
| Data format | Raw Datasets |
| Parameters for data collection | Daily rainfall amount collected using a manual rain gauge, Relative chlorophyll concentration measured using SPAD-502Plus®, Ruler for plant height, Grain moisture was measured using Dickey-John MiniGAC® moisture meter, Observation and recording of crop phenological phases, Soil moisture content was measured using Diviner2000™. |
| Description of data collection | Rainfall amounts were recorded daily at 9.00 am EAT. A non-destructive sampling of four adjacent plants in the center row of each treatment at the 6 th and 10 th leaf phase for crop growth dynamics. Maize was harvested from net plots of 21 m ² and 15 m ² in Chuka and Kandara, respectively. Soil moisture was measured weekly at intervals of 10 cm. Crop phenological stages were observed and recorded at 50 and 100% stages. |
| Data source location | Region: Upper Eastern Kenya, Chuka Sub-county, Tharaka-Nithi County, and Central Kenya, Kandara sub-county, Murang'a County Country: Kenya |
| Data accessibility | Repository name: Mendeley Title of the dataset; Datasets for the article "Response of Zea Mays L. and soil moisture to different tillage methods and soil inputs in the sub-humid tropics" Direct URL to data: http://dx.doi.org/10.17632/8bx88zpvdp.1 |
| Related research article | M.N. Kiboi, K.F. Ngetich, A. Fliessbach, A. Muriuki, D.N. Mugendi, Soil fertility inputs and tillage influence on maize crop performance and soil water content in the Central Highlands of Kenya. <i>Agric. Water Manag.</i> 217 (2019) 316–331 https://doi.org/10.1016/j.agwat.2019.03.014 |

Value of the Data

- The data can be used to determine and recommend the best-fit soil management strategies for enhanced crop production
- The data is of interest to agricultural advisors, policymakers, researchers, and modelers of crop productivity and validate performance in the tropical sub-humid regions.
- Soil scientists can use the data to develop appropriate nutrient combination rates for crop growth in the sub-humid tropics thus and
- Researchers can also use the data to carry out long-term experimentation, specifically to assess conservation tillage effects.

Table 1

Treatments conducted at Chuka and Kandara research sites [1].

| Tillage method | Abbreviation | Soil amendment | Abbreviation |
|----------------|-----------------|--|--------------|
| Conventional | D ₁₅ | Control | C |
| Conventional | D ₁₅ | Sole mineral fertiliser | F |
| Conventional | D ₁₅ | Crop residue+mineral fertiliser | RF |
| Conventional | D ₁₅ | Crop residue+mineral fertiliser+animal manure | RFM |
| Conventional | D ₁₅ | Crop residue + <i>Tithonia diversifolia</i> L. + phosphate rock (Minjingu) | RTiP |
| Conventional | D ₁₅ | Crop residue+ animal manure+legume intercrop (Dolichos Lablab L.) | RML |
| Conventional | D ₁₅ | Crop residue + <i>Tithonia diversifolia</i> L. + animal manure | RTiM |
| Minimum | D ₀ | Control | C |
| Minimum | D ₀ | Sole mineral fertiliser | F |
| Minimum | D ₀ | Crop residue+mineral fertiliser | RF |
| Minimum | D ₀ | Crop residue+mineral fertiliser+animal manure | RFM |
| Minimum | D ₀ | Crop residue + <i>Tithonia diversifolia</i> L. + phosphate rock (Minjingu) | RTiP |
| Minimum | D ₀ | Crop residue+ animal manure+legume intercrop (Dolichos Lablab L.) | RML |
| Minimum | D ₀ | Crop residue + <i>Tithonia diversifolia</i> L. + animal manure | RTiM |

Table 1 is an amended version of Table 1 in [1]

1. Data Description

The data presented in the datasets were collected from two on-station trial sites in Kenya and conducted for two years; four consecutive maize-growing seasons. The tillage methods applied soil amendments (Table 1) [1], and the number of replicates is included in the datasets showing crop growth dynamics, yield, and soil moisture content. Daily rainfall data provided is for the 2016/2017 and 2017/2018 seasons. The rainfall in the research sites is bimodal, with long rains season running from March through June and short rains season from October to December. It shows the daily rainfall amount and distribution observed in each station during long rains 2016 (LR16), short rains 2016 (SR16), long rains 2017 (LR17), and short rains 2017 (SR17) seasons (Dataset 1). Dataset 2 presents the relative chlorophyll content (Netto et al., 2005) measured at the sixth and tenth leaf stage of the *Zea Mays* L. crop. However, relative chlorophyll content was not measured in the Kandara site during SR17. Plant height data included measurements recorded in centimetres at the 6th and 10th leaf phases counted from the bottom of the plant to the topmost fully drawn-out leaf tip (Dataset 3). Dataset 4 presents both maize grain and stover yields in Mg ha⁻¹. Nonetheless, during LR17, no grain yield was harvested in Kandara due to a rainfall shortage. Dataset 5 shows soil moisture content data, including the vegetative and grain formation/filing phenology stages, dates measured, and total moisture content per depth in millimetres.

2. Experimental Design, Materials and Methods

On-station field trials were carried out during four consecutive maize-growing seasons in Upper Eastern Kenya, Chuka Sub-county, Tharaka-Nithi County, Central Kenya, and Kandara sub-county, Murang'a County [1]. The trials design was a split-plot arranged in a randomized complete block design. Prior to implementation of the trials, a homogeneity trial was carried out during the short rains season of 2015 in each station using the test crop (*Zea Mays* L. variety H516)- the predominant food crop. The performance of *Zea Mays* L was used to determine blocking. The trials were then designed, and implementation began during the long rains of the 2016 (LR16) season. Tillage methods – conventional and minimum – were the main treatments, while soil amendments were the sub-treatments (Table 1) [1]. A total of fourteen treatments were implemented, with each treatment replicated four times at each station. At Chuka station, the plots measured 6 m by 4.5 m, while at Kandara, they were 4.5 m by 4.5 m. Cultivation under conventional tillage (D₁₅) treatments was done using a hand hoe to 0.15 m depth and in minimum tillage (D₀) treatments, only planting holes were plowed.

In both stations, planting was done at an inter-row spacing of 75 cm and intra-row spacing of 50 cm. Three seeds were planted per hole to ensure the maximum plant population. Two weeks after plant emergence, the extra plant was thinned out to remain with two plants per hole, thus a population density of 53,333 plants ha⁻¹.

In each treatment, soil amendments were applied following the Fertilizer Use Recommendation Project (FURP) [2], which recommends a 60 kg N ha⁻¹ to meet the required *Zea Mays L.* nutrient for the two regions. Triple Super Phosphate (TSP) was applied to supply phosphorus in treatments with mineral fertilizer only and integrate organics with mineral fertilizer during planting at the rate of 90 kg P ha⁻¹. A fortnight before each cropping season onset, organic resources (animal manure and *Tithonia diversifolia*) were incorporated into the soil in conventional tillage plots. In contrast, the incorporation was only done in the planting holes in minimum tillage plots. The animal manure used in the treatments was collected from the nearby local farmsteads, mixed thoroughly, and dried under shade for a minimum of eight weeks. *Tithonia diversifolia* was obtained from nearby biomass transfer ridges, weighed, chopped into small pieces, and incorporated into the soil. A sample of each organic resource was analysed to assess the nitrogen content before integration in the soil (animal manure had 2.1% of N while *Tithonia diversifolia* had 3.8%). The determined N content was used to decide the quantity of organics to be used, equal to 30 or 60 kg N ha⁻¹. In treatments with only organics, an equivalent of 60 kg N ha⁻¹ was applied, while under intergration with mineral fertilizer, an equivalent of 30 kg N ha⁻¹ for each amendment used. Equal amounts of crop residue were (5 Mg ha⁻¹) surface applied in five treatments under each tillage method (Table 1) [1] after plant thinning. In conventional treatments, removal of weeds was done thrice in a season using a hand hoe, while in minimum treatments, weeds were hand-pulled. To control damage by stem borers, Tremor® GR 0.05 (a granule formulated synthetic pyrethroid insecticide with Beta-cyfluthrin being the active ingredient) pesticide was used.

2.1. *Zea Mays L.* (Maize) growth dynamics

To determine maize growth dynamics, non-destructive sampling of four maize plants next to each other in the centre row of each plot was done at the 6th leaf phase [3] and 10th leaf phase. To measure the relative chlorophyll content of the maize leaves, a Soil Plant Analysis Development SPAD-502Plus® meter (Konica Minolta Optics, Inc., Japan) was used [4]. The leaves were counted from the base of the plant. The average of 3 readings (from the left and right sides and middle of the leaf), was used. Plant height was measured in centimetres using a ruler as the distance from the base of the plant to the topmost drawn-out leaf tip.

2.2. Crop yield

The grains and stover of the crop were harvested from net plots of 21 m² in Chuka and 15 m² in Kandara. Guard rows, the first and last plants of each row were not harvested to minimize the edge effect. After harvesting, the maize cobs from each treatment were detached from the stover, and fresh weight was determined. Afterward, the cobs were air-dried, hand-shelled to separate the grains, and weighed. Subsequently, grain moisture for each treatment was determined using the Dickey-John MiniGAC® moisture meter. The meter has a moisture range of 5-45%, ±0.02% moisture precision. The weight of dry grains was amended based on the measured moisture content to the standard 12.5% and converted to per hectare basis. Stovers were weighed at harvest, subsampled and weighted. Subsequently, they were dried under shade until constant weight. The final weight of the dry stover was used to correct the moisture content of the stover weight and derivation of per hectare yield.

2.3. Soil moisture and rainfall amount

A manual rain gauge installed 200 cm from the treatments in each station was used to collect rain amounts. The amount was recorded daily at 9. 00 am EAT. Soil moisture was measured using a Diviner2000™ Version 1.5 190 capacitance sensor (Sentek Sensor Technologies, Stepney, South Australia) in Polyvinyl Chloride access tubes installed at the centre of each treatment. Installation of the Polyvinyl Chloride access tubes was done during the LR16 season just after planting and allowed to equilibrate in the soil before actual measurements. The actual measurements began during the SR16 season and were conducted every week up to a depth of 50 cm (0-10 cm, 10 -20 cm, 20-30 cm, 30-40 cm, and 40–50 cm depths) in each treatment. Additional Polyvinyl Chloride access tubes were installed in plots next to the trials plots to calibrate the diviner gravimetrically. Soil moisture was not measured during the LR17 season because the probe was broken. Crop phenology (vegetative and grain formation/filling stages) was observed and recorded at 50 and 100% stages per treatment.

Ethics Statements

Not applicable.

CRedit Author Statement

Kiboi Milka: Conceptualization, Methodology, Data curation, Original draft preparation, Writing, Software; **Andreas Fliessbach:** Investigation, Writing – reviewing; **Anne Muriuki:** Visualization, Investigation, Supervision; **Felix Ngetich:** Supervision, Conceptualization, Methodology, Data curation, Software Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability

[Datasets for the article "Response of Zea Mays L. and soil moisture to different tillage methods and soil inputs in the sub-humid tropics \(Original data\) \(Mendeley Data\).](#)

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