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Effect of nitrogen fertilizer on growth, quality and yield of Mrenda (*Corchorus olitorius*) morphotypes in Kenya

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Abstract
Production of Mrenda (*Corchorus olitorius*) in Kenya has been low due to various reasons, such as poor agronomic practices like incorrect fertilizer rates. Observations from the Mrenda growing areas showed that there is high unmet demand for crop in local market and even for export. This is due to yields being low, 2-4 tons/ha as compared to expected yield of 5-8 tons/ha. Therefore, the main objective of this study was to discern effect of Nitrogen fertilizer on growth and yield of Mrenda (*Corchorus olitorius*) morphotypes. Seed samples were planted at two sites of University of Eldoret and Kenya Agriculture and Livestock Research Organization, Kitale using Randomly Complete Block Design with three replicates and three levels of nitrate (Calcium nitrate) fertilizer. Five plants were tagged and the following traits were recorded: plant height, number of branching at main stem, number of pods and fresh leaf yield. Results showed highest N fertilizer rates had most effect exhibited by Morphotypes GT and BT on plants height; plant branching; pods number per plant and yield weight per plant respectively. Use of no N fertilizer caused lowest plant height, branching at main stem, pods and leaf weight per plant by Morphotypes GT and BT. It is concluded that Mrenda is N loving plant as it enhanced its growth when high amount of Nitrogen fertilizer was applied. It is recommended farmers use high N fertilizer for Mrenda production.

Keywords: Fertilizer, Growth, Mrenda, Yield.

Introduction

Plants existence and their use in various biological forms are important for survival of human race (Kochhar, 2016). They provide direct source of world's stable foodstuffs like leaves, tubers, fruits and seeds (Abukutsa-Onyango, 2003). Other plant species provide products or services that people depend on directly like medicine, fodder for livestock, fiber, among many use (Furumoto, et al., 2002). For these reasons over 200 plants have been domesticated and grown for various purposes by man including *Corchorus olitorius* (Roberts, 2009). Currently African indigenous vegetables like Mrenda, black nightshade, spider plant among others are known for their high nutritional value contents (IPGRI, 2000) which are appreciated both in rural and urban areas (Rubaihayo, 2003).

In several communities in Kenya, these vegetables are important as food and economic source (Walingo, et al., 2001). Mrenda has been known to have medicinal and culinary properties (Muhammad and Shinkafi, 2014). Farmers have used cultural practices in growing crops and

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have not employed effective crop management yet are known to influence growth and yield (Abukutsa, 2010). Studies show that research in the country is mainly focused on identification of high yielding varieties of crops like maize, wheat among others and their adaptation to improved management practices leaving out vegetables which are nutritive (MOA, 2012). Reports show that up to 2 billion people in the world lack enough food or suffer from diseases due to insufficient intake of vitamins and minerals (Kwennin, 2011), of which African leafy vegetables like Mrenda can remedy the situation due to its' high such contents needed by body (Van Rensburg, et al., 2004). The lack of adequate volumes of this crop to satisfy demand and check food scarcity in both rural and urban markets has enhanced low uptake of this important vegetable (Chadha, et al., (2007).

To subdue such impediment as crop inadequate volumes, there is need to step up production of Mrenda for both consumption and sale (Kamwaga, et al., 2005). Such is possible through increased production by researching best production practices (Ruibaihayo, et al., 2002) like use of improved agronomic practices e.g. correct nitrogen fertilizer rates and crop protection (Keller, 2004). Such researches therefore try to ravel information concerning crop improvement and production (Voster, et al., 2007). Such information will help enhance image of *Corchorus olitorius* among other indigenous crops (Schippers, 2000) and possibly widen scope of its cultivation by farmers' thereby increasing profit and nutrition at homes (Chadha and Oluoch, 2003). Farmers often desire to produce high crop yields in order to maximize profit (Fermont and Benson, 2011). However, scientific data have been scanty especially on improvement, production, management (Opabode and Adegbooye, 2005) and harvesting as well as post harvest handling of most indigenous crops (Odhiambo and Oluoch, 2008), necessitating research to discern effect of Nitrogen fertilizer on growth and yield of Mrenda morphotypes in Kenya thereby try bridging the data gap on the crop.

Nitrogen fertilizer usage in crop production significantly enhances not only plant growth but quality and yield of crops (Abdelhamid, et al., 2011). Though so, when fertilizer is used, amounts are very variable due to variation of nutrients in the soil (Brady and Weil, 2002) and so farmers need established rates that are most economical for their production purposes (Mauyo, et al., 2008). Inadequate fertility nutrients are shown by yellowing of crop or reduced plant height, branching, pod numbers and general leaf size before maturity, a sign that plant needs more nutrients (Goyal, et al., 2012). To enhance plant growth and yield, compound fertilizers or nitrogen fertilizer can be used (Aliniaeifard and Tabatabaei, 2010). Such nitrogen fertilizer include Calcium Ammonium Nitrate or Sulphate of Ammonia can be applied (Opiyo, 2004) at rate of two and half teaspoonfuls per running meter as a remedy (KARI, 2013). Alternatively foliar feed can be sprayed once every week (Hamayun, et al., 2011). The use of proper agronomic practices like nitrogen fertilizer application and use of good quality seed has helped to raise yields thereby stimulating interest in its farming (Weinberger and Msuya, 2004).

In Kenya, quantity and quality of farm produced Mrenda is usually of low and poor quality (KARI, 2012). Several reports indicated that farm produced *Corchorus olitorius* is not always optimal (Khandakar, 2003). Because of high cost of fertilizers and chemicals and low purchasing power of farmers, most Mrenda farmers do not use them; yet good quality plants need to be well fertilized to get a high yield (Ekwu and Okporie, 2002). To increase Mrenda production to meet current high demand of this vegetable (Shiundu and Oniang'o, 2007), there is need to do research on various aspects of production to come up with best agronomic practices like optimum amounts of nitrogen fertilizer that enhances quality and yield (Van Averbeke, et al., 2007; Aliniaeifard and Tabatabaei, 2010). Such will enable farmers to maximize profit and increase food security at home and nation (Musotsi, et al., 2008), necessitating research on optimum nitrogen fertilizer rates for enhanced growth, quality and yield of Mrenda.

Materials and Methods

Experimental sites

The research was carried out in two sites of Kenya Agriculture and Livestock Research Organization (KALRO), Kitale (Site 2), situated in North rift region, Kenya, between Mount Elgon and Cherangani hills at latitude of 1^{o} 02’ North and 35 ^{o} East longitude and altitude of 1901 meters above sea level in Trans Nzoia county, Kenya. The University of Eldoret (Site 1) is in North rift region, Kenya, situated at longitude 0 ^{o} 30’ N and latitude 35 ^{o} 15’ E and altitude of about 2140 m above sea level, and is 9 km North of Eldoret town in Uasin Gishu County, Kenya.

Field experimental management of Mrenda (Corchorus olitorius) Morphotypes

The Mrenda seed Germplasm (Morphotype GS, Morphotype GT, Morphotype BS, and Morphotype BT) were obtained from North rift region, Kenya, sampled and planted in the field to discern their response to Nitrogenous fertilizer in terms of quality and yield. Nitrogen fertilizer experiment on Mrenda was conducted at two sites of University of Eldoret farm and KARI - Kitale farm. Before the start of experiment, soil sampling was done in both sites at the experimental plots before seed samples were planted. This was to know the nutrient variation between the soils of the two sites at the time the experiment commenced. The soil samples were then taken to the soil laboratory where it was air dried and passed through a two millimeter sieve. The fraction which passes through the sieve was used to analyze total nitrogen, exchangeable cations, organic carbon, available P and pH using described analytical methods (Tan, 1996) and available nitrogen analysis determined using fresh soils.

In the field, soils were worked out to fine tilth as recommended for small seeds (MOA, 2013). Mrenda seed were then drilled and nitrate fertilizer (Calcium nitrate) at rates of 0, 60, and 120 kg/ ha, (Masinde, et al., 2010) in the experimental plots. Weeding was carried out in all plots in the sites simultaneously. The seedlings were then thinned two weeks later to the recommended spacing of 30 cm x 30 cm. The experimental plots were kept weed free and pests and diseases scouted (though none observed) throughout the experimental period. To discern the effect of nitrogen fertilizer treatments on Mrenda, five plants in each plot were systematically random sampled (Kothari, C. 2004), tagged and their heights, branching at main stem, pod count and leaf yield determined. Analysis of variance (ANOVA) on plant growth (height, branching, pod count and leaf yield) was performed to determine presence of any significant difference between treatments by using GENSTAT computer package analysis (12.2.2010). The means were separated using Duncan Multiple Range Test (DMRT) at $p<0.05$.

Results

Effect of nitrogen (N) fertilizer on plant height

From plant height results (Table 1) of Mrenda, it is observed that use of higher nitrogen fertilizer rates of 120kg/ha from both site 1 (Eldoret) and site 2 (Kitale) showed significant variance ($p<0.05$) in plant height within and across varieties exhibiting tallest plant compared to rates of 0kg/ha N and 60kg/ha N.

Table 1. Table of means of plant height in centimeters from site 1 (Eldoret) and 2 (Kitale)

Fertilizer rates	Site 1 (Eldoret-UoE) Mrenda morphotypes				Site 2 (Kitale-KALRO) Mrenda morphotypes			
	GS	BS	GT	BT	GS	BS	GT	BT
F0	30.89a	30.00a	79.44a	79.78a	30.78a	31.00a	79.78a	80.22a
F1	31.78a	32.00a	83.22a	83.11a	32.00a	33.22a	83.89a	84.11a
F2	37.67b	36.44b	88.56b	88.00b	36.67b	37.89b	90.11b	89.89c

Note: (F) is Nitrogen Fertilizer rates; F0=0kg/ha; F1=60kg/ha; F2=120kg/ha and figures having same letters 'a' or 'b' in columns shows no significant difference ($p<0.05$) in means at site.

Short Mrenda morphotypes (GS and BS) had 37.67 cm and 37.89 cm as the tallest plants from 120kg/ha N fertilizer rate and shortest at 30.78 cm and 30 cm from 0kg/ha N fertilizer rate respectively. This indicates that N fertilizer rates have effect on the overall plant growth i.e. plant height, thereby also affecting plant leaf yield in the Mrenda production. There was significant variance ($p<0.05$) in effect by N fertilizer rates treatments as observed in the tall Mrenda morphotypes (GT and BT) where both had 90.11 cm and 89.89 cm as tall plants exhibited by nitrogen fertilizer rates of 120kg/ha and 79.44 cm and 79.78 cm as short plants exhibited by 0kg/ha N fertilizer rates.

The plant height Duncan Multiple Range Test (DMRT) means separation ($p<0.05$) showed no significant variance within the short Mrenda morphotypes (BS and GS) with mean plant height of 33.13 cm at Eldoret site and 33.61 cm at Kitale sites respectively by 0kg/ha N fertilizer rate. Also within tall Mrenda morphotypes (GT and BT) there was no significant variance ($p<0.05$) with mean plant height of 83.80 cm in Eldoret site and 84.65 cm in Kitale site respectively by 0kg/ha N fertilizer rate. Generally, Kitale site had taller plants compared with Eldoret site on all nitrogen fertilizer treatment levels of 0kg/ha N, 60kg/ha N and 120kg/ha N.

Effect of nitrogen (N) fertilizer on number of branching per plant

Result on number of braches per plant of Mrenda morphotypes on various treatments of nitrogen (N) fertilizer (Table 2) showed that use of higher fertilizer rates of 120kg/ha showed highest increase in number of braches per plant from both sites within and across morphotypes. The tall Mrenda morphotypes (GT and BT) had highest mean branching/plant at 8.3 and 7.3 by 120kg/ha N fertilizer rate and lowest at 1.9 and 2.3 by 0kg/ha N fertilizer rate respectively from both sites 1 and 2. The short Mrenda morphotypes (GS and BS) had highest mean branching per plant at 7.3 and 7.1 by 120kg/ha rate and lowest at 1.6 and 1.5 by 0kg/ha respectively from site 1 and 2. Generally there were more branching on plants from site 2 (Kitale) of 8.3 branching/plant, than those from site 1 (Eldoret) of 7.3 branching/plant as exhibited by rates of 60kg/ha and 120kg. The control (0kg/ha) had lowest mean branching numbers per plant of 1.5 (Morphotype BS) in Eldoret site and 1.8 branching/plant at Kitale site.

Table 2. Table of means of number of branches per plant from site 1 (Eldoret) and 2 (Kitale)

Fertilizer rates	Site 1 (Eldoret-UoE) Mrenda morphotypes				Site 2 (Kitale-KALRO) Mrenda morphotypes			
	GS	BS	GT	BT	GS	BS	GT	BT
F0	1.6a	1.5a	1.9a	2.3a	2.2a	1.8a	2.5a	2.6a
F1	4.3b	4.3b	4.9b	4.4b	4.7b	5.2b	5.8b	5.3b
F2	6.4c	6.3c	7.3c	6.4c	7.3c	7.1c	8.3c	7.3c

Note: (F) is Nitrogen Fertilizer rates; F0=0kg/ha; F1=60kg/ha; F2=120kg/ha and figures having same letters 'a' or 'b' or 'c' in columns shows no significant variation ($p<0.05$) in means at site.

The DMRT mean separation results of number of branches ($p<0.05$) showed significant variation within the short Mrenda morphotypes (GS and BS) with lowest mean branches/plant of 4.1 and 4.8 for Eldoret site and Kitale site respectively by N fertilizer rate 60kg/ha. There was significant variance ($p<0.05$) within tall Mrenda morphotypes (GT and BT) with lowest mean branching per plant of 4.4 and highest of 5.6 for Eldoret and Kitale sites respectively by N fertilizer rate of 60kg/ha. The site comparison showed significant variance ($p<0.05$) between short Mrenda morphotypes (BS and GS) and Tall morphotypes (GT and BT) with lowest mean branching/plant of 4.1 and 4.4 by N fertilizer rate of 60kg/ha and highest mean branching per plant of 4.8 and 5.6 respectively from both Eldoret and Kitale sites by 60kg/ha N fertilizer rate .

Effect of nitrogen (N) fertilizer on number of pods per plant

The number of pods per plant results (Table 3) of Mrenda morphotypes showed that use of higher nitrogen fertilizer rates of 120kg/ha from both sites 1 and 2, increases number of pods/plant within and across morphotypes. The short Mrenda morphotypes (GS and BS) highest mean pods per plant were 11.5 and 11.6 respectively in Eldoret and Kitale sites respectively by 120kg/ha N fertilizer rate and lowest mean pods per plant at 5.4 and 5.3 pods respectively in same sites by 0kg/ha N fertilizer rate. The Mrenda morphotypes GT and BT had highest mean pod count at 22.6 and 21.3 by 120kg/ha N fertilizer rate and lowest mean pod count of 15.9 and 14.8 at Eldoret and Kitale sites respectively by 0kg/ha N fertilizer rate. The control plots (0kg/ha) had lowest mean pods/plant on at 5.3 pods (BS morphotypes) and 14.8 pods (BT morphotypes) while highest fertilizer (120kg/ha) had 10.1 pods (GS morphotypes) and 21.3 pods (BT morphotypes) and at Eldoret and Kitale sites respectively. Pod count variation indicated that use of N fertilizer at different rates had significant effect on number of pods per plant and subsequent yield of Mrenda.

There was significant variation ($p<0.05$) in number of pods per plant effect by fertilizer rates treatments within the tall Mrenda morphotypes (GT and BT) with highest at 22.6 pods and 23.7 pods and lowest at 14.8 pods and 17 pods respectively in both Eldoret and Kitale sites by use of no fertilizer (0kg/ha).

The DMRT means separation ($p<0.05$) of pods per plant result showed no significant variance within the short Mrenda morphotypes (BS and GS) with mean of 7.8 pods and 7.7 pods by 60kg/ha N fertilizer rate and within tall Mrenda morphotypes (GT and BT) being 19.5 pods and 19.8 pods respectively by 120kg/ha N fertilizer rate. Though so, there was significant variance ($p<0.05$) between means of tall and short morphotypes with the tall Mrenda morphotypes (GT and BT) having mean of 19.7 pods and 20.5 pods by 120kg/ha N fertilizer rate and short morphotypes (GS and BS) with 7.8 pods and 8.7 pods from both Eldoret and Kitale sites respectively by no fertilizer rate (0kg/ha).

Table 3. Table of means of number of Pods per plant from site 1(Eldoret) and site 2 (Kitale)

Fertilizer rates	**Site 1 (Eldoret-UoE) Mrenda morphotypes**				**Site 2 (Kitale-KALRO) Mrenda morphotypes**			
	GS	**BS**	**GT**	**BT**	**GS**	**BS**	**GT**	**BT**
F0	5.4a	5.3a	15.9a	14.8a	6.3a	5.9a	17.3a	17.0a
F1	7.6b	7.8b	19.8b	17.4b	8.4b	8.5b	21.2b	20.5b
F2	10.4c	10.1c	22.6c	21.3c	11.5c	11.6c	23.3c	23.7c

Note: (F) is Nitrogen Fertilizer rates; F0=0kg/ha; F1=60kg/ha; F2=120kg/ha and figures having same letters 'a' or 'b' or 'c' in columns shows no significant variation ($p<0.05$) in means of Morphotype at site.

Effect of nitrogen (N) fertilizer on fresh leaf yield

Mrenda fresh leaf yield results per plant (Table 4), showed that use of higher nitrogen fertilizer rates of 120kg/ha caused highest yield weight of 99.20g (Morphotype GT) for tall morphotypes and 66.80g (Morphotype BS) for short Mrenda morphotypes. There was generally an increase in yield weight of fresh leaf per plant from both sites within and between varieties as increasing nitrogen fertilizer was applied. Though so, plants from Kitale site had higher weight (66.80g) from Morphotype BS than those from Eldoret site of 66.31g (Morphotype GS) by 120kg/ha N fertilizer rate. Plants with no fertilizer (0kg/ha) had lowest mean plant weight of 31.55g (Morphotype GS) and highest of 54.13g (Morphotype GT) from Eldoret site.

Table 4. Table of means of fresh yield in grams (g) per plant from Eldoret and Kitale sites

Fertilizer rates	Site 1 (Eldoret-UoE) Mrenda morphotypes				Site 2 (Kitale-KALRO) Mrenda morphotypes			
	GS	BS	GT	BT	GS	BS	GT	BT
F0	31.55a	31.66a	54.13a	52.85a	32.04a	32.02a	53.69a	52.83a
F1	46.01b	46.13b	74.08b	66.97b	44.65b	46.41b	74.13b	66.77b
F2	66.31c	66.77c	99.09c	96.30c	66.69c	66.80c	99.20c	96.15c

Note: (F) is Nitrogen Fertilizer rates; F0=0kg/ha; F1=60kg/ha; F2=120kg/ha and figures having same letters 'a' or 'b' or 'c' in columns shows no significant variation ($p<0.05$) in means of Morphotype at site.

Results across tall Mrenda morphotypes (GT and BT) showed the lowest mean plant leaf weight as 53.69g and 25.83g for no fertilizer (0kg/ha), while highest plant mean fresh leaf weight as 99.20g and 96.30g respectively, from Eldoret and Kitale sites by 120kg/ha N fertilizer rate.

The DMRT means separation on fresh leaf yield showed no significant variance ($p<0.05$) within the short Mrenda morphotypes (BS and GS) with highest mean yields per plant of 46.29g and 46.53g respectively by 120kg/ha N fertilizer rate. There was significant variance ($p<0.05$) within tall Mrenda morphotypes (GT and BT) with highest mean yield per plant of 72.52g and 69.15g respectively by 120kg/ha N fertilizer rate. On comparison, there was significant variance ($p<0.05$) of effect due to nitrogen fertilizer, between the tall Mrenda morphotypes (GT and BT) fresh leaf yield per plant of 70.84g and 70.74g per plant exhibited by higher nitrogen fertilizer rate of 120kg/ha and short Mrenda morphotypes (BS and GS) being 46.29g and 46.53g exhibited by no fertilizer (0kg/ha) respectively from Eldoret and Kitale sites. This means the use of nitrogen fertilizer during crop production had significant effect on plant growth, quality and fresh leaf yield of Mrenda no matter the Morphotype available.

Discussion

Effect of nitrogen (N) fertilizer rates on plant height of Mrenda morphotypes

The N fertilizer rates of 120kg/ha showed highest effect on plant height of short morphotypes GS and BS as indicated by their plant height of 37.67 cm and 37.89 cm as the tallest plants and shortest at 30.78 cm and 30 cm respectively concurring with Ruibaihayo, et al., (2002) out-put. This showed variation of 0.22 cm and 0.78 cm respectively. The lowest effect was from no fertilizer rate (0kg/ha) with 30.78 cm and 30 cm for GS and BS morphotypes respectively from site 1 and 2. The plant height variation between highest N fertilizer (120kg/ha) and no fertilizer (0kg/ha) was 7.67 cm (Wang, et al., 2002). This indicates that N fertilizer rates variation has effect on overall plant growth as also found out by Aliniaeifard and Tabatabaei, (2010), thereby also affecting plant leaf yield of crop. Such effect was also shown by higher N fertilizer rate (120kg/ha) with plant height results of tall Mrenda morphotypes GT and BT varied with 90.11 cm and 89.89 cm from Eldoret site as well as 79.44 cm and 79.78 cm from Kitale site respectively supporting results also observed by Abdelhamid, et al., (2011). This variation was 0.22 cm and 0.34 cm respectively compared with effect from control (0kg/ha) having 79.44 cm and 79.78 cm for GT and BT respectively from site 1 and 2. The plant height variation between highest N fertilizer (120kg/ha) and 0kg/ha was 10.67 cm for GT Morphotype and 10.11 cm for BT Morphotype. The variation in plant height shows there was significant variance ($p<0.05$) in effect by nitrogen fertilizer rates treatments on Mrenda morphotypes supporting what was observed by KARI, (2013).

Effect of nitrogen (N) fertilizer rates on branching of Mrenda morphotypes

Nitrogen fertilizer rates had varied effect on number of braches per plant of Mrenda morphotypes with use of higher fertilizer rates (120kg/ha) showing highest increase in number of braches per plant (Aliniaeifard and Tabatabaei, 2010) from both tall Mrenda morphotypes GT and BT with mean branching/plant at 8.3 and 7.3 and lowest on no fertilizer rate (0kg/ha) at 1.9 and 2.3 mean branching/plant respectively from both Eldoret site and Kitale site as also observed by (Goyal, *et, al*., 2012). This gave variation of 6.4 and 5.0 mean branching/plant respectively. Such trend was also seen on fertilizer rate 60kg/ha where tall morphotypes (GT and BT) had highest effect with mean branching/plant of 4.9 and 5.8 respectively and lowest from Morphotype GS (4.3) at Eldoret site and 4.7 at Kitale site. This gave variation of 0.6 and 1.1mean branching/plant. This indicates that varied rates of fertilizer used had significant effect on plant growth as seen by increasing branching of plants supporting observation by Van Averbeke, et al., (2007) that use of higher fertilizer rates enhanced yield of crop.

Effect of nitrogen (N) fertilizer rates on pods per plant of Mrenda morphotypes

There was highest fertilizer effect on number of pods per plant of Mrenda morphotypes by 120kg/ha rate where the short morphotypes (GS and BS) highest mean pods per plant were 11.5 and 11.6 respectively in Eldoret and Kitale sites. The lowest mean pods per plant was observed in no fertilizer rate (0kg/ha) at 5.4 and 5.3 pods. This gave variation of 6.1 and 6.3 pods/plant for GS and BS morphotypes respectively from both site 1 and 2 indicating that fertilizer rates had significant effect on increasing the overall pods per plant (Weinberger and Msuya, 2004), thereby also affecting the overall yield in the Mrenda production. Equally, effect was seen in tall Mrenda morphotypes GT and BT with highest mean pod count at 22.6 and 21.3 pods by 120kg/ha N fertilizer rate and lowest mean pod count of 15.9 and 14.8 by no fertilizer (0kg/ha) rate at Eldoret and Kitale sites respectively. The variation was 7.4and 6.5 pods/plant for GT and BT morphotypes respectively from site 1 and 2 indicating that fertilizer use enhances growth of Mrenda concurring with findings by Shiundu and Oniang'o, (2007). In comparison, the number of pods per plant of Mrenda morphotypes showed that as increasing nitrogen fertilizer rates was used there was consequently increase in number of pods per plant (Zebarth, et al., 2009) with highest by 120kg/ha N fertilizer rate exhibited on GT (22.6 pods) and BT (23.7 pods) from both sites 1 and 2.This was also seen on N fertilizer rate of 60kg/ha having highest effect from Morphotype GT (19.8 pods) site 1 and Morphotype GT (21.2 pods) from site 2. Lowest effect was on treatments without fertilizer (0kg/ha) on Morphotype BS with 5.3 pods concurring with Abukutsa (2010) that use of fertilizer enhances crops plant growth.

Effect of nitrogen (N) fertilizer rates on fresh leaf yield of Mrenda morphotypes

The Mrenda fresh leaf yield results per plant, showed that use of higher fertilizer rates gave higher yields (Hamayun, et al., 2011). This is shown by higher N fertilizer rates (120kg/ha) which had the highest leaf yields exhibited by Morphotype GT (99.2g), 60kg/ha of 74.1g and 54.1g from no fertilizer plot (control) respectively concurring with Musotsi, et al., 2008. The other tall Morphotype BT exhibited the same trend where highest yield per plant was 96.3g on N fertilizer rate of 120kg/ha, 66.97g/ha for 60kg/ha and 58.9g per plant for control (0kg/ha fertilizer rate). Such trends where using of increasing fertilizer rates increased plant leaf yield was also observed by Ekwu and Okporie, (2002). This trend of increasing fertilizer use caused elevated leaf yield per plant was also exhibited by all other Morphotypes (Pavlou, et al., 2007) where short Morphotype GS and BS highest was 66.7g and 66.8g respectively for N fertilizer rate of 120kg/ha, 46.0g and 46.4g respectively for fertilizer rate 60 kg/ha and 31.6g and 32.0g respectively for fertilizer rate 0kg/ha (control). The increase in leaf yield per plant showed there was significant variance ($p<0.05$) by N fertilizer rates on Mrenda morphotypes supporting observation gotten by Khandakar, (2003) and Mauyo, et al., (2008).

Conclusion and Recommendation

It is concluded that Mrenda is a N-loving plant as application of higher N fertilizer improved its production through enhancement of plant height, branching, pods per plant and fresh leaf yield. It is recommended to use high nitrogen fertilizer rates at farming for ensure enough quality and adequate plant growth with better crop yields.

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