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EFFECT OF *MUCUNA PRURIENS* (L) EXTRACT ON GROWTH AND DRY MATTER YIELD OF JUTE MALLOW (*Chochorus olitorius.* L)

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Abstract

The experiment was laid out in a Randomized Complete Block Design (RCBD) with Five treatments (0, 10, 20, 30, and 40ml) replicated five times to make a total of 25 plastic containers. Each 7 litre container was perforated at the bottom and filled with top soil. Jute mallow seeds were sown 2cm deep and 5cm apart. Treatment was applied with the use of a hand sprayer for six weeks to assess the effect of mucuna extract on the performance of jute mallow. The extract was applied to the foliage at different rates for each crop in the early morning period until the plants were completely wet. For control plots, each plant was amended with distilled water (without the extract at equal rates). The diluted extract was applied as a foliar spray to jute mallow plants at 3 days intervals only in the morning followed by recording different growth and yield parameters. The result of this study revealed that significantly higher values were recorded for the 20ml extract of mucuna for fresh shoot weight (29.0cm), shorter days to first flowering (26.25 days), number of seeds per plant (18.0), and fresh leaf weight (4.83kg/ha) over other treatments with significantly lower values The harvest index (HI) results showed a mean value of 13.27%, indicating that on average, 13.27% of the total biomass is converted into economic yield. The extract of M. pruriens used in this study likely contained high levels of nitrogen, phosphorus, and potassium, which are essential nutrients for plant growth and development. The improved growth and yield of jute mallow with Mucuna extract application can also be attributed to the presence of other beneficial compounds in the extract, such as plant growth promoters and antioxidants. These compounds may have enhanced plant growth and yield by promoting cell division, cell elongation, and cell differentiation. The study concluded that M. pruriens extract has potential as an organic amendment for improving jute mallow growth and dry matter yield. The highest rate of extract (20 ml) resulted in the highest growth and yield. Further research on long-term effects and potential phytotoxicity is recommended.

Keywords: *Mucuna pruriens extract, Jute mallow, Growth, Dry matter yield*

Introduction:

Jute mallow (*Corchorus olitorius* L.) is an important leafy vegetable crop in many tropical countries (Ewulo *et al*., 2018). However, its growth and yield are often limited by soil fertility and pests. *Mucuna pruriens*, as a leguminous cover crop, has been reported to have potential as an organic amendment for improving soil fertility and crop growth. The use of synthetic fertilizers to address these limitations has negative environmental impacts, such as soil degradation and water pollution (Gopalakrishnan, *et al*, 2015). Therefore, there is a need to explore sustainable alternative methods to improve soil fertility and jute mallow growth. However, there is limited information on the effect of *M. pruriens* extract on jute mallow growth and dry matter yield. *M. pruriens* has been widely studied for its benefits as a green manure crop (Kumar *et*

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al., 2017), as a mulch material, (Okeleye *et al*., 2018), and as compost material, (Ewulo *et al*., 2018, Gopalakrishnan, *et al*, 2015). Its extract has been shown to promote plant growth and yield in various crops (Akanbi *et al*., 2017). In recent years, the natural plant growth enhancer has been the main focus of study for many researchers around the globe (Gopalakrishnan, *et al*, 2015). Mucuna leaves are used as green manure and as a potential natural growth stimulant (Leaone *et al*, 2015). The extract prepared from fresh mucuna leaves is a unique source of vitamins, hormones, antioxidants, phenolic acids, flavonoids, alkaloids tannins, saponins and secondary metabolites (Mvumi *et al*, 2013). The presence of a significant quantity of phytohormones such as cytokinins, gibberellins, indole-3-acetic acid, zeatin, mineral nutrient elements, vitamins such as ascorbic acid, carotenoid, anti-oxidants such as flavonoid and phytochemicals like phenolics, glucosinolates and isothiocyanates, osmoprotectants in the extract has made it an effective plant bio-stimulant (Gopalakrishnan, *et al*, 2015).When the extract is exogenously applied to plants, it has the potential to act as a growth promoter to increase the production of many vegetable and field crops (Mvumi *et al*, 2013). However, the optimal application rate of *M. pruriens* extract for maximizing jute mallow dry matter yield remains unknown. This study aims to bridge this knowledge gap by investigating the rate-dependent effect of *M. pruriens* extract on jute mallow growth and dry matter yield.

MATERIALS AND METHODS

Study site

The experiment was conducted in the Teaching and Research Farm of the Federal University of Technology, Akure, Ondo State in June, 2018. The study area experiences rainfall and sunshine. with an annual rainfall of about 2000 mm-3000 mm and a temperature of between 25 to 30. This encourages fast growth of crops and other vegetables in the area.

Collection, preparation and foliar application of mucuna leaf extract

Fresh and young leaves of *M. pruriens* (40-50 days old) were collected from mature plants. Which were initially planted and harvested at the school farm for the purpose of the experiment. Approximately, 10 g of the leaves were washed properly and transferred into a mortar with a small amount of distilled water (1 ml/10 g mucuna leaves) to pound using pestle. The leaf extract was collected by pressing with hand and filtered through a Whatman filter paper (No 2). The collected extract was mixed with distilled water (extract: water = 1:0.32) (v/v) and kept in a plastic bottle for application to the foliage. The extract was diluted to 10, 20, 30, and 40ml concentrations while the control was distilled water. For control plots, each plant was s[rayed with distilled water (without the extract at equal rates) and monitored daily followed by recording different growth and yield parameters.

The experiment was laid out in a Randomized Complete Block Design (RCBD) with five treatments (0, 10, 20, 30, and 40ml) replicated five times to make a total of 25 plastic containers which were perforated at the bottom and filled with top soil with Ph of 6.5-7.5 Jute mallow seeds were sown 2cm deep and 10cm apart. Regular watering was done every day to maintain soil moisture and early seed emergence of Jute mallow. No fertilizer was applied. Treatment was applied with the use of a hand sprayer for a period of six weeks to assess the effect of mucuna extract on the performance of jute mallow.

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Measurement of growth and yield parameters

The following parameters were monitored and data were collected and recorded for analysis:

Days to Emergence: Time from sowing to seedling emergence in days (Amanuel *et al*., 2000)

Plant height (cm): The height of selected plant from each plot was taken from the base of the plant to the tip in cm and recorded using a meter rule (Kumar *et al*., 2017)

Stem Girth (cm): The girth of the selected plants was taken using a veneer-caliper and was recorded. This began at 2 weeks after planting (WAP). (Okeleye *et al*., 2018)

Number of Leaves/Plant: The visual count of number of leaves per plant was done on the plants and recorded. This began at 2 weeks after planting (WAP) and repeated 3, 4, 5, 6 and 7 WAP. Ewulo *et al*., 2018

Leaf Area (cm2): This was estimated by multiplying the length x the breath x the correction factor of 0.85 (Okeleye *et al*., 2018)

Fresh Shoot Biomass: This was measured after harvesting with a top load weighing balance (Okeleye *et al*., 2018)

Days to First Flowering: This was estimated from the time of sowing to first flower appearance
(Okeleye *et al*., 2018)

Fresh Root Weight: Measured after harvesting with a top load weighing balance (Ewulo *et al*., 2018)

Number of Seed/Plant: This was counted manually (Kumar *et al*., 2017)

Fresh Leaf Weight: This was measured after harvesting with a top load weighing balance (Okeleye *et al*., 2018)

Harvest Index: Calculated as (Yield/Biomass) × 100 (Kumar *et al*., 2017)

Data Analysis

Data collected were subjected to One-way analysis of variance (ANOVA) and Duncan Multiple Range (DMR) Test. Standard deviation and standard error were used to establish the mean differences at 5% level of probability, using SPSS Version 16.0.

Result and Discussion

The result of the effect of different rates of *M. pruriens* extracts on growth and growth characteristics of Jute mallow is presented in Table 2. The result shows that different rates of mucuna extracts significantly affected the growth and growth characters of Jute mallow. For instance days to emergence were significantly shorter under the application of 20ml-30ml (5 days) of the extract while it took significantly longer days at 40ml and the control (8 days, 7 days) respectively. Similarly, significantly higher values were recorded for the 20ml extract of mucuna for plant height (101.6cm, number of leaves (149.6) number of branches (20.5), and leaf area development (55.91cm^2), over the 40ml and the control with significantly lower values. Table 3 shows that the extracts significantly affected the yield and yield characters of Jute mallow. Similarly, significantly higher values were recorded for the plant treated with 20ml extract for fresh shoot weight (29.0cm, shorther days to first flowering (26.25), number of seeds per plant (18.0), and fresh leaf weight (4.83kg/ha) over other treatments with significantly lower values. The harvest index (HI) results showed a mean value of 13.27%, indicating that on average, 13.27% of the total biomass is converted into economic yield. The standard deviation of 4.33% and standard error of 1.93% indicate moderate variability in the Harvex index (HI) values. Comparing this result to previous work, authors such as Fagbayide *et al*., (2022) and Matthews and Hunt (2019) reported HI values ranging from 10% to 20% for cassava crops under different extract applications (Cock, 2013) The result of this research fall within this

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range, indicating that the crop's efficiency in converting biomass into economic yield is comparable to previous studies. The low HI value of 6.48% at 0ml extract application can be attributed to nutrient deficiencies, as reported by Howeler, (2011). On the other hand, the high HI value of 16.66% at 20ml fertilizer application can be attributed to optimal nutrient availability, as reported by Okogbenin, & Fregene, (2007). *M. pruriens* is a leguminous cover crop that has been reported to have high nitrogen-fixing ability, making it an excellent source of organic nitrogen for crops (Kumar *et al*., 2017). The extract of *M. pruriens* used in this study likely contained high levels of nitrogen, phosphorus, and potassium, which are essential nutrients for plant growth and development. (Leaone *et al*, 2015) The improved growth and yield of jute mallow with *M. pruriens* extract application can also be attributed to the presence of other beneficial compounds in the extract, such as plant growth promoters and antioxidants (Fagbayide *et al*., 2022). These compounds may have enhanced plant growth and yield by promoting cell division, cell elongation, and cell differentiation (Mvumi *et al*, 2013). The highest rate of *M. pruriens* extract (20 ml/L) resulted in the highest growth and yield of jute mallow. This suggests that the extract has a dose-dependent effect on jute mallow growth and yield (Fagbayide *et al*., 2022). The control treatment had the lowest growth and yield, indicating that the soil used in this study was deficient in essential nutrients. The results of this study are consistent with previous studies that have reported the beneficial effects of *M. pruriens* on crop growth and yield (Okeleye *et al*., 2018). However, further studies are needed to fully understand the mechanisms by which *M. pruriens* extract improves crop growth and yield. The enhanced plant growth following the application of mucuna extract (ME) has also been reported in previous studies mentioning that ME acts as a biostimulator for enhancing the mineral nutrient use efficiency and promotes plant growth (Gopalakrishnan, *et al*,. 2016). This might have occurred due to having a cytokinins hormone (zeatin) in the extract, which acts as a stimulator for plant growth and productivity (Mvumi, *et al*, 2013, Leone et al, 2015). These findings suggest that foliar application of ME enhances crop yield by increasing growth parameters. This result suggest that providing an external supply of ME to the foliage could be one of the best possible ways to enhance jute mallow production compared to control (Rady &Mohamed, 2015): ME has been reported to have high nitrogen-fixing ability, making it an excellent source of organic nitrogen for crops. The improved growth and yield of jute mallow with ME application can also be attributed to the presence of other beneficial compounds in the extract, such as plant growth promoters and antioxidants (Fagbayide *et al*., 2022). These compounds may have enhanced plant growth and yield by promoting cell division, cell elongation, and cell differentiation (Gopala krishnan *et al*., 2015). According to Agele, *et al* (2018), the phenolic compounds, alkaloids, saponins, and other bioactive compounds present in ME have been reported to contribute to its potential benefits as an organic amendment for improving soil fertility and crop growth. These compounds can support plant dry matter yield by various mechanisms, including Antioxidant activity. Phenolic compounds and flavonoids in ME can scavenge free radicals, reducing oxidative stress and promoting plant growth (Gopala krishnan *et al*., 2015, El-Sharkawy, 2006)). Saponins and other compounds in ME can stimulate beneficial soil microorganisms, enhancing nutrient cycling and availability, which can support plant growth. Phenolic compounds

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and other bioactive compounds can enhance nutrient uptake by plants, promoting dry matter yield. L-DOPA has been reported to stimulate plant growth and development (Kumar *et al*., 2017), enhance nutrient uptake and utilization (Gopala krishnan *et al*., 2015), modulate plant hormone regulation, and promote cell division and elongation.

Conclusion:

In conclusion, the results of this study demonstrate the potential of ME as an organic amendment for improving jute mallow growth and dry matter yield. The extract has a dose-dependent effect on jute mallow growth and yield, and the highest rate of extract application resulted in the highest growth and yield. Further studies are needed to determine the optimal rate of ME application and to fully understand the mechanisms by which the extract improves crop growth and yield. The significant improvement in growth and yield with increasing rates of ME application can be attributed to the nutrient-rich content of the extract. L-DOPA is a notable compound in ME, which has been reported to have various biological activities, including antioxidant, anti-inflammatory, and neuro protective effects. The phenolic compounds, flavonoids, alkaloids, saponins, and tannins present in ME may contribute to its potential benefits as an organic amendment for improving soil fertility and crop growth. The study concluded that ME has potential as an organic amendment for improving jute mallow growth and dry matter yield. The highest rate of extract (20 l/L) resulted in the highest growth and yield. Further research on long-term effects and potential phytotoxicity is recommended.

Table 1: Phytochemical concentration of *Mucuna pruriens* leaf extract

Photochemical	Concentration
Total phenolic content	34.6 mg/g
Flavonoids	21.1 mg/g
Alkaloids	15.6 mg/g
Saponins	10.2 mg/g
Tannins	8.5 mg/g
L-DOPA (L-3,4-dihydroxyphenylalanine):	12.1 mg/g

Table 2: Effect of different rates of *Mucuna pruriens* extract on growth and growth characters of Jute mallow

Treatment/Rates	Days to emergence	Plant height (cm)	Number of Leaves	Number of branches	Stem girth (cm)	Leaf Area (cm^2)
0mls	7.00	65.9^{d}	88.9^{e}	14.0^{d}	0.56^{a}	30.99^{c}
10mls	5.00	87.9c	127.8^{b}	16.9^{c}	0.64^{a}	39.90^{b}
20mls	5.00	101.6^{a}	149.6^{a}	20.5^{a}	0.79^{a}	55.91^{a}
30mls	6.00	84.9^{c}	99.0^{d}	13.9^{d}	0.70^{a}	34.90^{c}
40mls	8.00	82.7^{c}	90.5^{d}	11.0^{d}	0.60^{a}	31.00^{c}
Mean	6.2	84.8	111.4	15.4	0.66	38.6
SD	1.3	14.1	24.5	3.5	0.08	10.3
SE±	0.6	6.3	11.0	1.6	0.04	4.6
LSD (0,05)	2.3	23.4	40.8	6.0	0.15	17.1

Mean followed by the same superscript significantly different at 0.05% probability on the same row using Duncan's Multiple Test (DMRT).

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Table 3: Effect of different rates of *Mucuna pruriens* extract on yield and yield characters of Jute mallow

Treatment/Rates	Fresh Shoot biomass (g)	Days to first flowering	Fresh root weight (g)	Number of seed/plant	Fresh leaf weight (kg/ha)	Harvest Index
0mls	21.00^{c}	30.33^{b}	1.89^{a}	12.90^{c}	1.36^{d}	6.48
10mls	23.88^{c}	33.18^{b}	1.78^{a}	13.67^{c}	3.02^{b}	12.65
20mls	29.00^{a}	26.25c	2.70^{a}	18.00^{a}	4.83^{a}	16.66
30mls	26.18^{b}	37.00^{a}	1.90^{a}	15.56^{b}	3.96^{b}	15.09
40mls	20.00^{d}	31.20^{b}	2.00^{a}	11.86^{c}	2.90^{c}	15.40
Mean	24.2	31.4	2.05	14.6	2.84	13.27
SD	3.5	3.5	0.43	2.3	1.23	4.33
SE±	1.6	1.6	0.19	1.0	0.55	1.93
LSD (0,05)	6.0	6.0	0.71	3.7	2.00	3.85

Mean followed by the same superscript significantly different at 0.05% probability on the same row using Duncan's Multiple Test (DMRT).

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