

**Bioassay of potentials of aqueous
extract of *Vernonia amygdalina*
leaves as organic fertilizer using
three leafy vegetables in a derived
savanna of Nigeria**

BY

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INTRODUCTION

- Land degradation and reduction in soil fertility have been identified as the greatest challenge for sustainable crop production in the tropics and nutrients are lost through crop removal (Agegnehu and Amede, 2017).
- Use of chemical fertilizers is associated with the challenges of scarcity, high prices and pollution of ground water (Savci, 2012).



INTRODUCTION

- The use of more eco-friendly practices like crop rotation, animal manure, green manure, alley cropping have resurfaced in recent years (Kumari,*et al.*, 2014).



INTRODUCTION

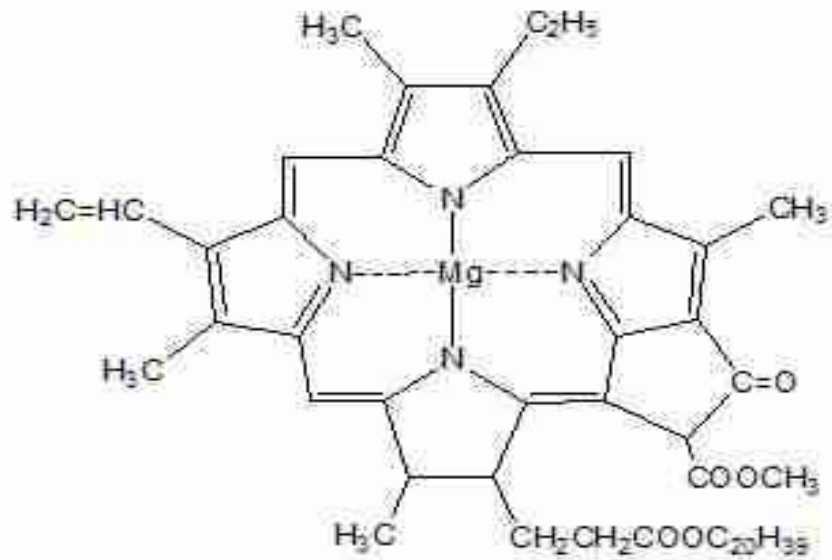
- *Vernonia amygdalina* popularly referred to as bitter leaf is a shrub that is popular in Nigeria.
- This plant is underutilized with nutritional, medicinal and antioxidant values (Kadiri and Olawoye, 2016, Hamman et al; 2016, Ofor, 2014).
- The leaves are macerated and washed severally with water to extract, remove or reduce the bitter taste to the acceptable minimum before using the leaves as vegetable in making of soup.



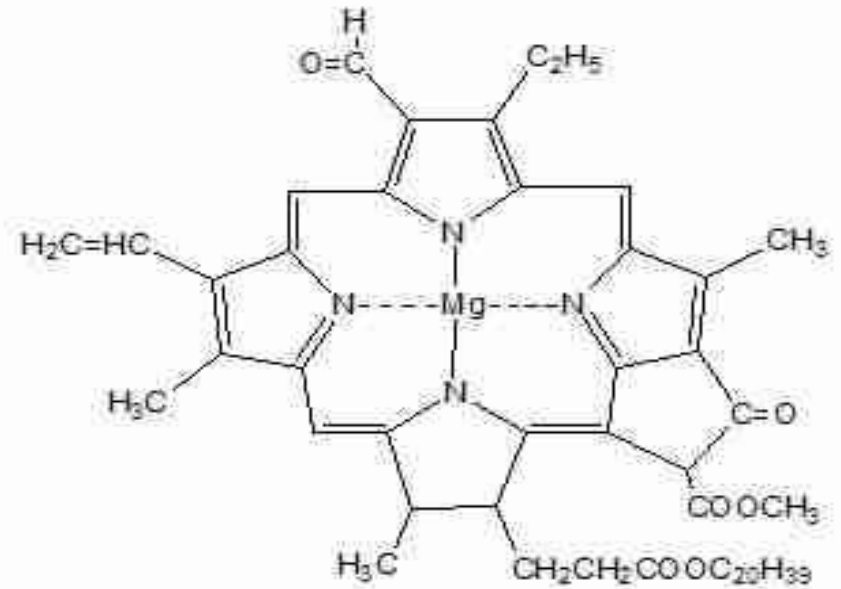
INTRODUCTION

- Both the leaves and the extract remain green after series of washing.
- Greenness in plant is associated with the pigment chlorophyll.
- Chlorophyll ($C_{55}H_{72}MgN_4O_5$) is rich in nitrogen and magnesium which are both essential mineral nutrients required for plant growth, development and yield.

INTRODUCTION



Chlorophyll a



Chlorophyll b

INTRODUCTION

- *Celosia argentea*, *Amaranthus hybridus* and *Cochorus olitorious* are common leafy vegetables consumed in Nigeria.
- They are rich in proteins, vitamins and minerals essential for human healthy living (Alegbejo,2013; Ebert et al., 2011, Choudhary et al., 2014, Adeyeye et al., 2013, Olawuyi et al., 2014) .



INTRODUCTION

- This study was therefore conceptualized to evaluate the fertilizer potential of aqueous extract of *Vernonia amygdalina* (VA) using the above mention leafy vegetables as test crop.

INTRODUCTION

- The objectives are:
- To ascertain the nutrient content of the aqueous extract of *Vernonia amygdalina* and
- To evaluate the growth performance of the leafy vegetables using three rates of the extract relative to two rates of chemical fertilizer and no fertilizer which serve as control.

Materials and Methods

- **Experimental site treatments and design**
- The trial was a pot experiment carried out at College of Plant Science and Crop Production of the Federal University of Agriculture Abeokuta, Ogun State Nigeria between the month of October and November, 2017.
- Three leafy vegetables: *Amaranthus hybridus*, *Cochorus olitorius* and *Celosia argentea* were evaluated simultaneously for their growth response to three rates of VA aqueous extract (500, 250 and 150 ml per pot) and three controls: two rates of NPK 15:15:15(0.78g and 1.55g per pot) and no fertilizer application.
- Thus given a total of six treatments arranged in completely randomized design and replicated three times per vegetable.



Materials and Methods

- **Preparation of aqueous extract of *Vernonia amygdalina***
- 2.225 Kg of fresh leaves of *Vernonia amygdalina* harvested, pounded in a mortar manually, the
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- Macerated leaves was rinsed severally with a total of 9000 ml of tap water and sieved to obtain the extract (1 g of leaves to 4 ml of water).
- The extract was stored in plastic bottles for 7 days under room temperature before application. The moisture content of the leaves was 14.7%. Sample of the aqueous extract was then taken to the laboratory for chemical analysis.



Materials and Methods

- **Planting of vegetables and application of treatments**
 - *Seven (7) kg of homogenized sandy loam soil each was put in 54 plastic pots and watered to field capacity.
 - *The three leafy vegetables were planted in 18 pots each.
 - *The seed rate for each was 0.5g/pot, 0.3g/pot and 0.2 g/pot for cochorus, celosia and amaranthus respectively.
 - *The seeds of the vegetables were sown on the 13th of October, 2017.



Materials and Methods

- The liquid extract was applied at the rate of 50, 150 or 250 ml per pot one week after planting of seeds.
- Chemical fertilizer was applied 2 weeks after planting at the rate of 0.78g and 1.55g per pot representing 37.8 Kg/ha and 75 Kg/ha respectively of N, P₂O₅ and K₂O/ha using NPK 15:15:15.
- Quantity applied per pot was arrived at by using the weight of soil per hectare furrow slice (2.26×10^6).



Materials and Methods

- **Data collection and statistical analysis**
- Data were collected on
 - Plant height was taken using a meter rule,
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- Fresh and dry weight per plant were measured by weighing using a sensitive scale before and after oven drying to stable weight, the value for each parameter was average measured from two plants per pot.
- The data collected were analyzed using analysis of variance; significant means were separated using least significant difference (LSD). Genstat statistical package was used for the analysis.



RESULTS

- **Chemical analysis of the soil and Vernonia amygdalina extract used for the trial**
- The results of the pre planting physico-chemical analysis of the soil used for the study showed that the soil is **sandy** (91.4%, 3.8% and 4.8% for sand silt and clay respectively). Percentage **nitrogen was 0.07**, available **P was 6.78 mg/g**, pH 6.7, Na, **K**, Ca, Mg were 0.26, **0.43**, 2.04 and 0.54 (all in cmolkg⁻¹) respectively.
- The results of the laboratory analysis of the VA leaf extract use for the trial on the other hand showed that the concentration of **potassium (K)** was the highest in the extract: **877.21 mg/l**; while **nitrogen** and **phosphorus**, calcium and magnesium were **122.42**, **70.09**, 24.22 and 11.89 mg/l respectively.



Table 1: Some physical and chemical properties of the soil before planting

Parameters determined	Quantity/Value
pH	6.71
Na (cmolkg ⁻¹)	0.26
K (cmolkg ⁻¹)	0.43
Ca (cmolkg ⁻¹)	2.04
Mg (cmolkg ⁻¹)	0.54
Al+H (cmol kg ⁻¹)	0.08
Total Organic Carbon (%)	0.59
Total Nitrogen (%)	0.07
Sand (%)	91.4
Silt (%)	3.8
Clay (%)	4.8
Available P (mg/kg)	6.78
Textural Class	Sandy

Table2. Laboratory analysis of aqueous extract of leaves of *Vernonia amygdalina*

Nutrient	Value(mg/l)
Nitrogen	122.42
Phosphorus	70.09
Potassium	877.21
Calcium	24.22
Magnesium	11.89

RESULTS

- **Growth of vegetable amaranth, *Celosia argentea* and *Cochorus olitorius* as influenced by rates of aqueous extract of leaves of *Vernonia amygdalina* and NPK fertilizer are presented in Tables 1,2 and 3 respectively.**



Table 3. Growth of vegetable amaranth as influenced by rates of aqueous extract of leaves of *Vernonia amygdalina* and NPK fertilizer at different weeks after planting (WAP)

Treatment	Plant height (cm)			Fresh weight (g/plant)				Dry weight (g/plant)			
	4	5	6	3	4	5	6	3	4	5	6
500ml VA	9.0	14.6	21.7	0.34	1.00	1.44	2.62	0.05	0.13	0.48	0.52
250ml VA	10.0	9.3	12.0	0.27	0.79	1.01	1.46	0.06	0.08	0.27	0.40
150ml VA	5.7	9.3	10.3	0.27	0.66	0.77	0.79	0.06	0.09	0.16	0.43
No Fert.	5.7	6.7	7.67	0.26	0.41	0.62	0.48	0.07	0.06	0.15	0.25
0.78g NPK15:15:1 5	14.7	18.7	20.0	0.51	1.35	2.32	2.62	0.07	0.23	0.52	0.58
1.55g NPK15:15:1 5	11.0	24.3	27.7	0.57	2.16	3.34	4.11	0.10	0.27	1.35	1.16
LSD (p=0.05)	4.36	4.42	2.22	0.18	0.28	0.48	0.86	0.03	0.05	0.24	0.19

500ml VA= 500ml of *Vernonia amygdalina* leaf extract per pot, No fert.= No fertilize

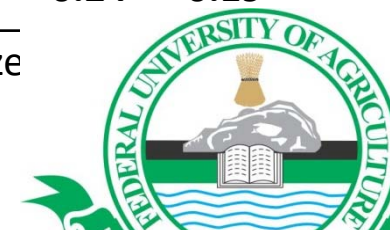


Table 4. Growth of *Celosia argentea* as influenced by rates of aqueous extract of leaves of *Vernonia amygdalina* and NPK fertilizer at different weeks after planting (WAP)

Treatment	Plant height (cm)			Fresh weight (g/plant)				Dry weight (g/plant)			
	4	5	6	3	4	5	6	3	4	5	6
500ml VA	12.3	20.0	22.0	0.42	0.67	3.91	4.22	0.06	0.16	0.26	0.69
250ml VA	13.0	13.7	20.3	0.38	0.63	1.47	1.71	0.07	0.10	0.22	0.36
150ml VA	10.3	12.3	16.7	0.37	0.59	1.45	1.92	0.07	0.14	0.23	0.33
No Fert.	9.0	11.3	14.0	0.33	0.44	0.80	1.49	0.06	0.11	0.15	0.23
0.78g NPK15:15: 15	15.0	19.3	26.7	0.72	1.77	3.21	3.09	0.09	0.29	0.46	0.36
1.55g NPK15:15: 15	16.0	24.7	37.3	0.78	1.91	5.67	5.52	0.43	0.28	0.71	0.54
LSD (p=0.05)	3.82	4.46	2.65	0.13	0.80	1.18	0.98	Ns	0.08	0.09	0.17

500ml VA = 500ml of *Vernonia amygdalina* leaf extract per pot, No fert.= No fertilizer

Table 5. Growth of *Cochorus olitorius* as influenced by rates of aqueous extract of leaves of *Vernonia amygdalina* and NPK fertilizer at different weeks after planting (WAP)

Treatment	Plant height (cm)			Fresh weight (g/plant)			Dry weight (g/plant)				
	4	5	6	3	4	5	6	3	4	5	6
500ml VA	19.7	26.3	31.67	0.67	1.05	2.05	2.20	0.09	0.08	0.33	0.41
250ml VA	19.0	23.7	28.3	0.49	0.67	0.99	2.02	0.08	0.05	0.30	0.33
150ml VA	16.0	22.3	27.7	0.41	0.41	0.90	1.19	0.04	0.05	0.27	0.25
No Fert.	15.7	20.3	26.0	0.34	0.34	0.87	0.74	0.01	0.01	0.20	0.21
0.78g NPK15:15 :15	28.3	36.7	41.3	0.76	0.76	2.27	2.42	0.09	0.12	0.54	0.48
1.55g NPK15:15 :15	32.0	43.0	48.7	0.93	0.93	3.32	4.11	0.10	0.19	0.66	0.81
LSD (p=0.05)	8.31	4.51	2.97	0.12	0.12	0.42	0.78	0.02	0.05	0.11	0.12

500ml VA = 500ml of *Vernonia amygdalina* leaf extract per pot, No fert.= No fertilizer

Summary of results

- Across the three types of vegetables, application of 500ml/pot of VA extract produced plants that were as tall as those that received 0.78g/pot (37.8 Kg N,P and K /ha) ($p>0.05$), while the least plant height was recorded from the plants without fertilizer application ($p<0.05$).
- The observation made on plant height was similar for both fresh and dry weight across the three vegetables.
- The exceptions however were that at 6 WAP celosia plant that received 500ml of VA had dry weight that was at par ($p>0.05$) with that which received 1.55g/pot of NPK 15:15:15.



Summary of results

- While for **cohorus** and **amaranthus** dry weight of plants that received 500ml of VA were at par ($p>0.05$) with those that received 0.78g/pot of NPK 15:15:15. The trend observed for the dry weight is similar to that observed for the dry weight.
- However, the third control (check) that received 1.55g of N: P:K per pot (equivalent to 75 kg/ha of each nutrient element) produced plants that were superior ($p<0.05$) in the growth parameters.



Conclusion

- The response of the growth parameters of the three leafy vegetables in this study revealed that aqueous extract of *V. amygdalina* can be used intentionally as a nutrient source in organic cropping systems.
 - *This was proven by similar response of growth parameters of the three vegetables.
 - *Further studies will however be needed to ascertain the economic feasibility of the usage in large scale in terms of the number of the plants that will supply certain quantity of nutrients per a given area and better processing methods of the leaves to get the extract.



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- THANKS FOR YOUR ATTENTION

- **MERCI**

