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Determination of Appropriate Placement Method of Poultry Droppings and Harvesting Frequency on Performance of Malabar Spinach *(Basella Rubra)* in Oyo, Oyo State

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Abstract

A lot of experiments have been conducted on rate of fertilizer application on various crops but information was scanty on the placement method especially on Basella rubra. Thus this experiment was conducted to determine appropriate placement method of poultry droppings and frequency of harvesting on yield of B. rubra at Oyo, Oyo State. The experiment was laid in a completely randomized design with three replications. The treatments were T_1 – Total harvesting, No application; T_2 – Total harvesting, mixed application; T_3 – Total harvesting, surface application; T_4 – Every 2 week harvesting, no application; T_5 – Every 2 week harvesting, mixed application; T_6 – Every 2 week, surface application; T_7 – Every 3 week, no application; T_8 – Every 3 week, mixed application; T_9 – Every 3 week, surface application. In the course of the experiment, observations were made and data were collected at 5 and 6 weeks after treatment and data were also collected on frequencies of harvesting on total harvest, every 2 week harvest and every 3 week harvest. The significant means were separated using Duncan Multiple Range Test at 5% level of probability. It was revealed that $T_9(H_2P_2)$ that is every 3 week harvesting, surface application performed best when compared with other treatments.

Keywords: *Malabar spinach, Basella rubra, frequency, placement, surface and mixed.*

Introduction

Indian spinach (*Basella rubra*) is cultivated for its young succulent vine-like shoots and leaves which are relatively high in food value. Basella rubra originated from India and are commonly referred to as Malabar Spinach. It is a tender and fast growing succulent climbing tropical vine with thick fleshy bright red/dark purple stems with green leaves. It is used extensively in Thai cuisine. It grows up to 12 feet tall. The succulent heart shaped leaves with petioles and tender stems are three to seven inches in length and are bright glossy green on both sides. The stem and veins in the leaves are purple red in colour while leaves are dark green. The flowers are white, purple or red and are followed by small purple coloured berries (Sakthi, 2012). The leaves can be used raw in Salad, stir-fried, steamed, boiled and cooked with other vegetables, omelet, meat and sea food. Since the leaves have succulent mucilage, it can be used as a thickener while making soups. Only the leaves and the young stem are eaten. It is a rich source of vitamin A, protein and iron. The leaves are used as an analgesic, anti-fungal to sooth burns and skin irritation as a treatment of anemia, to treat diarrhea and cold. The berries are used to make dyes and food colour (Sakthi, 2012). Farmers grow it because of its high water content and fibre which provides essential roughage. It has positive effects on human health as it reduces some chronic diseases such as hypertension and it is highly desired for use as a traditional medicinal plant particularly for treating hypertension (Baynes, 1991). The juice from the fruits is used sometimes as food colouring while the dark red juice is used as both dye and ink in ancient China.

Basella alba, commonly referred to as Indian spinach belong to the family basellaceae. It is a fast growing leafy vegetable, native to tropical Asia (India or Indonasia) and extremely heat tolerant (Grubben & Denton, 2004). The two specific names associated with basella are often noticeable and distinguished by foliage colouration, the rubra which

has deeply red foliage colour, and its green form which is sometimes distinguished by the name alba (Facciola, 1990; Denton & Olufolaji, 2000).
The cultivation of Basella alba or B. rubra requires proper supply of plant nutrient. This requirement can be provided by applying inorganic fertilizer or organic manure or both. Organic manure improves soil structure as well as increase its water holding capacity. Moreover, it facilitates aeration in soil. Recently, organic farming is appreciated by vegetable consumers as it enhances quality of the produce. Nowadays, people are willing to get the vegetable without the inorganic fertilizer, because they are suffering from serious diseases which are due to the bad effects of inorganic fertilizer. A number of agronomic practices have been found to affect the yield of vegetable crops (Boztok, 1985). Basella can grow under moderate soil fertility but production is enhanced with application of fertilizers either organic or inorganic form added to supply one or more plant nutrienet essential for the growth and it is a major limiting nutrient for crop production (Pionke, Sharma and Hirschberg, 1990). High nitrogen level application reduces fruit size due to growth of vegetative matter in leafy vegetables which may shift sink to the leaves instead of the recemes (Kirimi, Italya and Mwaja, 2011). Application of 10t/ha of poultry manure increased the yield of Basella alba (Adedeji, 2014). A basal dressing of 20-30 ton/ha of farmyard manure and 60:60:40 kg of NPK/ha to be applied before transplanting/sowing. Nitrogen is essential for optimal growth (Sakthi, 2012). Salami and Babajide (2015) asserted that weekly harvesting of *Basella alba* under improved soil amendment with poultry manure application at 3.0 tons ha^{-1} is most suitable for improved performance of *Basella alba* in the guinea savanna. The yield obtained in their experiment was 1,774 kg ha^{-1}

Basella rubra commonly grown for its leaves and young shoots, which are high in vitamins, A, B and C and minerals such as iron and calcium (Gruben & Denton, 2004). Basella rubra is usually ready for harvest in 30-45 days after planting. Plant may be harvested once or several times (Grubben, 1997). Once-over harvest is adapted for early maturing and quick growing varieties. Stems or shoots 15-25 cm in length are cut close to the ground, washed and tied in bundles. With multiple harvest, young leaves and shoots are picked at weekly intervals. Frequent harvesting delays flowering and stimulate growth of the side shoots. When plants are not regularly harvested side shoots develop into longer vines thus there is a need to support long vine with trellis (Ken, 1997). A short term crop yields up to 40 t/ha in 75 days, for long term crops, yields are very

variable, up to 1.5 kg of shoot or leaves per plant or 80 t/ha in 180 days. Yield of 20-50 t/ha per month of cultivation have been reported (Palada & Crossman, 1999).

In Nigeria, Basella rubra is an unexploited leafy vegetables, though it has much desired for supply of protein, vitamins and mineral nutrients vital for healthy growth in human diets. Moreover, most local farmers grow Basella in backyards along water drains or in water logged areas for off-season vegetable supplies and apply manure and harvest without any records of method of application or placement as well as frequency of harvest thus the aim of this study is to determine the appropriate placement method of poultry droppings (nitrogen source) and harvesting frequency on performance of *Basella rubra* in the study area.

Materials and Methods

Experimental Location

The experiment was conducted at the Agronomy Unit of the Teaching and Research Farms, Emmanual Alayande College of Education, Oyo, Oyo State, Nigeria. Oyo lies on the longitude $3^0$57' East and latitude $7^0$51' North of equator. The altitude is between 300 and 600 metres above the sea level. The vegetation of the area is guninea savannah zone dominated by grasses and herbaceous plant and sparsely dominated by trees and shrubs. The means of annual temperature and rainfall are about 27^0C and 1,165 mm respectively (Iwena, 2012).

Nursery establishment and soil preparation

Land clearing was carried out manually by making use of simple farm tools such as hoe, cutlass, mattock, rake, etc. Nursery bed was prepared which can be of any length while its width is 1 m because of easy weeding. The soil on the surface of nursery bed was removed and level with gravel at a depth of 5 cm for easy drainage. Standard good soil produced by mixture of top soil collected under the tree between 0-15 cm depth, clayey soil and sandy soil together in 3:2:1 (3 basins of top soil, 2 basins of clayey soil and sandy soil) respectively. The soil was firstly airdried and sieved through 2 mm sieve in order to remove stone and debris from the soil. It is called standard good soil require for seed bed preparation. Standard good soil prepared for nursery bed was mixed with

fully decomposed poultry droppings and used to fill at depth of 10-15 cm. Wetting was done before planting.

Experimental Layout

The experiment was 3 x 3 factorial that is three levels of harvesting frequencies and three levels of placement totaling nine (9) treatment combinations. The experiment was laid in a completely randomized design with three replicates and arranged on the welded iron. The soil used for the experiment was collected in various locations at the teaching and research farms, airdried and bulked. A soil mass of 8 kg was filled into each polyethylene bag. The total number of treatment combinations was nine (9) and each treatment was replicated three times and the rate of application was 3,000 kg ha^{-1} as established by (Salami & Babajide, 2015) in the study area. The implication is that each unit as regards surface and mixed application will received 500 g measure of poultry droppings at a concentration of 3% N in the fertilizing material.

Treatments Factors:

(1) *Harvesting frequencies*

Levels: (H0 - Total harvesting; H1 – Every 2 week harvesting; H2 – Every 3 week harvesting).

(2) *Placement*

Levels: (P0 – No application; P1 – Mixed application; P2 – Surface application)

Treatment Combinations

T_1	-	**H_0P_0 (Total harvesting, no application)**
T_2	-	H_0P_1 (Total harvesting, mixed application)
T_3	-	H_0P_2 (Total harvesting, surface application)
T_4	-	H_1P_0 (Every two week harvesting, no application)
T_5	-	H_1P_1 (Every two week harvesting, mixed application)
T_6	-	H_1P_2 (Every two week harvesting, surface application)
T_7	-	H_2P_0 (Every three week harvesting, no application)
T_8	-	H_2P_1 (Every three week harvesting, mixed application)
T_9	-	H_2P_2 (Every three week harvesting, surface application)

Data Collection

Data collection on growth parameters were carried out at five (5) weeks after transplanting on the number of leaves and branches (by direct counting of all well opened leaves and developed branches per plant); Stem diameter (using Vernier Calipers) and plant height using tape rule. After which, the three (3) harvesting frequencies were introduced. At every harvest, the harvested fresh shoot of Basella rubra were weighed using electronic pocket scale, EHA 251 Camry and the values were recorded cumulatively.

Data Analysis

Data collected on growth and yield parameters were analysed using Analysis of Variance (ANOVA) at $P<0.05$ and significant means were separated using Duncan Multiple Range Test (DMRT) in accordance with SAS (2013).

RESULTS AND DISCUSSION

Table 1: Physico-chemical properties of the soil used.

Properties	**Values**
pH (H_2O)	6.39
N (%)	1.01
P (mg kg^{-1})	12.45
K (cmol kg^{-1})	0.10
Ca (cmol kg^{-1})	1.16
Mg (cmol kg^{-1})	0.49
Fe (mg kg^{-1})	9.69
Zn (mg kg^{-1})	5.38
Cu (mg kg^{-1})	3.42
Organic carbon (%)	1.03
Sand (%)	88.00
Silt (%)	7.30
Clay (%)	2.70
Textural class	Sandy-loam

Table 2: Chemical properties of the poultry droppings used.

Properties	**Values**
pH (H_2O)	6.03

N (%)	3.04
P (%)	0.61
K (%)	1.34
Ca (g kg^{-1})	6.62
Mg (g kg^{-1})	1.12
Fe (mg kg^{-1})	9.69
Zn (mg kg^{-1})	155.28
Cu (mg kg^{-1})	31.42
Organic C (g kg^{-1})	30.45

The chemical analyses of the poultry manure showed that the manure was acidic (mildly) with a pH value of 6.03 The nitrogen level was relatively high (3.04%) compared to P (0.61%) and K(1.34%). Other nutrient concentrations determined were Ca, Mg, Fe, Zn, Cu and organic C with the values of 6.62 g kg^{-1}, 1.12 g kg^{-1}, 9.69 mg kg^{-1}, 155.28 mg kg^{-1}, 31.42 mg kg^{-1}, 30.45 g kg^{-1} respectively.

The results from the pre-cropping physical and chemical soil analyses revealed that the soil was mildly-acidic (Table 1) and texturally sandy-loam (sand, 88.00%, silt, 7.30%, and clay, 2.70%), pH, 6.39, N, 1.01%), available P, (12.45 mg kg^{-1}) and exchangeable bases (cmol kg^{-1}), K, 0.10, Ca, 1.16 and Mg, 0.49), (mg kg^{-1}), Fe, 9.69, Zn, 5.38, Cu, 3.42) and organic carbon, 1.03%. These results agreed with Babajide et al., (2008; 2012), who reported that soils at guinea savanna ecoregion area were slightly acidic and were grossly low in nutrient concentrations for sustainable crop production. The results of these analyses was in line with report of Akanbi, (2002) and Babajide and Salami (2012) who viewed relatively high nitrogen concentration in poultry manure.

Table 3: Effects of placement methods of poultry droppings and frequencies of harvesting on growth and shoot yield of Basella rubra at six and twelve weeks after transplanting for growth and shoot yield respectively at (P = 5%)

Treatments	*Plant Height (cm)*	*Stem Diameter (cm plant^{-1})*	*Number of Branches (plant^{-1})*	*Number of Leaves (Plant^{-1})*	*Cumulative shoot weight (g treatment^{-1})*
T_1 - (H_0P_0)	22.23^{bcd}±0.79	7.77^{bc}±6.30	2.0^{b}±0.58	13.00^{b}±0.40	106.17^{b}±4.48
T_2 - (H_0P_1)	13.67^{cd}±2.49	5.90^{cde}±0.99	2.0^{b}±0.07	11.0^{bc}±0.31	200.33^{ab}±5.67
T_3 - (H_0P_2)	29.10^{b}±0.79.	10.13^{ab}±0.57	8.0^{a}±0.11	14.0^{b}±0.30	227.37^{ab}±3.48
T_4 - (H_1P_0)	25.23^{bcd}±1.58	7.90^{bc}±0.49	3.0^{b}±0.20	14.0^{b}±0.31	89.93^{c}±5.24
T_5 - (H_1P_1)	12.43^{d}±2.77	5.00^{de}±1.25	1.0^{a}±0.01	10.0^{c}±0.71	118.03^{b}±3.78
T_6 - (H_1P_2)	26.83^{bcd}±0.83	9.77^{ab}±0.62	9.0±1.07	13.0^{b}±0.31	202.00^{ab}±4.48
T_7 - (H_2P_0)	21.63^{bcd}±1.33	7.53^{bcd}±0.79	1.0^{a}±0.11	14.0^{a}±0.41	95.50^{c}±3.48
T_8 - (H_2P_1)	12.80^{d}±2.27	4.87^{e}±0.87	3.0^{b}±0.04	10.0^{c}±0.31	121.63^{b}±5.48
T_9 - (H_2P_2)	46.10^{a}±10.85	11.50^{a}±0.76	10.0^{a}±0.21	17.0^{a}±0.91	285.27^{a}±6.84
Number of Observations - 27					

Note: *T_1 - H_0P_0 - (Total harvesting, no application); T_2 - H_0P_1 (Total harvesting, mixed application); T_3 - H_0P_2 (Total harvesting, surface application); T_4 - H_1P_0 (Every two week harvesting, no application); T_5 - H_1P_1 (Every two week harvesting, mixed application); T_6 - H_1P_2 (Every two week harvesting, surface application); T_7 - H_2P_0 (Every three week harvesting, no application); T_8 - H_2P_1 (Every three week harvesting, mixed application); T_9 - H_2P_2 (Every three week harvesting, surface application).*

DISCUSSION

The result obtained in the study area state that the highest total cumulative value of fresh shoot yield of Basella rubra was 285.27 g and the result was not correlated with that of Salami and Babajide (2015) who reported that the highest total cumulative value of fresh shoot yield of Indian Spinach was 177.40 g in the study area. This result was not also in consonance with Palada and Crossman, 1999 who reported yield of 20-50 t/ha per month of cultivation.

SUMMARY AND CONCLUSION

The experiment was conducted at the Agronomy Unit of the Teaching and Research Farms, Emmanuel Alayande College of Education, Oyo, Oyo State

Nigeria to determine the effects poultry droppings placement methods and frequencies of harvesting on growth and shoot yield of Basella rubra. The experiment was a 3 x 3 factorial layout in completely randomized design (CRD) with three replicates. The statistical analysis obtained from the experiments showed that poultry droppings placement and frequencies of harvesting have significant effect on the growth and shoot yield of Basella. It was concluded after the experiment that T_9 (H_2P_2) which is every three (3) weeks harvesting with surface application performed best with cumulative yield of 285.27g per plant estimated to be 2,850 kg ha^{-1} for the period of the experiment. The result obtained resulted from direct release of nutrient to root zone and maximum utilization of same by the plant via hydraulic conductivity of the nutrient material used in the soil.

RECOMMENDATION

From the result obtained from Table 3 which showed the superiority of T_9(H_2P_2) which is every three weeks with surface application. Therefore, in this experiment, the treatment should be encouraged while all other treatments should be discouraged in the study area.

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