

Enhancing Dry Season Production of Indian Spinach (*Basella Alba*) Through Fertigation

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Abstract

Optimum and qualitative production of vegetables in the depleted soils during the dry season are best achieved through fertigation. Two experiments were concurrently conducted in 2010 to determine the effect of fertigated poultry manure on the vegetative growth and nutritional quality of Indian Spinach (*Basella alba*) in South Western Nigeria. Poultry manure rates at 0 (P_0+W), 5 (P_1+W), 10 (P_2+W), 15 (P_3+W) and 20 t/ha (P_4+W) were each diluted with 6,000 litres of water per hectare and the plots were arranged on a complete Randomized Block Design with four replications. The plot that had no manure but irrigated with 6,000 litres of water served as control. Compared with control, all the treatments significantly increased *Basella* height, leaf area, wet leaf weight and dry matter yield. The percentage increase in the leaf area of *Basella alba* were $P_1 + W$ (0.68%), $P_2 + W$ (6.48%), $P_3 + W$ (10%) and $P_4 + W$ (25.95%). Accumulation of crude protein, fat and ash were highest in $P_3 + W$ and were respectively 19.47, 4.34 and 13.49%. Crude fiber and dry matter yield were highest in $P_4 + W$ with increase of 15.3 and 0.1% respectively. Treatment P_1+W had the highest carbohydrate with percentage increase of 18.51%.

Key words: Poultry manure, Moisture, Crude protein, fat, carbohydrate.

Introduction

Vegetables attract more prices during the dry season when they are short of market supply than during the raining seasons termed glut season. Vegetables are naturally found everywhere as weeds during the wet season because of adequate moisture supply. Indian Spinach is one of the cherished but scarce vegetables during the dry season in southern Nigeria.

Among the importance of Indian spinach is its richness in vitamins A and C, low less calories or highness in calories compared with other vegetables (Grubben and Denton, 2004). It is very good as laxative; its high water content and fiber provide roughage for human diet. It sometimes locally used to treat hypertensive patients. The young leaves of Indian spinach are good as salad.

It is advisable to grow Indian spinach during the dry season by farmers who intend to grow the crop for sale. The two major problems allayed by farmers are the inherent low nutrients supply by the native soil and inadequate moisture supply. Fertilization and irrigation are the two agronomic measures that can be used to solve the problems of nutrients deficiency and shortage of water for the production of the crop. Hebber *et al.* (2004) observed higher yield in tomato fruit through fertigation than irrigation alone.

Poultry manure could be an excellent source of nutrients for Bassella as it has been extensively used for the production of other crops such as maize, Amaranth, tomato e.t.c (Ayeni *et al*, 2010, Makinde *et al* (2011). In order to minimize cost and make the poultry manure readily soluble and effective as source of fertilizer; there is need to dilute poultry manure with water, a process called fertigation. Hence, the objective of this work was to determine the effect of fertigation on the growth, vegetative yield and nutritional quality of Indian Spinach (*Basella alba*) in Southern Nigeria.

Materials and Methods

Two experiments were concurrently carried out at Adeyemi College of Education and Fagun both located in Ondo southwestern Nigeria in 2010 to determine the effect of fertigation of poultry manure on growth and nutritional quality of *Basella alba*.

The initial soil chemical properties of the soil used for the study at the two locations and the nutrient composition of poultry manure were collected, sieved and analysed with the normal analytic procedures set out by Association of Analytical Chemist (AOAC, (1990)

The land was cleared, harrowed, pegged and ridged. Twenty plots of size 5m x 5m with 1m discard area were made in each location.. The experiment was laid out in a randomized complete block design with four replications.

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69 The seeds of Indian Spinach were collected from the local farmers. The seeds were sown
70 directly in the field at a spacing of 1m x 1m, four seeds were sown per drill and thinned to
71 one plant per stand.

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73 Poultry manure at 0 (P_0+W), 5 (P_1+W), 10 (P_2+W), 15(P_3+W) and 20 (P_4+W) t/ha were
74 calculated per plot and mixed with equal amount of water as 6,000 litres of water /ha. There
75 was a plot that was planted with *Basella alba* without any treatment application (that is no
76 poultry manure and no water applied). This plot was discarded at the middle of the
77 experiment since all the *Basella alba* sown on this plot wilted before the data collection
78 There was another plant irrigated with water but without poultry manure which served as
79 control ($P_0 +W$). There were five treatment replicated four times to make a total sum of
80 twenty four ridges. The whole plots were irrigated with clean water for three weeks before
81 the treatments were applied. The treatments were applied for two weeks.

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83 The poultry manure used for the experiment was collected from abattoir and mixed with
84 water and kept in dry cool room in the laboratory. The treatments were applied daily for two
85 consecutive weeks after planting. Each basella plant was staked.

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87 Data such as plant height, leaf area dry matter yield, fresh stem and root weight were
88 determined two weeks after the completion of treatment application. The leafs were collected
89 from each plant/plot and bagged in brown envelope for the determination of the nutritional
90 quality of *Basella alba*. The leaf area was determined by graphical method and calculated in
91 cm^2 . Fresh leaf weight was determined by cutting the fresh leaf/plant weekly, weighed with
92 sensitive scale and recorded. The cumulative weight of the leaves per plot was used to
93 determine the fresh leaf weight.

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95 . The fresh leaves were washed and rinsed with the distilled water and dried in the oven at
96 65°C . The leaves were digested with 10ml of concentrated H_2SO_4 in the presence of selenium
97 catalyst before the distillation and titration processes were carried out. The crude protein of
98 *Basella alba* was determined by kjedahl method. The N content was determined and
99 multiplied by 6.25 to get the crude protein

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The crude fibre content of *Basella alba* leaves was analyzed by weighting 5.0g of the sample into 500g conical flask and boiled gently with 1.25% H_2SO_4 and 1.25% of N_4OH . The residue from the filtrate of the digest was dried in the oven at $105^{\circ}C$, cooled in desiccators and weighed. This was also placed in the muffle furnace at about $300^{\circ}C$ for 30 minutes, cooled and re-weighed. Percentage crude fibre was calculated by deducting the weight of the crucible and the sample after furnace from the weight of crucible and wet sample divided by weight of the sample used and multiplied by 100. Soxhlet extraction method was used to extract crude fibre. The percentage crude fibre was calculated by subtracting weight of the sample after extraction from the weight of the sample used and multiplied by 100.

The total ash content of *Basella alba* was determined by ashing the leaves until the ash became whitish in colour. The crucible and the content were re-weighed and calculated in percentage. The percentage moisture content was calculated by deducting oven dried weight of leaves from the fresh weight and multiplied by 100.

Carbohydrate content of *Basella alba* was determined by deducting the sum of ash, protein, crude fibre and fat from 100 on dry matter basis.

Data Analysis

The data obtained were subjected to analysis of variance and the means were separated by fishers at 5% level of probability.

Result and Discussion

Before the conduct of the experiments, the soil nutrient status of Adeyemi College of Education (ACE) consisted of pH 5.92, N, 0.09%, P 6.23 mg/kg, K 0.12c mol/kg, Ca 0.27 C mol/kg and Mg 0.19 C mol/kg. while Fagun soil consisted of Ph 6.0, N 0.16%, P 6.38 mg/kg, K 0.14 C mol/kg, Ca 2.13 C mol/kg, and Mg 0.83 C mol/kg. This shows that the two soils were deficient in major nutrients hence; they needed additional supply of plant nutrients.

Analysis of poultry manure used for the conduct of the experiments showed that it contained 1.85, 1.24, 3.95, 3.63, and 0.92% for OC, N, P, K, Ca and Mg respectively. This shows that the poultry manure was likely to add the essential nutrients to the soil.

The effect of poultry manure at different rates combined with fixed water rate of 6,000 litres/ha on growth, yield and nutritional quality of *Basella alba*. are presented in tables 1 and 2. Compared with control, 5 t/ha of poultry manure dissolved in 6,000 litres of water/ha (P₁), 10 t/ha of poultry manure dissolved in 6,000 litres of water (P₂), 15 t/ha of poultry manure dissolved in 6,000 litres of water (P₃) and 20 t/ha poultry manure dissolved in 6,000 litres of water (P₄) significantly increased ($P<0.05$) basella height, wet stem weight and wet root weight (Table) while there was no significant different in the basella leaf area among the treatments.

The better performance of *Basella alba* fertigated with poultry manure and water might be traced to the adequate nutrients supplied by the poultry manure and the adequate water supplied. Adequate nutrients, air and moisture are known to provide good medium of growth for plants (Haggin and Lowengart, 1996).

The major problem of vegetable during the dry season is inadequate supply of moisture. Water also helps in the mineralisation of plant nutrients in the soil. The highest growth parameters recorded by P₄ might be the highest nutrient released by poultry manure.

The *Basella alba* without manure and water application clearly showed the significant effect of water on growth and yield of the crop as all of the plants wilted before harvesting. Also, the growth and yield of *Basella alba* watered without poultry manure had lower yield compared with the fertigated plants. This shows that there is synergistic relationship between poultry manure and water in *Basella alba* production as evident in this experiment.

The percentage increase in the leaf area of *Basella alba* compared with control were P₁ (0.68%), P₂ (6.47%), P₃ (10%) and P₄(25.95%). The percentage change in the leaf area of *Basella alba* fertigated compared with control indicated that application of 20 t/ha poultry manure mixed with 6,000 litres of water/ha. This shows that application of 20t/ha poultry manure + 6,000 litres of water during the dry season is economical where poultry manure is abundant like the urban cities of southwestern Nigeria where poultry dung is dumped beside the road.

Compared with control (P₀), treatments P₁+W, P₂+W, P₃+W and P₄+W significantly increased crude protein, fat and fibre content of *Basella alba* Fertigation had influenced on nutritional quality of *Basella alba*. Accumulation of protein, crude fat and ash were highest in

P₃+W and were respectively 19.47, 4.34 and 13.49% why accumulation of carbohydrate was highest in P₁+W with percentage increase of 18.51%.

Crude fibre and dry matter yield were highest in plots fertigated with 20 t/ha poultry manure. P₁ had the highest moisture.

Adequate supply of N, P, and K, by 10 t/ha poultry manure mixed with 6,000 t/ha water might have led to highest accumulation of protein and fat contents of *Basella alba* grown in this medium. Makinde *et al* (2011) observed that adequate supply of N, P, K, Ca and Mg enhanced their uptake by *Amaranthus cruentus* in the experiment conducted to show the effects of organic, organomineral and NPK fertilizers on the nutrient uptake of *Amaranthus Cruentus*. Also, Makinde *et al* (2010) observed that organic manure increased accumulation of protein, fat and crude fibre in *Amaranthus cruentus*. Grubben nad Dentus (2004) observed that *Basella alba* thrives well in soils that are rich in organic manure. Zakaria and Vimala (2002) and Sunassee (2001) observed increase in yields of vegetables crops with application of poultry of manure.

Table 1: Growth of *Basella alba* as affected by fertigation (ACE and Fagun sites)

Treatment	height	Leaf Area cm ²	Wet leaf weight ----- g/plant-----	Root wet	Stover Yield
P ₀ +W	29.43	19.00	206.93	15.70	195.13
P ₁ +W	52.13	19.13	214.23	16.77	202.37
P ₂ +W	61.67	22.23	283.10	21.67	268.13
P ₃ +W	65.23	20.90	278.10	18.93	263.20
P ₄ +W	75.67	23.93	234.46	16.17	223.07
Lsd(0.05)	5.12	2.00	11.07	ns	7.03

P = poultry manure

W = water

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195 Table 2: Nutritional quality of *Basella alba* as influenced by fertigation (ACE and Fagun
196 sites)

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198Treatment	Protein	Fat	Crude Fibre	Total ash	carbohydrate	Moisture	Dry Matter
199P ₀ +W	16.79	3.89	17.38	13.21	43.25	9.46	90.54
200P ₁ +W	13.38	3.76	19.13	12.62	51.21	9.57	90.43
201P ₂ +W	17.92	4.05	18.86	13.18	45.99	9.39	90.61
202P ₃ +W	19.47	4.34	19.61	13.49	43.09	9.51	90.49
203P ₄ +W	18.65	3.95	20.08	12.76	44.56	9.37	90.63
204LSD(0.05)	1.10	1.02	0.91	NS	3.45	NS	NS

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206 P = poultry manure

207 W = water

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