

## **Growth and Productivity of *Vernonia hymenolepis* A. Rich. Under Different Plant Densities and Spacing Configurations**

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**Abstract:** *Vernonia hymenolepis* A. Rich. (Asteraceae) is a popular indigenous leafy vegetable in southwestern Cameroon, where its production is an important economic activity among the women. Production hardly meets the market demand due to inappropriate production technology amongst other factors. A study to establish an optimal plant density and configuration for this crop was carried out during the wet seasons of 2002 and 2003. Based on the spacing in a broadcast planting of the crop on farmers' fields, two plant densities, 20 plants  $\text{m}^{-2}$  and 25 plants  $\text{m}^{-2}$  were each assessed using two spacing configurations for growth and productivity in randomized complete block design. Growth rate was higher for the high at plant density than the lower. Growth rate was the highest at 6 weeks after transplanting, with the 20 cm x 20 cm spacing being the highest. Estimates of the leaf area index (LAI) were higher at the high plant density where they ranged from 16.5 to 22.5 than at the low plant density with a range of 8.2 to 9.4. Although the leaf area ratio estimates were the highest for the high plant density there were no significant differences ( $P = 0.05$ ) among the treatments. Dry matter yield ranged from 5.2 tons  $\text{ha}^{-1}$  in the 50 cm x 10 cm low plant spacing to about 12 tons  $\text{ha}^{-1}$  in the 20 cm x 20 cm high plant spacing. The results indicate that high plant density in a square configurations has a better performance than the low-density spacing and is therefore recommended for *V. hymenolepis*

**Key words:** *Vernonia hymenolepis* • plant density • spacing configuration • growth

### **INTRODUCTION**

*Vernonia hymenolepis* A. Rich. (Asteraceae) is a popular indigenous leafy vegetable cultivated in Cameroon and other west and central African countries. It is frequently preferred to the three other cultivated species-*Vernonia amygdalina* Del., *Vernonia colorata* (Willd.) Drake and *Vernonia thomsoniana* Oliv. and Hiern.-because of its reduced bitterness and is often referred to as "sweet bitter leaf" [1]. Apart from its use as a vegetable *V. hymenolepis* has been used traditionally for medicinal purposes [2, 3]. The demand for indigenous vegetables has increased, especially in the urban centers where the people are involved in secondary and tertiary production [1]. This has made the indigenous vegetables to become an important commodity of internal trade. Their production therefore has become an important economic activity, especially for women in rural areas in the peripheries of urban centers [1,4-6]. The lack improved agronomic packages for indigenous vegetables has contributed to the sub-optimal production practices

such that the demand for these vegetables is hardly met. *V. hymenolepis* is commonly intercropped with other vegetables and staple food crops. Mono-cropping is becoming increasingly important in market gardens where the crop is commonly broadcast and later on thinned down to a population density of 17-30 plants  $\text{m}^{-2}$  (Mih, unpublished data). Row planting would be preferred since this optimizes space and eases cultivation and other field operations. We therefore selected two densities within the range observed in farmers' fields and tested each in two spacing configurations in a bid to identify an optimum planting regime that would optimize yield and productivity and the results are reported herein.

### **MATERIALS AND METHODS**

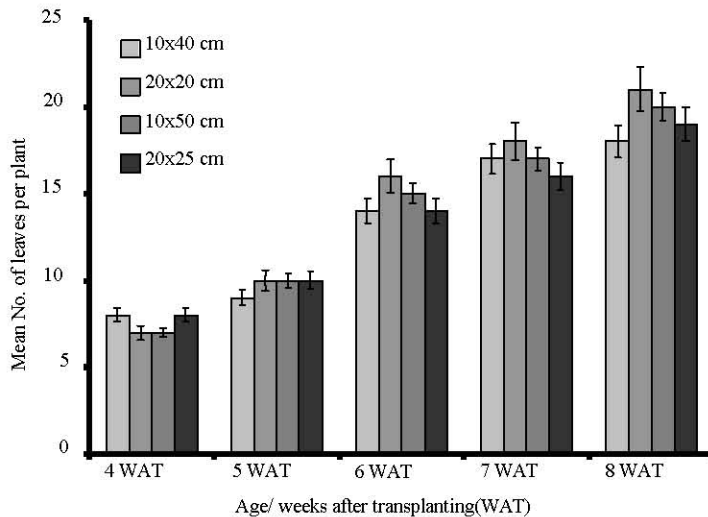
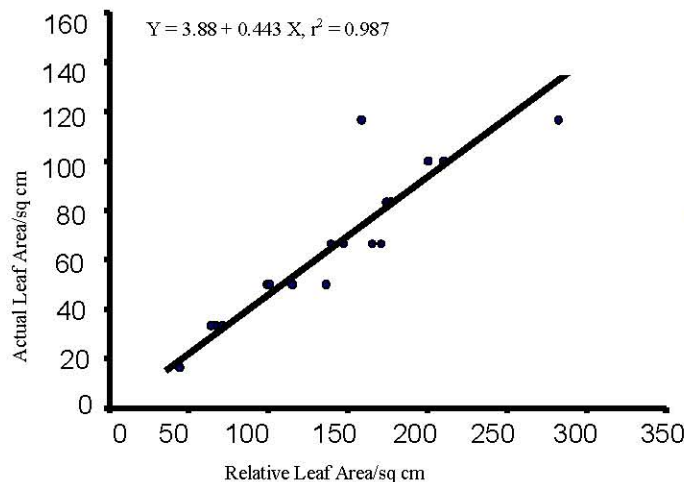
**Plant establishment and field management:** The work was carried out during the rainy seasons of 2002 and 2003 in the University of Buea research farm located at an altitude of about 500 m above sea level on Mount Cameroon. Seeds of a landrace of *V. hymenolepis*

obtained from the local market in Buea were used to raise seedlings in nursery trays filled with topsoil. A 100% sum of the leaf areas of reach plant to the dry matter of the

Table 1: Yield and productivity of *Vernonia hymenolepis* under different plant densities and spacing

Density (plants m <sup>-2</sup> )	Spacing (cm)	LAI	LAR (m <sup>2</sup> kg <sup>-1</sup> )	Dry matter yield per plant (g)			Biomass production (Tons ha <sup>-1</sup> )
				Leaf	Stem	Total	
25	40 x 10	6.51b	16.13a	11.7b	27.6a	39.3a	9.8b
25	20 x 20	22.54a	18.89b	14.2a	34.1a	48.3a	12.1a
20	50 x 10	8.16c	15.65a	6.8c	19.4b	26.2b	5.3c
20	25 x 20	9.40c	14.64c	7.8c	23.4b	31.1b	6.2d

Values within a column followed by the same letter are not significantly different at 5% probability level according to DNMR

Fig. 2: Leaf production in *Vernonia hymenolepis* plants under plant different densities and spacing configurationsFig. 3: Relationship between relative and actual leaf areas for *Vernonia hymenolepis* leaves

Within each plant density, there were no significant differences in above ground biomass production per plant ( $P = 0.05$ ). A similar trend was observed for dry matter partitioning to the stems (Table 1). Significant differences were however noticed in dry matter partitioning to the leaves with the 20 cm x 20 cm spacing giving the highest

leaf dry matter per plant. Leaf dry matter for low plant spacing treatments was the lowest, with no significant differences between the two plant densities. With respect to dry matter yield per hectare, the 20 cm x 20 cm spacing performed best, producing up to 12 tons ha<sup>-1</sup> (Table 1). Low plant density produced the lowest dry matter. Within

each plant density, the spacing approximating a square configuration in each case produced the better yield.

The regression analysis showed a significant positive correlation between relative leaf area and actual leaf area with  $r^2 = 0.987$  (Fig. 3).

## DISCUSSION

The results of this study show that plant density and spacing have ample effects on the growth and yield of *V. hyminolepis*. The growth data indicate high competition between plants when intra-row spacing is low as can be seen with the 50 cm x 10 cm spacing. Giselle [8] reported that similar intra-row competition for *Solanum nigrum* L., where the plants were etiolated. The substantial heights of plants in low intra-row spacing in this study are actually signs of etiolation, characterized by long internodes and low number of leaves per plant, each highly reduced in size. This intra-row competition could have led to low yields irrespective of whether the plants were planted at high density or not. The dry matter partitioning to the leaves is poor in these etiolated plants and this is undesirable here where the leaf is the economic product. The plant spacing that was or approached a square conformation in each case, gave a better yield than the strictly oblong conformation. This is expected since the plants are able to better utilize the feeding area, complemented by reduced competition for light, in conformity with the findings of Janick *et al.* [9] and Qayyum *et al* [10]. Plant density of 20 plants  $m^{-2}$  did not maximize the use of space since the biomass production per plant and per hectare were low compared to the 25 plants  $m^{-2}$  density. This shows that *V. hyminolepis* can be grown profitably under high densities, with the 20 cm x 20 cm spacing being the best. Other indigenous vegetable have been found to do well too under high density planting [11].

The fact that the vegetative growth was at its peak between 5 and 6 WAT shows that the plants can be harvested around this period to maximize returns. Harvesting at this time may actually induce branching [12], so that a ratoon crop could be harvested. Ratoon harvesting is already a common practice in kitchen garden plantings of this species [1] and could improve on the farmers' income in the market garden. For the landraces currently being cultivated, a plant spacing of 20 cm x 20 cm can thus be recommended and harvesting done at 5 to 6 WAT.

The positive linear correlation between the relative leaf area and the actual leaf area indicates that leaf

area can be accurately estimated by a non-destructive sampling technique using linear measurements. Such techniques are important for field situations and in resource-poor laboratories. The use of linear measurements to estimate actual leaf area has been used for several crop plants, notably oil palm [13] and cassava [14].

From this work, it has been shown that planting *V. hyminolepis* at a plant density of 25 plants  $m^{-2}$  in a square configuration ensures maximal use of land with high dry matter production that is largely partitioned to the leaves. Estimation of growth and productivity using linear measurements of the leaf in a non-destructive manner is also possible for this crop.

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