# Seed production of *Vernonia hymenolepis* A. Rich. (Asteraceae) under different foliage harvest regimes

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## ABSTRACT

*Vernonia hymenolepis* A. Rich. is an African indigenous vegetable with growing economic importance in Cameroon and other West and Central African countries. Inadequate quality seeds due to the absence of a formal seed sector limit its production in Cameroon. To situate adequate seed production of the landraces within the present leafy vegetable production system, the effect of four foliage harvest regimes on seed and foliage yield was tested in a completely randomized design. It was found that foliage harvesting significantly reduced capitulum size and number of seeds per capitulum. It also delayed flowering, but ensured more uniform flowering than in plants not harvested. Cumulative foliage yield increased with number of harvests even though the individual shoot weight reduced drastically with increasing number of harvests. The study showed that the regime with two foliage harvests resulted in adequate marketable shoots with minimal depression in seed yield, and is recommended for use by farmers. The planting period also ensured that seeds mature during the dry season to reduce the cost of seed drying.

**Key words:** *Vernonia hymenolepis*, harvest regimes, seed production.

## RÉSUMÉ

*Vernonia hymenolepis* A. Rich. est un légume traditionnel d'Afrique dont la valeur économique est croissante au Cameroun et dans d'autres pays d'Afrique Centrale et de l'Ouest. L'absence de structures spécialisées dans la production des semences est à l'origine de la mauvaise qualité des graines avec pour corollaire une faible production au Cameroun. Pour déterminer la production optimale des graines chez les espèces locales dans le contexte actuel où la plante est essentiellement cultivée pour ses feuilles consommées comme légume, l'effet de quatre régimes de récolte des feuilles sur les graines et sur la foliation a été testé suivant un échantillonnage essentiellement aléatoire. Le résultat a montré que la récolte des feuilles réduit largement la taille capitulaire et le nombre de graines par capitule. Malgré le fait que la récolte des feuilles retarde la floraison, elle garantit néanmoins une floraison plus uniforme que chez les plantes non récoltées. La production de nouvelles feuilles augmente consécutivement avec le nombre de récoltes, même si le poids des bourgeons solitaires diminue considérablement au fil des récoltes. L'étude a montré que sous le régime de deux récoltes annuelles de feuilles, la production de nouveaux bourgeons en quantité et en qualité est plus élevée avec un effet minimal sur la production des graines. Ce régime est par conséquent plus appropriée à la commercialisation et est recommandable aux agriculteurs. La période des semailles s'est avérée être un facteur important parce que en s'assurant que les graines atteignent leur maturité en saison sèche, on réduit le coût du séchage.

**Mots clés :** *Vernonia hymenolepis*, régimes de récolte, production de semences.

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## INTRODUCTION

*Vernonia hymenolepis* A. Rich. is an African indigenous vegetable that is commonly cultivated in Cameroon and other parts of West and Central Africa, where it is consumed as a leafy vegetable. Its production is in the hands of resource-poor farmers, mostly women, in rural and peri-urban settings where it constitutes a major source of income and food (Fube & Djonga, 1987; Schippers, 2000; Gockwoski *et al.*, 2003). *V. hymenolepis* is a shrubby perennial in the wild, but an annual under cultivation. Its stem cuttings do not root easily, unlike other cultivated species of *Vernonia*, and so propagation by seed is the only option for commercial production. The formal seed sector is completely absent for indigenous vegetables in Cameroon since commercial cultivars do not exist for these vegetables. Seed production for the landraces is in the hands of crop farmers and such seeds are often a by-product of the commercial leafy vegetable crop. As such, the quantity and quality cannot be guaranteed. Inadequate quality seeds have been identified as one of the major constraints to indigenous vegetable production (Chweya, 1985; Schippers, 2000). To meet the present seed needs, it is necessary to situate seed production in the existing commercial leafy vegetable production system. A preliminary survey of traditional seed systems in southwestern Cameroon shows that some farmers earn appreciable income from sales of excess seeds and see seed production as a potential gainful economic activity (Mih *et al.*, 2003). The leafy shoots of *V. hymenolepis* constitute the primary economic product for the farmers. In the production of *V. hymenolepis*, the main crop and three to four ratoon crops are harvested, then the plants are allowed to flower for seed production without any further care. This paper reports the results of field experiments carried out during the late seasons of 2004 and 2005 in southwestern Cameroon to identify a foliage harvest regime for *Vernonia hymenolepis* under which foliage and seed yields are optimized.

## MATERIALS AND METHODS

### *Establishment and management of test plants*

The work was carried out at the University of Buea in southwestern Cameroon during September to December of 2004 and 2005. Seedlings of *V. hymenolepis* from seeds of landraces obtained from farms around Buea were raised in seed trays filled with a potting medium made up of garden soil and well-decomposed poultry manure in the ratio 3:1 (v/v). Seedlings were transplanted to finely tilled field at 20 x 20 cm spacing at five weeks after sowing ($5^{th}$ – $6^{th}$ leaf stage). There were four replicates spaced 1m apart, each consisting four plots measuring 3 m x 2 m. At transplanting, Mocap 10 G was applied at the rate of 1 kg ai ha$^{-1}$ using sieved wood ash as a carrier, to control crickets. Subsequently the plots were sprayed with Cypercal 12 EC at the rate of 48 g ai ha$^{-1}$ fortnightly to control aphids and other defoliators. The compound fertilizer Nutrigizer 60+2E ($N:P_2O_5:K_2O$ = 20:20:20, plus micronutrients) was applied as a foliar spray at the rate of 4 kg ha$^{-1}$ every three weeks for twelve weeks. The weeds were removed manually by hoeing.

### Treatment application and data collection

Four harvests regimes were applied in a completely randomised design with four replicates as shown in Table 1. Cutting was done at 15 cm from the ground level and the height of subsequent cutting was sequentially increased by 5 cm each. The fresh weight of the shoots for each plot (excluding the guard rows) was measured immediately after harvest.

The number of days to 50% flowering for each treatment was noted. Plant height at flowering was measured for 20 randomly selected plants per treatment (five plants per plot). The number of capitula per plant was determined for 20 randomly selected plants per treatment when about 50% of them were ripe. The diameters of 10 ripe capitula per treatment were measured with a digital calipers and the number of seeds per capitulum counted after cleaning. The seed

**Table 1:** Harvest regime treatments applied to field plants of *Vernonia hymenolepis* to study the effect on seed yield.

| Treatment No. | Harvest Regime |
|---|---|
| $T_1$ | No harvest of foliage |
| $T_2$ | One harvest of foliage at 6 weeks after transplanting (6WAT) |
| $T_3$ | Two harvests of foliage at 3-week intervals, starting at 6 weeks after transplanting. |
| $T_4$ | Three harvests of foliage at 3-week intervals, starting at 6 weeks after transplanting. |

**Table 2:** Effects of different foliage harvest regimes on *Vernonia hymenolepis* seed yield components.

| Parameter | Treatment* | | | | $LSD_{0.05}$ |
|---|---|---|---|---|---|
| | $T_1$ | $T_2$ | $T_3$ | $T_4$ | |
| Days to flowering | 51 | 80 | 102 | 107 | 4 |
| Plant height at flowering (cm) | 121.4 | 101.5 | 75.2 | 52.0 | 24.3 |
| Number of capitula per plant | 12 | 15 | 16 | 14 | 6 $^{ns}$ |
| Diameter of capitula per plant (mm) | 26.8 | 21.3 | 20.3 | 18.7 | 1.4 |
| Number of seeds per capitulum | 156 | 135 | 129 | 109 | 21 |
| Seed weight per plant (g) | 5.8 | 3.7 | 3.3 | 2.1 | 1.4 |

* $T_1$ = No harvest of foliage, $T_2$ = One harvest of foliage, $T_3$ = Two harvests of foliage, $T_4$ = Three harvests of foliage.

weight per plant was determined for 20 randomly chosen plants per treatment after cleaning and sun drying for two weeks. The data were subjected to a one way analysis of variance, and where appropriate, the means were separated using the Duncan's New Multiple Range Test.

## RESULTS AND DISCUSSION

Table 2 shows the effects of different harvest regimes on seed production parameters. Apart from number of capitula per plant, all other parameters showed significant treatment effects. Un-harvested plants flowered earliest while flowering was delayed most in the plants that were harvested three times. At flowering, un-harvested plants were the tallest and the height decreased with increasing number of harvest. Capitulum size was highest for un-harvested plants. There was no significant difference in flower size between plants harvested once and those harvested twice. The number of seeds per capitulum ranged from 109 in plants harvested three times to 156 in un-harvested plants. The values for plants harvested once or twice did not differ from each other, but were significantly lower than for the un-harvested plants ($\rho \geq 0.05$). Plants harvested at least once had a significantly lower seed yield per plant than the un-harvested ($\rho \geq 0.05$), with three harvests having the least yield.

Foliage harvest reduces the photosynthetic capacity of a plant, resulting in reduced quantity of assimilate available for reproduction. This accounts for the reduced seed number per capitulum and, subsequently, the reduced seed weight per plant observed for

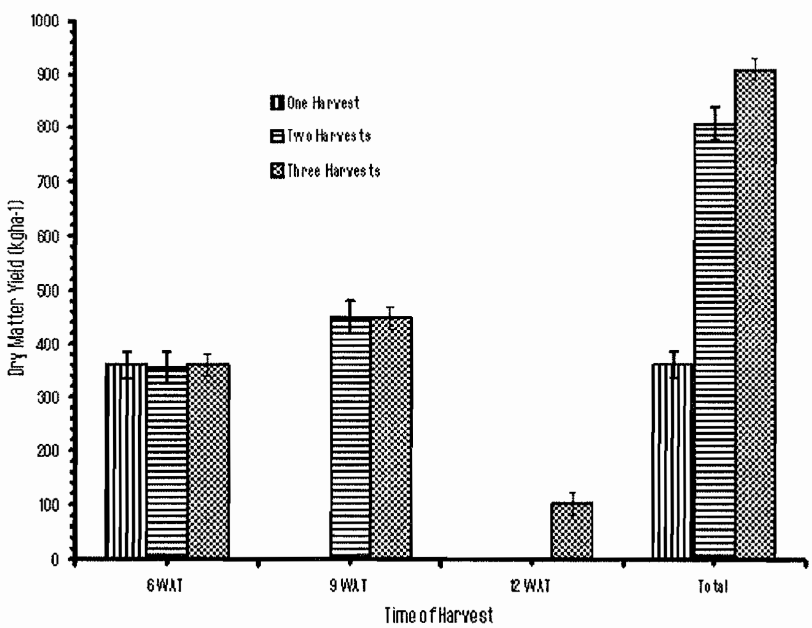



**Fig 1:** Dry matter yield of marketable shoots of *Vernonia hymenolepis* A. Rich. under different harvest regimes at 6, 9 and 12 weeks after transplanting (WAT). (Means of two seasons)

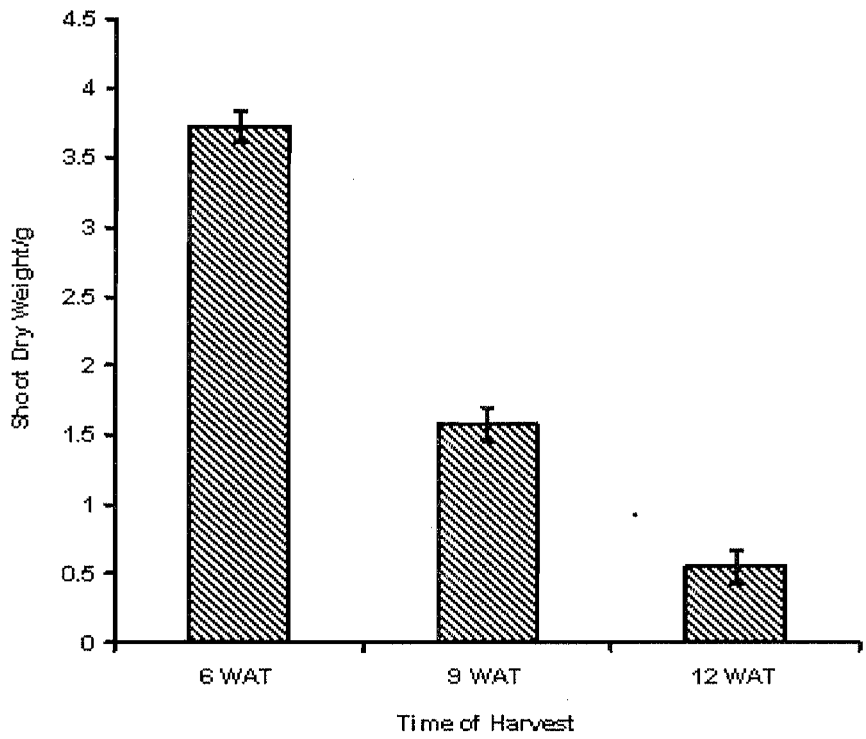


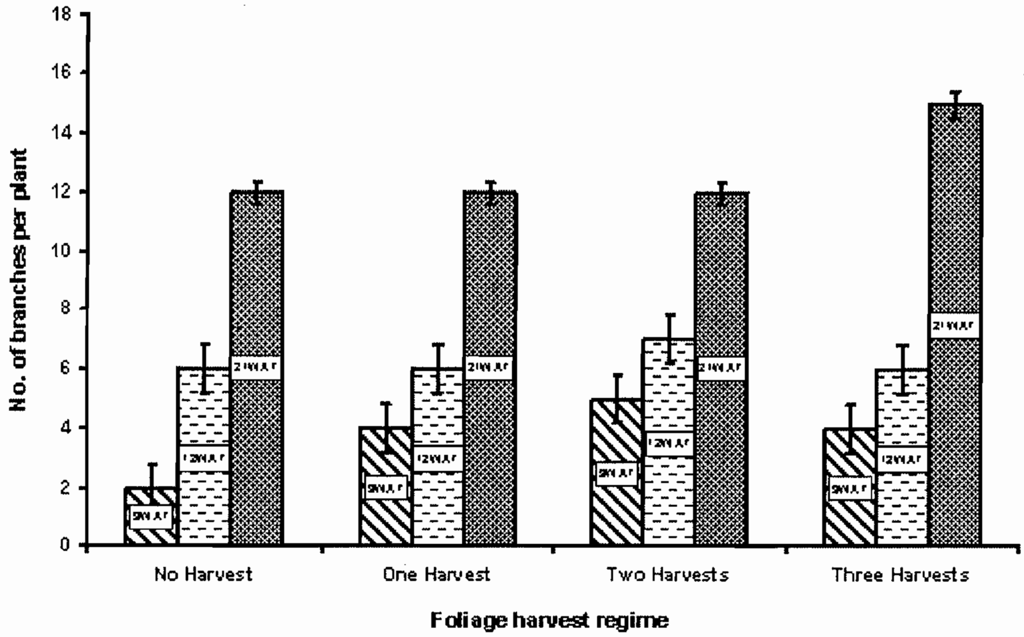

**Fig 2:** Dry weight of individual marketable shoots of *Vernonia hymenolepis* A. Rich. at three successive harvests – 6, 9 and 12 weeks after transplanting (WAT).

treatments where foliage harvest was done at least once. Alkio *et al.* (2003) reported similar reduced seed yields in defoliated plants of *Helianthus annus*. Cutting in Lucerne (*Medicago sativa*) prior to seeding has been shown to severely reduce the reproductive potential resulting in delayed flowering and reduced seed yield (Kowithayakorn & Hill, 1982).

Harvesting of foliage prolonged vegetative growth since potential sites for floral initiation were cut off as shoots. Frequent harvesting of leaves and shoots has been shown to delay the onset of flowering and thus prolongs the harvest period (Dupriez and De Leener, 1989). This suggests why flowering in the un-harvested control occurred earlier than in the harvested treatments. The delayed flowering observed for harvested plants in this study may also be accounted for by the imposed reproductive stress. This is similar to the results of Baye *et al.* (2001) for *V. galamensis*.

The cumulative dry weight of marketable shoots per hectare was highest for plants harvested three times even though this was not significantly different from that of plants harvested twice (Fig. 1). The dry weight of individual marketable shoots decreased drastically from 3.72 g for the first harvest to 0.54g for the third harvest (Fig. 2). At the first harvest 6 weeks after transplanting, there were no branches. At 9 weeks after transplanting, the plants that had been harvested had more branches than the unharvested ones (Fig 3) but there were no differences in subsequent sampling dates, although those harvested three times had slightly more branches at 21 WAT.

Cumulative weight of marketable shoots is a function of shoot number and individual shoot weight. At the first harvest, the individual shoots were robust and tall, but fewer in number since there was virtually no branching at this stage. Subsequent harvests had not given sufficient time for the branches to become as robust as the primary shoot even though there was an increase in the number of marketable shoots. This accounted for the increased cumulative weight of marketable shoots per hectare. The reduced individual shoot weight explains why the increase in cumulative shoot weight was not commensurate with the increase in number of shoots. The drastic reduction in individual shoot weight at the third harvest might also indicate vegetative maturity. At this stage, the trend of dry matter partitioning favours reproductive development (Larcher, 1983; Patrick, 1988).




Branching is encouraged by the removal of apical dominance. Foliage harvest caused early profuse branching in test plants, accounting for the significant more branching in harvested plants than those not harvested. Flowering seemed to also remove apical dominance in unharvested plants so that there was no significant difference in number of branches per plant in subsequent sampling dates. Foliage harvest encouraged more uniform flowering, compared to the telescoping nature of flowering in the unharvested plants. This is advantageous in that the number of harvest times is reduced. Teynorl *et al.* (1992) made similar observations for *Vernonia galamensis* where cutting the plants back to 15cm above the ground resulted in more uniform seed ripening.

The results from this study show that maximum seed yield in *Vernonia hymenolepis* occurs when there is no foliage harvest. However, flowering here is telescoping in nature, with the same plant having seeds and flowers at different stages of development. This creates a problem of synchronizing harvesting operations. Two harvests of shoots gave ample foliage yield with minimal depression in seed yield. This harvest regime has an additional advantage in that there is more uniform ripening of the seeds that allows for synchronization of harvesting. The late season planting was adapted so as to take advantage of the dry season to reduce the cost of drying the seeds. This is very pertinent to the resource-poor farmers.

## ACKNOWLEDGEMENTS

The University of Buea and the Non Governmental Organization, WACOMAC provided funds for this work. Mrs JF Bezafut and Ms A Nkegua provided technical assistance. Thanks to Dr Chuyong, GB for statistical advice, and Dr Suh, C.E. for internal review of the manuscript

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Recieved: 06/09/2007
Accepted: 19/11/2007