E. Afr. agric. For. J. (1985) 51 (1) 22-29

OBSERVATIONS ON THE GROWTH AND YIELD OF OXYTENANTHERA ABYSSINICA (A. RICH) MUNRO IN PLANTATION

B. N. Kigomo and J. F. Kamiri, Forest Research Department, Kenya Agricultural Research Institute, Muguga

(Accepted for publication in January, 1986)

Oxytenanthera abyssinica (A. Rich) Munro is a bamboo species belonging to the family gramineae. The species has natural distribution between 1220 m and 2130 m above sea level (a.s.l.) (Mooney, 1959; Smith, 1962, and Groome, 1955). No record of this particular bamboo species has been made in Kenya (Dale and Greenway, 1961) and a recent survey conducted in 1983-84 by the senior author on the distribution of bamboo crop in Kenya seems to confirm this.

There is need to introduce exotic bamboo species useful in soil conservation and in the production of diminishing handicraft and other domestic and industrial use materials. Species adaptable to lower altitudes and to low rainfall areas should be given priority. *O. abyssinica* thrives well at medium altitudes below the lowest altitude line of the local indigenous hollow stemmed *Arundinaria alpina* K. Schum. The species is semi-solid (usually young culms) to solid (older culms) and is of moderate size. Like many other bamboo species, *O. abyssinica* is versatile in its utilization and being especially solid, would be of greater use in handicraft industry among other uses (Rao, 1960; 1963; 1966 and Wimbush, 1945). The present study reports on some growth and developmental observations made on *O. abyssinica* over a 30-year period.

Materials and Methods

The seed source was Zimbabwe Forest Department. Seeds were sown in an open bed and then put out as transplants in nursery beds after three months. The transplants were kept in the nursery for two years at the end of which the seedlings were planted out as unreplicated trial at Muguga, which has an altitude of 2100 m a.s.l., mean annual rainfall of 970 mm and a mean monthly temperature of 16°C (E.A.A.F.R.O., 1975).

Seedlings were planted out in 25 clumps per 0.04-ha. plot or 618 clumps per hectare to give 3.8 m between clumps. In the course of growth, health and vigour of the clumps were monitored and top height of 10 bamboos measured monthly and later on annually. Thinning of old culms was undertaken as prescribed. To study rate of growth of new culms (shoots) to maximum height, lettered metal labels were placed in the ground at the bottom of selected shoots. Height measurements were repeated over four years during the months of April, May, and June. Life span of individual culms was investigated by tying numbered metal labels onto young selected culms with nylon line and red tape. Culms were selected at the rate of one per clump. Dates of culm selection, death and annual comments were recorded.

Yield from clumps was investigated through thinnings on an annual basis. Intensity of thinning was based on oldest culms only. Cut culms were counted, tied up and green weight taken. Reweighing was carried out until constant air-dry weight was obtained. The number of culms left after thinning and average length of culms per clump were recorded. Yield measurements were carried out annually for five years. All yield results were given per clump, per plot, and were later summarised on a per hectare basis.

Results and Discussion

Table I shows growth in height under various thinning intensity. The thinning intensity ranged from 50-70% of oldest culms per clump. The seedlings at time of planting out were on average 0.5 m in height but after one year of growth were 3.1 m. Culms were produced annually but due to annual thinning treatments it was not possible to detect maximum attainable height by an old culm in the initial period of clump development. After the age of 15 years no more thinning treatments were carried out in the clumps and the crop attained a top height of 36.5 m. Culms of this height had diameters of up to 9 cm at breast height.

Figure 1 shows initial rate of growth of young culms to maximum height. Measurements were short and repeated over a period of four years. The species attained full culm length in 2-3 months at Muguga. There were,

TABLE I—GROWTH IN HEIGHT OF *Oxtenanthera Abyssinica* AT MUGUGA

Age (years) ..	1	2	3	4	5	6	7	8	9	10
Thinning intensity (% of old culms)	—	50	50	50	50	62	70	50	70	70
Mean height (m) ..	3·1	3·7	3·6	4·3	4·3	5·5	5·5	4·6	6·1	4·6
Contd.—										
Age	11	12	13	14	15	16	17	18	19	20
Thinning intensity (% of old culms)	70	50	65	—	50	—	—	—	—	—
Mean height (m) ..	—	—	—	—	4·9	—	—	—	—	5·0
Contd.—										
Age	21	22	23	24	25	26	27	28	29	30
Thinning indensity (% of old culms)	—	—	—	—	—	—	—	—	—	—
Mean height (m) ..	—	—	6·5	6·5	7·0	—	—	—	—	6·4

however differences in maximum culm height over the four years especially after the fifth week of young culm (shoot) growth.

The differences in growth may be attributed to differences in growth conditions over the years and especially to the developmental state of the clumps. Despite the observed difference in the maximum attainable heights, side branches appeared within the fifth week of shoot growth in each measurement period of the four years of study. It was noted that higher maximum culm height occured in clumps with lower numbers of culms (Fig. 2). Closer observation indicated that lower mean maximum height in clumps with larger number of culms or shoots may be the result of physical interferance in upright growth of the shoots by the dense older culms in a clump. Several shoot tips were seen to be damaged amongst the dense culms.

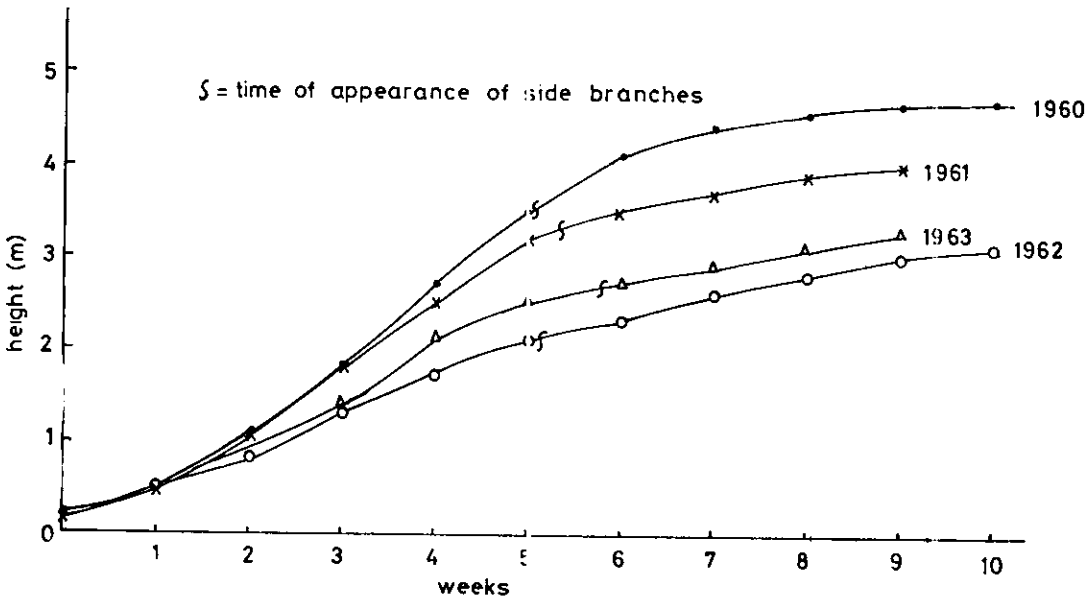

Fig. 1: Growth in height of young culms of *Oxytenanthera abyssinica* **bamboo at Muguga**

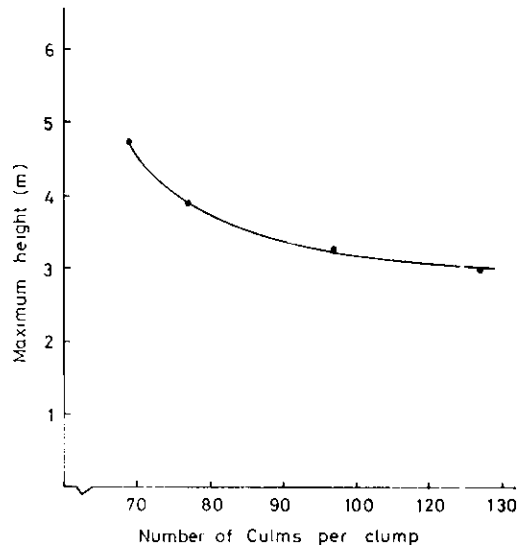

Fig. 2: Relationship between number of culms per clump and maximum attainable height by young culms (shoots)

Figure 3 shows mean weekly height increments taken over four years; the figure shows a wide variation in the rate of height increment. Depsite differences in the rate of increments over the years, it is evident from the figure that the bamboo species attained its maximum rate of increment in 3-4 weeks and thereafter rate of increment in height declined rapidly.

Yield results over five years of measurement are shown in Figure 4, which presents green and dry weight annual yields in tons per hectare under a 75% thinning intensity of oldest culms per clump. Mean loss in weight of green culms to constant dry weight over about three months was 48 ± 4%. No marked effect of thinning intensity on yield over the five measurements was observed. However the results showed that annual yield seemed to be influenced by the previous year's annual rainfall. This relationship could therefore be an important factor in the determination of cutting intensity as well as cutting cycles.

Yield in terms of number of culms per clump was also considered. Number of old culms per clump did not have significant influence on the average old culm height in a clump ($r = 0.353$ NS). There was however a significant positive relationship ($p = 0.01$) between mean old culm length of a thinned lot of a clump and yield (Fig. 5). This means that longer culms yielded significantly more biomass than shorter culms. This suggests that sale by green weight and therefore dry weight would be more profitable and preferable especially where species' management aims at small assortment canes for handicraft or for paper and pulp production. The results further indicate that, with more data than the present one it would be possible to get standard measures to facilitate the suggested mode of yield sales.

Observations on the life span of an individual culm were made over four years only. By the end of five years, 53% of the labelled culms were still surviving. Records of performance and survival did not continue beyond the five years and it was difficult to conclude on the life history of a culm of *O. abyssinica*. Most bamboo culms have life spans ranging from 8 to over 10 years (Khan. 1960; Manthauda, 1960; Wimbush, 1945) and would be important to extend the life span study of *O. abyssinica* to beyond the five years undertaken in the present study.

It has been pointed out that the best rational method for bamboo management should be based on knowledge of relations between clump size or number of culms per clump to new culm production (Manthauda, 1960 and Tomar, 1963, 1974). With such knowledge it would be possible to establish cutting intensity and cycle regimes for sustainable management. Data on this requirement was unfortunately not collected and future experiments should take into account this aspect of the species management. There is also a need to replicate the suggested future studies on the species over more sites mainly to investigate the altitudinal and other possible associated environmental limitations to the species growth. Utilization tests should also be undertaken to find the scope of the species utility.

The present results show that *O. abyssinica* has a great potential for cultivation in the medium and possibly even lower altitudes and by improving its management the species should play a future role in diversification of handicraft and other domestic use materials.

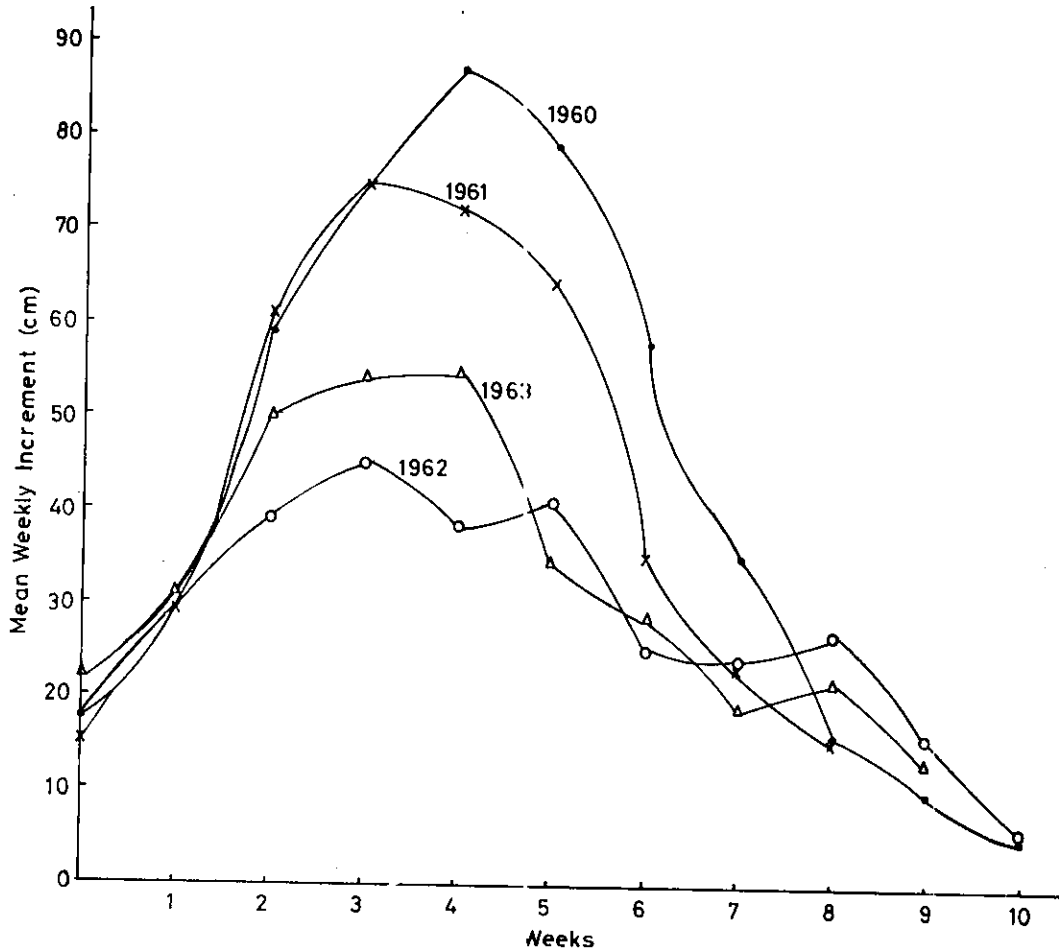

Fig. 3: Mean weekly increment culves of young *O. abyssinica* culms (shoots)

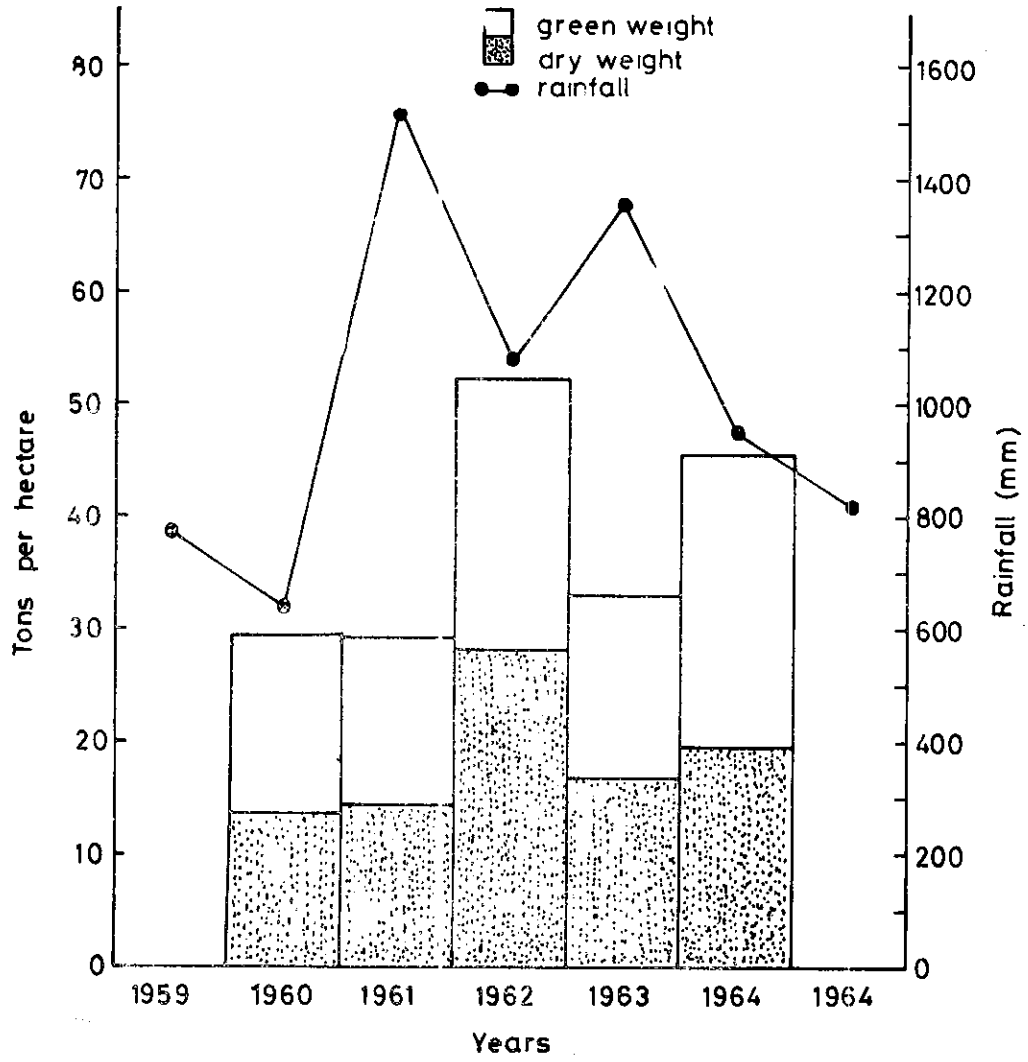

Fig. 4: Green and dry Weight yield (75% of oldest culms) by *O. abyssinica* over five years and its relation to rainfall

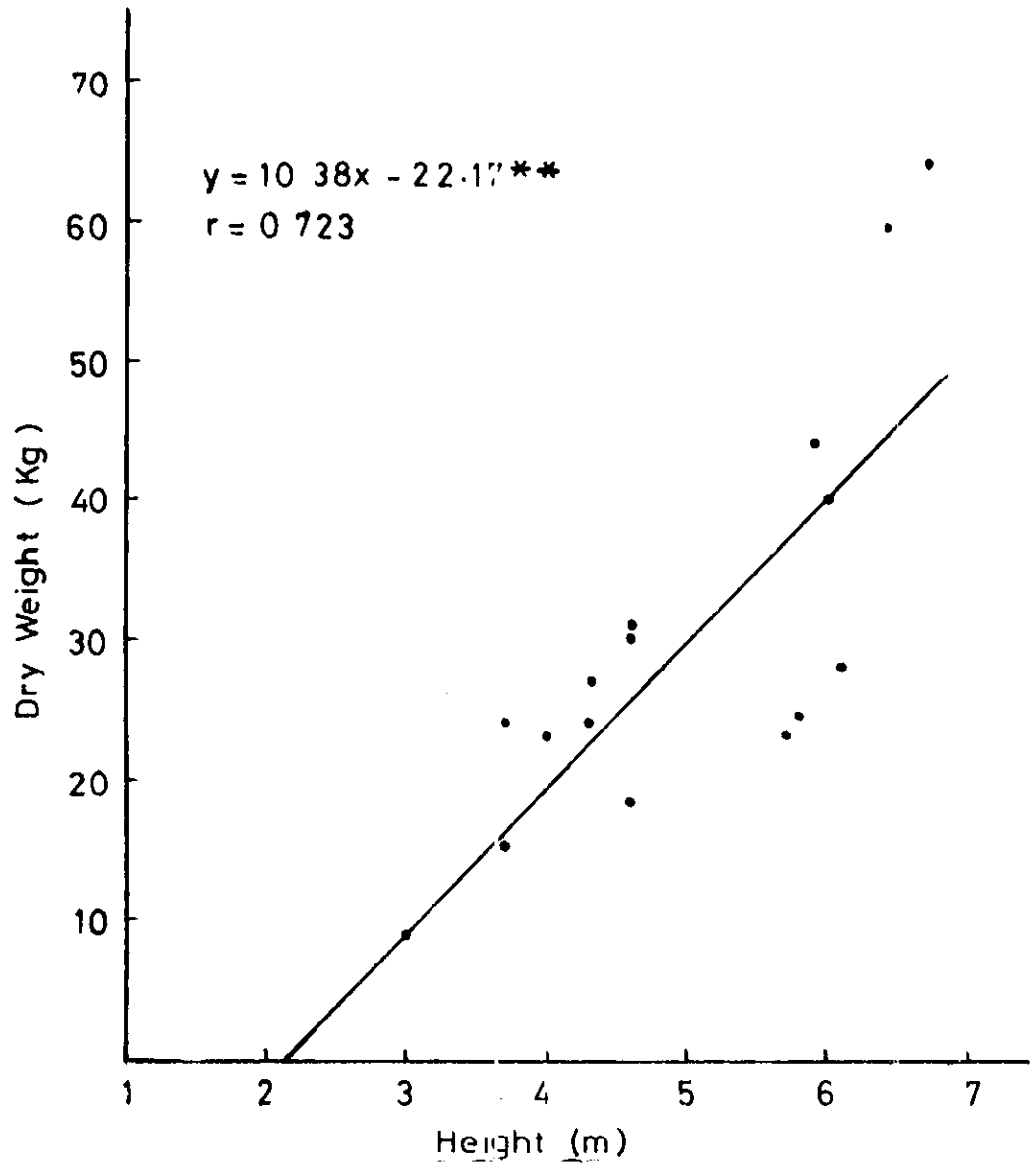

Fig. 5: Relationship between old culms mean height and yield (dry weight) in a clump

SUMMARY

A trial plot of *Oxytenanthera abyssinica* (A. Rich) Munro, a bamboo species was planted out at Muguga mainly as a trial species. The plot was used to investigate growth characteristics of the species. Growth and yield habits have been summarised in this paper. The results show that young culms or shoots grow very fast, and depending on the density of the culms per clump, within 2 to 3 months, the culms will have attained average maximum height. Maximum height increment culminated

within 3-4 weeks. Rainfall had an influence on annual production where higher rainfall produced more biomass in terms of dry weight. An annual production range of 14-28 tons per hectare of air dry bamboo culms may be expected depending on previous year's rainfall. The importance of the present results to the future cultivation of the species and limitations of the available data in establishing full management strategies on this species are discussed and possible future lines of investigations suggested. The successful introduction of *O. abyssinica* in the medium zone of the country is noted and should now have a wider trial for further observations and provision of domestic and handicraft use materials.

ACKNOWLEDGEMENT

The authors wish to acknowledge contributions by *P.* Howland, who started the short term experiments and A. G. Wanene for his technical assistance. The paper is published with the permission of the Director, Kenya Agricultural Research Institute.

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