Use of bast fibre plants as staking materials for yam production in the Guinea Savanna Zone of Ghana

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SUMMARY

In a study carried out at the Nyankpala Agricultural Experiment Station in 1990 and 1991 to investigate the possibility of integrating yam production in the Guinea Savanna Zone with bast fibre production, Kenaf variety C2032 was found to be better than Urena, Rosselle and Jute in fibre production and as a live stake for yam. The tuber yield of yam variety Puna (*Dioscorea rotundata*) staked with Kenaf was 124.9 per cent higher than unstaked yam controls in 1991 when rainfall was adequate for growth. In 1990, when rainfall was inadequate for growth, Kenaf-staked yam outyielded unstaked controls by 61.3 per cent. Rosselle or Jute-staked yam yielded higher than unstaked yam under good rainfall conditions. Under drier conditions, the yields were the same. Yields from Urena-staked yam was low in both years. It is concluded from this study that Kenaf, Rosselle or Jute can be used as live support to increase yam production, and to produce bast fibre in the Guinea Savanna Zone.

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RÉSUMÉ

ASANTE A. K. : *Utilisation de plantes de fibre baste comme matériels de tuteurage pour la production d'igname dans la zone savane-guinéenne du Ghana.* A partir d'une étude effectuée à la Station d' Expérimentation Agricole de Nyankpala en 1990 et 1991 pour enquêter la possibilité d' intégrer la production d'igname dans la zone savane-guinéenne avec la production de fibre baste, la variété Kenaf C2032 était considérée mieux qu' Uren: Rosselle et Jute et en tant que tuteurage vivant d'igname. Le rendement de tubercule Puna (*Dioscorea rotundata*), une variété d' igname tuteurée avec Kenaf était 124.9 pour cent plus élevé que les contrôles d'igname non-tuteuré en 1991 lorsque la pluie était adéquate pour la croissance. En 1990, lorsque la pluie était inadéquate pour la croissance, l'igname tuteuré avec kenaf avait plus de rendement que celui de contrôle non-tuteuré par 61.3 pour cent. Rosselle ou l'igname tuteuré avec Jute avait un rendement plus élevé que celui d' igname non-tuteuré sous des bonnes conditions des pluies. Sous des conditions plus séches, les rendements étaient égaux. Les rendements d' igname tuteuré avec Urena étaient basses pendant les deux années. La conclusion a été tirée de cette étude que Kenaf, Rosselle ou Jute pourrait être utilisé en tant que support vivant pour augmenter la production d' igname et pour produire la fibre baste dans la zone savane-guinéenne.

Introduction

In the cultivation of climbing crops, the use of suitable supports, in the form of stakes or trellises, is very important. These supports help to expose the leaves of the crops to sunlight for optimum photosynthesis and also keep the fruits off the ground, thereby preventing them from being infected by soil-borne pathogens.

Staking of yam (*Dioscorea* spp.) is practised in many yam-growing areas of the tropics especially in West Africa and West Indies where wooden supports or stalks of the previous crops such as maize and sorghum are used (Igwilo, 1989).

In an experiment conducted in south-east Nigeria in 1980-1983 in the rain-forest zone, Igwilo (1989) concluded that staking increased the tuber yield of yam. In another trial carried out at Port Harcourt, Nigeria, it was observed that staking increased tuber yield by as much as 34-105 per cent over unstaked yams (Ndegwe *et al.*, 1990).

Wilson & Metha (1977) working at the International Institute of Tropical Agriculture (IITA), Nigeria, also found that okro stalk left standing in the field provided a suitable support for climbing cowpeas and produced significant yield increases of 58 per cent and 32 per cent for the two varieties they used.

Yam is a stable food in West Africa especially in Ghana but staking or trelising has been a major constraint in the production of the crop. In Ghana, yams are produced mainly in the Forest Transitional Zone and the Guinea Savanna Zone.

In the Forest Transitional Zone, farmers leave shrubs and trees standing in the field during land preparation. Fire is later set at the base of these trees and shrubs to kill them. Thereafter, they are used as stakes for yam. Though this system is inexpensive, it is hazardous and does not provide for the establishment of uniform stands of climbing crops (Wilson & Metha, 1977).

In the Guinea Savanna Zone, farmers are unable to provide supports for their climbing crops especially yams, because of unavailability or scarcity of the supporting materials.

Since staking cost forms a large proportion of the total production cost in yam cultivation (Wholey & Haynes, 1971), any farm practice that will bring about a drastic reduction in the number of stakes per hectare without a corresponding reduction in yield will be a welcome relief for yam growers.

Local farmers have not adopted large-scale cultivation of bast fibres when compared with food crop production. However, some bast fibre plants are occasionally grown sporadically in maize, sorghum, millet and yam fields primarily as vegetables and as a source of fibre.

The objective of this study was to find out the possibility of integrating bast fibre production with food crop cultivation and also to determine which of the fibre species grown in the country will be the most suitable as staking materials for yams. By adopting such a practice, farmers may have multiple benefits of the bast fibre plants as staking materials, vegetables and as source of fibre.

Materials and methods

The experiment was conducted at Nyankpala Agricultural Experiment Station of the Crops Research Institute of Ghana in the Guinea Savanna Zone during 1990 and 1991. Nyankpala Agricultural Experiment Station is located at an altitude of 183 m above sea level, 058 W longitude, 9°25 N latitude and receives over 1000 mm of rainfall annually (NAES, 1989).

The experiment was laid out in a randomized complete block design, with three replications. Three hundred and sixty yam mounds, each measuring about one and half metres in height and a base diameter of one metre, were used for the trial in each year. Seed yams variety Puna (*Dioscorea rotundata*) were bought from the local market. The seed yams weighed an average of 300 g and 250 g each in 1990 and 1991 respectively. Each plot measured 8 m × 14 m and was made up of 24 yam mounds which were spaced at one metre apart. The yam mounds were prepared in the 2nd week of May during the 2 years.

There were five treatments, namely control i.e. no staking, four varieties of bast fibre plants, i.e. Kenaf variety "C2032", Urena variety "Ex-Mokwa", Rosselle variety "Thai Red" and Jute variety "B-2" planted around the mounds as stakes. After the yam mounds have been prepared, four seeds per hole of the bast fibre plants were sown at two hills at the base of each mound and later thinned to two per hole. Yam setts were planted 14 days after fibre seedling emergence. The fertilizer NPK mixture (15-15-15) was applied at the rate of 300 kg/ha at 2 weeks after seedling emergence and 200 kg/ha of sulphate of ammonia was applied at 6 weeks of age.

Growth parameters were taken on five fibre plants in the middle row of each plot and the following variables were studied:

1. Plant height of fibre plants at first branching and at harvest; this was measured from the ground level to the first plant branch and from cut butt point to the terminal end respectively.
2. Number of branches per fibre plant.
3. Stem diameter of fibre plants at harvest; this was measured about 6 cm above the soil level prior to harvesting.
4. Yam yield per plot.
5. Fibre yield per plot.

The plots were kept clean of weeds by hand hoeing. Both the yams and the fibre plants were harvested at the same time in December and January during 1990 and 1991 respectively when the yam vines had withered. After harvesting, the fibre stalks were retted and washed. The fibre yield (in weight) obtained from each plot was recorded.

Results and discussion

Number of branches

There were significant (P=0.5) differences in the number of branches produced by the four bast fibre plants in both years (Tables 1 & 2). Urena produced the highest number of branches in both years, while Jute and Kenaf gave the lowest number in 1990 and 1991 respectively. The number of branches produced by each variety in 1990 was comparatively lower than that produced in 1991. This may be attributed to more favourable climatic conditions, especially rainfall in 1991 (Table 3).

It has been suggested (Chapman, 1965; Coursey, 1967; Okigbo, 1973) that high number of branches produced on the fibre plants with their attendant foliage would not render the plants suitable as yam stakes since the leaves would screen off sunlight from the yam foliage thereby reducing the latter's photosynthetic activity. However, there was no evidence of this in the present experiment. For in spite of the profuse branching of fibre species in 1991, yam yields generally increased.

TABLE 1

Effect of Using Bast Fibre Plants as Staking Materials for Yam (1990)

Treatment	No. of branches	Height at branching (cm)	Height at harvest (cm)	Stem diameter (cm)	Dry weight fibre (kg)	Yam yield per plot (kg)
Kenaf	6.6	100.0	316.0	3.2	2.47	126.87
Urena	12.4	28.2	222.6	3.4	2.10	57.27
Rosselle	7.8	41.4	309.0	2.9	2.00	67.20
Jute	5.6	128.0	290.2	2.7	2.07	57.60
No staking	-	-	-	-	-	56.40
CV (%)	1.6	2.6	1.2	0.6	6.8	16.94
LSD at P=0.05	1.0	15.8	25.4	0.2	0.22	26.14

TABLE 2

Effect of Using Bast Fibre Plants as Staking Materials for Yam (1991)

Treatment	No. of branches	Height at 1st branching (cm)	Height at harvest (cm)	Stem diameter (cm)	Dry weight fibre (kg)	Yam yield per plot (kg)
Kenaf	7.5	104.0	319.7	3.5	2.9	120.00
Urena	13.0	30.9	227.3	3.6	2.5	71.33
Rosselle	8.2	44.8	312.3	3.0	2.3	105.60
Jute	6.0	132.5	293.5	3.2	2.4	105.60
No staking	-	-	-	-	-	74.35
CV (%)	7.4	2.1	2.3	15.2	5.0	3.55
LSD at P=0.05	1.1	2.8	11.0	0.8	0.2	7.15

Plant height

Jute attained the highest point before branching in each of the 2 years while Urena produced branches at the lowest height in both years. Differences in plant height at first branching were significant (P=0.5) (Table 1). Comparatively, bast fibre plants grown in 1991 attained greater heights before branching than those planted in 1990. At harvest, Kenaf plants were the tallest while Urena plants were the shortest in both years. Generally, plant growth in 1991 was more vigorous than in 1990 and this was reflected in their shoot heights at the time of harvest.

Stem diameter at harvest

In 1990, Urena produced the biggest stalks while Jute gave the smallest. By comparison, Kenaf plants were biggest in 1991 while Rosselle produced the smallest stalks. No significant differences (P=0.5) were found in stem diam-

TABLE 3

Record of Rainfall Measured at 09 hours GMT in mm at Nyankpala Agricultural Experiment Station

Year	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Total*
1990	-	33.7	57.9	101.9	77.0	74.6	86.1	260.0	72.3	11	-	-	740.9
1991	-	43.7	31.7	96.1	257.2	98.0	178.6	393.4	256.8	102.8	-	-	1458.3

eter among the fibre species in 1991; however, significant differences (P=0.5) existed among some of the species in 1990 (Table 1). All the varieties planted in 1991 produced bigger stalks than those planted in 1990.

Fibre yield

Kenaf outyielded all other varieties in washed dry fibre in both years, although yield differences were not significant. Washed dry fibres produced in 1991 by the four varieties were generally higher than those produced in 1990. The higher fibre yield in 1991 was no surprising since both plant height and butt diameter at harvest, which were the fibre yield components, (Wilson & Joyner, 1969) were greater in 1991 than in 1990.

Yam yield

Of the four bast fibre varieties used as stakes for yams, mounds planted to Kenaf produced significantly (P=0.5) the biggest mean tuber weight in both years. Significant differences (P=0.5) were also found among the other treatments in yam yields (Tables 1 & 2).

Mounds planted to Urena and Jute produced the smallest yam tubers in 1990, while Urena-staked mounds gave the smallest in 1991. Small yam tubers produced by Urena-staked mounds might be attributed to the branching habit of the fibre plants, especially as the relative increase in yam yield in 1991 was much lower than the non-staked yams. In both years, Urena produced the largest number of branches, and also branched at the lowest height.

Early branching coupled with high number of branches produced by Urena and the attendant foliage, might have decreased the amount of solar radiation reaching the yam vines and their leaves. This decrease might have eventually reduced the process of photosynthesis which might have subsequently resulted in the small sizes of the yam tubers (Chapman, 1965; Okigbo, 1973). On the contrary, Kenaf produced relatively fewer branches in both years. At harvest, Kenaf plants were the tallest of all the fibre plants used in the study.

Lower number of branches together with big stalks produced by Kenaf in both years could hold the yam foliage in place and expose them for efficient use of solar radiation for more efficient photosynthetic activity of the yam foliage. In each of the 2 years, Kenaf-staked yam mounds increased tuber yield by 124.9 and 61.3 per cent over unstaked yams respectively. This is in agreement with the report by Igwilo (1989), Ndegwe *et al.* (1990) who had yield increases from staked yams over unstaked yams.

The results of the present study have demonstrated that Kenaf variety "C2032" can be used successfully as life yam stakes without reducing yam tuber yield. The use of Kenaf as a support plant may not be confined to yams only but can be extended to vegetable gardens where other benefits of the crop, as source of vegetable and fibre may be achieved.

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