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Substituting wooden sticks with plastic stakes in yam production in in Niger State, Nigeria.

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ABSTRACT

This study is an approach to addressing the problem of yam stakes in the middle belt agro-ecological zone of Nigeria. The aim was to find an alternative to the cutting down of tree branches for the purpose of staking in yam production. The environmental degradation due to deforestation is becoming enormous; a further hewing down of trees is contributing to this catastrophe of deforestation. Various agronomic approaches as the use of plastic mulches, varying length of staking among others, have in the past been recommended to solving this problem. This study attempts to substitute wooden sticks with PVC-plastic stakes in yam production. The experiment conducted at the Crop Production Experimental farm, Gidan Kwano Campus, Federal University of Technology Minna, used two staking methods (wooden sticks, PVC-plastic stakes and a control [no staking]). Results show a significantly more number of vine branches on p PVC-plastic staked yam compared to wooden sticks. Leaves on the vines of staked yam were significantly higher than those of the control, while yield of yam from heaps with PVC-plastic stakes was significantly higher than those from wooden sticks and the control plots (of no staking) which was the poorest. The use of PVC-plastic stacks has a good potential in yam production, thereby contributing to environmental improvement.

KEY WORDS: PVC-Plastic stakes, Tuber setts, Twigs/tree branches, Wooden sticks, Tuber yield.

INTRODUCTION

Yam (*Dioscorea* spp.) is an important and highly valued staple food crop in many tropical regions of Africa. The total World production was about 39.9million tons in 2005, the bulk of which comes from the yam belt of West Africa (from Nigeria to Côte d'Ivoire). From this zone comes about 91% of world's production (FAOSTAT 2005).

Important cultural values are attached to yam production especially at ceremonial activities e.g. weddings, funerals and other social and religious ceremonies. Its consumption is either as fried, roasted, boiled pounded or as dried chips which are recombined as *amala* (Hounhouigan *et al.* 2003, Akissoe *et al* 2009). Yam consumption is also relatively high in urban areas, in spite of the competition with other products like maize, cassava, rice and sorghum (IITA, 2001). Yam production in Nigeria has more than tripled over the past 45 years, from 6.7 million tons in 1961 to 39.3 million tons in 2006 (FAO, 2008).

Although the area cultivated to yam is still increasing, production growth rate has declined tremendously from the average of 27.5% between 1986 and 1990 to 3.5% in the 1996-1999 periods. Production rate increased by about 31.5% between 2001–2006 (Amegbeto et al., 2002). Yam production dropped in Nigeria, from 14.9% in 1986-1990 to 2.5% in 1996-1999 (Amegbeto et al., 2002). An increase in average yield (about 23.4%) was however, recorded between 2001-2006. This observed trend represents a major challenge to increasing yam production and its availability as food in the country.

Onwueme, (1978) reported that when whole tubers were planted, yield was better than when either setts from heads, middle or tail regions of yams were used, but most importantly, he stressed that staking was a very important operation in yam production as staked yam plants, yielded higher than un-staked yams. Staking keeps the shoots away from the soil surface which may result in the burning of young leaves and predisposing the leaves to microbial attack. Staked yam fields allow for easy weeding and other farm operations. Staking however, is a very laborious aspect of yam production. Akobundu (1980) estimated that a total of 325 man-days can be required to produce a hectare of yam crop. But 70 man-days of this total, was allocated to weeding operations per growing season, but this however could be reduced if yam farms are

stacked.
Staking is therefore a yam planters' main concern especially in the yam growing areas of the forest to guinea savannah; or transitional areas of most yam belt zones of the world (Degras, 1993). The environmental degradation due to deforestation is enormous but most pronounced when yam production is considered. Staking especially in the humid forest is carried out to help the twining yam stems display their leaves to attract adequate solar energy for efficient photosynthesis (Orkwor and Asadu, 1998). In the forest zone of Nigeria, for example, staking is needed for maintaining high leaf area duration (LAD) resulting in an associated high yield (Enyi, 1972; Hahn and Hozyo, 1983).
Kumar (2007) reported that when yams are grown as sole crop and staked, yield increased between 34 and 105 percent. Manyong et al., (2005) showed that an irregular response to staking was found when yams are planted with other crops. Staking is not only laborious (accounting for 20% of all work in yam production), but can also be very costly and scarce. For addressing this Staking problem, several approaches have been adopted. Methods of supporting weak stems have been conceived including using live or killed in-situ stems of other erect plants, wooden poles or stakes, trellis made of wood, Fences with strings, wood with rope, wire or mental, strings attached to wire or plastic mesh and mental cages. Of these practices, the single stake and wood frame trellis have been the most popular in the tropics where the materials were obtained from nearby forests or bush.

Comparing three leguminous trees, (*Leucaena leucocephala*, *Gliricidia sepium* (Gliricidia) and *Flemingiam acrophylla*) in Ivory Coast for their suitability as live-stakes for *Dioscorea alata*, Budelman (1990a and 1990b) showed that Gliricidia was most suitable because of the architecture of both tops and roots, providing sturdy support without excessive shading, and minimizing competition for the crop root zone. Otu and Agboola (1994) also reported positive results of *Gliricidia* as live-staking for *D. rotundata*. Okra stem however, provid excellent support for cowpea *Vigna unguiculata* L.Walp, and gave 30-50% increase in yield over cowpea grown without support (Wilson and Atta-Krah, 1983). The current study is an attempt of substituting wooding sticks with PVC-plastic stakes in yam production in Nigeria.

MATERIALS AND METHODS

Experimental site.

The experiment was conducted in the rainy season of 2009. The trial was sited at the experimental farm of the Gidan Kwano Campus, School of Agricultural and Agricultural Technology, Federal University of Technology, Minna, Niger State, Nigeria.
Minna is located at latitude $9^{o}40'$N and longitude $60^{o}30'$E in the southern guinea savanna. It has a mean annual precipitation of 1,200 mm and mean annual temperature of 29^{o}C. The soil type is sandy loam (Ojanuga, 2006).

Land preparation

A good site was selected, demarcated, cleared and heap mounds made manually. The land was divided into three blocks (of 60 heaps each) such that plastic stakes, wooden stakes and no stakes were assigned to the plots.

Planting material and planting.

The yam planting material used was *D. rotundata* **(**white yam, local name - **Giwa**). Heap mounding and planting of yam seeds was done on 5^{th} and $6^{th}$of May, 2009.

Preparation of staking material

Sixty pieces of PVC plastic pipes of 2 meters tall and pieces of ply wood sticks were affixed as arms on each PVC plastic piper at 60cm apart from each other (see Plate 1). The ply wood arms measured 60cm, 45cm, 30cm and 15cm from each other. These were held in place with metal plates and affixed with nails to the PVC-plastic pipes.
Sixty wooden stakes were also hued from the nearby bush for staking plots assigned to wooden stakes. A third set of heaps had no stakes. The experiment was laid out in a randomized complete block design.

Data collection

The parameters for which data were collection included number of sprouts, number of vine branches at two weeks six weeks and ten weeks after emergence - WAE, Leaf area and Vine length after 2, 6, and 10WAE. Incidence of pest and diseases was also measured. Number of leaves; Leaf area was calculated from length and width of leaf after measurement with a digital Vanier caliper. Length of vine was measured with a tape rule (measurement was taken from the base to the top most leaf of the plant). Incidence of pest and diseases like aphids, worms and grasshoppers were scored. Field diseases that could cause economic damage to yam in the field from the seedling stage to harvest are major concern of yam farmers; therefore this study took a keen interest in its observation

Plate. 1. A structural design of the PVC-plastic stakes used in the study.

Statistics and data analysis

Analysis of variance was performed using the Minitab release 14 (Statistical Software Inc.) to test the effect of staking on the various parameters in yam production. Means were compared with the least significant difference (LSD) at $P < 0.05$. Graphs were drawn using Microsoft Excel computer program.

RESULTS AND DISCUSION

Sprouting of yam vines started from the 46th day of sowing. This lasted about 10 days indicating that the tuber setts planted came from very healthy tubers. The rate of emergence was quit high (96.7% after 60 days of sowing). Data collection began 66 days after sowing of the setts.

Effect of number of yam sprouts as affected by type of staking material.

The mean number of yam vine sprouts was not affected by the staking material. Result show that staked plots had a mean of 2 vine sprouts per heap. The same number of vines lasted up to the 11thweek. But the plots without stakes (the control) increased from2.4 vine sprouts at week 2 to a mean of 3 vine sprouts by the 11th week after emergence. The no staked heaps where multiple sprouting was observed differed from both the wooden and PVC-plastic staked plots (Fig. 1).

Effect of staking material on length (cm) of yam vine.

The result for mean length of yam vines (Fig. 2) showed that length of vines produced when plastic pipes were used was significantly superior to that of the control plots but only slightly higher than that of the wooden sticks, which was itself better than the control plots. At 3 WAE, plots with wooden sticks appeared to be better than the plastic pipes but this was soon surpassed by the latter before 5 WAE. By the 11 WAE, it was observed that plastic staked plots produced the longest yam vines of 194.7cm followed by yam plots that had been stacked with wooden sticks (with a length of 156.2cm). The plots with no stakes produced the least vine length of 113.00cm (3-11 WAE).

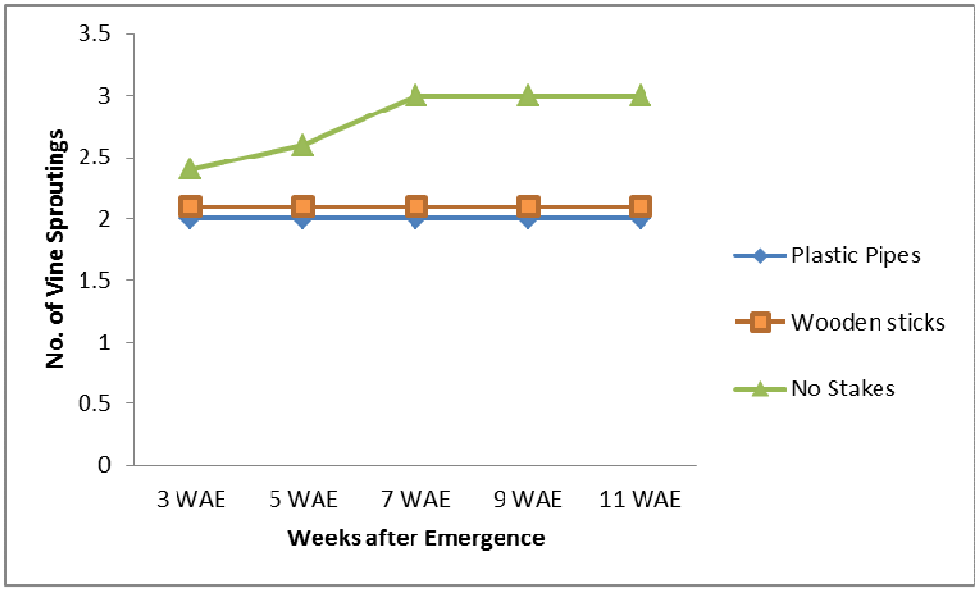

Fig. 1. Effect of type of staking on vine sprouts.

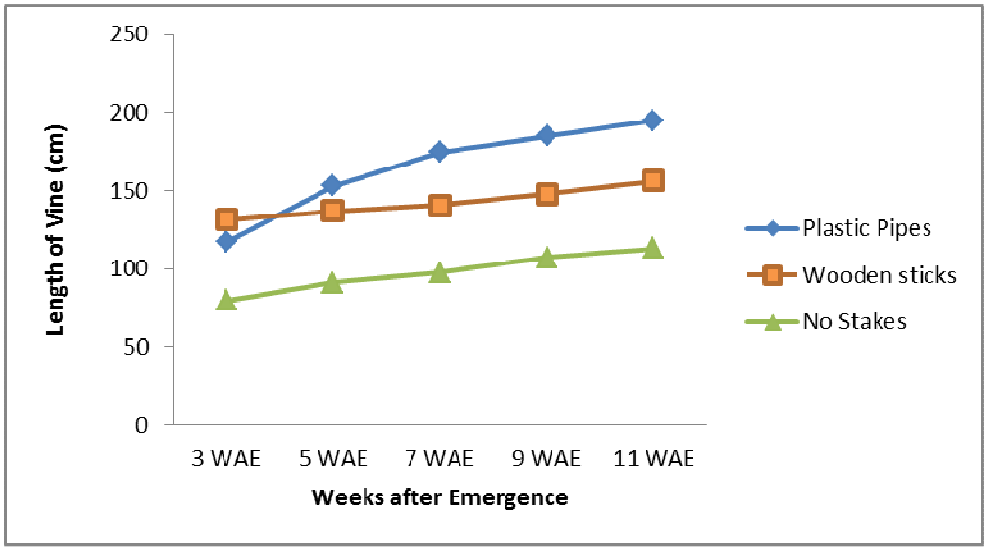

Fig. 2. Effect of type of staking on Length of main vine.

Effect of staking on vine branches

Result for mean number of vine branches (Fig. 3) produced per plant also showed significant difference between staked and unstaked yam heaps. Although no significant difference existed between number of branches where PVC-plastic pipes were used (a mean of 10.8 vine branches) and wooden stakes (10.5 vine branches), these were however more than the mean number of vine branches recorded for the unstaked heaps that had a mean of 6.8.

No significant number of vine branches existed between PVC-plastic staked heaps (that produced the highest number of branches of 8.1 and that of wooden staked heaps that had a mean of 7.9 branches. These values where however, greater than those of the control (no staked heaps) that had a mean of 5.0 branches. By 11WAE however, the number of vine branches within PVC-plastic staked yam heaps had risen to 12.4; 11.7 for wooden staked yam heaps while a mean of 8.3 branches was recorded for heaps where neither PVC-plastic stakes or wooden sticks had been used.

Effect of staking on number of leaves per plant.

Result of mean number of leaves per vine in Fig. 4, was not different from that of number of branches presented above. Significant number of leaves per plant was observed as the yam crop increased in growth. The result show that mean number of leaves produced per plant at 3WAE (36.8), increased by about 90% by the 5th week and a total of 124.7 by the 11th week – an increase of 339%.

Although higher mean number of leaves was observed in wooden stakes (100.98), this was not different from that of PVC-plastic stakes (91.9). This was however significantly different from that of the control where there was no staking (72.54).

No statistical significant difference was observed in the interaction between number of leaves produced per type of staking and the time of observation (11 weeks after emergence).

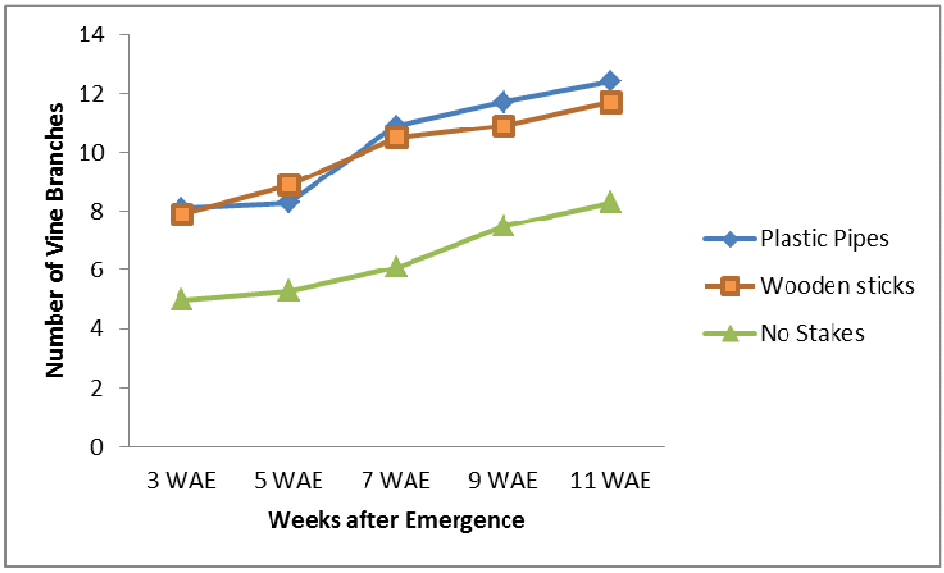

Fig.3. Effect of type of staking on number of vine branches.

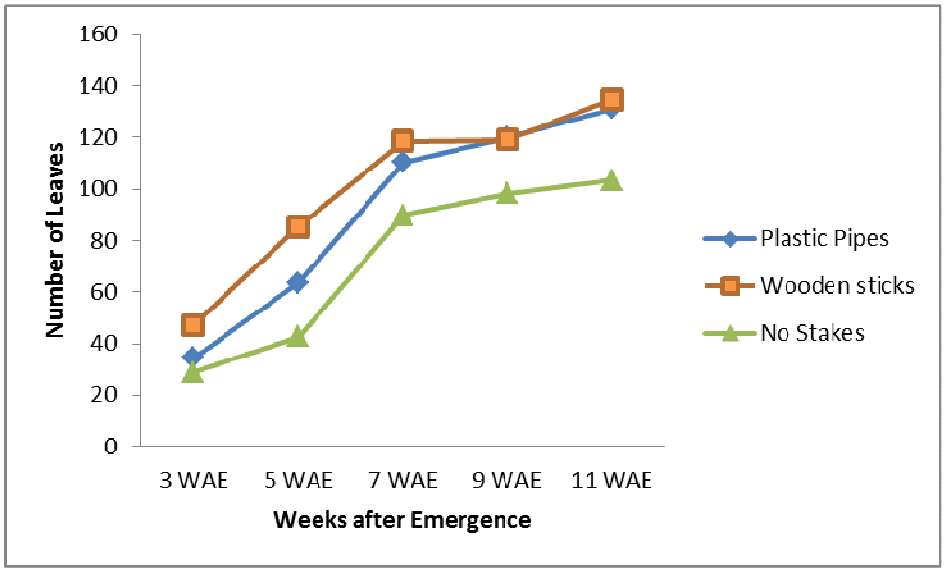

Fig.4. Effect of type of staking on number of leaves.

Effect of type of stake on mean yield of yam tubers (tonnes/Ha)

Result of the ANOVA for mean tuber yield produced per heaps presented as Fig. 5, show the obvious difference in the mean tuber weight produced at the types of staking. Mean tuber weight from PVC-plastic staked heaps yielded 5.3kgs compared to that of wooden sticks that was 3.4kgs while that of the control (no stakes) was 1.4kgs.

Discussion

Orkwor and Asadu (1998) had shown that staking especially in the humid forest regions helps the twining of yam vines, thereby enabling yam leaves to be properly and adequately positioned for solar energy hence for efficient photosynthesis. The result obtained in this study show that PVC-plastic stakes produced the best value compared to wooden sticks or the control (no stake at all) that produced a vine length of 97.6cm. This implies that the longer the material used for staking the longer the vines of yam might be. Reduced solar radiation reaching the soil surface also means less sunlight available for weeds to grow. This will form a smothering effect for the under growth hence little weed growth. The better the yam canopy, the higher the efficiency of raindrops and also the lower the impacting force of rain drops on the soil surface and hence the lower soil detachment resulting in low erosion rate. This has the potential of exposing yam tubers to the heat of the sun at the later part of the growing season

The results obtained in this study showed that wooden sticks had the greatest number of leaves - 100.98 while PVC-plastic stakes had 91.90, though statistically, no significant difference was seen between the two staking methods, but this may imply that if PVC-plastic stakes are used, as much leaves can be produced as wooden stakes. This in turn means more leaf cover and shading of the ground and keeping the yam heaps cooler for as long as the leaves remain on the plant.

The lower the temperature of the immediate environment of the yam heaps, the higher the microbial activity. This will result into higher break down of organic matter in the heap room by microbes thereby increasing the rate of organic matter decomposition making nutrients available to the growing plant and hence new formed tubers. Plastic stakes produced better leaf length and width thus a good leave area that is necessary for photosynthesis is ensured. But photosynthetic activity leads to good starch formation and so better storage in the tubers. This suggests that when plastic stakes are used by yam farmers especially in areas where wooden stakes for yam production is in limited supply, more yam tuber can still be obtained/produced and therefore more money to the farmers.

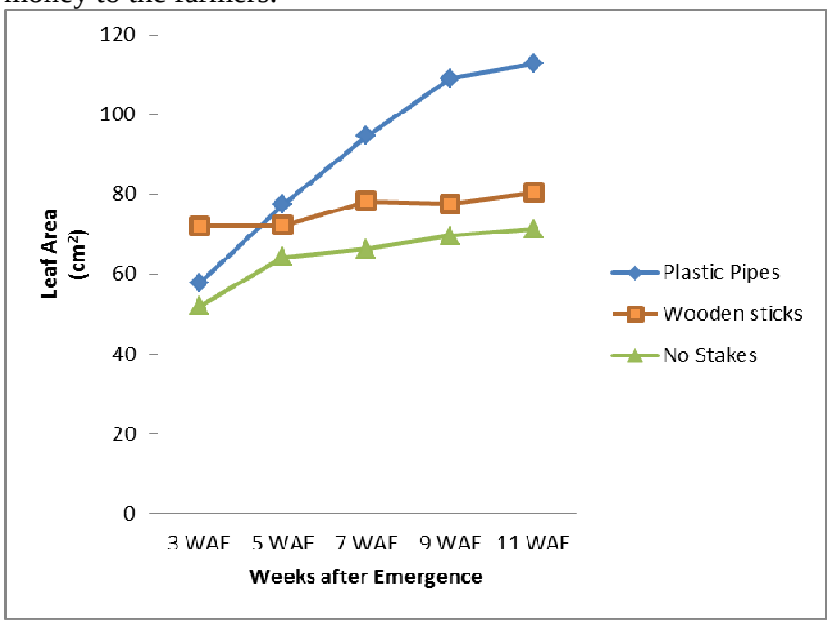

Fig.5. Effect of type of staking on mean leaf area of yams.

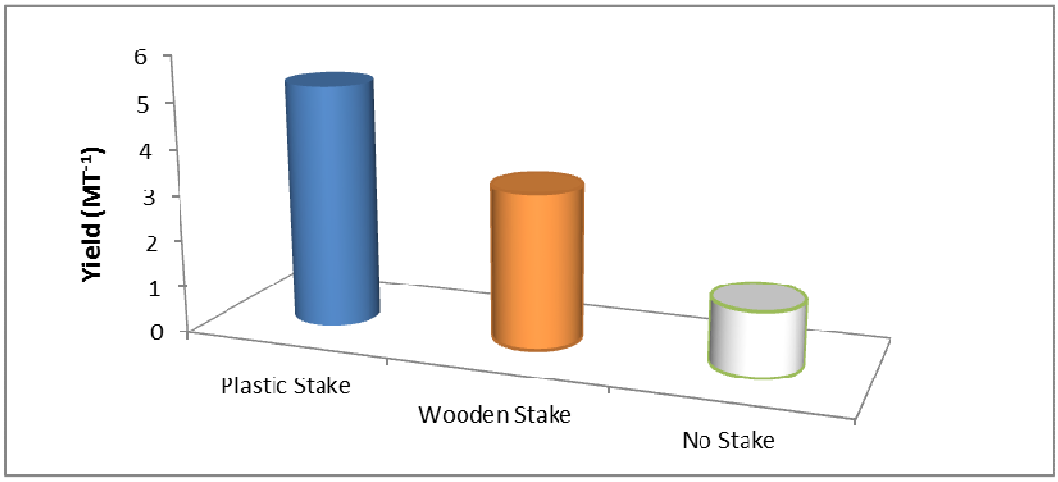

Fig.6 Effect of type of staking on tuber yield of yams.

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