Improved Agronomic Practices for Sustainable Yam Production: The on Farm Experience

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Abstract
Yam production in Ghana and other West African countries are characterized by annual shift from land to land in search for fertile soils contributing to deforestation and land degradation. There is therefore the need to address this challenge with innovative land use technology that would sustain production in the face of this challenge. The specific objective of the study was to verify and demonstrate improved agronomic package for sustainable yam production in yam growing communities of Ejura and Atebubu in the forest-savannah transitional ecology of Ghana. Two treatment packages of improved agronomic practices and farmers' practices were arranged in Randomised Complete Block Design on a total of 8 farmers' fields consisting of 4 each from Ejura and Atebubu. The improved agronomic package consisted of ridging as seedbed, seed treatment with insecticide and fungicide, fertilizer application at a rate of 45:45:60 N: P_20_5: K_20 kg/ha and the use of minimum staking (trellis; 30-50% number of stakes used in farmers staking). This was compared with farmers' practice, which consisted of mounding, no fertilizer application and no seed treatment. The results revealed high yam tuber yields of 196% and 205% on the improved agronomic fields over farmers' practice fields in Ejura and Atebubu farming communities respectively. The study had demonstrated that out-scaling of improved agronomic packages would sustain yam production on continuously cropped fields and address the problem of deforestation associated with yam production.

Key words: Deforestation; Land degradation; Fertilizer application; Continuously cropped field; Farmers' practice

Pratiques agronomiques améliorées pour une production durable de l'igname: l'expérience à la ferme

Résumé
La production d'igname au Ghana et dans d'autres pays de l'Afrique de l'Ouest se caractérise par un déplacement annuel de la terre à la terre à la recherche de sols fertiles contribuant à la déforestation et à la dégradation des terres. Il est donc nécessaire de relever ce défi grâce à une technologie innovante d'utilisation des terres qui permettrait de soutenir la production en dépit des défis. L'objectif spécifique de l'étude était de vérifier et de démontrer un ensemble agronomique amélioré pour la production d'igname durable dans les communautés d'igname d'Ejura et d'Atebubu dans l'écologie transitionnelle forêt-savane du Ghana. Deux lots de traitement de pratiques agronomiques améliorées et de pratiques des paysans/paysannes ont été organisés dans le cadre de la conception de blocs complets

randomisés sur un total de 8 champs d'agriculteurs comprenant chacun 4 dans la communauté d'Ejura et d'Atebubu. Le paquet agronomique amélioré consistait en l'utilisation de billons comme couche desemis, traitement des semences avec insecticide et fongicide, application d'engrais à un taux de 45:45:60 N: P2 05: K20 kg/ha et utilisation d'un tuteurage minimum (treillis; % nombre de piquets utilisés dans le jalonnement des agriculteurs). Cela a été comparé à la pratique des agriculteurs, qui consistait en une mise en tas, pas d'application d'engrais et pas de traitement des semences. Les résultats ont révélé des rendements en tubercules d'igname très élevés (P ≤ 0,05) de 196% et 205% dans les champs agronomiques améliorés par rapport aux champs de pratique des agriculteurs dans les communautés agricoles d'Ejura et d'Atebubu respectivement. L'étude avait démontré que l'extension des emballages agronomiques améliorés permettrait de maintenir la production d'igname dans les champs cultivés en continu et de résoudre le problème de la déforestation associé à la production d'igname.

Mots clés: Déforestation; Dégradation du sol; Application d'engrais; champ de culture continue; La pratique des agriculteurs

Introduction and rationale of the study

Yam is an important staple food crop and currently a major non-traditional export crop in Ghana. It is the major tuber crop produced and consumed in Ghana and West Africa. For the past decade, yam production in Ghana has ranked third in the world and contributes about 16% to the National Agricultural Gross Domestic Product (FAOSTAT, 2012). However, the major challenge to yam production is soil fertility regeneration and maintenance. Farmers address this constraint by clearing new areas on yearly basis in search for fertile lands leading to deforestation and soil degradation (Akwaag *et al.,* 2000; Ennin *et al.,* 2014; Garrity, 2004; Young 1997). This current yam production system where there is annual shifting of farm to new lands is not sustainable and therefore the urgent need to disseminate an environmentally sound yam production technology that would increase yield and sustain production on continuously cropped fields.

The use of ridges, fertilizer application, seed treatment before planting and trellis staking have been observed to be very good technologies for yam production (Ennin *et al.*, 2014; Owusu Danquah *et al.,* 2015; Ennin et al., 2009). The use of ridging and yam seed treatment help to maintain optimum number of stands per unit area whiles fertilizer application addresses the soil nutrient depletion (Ennin *et al.,* 2014; Ennin *et al,* 2013). The trellis staking option with ropes and few stakes addresses the challenge of scarcity of stakes and cutting of more trees/bamboo for staking which exacerbates deforestation (Owusu Danquah *et al.,* 2015). Through participatory approach, an improved yam production technology of planting treated yam seeds on ridges with fertilizer rate of 45:45:60 N: $P_2$05:$K_2$0 kg/ha and trellis staking were verified/demonstrated by comparing it with the farmers' practices on fields in Ejura and Atebubu yam growing communities during 2015 cropping season. This paper presents the results of the study to farmers and all stakeholders and the way forward for sustainable yam production.

Materials and Methods

The study was conducted on selected farmers' fields in the Ejura and Atebubu farming communities in the forest-savannah transition zone of Ghana. Continuously cropped

farmers' fields, which normally would not be used for yam production by farmers, were selected for the study. The experiment was arranged in a randomized complete block design with improved agronomic practices and farmers' practices as treatment on each farmer's field. Ridging, yam seed treatment with insecticide and fungicide, trellis staking and fertilizer application at rate of 45:45:60 $N:P_2 05:K_2 0$ kg/ha were the improved agronomic practices. The adjacent farmers' practices, consisted of mounding, no fertilizer application and staking of about 2 stands to a stake. A total of 8 farmers' fields consisting of four each from communities in Ejura and Atebubu farming communities were used. Each plot had an area of 0.10 ha . Spacing was 1.2 m inter-row and 0.8 m within rows for the improved agronomic practice (10,416 stands/ha) and spacing for the farmers' practice without rows, was about 1.5 m x 2 m (2500 - 3333 stands/ha). Local white yam (*Dioscorea rotundata*) varieties such as Dente and Serwaa were used in the study. Plantings were done between June and July, 2015 in both farming communities. The Fertilizer treatment was applied at 50% split at 5-6 weeks and 11-12 weeks after planting in all the locations. The seed setts of the improved agronomic fields were about 250 g and treated with Dursban (Chlorpyrifos from Dow Agro Sciences; 1.25 l/ha) and Mancozeb (Dithiocarbamate from Ag-Chem Africa 80%; 75 g in 15 l of water) before planting. Weeds were controlled with glyphosate, N-(phosphonomethyl) glycine at 2.5 l/ha before the sprouting of the yam. Each farmer field in each farming community was considered as a replication and the data collected were subjected to analysis of variance at 5% significant level using SAS 2007 version.

Results and Discussions

Generally, the improved agronomic practices had significantly ($p \leq 0.05$) higher total tuber yields as compared with the farmers' practice in all the locations (Figures 1 and 2). The use of improved agronomic package of ridging,

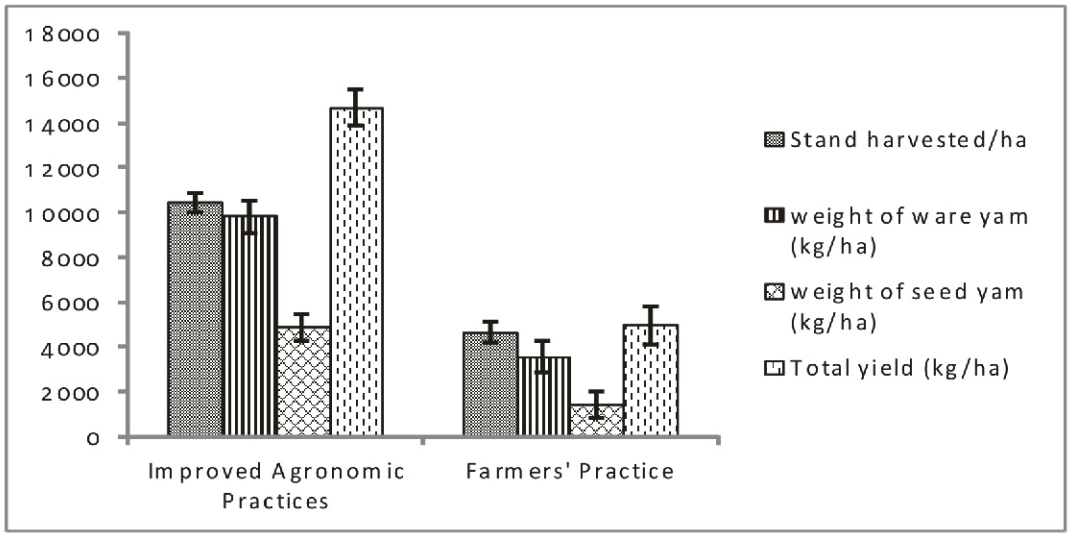

Figure 1: Yam tuber yields as influenced by improved agronomic package and farmers practice in the Ejura farming communities (2015)

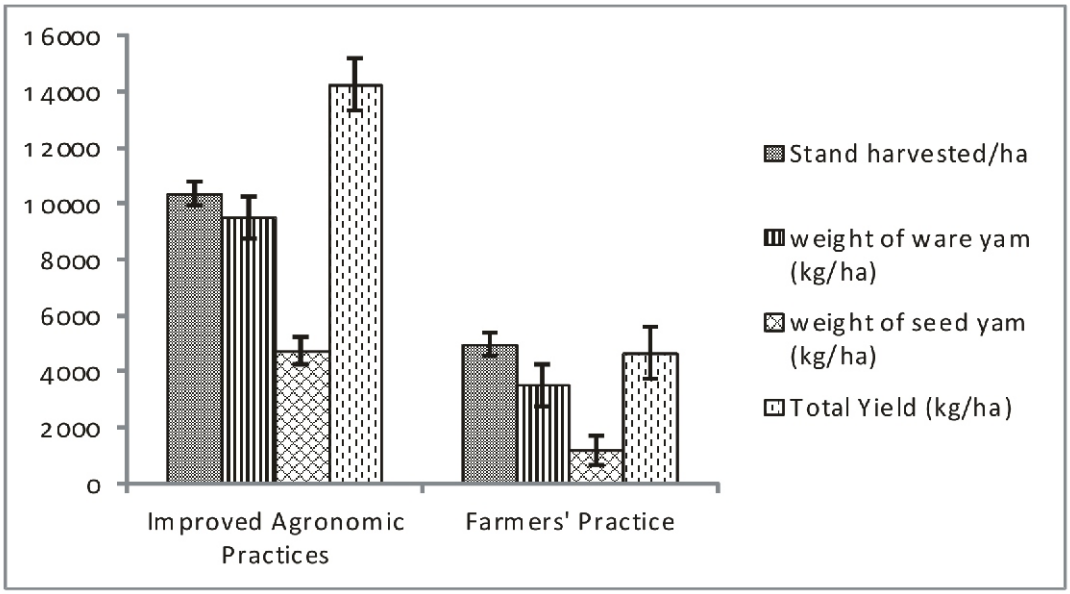

Figure 2: Yam tuber yields as influenced by improved agronomic package and farmers practice in the Atebubu farming communities (2015)

seed treatment, trellis staking, and fertilizer application and higher plant population resulted in 196% and 205% total tuber yield increase in Ejura and Atebubu farming communities respectively (Figs. 1 and 2). The plant stand establishment on the ridges were significantly higher ($p \leq 0.05$) on the improved agronomic practice fields than farmers practice fields for all the locations (Fig. 1 and 2). This could be attributed to the use of ridges which made it possible to plant at 1.2 m between ridges and 0.8 m on the ridges resulting in a planting density of about 10416 stands per hectare whiles the farmers' practice of mounding were relatively widely spaced (1.5m - 2m) resulting in just about 3400 stands per hectare. Thus, ridging resulted in optimum number of plants and efficient use of fertilizer than the use of mound (Ennin *et al,* 2009). A study by Ennin *et al.,* 2014 also, revealed similar tuber yields on fertilized mounds and unfertilized ridges suggesting that fertilizer application is more profitable on ridges than mounds. Also, seed treatment before planting on the ridges (improved agronomic fields) would have reduced rot and increased sprouting rate than on mounds (farmers' practice fields) seeds were not treated. Planted on continuously cropped fields, fields farmers would normally not use for yam production, yam fields improved agronomic fields in all the locations could be similar to yields farmers normally obtain from newly cleared fields. The practice of clearing new fields in search for fertile soil for yam production results in deforestation and land degradation (Akwaag *et al.,* 2000; Ennin *et al.,* 2014; Young, 1997).

Conclusion

This study has shown yam production can be increased and sustained with the use of

improved agronomic practices on continuously cropped fields. This would help address the problem of deforestation and land degradation associated with yam production.

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