Figure 2: State of a yam farm with organic matter(top) and without organic matter (bottom) after along dry spell at the beginning of the 2015 growing season

Conclusions

Use of fertilizers, especially from organic sources, can improve productivity and production of yam. The use of fertilizers in yam production can widen the sowing window and thus lessen the pressure on farmers' precious time.

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Case study

ORGANIC MATTER FOR CLIMATE SMART YAM PRODUCTION: OUTCOMES OF A FARMERS FIELD SCHOOL IN NORTHERN GHANA

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KEY FINDINDS

- Fertilizers are very important for sustainable production of yam
- Use of organic matter can widen the planting window for yam
- Full season yam cultivars respond better to organic fertilizer application than early maturing cultivars
- Application of organic matter reduces effect of dry spell on the yam crop

Background

Yam (*Dioscorea* species), especially white yam (*Dioscorea rotundata*) is a major staple and important source of livelihood for many people in Ghana, especially those in the forest, forest-savanna transition and Guinea savanna agro-ecologies where its cultivation is very intensive (Sam and Dapaah, 2009). The Guinea savanna zone contributes significantly to the total yam production in Ghana (Asante et al.,2007).

Yam is a heavy feeder with a high demand for plant available nutrients so producers normally allot the most fertile of their soils to its production. Such soils are obtained by either clearing virgin lands (deforestation) or through long periods of fallow. However, natural catastrophes, increased pressure on land due to the ever increasing human population and the use of agricultural lands for housing, roads, industry and other human activities have caused reductions in both the forest cover and the fallow period. These developments have also resulted in a general decline in fertility of soils and subsequently marginal lands are sometimes used for yam production. Farmers in most yam producing areas in Ghana continue to crop such infertile lands with little or no added external sources of nutrient elements to improve crop yield. Hence yields continue to decline.

Major constraints identified for large scale yam production include high cost and / or unavailability of planting materials, declining soil fertility, scarcity and high cost of labour and lack of staking materials especially in the Guinea savanna zone of Ghana (Obeng-Ofori, 1998). Other production constraints are insect pests, nematodes and diseases which attack yam both on the field and in storage (Asante et al., 2007).

The project on “Enhancing resilience and Adaptive Capacity to Climate Change through integrated Land, Water and Nutrient Management in Semi-arid West Africa” (ENRACCA-WA) adopted the farms of the future concept (FotF) to enhance the resilience of yam production systems at Demonaayili in the Northern region of Ghana which is situated in the Guinea savanna zone. Majority of the people in this community are engaged in the yam value chain (production through marketing to processing).
The objective of the intervention was to enhance the capacity of yam farmers to produce yam with minimal cost to the environment.

Scope and Methods

Before the initiation of this intervention, the community members were sensitized on climate change in 2013. Researchers from Savanna Agricultural Research Institute of the Council for Scientific and Industrial Research (CSIR-SARI) in collaboration with agricultural extension officers from the Nanumba North District office of the Ministry of Food and Agriculture (MoFA) and members of the Demonaayili community created an Innovation Platform (IP) to address livelihood and yam production problems. All stakeholders (input dealers, tractor service providers, farmers, aggregators, traders and processors) agreed that farmers were the pivot of the yam value chain, so their constraints should be addressed first.
When the farmers were given the chance to catalogue and prioritize their constraints, it emerged that the top three constraints to yam production were (i) low soil fertility, (ii) variable climate and (iii) market outlets for produce.
Other constraints included physical and economic access to yam planting material, sufficient and affordable supply of labor, and timely access to inputs and tractor services. It also emerged that farmers did not apply any form of fertilizer to yam because they believed that fertilizer, especially the mineral fertilizer, reduces both its palatability and shelf life.
In 2014, a demonstration plot was established at Demonaayili to serve as a participatory learning center for the integration of the application of external organic and / or inorganic sources of fertilizer in the production of yam.
The demonstration plot involved two contrasting yam cultivars and four soil amendment treatments. The yam cultivars were Laribako (an early maturing cultivar with premium quality) and Alondo (a late maturing cultivar with high yield potential). The fertilizer treatments were: (i) Control – no soil amendment; (ii) 4t/ha of organic fertilizer, (iii) recommended rate of inorganic fertilizer – 64-38-38 kg/ha as N, P^2O^5 and K^2O respectively and (iv) combined use of 2t/ha of organic fertilizer and half rate of inorganic fertilizers - 32-19-19 kg/ha as N, P^2O^5 and K2O respectively. To promote a sense of ownership, community members provided labour for mounding, weeding, fertilizer application, harvesting and any other cultural practices required on the field. All other resources such as inputs (seed and fertilizers) were provided by the project.

In 2015, the project was expanded to Makayili and Binchera with 5 farmers in each community participating in an out-scaling scheme.
Participatory learning sessions were organized every fortnight (on Fridays to guarantee the participation for majority of community members) to ensure that community members made critical observations on the field.
Technology dissemination pathways adopted to enhance the capacity of the community members, especially the producers to improve yam productivity were:

1. Community workshops to sensitize local stakeholders on the value of soil organic matter for nutrient supply, water holding capacity of soil and biodiversity in the soil.
2. Training of Farmers - We instituted monthly innovation platform meetings to plan and review project activities as well as discuss good agricultural practices (GAPs) for yam.
We also trained community members on interpretation of early warning information.
3. Established a demonstration plot which served as a learning center for the farmers.
These learning centers served as good sites for research, training and demonstration as well as good interactions between researchers, extension staff and farmers
4. Field days at key growth stages of yam - for example a field day was organized to showcase the effects of the various fertilizer treatments on the growth of yam. This was attended by 110 participants draw form Demonaayili, Pusuga, Makayili and Binchera and comprised of 69 male and 41 female.
5. Mounted two rain gauges and trained the community members to read and record rainfall.
6. E-communication - We also enrolled 10 community members onto a weather information dissemination platform (Esoko).
7. As part of our community outreach programme, CSIR-SARI also collaborated with the Ghana Meteorological agency (GMET) and a local FM station in Tamale (Radio North Star) to provide climate information services.
Capacity building on the interpretation and use of climate information was done during the IP meetings from November 2014 to January 2015.

Details on Findings

Organic fertilizer is crucial for sustainable yam production in Nanumba North District

Yam tuber yields were highest on the plots treated with 4t/ha of organic fertilizer than all the other treatments. Yam yields recorded for each of the plots with fertilizer treatments were higher than for the control. Yield advantages for the fertilizer treatments (over the control) ranged from 34% (sole inorganic fertilizer) to 98% (sole organic fertilizer). Benefit cost ratios showed that applying any form of fertilizer would result in higher returns to investment (2.8 to 3.3) than when no fertilizer is applied (2.5). In general, returns to investment for applying organic fertilizer alone was the highest followed by integrated use of organic and inorganic fertilizer.

Figure 1: Tuber yield of Alondo (full season culti-var) in response to sole organic fertilizer (top) and no fertilizer (bottom) at Demonaayili in 2014

Application of organic source of nutrients could widen the planting window for yam
The normal planting window for yam in the study area is November to March, but the demonstration plot was ploughed and harrowed in the first week of May and mounding was done in the second week of May. Sowing was done from May 8-10, 2014. No farmer in this community would normally plant yam after the end of March as this period is normally considered too late for the planting of yam in this area.
However, the plots with external fertilizer input, especially those planted to the full season cultivar, produced comparatively more and bigger tubers than those from a nearby farm on which the same variety was sown in December, 2013 without any fertilizer addition which is a normal practice in this area.

Full season yam cultivar was more responsive to organic fertilizer than early maturing.
Yam tuber yield advantages of the fertilizer treatment (over the control) for the early maturing variety ranged between 6% (sole organic fertilizer only) and 34% (organic + inorganic fertilizers) while those for the full season cultivar ranged between 45% (sole inorganic fertilizer)
and 160% (sole organic fertilizer only). For each treatment, higher tuber yields were recorded for the full season cultivar than the early maturing one. Yield advantages of the full season cultivar (over the early one) for the fertilizer treatments ranged between 44% (control) and 250% (sole organic fertilizer).

Organic fertilization resulted in healthy yam plants under intermittent dry spells
In 2015, as part of an out-scaling scheme, fifteen (15) farmers were supported with organic fertilizer (Fertisol) to apply on the full season yam cultivar on their own farms. A prolonged dry spell from the middle of May to the middle of July resulted in heavy losses to yam farmers (with total crop loss on some farms), but the crops of those who applied the organic fertilizer suffered very little setback.