Pigeon peas could work for smallholder African farmers in multiple ways

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Over 20% of residents of sub-Sahara Africa are smallholder farmers who live below the poverty line. They are consequently un-able to access sufficient and nutritionally balanced food, proper medical care, education and other basic requirements. Pigeon pea production presents a great potential for improving livelihoods for these resource poor African farmers as it can grow well even with limited fertilizer and it is highly nutritious. This is because, pigeon pea uniquely combines nutritional benefits, high tolerance to environmental stresses and impressive economic returns.

Pigeon peas grow in a variety of agro-ecological zones, and are well adapted to semi-arid climate conditions under a wide variety of cropping systems. It is widely grown across sub-Saharan Africa (SSA) countries, with the leading producers being Kenya (164,000 ha), Uganda (113,000 ha), Malawi (110,000 ha), Tanzania (33,000 ha) and Mozambique (Kimani, 2000).

Benefits of pigeon pea

Pigeon peas have ability to fix up to 235 kg N ha^{-1} (Peoples et al., 1995) and produce more N per unit area from biomass than many other legumes (Chikowo et al., 2004). Pigeon pea enriches soil through symbiotic nitrogen fixation and provides farmers with valuable organic matter and micronutrients.

As pigeon pea is often planted either as intercrop or in rotation with cereals, this fixed N is crucial for nutrition of associated cereals boosting the overall amount of food that farmers can produce irrespective of their in- ability to afford sufficient N fertilizers which are often expensive and in short supply in most African countries.

In Tanzania, Myaka et al. (2006) demonstrated that maize yields from unfertilized maize intercropped with pigeon pea could equal the yields of moderately fertilized sole maize.

In west Africa, Sogbedji et al (2006) demonstrated a maize crop yield increase of 32% when maize was planted in association with pigeon pea. Nitrogen fixation rates for pigeon pea in Africa were estimated to range from 40 – 97 kg/ha with leaf drops contributing up to 40 kg/ha of nitrogen to the system (Mafongoya et al., 2006).

Under rotation cropping, the residual N usable by the rotated non fixing crop could be as much as 40 kg N ha^{-1} (Odeny, 2007) translating to savings of more than US$ 60 ha^{-1} that could have been used for purchase of N fertilizers. These type of savings are crucial in SSA households as they are useful for other crucial needs like education and medical care.

Pigeon peas have a deep rooted system that helps to break hard pans, improve water infiltration and mines nutrients and moisture from the lower soil layers (Mafongoya et al., 2006). They have also been used effectively as cover crops, mulches and forage improving soil fertility, weed competition/suppression and increased arthropod diversity (Odeny, 2007).

Economic potential of pigeon pea production

In SSA pigeon pea is grown by smallholder for both subsistence and cash returns. A large market exists both regionally and internationally for whole and a range of processed pigeon pea products from Africa. Indeed the demand for processed pigeon pea products on the local, regional and export markets in Asia, North America and Europe outstrips supply by over 30% (Odeny 2007) and the value for pigeon pea stands at about US$ 700 per ton against approximately US$300 per ton for cereals. This suggests a potential for more than doubling household incomes when pigeon peas are included in the cereal cropping systems.

Research has shown that fertilization of pigeon pea increases yields by 70% and maize yield by 200% boosting net annual returns by US$ 200 ha^{-1}. Net returns increase even further when fertilizer application is coupled with use of high yielding pigeon pea seed varieties (USAID, 2011).

Best management practices for pigeon pea production

Once the right variety is acquired and the climate is favorable, then management is the next key determinant of pigeon pea yields. In this section, we focus on the role of fertilizers and pest/disease control on pigeon pea performance.

Often most African soils are poor with high acidity, low P and K levels. When this is the case, a number of soil amendments including liming and fertilizer application (especially P and K rich fertilizers) are required to boost pigeon pea yields. One essential, function of P is in energy storage and transfer where ADP and ATP act as energy currency within the plant. This is crucial for growth and N fixation. Short supply of P may decrease nitrogenase activity and ATP concentration in nodules decreasing the ability of the plant to fix N and thus meet its N requirements. The effect of P on N fixation by pigeon pea can further be boosted by rhizobial inoculation. Recently pigeon pea yield increase of about 70% was observed when planted with P at a rate of 20 kg ha^{-1} in southern Tanzania (AGRA, 2012).

K is related to several important functions such as enzyme activation, water and energy use relationships, translocation of assimilates and protein synthesis. P deficiency could reduce pigeon pea yields by over 30% (Chauhan et al., 1992).

The production of pigeon pea is however constrained by a range of other biotic and abiotic factors particularly the crop being sensitive to photoperiod, susceptibility to diseases especially fusarium wilt and a broad range of insect pests (Gwata et al., 2006).

Insect pests like pod boring Lepidoptera and pod sucking bugs can reduce yields by more than 10%. Recent surveys indicate that Fusarium wilt (*Fusarium udum Butler*), sterility mosaic disease (SMD), leaf spot (*Mycovellosiella cajani*) and to a lesser extent powdery mildew (*Leveillula taurica*) are diseases of economic concern in relation to pigeon pea production (Odeny, 2007). It is therefore crucial to manage these pest and diseases to avoid losses.

Challenges facing pigeon pea production

Pigeon pea production in Africa faces a myriad of challenges. Despite its importance especially in the semi-arid tropics, little concerted research effort has been directed at either crop improvement or technology transfer. As is the case with most other grain legume crops, most private companies are often unwilling to invest in improvement of pigeon pea germplasm due to the low profits associated with legume seed breeding and multiplication and the training of most extension workers is geared towards cash crops and cereals. Additionally, majority of the African farmers are poor and therefore unable to afford sufficient fertilizers and herbicides to boost pigeon pea production. Even in situation where farmers manage to deal with all the production constraints, farmers' access to good markets is poor. Most of the time, they are therefore exploited by unscrupulous middlemen leading to low motivation to continue the production.

Opportunities for improved production

Great opportunities for boosting farmers' livelihoods through pigeon pea production exist. These include:

i. The existence of good pigeon pea market prices which could be exploited to guarantee good returns to investment for farmers.
ii. A number of African countries have enacted policies to increase grain legume production in an attempt to exploit the benefits of N fixation and thus reduce the national fertilizer bill.
iii. Research institutions, such as ICRISAT have identified higher yielding and pest/disease resistant varieties that are favourable for African soils.
iv. There is increasing support from development organizations, to boost the capacity of NARS, African universities, CGIAR centers and other stakeholders to develop additional technologies for boosting the productivity of pigeon peas.

Conclusion

There is sufficient evidence to suggest that improved pigeon pea production can boost food security and improve household incomes. For, best production, there is a need to make use of improved seeds, P fertilizer, good extension services and favorable market. Implementation of improved production of pigeon pea in African smallholder farming systems therefore require public investment/support in the areas of input supply/access, extension services and output market. Once this is done properly the system has a potential for running itself with minimal external support.

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