Pigeon peas could work for smallholder African farmers in multiple ways

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Overview

Over 20% of residents of sub-Sahara Africa live below the poverty line. They are therefore unable to feed themselves and get access to other basic needs. Even in situations where they have access to land, they are unable to afford sufficient fertilizers and other farm inputs to produce efficiently. Pigeon pea production presents a great potential for improving livelihoods for resource poor African farmers as it can grow well even with limited fertilizer and water and fix N that can boost nutrition of associated cereals. This brief highlights the potential contribution of pigeon pea to food security, income, the best management practices and policy implications for improved production.

Introduction

Pigeon peas grow in a variety of agro-ecological zones, and are well adapted to semi-arid climate conditions. In sub-Saharan Africa (SSA) it is widely grown in Kenya, Uganda, Tanzania, Malawi and Mozambique for subsistence and for domestic and international markets. Despite potential yields of about 5 t ha^{-1} (Kimani, 2001), pigeon peas yield less than 1 t ha^{-1} in the farmers fields (FAOSTAT, 2008). As droughts become common and dry lands expand due to climate change, pigeon peas will continue becoming important for managing food security and nutritional situation in Africa. This is because pigeon pea is often the only crop that gives some grains during the dry spells, when other grain legumes and cereals wilts and dries up as a result of moisture stress (Okiror 1986). Additionally, unlike other legumes, pigeon pea is one of the few crop species that can utilize iron bound P efficiently (Subbarao et al., 1997) making it capable of producing appreciable yields even under P limiting conditions which are widespread in SSA.

Besides, protein rich grains which are crucial for nutrition security especially because over 40% of households in SSA are not able to afford sufficient animal proteins, 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. As pigeon pea is often planted either as intercrop (see caption 1) 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 ability to afford sufficient N fertilizers. 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. Similarly, in west Africa, Sogbedji et al (2006) demonstrated a maize crop yield increase of 32% when maize was planted in association with pigeon pea. Under rotation cropping the residual N usable by the rotated not fixing crop could be as much as 40 kg N ha^{-1} (Nene, 1987). This translates to savings of more than US$ 60 ha^{-1} that could be used for purchase of N fertilizers.

 

Caption 1: Pigeon pea growing in a mono-cropping and an intercropping system between 2007 and 2012 (Photos adopted from ICRISAT)

Economic potential of pigeon pea production

A large market exist both regionally and internationally for whole and 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$300 per ton for cereals. This suggests a potential for more than doubling household incomes when pigeon peas are included in the cereal cropping systems. In southern Tanzania, fertilization with 20 kg P ha^{-1} increased pigeon pea yields by 70% and maize yield by 200% boosting the net annual returns by about US$ 200 ha^{-1}. Net returns increase even further when fertilizer application is coupled with use of high yielding pigeon pea seed varieties. This was the case in eastern Kenya when a group of 225 farmers harvested 108 tons of fresh pigeon peas worth $162,500 after adopting improved short to medium duration seed varieties compared to a baseline of 24 tons worth $37,500 (USAID, 2011).

Best management practices for pigeon pea production

Once the right variety is acquired and the climate is favourable then management is the next key determinant of pigeon pea yields. The most important management practices include; planting dates, planting density, fertilization, inoculation and pest/disease control. 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 the first ameliorations required to achieve good pigeon pea yields are lime, P and K fertilizers. 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 plant to fix N and thus meet its N requirements. 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 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 they were planted with P at a rate of 20 kg ha^{-1} in southern Tanzania (AGRA, 2012). Similar observations have been made for pigeon peas and other legumes within the AGRA supported projects in Kenya, Malawi and Uganda. Inoculation boosted pigeon pea yields further by up to 30% above the yields resulting from P fertilization especially on those sites where pigeon peas were being planted for the first time. P is however not as big problem with pigeon peas as it is with other common grain legumes because pigeon peas, exude piscidic acid which enhances the availability of phosphate from iron-phosphate and rock-phosphate (Ae et al., 1990).

Pigeonpea yields can be reduced significantly by pests and diseases. 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). *Fusarium* wilt, a soil borne disease, is especially prevalent in East Africa, where field losses in excess of 50% are common (Marley and Hillocks, 1996) but recently it was reported to be spreading to southern Africa (Gwata *et al.*, 2005). It is therefore crucial to manage these pest and diseases to avoid such losses.

Challenges facing pigeon pea production in Africa

Pigeon pea production in Africa faces a myriad of challenges. First the private companies are unwilling to invest in production of improved varieties due to the low profits associated with legume seed breeding and multiplication. Secondly, majority of the farmers are poor and therefore un able to afford sufficient fertilizers and herbicides. Thirdly, most of the African extension services are geared towards traditional cash crops and cereals and fourth, in spite of existence of good markets, often farmers are un able to access the remunerative markets. As a result of market failure, they get low returns to investment, thus decreasingtheir willingness to invest in improved seed varieties and fertilizer to increase productivity.

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, such as AGRA and Bill and Mellinda Gate foundation to boost the capacity of NARS, African universities, CGIAR centers and other stakeholders to develop additional technologies for boosting the productivity of pigeon peas.

Conclusions

There is sufficient evidence to suggest that improved pigeon pea production can boost food insecurity and improve household incomes. For, best production there is a need to make use of improved seeds, P fertilizer, good extension services and favourable market for surplus. Implementation of improved production of pigeon pea in African smallholder farming systems therefore requires 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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