Global Science Research Journals

ISSN: 2437-1866 Vol. 4 (2), pp. 189-191, August, 2016.

http://www.globalscienceresearchjournals.org/

Global Journal of Crop, Soil Science and Plant Breeding

Review

An evaluation on Intercropping and application to banana production in Kenya

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Accepted 23 July, 2016

Bananas are very important in Kenya for domestic consumption and export. They are extensively grown where they are mainly intercropped with short term crops. There has been an increase in the grower interest in using intercropping, growing two or more crops simultaneously on the same land in the development of new cropping systems for their land. Intercropping could reduce management inputs and result in sustainable systems that more effectively use and even potentially replenish natural resources used during crop production for long term management of farmland. While intercropping has been practiced more widely in the developing countries of Central America, Asia and Africa, developed countries have not adopted it well. Some benefits of intercropping to the grower are risk minimization, effective use of available resources, efficient use of labour, increased production per unit area of land, erosion control and food security. This paper discusses the effects of intercropping on pest and disease control, physiology of the crops grown, cultural practices such as date of planting, spacing and plant density, soil fertility and time of planting among other effects and lastly banana production in East Africa in relation to intercropping and declining soil fertility in banana-based cropping systems.

Key words: Sustainable, cultural, food security, crops, efficient, cropping system, management.

INTRODUCTION

Banana Production in East Africa

Bananas (Musa spp. AA) and plantains (Musa spp. AAB) are of major importance as staple food crops in much of Sub-Sahara Africa. The region as a whole produces nearly 30 million tonnes of the crop annually (Gold et al., 1999). Production has increased in recent years but this has been due to increased in area planted rather than increase in productivity. Between 1970 and 2001, the area under banana and plantain in Africa increased from 3.2 to 4.7 million hectares and in the same period yields marginally decreased from 6.16 tonnes per ha 5.99 tonnes per ha.

The largest producer and consumer in East Africa is Uganda which produced 9.5 million tonnes in the year 2001 (Reddy et al., 1992). The crop is produced almost exclusively by small scale farmers and is used almost entirely for home consumption. The type of banana grown is the cooking type (East African highlands banana). It is the main type grown in the East African Highlands. The constraints to banana production are pests, diseases and its perishability. These are the major constraints to banana production. Black sigatoka leaf spot disease (*Mycosphaerella fijiensis*) has spread throughout the region and all the banana cultivars are susceptible (Reddy et al., 1992). Another disease is *Fusarium oxysporum* (Cubense).

This is a soil borne fungus that affects banana production. The fungus is persistent in the soil for many years after infection rendering chemical control impossible.

Nematodes are also a problem in bananas. Nematodes (*Rodopholus similis, Pratylenchus* spp., *Melodygyne* spp., *Helicolylenchus,* M*ultunctus* and weevils (*Cosmo-polites sordidus* are common and cause yield losses due to reduced nutrient up take and toppling of plants viruses such as banana streak virus are also constraints to banana production (Reddy et al.,1992).

Bananas are also very perishable causing losses between farm gate and market. There is need to improve post-harvest handling and storage techniques during periods of over production (Reddy et al., 1992).

Banana intercropping in East Africa

Intercropping is a very common cropping system in East Africa and it is practiced by majority of the farmers mainly due to declining land sizes and food security needs. There has been in grower interest using intercropping pos-sibly because it could reduce management inputs that result in sustainable systems that more efficiently use and even potentially replenish natural resources used during crop production for long term management of farm land. It has been used in the developing countries of Central America, Asia and Afica (Altier and Liebman, 1994) and its advantages are: risk minimization, effective use of available resources, efficient use of labour, increased crop productivity, erosion control, food security (Andrew and Kassam, 1976) and pest control (Wein and Smithson, 1979).

Bananas have perennial characteristics and may be grown on the same piece of land for up to 50 years. Cultivation is through clonal propagation. The usual spacing is 3 by 3 m. When being established crops like beans, coffee, maize and sweet potatoes are intercropped with the young banana plants. When the land was still plentiful, the intercrop would be phased out after a year (two cropping seasons) and farmers would start mulching the bananas. Only a few tree crops such as ficus (*Ficus nataliensis*), Jack fruit (*Artocarpus heterophillus*), and pawpaw (*Carica papaya*) remained in the plantation mainly to serve as wind breaks. In Tanzania coffee-banana cropping system is the most widespread farming practice characteristic of the Kilimanjaro region, Mbeya, Kagera and Arusha areas (Anon, 2008). The benefit to adopting this system versus a pure coffee system is that it offers higher returns to the small holder (Anon, 2008). Bananas can also be inter planted with coconut of any age between 8-25 years but palms of more than 25 years are more suitable for intercropping since the light transmitted increases with increase in age and it is ideal for raising perennial crops (Jodha, 1979; Grossman and Quales, 1993). This happens at the Kenyan coast. Intercropping banana with annual crops can be remunerative. Farmers with limited resources have traditionally multicropped their lands to minimize risks associated with growing a single crop and to ensure more stable subsistence in terms of food nutrition and possible income. Intercrops which can easily be raised in banana plantation at early stages of growth are radish, cauliflower, cabbage, spinach, chili, brinjal, yam and cucurbitaceae crops are grown as intercrops. (Cassava/banana combination is one of the most efficient cropping systems (Bekunda and Woomer, 1996, 1999).

In Uganda bananas are intercropped with pineapple as a source of food and income for the family while pineapples are exported (Grossman and Quales, 1993; Jodha, 1979). Due to the increase in land pressure recently in East Africa intercropping of bananas is now carried out in old plantations and some other crops inter planted between banana plants are vanilla, solanacea crops, fruit trees and sugarcane (Bekunda and Woomer, 1996).

Effects of banana intercropping

Several studies have been conducted to investigate the effect of various intercrops on the performance of bananas with respect to yield, growth and pest incidence. For example there are attempts to investigate bananas in Agro forestry systems. This has been undertaken by small holder farmers with small pieces of land to meet their wood, fodder and food needs (Akeampong, 1995 and 1999). In a study conducted in Burundi to study the effects of nine trees species planted at 4 × 8 m on the yield of bananas planted at 4 × 4 m and beans planted at a density of 1000 plants per hectare., the results showed that none of the trees affected the yield of bananas and beans at their early growth stage. The legume intercrops had no effect on banana yield.

Therefore, land use efficiency of small holder farms in East Africa can be increased by incorporating food and or fodder legumes into banana cropping systems (Ddungu, 1987) Akeampong et al., 1999). In the same study when banana was intercropped with three densities of *Grevilla robusta* of 208, 313 and 0.25 trees per hectare, it was reported that after three and a half years wood volume *of G. robusta* was highest, but banana and bean yields were unaffected (Ddungu,1987). *Cedrela serrata* was found to be the best tree to b *e* intercropped in a banana/bean intercrop (Akeampong et al., 1995; Akeampong et al., 1999). As far as pest management in banana intercropping is concerned it has been reported that the number of *C. sordidus*, banana weevil was lowest in banana intercropped with millet. Yields losses were as high in the intercropped banana and mulched ones (Raman, 2006).

Similar findings were also reported by other workers (Raman et al., 2006). Leguminous crops in the *genera Canavalia muzinna* and *Tephrosia vogelli* have been reported to be having repellent or insecticidal properties against the banana weevils, *C. sordidus* and nematodes (*R. similis*) when intercropped with bananas (McIntyre et al., 1981). In one study it was tested if weevil and nematode populations can be affected under banana intercropped with the legumes such as *Canavolia ensiforms*, *Mucuna pruviens* and *T. vogelli*. It was reported that they caused an attack by banana root neorosis whose incidence was highest in *T. vogelli* intercrop than the banana mono culture. Banana yields were unaffected by the legumes showing that they can be intercropped with bananas (Mcintyre et al., 1981). Similarly banana intercopping with sweet potatoes has reduced the incidence of the root lesion nematode (*Pratylenctius goodey*) in heavily infected banana plants around Lake Victoria Basin (Bekunda and Woomer, 1996). Banana is mostly grown by small scale farmers on an average land size less than two hectares. Nutrient depletion on small holder farms has been cited as the main reasons for the decline

in banana yields (De and Singh, 1979). Soil fertility in East Africa is mainly replenished by the use of organic crop residues (Delvaux, 1996) but many banana residues are not returned to the soil because there have been many alternative uses (Rubaihayo, 1991; Rogers and Dennis,1993).

Inorganic fertilizers could be used to supplement the organic inputs. Unfortunately these have a supply constraint that hindering their uses (Rubaihayo, 1991). According to (Rubaihayo 1991)) soil fertility depletion in small scale farms is largely a consequence of socio economic and policy constraints and distortion. Farmers in East Africa use the following organic resources to replenish soil fertility in banana based cropping systems namely banana stalks and leaves at pruning upon harvest, a practice that may contribute to banana weevil, stem nematode and sigatoka fungal attacks. Banana stalks are also applied as mulches (Bekunda and Woomer, 1996). Farmers apply a wide range of additional resources to banana based cropping systems including field crop residues and burned residues and on farm manures, intercropping with legumes may also be as strategy to offset fertility depletion (Bekunda and Woomer, 1996). With respect to light particularly where Banana is interplanted with big agroforestry trees, it has become adapted to such shaded conditions and its yields are not affected (Senevirathing et al., 2008). Further, some nutrients are absorbed better under intercropping systems (Kurien et al., 2006).

Conclusion

Intercropping is a very beneficial cropping system in East Africa because of its advantages of increasing food security and reducing poverty and increasing soil fertility. It is increasingly becoming important in East Africa where land scarcity is increasing.

Banana is a very important crop in East Africa but due to the fact that small scale farmers also require food security, it should be intercropped with many of the annual crops being grown by farmers to achieve this.

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