Maize-legume rotation and intercropping

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Summary

Cultivating maize and legumes on the same piece of land simultaneously or alternatingly offers multiple advantages as compared to growing the cereal as continuous monocrop. Legumes enhance the amount of nitrogen (N) in soils during and after its cultivation which can be used to tackle constraints on cereal yields in subsistence farming systems because of nutrient limitation and make savings on N fertilizer expenses in commercial farming systems. Rotation and intercropping of maize with legumes make it possible to achieve a high level of land, nutrient and water use efficiency thanks to carry-over and synergistic effects among the two different crops. Mixing of maize and legume is also reducing the infestation rate of weeds, pests and diseases on farmer fields which benefits the productivity of both crops and slows down the spread of organisms that are harmful to agriculture. Rotational and intercropping maize-legume systems have been tested and disseminated with large numbers of farmers in major growing areas of Sub-Saharan Africa, giving rise to substantial increases of maize and legume yields, and total harvests from an area of land. The cultivation of a high-carbohydrate crop and high-protein crop on the same piece of farmland is leading to a more nutritional and balanced diet for subsistence farmers, and also mitigates the risk of a hunger season when one of the crops fails because of drought or pest attacks.

Technical Description

Biological nitrogen fixation taking place in the roots of legumes benefits the productivity of maize crops that are rotated or intercropped on the same field because part of the assimilated nitrogen is transferred between the crops through different soil processes. Mineral fertilizer application in this type of mixed cropping systems are used very efficiently since either of the crop will take advantage of dispersing and residual nutrients. Intercropping of maize and legumes is especially helping to alleviate weed infestation, soil erosion and run-off as the method of cultivation keeps more land covered and protected throughout the growing season. Food legumes like soybeans and forage legumes like desmodium are known to decrease infestations of parasitic Striga weeds in maize crops since these crops will induce germination of Striga spores but do not get attacked by the pest at its roots; with effects being largest under intercropping, and to a lesser extent under rotation. Tall-growing maize crops help to better regulate the temperature of the soil and inside the canopy of legumes grown alongside through shading, which enhances crop water productivity and also optimize light use efficiency. In comparison to monocrop cultures, intercropping typically generates larger returns

from labor, and like for maize-legume rotation enhances the profitability of mineral fertilizer and organic matter inputs.

Uses

Intercropping and rotation is suitable for all maize and legume growing areas in Sub-Saharan Africa, as long as the variety and type of crops is appropriately selected for prevalent conditions. The mixed cultivation method is advantageous in regions or on individual farmer fields that suffer from low nitrogen availability in soils, which is the case for many smallholder farmers that continuously monocrop maize and have limited use of fertilizer, especially in dense-populated highlands where land resources are scarce. Also for intensive maize production systems the intercropping and rotation of legumes has benefits on yields and profits in the short and long term through reductions in fertilizer use and losses to the environment. Intercropping of maize and legumes is very effective for rural communities in which availability of labor is limited as the cultivation method brings down the total time spent on farm and crop management. The improvement of soil fertility and crop nutrition that is realized in mixed maize-legume systems contribute to strengthening the climate resilience of food systems and the communities that draw income from them.

Composition

Rotation and intercropping of maize can involve a large range of food legumes such as common beans, pigeon peas, cowpeas, groundnuts and soybeans, as well as legumes grown for animal fodder like desmodium, velvet beans and jack beans. The type of legume that is mixed with maize can be chosen by farmers to in line with agro-ecological conditions, production needs, eating habits and value:cost factors. Improved varieties of both crops that are adapted to specific conditions in growing areas should be used to get maximal benefits out of double-crop cultivation method.

Means of application

The approaches used for cultivating a maize-legume rotation or intercrop are the same like when growing a monocrop culture. For intercropping, the two crops can be planted simultaneously or in relay so their growth and harvest are aligned with farmer conditions and needs. Different layouts can be used for intercropping, with maize and legumes planted on alternating rows, in strips of 2-3 rows or randomly scrambled across rows. If mixed with common beans, soybeans or peas, the maize crop can be planted at its usual density and the legume in between, while for large growing legumes the spacing of maize crops needs to be adjusted. Legume crops should be inoculated with an elite strain of N-fixing microorganisms to maximize carry-over effects on maize.

Agroecologies	All Agroecologies.
Regions	Africa.

Developed in Countries	Uganda, Tanzania, Rwanda, Nigeria, Mozambique, Malawi, Kenya, Ghana, Ethiopia, Democratic Republic of the Congo, Cameroon, Burkina Faso, Benin.
Available in	Uganda, Tanzania, Rwanda, Nigeria, Mozambique, Malawi, Kenya, Ghana, Ethiopia, Democratic Republic of the Congo, Cameroon, Burkina Faso, Benin.
Solution Forms	Management.
Solution Applications	Soil fertility management.
Agricultural Commodities	Maize.
Target Beneficiaries	Small-scale farmers, Commercial farmers.

Commercialization

Commercialization Category

Commercially available

Startup Requirements

1) Educate farmers about the benefits of maize-legume rotation and intercropping, 2) Advise farmers on suitable methods for mixed cultivation and varieties to grown depending on local contexts, 3) Get high quality seed of maize and legumes, and 4) Purchase mineral fertilizer and legume inoculants.

Production Costs

Legume cultivation is associated with higher labor costs and often lower farmer incomes as compared to maize, which makes that mixing the two crops provides an avenue to balance and diminish investment needs for smallholder farming systems in Sub-Saharan Africa. Intercropping systems of maize and legumes usually have greater planting density than monocrop cultures and thus bears a greater cost of seed and fertilizer per hectare for farmers. Planting maize and legumes simultaneously on a cropland usually requires a relative higher degree of labor but these expenses are offset by savings in time spent on weeding and pest/control.

Customer Segmentation

Agro-input dealers, Subsistence and commercial maize and legume farmers

Potential Profitability

Basic research and agricultural development programs in Sub-Saharan Africa have found that maize grain yields are increased by 0.5 - 1 ton per hectare when cultivating after a legume rotation as compared to a continuous maize monoculture. Yields of maize on croplands with a high infestation rate of Striga weeds in Kenya were found to go up by 90% when planted after a soybean rotation. In Burkina Faso, Cameroon, Kenya, Malawi, Nigeria and Zimbabwe it has been found that 30 to 70 kilogram of nitrogen is carried over from soybean to maize crops that are grown as a rotation, and in some cases also made that phosphorus was more accessible to the cereal. This can translate into major savings on mineral fertilizer inputs by farmers, which reduces risks and increase profit margins. Mixed maize-legume cultures are able to maintain a high level of agricultural productivity for many years, which renders this type of cropping system to be more valuable and sustainable over time in comparison with

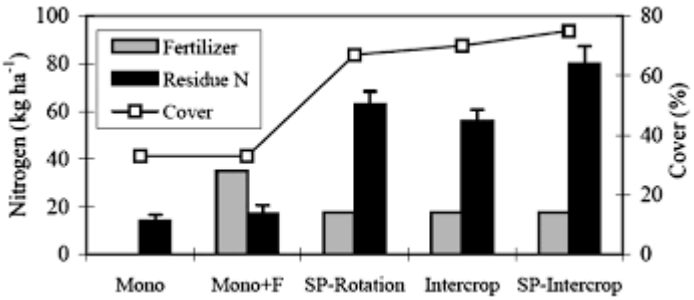
Licensing Requirements

No commercial or environmental licenses are needed for mixed maize-legume cultivation.

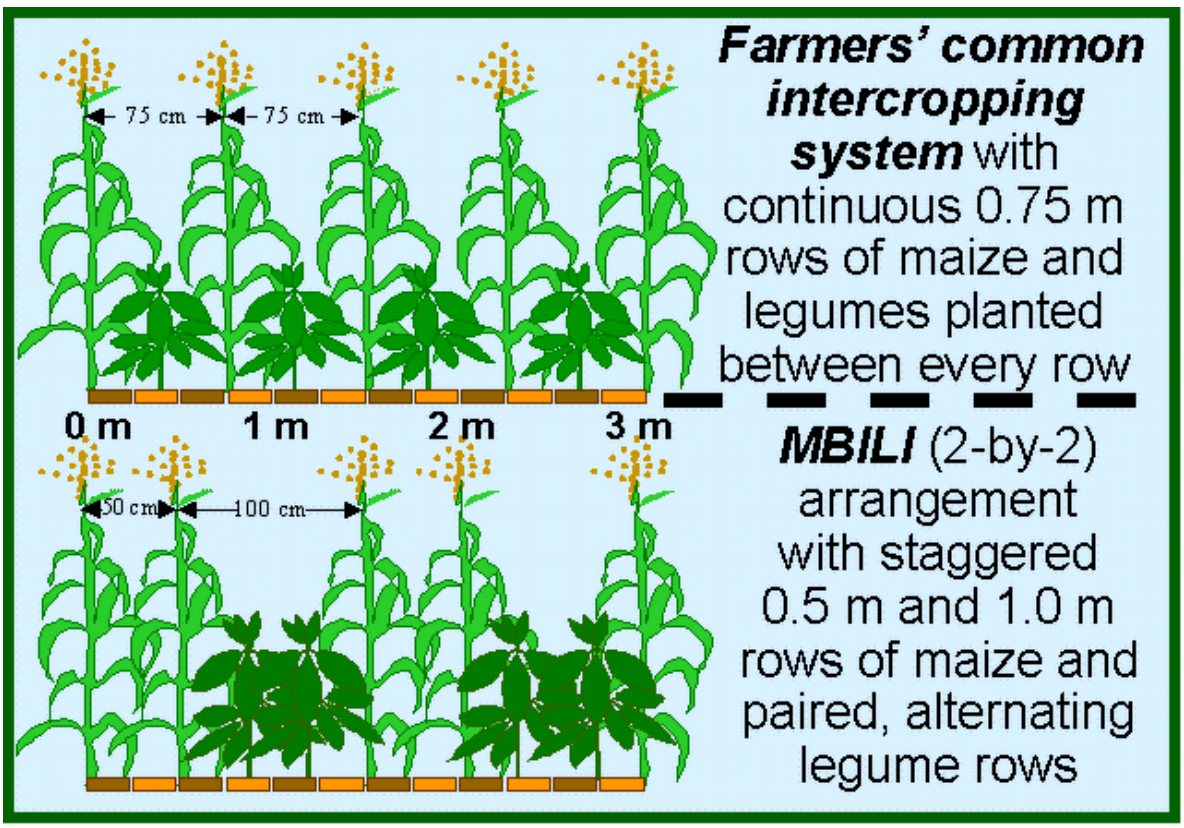
Innovation as Public Good

Knowhow connected with intercropping and rotation of maize with legumes is a regional public good. Development of the technology is a responsible of the International Institute of Tropical Agriculture and the African Agricultural Technology Foundation.

Solution Images



Labour productivity…soil fertility



Institutions

Accompanying Solutions

Drought tolerant varieties (DTMA, WEMA, others), Specialized pre-plant fertilizer blending and N topdressing, Fall armyworm control (e.g. FORTENZATM Duo)