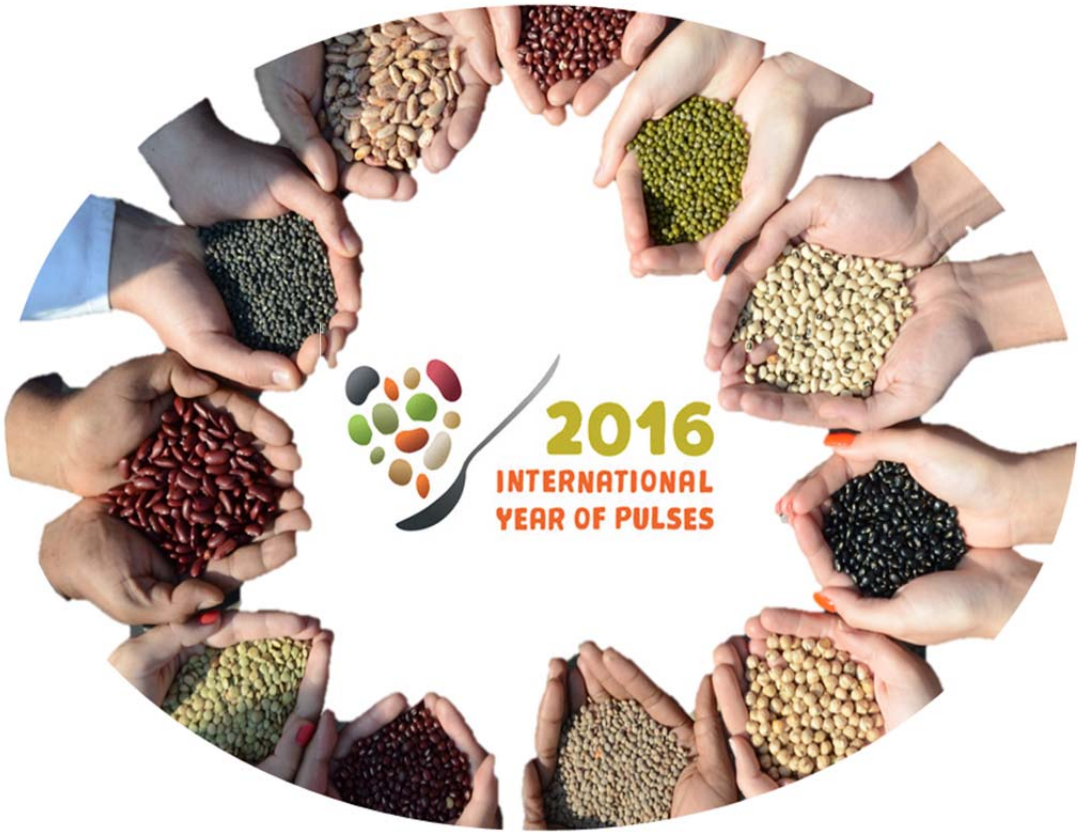
Joint FAO/IAEA Programme
Nuclear Techniques in Food and Agriculture

2016 INTERNATIONAL YEAR OF PULSES

SOILS AND PULSES

MANAGING SOILS FOR SUSTAINABLE PULSE PRODUCTION



Important Facts about *Pulses*

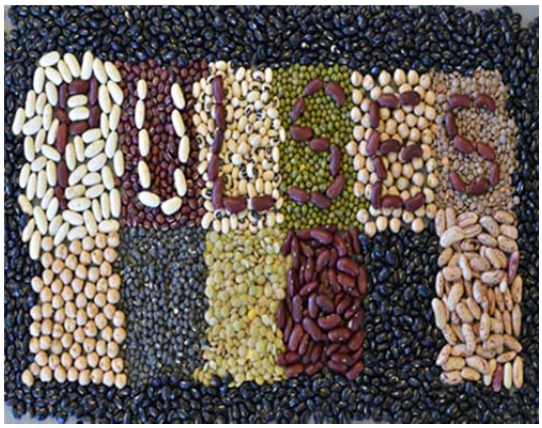
Food security and boosting human health & wealth

- Pulses are source of plant-based-proteins, amino acids and other nutrients to human diets.
- They contribute more than 10% of per capita total protein intake in more than 25 countries in Africa and Latin America.
- Pulses cover 57.3 million hectares, one-tenth of all cereal crops. Global production is 40 million tons; with average yield is 0.86 tons per hectare compared to 3.5 tons per hectare for cereals.
- Global pulse production comprises dry beans (46%), fababeans (10%) chickpea (22%), cowpeas (7%), lentils (7%) and pigeon peas (7%).

Ecological and soil health

- Pulses boost soil fertility and reduce the need for industrial nitrogen fertilizers because they fix nitrogen (N) from the atmosphere and provide organic matter to soils.
- When included as a rotation crop with cereals, it could save up to 88-350 kilograms of nitrogen per hectare.
- The pulse-cereal rotation helps to control weeds and reduce disease and pest infections.
- Pulses extract water and nutrient from deep soil through their deep (tap) roots that minimise the impact of water stress.
- It produces lower carbon and water food prints compared to cereals: Their water footprint to produce a kilogram of pulses is 18, 11 and 5 times lower than the water footprint to produce similar amount of pork, chicken and soybeans.
- When grown as cover crops, pulses are effective in controlling soil erosion.
- Pulses reduce nitrous oxide (N_2O) emission because of minimal N inputs via chemical and organic fertilizers.
- Pulses support a large and diverse population of soil organisms (including microbial population) and therefore promote/enhance biodiversity in soil.

What are pulses?



Pulses are leguminous crops yielding between one and 12 seeds of variable size, shape and colour within a pod. They include dry broad beans, dry peas, lentils, pigeon peas, cowpeas, chickpeas, Bambara groundnut, vetch, lupins broad beans, lablab etc. They offer nutritional security and a major source of plant-based proteins/amino acids for large number of human populations. Thus, pulses are an important part of the general food basket globally. Recently there have been shifts in the pattern of consumption from meat-based diet to pulses in many developed countries, where they are increasingly considered as 'health' foods.

Pulses fix nitrogen in the soil and reduce the need for industrial nitrogen fertilizers and therefore boost soil fertility. When included as a rotation crop with cereals, it could save up to 88-350 kilograms of nitrogen per hectare, helps to control weeds and reduce disease and pest infestations. It is reported that pulses help to lower carbon and water food prints compared to cereals. However, pulses crops have not received the same attention and production resources at the farm level compared to cereal crops.

On the occasion of the 2016 International Year of Pulses, this Brochure gives a brief summary of the work on biological nitrogen fixation of the Soil and Water Management and Crop Nutrition (SWMCN) Subprogramme of the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture. The Brochure also showed the work of the SWMCN on the roles of pulses in improving soil fertility and in reducing greenhouse gases (GHGs) emission from agricultural production systems.

Pulses for soil fertility and sustainability of cropping systems

1 Pulses fix nitrogen and reduce the need for fertilizers

Nitrogen (N) is the most essential plant nutrient, and is the most deficient in soils contributing to reduced crop yields throughout the world. Fortunately, on the average pulses could fix up to 123 kilograms of N through biological fixation of atmospheric N_2, a process which not only reduces fossil fuel energy input costs, but also providing a more sustainable crop yield and agricultural production. Pulses fix N through nodules formed on their roots, with the bacteria (rhizobia) in these nodules converting the atmospheric N_2 into ammonia (NH_3) and absorbed by the plant. The annual global input of atmospheric N_2 fixed biologically amounts to 2.95 million tons.

The Soil and Water Management and Crop Nutrition (SWMCN) Subprogramme of the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture for the past thirty years

has been assisting Member States in various parts of the world on the development of ^{15}N isotopic methodology to identify pulses and legumes with high nitrogen fixing abilities and to quantify the amount of nitrogen fixed, to improve yield and enhancing soil fertility, for sustainable farming systems. The methods of inoculum production for specific pulse species and the use of these inoculums have helped to increase pulse yield and nitrogen fixation by the pulse plants.

The work of the Joint Division showed that the nitrogen fixation capacity of pulses ranged greatly from 35% in common bean to as high as 75% in Fababean over a wide range of environmental conditions. There was also considerable genotypic variation in N fixation between cultivars of the pulses. The availability of phosphorus in the soil is the key to optimize the amount of nitrogen fixed by legumes.

2 Soil fertility improvement by the inclusion of pulses in cropping systems

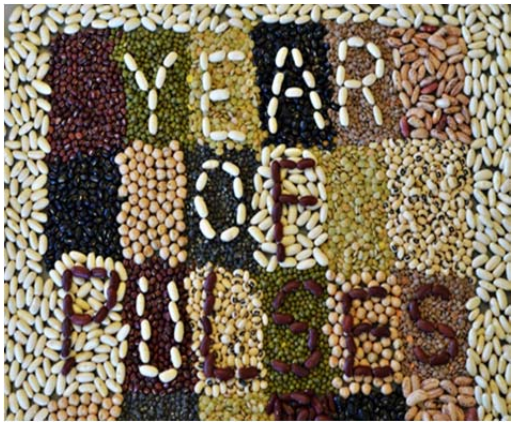
The Joint FAO/IAEA Division's work showed that yield increases from 20% to 34% have occurred when spring wheat or barley is followed by a crop of peas. In India and Bangladesh the use of pulses has been re-invigorated by successful inclusion of short duration pulses (lentil, mung bean and pea) into new cropping niches, e.g. within a rice- and wheat-based system. Here, cereal grain yields were sustained and residual N increased through the use of short duration pulses in the Indo-Gangetic Plains in India and in western Bangladesh.

Pulses for climate change mitigation

Soil can be both a source or sink of greenhouse gas such as carbon dioxide (CO_2) and nitrous oxide (N_2O), depending on land uses and management practices. The Soil and Water Management and Crop Nutrition Subprogramme in the Joint FAO/IAEA Division is currently developing protocols to measure CO_2 and N_2O GHG emissions in legume-based cropping systems. Field studies using isotopic technique in Latin America showed that the N_2O emission factor (amount of nitrogen emitted as N_2O as percentage of applied N) was influenced by N inputs from green manure of pulses. The emission factors were 0.47% for jackbean and 0.80% for velvet bean compared to 1% for chemical fertilizer, implying low N_2O emission from pulses.

Conclusions

Pulses are good for human, soil and ecological health. They play major role in food security of the poor in many developing countries. Pulses contribute to soil fertility improvement and climate change mitigation by counterbalancing the increased GHGs emissions. Despite its important role in improving the sustainability of agricultural cropping systems, mitigation to the effects of climate change, pulse crops have not received the same attention and production resources at the farm level compared to cereal crops.



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