



SAVE AND GROW FARMING SYSTEMS

FACT SHEET 4



WHEAT/LEGUMES

Agro-ecological zone

Temperate, sub-tropical rainfed and irrigated

Main cereal Wheat

Other crops

Grain and forage legumes

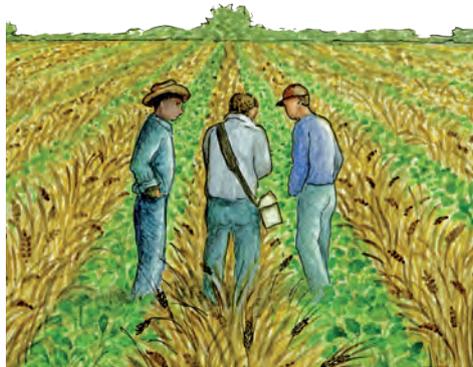
The extra benefits of legumes-before-wheat

Growing legumes can be a very good investment in its own right. Since they derive 70 to 80 percent of their nitrogen needs from the atmosphere, through biological nitrogen fixation in their root nodules, grain and forage legumes generally do not require nitrogen fertilizer to achieve optimum yields.

Grain legumes, such as lentils, are high in protein, dietary fibre, vitamins, minerals, antioxidants and phyto-estrogens and can be sold to generate income. Forage legumes, such as alfalfa, can be used on the farm to feed livestock.

When grown before wheat, legumes produce another significant benefit – nitrogen in legume residues reduces the need to apply nitrogen fertilizer to the wheat crop. It is estimated that globally, some 190 million ha of grain legumes contribute around 5 to 7 million tonnes of nitrogen to soils. Thanks to that ‘natural fertilization’, wheat grown after legumes produces higher grain yields and has higher protein content than wheat grown after another wheat crop.

The high productivity of wheat-legume rotations has long been recognized by wheat farmers, and for as far back as 2 000 years



ago in Western Asia and North Africa. Typical rainfed wheat-based rotations include grain legumes, such as chickpeas, lentils and faba beans, and the forage legumes vetch, berseem clover and *Medicago* species.

Choosing the right legume for a specific wheat farming system is extremely important, as

different legume species and varieties growing in the same location can differ significantly in dry matter production, nitrogen fixation and accumulation, and residue quality. Residual nitrogen values from grain legumes vary greatly, but can cover between 20 and 40 percent of wheat’s nitrogen needs.

While grain legumes can add to the soil from 30 to 40 kg of nitrogen per ha, legumes grown as green manure crops or as forage for livestock build up nitrogen much faster, and can fix as much as 300 kg of nitrogen per ha.

KEY POINTS

Plant residues from forage legumes add to the soil up to **300 kg of nitrogen per ha**.

Chickpeas and pigeon peas secrete organic acids that facilitate **wheat’s access to soil phosphorous**.

Wheat grown after legumes produces higher grain yield with **higher protein content**.

In Ethiopia, rotating faba beans and wheat produced **77 percent more wheat grain** while reducing fertilizer applications.

Short-duration **legume varieties grown in summer** enhance soil fertility and increase water-use efficiency.

Zero-tillage and surface residues help realize the full benefits of legume rotations.

Legumes enhance wheat’s uptake of other nutrients. Wheat grown after legumes tends to have a healthier root system than wheat-after-wheat, making it better able to use other available nutrients. The roots of chickpeas and pigeon peas secrete organic acids which can mobilize fixed forms of

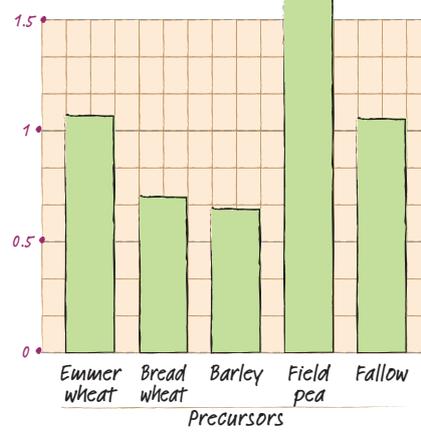
soil phosphorus and make it more readily available.

Legumes also release hydrogen gas into the soil, at rates of up to 5 000 litres per ha per day. A by-product of nitrogen fixation, hydrogen is oxidized by soil microbes surrounding the root system of the plant, leading to changes in the soil biology that improve the development of the wheat plant. Deep-rooting legumes such as pigeon peas, lablab and velvet beans help build soil structure and biopores, which improve drainage and aeration.

Wheat sown in the autumn and followed by a summer fallow is the predominant production system in dry areas. In the Middle East and North Africa, fields are commonly left fallow owing to the lack of sufficient moisture to sustain reliable production of rainfed summer crops. However, with the development of early maturing legume varieties, farmers can now replace long fallows with legume crops, which make more productive use of land. Growing food legumes in summer not only helps enhance soil fertility and water-use efficiency, but boosts yields of the subsequent wheat crop.

In the highlands of Ethiopia, pulses are grown in rotation with cereals, or as intercrops, to spread the risks of drought and to improve soil fertility. In the Bale region, wheat after field peas significantly out-yields wheat-wheat and wheat-barley rotations. A faba bean-wheat rotation system resulted in wheat yield increases of up to 77 percent while reducing the need for nitrogen fertilizer. In the Islamic Republic of Iran, cereal-legume intercropping has been shown to be more productive and profitable than wheat monocropping.

Yields of bread wheat grown as a second crop following selected precursors, Bale Region, Ethiopia (t/ha)



Managing legumes to achieve 'win-win' outcomes – a profitable legume and maximum benefits for the subsequent wheat crop – is complex for many farmers. Legumes are generally seen as more risky to grow than wheat or other cereals. This is partly because legumes are often more susceptible to biotic and abiotic stresses, which can reduce yields and plant biomass. If the legume fails to produce enough biomass to yield well and also leave residual nitrogen in straw and root residues, the smallholder loses income in one growing season without compensation in the next.

In addition, prices for grain legumes are often more volatile than for cereals.

Due to their shorter growing season, some legume crops do not remove as much soil water as wheat, and leave more residual moisture for the wheat crop. However, this moisture can be easily lost if the legume residues are heavily grazed or removed for other purposes. It is recommended, therefore, that residues are left as a surface cover and wheat is drill-seeded with minimum soil disturbance.

To manage risk, farmers are advised to plant legumes only when there is sufficient moisture stored in the soil profile, or available as irrigation. While early planting enhances biomass production and nitrogen fixation, it can also increase susceptibility to pathogens. To realize the full benefits of wheat-legume rotation, residues should be retained on the soil surface, and both legumes and wheat crops should be established with zero-tillage to conserve soil structure, soil water and soil nutrients.



Adapted from:
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Contact

Plant Production and Protection Division
Food and Agriculture Organization of the United Nations
Viale delle Terme di Caracalla, 00153 Rome, Italy

AGP-Director@fao.org
www.fao.org/save-and-grow