Faba Bean Fertilization in Morocco

By K. Daoui, M. Karrou, R. Mrabet, Z. Fatemi, and K. Oufdou

Faba bean represents one of the important annual food crops grown in Morocco.
Research is showing that fertilizer, mainly P, management can contribute significantly to the increase of faba bean yields.

Food legumes (beans, chick peas and lentils) are very important for the nutrition of humans and animals, as well as for sustainable farming in Morocco and throughout North Africa.

Faba bean (*Vicia faba* L.) has many important advantages, both during its planting year and for crops that follow in rotation. These advantages include a large biological N fixation potential, and its positive impact of improving soil structure and health. Interest in legume crops is increasing as a means to ensure food and feed security, and as a benefit to soil ecology. However, productivity of food legumes in Morocco has remained low and variable. One possible reason for this is the absence, or the limited use, of mineral fertilizers. According to national statistics, about 50% of farmers use mineral fertilizer in food legumes, despite its well documented contribution to improving yield.

Nitrogen

The N requirement of faba bean is high, with about 80% of its need commonly from biological fixation (Zapata et al., 1987). Although the crop can fix N, it is often suggested to apply small amounts of fertilizer N at planting. The application of 20 kg N/ha at planting time has been shown to be beneficial for faba bean to enhance biological fixation (R'kiek, 1994). Daoui et al. (2010) indicated that this N application could be avoided because of the indeterminate growth habit of the crop, and limited rainfall.Their research showed that the application of 30 kg N/ha in different agro-ecological conditions, and with different varieties, had no significant effect on grain yield but instead reduced nodulation (**Figures 1** and **2**).

Phosphorus

In their study on the impact of P application on faba bean productivity Daoui et al. (2009) observed a positive effect of P fertilization on crop growth (i.e., leaf area, flowering, root growth, etc.) and grain yield. Maghraoui et al. (2014) showed that the inoculation of faba bean plants with phosphate-solubilizing rhizobia increased the plant dry weight and P uptake.

The response of faba bean to P application, in relation to initial soil P content, has been compiled from different studies conducted on different soils, years and climatic conditions (**Figure 3**). Results show that under Moroccan conditions, the critical level for pre-plant soil P (Olsen test) is 15 mg/kg. Negative effects of P application on yield when soil P content is higher than 15 mg/kg could be attributed either to antagonism with Zn (**Figure 4**) or to vegetative growth competing with reproductive growth, confounded by the indeterminate

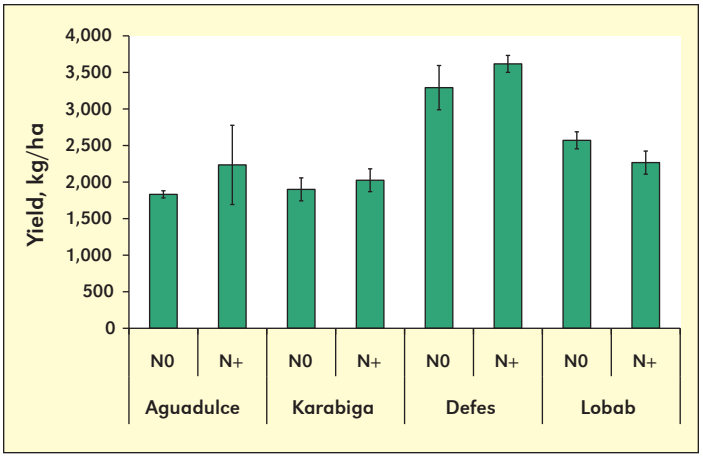

Figure 1. Effect of starter N application on yield of four faba bean varieties (N0 and N+ = 0 N and 30 kg N/ha, respectively). Daoui et al. (2010). Error bars = Standard Deviation.

Abbreviations and notes: N = nitrogen; P = phosphorus; Zn = zinc.

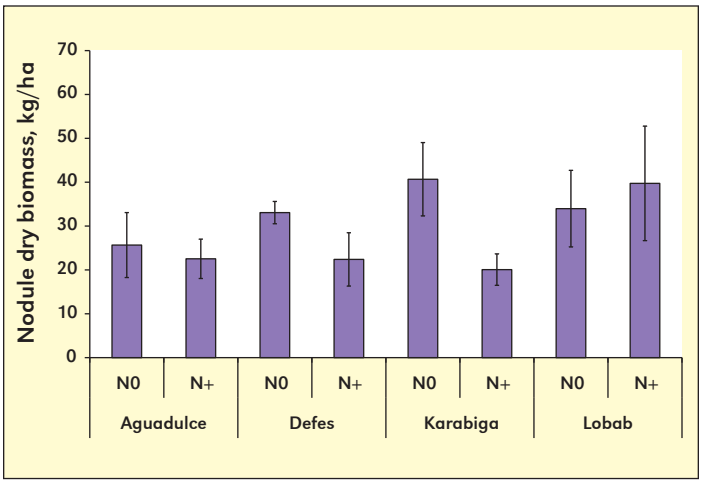

Figure 2. Effect of starter N application on nodule dry biomass for four faba bean varieties. (N0 and N+ = 0 N and 30 kg N/ha, respectively). Daoui et al. (2010) Error bars = Standard Deviation.

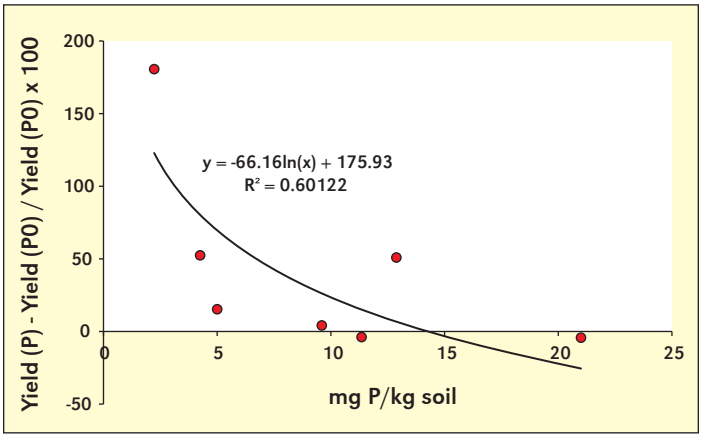

Figure 3. Relationship between soil P concentration and faba bean grain yield response (Adapted from Amnay, 2010; Daoui et al., 2012)

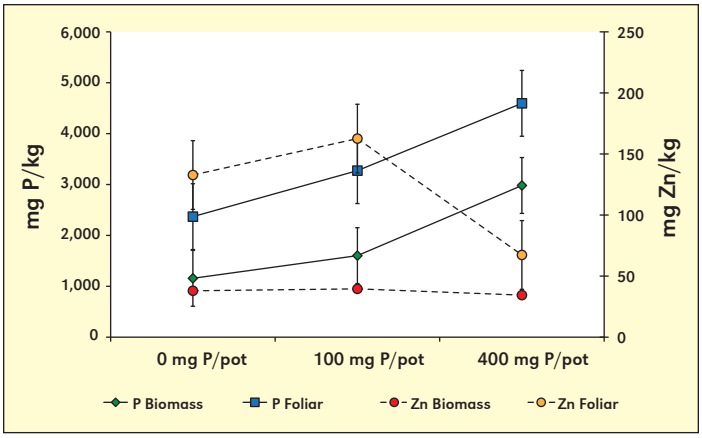

Figure 4. Effect of P application on P and Zn concentrations measured in total biomass and foliar tissue of faba bean (Daoui, 2002). Error bars = Standard Deviation.

growth habit of faba bean.

Since P is less mobile in soil, its uptake is affected by whether it is broadcast or banded. According to Hoeft et al. (2000), plants often use 15 to 20% of broadcast P in the year of application, but 40 to 50% of P placed in a band near the early root growth zone. In Morocco, Amnay (2010) showed that the application of 120 kg P_2O_5/ha to soil with an initial Olsen P of 4 mg/kg could increase faba bean grain yield by 73% to 246%. However, banded application of P out-yielded broadcast P by 13 to 25%.

Phosphorus use efficiency (PUE) is variable among faba bean varieties (Daoui et al., 2012). Studies conducted during two years under two different soil P concentrations (11 mg/kg and 5 mg/kg) showed significant genetic variation of PUE. Varieties with small seeds and high harvest index (producing less straw versus grain) had higher PUEs values at the higher soil P site. However, a larger seed variety appeared to have higher PUE at the low soil P site (data not shown).

Potassium

Under Moroccan conditions where K is deficient, K recommendations for faba bean production is about 90 kg K_2O/ha. However, according to soil analysis from the locations where faba bean is cultivated, scientists have not found research sites where there was a need for K application.

Summary

Although faba bean can fix N, studies conducted have focused on starter N application. Some results showed that the application of 20 kg N/ha is beneficial. However, other results showed that the application of 30 kg N/ha at planting in different agro-ecological zones and for different varieties of faba beans had no significant effects on yield but negatively affected nodulation. Regarding P, research has focused on the rate, mode of application (banded or broadcast) and on PUE based on genetic diversity. There is generally a beneficial effect of P application on grain production and nodulation. In addition, inoculation of faba bean with *rhizobium* strains showed a beneficial effect on the plant growth as well as phosphate uptake. For K, fewer studies have been conducted and all have shown no significant benefit on production since the soil where studies were conducted had high K concentrations. BC

Faba bean nodulation with N application (left) and without N (right).

Indeterminate faba bean plants: only the first flowering stages produce pods.

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