Growth and yield of faba bean (*Vicia faba* L) under rain fed and irrigated conditions in Jordan.

Talal Thalji*

Seed technology unit, Department of Horticulture and Crop science, Faculty of Agriculture, University of Jordan, P.O. Box: (13176) Amman (11942) Jordan.

*Corresponding author

Experiments were conducted to access the effect of rain fed and irrigated conditions on yield and some agronomical traits in five faba bean cultivars. Studies were conducted during two successive growing seasons (2005-06 and 2006-07) at Jordan University Research Station under irrigated condition and Jubeiha Research Station under rain fed conditions. The results showed that, the effect of water stress under rain fed condition was very clear on bud and flower initiation. The more frequently the plants were watered, the more flowers were produced and therefore more pods were set. The pollen grains were affected only slightly by frequency of watering. Plant height and weight showed a high significant positive association with grain yield, pod number, plant height and nodule number at two locations during both growing seasons. Present study demonstrated good prospects for Faba bean improvement under semi-arid conditions. Moreover, it revealed the importance of leguminous crops in nitrogen fixation which is entirely reflected on the performance of the crop and on ecology.

Key words: Faba Bean, Irrigated condition Mediterranean region, Seed yield

Faba bean is one of the major winter-sown legume crops grown in the Mediterranean region, and has considerable importance as a low-cost food rich in proteins and carbohydrates (Theib *et al.*, 2005). Faba bean (*Vicia faba* L.) yields are highly sensitive to variations of water availability (De-Costa *et al.*, 1997). The period during which the crop's evaporative demand is high coincides with the end of the rainy season; thus, faba bean experiences considerable soil moisture stress during the reproductive growth stage and often produces poor yields (Theib *et al.*, 2005). Faba bean was thought unsuitable for commercial dryland production in short-season Mediterranean-type environments because of its susceptibility to moisture and high temperature stresses (Lossa and Siddique 1997). Faba bean (*Vicia faba* L.) was considered poorly adapted to the low-rainfall environments of south Western Australia because of its susceptibility to moisture and heat stresses (Lossa *et al.*, 1997). Moreover, for indeterminate faba bean, high levels of water could promote excessive vegetative growth at the expense of pod growth (De-Costa *et al.*, 1997).

In Jordan faba bean is mainly grown under irrigation for fresh pod utilization. However considerable areas of the crop are grown under rain fed condition for dry seed production (Thalji and Shalaldeh, 2006). As a rainfed crop, Faba bean is treated as a winter crop and fit well with cereals in the rotation. The results from the Agricultural Statistical book shown that the total area used for both rainfed and under irrigation is (1440 ha), with (963)tons. However reported yields in Jordan are low in general. The moisture supply seems to play a dominant role in determining the productivity in these regions. The genotypes adapted to specific environments, when grown with appropriate husbandry and care, show an impressive yield potential which is several times higher than the average yields.
obtained in the Mediterranean basin (Saxena, 1991).

In this study, several aspects of yield and yield components were studied in *Vicia faba* L., under irrigated and limited water supply under rain fed conditions. The objective was to find the effect of water deficit on faba bean production, agronomic traits and yield losses under rain fed conditions.

**MATERIALS AND METHODS**

Five local indeterminate (*Vicia faba* L.) cultivars were used to study variation in production and some agronomic traits under irrigated and rainfed conditions in Jordan. The experiments were conducted during the 2005-06 and 2006-07 growing seasons at two different locations, namely Jordan University Research Station under irrigated condition and Jubeihia Research Station under rainfed conditions. Jordan University Research Station lies on a latitude of 32º:12 and longitude of 35º:37 with an altitude of about 300 meters below sea level. The area is characterized by a relatively warm winter with mean monthly temperatures ranging from 14-22 °C during the growing season. The soil in this experiment site was deep, Sandy Loam with average water holiday capacity of 130mm/m in the top 90 cm. Apparent specific gravity was 1.52, pH 8 and EC ranged between 1.5ds/m, at the surface to 2.4 ds/m at 1.0m depth. Jubeihia Research Station is located in central Jordan in the high rainfall zone, with an average annual rainfall of about 500 mm.

The sites were prepared for planting by standard procedures. Triple super phosphate was broadcasted at rate 80kg P/ha and potassium chloride and urea were banded at rates 60kg/ha and 40kg N/ha respectively. These rates were determined by soil tests, and recommendations by the university farm for optimal conditions. At the second site i.e. Jubeihia Research Station selected for rainfed conditions the rainfall during the two growing seasons (2005-06 and 2006-07) was 478 and 585mm respectively. The soil class was clay with a pH of 7.7. The total soil Nitrogen percentage was 0.118. The seeding rates were 80 kg/ha for both experimental sites. Each experiment was completely randomized in a split-plot design, with the varieties as a main plot and four replications.

The planting dates were 18-December 2005 and 22-November 2006. Every main plot consisted of six rows (5 meter long) with row to row distance 50 cm and 25-30 cm distance between plants within a row. Seeds for each row were calculated according to the respective seeding rate (80 Kg/ha) and planted by hand in well- prepared soil. The plots were hand weeded when necessary. Ten plants were randomly selected from each sub-plot before harvest. These plants were pulled and used to record plant height and various yield components. At maturity, the four central rows were shorted to three meters length, and then harvested. The harvest from each plot was bundle, weight and threshed by hand. Data were recorded for different traits from the whole plot referred to as bulk, and for the ten randomly selected plants mentioned.

**RESULTS**

Yield and agronomic traits were studied in faba bean cultivars under irrigated and rainfed conditions during two consecutive years (2005-06 and 2006-07). Plant height was promptly affected under rainfed condition as compared to that under irrigated condition during both years (table 1). Plant height was less under rainfed condition as compared to irrigated condition in all cultivars.

Similarly, total biomass yield was also considerably reduced under rain fed condition as compared to irrigated condition during both years (table 2). Most severe reduction in total biomass yield under rainfed condition was observed in Syria-1 during both experimental years. Total no of branches in different faba bean cultivars were also affected under irrigated and rainfed conditions. Total number of branches was comparatively higher under irrigated conditions as under rainfed conditions (table 3). Under irrigated conditions highest number of branches was observed in Syria-1 while under rainfed conditions number was maximum in Cyprus.

Total no of pods in different faba bean cultivars also varied under irrigated and rainfed conditions. Total number of pods was relatively higher under irrigated conditions as compared to that under rainfed conditions (table 4). Under irrigated conditions highest number of pods was observed in Balady and 4 while under rainfed conditions number was maximum in Cyprus. This showed clear differences in pod per plant under limited water supply in faba bean.

Total no of seeds per pod varied under irrigated and rainfed conditions in some of faba bean cultivars. Total number of seeds per pod was relatively higher under irrigated
The difference in pod weight was observed under irrigated conditions as compared to that under rainfed conditions in Balady and 5 (table 5). However, in Syria-1 no of seed per pod was higher under rainfed condition as compared to irrigated conditions. Under irrigated conditions highest number of seeds per pod was observed in Hudeiba while under rainfed conditions number was maximum in Cyprus.

Weight of pods in different faba bean cultivars varied promptly under irrigated and rainfed conditions. Weight of pods was relatively higher under irrigated conditions as compared to that under rainfed conditions (table 6). Under irrigated conditions, highest weight of pods was observed in Cyprus while under rainfed conditions weight was also maximum in Cyprus. This clearly showed that little difference in pod weight was observed under irrigated condition in this cultivar of faba bean.

**DISCUSSION**

The period during which the crop’s evaporative demand is high coincides with the end of the rainy season; thus, faba bean experiences considerable soil moisture stress during the reproductive growth stage and often produces poor yields (Theib et al., 2005). In our study, total number of pods was relatively higher under irrigated conditions as compared to that under rainfed conditions. A clear differences in pod per plant under limited water supply in faba bean was observed. According to Lossa et al., (1997) the final numbers of nodes were 20 to 24 with early sowing and pod set in this study was adequate for moderate yields and harvest index was consistently high.
Our results under irrigated conditions are inline with these previous findings. In our study weight of pods was also relatively higher under irrigated conditions as compared to that under rain fed conditions.

Total no of seeds per pod also varied under irrigated and rain fed conditions in some of faba bean cultivars. Total number of seeds per pod was relatively higher under irrigated conditions as compared to that under rain fed conditions in Balady and 5 (table 5). In a previous study it was reported that seed number per pod was relatively consistent across times of sowing, while mean seed weight decreased with delayed sowing in dry environments (Lossa and Siddique 1997). However, in Syria-1 no of seed per pod was higher under rain fed condition as compared to irrigated conditions. In this connection a previous study demonstrated that faba bean can produce impressive biomass and seed yield in a range of dryland Mediterranean-type environments. They demonstrate that given a suitable cultivar, faba bean is adapted to dryland Mediterranean-type environments with 300 to 400 mm yr⁻¹ average rainfall; however, early sowing is critical for high seed yields (Lossa and Siddique 1997).

Water stress has a determinant effect on faba bean vegetative growth, as well as reproductive growth (Minguez et al., 1993). Plant height was promptly affected under rain fed condition as compared to that under irrigated condition during both years. Plant height was less under rain fed condition as compared to irrigated condition in all cultivars. In present total number of branches was comparatively higher under irrigated conditions as under rain fed conditions. Previously, it has been reported that limited water supply through supplemental irrigation (SI) can boost and stabilize faba bean production. The overall mean grain yield, which was 1.13 t/ha under rainfed conditions increased to 1.49, 1.89 under full supplemental irrigation (Theib et al., 2005). Similarly, total biomass yield was also considerably reduced under rain fed condition as compared to irrigated condition during both years.

In conclusion, the grain yield produced was seriously affected by limited water supply under rainfed conditions. The agronomic traits were also adversely affected by the water stress. Different cultivars vary in response to water stress as some performed comparatively better under inadequate irrigation.

REFERENCES

