University of Birjand

تنشهای محیطی در علوم زراعی
Environmental Stresses In Crop Sciences
**Env. Stresses Crop Sci.**
**Vol. 15, No. 1, pp. 105-113 (Spring 2022)**

http://dx.doi.org/10.22077/escs.2020.3238.1847

***Original article***

# The effect of topping, nitrogen and supplemental irrigation on green pod yield, protein percentage, proline rate and agronomic efficiency of nitrogen in faba bean (*Vicia faba* L.)

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Received 25 April 2020; Accepted 4 July 2020

## *Extended abstract*

### Introduction

Fertilizer use is cost-effective until the higher yield supply the cost of consuming more fertilizer. In other words, like any other investment, fertilizer use should have a reasonable return because the law of diminishing returns also applies to fertilizers (Khajehpour, 2008). Application of nitrogen increased Seed yield and Protein percentage but nitrogen agronomic efficiency decreased (Doaei, 2018). In many crops, topping reduces vegetative growth and transfers more and better photosynthetic materials to specific organs, especially seeds. This increases the penetration of light into the canopy and the lower leaves of the plant can use more light. Therefore, increases the photosynthesis of the lower leaves, transfers more photosynthetic materials to growing organs and as a result, productivity will increases. It seems that earlier topping will reduce the number of pods per plant and will improve the conditions for photosynthetic material to be transferred to the pods. Thus, more seeds per pod will be produced. Furthermore, the flowers that will be set in late, have no opportunity to form a large pod and consequently, the fewer seeds will be set in the pod. Delay in topping will reduce the number of seeds per pod of faba bean (Nakhzari Moghaddam, 2013).

### Matherials and methods

In order to study the effect of topping, nitrogen and supplemental irrigation on green pod yield, protein percentage, proline rate and agronomic efficiency of nitrogen in faba bean, a factorial experiment based on Randomized Complete Block Design was conducted with three replications at research farm of Gonbad Kavous University during growing season of 2016-2017. Planting date was 11.13.2016 and harvest date was 5.6.2017. Topping factor was in three levels of non- topping, topping at beginning of flowering and topping at beginning of seed filling, nitrogen in three levels including 0, 50 and 100 kg nitrogen per hectare and supplementary irrigation in two levels of non irrigation and irrigation at the filling stage. Each plot had four rows with 50 cm width and four meter length. Seed planted in depth of three cm. one third of nitrogen were used in sowing date, one third in branching and other one third in seed filling stage. Supplemental irrigation was done in 5.24.2017, first topping in 4.30.2017 and second in 5.13.2017.

### Results and discussion

The results showed that the effect of topping on green pod yield, proline rate and agronomic efficiency of nitrogen was significant but on protein percentage was not significant. Effect of nitrogen and

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supplementary irrigation on green pod yield, proline rate, protein percentage and agronomic efficiency of nitrogen were significant. Green pod yield in none topping treatment, topping at the beginning of flowering and seed filling stages was 21523, 29118 and 27737 kg.ha$^{-1}$, respectively. The highest yield of green pod with 29118 kg.ha$^{-1}$ was related to consumption of 100 kg N.ha$^{-1}$ and the least was related to treatment of non application of nitrogen with 22149 kg ha$^{-1}$. Although application of nitrogen increased green pod yield but agronomic efficiency of nitrogen was decreased. Reducing of nitrogen use efficiency was due to increasing nitrogen loss through leaching and sublimation and the lack of effective absorption by the plant. Supplemental irrigation increased green pod yield 5143 kg ha$^{-1}$ (21.83%). Topping by reducing top dominance transfered more nutrients into pods and therefore pod yield increased. Agronomic efficiency of nitrogen in treatment of topping at beginning of seed filling was 89.85 and at beginning of flowering was 55.96 seed grain.ha$^{-1}$ nitrogen. Nitrogen consumption increased protein percentage of the seed so that in treatment of 100 kg N ha$^{-1}$ protein percentage was 22.65 (7.65% more d the protein cont than non consumption). Proline rate and protein percentage in none irrigation treatment was greater than irrigation treatment but green pod yield and agronomic efficiency of nitrogen was lower .

## Conclusions

Topping, nitrogen consumption and irrigation increased green pod yield. Therefore, for obtaining more yield of faba bean it is nessesary to remove head of plant, use enough nitrogen and irrigate plans at least one time in reproductive stage.

***Keywords*:** Flowering, Pod filling, Proline, Nitrogen, None irrigation

**Table1. The mean temperature and precipitation in Gonbad Kavous during growing season (2016-2017)**

| Character | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May |
|---|---|---|---|---|---|---|---|
| Temperature (°C) | 14.8 | 8.2 | 8.4 | 6.7 | 7.11 | 14.8 | 21.4 |
| Precipitation (mm) | 58.2 | 37.5 | 9.0 | 94.6 | 35.6 | 37.2 | 30.4 |

**Table2. Physicochemical characteristics of soil**

| Potassium available | Phosphorus available | nitrogen | Organic carbon | Sand | Silt | Clay | pH | EC |
|---|---|---|---|---|---|---|---|---|
| ----------(mg.kg$^{-1}$)---------- | | | ----------(%)---------- | | | | | (dS.m$^{-1}$) |
| 414 | 12.3 | 0.08 | 1.16 | 8 | 62 | 30 | 7.6 | 1.1 |

**Table2. Analysis variation of green pod yield, proline rate, protein percentage and nitrogen agronomic efficiency under topping, nitrogen and consumption Irrigation**

| S.O.V. | df | Green pod yield | Proline rate | Protein percentage | Nitrogen agronomic efficiency |
|---|---|---|---|---|---|
| **Replication** | 2 | 8368454 | 0.011 | 2.641 | 2116* |
| **Topping** | 2 | 294620930** | *0.043 | 3.755 | 4091** |
| **Nitrogen** | 2(1)+ | 233900591** | 0.154** | 11.68** | 2198* |
| **Irrigation** | 1 | 357055347** | 0.123** | 35.61** | 2467* |
| **T×N** | 4(2)+ | 8568886 | 0.006 | 0.516 | 1082 |
| **T×I** | 2 | 11695489 | 0.01 | 0.264 | 1048 |
| **N×I** | 2(1)+ | 3985610 | 0.002 | 4.715 | 183.8 |
| **T×N×I** | 4(2) | 3439120 | 0.003 | 0.628 | 859.6 |
| **Error** | 34 (22)+ | 7253593 | 0.012 | 1.559 | 411 |
| **CV%** | - | *10.31* | *14.53* | *5.73* | *26.22* |

*, ** and +: significant at 5%, 1% probability levels and df of nitrogen agronomic efficiency, respectively.

**Table 3. Mean comparison of green pod yield, proline and Nitrogen agronomic efficiency under topping**

| Topping | Green pod yield (kg.ha$^{-1}$) | Proline rate (mg.g$^{-1}$) | Nitrogen agronomic efficiency (kgpod.kgN$^{-1}$) |
|---|---|---|---|
| **None topping** | 21624$^{c}$ | 0.714$^{b}$ | 86.02$^{a}$ |
| **Topping at flowering** | 28812$^{a}$ | 0.811$^{a}$ | 56.2$^{b}$ |
| **Topping at pod setting** | 27515$^{b}$ | 0.771$^{ab}$ | 89.85$^{a}$ |
| **LSD 5%** | *1270* | *0.075* | *17.17* |

Different alphabet in each column indicate significant difference (0.05) based on LSD

**Table 4. Mean comparison of green pod yield, proline rate, protein percentage and nitrogen agronomic efficiency under nitrogen consumption**

| Nitrogen (Kg.ha$^{-1}$) | Green pod yield (kg.ha$^{-1}$) | Proline rate (mg.g$^{-1}$) | Protein percentage | Nitrogen agronomic efficiency (kgpod.kgN$^{-1}$) |
|---|---|---|---|---|
| **0** | 22249$^{c}$ | 0.852$^{a}$ | 21.04$^{b}$ | - |
| **50** | 26506$^{b}$ | 0.776$^{b}$ | 21.74$^{b}$ | 85.14$^{a}$ |
| **100** | 29206$^{a}$ | 0.668$^{c}$ | 22.65$^{a}$ | 69.57$^{b}$ |
| **LSD5%** | *1270* | *0.075* | *0.85* | *14.02* |

Different alphabet in each column indicate significant difference (0.05) based on LSD

**Table 5. Mean comparison of green pod yield, proline rate, protein percentage and nitrogen agronomic efficiency under supplemental irrigation**

| Supplemental irrigation | Green pod yield (kg.ha$^{-1}$) | Proline rate (mg.g$^{-1}$) | Protein percentage | Nitrogen agronomic efficiency (kgpod.kgN$^{-1}$) |
|---|---|---|---|---|
| **Irrigation** | 28345$^{a}$ | 0.718$^{a}$ | 21$^{b}$ | 85.61$^{a}$ |
| **Non irrigation** | 23629$^{b}$ | 0.813$^{b}$ | 22.62$^{a}$ | 69.05$^{b}$ |
| **LSD5%** | 1490 | 0.062 | 0.69 | 14.02 |

Different alphabet in each column indicate significant difference (0.05) based on LSD