

## **THE RESPONSE OF GERMINATION PERCENTAGE AND POD APPEARANCE TRAITS OF FABA BEAN TO CULTIVAR, PLANT DENSITY AND WEED CONTROL IN CLIMATIC CONDITIONS OF KHUZESTAN**

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### **ABSTRACT**

An experiment was performed in Mian-Ab Region of Shushtar, 13th km, Ahwaz-Shushtar Road, for one year in agricultural year of 2011-2012 in order to investigate the effect of plant density and cultivar on weed control in faba bean fields in climatic conditions of Shushtar. In this experiment a complete randomized block design in a factorial-split arrangement with four repetitions was used, in which faba bean cultivar was considered at three levels (Barekat, V1; Saraziri, V2; and Mahalli, V3), density at three levels (7, 11 and 14 Plants per square meter; D1, D2 and D3 respectively) and weed population of 0%, 50% and 100% (R3, R2 and R1 respectively). The results showed that all the studied phenological traits were affected by cultivar and plant density. Moreover, germination percentage and generative duration were not affected by interactions. Mahalli mass had the lowest germination percentage at the three levels of weed control; however, germination percentage of this cultivar was higher than the other two cultivars at 100% level of weed control. This shows that this cultivar had higher germination in non-weed condition; in other words, it was affected more than the other two cultivars in condition of weed presence and its germination percentage lowered. In other conditions cultivar Barakat had the most number of days until pod appearance, and in density condition of 11 plants per m<sup>2</sup> at level of controlling weed, Mahalli mass obtained the most number of days from planting time to pod appearance. In other words, Mahalli mass is more sensitive in this condition than the other two cultivars.

**Keywords:** *Faba Bean, Plant Density, Percentage of Weed Control, Phenological Traits*

### **INTRODUCTION**

The rate of plant's development and growth in each of the phenological phases (i.e. phenophases) determines growth rate, and the study of plant growth rate in relation to environmental conditions is called phenology (Mousavi *et al.*, 2010). The study of occurrence of different growth phases based on time calendar and thermal units allows easier analysis of plant's phenology, especially under hard conditions (Loomis and, 1992). Russel *et al.*, (1984) reported that the rate of approaching each phase of growth is explicitly under the direct effect of temperature and that there is a close relation between temperature and crop growth. In this way, Jahansooz *et al.*, (2006) found out that there was significantly a negative correlation between yield and trait of the number of days until the appearance of the first flower. Also characteristic of the number of days until complete ripeness was positively and negatively significant in relation to the traits of the number of days until appearance of the first flower and plant's form respectively. From the initial stage of growth to the initiation of flowering, faba bean is sensitive to competition with weeds (Agnehoo and Fece, 2006; Casto and Pakanoksi, 2007) such that when investigating the effect of time of weed removal on yield and yield components of faba bean, it was determined that weed control from 25 to 75 days after planting led to higher yield than plots having weeds (Tawaha and Turk, 2001). When sorghum's weed was removed 30 days after planting, no reduction was observed in final yield of sorghum plant, in spite of reduction in plant growth due to the presence of weeds. That shows that in weed control condition on the 30th day of planting, in some cases the plant

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affected by weeds continues to have yield potential similar to that in non-weed condition (Ayeneh-Band, 2006).

James *et al.*, (2000) reported that weeds not controlled for 4 weeks after corn germination, reduced crop yield significantly. The ratio of agricultural plant height to weed height is one of the factors of superiority of plants to each other. Because weed and agricultural plant are not different in height in the early season; however, this difference becomes more prominent over time and causes superiority between weed and agricultural plant (Yaghoubi *et al.*, 2009; Fernandez *et al.*, 2002). Selecting suitable cultivar adaptable to climatic conditions and determining plant density and proper planting date are of important factors to achieve environmental favorable conditions and high yield. Agricultural plants and even an agricultural species have a of ideal plant density special to their own to produce the maximum yield depending on their own genotypic and phenotypic capabilities to response to change in plant density and potential of competition with other plants (Dwyer *et al.*, 1991). In addition to the above-mentioned factors, climatic conditions affect the yield rate different cultivars of agricultural plants (Aryan-Nia *et al.*, 2012; Inayat Gholi-zadeh *et al.*, 2013). Ideal plant density is one by which environmental factors (water, air, sunlight and soil) are applied completely while intra- and extra-plant competition is at the minimum level so that the maximum yield can be achieved with a desirable quality. Alternatively, that density must provide adequate space for maintenance and harvest operations (Khajeh-pour, 2008; Sharafi-Zadeh *et al.*, 2012). Mathew *et al.*, (2008) believe that plant density is the most determining factor for plant growth and matter accumulation. Ideal density depends on various factors the most important of which are: plant,s properties, vegetative duration, date and method of planting, soil,s productivity, plant size, available humidity, solar radiation, planting pattern and weed condition (Shirlif and Johnson, 2002).

### **MATERIALS AND METHODS**

This experiment was conducted in field located on 13th km, Shushtar-Ahwaz Road, for one year in agricultural year of 2010-2011. This field with a height of 67 m above sea level and 32° 3' north latitude and 48° 50' east longitude is locate in the southwestern part of Iran. On the whole, all the south coastal lands of the country whose height is less than 100 meters have desert climate.

Therefore, whole the plain of Khuzestan to the feet of Lodestones Mountains have the properties of this kind of climate. There is an intense warm all over this region (the absolute maximum temperature recorded for this region is 53° related to Ahwaz). Average rainfall in this region is low and at the same time irregular. All the rainfall almost happens in winter, and 7 months of the year lacks rainfall (Kuchaki *et al.*, 1995).

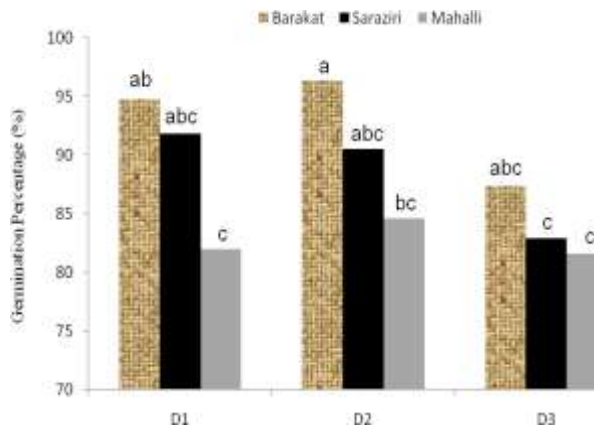
This experiment used a complete randomized block density in a factorial-split arrangement with four repetitions in which cultivar of faba bean was considered at three levels (Barakat, V1; Saraziri, V2; Mahalli, V3), density at three levels (7, 11, and 14 plants per square meter; D3, D2 and D1 respectively) and population of weed of %0, %50 and %100 R1, R2 and R3 respectively).

For weed which was considered at three levels of %0, %50 and %100, R1, R2 and R3 respectively, at %0 level weeds were removed until the end of growth period. At %50 level, 50 percent of weeds were controlled. Their control was performed in the manner of removing them from between 1 and 2, 3 and 4, and 5 and 6 lines. From the time of growth of weeds fighting against them started and continued until the end of plant growth such that weeds on the one side of the hill were removed and weeds on the other side were not. In other words, weeds of one ditch were removed and weeds of the next one were not (weed control of every other ditch).

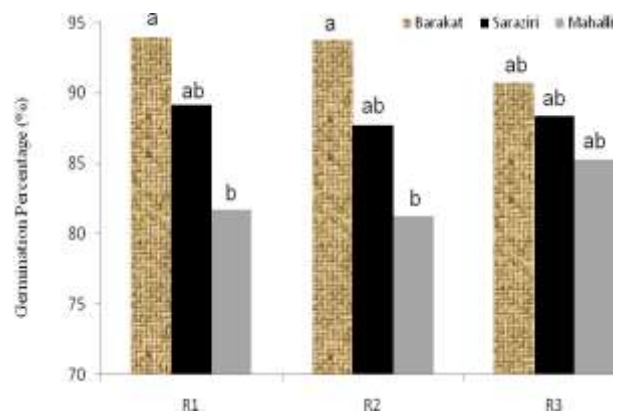
At level R3, weeds existed until the end of growth period. Final harvest was performed at time of ripeness from line 4. The entire length of line (6m long) was harvested by using method after removing upper and downer 0/5-mere margins. Obtained data were inserted into tables of spreadsheet of Excel after conclusion and classification. Raw data were variance analyzed by SAS statistical program, and means comparison was performed using Duncan test method. Diagrams were depicted by using Excel Software.

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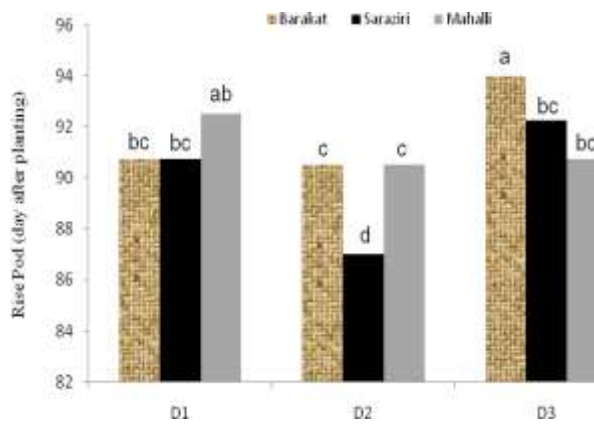
**RESULTS AND DISCUSSION**



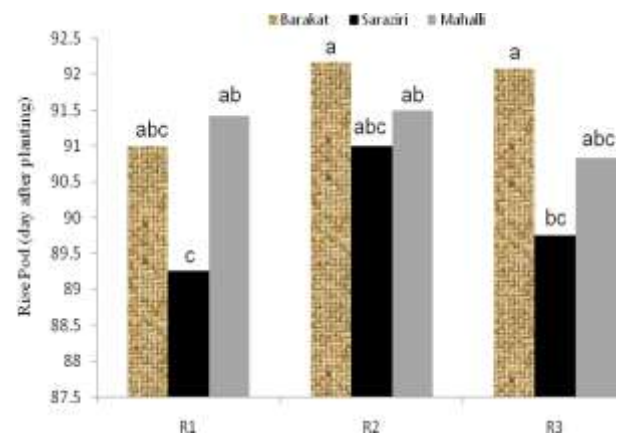
**Figure 1: effect of density and Cultivar in Germination Percentage**



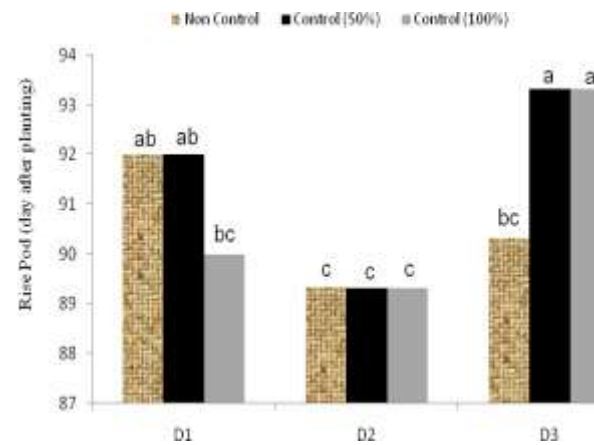
**Figure 2: effect of weed control and Cultivar in Germination Percentage**



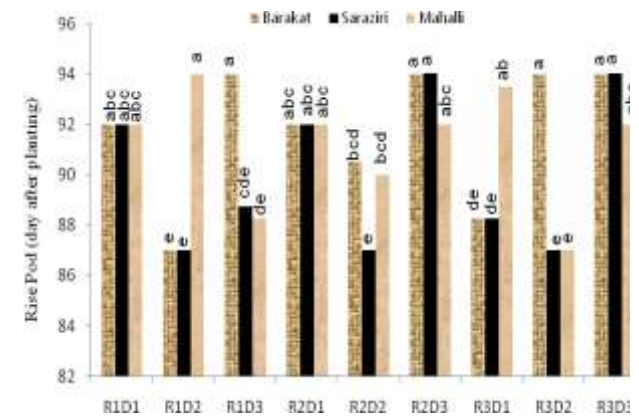
**Figure 3: effect of density and Cultivar in Rise Pod**



**Figure 4: effect of weed control and Cultivar in Rise Pod**



**Figure 5: effect of weed control and density in Rise Pod**



**Figure 6: effect of weed control, density and Cultivar in Rise Pod**

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**Table 1: Analysis of variance (mean squares) Phonological characteristics**

S. O. V	df	Mean Squares	
		Germination Percentage	Rise Pod
R	3	454/4293**	ns1/3333
Cultivar	2	920/7608**	29/2500**
Cultivar × R	6	51/8256	1/1389
Density	2	412/994*	84/0000**
weed control	2	ns1/4304	9/3333*
Density × Cultivar	4	68/2685*	31/8750**
weed control × Cultivar	4	49/8051*	3/5417*
weed control × Density	4	ns38/8363	21/3333**
Cultivar × Density × weed control	8	ns36/8930	33/7291**
Error	72	63/9452	2/5440
CV (%)	-	9/09	1/75

respectively significant ( $p \leq 0.05$ ) and highly significant ( $p \leq 0.01$ ) :\*\* ,\* ns: non significant,

**Results**

**Germination Percentage**

Table of analysis variance indicated that germination percentage was influenced by cultivar, density, interaction of cultivar and density and interaction of cultivar and weed control; however, it wasn't affected by weed control, interaction of plant density and weed control and triadic interaction of cultivar, plant density and weed control (table 1). Means comparison of main effects showed that germination was influenced by cultivar, such that Barakat cultivar with a mean of %92.83 and Mahalli mass with an average of %82.73 held the highest and the lowest germination percentage respectively. Furthermore, this trait was affected by plant density, such that the highest germination percentage (%90.15) belonged to density of 11 plants per square meter, whereas the lowest germination percentage with a mean of %84.12 was obtained for treatment of 14 plants per square meter. However shows, different levels of weed control could not affect this trait and all the levels of weed control were placed in the same statistical category in terms of germination percentage. It can be concluded that since treatment of weed control was weed applied about 20 days after germinating and that environmental conditions were identical for all the evaluated treatments at time of germinating, the above-mentioned results seem to be scientific and reasonable. The above results express that in this experiment cultivar Barakat held the most germination in climatic conditions of Shushtar than the other two cultivars. Since the size of seed generally determines the amount of material stored in it and for this reason increases seed vigor, given that the size of seed for cultivar Barakat is bigger than the other two cultivars, it has been able to use this potential and cause higher germination percentage than the other two cultivars.

Interaction of cultivar and plant density: figure (1) indicates that the highest germination percentage was obtained for cultivar Barakat in all the three densities. Mahalli mass held the lowest germination percentage in all the three cultivars of density. Of course the highest germination percentage was observed for middle density, i.e. density of 11 plants per square meter. Interaction of cultivar and weed control: as it is observed in figure (2), germination percentage in different cultivars was influenced by the rate of weed control, such that cultivar Barakat held the highest germination percentage than the other two cultivars; therefore, this cultivar was placed in the same statistical category at the two %0 and %50 levels of weed control. Mahalli mass had the lowest germination percentage at the three levels of weed control ;



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however, as figure (2) indicates, germination percentage of this cultivar was higher than the other two cultivars at %100 level of weed control. This shows that this cultivar had higher germination in non-weed condition; in other words, it was affected more than the other two cultivars in condition of weed presence and its germination percentage lowered. Aryan-Nia *et al.*, (2011) reported that cultivars had no effects on duration of germination, 6-leaf and 12-leaf and that two cultivars had passed the same days to reach the desired phenological phases, whereas in studying two hybrids of corn, Hamidi and Dabbagh (2001) pointed out that there was a significant difference between hybrids single cross 604 and 601. This difference can be associated with difference in plant size and type of plant or cultivar. In regard to the cultivars used in this study it can be said that the three cultivars were not structurally different.

### **Pod Appearance**

The results from analysis of variance indicated that pod appearance was extremely significantly influenced by cultivar (table 1) such that the most number of days until the appearance of pod was obtained for cultivar Barakat and the least of that was observed for cultivar Saraziri with mean of 91.75 and 90 days respectively. Pod appearance was significantly affected by different levels of density as well (table 1). Means comparison of main effects showed that the most number of days until pod appearance was observed for density of 14 plants per square meter, whereas the least number of days was obtained for density condition of 11 plants per square meter with means of 92.33 and 89.33 days respectively. The results indicated pod appearance wasn't influenced by treatment of weed control (table 1). Interaction of cultivar and plant density: analysis of variance showed that pod appearance was very significantly by interaction of cultivar and plant density (table 1). Figure (3) displays that the most number of days until pod appearance belonged to cultivar Barakat in density condition of 14 plants per square meter and the least number of days until pod appearance was obtained for cultivar Saraziri in density condition of 11 plants per square meter. In general, different cultivars exhibited different responses in various densities such that Mahalli cultivar held the most number of days from planting until pod appearance in condition of 7 plants per square meter, and in density condition of 14 plants per square meter it displayed the least number of days from planting until pod appearance.

Interaction of cultivar and weed control: the results showed that pod appearance was affected by interaction of cultivar and weed control at statistically %5 probability levels (table 1). Figure (4) indicates that the most number of days after planting until pod appearance was obtained for cultivar Barakat at two levels of %50 and % 100 weed controls. However, the least number of days was observed for cultivar Saraziri in condition of not controlling weeds. Generally, this figure indicates cultivar Saraziri can sustain high densities of weed more than the other two cultivars. Interaction of plant density and weed control: weed appearance was very significantly affected by interaction of plant density and weed control (table 1). Means comparison of the interaction in figure (5) shows that the most number of days after planting until pod appearance was obtained in condition of 14 plants per square meter at two levels of %50 and %100 weed control, whereas the least number of days was obtained equally in density condition of 11 plants per square meter in the three treatments of weed control.

Triadic interaction of plant density, cultivar and weed control: analysis of variance showed that pod appearance was very significantly influenced by triadic interaction of plant density, cultivar and weed control (table 1). Figure (6) indicates that all the three cultivars exhibited the same behavior in terms of the number of days after planting until pod appearance in condition of density of 7 plants per square meter at two treatment levels of not controlling weeds and % 50 weed controls. In other conditions cultivar Barakat had the most number of days until pod appearance, and in density condition of 11 plants per m<sup>2</sup> at level of controlling weed, Mahalli mass obtained the most number of days from planting time to pod appearance. In other words, Mahalli mass is more sensitive in this condition than the other two cultivars.

### **Conclusion**

The results showed all the studied phenological traits were influenced by cultivar and plant density. Also, vegetative duration and pod appearance was affected by weed control; however, germination percentage and generative duration were not influenced by different levels of weed control. In addition, phenological trait was under the influence of interaction. Cultivar Barakat held the highest germination percentage at

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all the three levels of weed control. In this way, this cultivar was statistically placed in the same group at two %0 and %50 levels of weed control; Mahalli mass had the lowest germination percentage at the three levels of weed control; however, germination percentage of this cultivar was higher at %100 level of weed control compared to the other two levels. That is to say that this cultivar had higher germination in non-weed condition; in other words, in condition of weed presence it was affected more in comparison to the other two cultivars and its germination percentage lowered. Aryan-Nia *et al.*, (2011) reported that cultivars had no effects on duration of germination, 6-leaf and 12-leaf, and that two cultivars had passed the same days to reach the desired phenological phases, whereas in studying two hybrids of corn, Hamidi and Dabbgh (2001) pointed out that there was a significant difference between hybrids Single cross 604 and 601. These differences can be associated with difference in plant size and type of plant or cultivar. In regard to the used in this study it can be said that the three cultivars were not structurally different.

All the three cultivars had the same vegetative duration in density condition of 7 plants per square meter at two levels of not controlling weeds and % 50 weed controls. In general, cultivar Barakat had the longest vegetative duration in all conditions, except in density condition of 7 plants per square meter at %100 level of weed control. Mahalli mass exhibited the shortest vegetative duration in density condition of 11 plants per square meter at %100 level of weed control and showed its longest vegetative duration in conditions of 11 plants per m<sup>2</sup> and not controlling weeds. Like cultivar Barakat, for cultivar Saraziri the shortest vegetative duration was obtained in density condition of 11 plants per square meter at %100 weed control, whereas its longest vegetative duration was observed in condition of density of 14 plants per square meter at %50 level of weed control. All the three cultivars exhibited the same behavior in terms of the number of days after planting until pod appearance in density condition of 7 plants per m<sup>2</sup> in two treatment levels of not controlling weeds and % 50 weed controls. In other conditions cultivar Barakat had the most number of days until pod appearance, whereas in density condition of 11 plants per m<sup>2</sup> at level of not controlling weeds it was Mahalli mass that had the most number of days after planting until pod appearance. In other words, cultivar Mahalli was more sensitive than the other two cultivars in this condition. Cultivar Mahalli in all conditions of the experiment, i.e. in different densities and at different levels of weed control, exhibited a longer generative duration.

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