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Short Communication

Effect of planting method on agricultural characteristics of kidney beans (*Phaseolus vulgaris* L) in Khuzestan

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ABSTRACT:

To evaluate the effects of plant density and planting pattern on the process of growth of kidney bean varieties, an experiment was conducted by using factorial split plot in a completely randomized block design with three replications during the agricultural year of 2014-2015 in Sardasht in Khuzestan. In this experiment, the distances between row at three levels of 30, 45 and 60 cm were used as the main factor and two varieties (Naz and Derakhshan) and three distances between the rows at the levels of 5, 10 and 15 cm were used as the secondary factors. The Dry Matter (DM), Crop Growth Rate (CGR) and Relative Growth Rate (RGR) were used to evaluate the growth indices that the process of changes in growth indices were obtained based on growing degree days by sampling the farm with one-week intervals. According to the results of this experiment, it was observed that the process of changes in the shoot dry matter in all treatments were sigmoidal. The highest dry matter produced was obtained in 1029 growing degree days in Derakhshan variety and in 1200 growing degree days in Naz variety. It was also found that by increasing plant density, the dry matter content was significantly increased and the highest dry matter in Naz and Derakhshan variety was obtained in the planting pattern of 5 × 30 cm and plant density 66.67 plants per square meter. In the varieties studied, by decreasing the distances between rows and between two plants in the row, the crop growth rate increased and the maximum amounts of crop growth rate were obtained in Naz and Derakhshan varieties with the amounts of 3.67 and 3.12 g per growing degree days, respectively. The results also showed that in the varieties studied by decreasing the distances between rows and between two plants in the row, the bean seed yield increased and the planting patterns of 5 × 30 cm in Naz variety and 10 × 30 cm in Derakhshan variety led to produce the maximum seed yield.

Keywords:

Plant density, Planting pattern, Growth indices, Total dry matter, Crop growth rate and relative growth rate, Seed yield.

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INTRODUCTION

Identifying and studying the growth indices are important for analyzing the factors affecting the seed yield and the stages of plant growth can be determined with their aid and the crop production can be evaluated by quantitative description of growth and development (Hoover and Ratnayake, 2002; Luthria and Pastor-Corrales, 2006). On the other hand, the plant density is one of the factors that can affect the growth indices. So studying the effects of plant density on the growth characteristics can help us in analyzing the seed yield (Cornic and Briantais, 1991; Blair *et al.,* 2003). Considering the problems of kidney beans, the study aimed to evaluate the effect of planting method on the agricultural characteristics of kidney bean in Khuzestan.

MATERIALS AND METHODS

This experiment was conducted in Khuzestan field to study the effects of planting patterns on some growth indices of two varieties of kidney bean in 2014-2015. The design used in the experiment was a split plot design in a completely randomized block design with three replications. For this purpose, two varieties of kidney bean (Naz and Derakhshan) were prepared from Khuzestan. The factors used in this study included three distances between the row (30, 45 and 60 cm) as the main factor and two varieties and three distances between the plant per row (5, 10 and 15 cm) as the secondary factors. To calculate the factor indices, the samples were regularly taken from the field every week from one week after planting to the final sampling and finally the Dry Matter (DM), Crop Growth Rate (CGR) and Relative Growth Rate (RGR) were calculated with the help of GDD (Lucas and Milbourn, 1976; Mehraj *et al.,* 1996; Chaoui *et al*., 1997; Hassani *et al.,* 2014). The soil parameters were also studied and recorded (Table 1).

RESULTS AND DISCUSSION

Considering the results of this study, it was found that the process of changes in dry matter in all treatments studied was sigmoidal (S-shaped) so that increasing DM in Naz and Derakhshan to about 550 and 400-450 growing degree days, respectively, was slow. Then, the amount of dry matter were added linearly to a point where the maximum dry matter production was obtained that the amount in Naz variety was in 1200 growing degree days and in Derakhshan variety was in 1029 growing degree days and finally, by continuing the growth period and further increasing GDD the amount of dry matter production was decreased. It was also observed that the amount of DM increased by increasing the plant density and in the varieties studied the highest DM was obtained in the planting pattern of 5 × 30 cm or the plant density of 66.67 plants per square meter. Regarding the effects of increasing plant density on dry matter, it should be said that it seems that it is mostly due to the increase in the number of plants per unit area and also it had been reported by others (Hoover and Ratnayake, 2002) (Figure 1).

In the research, by studying the process of changes in CGR during the growth season, it was observed that at first CGR had a relatively slow increase in all treatments and then showed more rapid increase. In later stage, CGR decreased with a steep decline so that it became negative at the end of the growing season. At first, the slow increase in CGR was due to the vegetative meristems but the amount of CGR increased sharply by the completion of vegetation and more efficient use of

Table 1. Physical and chemical characteristics of the soil

Depth (cm)	Salinity (ds/m)	Acidity (pH)	Soil texture	Organic carbon OC%	Nitrogen N%	Phosphorus P%	Potassium K (ppm)	Zinc Zn (ppm)	Iron Fe (ppm)	Manganese Mn (ppm)
0-30	0.68	6.65	Sandy loam	0.75	0.12	8.1	223	0.72	5.44	7.5

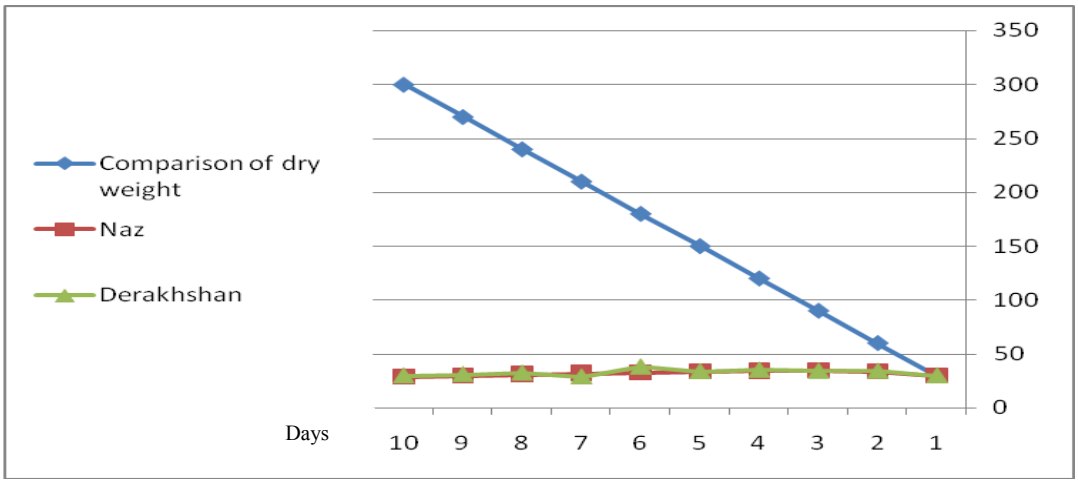

Figure 1. Comparison of dry weight in Naz and Derakhshan kidney bean varieties in two planting patterns

sunlight and leaf area increase so that the maximum CGR was obtained. After that, given increasing the competition between plants, decreasing the light penetration into the canopy, the yellowness of photosynthetic organs, and the transfer of food to the seeds, CGR is decreased. Such results have already been reported by other researchers (Lucas and Milbourn, 1976; Cornic and Briantais, 1991).

Among the varieties studied, it was found that the highest amount of CGR was obtained from applying the planting pattern of 5 × 30 cm and with the amount of 3.12 and 3.67 grams per square meter/growing degree days in Naz and Derakhshan varieties, respectively. Higher CGR is obtained in Naz variety due to better structure of canopy and paying less in its supporting tissues. In this study, RGR decreased in all treatments by increasing the plant age so that RGR became negative at the end of the growing season. It seems that the amount of RGR is higher at the beginning of the growing season due to light penetration into the canopy and less shading the leaves on each other and thus less respiratory. Its amount decreases over time and by increasing the vegetative organs and shading leaves on each other. In the varieties studied, the highest RGR was obtained in about 260 GDD but after that the amount was decreased so that the amount became negative in Naz and Derakhshan varieties in 1100-1050 GDD, respectively (Martínez-Romero *et al.,* 1991). The results obtained from the analysis of variance showed that the effect of treatments of distance between rows and between two plants per row and their interactions on been seed yield was significant at the probability level of 1% and in the experiment the amount of seed yield was added by decreasing the distance between rows and between two plants per row or increasing the plant density so that the highest seed yield was obtained in Naz and Derakhshan varieties in planting patterns of 5 × 30 and 10 × 30 cm, respectively. It seems that the main factor in increasing the seed yield by increasing the planting density is increasing the number of plants per unit area that increases the light use efficiency and available resources and thus the yield. The are also in cooperation with the studies done by Mehraj *et al.* (1996) and Hoyos-Carvajal *et al.* (2009). According to the results obtained in this experiment, more and wider research in this field is recommended and for cost-effectiveness, the use of this type of planting pattern can be widely recommended to farmers.

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