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EFFECTS OF DIFFERENT PLANTING ARRANGEMENT ON YIELD AND YIELD COMPONENTS OF FABA BEAN (VICIA FABA)

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ABSTRACT

A field experiment was undertaken at educational and researchable field of Gorgan university-Iran during 2015 to determine the best planting armament of Faba Bean (ViciaFaba). This research was laid out in a randomized complete block design arranged with three replications. The planting patterns consisted of 3 levels; P1=single row, P2=parallel double row with 15 cm space and P3=zigzag double row with 15cm space, and plant density consisted of 4 levels; D1=75000 plant ha-1, D2=85000 plant ha-1, 95000 plant ha-1 and 105000 plant ha-1. Plant density was impressed the amount of pod product, biomass, grain/pod ratio and harvest index. The highest pod dry weight and total dry yield were 10.42 ton ha-1and 3.66 ton ha-1 respectively at the plant density of 75000 plant ha-1. While the great grain/pod ratio and harvest index parameters with amounts of 76.54 and 29.57% respectively got from low plant density (75000 plant ha-1). Combination treatment of planting patterns and plant density showed: high plant density (75000 plant ha-1) by double row pattern produced the most pod dry weight (3.99 ton ha-1) and total dry weight (10.85 ton ha-1). In contrast the highest harvest index (27.82%) was related to low plant density (75000 plant ha-1) with 15 centimeter double row planting pattern. Overall findings showed that double – row planting pattern had better performance compare to single row. Double - row planting arrangement where on double - row raised

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KEY WORDS

Faba Bean (ViciaFaba), Plant density, Planting arrangement

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INTRODUCTION

With the increase in world population, demand for food consequently will grow. It is expected that human population will increase to over 8 billion by the year 2020 and this will worsen the current scenario of food security. Improved crop productivity over the past 50 years has resulted in increasing world food supplies up to 20% per person and reducing proportion of food-insecure peoples living in developing countries from 57% to 27% of total population [1]. It is predicted that at least 10 million people will be hungry and malnourished in the world by the end of this century [1].Thus, to reduce the food insecurity, crop production will have to be doubled, and produced in more environmentally sustainable ways [2].This can be achieved by expanding the area of crop production, increasing per hectare yield and improving crop quality. Furthermore, during the second half of the past century, rise in per hectare crop productivity was due to improved or high yield potential [3].

The relationship between growth of Faba Bean under different planting pattern is not well understood. Many changes take place in plants to enable them to compete and maintain photosynthetic activity. A consideration of the adaptation mechanisms by which density affects photosynthesis would aid the improvement of growth conditions and crop yield and would provide useful tools for future genetic engineering. Research in the late 1980s demonstrated that yields can be raised two to three-fold by using available improved varieties and appropriate agronomic techniques. But these findings need to be refined, improved and tested for local climatic, soil and crop conditions [4].

These include in the aspects of to what extent of planting pattern and plant density affect the yield and of Faba Bean (ViciaFaba). In addition, no comprehensive database is available on sweet corn under combination of pattern and density at north of Iran. Thus, studies are still needed to improve understanding of the effects of pattern for Faba Bean. Hence, the present study was designed to study the effect of planting arrangement on yield and morphological parameters of Faba Bean (ViciaFaba).

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MATERIALS AND METHODS

The field experiment was conducted at the research farm of Gorgan university of Agricultural Sciences and Natural Resources, Iran in 2015. The farm was under wheat-soybean rotation. Geographical coordinate of the farm were 36º, 54.00´ N; 54º, 25.00´ E and altitude of 51m. The 25-year mean temperature, humidity and precipitation recorded were 17.7 °C, 70% and 617 mm, respectively. Table 1 shows some soil analysis of the farm.

Table :1. Some physical and chemical analysis of farm soil

CEC (Cmol/kg)	EC (ds/m)	OM (%)	pH	Soil texture	Sand (%)	Silt (%)	Clay (%)
20.60	0.88	1.8	8.2	silty- clay loam	18	46	36

Table1. Climatically data at Agricultural Research Station of Gorgan during the growth period of Sweet corn in three growing seasons 2005-2006.

	Precipitation		Mean temperature (c)		Mean of maximum temperature (c)		Mean of minimum temperature (c)		Evaporation (mm)		Mean of Relative humidity(%)	
Month	Y1	Y2	Y1	Y2	Y1	Y2	Y1	Y2	Y1	Y2	Y1	Y2
April	69.1	104.5	16.2	15.3	21.9	20	10.6	10.7	82	85.6	73.4	76.4
May	53.6	52.8	20.7	17.2	26.9	21.4	14.6	13	148.9	95.2	64.5	74.8
June	20.2	10.5	24	25.1	29.4	31.9	18.6	18.3	170.3	181.6	65.4	60.6
July	27.4	32	27.5	28.3	32.1	33.9	22.9	22.8	213.6	225.7	61.7	60.4
August	2.3	19	29.3	29.2	35.1	34	23.6	24.4	247.4	213.3	59	64.9

Y1 : 2005
Y1 : 2006

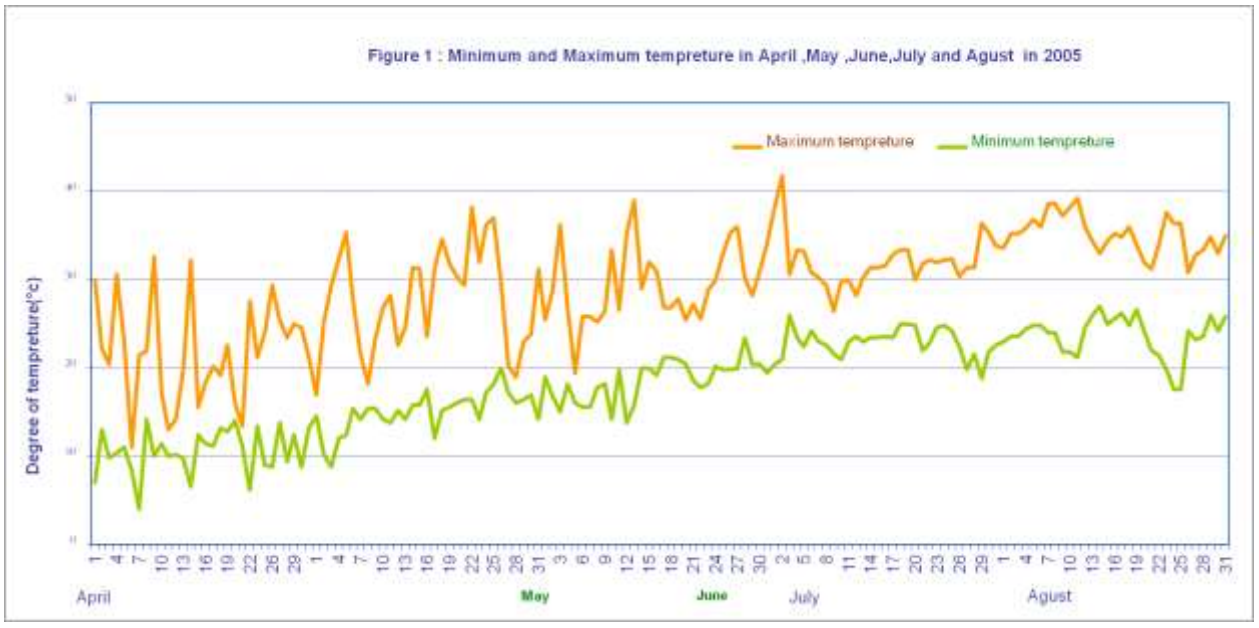

Fig.1: 2005

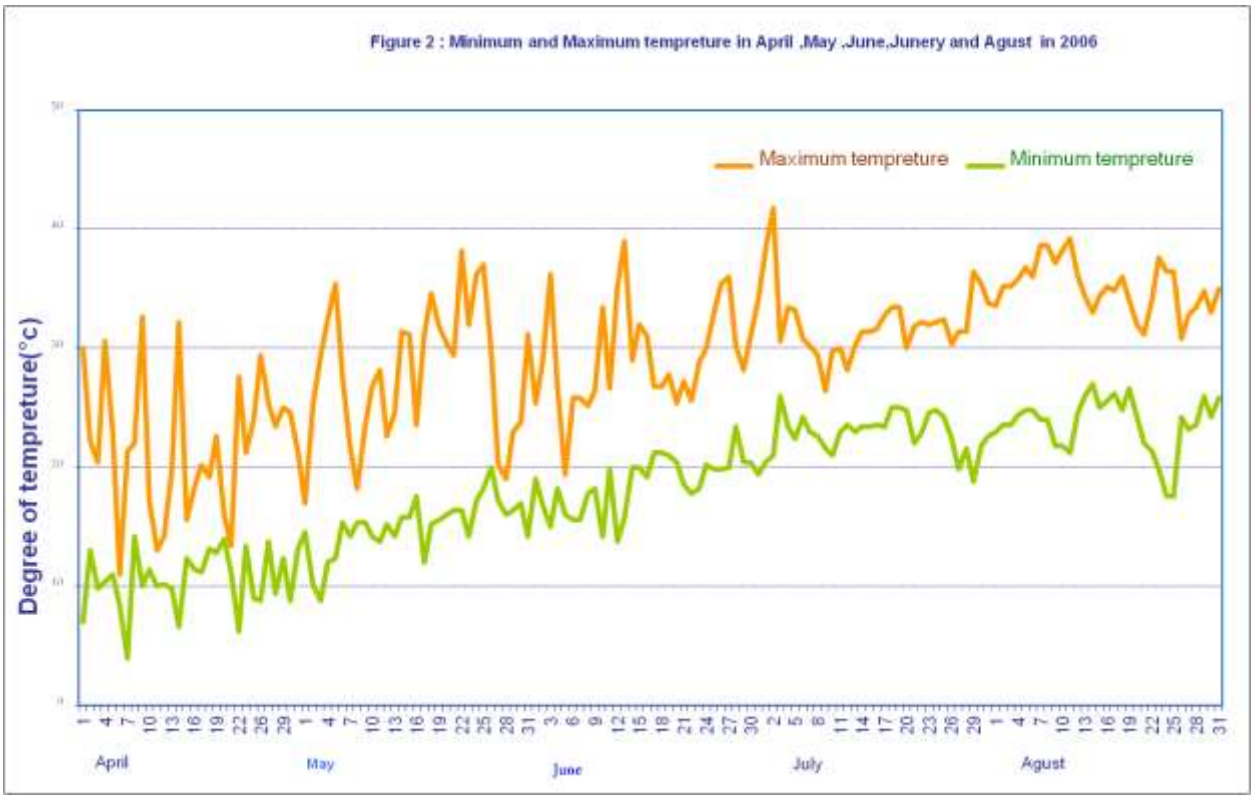

Fig. 2:2006

The experiment was laid out in a randomized complete block design and replicated three times. The experiment consisted of following treatments:

P1=single row, P2=parallel double row with 15 cm space and P3=zigzag double row with 15cm space apart, and plant density consisted of 4 levels; D1=75000 plant ha-1, D2=85000 plant ha-1, 95000 plant ha-1 and 105000 plant ha-1. The inter row spacing was fixed at 60 cm while within row spacing was adjusted according to plant densities and planting arrangement. Each treatment combination was replicated in four blocks using a randomized complete block design. Each plot comprised of four raised beds of 6 meters length –and plants were harvested at the dough-milking stage.

Sufficient numbers of plants were sown for each treatment to facilitate destructive sampling for determining quality parameters. The field was previously under wheat which was harvested on 15 June of 2015. The land was plowed to a depth of 20-25 cm followed by harrowing before planting. Data were analyzed using the analysis of variance (ANOVA) procedure with of SAS (2004) by means between the treatments were compared using Duncan Multiple Range Test at P<0.05.

RESULTS AND DISCUSSION

The results of comparing agronomic parameters of faba at four plant densities **[Tables 2 & 4]**showed, that most of the corn characters including total dry weight, total dry pod, stem dry weight, leaf dry weight, chaff dry weight, stem diameter, pod height and plant height were significantly different (P<0.05) between plant densities. Generally yield and yield components parameters increased with increasing in plant density. The highest total dry weight and pod dry weight were 10.42 ton ha-1and 3.66 ton ha-1 respectively at the plant density of 75000 plant ha-1. In contrast the great grain/pod ratio and harvest index parameters with amounts of 76.54 and 29.57% respectively got from low plant density (45000 plant ha-1).

As shown at **tables 3 & 4**, planting arrangement did not significantly affect the yield parameters except for harvest index, ear height, grain/ear ratio, stem diameter and chaff fresh weight which were 9.5, 9.8, 9.7, 9.7 and 10.0 % greater in the double row compared to the single row pattern and plant height which was 6.1% smaller in the double compared to the single row pattern **[Tables -2&5]**.

Interaction of planting pattern and plant density become significant at most pod studied characters. Combination treatment of planting patterns and plant density showed: high plant density (75000 plant ha-1) by double row

pattern produced the most pod dry weight (3.99 ton ha-1) and total dry weight (10.85 ton ha-1). While the maximum harvest index (27.82%) obtained from low plant density (75000 plant ha-1) with 15 centimeter double row planting pattern. Other parameters such as stem diameter, grain/pod ratio chaff dry weight and chaff fresh weight were the best at low plant density **[Table- 4]**, it means at minimum and medium plant density specially on one double - row pattern, the bushes can grown better and produce a good pod [5,6,7].

Increasing the yield at high plant density due to double row pattern, may is because of closing to square planting arrangement. The yield at low plant density due to lacking number of plant per surface and at high plant density because of competition for absorption growth elements and interference of male and females flowers become limited [8,9,10].

The results showed the highest stem biomass obtained on double row - 95000 plant density treatments. With study this character and in base of that after harvesting pod in doughing - milking stage (for proper conserve or …) rest of green shrub used as forage, selecting density of 95000 or 105000 plant ha-1 should be done. Although pod marketing obviously decreased not only for fresh consumption in despite of significant increase of faba weight in 95000 plant per hectare was recommended for better marketing fababean with double row planting arrangement.

Table 1: ANOVA on fresh yield and some agronomic characteristics of Faba Bean as affected by Planting arrangement

S.O.V.	df	Mean square (MS)						
		Number of plants per plot	Fresh forage yield	Internodes distance	Number of nodes	Number of pod filling	Number of empty pod	Height to node
Reap	2	10.667	813	0.03097	9.14815	96.056	7.056	0.04255
Planting arrangement	2	6464.667**	1439124**	22.83847**	546.81481**	4936.222**	1243.722**	11.33671**
Error	34	17.961	4455	0.01852	0.7702	12.546	1.507	0.01671
CV(%)	-	22.85	32.18	30.67	24.77	32.33	26.96	27.46

**, * and ns are significant at 0.01, 0.05 level and non significant, respectively

Table2. Mean comparison of dry yield and some agronomic characteristics of Faba Bean at deferent Planting arrangement.

Treatment	Number of plants per plot	Fresh forage yield(kg ha$^{-1)}$	Internodes distance (cm)	Number of nodes	Number of pod filling	Number of empty pod	Height to node (cm)
	Planting arrangement						
P1	54.2222c	509.2778c	2.07500c	10.6667c	63.5556a	20.2222c	1.90000c
P2	67.2222b	588.6667b	3.18889b	15.0000b	47.6667b	27.9444b	2.64167b
P3	91.5556a	6374.7778a	4.32778a	18.4444a	30.4444c	36.8333a	3.48611a

P1=single row, P2=parallel double row with 15 cm space and P3=zigzag double row with 15cm space.

Table 3. Mean comparison of dry yield and some agronomic characteristics of Faba Bean at deferent planting pattern.

Treats/ Treatment	Chaff dry weight (Tonh^{-1})	Pod dry weight (Tonh^{-1})	Kernel dry weight (Tonh^{-1})	Stem dry weight (Tonh^{-1})	Leaf dry weight (Tonh^{-1})	Total dry weight (Tonh^{-1})	Harvest index	Pod height (cm)	Grain/ pod ratio	Stem diameter	Kernel fresh weight (kgh^{-1})	Chaff fresh weight (kgh^{-1})
Planting pattern												
Single row	0.617 a	2.488 a	1.371 a	4.706 a	2.377 a	5.53 a	24.28 b	78.1 ab	53.40 ab	19.23 b	3432a	3284 a
Parallel double row	0.580 ab	2.949 ab	1.0 74 ab	5.469 ab	2.791 a	6.44 a	25.60 ab	71.88 c	56.85 a	20.5 ab	3210a	2985.4b
Zigzag double row	0.790 a	3.949 a	1.884 a	6.559 a	2.991 a	6.88 a	28.70 a	81.68 b	66.85 a	22. 2 a	3550a	3385.4b
LSD (%)	0.116	1.42	0.770	1.584	1.008	4.427	1.310	3.646	4.76	0.6336	82.19	621.6

Means within columns followed by same letters are not significantly different at 5% level
P= Planting pattern; P1= Single row, P2= Parallel double row, P2= Zigzag double row

CONCLUSION

Overall findings showed that: with considering double row planting arrangement, would be increase 11.7% without negative effect on dry yield and dry component of Faba Bean and these treats could be increase 9.5%. The highest leaf dry weight (3.99 ton ha-1) and total dry weight (10.85 ton ha-1) were produced by 95000 plant ha-1 plant density and 15 centimeter double row. In contrast the highest harvest index (27.82%) was related to low plant density (75000 plant ha-1) with 15 centimeter double row planting pattern. Double row planting pattern may be recommended as a suitable farming method in northern Iran due to the benefits associated with increasing number of plant per surface unit and decreasing inter plant competition.

CONFLICT OF INTEREST

Authors declare no conflict of interest

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None

FINANCIAL DISCLOSURE

None

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