



Global Advanced Research Journal of Agricultural Science (ISSN: 2315-5094) Vol. 4(5) pp. 230-234, May, 2015.
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Full Length Research Paper

Effects of planting arrangement and different tillage methods on some morphological characteristics of *Vicia Faba*

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Accepted 12 May, 2015

In order to investigate on the effect of planting arrangement and tillage method on seed yield and yield components for Barakat cultivars of *Vicia faba*, an experiment was carried out in the research farm, faculty of agriculture Gorgan University during 2013. This research was performed in randomized complete block design with three replications. Plots were assigned by three inter- row spacing planting arrangements (P1= parallel double row 15 cm space apart, P2= Zigzag double row 15 cm space apart and P3= single row 7.5 cm inter- row spacing). The tillage methods were included; T1=No tillage T2= Minimum tillage T3= Conventional tillage. Results obtained from data variance analysis showed that the effect of inter- row spacing and tillage methods on stem diameter character within probability level of 1% was significant, the greater stem diameter (11.86 mm) by double row pattern in no tillage treatment produced. The most characters of *Vicia faba* including; stem diameter, height to node, plant height, number of branch and number of seeds per pod were significantly ($P < 0.05$) affected by tillage method. The highest plant height and height to node were 70.91 cm and 3.65 cm respectively obtained from no tillage and minimum tillage treatment. The greater stem diameter (11.28 mm) got from no tillage system, the most number of branches (5.22) obtained from conventional tillage and the large number of seeds per plant (20.88) was related to minimum tillage.

Keyword: common bean, planting arrangement, tillage system

INTRODUCTION

Legumes are the secondary important sources of food after cereal in Iran. In addition, legumes contain protein in abundance that is about 18 to 32 percent, and they

have an important role in supplying protein materials to the human. 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 (FAO 2003). It is predicted that at least 10 million people will be hungry

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and malnourished in the world by the end of this century (FAO 2003). Thus, to reduce the food insecurity, crop production will have to be doubled, and produced in more environmentally sustainable ways (Borlaug and Dowsell, 2005). 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 (Arous et al., 2004).

Short term effects of tillage include reduction in weeds, expansion of root depth and increasing soil moisture (Saral and Yavuzscan, 2000). The field experiments have shown that for tillage operation of one hectare land with mouldboard plough, more fuel was utilized as compared to chisel plough, and field capacity of chisel plough (in ha hr⁻¹) was about two-fold as much when compared to mouldboard plough (Khosravani et al., 1995).

Aykas and Onal (2004) showed that different tillage techniques did not reveal significant differences on seed cotton and leaf quality. They also determined that the proper tillage (new alternative system) reduced the tractor traffic on soil and make the plants grown in these plots emerged earlier.

The relationship between growths of *Vicia faba* 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 (Qureshi et al., 2007).

These include in the aspects of to what extent of planting pattern and tillage methods affect the morphological characteristics of *Vicia Faba*. In addition, no comprehensive database is available on *Vicia faba* under combination of mention treatments at north of Iran. Hence, the present study was designed to study the effect of planting arrangement and tillage systems on morphological parameters of *Vicia Faba*.

MATERIALS AND METHODS

The field experiment was conducted at the research farm of Gorgan university of Agricultural Sciences and Natural Resources, Iran in 2013 to determine the best planting arrangement and tillage method of *Vicia Faba*. The field was previously under wheat-soybean rotation

which was harvested on 15 June of 2013. The land was plowed to a depth of 20-25 cm followed by harrowing before planting. Geographical coordinate of the farm were 36° 54.00' N; 54° 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.

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

The planting patterns consisted of 3 levels; P1= parallel double row 15 cm space apart, P2= Zigzag double row 15 cm space apart and P3= single row 7.5 cm inter- row spacing.

The tillage methods were included; T1=No tillage T2= Minimum tillage T3= Conventional tillage.

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. 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 ANOVA on some morphological characteristics of *Vicia faba* showed (Tables 2 & 3), the most characters of *Vicia faba* including; stem diameter, height to node, plant height, number of branch and number of seeds per pod were significantly (P<0.05) affected by tillage method. The highest plant height and height to node were 70.91 cm and 3.65 cm respectively obtained from no tillage and minimum tillage treatment. The greater stem diameter (11.28 mm) got from no tillage system, the most number of branches (5.22) obtained from conventional tillage and the large number of seeds per plant (20.88) was related to minimum tillage.

As shown at tables 1 & 2, planting arrangement did not significantly affect the morphological parameters, except stem diameter which parallel double row with 15 cm space treatment with 11.12 mm had greater diameter compared to the single row pattern and zigzag double row with 15cm space.

Interaction of planting pattern and tillage method become significant for stem diameter character.

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

Table 2. ANOVA on some morphological characteristics of *Vicia faba* as affected by planting arrangement and tillage methods

S.O.V.	df	Mean square (MS)						
		Stem diameter	Height to node	Plant height	Internodes distance	Number of branch	Number of pod	Number of seeds per plant
Tillage	2	27.3 *	1.73 *	136.03 **	1.55 ^{ns}	14.11 **	3.004 ^{ns}	67.85 *
Planting arrangement	2	23.05 *	0.435 ^{ns}	6.03 ^{ns}	1.17 ^{ns}	0.25 ^{ns}	0.88 ^{ns}	9.49 ^{ns}
Tillage× Planting arrangement	4	23.9 **	0.78 ^{ns}	18.14 ^{ns}	1.69 ^{ns}	0.29 ^{ns}	0.882 ^{ns}	9.5 ^{ns}
CV(%)	-	24.58	19.84	6.77	16.61	17.43	23.37	18.64
Error	-	5.2	0.39	22.4	0.58	0.434	0.0874	11.5

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

Table3. Mean comparison of some morphological characteristics of *Vicia faba* as affected by planting arrangement and tillage methods

Treatment	Number of seeds per plant	Number of branch	Stem diameter (mm)	Plant height (cm)	Internodes distance (cm)	Height to (cm) node	Number of pod
T ₁	15.4 b	3.0 b	11.28 a	70.91 a	4.3 b	2.8 b	3.42 b
T ₂	20.88 a	3.11 b	8.34 b	73.05 a	5.08 a	3.65 a	4 ab
T ₃	18.28 ab	5.22 a	8.2 b	65.51 b	4.45 ab	3.03 ab	4.57 a
P ₁	19.37 a	3.8 a	11.12 a	70.52 a	5.01 a	3.41 a	3.95 a
P ₂	17.64 a	3.6 a	8.442 b	70.03 a	4.3 a	3.04 a	4.33 a
P ₃	17.55 a	3.93 a	8.26 b	68.92 a	4.52 a	3.01 a	3.71 a
P ₁ × T ₁	18.06 a	3.13 a	11.86 a	70.03 a	4.89 a	3.34 a	3.73 a
P ₁ × T ₂	21.46 a	2.26 a	8.7 a	76.0 a	5.64 a	4.06 a	3.4 a
P ₁ × T ₃	18.60 a	5.0 a	7.8 a	65.53 a	4.5 a	2.82 a	4.73 a
P ₂ × T ₁	14.66 a	3.0 b	8.72 a	73.4 a	3.96 a	2.43 a	3.33 a
P ₂ × T ₂	19.06 a	2.6 b	8.2 a	72.56 a	3.96 a	3.14 a	5.0 a
P ₂ × T ₃	19.2 a	5.2 a	8.4 a	64.13 a	4.99 a	3.56 a	4.66 a
P ₃ × T ₁	13.46 a	2.86 b	8.26 a	69.3 a	4.06 a	2.61 a	3.2 a
P ₃ × T ₂	22.13 a	3.46 b	8.13 a	70.6 a	5.65 a	3.73 a	3.6 a
P ₃ × T ₃	17.06 a	5.46 a	8.4 a	66.86 a	3.87 a	2.75 a	4.33 a

Combination treatment of planting patterns and tillage method showed: greater stem diameter (11.86 mm) by double row pattern in no tillage treatment produced (Tables 2 & 3). It means at double - row pattern, the bushes can grown better and produce a good morphological characteristics (Saber, et al., 2006; Proter, et al., 1997; Sprague and Dudley, 1988).

Increasing the plant high due to double row pattern, may is because of closing to square planting arrangement. The morphological characteristics 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 (Brown, et al., 1970; Duncan, 1984 and Lutz et al., 1971).

The primary tillage operation is often for reducing the compaction of the soil and increasing root growth. The compaction of soil also causes reduction in the moisture penetration, soil oxygen capacity, root penetration and amount of organic materials, and also increasing energy consumption because of high adhesion force between the soil layers and or breaking the hard pan layer (Tebrugge, 2002). Many farmers have accomplished tillage operation without much awareness of its effects on soil and crop characteristics. More investigation is required to evaluate the choice of different production systems. For an instance, there are various minimum tillage systems. One of them is the different types of chisel plough. It must be investigated which one of them is proper for which crop production. When production costs might be reduced, cotton production might be lower. In this regards, Ahmad and Haffer (1993) and Ozpinar and Isik (2004) reported that there is the significant difference between the two types of aforementioned tillage on cotton yield.

The planting patterns consisted of 3 levels; P1= parallel double row with 15 cm space, P2= zigzag double row with 15cm space and P3= single row.

The tillage methods were included; T1=No tillage T2= Minimum tillage T3= Conventional tillage.

CONCLUSION

Overall findings showed that: with considering double row planting arrangement, would be increase 11.7% without negative effect on morphological characteristics of *Vicia faba* and these treats could be increase 9.5%. No tillage and minimum tillage also had positive effect on the most characters of *Vicia faba*. The greater stem diameter produced by double row pattern in no tillage treatment. 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.

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