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ORIGINAL ARTICLE

The Effect of Planting date and the Extend of Nitrogen Fertilizer on Maize Agronomic Traits

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ABSTRACT
In this study, in order to evaluate the effects of planting date and nitrogen fertilizer and organic fertilizer on corn, split plot factorial experiment in a randomized complete block design with three replications was conducted. Iterations consist of 12 plots and 36 plots the total. Factor A contains two different planting dates (first and fourth August). Factor B contains varying levels of chemical fertilizer and organic fertilizer in three levels (organic, chemical, chemical and organic fertilizer), and treatment C includes two cultivars of corn (ZP and 704). Planting was in Ahmad Abad Mostofi district in Tehran- Eslam shahr Road in the year of 91-92. Analysis of variance showed a significant difference between planting dates on grain performance and harvest index. The first planting date had the highest yield of 1,070 grams per square meter. In case of simultaneous use of organic and chemical fertilizers that get most performance with 1130 grams per square meter had significant differences at the level of 1% with grain yield and harvest index. In addition, comparing the means showed that cultivar704 had a better yield and harvest index. The interactional effect of planting date × × fertilizer, treatment and its interactional effect × number and interactional effect of planting date × fertilizer treatment× number on the grain performance and harvest index was significant at 1%. Variance analysis results showed that plant height and biological yield with fertilizer, and interactional effect of fertilizer treatment × had a significant difference.
***Key words**: corn, planting date, nitrogen and organic fertilizer, performance*

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INTRODUCTION

Due to growing population, providing basic food needs of people living in a community is one of the main concerns of researchers and authorities in any country. Meeting the challenges of the present and future needs of any nation is the focus of nutrition research, studies, and creates appropriate grounds for moving to the stability of agricultural products. In agricultural development, fertilizers are the means to achieve maximum production per unit area. At the same time, using fertilizers not only increase production, but also improve the quality of agricultural products [1].

Corn is one of the best products for the production of forage, silage and grain [2]. Corn is accounted as an important part of feeding of the world's population. More than 80 percent of Central Americans are fed from corn. In some European countries silage corn [3] provides 90% of needed forage.

The purpose of determining planting date is to achieve the planting time of a figure or group of figures of a same plant. In such a way, that all the environmental factors at the time of emergence, and seedling establishment should be perfect, and while each stage of plant growth face favorable conditions and should not face with bad environmental conditions [4].

Sinclair & Horie [5] said that the relationship between photosynthesis and leaf nitrogen and finally its dependence with the amount of radiation use efficiency could be one of the physiological differences reason between soybean, rice and corn. Also commented that the importance of rapid canopy closure for increasing the biological performance in wheat, especially in situations where there are limitations in

terms of the growing season is much more than longer growth period to increase dry matter and finally its performance.

In a study, the effect of nitrogen on yield and quality of hybrid corn was reported that hybrid reaction to nitrogen testing in different years was different. In this study, the highest yield of protein specified to the consumption of 150 kg nitrogen per hectare [6]. Haj Seyed Hadi *et al* [7] in investigating the effect of vermicomposting fertilizer on chamomile reported the highest average plant height, diameter of flowers, fresh and dry flower yield of 20 tons per hectare using vermicomposting.

Akmal *et al* [8] in an experiment by applying different levels of nitrogen contained zero, 160, 200, 240, 280, 320 and 360 kg of nitrogen per hectare on maize, it is found that the effect of nitrogen on corn yield is significant. The performance of the zero level up to 320 kg nitrogen per hectare increased and in the level of 360 kg per hectare, it showed decreasing. According to Wajid *et al* [9], increase of nitrogen from 150 to 250 kg per hectare has a significant effect on traits such as plant height, seed number per maize, thousand-grain weight, yield and harvest index. Also Karasu *et al* [10] reported a significant effect of zero to 450 kg nitrogen per hectare on dry and wet matter yield and an insignificant and increasing effect of nitrogen on height and stem diameter of corn.

Khan *et al* [11] in Pakistan reported that the number of days after planting corn on 2 May to reach 50% cresting was 94 days. However, by delay in planting from June 13 cresting days became 71 days. The number of days from planting on second may to maturity was 132 days, and on June 13 was decreased to 105 days. Nielsen [12] stated that the annual raining and changes of temperature could affect the characteristics of corn hybrids cultivated. For example, in places like Nebraska, if irrigated corn planting date is before 1 June, for the highest yield, late maturing hybrids is used and in the same situation if the planting is after Jun, early varieties should be used.

Investigating the effect of planting date, plant density, fertilization, weed control and other agronomic factors on corn performance showed that planting date was the most important factor [13].

Accordingly, regarding the optimum planting date and the amount of nitrogen, this research project to determine the optimum amount of required nitrogen and specify appropriate planting time in maize on weather conditions of Tehran province.

MATERIAL AND METHODS

This experiment carried out in 2012-2013 in the region of Ahmadabad Mostofi located in Tehran Branch Road. It is located at 51 degrees and 6 minutes to 51 degrees and 38 minutes east longitude and 35 degrees and 34 minutes to 35 ° and 51 ' north latitude. The height from the sea level is varied between 1800 meters in north to 1200 meters in the center and 1050 meters in the south.

Experiment was conducted via split-factorial design in a randomized complete block design with three replications. Iterations include 12 plots and in totals 36 plots.

Factor ''A'' includes two different planting dates, Factor "B' contains varying levels of chemical and organic fertilizers and treatment ''C'' includes two varieties of corn.

Levels used in each treatment were as follows:

Planting date (A)

1. The first planting, august the first (A1)
2. The second planting, august fourteenth (A2)

Fertilizer treatment (B)

1. Organic fertilizers (B1)
2. Chemical fertilizers (B2)
3. Chemical and organic fertilizer (B3)

Treatment (C)

1. forage cultivar 704
2. forage cultivar ZP

For providing the plant's nitrogen, urea fertilizer was used. A third nitrogen fertilizer was given while planting and the rest was given to the plant by watering the plant in two stages and organic fertilizer plant was poured in a stage of notches and was mixed with soil.

For calculating the biologic performance, and the performance of the grain in any plot following procedure carried out. Five shrubs were taken randomly from the middle line of each plot after omitting 0/5 meter from the beginning and end of each line and then they were dried in an oven for 72 hours at 80 °C. The number of corns per plant and thousand seed weight and harvest index and plant height was calculated. In this study, statistical analysis and comparison of means were performed using SAS and

MSTATC and graphs were plotted using EXCEL program. Comparison of means was performed via Duncan's multiple range test at the level of 5%.

RESULTS AND DISCUSSION

Grain performance

Analysis of variance (Table 1) showed a significant difference between planting dates on grain performance at the 5% level. Comparing the means (Figure 2) revealed that first planting date, showed the highest performance of the grain with the average of 1070 grams per square meter. Considering the fact that in the first planting date, the number of days after planting was more, the first planting date had more yield. As well as different levels of fertilizer treatment, had significant difference in grain yield statistically at the level of 1%. Comparing the means (Figure 3) of different levels of fertilizer treatment showed the simultaneous use of organic and chemical fertilizers had the highest grain yield with an average of 1130 grams per square meter. The lowest yield was related to the chemical fertilizer with an average of 924 grams per square meter and the results showed the figures had significant differences in grain yield statistically at 1% level.

Table-1 Analysis of variance of corn traits

Sources Change	DF	**average of squares**				
		The number of ears per plant, plant height	The number of corn per plant, plant height	Grain yield	Biological yield	Harvest index
Repeat	2	2/97ns	0/08ns	936/27ns	6755/65ns	10/45ns
Planting date (A)	1	23/23ns	0/50ns	172739/98*	53945/47ns	210/54*
Experimental error	2	19/11	0/15	6315/23	16236/20	4/28
Fertilizers (B)	2	695/4**	0/45ns	150677/04**	186688/05**	126/07**
Interaction (A * B)	2	125/56*	0/05ns	19720/37**	522982/49**	527/22**
Figure (C)	1	103/23ns	0/01ns	34543/93**	5757/01ns	57/00*
Interaction (A * C)	1	4/26ns	0/03ns	25508/37**	4756/64ns	46/51ns
Interaction (B * C)	2	39/80ns	0/03ns	10399/41*	36420/38ns	107/73**
Interaction (A * B * C)	2	5/09ns	0/73ns	48894/71**	8741/42ns	88/04**
Experimental error	20	36/23	0/36	2499/83	12009/52	12/58
Coefficient of variation		2/61	17/73	4/99	6/01	6/4

***and ** are significant difference at 5 and 1%, respectively, ns not significant difference**

Comparing the means (Fig. 4) showed that 704 were better than the ZP. The results of analysis of variance (Table 1) showed that interactional effect of planting date × fertilizer treatment was significant on grain yield at 1% level. Comparison of interactional effects (Table 2) showed that the highest grain yield related to the simultaneous use of chemical and organic fertilizers in both planting dates.

Table.2 Means comparison of interactional effect of planting date and fertilizer treatments

Date implant	Fertilizer treatment	Shrub height (Cm)	Grain performance (Grams per square meter)	Biologic performance	HI
The first Planting date	Organic Fertilizer	223c	b1017	1435c	b17/51
	Chemical fertilizers	226/9bc	1035b	b1845	a20/59
	Chemical fertilizers and organic	239/1a	1159a	2072a	a06/63
Planting date	Organic Fertilizer	231/6ab	880/9c	a1987	a38/61
Second	Chemical fertilizers	222/8c	814/3d	1754b	c40/44
	Chemical and organic fertilizers	239/2a	1100a	b1842	b14/53

In each column for each treatment, the means, which have common letters have no significant difference according to Duncan's multiple range test at the 5% level.

The minimum value of this attribute as chemical fertilizer was obtained in the second planting date. Analysis of variance (Table 1) showed that fertilizer treatment × genotype on grain yield was significant at 1% level. Comparison of interactional effects (Table 3) showed that the highest grain yield related to the concomitant use of chemical and organic fertilizer in both the figures. The minimum value of this

attribute was in chemical fertilizer in 704. Some maize varieties have high fertilizing acceptance and they have high performance with the use of fertilizers.

Analysis of variance (Table 1) showed that interactional effects of planting date × cultivar on grain yield were significant at 1%. Comparison of interactional effects (Table 4) showed that the highest grain yield was related to the first planting date in both cultivars. The minimum value of this index was 704 in the second planting date. The results of analysis of variance (Table 1) showed that the interactional effect of planting date × fertilizer treatment × cultivar on grain yield were significant at 1%.

Comparison of interactional effects (Table 5) showed that the highest grain yield related to the concomitant use of organic and chemical fertilizer in the first planting date related to 704. The minimum value of this attribute with organic fertilizer in first planting date also related to 704. Based on the studies in this line, we can conclude that using a combination of different fertilizers with positive effect on different growth index increases products' qualitative and quantitative value.

The number of maize per plant

Analysis of variance (Table 1) showed no significant difference in any of the groups in the number of maize per plant. Number of maize per plant is one of the traits that were more influenced by genetic and less by environmental factors.

Shrub height

The results of variance analysis showed that (Table 1) there is a significant difference between fertilizer treatments in plant height at 1%. Mean comparison (Figure 1) of fertilizer treatments showed the highest plant height related to concomitant use of organic and chemical fertilizer with the average 239/1 cm. In addition, the lowest plant height was achieved with chemical fertilizer by the average of 225 cm. As it can be seen in table 1.4 there was a significant difference in interactional effect of planting date, fertilizer treatment, and plant height at 5% level.

Moreover, the comparison of means (Table 2) of different fertilizer treatments showed that concomitant use of chemical and organic fertilizers in both planting dates had the highest plant height and the lowest height of the plant was achieved in the second planting date by using chemical fertilizer. It can be concluded that physical and chemical properties of humic acid presented in vermicomposting, increases the concentration of nitrogen of the plant by increasing the storage capacity of nutrients and hormones (which increases growth regulators) [14, 15] as well as increasing activity of microorganisms [15] and also interaction with nitrogen. By increasing the nitrogen, plant growth, and plant height increases.

Biological function

Analysis of variance (Table 1) showed that different levels of fertilizer treatment had a significant difference in biologic performance at 1%. Means comparison (Figure 5) of different levels of fertilizer treatments showed that in case of concurrent use of organic and chemical fertilizers, best function was achieved with an average of 1957 grams per square meter. The lowest yield was related to organic fertilizer with an average of 1171 grams per square meter.

The results of analysis of variance (Table 1) showed that interactional effect of planting date × fertilizer treatment on biological yield was significant at 1%. Comparison of means of interaction effects (Table 2) showed that the highest grain yield related to the concomitant use of chemical and organic fertilizers in the first planting date. The minimum value of this attribute in using chemical fertilizer was obtained in the second planting date. The way vermicomposting effects on plant growth, is by the effect on the photosynthesis product and plant parts such as leaf, stem and root which stimulate the production of storage matters and absorption of nutrients and water by leaf and root [16], which leads to an increase of biological function.

HI (Harvest Index)

HI is one of the important physiological parameters that indicate the percentage of Photosynthesis matters transmission from vegetative growing organs to grains. Analysis of variance (Table 1) showed a significant difference between planting dates on grain yield at 5% level. Means comparison (Figure 6) showed the first planting date had the maximum harvest index with an average of 57/81%. Analysis of variance (Table 1) showed that different levels of fertilizer treatments had a significant difference in harvest index at the 1% level. Means comparison (Fig. 7) of different levels of fertilizer treatments showed that in case of concurrent use of organic and chemical fertilizers, the maximum harvest index was gained with an average of 58.1 percent, and the lowest harvest index related to the chemical fertilizer treatment with an average of 51/8 of percent.

The results of analysis of variance (Table 1) showed that the figures had significant differences in harvest index at the 5% level. Means comparisons (Figure 8) showed 704 compared to ZP had a better harvest index. Furthermore, the results of analysis of variance (Table 1) showed that the interactional effect of planting date × fertilizer treatment on harvest index was significant at the 1% level. Comparison of

interactional effects (Table 4-2) showed the highest harvest index related to the concomitant use of chemical and organic fertilizers in the first planting date. The minimum value of this attribute in chemical fertilizing was obtained in the second planting date. Analysis of variance (Table 1) showed that interactional effect of fertilizer treatment × cultivar on harvest index was significant at the 1% level. Comparison of interaction effects (Table 3) showed the highest harvest index related to the concomitant use of organic fertilizer at 704. The value of this attribute was obtained in chemical fertilizer at 704.
The results of analysis of variance (Table 1) showed that interaction between planting date ×fertilizer treatments × genotype on harvest index was significant at the 1% level. Comparison means of interactional effects (Table 5) showed the highest harvest index related to the concomitant use of chemical and organic fertilizers in both planting dates was at 704. The minimum value of this attribute in chemical fertilizer was at second planting date at the 704.

Table.3. Means comparison of interactional effect of fertilizers treatment and the cultivars

Fertilizer treatment	Cultivar	grain performance	Harvest index
		Grams per square meter	
Organic Fertilizer	704 cultivar	904c	b37/55
	ZP cultivar	993/9b	b17/57
Fertilizer	704 cultivar	874c	c38/47
	ZP cultivar	b5/975	b21/56
Chemical and organic fertilizers	704 cultivar	1133a	a64/59
	ZP cultivar	1127a	b55/56

In each column for each treatment, the means, which have common letters have no significant difference according to Duncan's multiple range test at the 5% level.

There are different factors that cause variation in harvest index. These factors lead to increasing or decreasing harvest index through the influence on grain yield, biological yield or both of them. A difference in plant height is considered as the most important factor of variety on the harvest index.

Table.4 Means comparison of interactional effect of planting date treatment and the cultivars

planting date	Cultivar	grain performance (Grams per square meter)
The first planting date	704 cultivar	1066a
	ZP cultivar	1075a
The second planting date	704 cultivar	874/3c
	ZP cultivar	989/5b

In each column for each treatment, the means, which have common letters have no significant difference according to Duncan's multiple range test at the 5% level.

Table .5 Means comparison of interactional effect of planting date, treatment fertilizer, and the cultivars

Planting date	Fertilizer treatment	cultivar	Grain performance (gm/m^2)	HI
first planting date	chemical fertilizers	704	858/7c	53/97bcd
		ZP	903/2bc	52/31cd
	Organic fertilizer	704	664/9d	35/95e
		ZP	963/8b	52/85bcd
	Organic and chemical fertilizer	704	1166a	65/31a
		ZP	1153a	60/81a
second planting date	chemical fertilizers	704	949/4b	48/94d
		ZP	1085a	53/40bcd
	Organic fertilizer	704	1083a	58/81abc
		ZP	987/2b	59/58ab
	Organic and chemical fertilizer	704	1099a	61/81a
		ZP	1101a	60/94a

In each column for each treatment, the means, which have common letters have no significant difference according to Duncan's multiple range test at the 5% level.

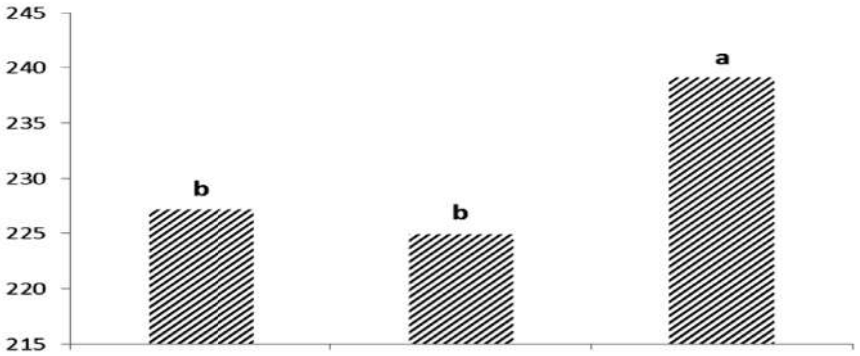

Figure.1 The effect of chemical and organic fertilizers on plant height

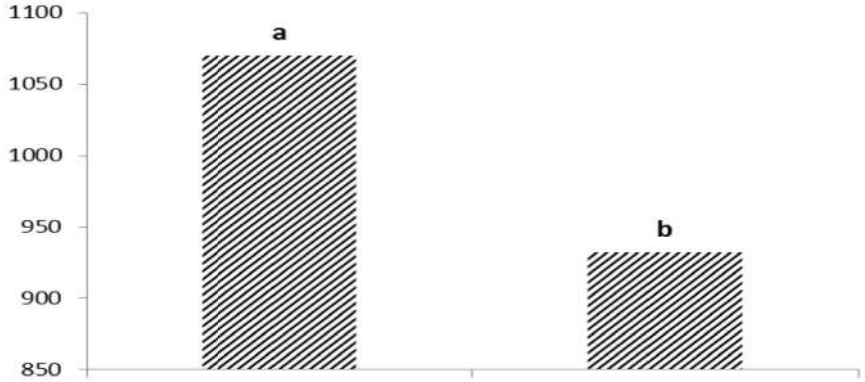

Figure-2: the effect of planting date on grain yield

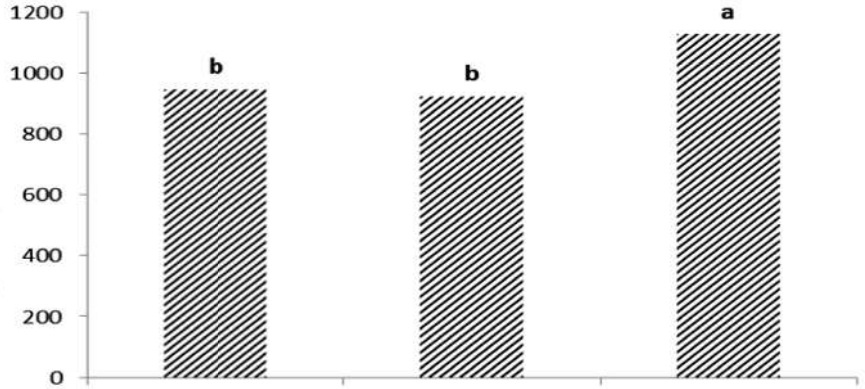

Figure.3 the effect of organic and chemical fertilizers on grain yield

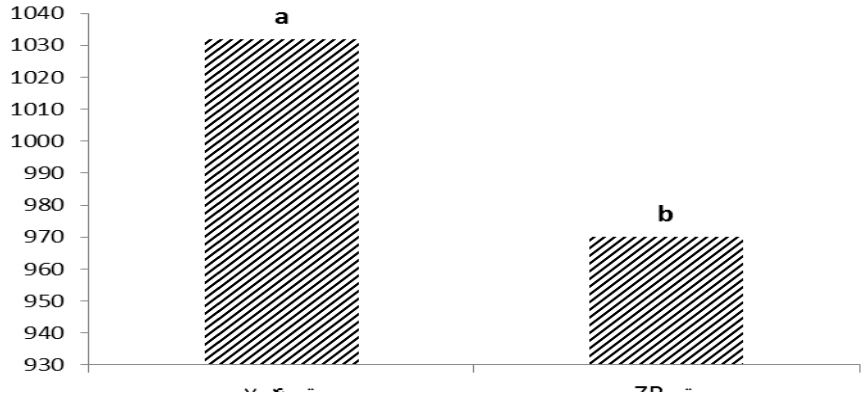

Figure-4: The effect of corn cultivars on grain yield

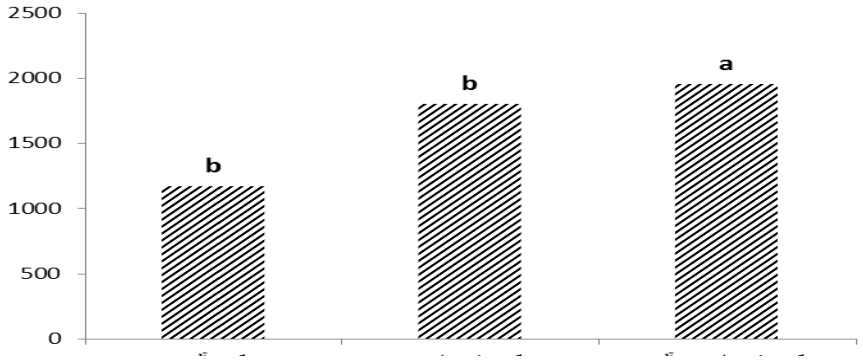

Figure 5. The effects of chemical and organic fertilizers on biological function

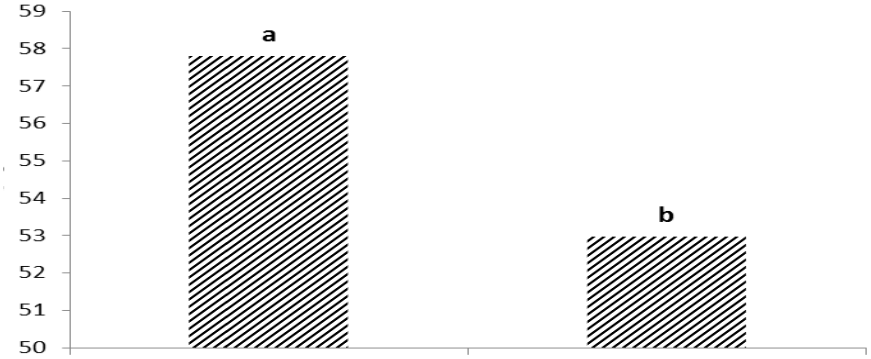

Figure.6 The effect of planting date on harvest index

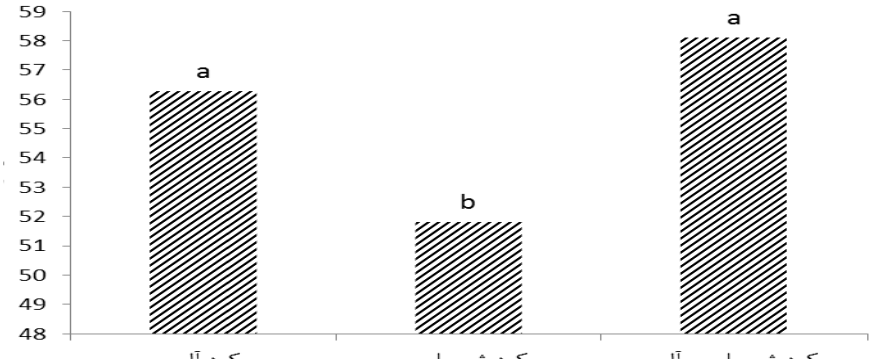

Figure.7 The effect of chemical and organic fertilizers on harvest index

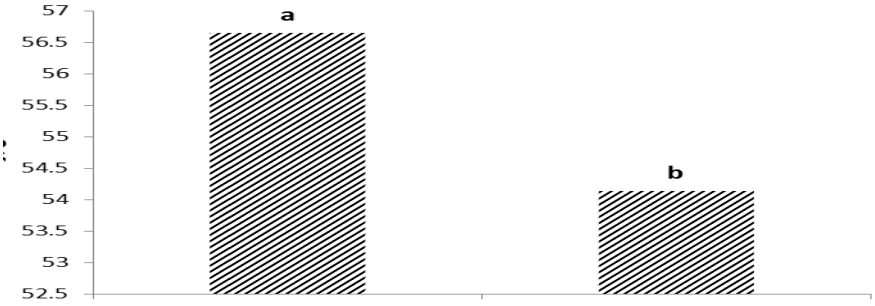

Figure.8 The effect corn cultivars on harvest index

CONCLUSION

In general, the results showed that simultaneous use of chemical and organic fertilizers and then organic fertilizers had the greatest effect on plant height and grain yield, biological yield and harvest index, respectively. Moreover, it was revealed that the first planting date leads to the increasing performance of grain and harvest index. Also the interactional effect of first planting date * simultaneous use of Chemical fertilizers*and cultivar 704 had the highest performance of grain with 1166 grams per square meter.

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