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ORIGINAL ARTICLE

Effect of Plant density to Yield and Yield components of Maize (*Zea mays* L.) Cultivars

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ABSTRACT
A field experiment was lay out in order to evaluate the effect of plant density to yield and yield components of maize (Zea mays L.) cultivars faculty of agronomy and plant breeding, Islamic Azad University, Boroujerd Branch, Boroujerd (field location: Kohdasht), Iran during the growing seasons 2011-2012. The experiment was a split-plot design based of RCBD with three replications. Treatments were four plant spacing (10, 15, 20 and 25 cm) in main plots and three early growing corn cultivars (AS31, AS54 and BIARIS) in sub plots. Results showed that, the effect of plant density, cultivar and interaction between them on cob weight, cob length, number of row per cob, biomass yield, grain yield and harvest index (HI) were significant. The effect of plant density on 1000 grain weight was significant only. The comparison of the mean values of treats showed that, AS54 cultivar in 25cm plant density treatment had the highest cob weight. Also, AS31 cultivar in 25cm plant density treatment had the highest cob length. However, BIARIS cultivar in 25cm plant density treatment had the highest number of row per cob and biomass yield and harvest index. Although maximum 1000 grain weight achieved in 20 cm plant density but, maximum was obtained in AS54 cultivar in 20cm plant density treatment. We can planting AS54 cultivar in 20cm plant spacing for obtained maximum grain yield in Kouhdasht region. Also for gave the maximum biomass for foliage purpose we can planting BIARIS cultivar in 25cm plant spacing.
Key words: Plant density, maize, yield and yield components

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INTRODUCTION

Maize (*Zea mays* L.) or corn is one of the three most important cereal crops in the world. It is a versatile crop and ranks third following wheat and rice in world production as reported (4). Maize is a crop of world repute and has a remarkable adaptability in a wide range of climates, and it is more extensively distributed over the cobth than any other local crops [6]. Corn is a very versatile grain that benefits mankind in many ways. Each ycob, 6 billion bushels of corn are used as feed for cattle, hogs and poultry in the United State. Another 2 billion bushels were exported, which is an integral part of this country's balance are converted to sweeteners, starch, flower cereal, liquor, animal feed, vegetable oil, alcohol for fuel and hundreds of other products [2]. Maize yield is more affected by variations in plant density than other members of the grass family due to its low tillering ability and the presence of a brief flowering period [17].

Plant density is an important agronomic attribute since it is believed to have effects on light interception during which photosynthesis takes place which is the energy manufacturing medium using green parts of the plant. Also, it affects the photosphere and rhizosphere exploitation by the plants especially when spacing is inadequate and the plants suffers clustering together [6]. Good plant spacing gives the right plant density, which is the number of plants, allowed on a given unit of land for optimum yield [9]. In agronomic practices plant density exerts a strong influence on maize growth, because of its competitive effect both on the vegetative and reproductive development [13]. Roy and Singh (1986) found that in maaize, 80000 plant population per hectare produced higher yield than 60,000 plant population [11]. The optimum plant population of 53,333 plants/ha for maximum yield of maize [7]. For getting the best goal, the approaches are quickly expansion of growing areas of good maize varieties and combined with intensive crop managements. The average maize yields compared with the yield potential for a given

variety and climate indicate significant opportunities to further increase maize productivity through site-specific, integrated nutrient and crop management [15].
Therefore this study was planned to examine effect of different plant densities on yield and yield components of maize.

MATERIALS AND METHODS

A field experiment was conducted in the faculty of agronomy and plant breeding, Islamic Azad University, Boroujerd Branch, Boroujerd (field location: Kohdasht), Iran during the growing seasons 2011-2012. The experiment was lay out in order to evaluate the effects of different plant densities yield and yield components of corn (*zeamayz* L.). The experiment was a split-plot design based of RCBD with three replications. Treatments were four plant spacing (10, 15, 20 and 25 cm) in main plots and three early growing corn cultivars (AS31, AS54 and BIARIS) in sub plots. The corn cultivars seeds were was planted in 5-rows in plot. Row to row distance was maintained at 75 cm. Plant samples were taken with 10 plants from each plot. The plant height, cob weight, and the number of grain per rows were determined. To determine grain yield, biomass yield and harvest index, we removed and cleaned all the seeds produced within two central rows in the field. Then grain yield and biomass yield recorded on a dry weight basis. Yield was defined in terms of grams per square meter and quintals per hectare. Replicated samples of clean seed (broken grain and foreign material removed) were sampled randomly and 100-grain were counted and weighed. The harvest index was accounted with follow:
HI = (Economical yield / Biological yield)$\times$100
The statistical analyses to determine the individual and interactive effects of time cultivation and weeds control methods were conducted using JMP 5.0.1.2 (SAS Institute Inc., 2002). Statistical significance was declared at $P \leq 0.05$ and $P \leq 0.01$. Treatment effects from the two runs of experiments followed a similar trend, and thus the data from the two independent runs were combined in the analysis.

RESULTS

Cob weight: The analysis of variance showed that, the effect of plant density, cultivar and interaction between them on cob weight was significant (table 1). The comparison of the mean values of the cob weight for interaction between plant density and cultivar showed that AS54 cultivar in 25cm plant density treatment had the highest (208g) cob weight and AS31 cultivar in 10cm plant density treatment had the lowest cob weight (94g) and the differences were significant (table 3).
Cob length: The analysis of variance showed that, the effect of all treatments on cob length was significant (table 1). The comparison of the mean values of the cob length for interaction between plant density and cultivar showed that AS31 cultivar in 25cm plant density treatment had the highest (16.7cm) cob length and all cultivars in 10cm plant density treatment had the lowest cob length (12.4g) and the differences were significant (table 3).
Number of row per cob: The effect of plant density, cultivar and interaction between them on number of row per cob was significant (table 1). The comparison of the mean values of the number of row per cob for interaction between plant density and cultivar showed that BIARIS cultivar in 25cm plant density treatment had the highest (42.5cm) number of row per cob and BIARIS cultivar in 10cm plant density treatment had the lowest number of row per cob (33cm) and the differences were significant (table 3).

Table1. Analysis of variance (mean squares) for effects of different plant densities on yield and yield components of maize cultivars

treatments	df	cob weight	cob length	number of row per cob	100 grain weight	biomass yield	grain yield	harvest index
R	2	0.221	0.01	0.38	0.33	5130	21397	4.21
Density (A)	3	9193**	20.95**	83**	42.8**	1311837**	29394875**	104.1**
Error (a)	6	11.12	0.018	0.98	3.5	41041	29265	21.25
Cultivar (B)	2	3037**	4.1**	9.2**	3	139235**	160727**	65.4**
D*C	6	537**	1.13**	18.7**	98	13056**	552337**	11.2**
Error (b)	16	1058	0.017	0.96	3.27	2852	21207	38.3
CV(%)		1.63	0.9	2.24	3.09	2.62	1.54	3.31

* and **: Significant at 5% and 1% probability levels, respectively

100 grain weight: The effect of plant density on 1000 grain weight was significant only (table 1). The comparison of the mean values showed that in density treatments, 25cm plant spacing treatment had the highest (30.8g) 1000 grain weight and 10 cm plant had the lowest 1000 grain weight (25.5cm) and the differences were significant (table 2).

Table2. Mean comparisons for 1000 grain weight of different maize cultivars under different plant densities

density	100 grain weight (g)	cultivar	100 grain weight (g)
10cm	25.5c	AS31	27.8a
15cm	28.4b	AS54	28.8a
20cm	28.4b	BIARIS	28.3a
25cm	30.8a		

Means by the uncommon letter in each column are significantly different ($p<0.05$)

Biomass yield: The analysis of variance showed that, the effect of plant density, cultivar and interaction between them on biomass yield was significant (table 1). The comparison of the mean values of the biomass yield for interaction between plant density and cultivar showed that BIARIS cultivar in 25cm plant density treatment had the highest (2585kg/ha) biomass yield and AS31 cultivar in 10cm plant density treatment had the lowest biomass yield (1531kg/ha) and the differences were significant (table 3).

Grain yield: The effect of plant density, cultivar and interaction between them on grain yield was significant (table 1). The comparison of the mean values of the grain yield for interaction between plant density and cultivar showed that AS54 cultivar in 20cm plant density treatment had the highest (11181kg/ha) grain yield and AS54 cultivar in 10cm plant density treatment had the lowest grain yield (7333kg/ha) (table 3).

Harvest index (HI): The analysis of variance showed that, the effect of plant density, cultivar and interaction between them on HI was significant (table 1). The comparison of the mean values of the HI for interaction between plant density and cultivar showed that AS31 cultivar in 20cm plant density treatment had the highest (54%) HI and AS54 cultivar in 10cm and BIARIS cultivar in 25cm plant densities treatments had the lowest HI (41%) and the differences were significant (table 3).

Table 3. Interaction effect of treats for effects of different plant densities on yield and yield components of maize cultivars

tratments		cob weight(g)	cob length(cm)	number of row per cob	biomass yield(kg/ha)	grain yield(kg/ha)	harvest index(%)
density	cultivar						
10cm	AS31	96g	12.4g	36e	1531d	7333bd	48ab
	AS54	154e	12.5g	36e	1673cd	7245bd	43abc
	BIARIS	128f	12.4g	33f	1583cd	7663a-d	48ab
15cm	AS31	155e	14.7de	38d	1806c	8199bc	45ab
	AS54	164d	14.6e	39cd	2023bc	8462bc	41bc
	BIARIS	163d	15.2c	40bc	1833bc	8676a-c	47b
20cm	AS31	129f	14.7e	34f	2023bc	1069ab	54a
	AS54	173c	13.3f	40bc	2248ab	11181a	49ab
	BIARIS	172c	15.7b	41ab	2230b	10831b	50ab
25cn	AS31	197b	16.7a	42a	2309ac	10816b	46b
	AS54	206a	15d	42a	2571a	10816b	42c
	BIARIS	208a	16.6a	42.5a	2585a	10803b	41c

Means by the uncommon letter in each column are significantly different ($p<0.05$)

DISCUSSION

The many of factors and processes such as light intercepted by the canopy, metabolic efficiency of plants, translocation efficiency of photosynthetic from leaves to economic parts and sink capacity or sink strength affected growth and yield of crops [3]. The extent of development of each yield character is also dependent on the interrelationship between the various yield components.

In the present study results indicates that there were significant differences in the response of yield and yield components of maize cultivars to the plant densities (table 1). Different plant spacing with different plant densities generally influenced maize plant yield components. According to the data of table 2, with increase in plant space in all cultivars cob weight, cob length, number of row per cob and biomass yield were increased significantly (table 3). Seed weight also increases due to better transfer of photosynthetic substances. The content of corn seeds in terms of conservation of plant materials is a function of numbers of endosperm and starch granules generated 10 to 14 days after pollination [5].

Ibeawuchi et al (2008) told that the plant spacing, for maize plant, which had the least plant, height, could be explained by the competition for scarce growth resources available, the genetic makeup and environmental factors of the plant [6]. It means that these identified factor could be harnessed especially close spacing which cause competition and removal of nutrients for growth and genetic makeup either for tallest or shortness for the particular plant. Both plant population density and cultivar and interaction between them had significant effects on cob length as shown in table 1. AS54 cultivar in 25*75 cm plant population treatment had the highest cob weight. The data showed that the cob length decreased as the plant population increased. These results are in line with the findings of Karim*et al.* (1983) and Akcin*et al.* (1993) who concluded that the cob length decreased linearly with increase in plant population [1, 8]. Our results indicate that there is a positive relationship between plant spacing and cob length of maize, probably due to variable plant competition [19]. Also, AS31 cultivar in 25*75 cm plant density treatment had the highest cob length. However, BIARIS cultivar in 25cm plant density treatment had the highest number of row per cob and biomass yield and harvest index. Dry matter yield was influenced by plant densities. These results indicate a close relationship between dry matter yield and plant density. Numerous workers have determined different plant densities for maximum dry matter yield changing from 79 000 to 165 000 plants ha^{-1}[16, 18].

1000-grain weight is an important yield contributing factor, which plays an important role in showing the potential of a variety (19). Grain yield is the end result of many complex morphological and physiological processes occurring during the growth and development of a crop. The growing conditions are changed by different plant spacing's [19]. Although maximum 1000 grain weight achieved in 20*75 cm plant population but, maximum was obtained in AS54 cultivar in 20*75 cm plant density treatment. Akcin*et al.* *(*1993) also reported that 1000-grain weight increased with decreasing plant population density in maize [1]. Grain yield is the product of crop dry matter accumulation and the proportion of the dry matter allocated to the grain (i.e., harvest index) and harvest index in corn declines when plant density increases above the critical plant density. Our findings are in good agreement [14, 19].

CONCLUSION

The present study showed that, adequate plant spacing coupled with plant population per unit area gives a good yield. We can planting AS54 cultivar in 20*75 cm plant spacing for obtained maximum grain yield in Kouhdasht region. Also for gave the maximum biomass for foliage purpose we can planting BIARIS cultivar in 25*75 cm plant population.

REFERENCES

1. Akcin, A., Sade, B., Tamkoc, A. &Topal, A. (1993). Effect of different plant densities and nitrogen fertilization rates on the grain yield, yield components and some morphological traits of hybrid TTM- 813 grown at Kenya. Doga, Turk Turmveorr manculik Dergisi. 17(1): 181-294.
2. Audrac, E. (2006). Changing the conversation about high fructose corn syrup. In: Corn refiners association, Washington, 4th edition.
3. Doku, E.V. (1977). Some concepts of Crop yield. Ghana Journal of Agric Sc. 10 (1), 53 – 60.
4. FAO. (2002). Fertilizer and the future. IFA/FAO Agriculture Conference on Global food security and the role of Sustainability Fertilization. Rome, Italy. 16th-20th March, 2003, pp 1-2.
5. Hay, R.K.M. & Gilbert, R.A. (2001). Variation in the harvest index of tropical maize: evaluation of recent evidence from Mexico to Malawi. Annals of Applied Biology 138: 103–109.
6. Ibeawuchi, I. I, Matthews-Njoku, Edna; Ofor, Miriam O; Anyanwu, Chinyere P and Onyia; V. N.(2008). African Journal of Biotechnology, 3(4): 102-107.
7. Iken, J.E. & Anusa, A. (2004). Maize Rescobch and Production in Nigeria. African Journal of Biotechnology, 3(6): 302-307.
8. Karim, M.A., Bakhash, P. & Shah, P. (1983). Effect of plant population on yield and yield components of synthetic 66(maize). J. Agron. Res. Rab, 21(2): Maize Absts., 1(5).
9. Obi, I.U. (1991). Maize, its agronomy, diseases, pests and food values. Optional Computer Solutions Ltd., Enugu Pp 207.
10. Onwueme, I.C. &Sinha, T.D. (1991). Field Crop Production in Tropical Africa CTA. Ede. The Netherlands Pp. 159 – 175.
11. Roy, R.K. & Singh, K.S.P. (1986). Response of popcorn (*Zea mays*) to plant population and nitrogen. Indian Journal of Agronomy, 31(1): 88-92.
12. SAS Institute. Inc. (1997). SAS/STAT Users Guide. Version 6.12. SAS Institute Inc. Cary. NC.
13. Singh, D. &Choudhary, J. 2008. Effect of plant population and fertilizer levels on yield and economics of pop corn. Indian J. Plant Sci., 78(4): 370-371.
14. Tollenaar, M. (1991). Physiological basis of genetic improvement of maize hybrid in Ontario from 1959 to 1988. Crop Sci., 31: 119–124

15. Trinh, Q.K., Pham, S.T. & Christian, W. (2008). Improving of maize yield and profitability through site-specific nutrient management (ssnm) and planting density. Omonrice 16: 88-92.
16. Turgut, I., Duman, A., Bilgili, U. &Acikgoz, E. (2005). Alternate Row Spacing and Plant Density Effects on Forage and Dry Matter Yield of Corn Hybrids (*Zea mays* L.). J Agron. Crop Sci., 191(2):146-151.
17. Vega, C.R.C., Andrade, F.H., &Sadras, V.O. (2001). Reproductive partitioning and seed set efficiency in soybean, sunflower and maize. Field Crops Res., 72: 165-173.
18. Yilmaz, S., Gozubenli, H.,Knuskan, O. &Atis, I. (2007). Genotype and Plant Density Effects on Corn (Zea mays L.) Forage Yield. Asian J Plant Sci, 6(3):538-541.
19. Zamir, M.S.I., Ahmad, A.H., Javeed, H.M.R., & Latif, T. (2011). Growth and Yield Behaviour Of Two Maize Hybrids (Zea Mays L.) Towards Different Plant Spacing. Cercetări Agronomiceîn Moldova 2 (146): 33-40.

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