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This is a refereed journal and all articles are professionally screened and reviewed **ORIGINAL ARTICLE**

Effect Ofplantingdateandplant Densityonyield And Yield Componentsof Garlic Infariman

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ABSTRACT

The idealplantingdate and planting density are among thefactor determining productivity of the crop cultivation.In this study, the effect of plantingdateandplant density were examined on the growth, yield and yield components of garlic (*Allium sativum*cv. Hamedani) plants. The experimental design was a split-split plot with two planting dates: 5 and 21 November comprising the main treatments, three spacing of 0.2, 0.3 and 0.4 m between rows as sub-treatments, and two spacing of 0.08 and 0.12 m within rows as sub-sub-treatments, that were applied with three replications. The experiment was conducted in 2011 at the Fariman research farm in Fariman, Northeast Iran.The result indicated that the impact of two planting dates on measured growth and productivity parameters of garlic plants was significant. Decreasing the distance between rows, significantly decreased the number of cloves in bulb, but the cloves weight and economic yield significantly increased.The greatest yield was observedat the spacing of 0.2 m between rows. Increasing the distance within row from 0.08 to 0.12 m increased weight of bulb and clove, and economic yield, although not significant. . These results suggested that garlic (cv. Hamedani) planting in 21 November, with spacing of0.12 ×0.20 wassuitable recommendation for farming this crop in the region.

Key words: Garlic, planting date, plant density, yield and yield components

Introduction

Garlic (*Allium sativum*, 2n=16) belongs to Family-*Alliaceae* is one of the most important bulbous spice crop [1]. Garlic is originated on the Northwestern side of the Tien- Shan Mountains of Kirgizia in the arid and semi-arid areas of Central Asia [2]. Garlic has a wide area of adaptation and cultivation throughout the world [3].

It is mainly used for flavouring and seasoning vegetables and meat dishes. The important areas of planting garlic in Iran are Hamedan, Khorasan, and Kermanshah. In Iran the main reason for lower productivity in garlic is due to inadequate and improper adoption of agronomic practices, pest and disease management, market support, etc. Among the cultural practices, planting date and planting density an important role in deciding the yield of any crop.

The productivity of garlic in many parts of the world is low [4]. A range of factors may contribute to garlic not achieving their potential yield. Among these factors influencing yield quantity and quality, planting date and density are the most relevant. The use of inappropriateplanting date and planting density could reduce yield considerably.

There is scarcity of information on specified planting density for different planting date of crop in Iran that can greatly help to increase garlic production. The present study, therefore, undertaken to identify appropriate planting date, inter-row and intra-row spacing for optimum yield and quality of bulb of garlic under open field conditions.

Materials And Methods

Field experiment were conducted in 2011 on agricultural experimental farm in Fariman (35°55 N, 40°14E, 1174 m above sea leve), in north east of Iran. The experiment was established in clay silt. Before planting based on soillaboratories recommendations50 t ha-1 manure was corporate with soil. The experimental site is located in warm andarid region with mean annual precipitation of 187 mm and annual mean long–term averagetemperature of 28 °C.

Seedbed preparation included ploughing, diskharrowing and cultivation. Garlic used in this experiment was the short season, called Hamedani. The experimental design for this study was a split-split–plot randomized complete block design with three replicates. Main plot treatments were two planting dates: 5 and 21 November. Subplot treatments consisted of three spacing of 0.2, 0.3 and 0.4 m between rows and sub-sub treatments were two spacing of 0.08 and 0.12 m within rows.The treatments were laid outin fiverows of 2 min length.

All plots were given N fertilizer at two-times (50 kg ha-1 at two-leaf stage and 75 kg ha-1 at Mid-

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April). Thedropmethodwas used forcropirrigation with 7-days intervals.During the growth period all plots were weeded manually. No serious incidence of insect ordisease was observed and no pesticide orfungicide was applied.

At the end of growth period five garlic plants were sampled and number of cloves in bulb, cloves weight and bulb weight were recorded. At maturity, bulb were harvested from each plot and weighed todetermine economic yield.

Data collected were subjected to the analysisof variance (ANOVA). Test of significance of thetreatment difference was done on a basis of a*t*–test. The significant differences betweentreatments were compared with the criticaldifference at 5% level of probability.

Results And Discussion

Planting date:

The effect ofplantingdateon economic yield, numberof cloves in bulb, cloves weight and bulb weight was notsignificant(Tables 1 and 2).Despite theincrease inthe average measured growth parameters on planting date of 21 November in comparison with 5 November, this advantagewas not significant.This was attributed to negligibledifferencebetweentwo planting date. Germinationisfollowed bya phase ofslowgrowth in all bulbous spice crops. Lowtemperaturescan causelongergrowth period (6 and 7). Inourstudy different in weather conditions between two dates of plantingwasnotsignificant. Dateof planting, therefore,had nosignificant impacton thestudied traits.

Kilgori, et al. [7] intheirstudieson theeffect ofplantingdateon yieldof two varieties ofgarlic in Sokoto, Nigeria found that the bulbyield in plantingdate of 13 Novemberand 14 December is greater than planting date of 28 December. Theyattributedthisresultto availability ofmore favorabletemperatureconditions in theplantingdateof13 Novemberand 14December.From point of view, 15-day delay in planting date from 5 to 21 November does not significant impact, the date of 21 November could be recommended under Fariman condition due to inthese circumstances moreopportunitiesprovided to better resource efficiencyofpreceding crop. Moreover, two-times irrigation less is required at later planting date.

Inter-row spacing:

The effect of inter-row spacing on economic yield of garlic, number of cloves in bulb, cloves weight and bulb weight was not significant (Tables 1 and 2). Plants grown at spacing of 0.2 m between rows had the greatest economic yield, while plants grown at 0.4 m inter-row spacing had the least economic yield. Thisis probablydue toincreasingplant densityper land unit area. Increasingplant density,however, through reducingthe distance betweenrows reduced number of cloves in bulb.

The results of our research indicated that, plant densityincreasedwithdecreasing row distance. This could result in increasing number of cloves and bulb per land unit area. These results are in line with Darabi and Dehghani [6], who found increased economic yield of garlic at greatest plant density (0.2 m inter-row space). Similar resultswere also reported byAhmadi and Rohaninezhad [5], who reported an increase in economic yield and decrease in number of cloves per bulb and bulb weight through reducing inter-row spacing.

Intera-row spacing:

No statistically significant differences have been found to exist between intera-row spacing on number of cloves per bulb, weight of bulb and weight of cloves (Table 1). Intra-row spacing of 0.12 m had the greater weight of bulb, weight of cloves and economic yield final compared with intra-row spacing of 0.08 m, although not significantly (Tables 1 and 2). These results are in contradiction with the findings of Karaye and Yakubu [8], who observed increasing in economic yield with decreasing intra-row spacing.

However, in our experiments at Fariman region, with attention to the no significance difference between intra-row spacing of 0.08 and 0.12 m, we can recommend intra-row spacing of 0.12 m for seed saving costs. Moreover, increasing the distance between rows, makes it easier mechanized farming operations and can be effective in reducing labor costs.

Correlation between yield components:

The results of this study showed that, a significantly negative correlation between numbers of cloves per bulb versus cloves weight at 1% level of probability was observed and increasing number of cloves per bulb decreased cloves weight (Fig. 1a). A significant correlation between numbers of cloves per bulb versus bulb weight and between bulb weight versus cloves weight was not found (Fig. 1 b and c). Garlic marketable yield was significantly dependent on the number of cloves per bulb, and increasing the number of cloves per bulb and hence reducing cloves weight reduces garlic marketable yield.

Therefore, the arrangements should be considered to possibly prevent the occurrence of this phenomenon. In this study, only effective treatment on the number of cloves per bulb was distance between rows (Table 2).

So that, reducing inter-row spacing decreased number of cloves per bulb, whilethis increased the

grain weight. It seems that the inter-row spacing of 0.2 m, is ideal inter-row spacing to achieve a low cloves number and high cloves weight. The least number of cloves per bulb (16.25) and the greatest cloves weight (4.57 g) was observed at inter-row spacing of 0.2 m. Similar number of cloves per bulb were also reported byNoorbakhshian et al. [9], whorecorded 8.6, 12.1, 9.5 and 7.3 cloves per bulb at landraces of Tafresh, Hamedan, Mazandaran and Golestan, respectively.

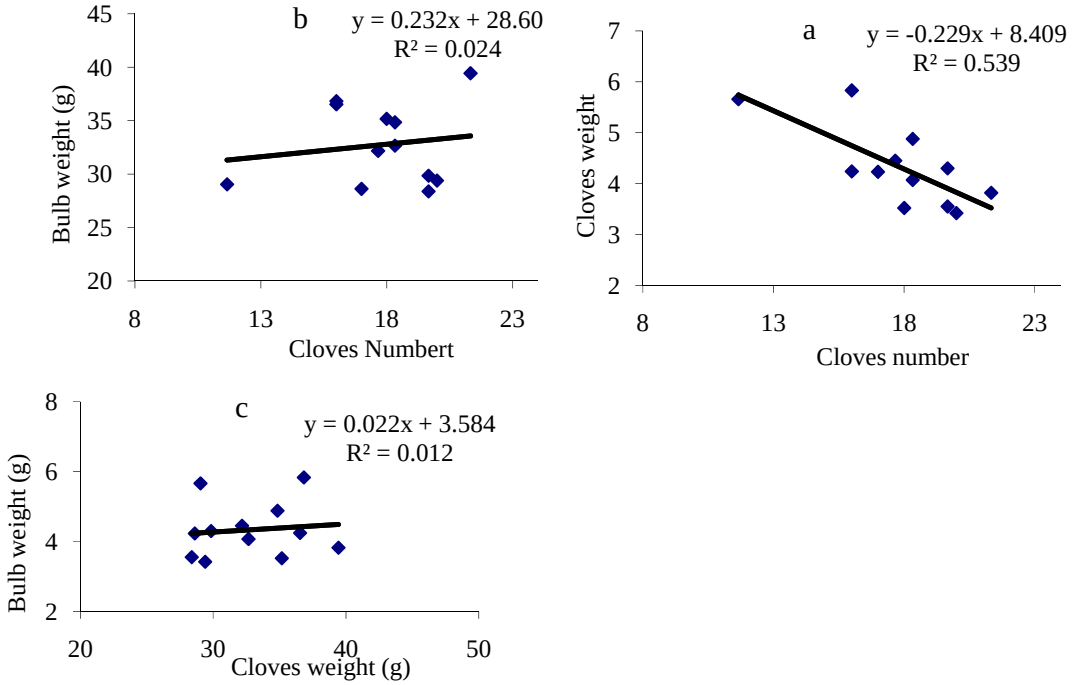

Fig. 1: Relationships between yield components in garlic. a, b and c are correlation between cloves weight vs. cloves No., bulb weight vs. cloves No. and cloves weight vs. bulb weight, respectively.

Table 1: Results of ANOVA testing the effect of planting date, inter- and intra-row spacing on economic yield, number of cloves per bulb, cloves weight and bulb weight in garlic.

SOV	DF	Economic yield	No. of cloves (bulb^{-1})	Cloves weight	Bulb weight
Replication	2	7.283	9.694	25.566	0.022
Planting date	1	4.936^{ns}	17.361^{ns}	17.364^{ns}	0.004^{ns}
Error a	2	1.417	4.196	0.448	0.432
Inter-row spacing	2	145.605**	27.111*	12.325ns	0.744
P. Date×Inter-row	2	13.631*	18.778^{ns}	140.298**	2.252**
Error b	8	2.562	6.778	3.826	0.121
Intra-row spacing	1	9.070^{ns}	3.361^{ns}	24.651^{ns}	0.227^{ns}
P. Date×Inter-row	1	3.796^{ns}	30.250*	1.206^{ns}	0.053^{ns}
Inter-row×intra-row	2	1.113^{ns}	26.778*	11.454^{ns}	6.360**
P.date×inter-row×intra-row	2	0.653^{ns}	6.333^{ns}	3.105^{ns}	0.648^{ns}
Errror c	12	3.569	5.389	10.476	0.350
Error	35	-	-	-	-

Errorns: not significant; (*) and (**) represent significant difference over control at *p<0.05* and *p<0.01*, respectively.

Table 2: Influence of various planting date, inter- and intra-row spacing on economic yield, number of cloves per bulb, cloves weight and bulb weight in garlic.

Treatments	Economic yield	No. of cloves (bulb^{-1})	Cloves weight	Bulb weight
Date of 5 Nov	10.9a	17.1a	31.02a	4.32a
Date of 21 Nov	11.6a	18.5a	33.47a	4.34a
Inter-row of 0.2 m	15.03a	16.25b	32.00a	4.57a
Inter-row of 0.3 m	10.53b	17.92ab	32.40a	4.08b
Inter-row of 0.4 m	8.17c	19.25a	33.90a	4.34a
Intra-row of 0.08 m	10.7a	18.1a	32.00a	4.25ab
Intra-row of 0.12 m	11.7a	17.5a	33.60a	4.41a

* Values followed by the same letter within the same columns do not differ significantly at *p* =5 % according to DMRT.

Conclusion:

This study has shown that planting date, inter- and intra-row spacing had significant effects on garlic economic yield and its components. Delaying in planting date did not significantly reduce yield and its components. Planting date of 21 November, however, was better in comparison with 5 November, because not only preceding crop has more opportunity to use resources but also water for irrigation can be saved. Results of the study suggest that inter- and intra-row spacing for garlic at Fariman can be recommended to achieve higher marketable garlic yield, and Ease of mechanized harvest.

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