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THE EFFECT OF PLANTING DENSITY ON THE CHARACTERISTICS RELATED TO THE RICE CULTIVAR PANICLE IN NORTH REGIONS OF KHUZESTAN, IRAN

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ABSTRACT

This paper aims at determining the most proper planting density in the form of transplantation on the yield and yield components of rice cultivars in north regions of Khuzestan located in Iran as factorial with two planting density factors in three levels (15×15, 20×20 & 25×25) and five cultivars (red Anbori, Champa, and Ramhormoz pollen) as split-plot design in randomized complete blocks with three replications in 2010 crop year. Variance analysis results revealed that there was a significant difference in all characteristics among different planting dates and cultivars at 1% level. while grain yield does not have a significant difference in the interaction of two factors. The maximum grain yield in 20×20 cm density was in average 3070.11 kg /ha; and among cultivars Champa and Ramhormoz pollen possessed the maximum and the minimum grain yield respectively with the average 3572.78 and 2910.22 kg/ha. Investigating changes in characteristics of 1000-grain weight, panicle length and floret number revealed that density rise caused increase in these characteristics, yet in secondary branches, as density increased changes trend descended. There was no significant difference in panicle length and secondary branches statistically. The maximum and minimum grain densities were attained respectively in 20×20 cm and 15×15 cm densities. Ultimately it can be concluded that 20×20 cm density is the most appropriate density in Khuzestan climate as it causes the maximum grain yield.

KEYWORDS: rice, density, cultivars, yield and its components, panicle.

INTRODUCTION

Rice is the most important food resource for human after wheat, and half of the world people use it as the main meal.[10] The increase in rice grain yield in high planting density may be due to increase in panicle number in level unit.[2] Plant density has a significant effect on grain yield and unfilled grain percentage; also as plant density increases, grain yield, plant height, and hollow grains number decrease and 1000-grain weight and filled grain number in each panicle increase.[9] As density increases, fertile panicle number in each square meter, biological yield and grain yield increase; but grains number in each panicle and dry weight of a plant aerial organ decrease.[15] Grain yield is influenced by inter- and intra-plant competition for environmental factors of growth, and the maximum yield in level unit is caused when these competitions are minimized and plant can take the maximum benefit from existing growth factors.[12] As planting density increases, production ascends.[18] Plant density has a significant effect on grain yield and unfilled grains percentage. As plant density increases, grain yield, plant height and hollow grain number decrease and 1000-grian weight and filled grain number in each panicle increase.[9] Determination of the best rice planting distance is dependent upon the cultivar so that local leg long cultivars with lodging resistance need more distance among plants compared with modified cultivars.[11] This paper aims at investigating the effects of plant density on grain yield and its related characteristics in rice different cultivars and determining the best plant density for increasing grain yield within level unit in Khuzestan climate.

METHODS AND MATERIALS

This paper aims at investigating the effect of different densities (D1=15×15, D2=20×20, and D3=25×25) on common cultivars in Khuzestan province with longitude 48 ˚, 28 ˝ and latitude 31 ˚, 50 ˝ with 33 m above sea level (V1=Anbori, V2=Champa, and V3=Ramhormoz pollen) and on yield and yield components in planting date 11-Jul-2010 as split-plot design in randomized complete blocks with three replications in the climate of north regions of Khuzestan with 4x4 m splits and 1 m distances. The soil characteristics of the studied region and some weather parameters from planting date to harvest date are presented respectively in Tables 1 and 2. The vault earth was prepared several days before seeds soaking and germination. This operation was similar to the main earth preparation and included plowing, disk, toweling and puddling (by tiller). Seeds were first put into distilled water, hollow seeds were removed and then healthy seeds were rinsed with water and disinfected with carboxin 4×1000. After germination, seeding with the rate of 100 kg/ha in vault earth was undertaken.

Before plowing, potash fertilizer from the resource of Potassium Sulfate were given to the earth with the rate 130 kg/ha. Before transmitting transplants into the main earth, earth lining was done to determine planting lines in different densities through string and metal hangers designed for every three densities. Planting operation including irrigation and weeding was done equally in all experimental treatments. By manual weeding on several occasions and spraying Saturn herbicide with the rate of 10 lit/ha, weeds were removed in the stage of 2-3 leaves of the weeds, and rice stem eater worms were removed by Diazinon 2×1000 insecticide. Nitrogen was given on three occasions with the rate of 150 kg/ha to the earth. As soon as maturity of 85 percent of grains in panicle, harvest was undertaken in the area of 1.5 square meter on the middle of each split to measure grain yield with 14% humidity. 30 panicles were examined to determine such characteristics as grain number, floret, 1000-grain weight, panicle length, primary and secondary branches. Finally data obtained from SAS software variance analysis and means comparison were calculated by Duncan multiple range test at 1% probability level.

Table 1- Soil characteristics of the research farm

Soil texture	Absorbent micro elements (ppm)				K (ppm)	P (ppm)	N (ppm)	EC	pH	Soil depth (cm)
	Fe	Mn	Zn	Cu						
Clay- loam	15.7	3.2	2.8	2.8	360	10	0.08	3.1	7.2	0-30

Table 2. Average air temperature and precipitation during growth period of rice

Factor	July	August	September	October	November
Average air temperature (˚ C)	38.3	39.2	36.5	32	24.4
Precipitation(mm)	0	0	0	6.3	7.9

DISCUSSION AND CONCLUSIONS

Grain yield: with regard to the variance analysis results, grain yield has a significant difference at 1% level among different densities and cultivars, yet there was no significant difference between two factors interaction (Table 3). Among levels of planting density, the maximum yield (3668.56 kg/ha) and minimum yield (3070.11 kg/ha) were obtained respectively in 20×20 cm and 15×15 cm planting distances (Table 4). Grain yield increase in 20×20 cm density may be due to the space availability and vegetative factors of other related characteristics and yield components compared with other densities which is consistent with other researchers [13, 3, 7, 1]. Among cultivars, the maximum and minimum grain yield belong respectively to Champa and Ramhormoz pollen with average 3572.78 and 2910.22 kg/ha

(Table 4). This stance is consistent with other studies indicating a significant difference in terms of grain yield.[16]

Panicle length: panicle length is among characteristics that are fully influenced by cultivars genotype; and as per variance analysis results, there was only a significant difference at 1% level among different levels of cultivars. Yet there was no significant difference among different density levels and interaction of density and cultivar (Table 3). Means comparison revealed that as density increases panicle length decreases; so among cultivars, Champa and red Anbori possessed respectively the maximum and minimum flag leaf length with average 27.106 and 25.688 cm. The findings are consistent with other studies indicating the impact of genotype on the mentioned characteristic.[8, 17]

Primary branches: variance analysis results depicted that there was a significant difference among different planting densities and cultivars at 1% and 5% levels, yet there was no significant difference between interactions of density and cultivar factors (Table 3). As density increases the number of primary branches decreases. Among cultivars, the maximum primary branches relates to Ramhormoz pollen cultivar with average 12.647 in each panicle. The main reason for such a result is the effect of genotype on this characteristic.

Secondary braches: variance analysis results revealed that secondary braches had a significant difference at 1% level among different levels of density, cultivars and interactions of two factors (Table 3). Means comparison reflected that alike primary branches, this characteristic also descends as density increases; so that the maximum secondary branches relates to Ramhormoz pollen cultivar in 25×25 cm planting density with average 44.900 per panicle, and the minimum secondary branches belongs to Champa cultivar in 15×15 cm planting density with average 22.333 per panicle (Tables 4 and 5).

Total spikelet number: as per variance analysis results, in this characteristic which includes total number of filled and hollow grains there is a significant difference at 1% level among different levels of density and cultivars and there is no significant difference between interactions of density and cultivar factors (Table 3). As density increases total spikelet will increase. Among cultivars, Champa has obtained the maximum total spikelet (Table 4). Regardless of genotypic differences among cultivars, the results may be due to decrease in grain number (filled spikelet) in panicle and consequently more space for growing more

grains. The findings are consistent with other researches indicating the positive relation between density and total spikelet number.[14, 19]

Filled spikelet number: variance analysis table showed that filled spikelet number was significant under the influence of different planting densities, cultivars and interaction of two factors respectively at 5%, 1% and 1% levels (Table 4). As density increase filled spikelet (grain) number decreases which may be due to higher competition and lower share of photosynthetic materials for each.

Table3- Analysis for variance of grain yield and panicle characteristics in rice Cultivars

S.O.V	df	Grain yield	Panicle length	Primary branches	Secondary braches	Total spikelet number	Filled spikelet number	1000-grain weight
Repeat	2	$1124.481^{n.s}$	$0.267^{n.s}$	$0.358^{n.s}$	$0.548^{n.s}$	$4.148^{n.s}$	$26.259^{n.s}$	$0.021^{n.s}$
Density	2	917295.259^{**}	$0.819^{n.s}$	1.596^{*}	45.854^{**}	809.592^{**}	164.481^{*}	8.134^{**}
Cultivars	2	1096829.592^{**}	4.554^{**}	28.781^{**}	761.854^{**}	653.592^{**}	850.481^{**}	31.054^{**}
Cultivar ×Density	4	$123992.203^{n.s}$	$0.432^{n.s}$	$0.297^{n.s}$	10.293^{**}	$45.814^{n.s}$	432.037^{**}	0.370^{**}
Error	16	7786.148	0.325	0.397	1.533	39.148	28.384	0.069
CV(%)		2.669	2.157	5.954	4.015	3.975	3.765	1.367

Ns, * and **: Nonsignificant and significant at 5 and 1% level of probability, respectively.

Table 4- Mean comparion of grain yield and panicle characteristics in rice Cultivars

Acting		Grain yield (kg)	Panicle length (cm)	Primary branches (number/ Panicle)	Secondary braches (number/ Panicle)	Total spikelet number (number)	Filled spikelet number (number)	1000-grain weight (g)
Density	1	3070.11 c	26.091 a	10.134 a	28.472 c	168.222 a	136.556 b	20.122 a
	2	3668.56 a	26.665 a	10.644 a	31.086 b	153.222 b	144.222 a	19.600 b
	3	3176.56 b	26.538 a	10.970 a	32.966 a	150.667 b	143.667 ab	18.277 c
Cultivars	V1	3432.22 b	25.688 b	9.531 b	28.475 b	149.222 b	142.667 b	18.222 b
	V2	3572.78 a	27.106 a	9.570 b	23.055 c	166.222 a	150.556 a	18.300 b
	V3	2910.22 c	26.500 a	12.647 a	40.994 c	156.667 b	131.222 c	21.477 a

Means in each column, followed by at least one similar letter(s) are not significantly different at 1% probability level using Duncan's Multiple Range Test.

Table 5- Mean comparion of grain yield and yield components in rice Cultivars density treatments

Acting		Secondary braches (number/ Panicle)	Filled spikelet number (number)	1000-grain weight (g)
D_1	V1	26.667 e	147.667 a	18.866 d
	V2	22.333 f	150.667 a	18.933 d
	V3	36.417 c	111.333 b	22.566 a
D_2	V1	28.427 de	137.000 a	18.733 d
	V2	23.167 f	150.333 a	18.333 d
	V3	41.667 b	145.333 a	21.733 b
D_3	V1	30.333 d	143.333 a	17.066 e
	V2	23.667 f	150.667 a	17.633 e
	V3	44.900 a	137.000 a	20.133 c

Means in each column, followed by at least one similar letter (s) are not significantly different at 1% probability level using Duncan's Multiple Range Test. panicle (Table 5). Ultimately the minimum spikelet number was in the panicle related to Ramhormoz pollen cultivar in 15×15 cm planting density (Table 5). The findings are consistent with other researches indicating less filled spikelet in high densities [14, 19].

1000-grain weight: as per variance analysis results, 1000-grain weight had a significant difference at 1% level among different planting densities, cultivars and interaction of two factors (Table 3). As density increases 1000-grain weight ascends, and the most 1000-grain weight relates to Ramhormoz pollen cultivar with average 22.566 g (Tables 4 and 5). Although it is expected that increase in planting distance and decrease in competition among adjacent plants make 1000-grain weight increases, more grains in each panicle in high planting distances caused allocating photosynthetic materials to more grains and consequently each grain share for receiving photosynthetic materials decreased. The findings are consistent with other studies indicating the negative impact of density increase on 1000-grain weight.[2, 14]

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