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Original article

The effect of diatomite on some morphological, physiological and yield characteristics of chickpea (*Cicer arietinum* L.) under different irrigation regimes

Gh.R. Zamani[1, 2], D. Ghotbinezhad[3], M.H. Sayyari[1, 2], Z. Nabipour[4*]

1. *Associate Professor, Department of Agronomy and Plant Breeding, Faculty of Agriculture, University of Birjand, Birjand, Iran*
2. *Plant and Environmental Stresses Research Group, University of Birjand, Birjand, Iran*
3. *Graduated MSc in Agronomy, Department of Agronomy, Faculty of Agriculture, University of Birjand, Birjand, Iran*
4. *Ph.D of Agriculture, Gonabad Agricultural and Natural Resource and Education station, Agricultural and Natural Resources Research Center of Khorasan Razavi, AREEO. Gonabad. Iran*

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Extended abstract

Introduction

Proper management and the use of advanced methods to preserve and store soil moisture and increase water containment capacity are among the most effective measures to increase water use efficiency and thus improve the utilization of water resources of the country. Considering the importance of chickpea as a source of protein and, on the other hand, the irreparable damage of drought stress to chickpea performance, it is very important to adopt methods that can increase the plant tolerance to drought stress. Considering the importance of chickpea as a source of protein and, on the other hand, the irreparable damage of drought stress to chickpea performance, it is very important to adopt methods that can increase the plant tolerance to drought stress. Recently, the use of superabsorbent has increased due to the ability to absorb and maintain water and consequently increase water use efficiency in the soil. Therefore, the aim of this study was to determine the proper amount of diatomite to obtain maximum chickpea yield under drought stress conditions.

Materials and methods

In order to investigate the effect of diatomite on some of the morphological and physiological characteristics of chickpea under different irrigation regimes, a test was conducted in Khaf in the year 1397-1396. This research was conducted as split plot based on randomized complete block design with three replications. The main factor of irrigation regimes was five levels (full irrigation, rainfed, one irrigation only in vegetative stage, one irrigation interval only at reproductive stage, two irrigation intervals, one vegetative stage and one reproductive stage) and factor The subdivisions of Diatomite were in three levels (0, 3.5 t/ha and 7 t/ha). Each plot had 6 planting lines at a distance of 30 cm from each other and 3 m long. In this experiment, diatomite was placed under the seeds next to the ridges at a depth of 20 cm (maximum root density area). Cultivation was done manually on the 15th of Esfand month with a density of 45 plants per square meter and a depth of 5 cm. In this experiment, native chickpea mass of Khaf region was used.

Results and discussion

*Correspondent author: Zohreh Nabipour; E-Mail: zohreh.nabipour@yahoo.com

The results showed that changing the irrigation regime from full to dry farming irrigation reduced Height stem, stem diameter, Number of primary branches, Number of secondary branches, relative water content, seed yield and increased relative electrolyte leakage. Application of diatomite under different irrigation regimes increased all evaluated traits and seed yield. The application of 7 t/ha of diatomite compared to the non-application of diatomite increased 29, 29, 77 and 39 percent of seed yield in irrigation regimes, including dry farming, one irrigation in the vegetative stage, one irrigation in the reproductive stage, two irrigations included vegetative and reproductive stages. The results of interactions showed that the application of 7 t/ha of diatomite under irrigation treatment in the vegetative and reproductive stages in stem diameter, Number of secondary branches, relative water content and relative electrolyte leakage was significantly different from the application of 3.5 t/ha of diatomite. Only in seed yield under irrigation treatment in vegetative and reproductive stages, application of 7 t/ha of diatomite in the joint statistical group with application of 3.5 t/ha of diatomite was included, although it had a higher numerical value.

Conclusion

In general, using diatomite as a superabsorbent while saving the cost of production in arid areas, by maintaining and storing soil moisture and improving soil water permeability can be an effective step towards exploiting limited water resources. And increase grain yield in the harvest. It is also recommended to further study and use different amounts of diatomite in a certain range of moisture stress and also the effect of its use on the amount of nutrients in soil and water.

***Keywords*:** Drought stress, Height stem, Relative water content, Super absorbent

Table 1. Physical and Chemical Properties Soil Test site (Khaf)

Soil texture	Sand	Silt	Clay	pH	Ec	N	P	K
	----------%----------				dS/m^{-1}	%	--------$mg.kg^{-1}$------	
Sandy clay loam	53.1	26.7	20.2	8.28	5.76	0.015	5.87	251

Table 2. Analysis of Variance (mean square) for the effect of irrigation regimes and different amount of diatomite on some morphology, Physiology and yield characteristics of chickpea

S.O. V	df	Stem height	Stem diameter	N. of primary sub branch	N. of secondary sub branch
Replication	2	9.44 ^{ns}	0.17 $^{n.s}$	15.30 **	2.63 $^{n.s}$
Irrigation (I)	4	530.97 **	5.83 **	117.61 **	148.02 **
Error (a)	8	3.60	0.31	2.15	2.27
Diatomite (D)	2	49.68 **	2.39 **	5.39 *	30.83 **
I × D	8	16.84 ^{ns}	0.7 **	7.54 **	3.40 $^{n.s}$
Total error	20	8.63	0.22	1.30	2.71
Cv (%)	-	*12.61*	*12.45*	*14.17*	*17.53*

Table 2. Continued

S.O. V	df	Relative water content	Relative electrolyte leakage	Seed yield
Replication	2	11.68 $^{n.s}$	104.40 *	22461.43 $^{n.s}$
Irrigation (I)	4	1362.9 **	600.39 **	6371047.59**
Error (a)	8	9.09	24.26	23442.86
Diatomite (D)	2	237.76 **	97.12 **	302200.60**
I × D	8	52.93 **	12.38 $^{n.s}$	53182.66**
Total error	20	25.34	25.74	15513.26
Cv (%)	-	*8.60*	*11.61*	*11.006*

** significant at α=0.01 probability level, * significant at α=0.05 probability level and, ^{ns} no significant

Table 3. Means comparison of Irrigation regimes and different amount of diatomite on some morphology, Physiology and yield characteristics of chickpea

Treatment	Height stem (cm)	N. secondary sub branch	Relative electrolyte leakage
Irrigation regime			
Dry farming	17.82 ^{c}	4.47 ^{d}	52.26 ^{a}
Irri. at vegetative St.	20.72 ^{b}	9.01 ^{bc}	50.24 ^{a}
Irri. at reproductive St.	18.64 ^{c}	7.57 ^{c}	44.24 ^{b}
Irri. at vegetative and reproductive St.	22.63 ^{b}	10.47 ^{b}	39.33 ^{b}
Full Irri.	36.61 ^{a}	15.47 ^{a}	32.24 ^{c}
Consumption of diatomite (ton/ha)			
0	19.90 ^{c}	7.74 ^{b}	46.58 ^{a}
3.5	22.61 ^{b}	10.26 ^{a}	42.49 ^{b}
7	25.35 ^{a}	10.25 ^{a}	41.92 ^{b}

Means in each column followed by similar letter(s) are not significantly different at 5% probability levels, using least significant different (LSD) Test

Table 4. Means comparison of interaction effect of Irrigation regimes and different amount of diatomite on some morphology, Physiology and yield characteristics of chickpea

Irrigation regime	Consumption of diatomite	Stem diameter	N. primary sub branch	Relative water leakage	Seed yield
	ton/ha	mm		%	kg/ha
Dry farming	**0**	2.43 ^{j}	3.90 ^{h}	37.88 ^{j}	363.97 ^{g}
	3.5	2.50 ^{ij}	4.71 ^{gh}	41.87 ^{ij}	373.68 ^{g}
	7	2.85 ^{hij}	6.60 ^{defg}	48.93 ^{ghi}	470.97 ^{fg}
Irri. at vegetative St.	**0**	3.50 ^{efgh}	6.36 ^{defg}	47.42 ^{hi}	394.56 ^{g}
	3.5	4 ^{cdef}	7.99 ^{cd}	51.29 ^{gh}	456.17 ^{fg}
	7	3.88 ^{cdef}	8.89 ^{c}	52.58 ^{fgh}	508.34 ^{fg}
Irri. at reproductive St.	**0**	3.06 ^{ghij}	4.74 ^{gh}	54.99 ^{fgh}	616.46 ^{f}
	3.5	3.30 ^{fghi}	5.42 ^{fgh}	56.43 ^{efg}	906.90 ^{e}
	7	3.83 ^{defg}	6 ^{efg}	60.88 ^{def}	1093.83 ^{de}
Irri. at vegetative and reproductive St.	**0**	3.53 ^{efgh}	6.72 ^{def}	60.88 ^{f}	1256.57 ^{d}
	3.5	4.62 ^{bcd}	7.76 ^{cde}	65.23 ^{cd}	1538.96 ^{c}
	7	5.02 ^{ab}	10.28 ^{b}	68.39 ^{bcd}	1745.67 ^{c}
Full Irri.	**0**	4.17 ^{cde}	11.37 ^{b}	70.63 ^{abc}	2167.42 ^{b}
	3.5	4.65 ^{bc}	14.52 ^{a}	76.83 ^{ab}	2476.29 ^{a}
	7	5.46 ^{a}	16.30 ^{a}	79.2 ^{a}	2587.19 ^{a}

Means in each column followed by similar letter(s) are not significantly different at 5% probability levels, using least significant different (LSD) Test