Journal of Chemical Health Risks 2(2):37-42, 2012
ISSN 2251-6719

The Effect of Drought Stress on Grain Yield and Oil Rate and Protein Percentage of Four Varieties Castor in Climatic Conditions of Damghan

Gh. Laei

Faculty Member, Agricultural Department, Damghan Branch, Islamic Azad University, Damghan, Iran

Abstract: In this study the effect of drought stress was investigated on grain yield and oil rate and protein percentage of four varieties of castor in the climatic conditions of Damghan. The experiment was done in the research farm of Damghan Islamic Azad University(Iran) in 2011 as split plots in a randomized complete block design with three replications. The main plots of drought stress were 5, 10 and15 days and another factor included four varities of castor (one-flower, two- flower, local and red-flower) which were performed in stable density of five bushes per cultured square meter. Therefore, after gremination, the amount of irrigation water was recorded using volumetric meters. The traits evaluated included oil rate, seed protein percentage, and grain yield. The results show that two-flower variety with 1241 kg per hectare on 5-day drought stress has the most grain yield. Most oil rate was observed in two-flower variety on 5 day drought stress with 496.4 kg/ha.

Keywords: drought stress, oil, castor, grain yield, protein

INTRODUCTION

Castor plant with scientific name of *Ricinus Communis* from of Euphorbiacea is a kind of oil that is a single year long plant that is cultivated in mode rate regions. Oil grains are grown in order to that oil be extracted from it. also they are valuable sources of protein. Castor oil is the most important grain-forming substance between 40-60 percent of its value in commercial varieties [17].

Iran because of its position (25 to 38 degrees north latitude) is climatic and natural percent semidry [8].

So drought is one of problems that in many parts of country decreases crops, such as sorghum and cowpea which are cultived in dry and semidry areas.

Because by pass plant from growth stage, to vegetative stage water limitation leads to more decrease in photosynthesis compared with the that time the number and weight of grains are forming it causes the decrease the period of increasing, the number of decrease, the period of increasing, the number of grain, and weight of grain by aging and finally decrease of grain yeild [6].

The possible reasons of inflaencind of droght stress in vegetative stage include: the remobilization of nitrogen and carbohydrates from leaf of grain by increasing age of leaf, the destruction of chlorophyll and light obserbing complexes increasing stomatal resistance with increasing age of leaf and decreased the leaf activity of Rabisco and its reviving [4].

Moosavifar and his colleagues (2010) expressed the decrease of irrigation in the final stages of growing plant in safflower crops remarkably because the drought and amount of precipitation are very low in

Corresponding Author: Gh. Laei, Faculty Member,Agricultural Department, Damghan Branch, Islamic Azad University, Damghan, Iran E-mail: G.laei@damghaniau.ac.ir

in differen parts of Iran is directly related to irrigation . water stress in plant causes stomatal closure in plant and prevents photosynthesis [1, 19].

Kittock and his colleagues (1967) reported that the amount of needed water in castor is related to its species, growing level, irrigation time and environmental conditions[10].

Brigham and Spears (1960) reported a period of 7 to 14 days and water need of 51 to 61 centimeter for Castor in Texas [3].

In same experiments, it is shown that the effects of water of growth and function on plants is different during season [10 , 9, 7, 2 ,5].

Irrigation causes the increase the tallness of bush and height of the first in inflorescence in Castor but this increase is not so much that be effect of drought stress on the grain yeild in caster [12].

Kittock and his colleagues (1967) reported that there are no differences in the function of caster in different periods of drught stress [10]. But Koutroubas and his colleagues (1999) reported that by increased irrigation the grain yield and congentration of dry material increase in castor [11].

Some of researchers believe that the druoght stress causes decrease in fanctin and weight of castor [12,10,13].

Rezvani Moghaddam and his colleagues (2006) reported that increasing the time between irrigation (drought stress) has much effect on the grain yield [18].

Also Kittock and his colleagues (1967) reported a positive correlation between thousand seed weight and castor oil.

But Koutroubas and his colleagues (2000) believe that reducing irrigation reduces crop yield and the number of inflorescence and capsules [12].

Laureti and Marras (1995) reported that the number of capsule in castor increases with decreasing the drought stress [13]. Amount of oil in castor grain is a genetics specification but it is affected by environmental conditions farming operation and time of harvest [13]. High temperature about 35 °C and water stress at during flowering and forming oil can have a harmful effect on oil function [11].

But Laureti and his colleagues (1998) reported that the amount of water had no effect on oil function in castor [14]. According to the limitations of water and in farming and its effect on production and the oil function in different kinds of castor, this experiment was performed in Damghan.

MATERIALS AND METHODS

In this study the effect of drought stress was investigated on grain yield and oil rate and protein percentage of four varieties of castor in the climatic conditions of Damghan. The experiment was done in the research farm of Damghan Islamic Azad University(Iran) in 2011 as split plots in a randomized complete block design with three replications. The main plots of drought stress were 5, 10 and15 days and another factor included four varities of castor (one-flower, two- flower, local and red-flower) which were performed in stable density of five bushes per cultured square meter. Therefore, after gremination , the amount of irrigation water was recorded using volumetric meters. Traits evaluated included oil rate, seed protein percentage and grain yield. Soxhlet extraction to the amount of 10 g of weighted dry sample Kartvsh was placed in the extractor tube. 1.5 times the size Akstrktvr n - hexane was added to the device and the operating temperature of about 40-60 fat separation was performed. Finally, fat and percent body fat was calculated from the solvent. Protein was estimated by Kjeldahl method. First, 0.5 g of dried sample in oven at 103 °C [16]. The filter paper and weighing no nitrogen was added 20 ml of pure sulfuric acid. Sample on the heater was completely transparent and digestion was performed under the hood. Then 200 ml of distilled water and 75 ml was added to 50% profit to be highlighted in blue. Then,we added a few

drops of methyl red indicator to the solution and Green Brvmvkrzvl Distillation to the accumulation of vapors in a collector containing 200 ml of 2% boric acid continued Finally, the Erlenmeyer flask containing a title and nitrogen were determined by standard acid [16]. Finally, after data collection, data sampling and analysis of variance by SAS statistical software compared by Duncan's multiple range test was performed at the 5% level.

RESULTS AND DISCUSSION

Standpoint of the main factors (stress) protein and oil, a significant difference in the 1% level and grain yield showed significant differences at 5% level. The sub-factor (cultivars) grain yield and oil content showed a significant difference in the 1% level. The interaction of major and minor factors (drought stress and cultivar) seed yield and oil percentage were significant at 1% level (Table 1).

Table 1. Analysis of variance four varieties of castor plants in irrigated treatments

S.O.V	df	Mean of Squares		
		Oil rate	Protein percentage	Grain yield
block	2	31.14 ^{ns}	3.44 ^{ns}	89.05 ^{ns}
irrigation	2	229.64**	61.32**	178.88*
Main Error	4	7.41	2.27	17.78
varities	3	43.82**	0.71^{ns}	105.75**
irrigation×varities	6	88.07**	2.21 ^{ns}	151.91**
Sub Error	18	6.43	2.71	5.63

^{ns},* and**:non significant, significant at 5% and 1% levels respectively

Grain yield

The highest grain yield 5 days with a weight of 1048 kg /ha and the lowest yield stress for 15 days with a weight of 713 kg per hectare were observed (Table 2).

Table 2. Comparison of means in different irrigation period studied in the castor

characteristics	Oil rate		Protein percentage		Grain yield	
irrigation	(Tan/ha)		%		(Tan/ha)	
5 day	419.2	a	22.27	b	1048	a
10 day	363.88	ab	26.37	a	827	ab
15 day	349.37	b	25.97	a	713	b

Means followed by similar letters in each column are not significantly different at 5% probability level

The interaction showed that the highest yield varieties of drought-related stress for 5 days with two flower in the 1241 Kg/ ha (Table 3).

Table 3. Comparison of means traits in four cultivars of castor

characteristics	Oil rate		yield Grain	
varities	(Tan/ha)		(Tan/ha)	
local	261.66	c	623	b
two- flower	461.25	a	1025	a
one-flower	404.34	b	879	ab
red-flower	415.8	ab	924	a

Means followed by similar letters in each column are not significantly different at 5% probability level

The interaction between variety and drought stress determined that two flower in five varieties produced more grain yield. It can be concluded that the drought was longer than two flower in the severe reduction in yield occurred in the 5 days of drought stress and the yield in terms of two flower for the Damghan is appropriate. The increased severity of drought stress in this experiment, yield decreased. The drought had a significant impact on the performance of the findings is consistent [11 , 17].

Brigham and Spears (1960) reported irrigation water requirement of 7 to 14 days and 51 to 61 cm of water in Texas for castor [3]. Studies have shown that the effect of drought stress on growth and yield in different crops during different seasons [10 , 9 , 7 , 2 , 5].

But this study produced a high yield stress of 5 to 10 days. Kittock and his colleagues (1967) The effect of drought on seed yield of castor were effective, but there are conflicting reports in this

field [10]. Kittock and his colleagues (1967) reported that grain yield is different between different treatments drought of Castor[10]. But Koutroubas and his colleagues (1999) reported that increasing levels of drought stress on yield and dry matter accumulation of castor increases[11]. Some other researchers believe that stress can reduce yield in castor. The study determined that two flower varieties with higher yield and seed weight are higher than other varieties Kittock and his colleagues (1967) stated that the amount of water needed in castor cultivar, growth stage, irrigation time depends on environmental conditions[10]. Dry matter is in direct proportion to plant photosynthesis, stomatal closing and reduced stress reduce photosynthesis and the potential evapotranspiration reduces dry matter production.

Protein percentage

Most seed proteins on 10 days, with %26.36 of irrigation and its lowest on five days, with %22.27 of irrigation were calculated. In this study it was found that the protein increased with increasing irrigation up to 10 days irrigation for 10 days on the protein appears to be no negative effect (Table 2).

RATE SEED OIL

Most rate seed oil in water during 5 days with 419.2 kg/ha and the lowest rate seed oil content in the irrigation period of 15 days 349.39 kg/ha were observed (Table 2).

The study determined drought stress was decreased with increasing amount of rate seed oil, so that, the drought had a significant impact on the amount of oil. It seems generally to achieve a high oil yield in castor plant is drought stress for 5 days. Most oil rose to number two with 461.25 kg/ha and the lowest figure in the oil with 261.66 kg/ha was observed (Table 3). The study determined that two-flower varieties had higher oil content than other varieties. The interaction of drought stress showed most of that oil to the two flower in drought for 5 days with 496.4 kg / ha Red flowers in the oil and the lowest figure in 15-day drought with 251.12 kg / ha (Table4).

Table 4. Comparison of means characteristics in the course of interaction between irrigation and cultivar Castor

characteristics interaction		Oil rate (Tan/ha)		yield Grain (Tan/ha)	
irrigation	varities				
5 day	local	398.49	ab	1077	ab
5 day	two- flower	496.4	a	1241	a
5 day	one-flower	418	ab	1045	ab
5 day	red-flower	433.37	ab	1057	ab
10 day	local	305.6	bc	764	ab
10 day	two- flower	437.1	ab	930	ab
10 day	one-flower	465.6	a	970	ab
10 day	red-flower	468.74	a	1019	ab
15 day	local	401.5	ab	803	ab
15 day	two- flower	255.68	c	544	b
15 day	one-flower	415.38	ab	903	ab
15 day	red-flower	251.12	c	584	ab

Means followed by similar letters in each column are not significantly different at 5% probability level

this study determined that the oil content was decreased with increasing frequency of drought stress, so stress had a significant impact on the amount of oil. Stress associated with the amount of castor oil showed an increased frequency of drought, reduced the amount of oil (equation1).

Equation 1

Y=37.70 -0.68Irrigation period

Coefficient of determination (R^2 = 0.45) showed any increase in the amount of stress. The amount of oil fell and the amount of oil, 45% were affected by drought.

Laureti and Marras (1995) reported The castor seed oil is a genetic trait affected by environmental conditions and crop operations and harvest time and can be irrigated [13].

Two goals on 5 days of irrigation produced the highest oil.

AKNOLEDGMENTS

Finding of this project is to provide funds Damghan Islamic Azad University(iran)

REFERENCES

1. Barradas,V. L., H. G. Jones, and J. A. Clark. 1994. Stomatal responses to changing irradiance in *Phaseolus vulgaris* L. J. Exp. Bot. 45: 931–936.
2. Berenguer, M. J., and J. M. Faci. 2001. Sorghum (*Sorghum bicolor* L. Moench) yield compensation processes under different plant densities and variable water supply. Eur. J. Agron. 15: 43–55.
3. Brigham, R. D., and B. R. Spears. 1960. Castorbeans in Texas. Agric. Exp. Sta. B-954. 12pp.
4. Cabuslay, G.S., Ito, O., Alejar, A.A., 2002. Physiological evaluation of responses of rice (*Oriza sativa* L.) to water deficit. Plant. Sci. 163, 815-827.
5. Champolivier, L., and A. Merrien. 1996. Effects of water stress applied at different growth stages to *Brassica napus* L.var. oleifera on yield, yield components and seed quality. Eur. J Agron. 5: 153-160.
6. Duysen, M.E., Freeman, T.P., 1974. Effects of moderate water deficits on wheat seedling growth and plastid pigment development. Plant. Physiol. 31, 262. 266.
7. Franc, M. G. C., A. T. P. Thi, C. Pimentel, R. O. P. Rossiello, Y. Z.Fodil, and D. Laffray.2006. differences in growth and water relations among *Phaseolus volgaris* cultivars in response to induced drought strerss. Env. Exp. Bot. 43:227–237.
8. Jazaeri Nushabadi, M.R., Rezaei, A.M., 2007. Evaluation of relations between parameters in oat cultivars in water stress and non- stress conditions. Sci. and Met. Agri. and Nat. Sou. 11(1), 265-278. (In Persian with English summary).
9. Kanga, S., W, Shib. and J. Zhangc. 2000. An improved water-use efficiency for maize grown under regulated deficit irrigation. Field Crops Res. 67: 207-214.
10. Kittock, D. L., J. H. Williams , and D. G. Hanway. 1967. Castor bean yield xnd quality as influenced by irrigation schedules and fertilization rates. Agron. J. 59: 463-467.
11. Koutroubas, S.D., D.K. Papakosta, and A. Doitsinis. 1999. Adaptation and yielding ability of castor plant (*Ricinus communis* L.) genotypes in a Mediterranean climate. Eur. J. Agron. 11:227–237.
12. Koutroubas, S. D., D. K. Papakosta, and A. Doitsinis. 2000. Water requirements forcastor oil crop (*Ricinus communis* L.) in a Mediterranean climate. J. Agron. Crop Sci. 184: 33-41.
13. Laureti, D., and G. Marras. 1995. Irrigation of castor (*Ricinus communis* L.) in Italy. Eur. J. Agron. 4: 229-235.
14. Laureti, D., A. M. Fedeli, G. M. Scarpa, and G. F. Marras. 1998. Performance of castor (*Ricinus communis* L.) cultivars in Italy. Indust. Crops and Prod. J.7: 91-93.
15. Moosavifar, B. E., M. A. Behdani, M. Jami Alahmadi and M. S. Hosaini Bojd. 2009. The effect of irrigation disruption in different reproductive growth stages on yield , yield components and oil content in three spring safflower cultivars. J. Agroecology. Vol. 1 No 1: 41–51.
16. parvaneh, v. 2008. Quality control and chemical analysis of nutrients. Tehran University Press, page 320.
17. Rezvani Moghaddam, J. Nabati, G. and A. A. Mohammad Norozpoorabadi. 2005. Investigation on morphological characteristics, grain and oil yields of castor bean at different plant densities and irrigation intervals. J. Agron. Vol. 2. No 1: 1–12.

18. Rezvani Moghaddam, P., Z. Bromand Rezazadeh, A. A. Mohamad Abadi and A. Sharif. 2009. Effects of sowing dates and different fertilizers on yield , yiled components, and oil percentage of castor bean *(Ricinus* communis L.). J. Agron. Vol. 6. No 2: 303–313.
19. Sepaskhah, A. R., and S. Ilampour. 1996. Relationships between yield, crop water stress. index (CWSI) and transpiration of cowpea (*Vigna sinesis* L). Axron. Agric. Environ. 16: 269-269.
20. Moosavifar, B. E., M. A. Behdani, M. Jami Alahmadi and M. S. Hosaini Bojd. 2009. The effect of irrigation disruption in different reproductive growth stages on yield , yield components and oil content in three spring safflower cultivars. J. Agroecology. Vol. 1 No 1: 41–51.