**Advances in Bioresearch**
Adv. Biores., Vol 7 (5) September 2016: 27-31
©2016 Society of Education, India
Print ISSN 0976-4585; Online ISSN 2277-1573
Journal's URL:http://www.soeagra.com/abr.html
CODEN: ABRDC3
ICV 7.20 [Poland]

Advances in Bioresearch

## ORIGINAL ARTICLE

# Evaluation of Yield and Yield Components of Four Winter Canola Cultivars under Drought Stress

**Hadi Jaberi[1], Babak Lotfi[2], Alireza Feilinezhad[*3], Amin Fathi[4], Farzad Kian Ersi[5], Aliashraf Abdollahi[6]**

[1]Lecturer of PNU unit of Dehloran , Iran
[2]Expert of Jahad University, unit of Ilam province, and Lecturer of Islamic Azad University, Dareshahr Branch, Iran
[3]Young Researchers and Elite Group, Ilam Branch, Islamic Azad University, Ilam, Iran
*Corresponding Author E-mail: A.feilinezhad@yahoo.com
[4]Young Researchers and Elite Club, Ayatollah Amoli Branch, Islamic Azad University, Amol, Iran
[5]Former Student of Bu-Ali Sina University, Hamadan, Iran
[6] Graduated MSc in Agronomy, University Ilam, Iran

**ABSTRACT**

*In order to evaluate the yield and yield components of winter canola cultivars under drought stress, was conducted a split plot experiment in randomized complete block design with three replications in 2011. Experimental factors included irrigation, as main factor; in four levels, including standard or control irrigation (irrigation after 60 mm evaporation from pan class A), cut of irrigation after the stage of the stemming, cut of irrigation after flowering stage and cut of irrigation after forming pods stage and cultivars were as sub factors in four type. Results showed that drought stress had significant effects on the number of pods per plant, number of seeds per pod, seed yield, and biological yield. The highest seed yield, biological yield at the normal irrigation till end of the growth season obtained 2244 kg per hectare, respectively, 8096 kg per hectare, respectively. Cultivar had the significant effect on number of pods per bush, number of seeds per pod, seed yield, and biological yield. The highest seed yield and biological yield, respectively, in cultivar Hyola 401, RGS 003 obtained amounts of 2962 kg per hectare, 7081 kg per hectare, respectively. The lowest cultivar of all indices obtained in the SG 2. Interaction effect of cultivar and drought stress was not significant on any one of the characters.*

***Keywords;*** *Canola, Drought stress, Cultivar, Yield, Yields components*

Received 24/04/2016 Accepted 12/06/2016


**How to cite this article:**
H Jaberi, B Lotfi, A Feilinezhad, A Fathi, F K Ersi, A Abdollahi**.**Evaluation of Yield and Yield Components of Four Winter Canola Cultivars under Drought Stress. Adv. Biores., Vol 7 [5] September 2016: 27-31**.** DOI: 10.15515/abr.0976-4585.7.5.2731

## INTRODUCTION

Oil is the most important nutrients required by humans and oils plant as a source of oil and protein has essential role in human nutrition. Canola is one of oilseeds, which are compatible with today's expansion, its cultivation is done in many parts of the world .it has most applications in the supply of edible oils in Europe and other parts of the world [1]. Drought resistance in terms of the ability of a cultivar in more economy produce compare to other cultivars and is defined by the conditions that these cultivars are subjected to dry soil or atmosphere [2]. Results of a survey showed that number of pods per bush was affected by two factors: the surface tension and the time it was applied. Thus, it was found that by reducing the amount of water available, the number of pods was also reduced. The lowest number of pods than the control was observed in at the beginning of the forming pods stage and the level of water treatment available 100% humidity. Reduction of pods was more in effect of their loss [3]. Cutting irrigation from the stage after stemming enters the plant severe stress that causes to sever decrease in the number of pods per bush. If cutting irrigation be applied after forming pods stage, Stress intensity on number of pods is lower [4]. Drought stress at flowering stage reduces the number of pods in per bush [5]. Failure to providing sufficient assimilates under drought stress is one of the main reasons for the loss

of pods [6]. At drought stress is reduced to 11% the number of pods per bush [7]. Therefore, the purpose of this study was to evaluate yield and yield components of four types of winter canola cultivars under drought stress.

## MATERIALS AND METHODS

The experiment implemented 2011-12 crop years, in the 20-acre farm, in 12 km East Dehloran at Ilam functions and a height of 127 meters above sea level. The experiment was performed as split plot in a randomized complete blocks design with three replications. Irrigation levels were put in main plots and cultivars in subplots.

### EXPERIMENTAL FACTORS

Experimental factors Experimental factors included irrigation, as main factor; in four levels, including standard or control irrigation (irrigation after 60 mm evaporation from pan class A), cut of irrigation after the stage of the stemming, cut of irrigation after flowering stage and cut of irrigation after forming pods stage and cultivars were as sub factors in four type.

This cultivar was, Hyola 401, RGS 003, SG2, and SG10. The total number of experimental plots was 48 in the scheme. In order to the soil characterization before the experiment sampling 30-0 cm soil depth and the characteristics of it was tested.

### STATISTICAL MODEL

Obtained data according to statistical model split plot in form of randomized complete block was used to analysis of simple variance and compare of means was performed use the Duncan multiple range test was. For this was used statistical software SAS and to plot graphs use Excel software.

## RESULTS AND DISCUSSION

Results showed that drought stress had significantly affected on the number of pods per bush, number of seeds per pod, thousand seed weight, seed yield, biological yield and harvest index. Cultivar had a significant effect on the number of pods per bush, number of seeds per pod, seed yield, and biological yield. Interaction effect of cultivar and drought stress were not significant any of the traits (Table 1). Results showed that drought stress and cultivar had significant effect on number of pods per sprig, but the interaction of the experimental treatments was not significant on these traits (Table 1).

### NUMBER OF PODS PER BUSH

About the effect of drought stress on the number of pods per bush, the largest number in normal irrigation obtained amounts of 161.5 that were increased by 27% relative to drought stress after flowering stage (Table 2). Reducing the number of pods per main branch and subsidiary, as well as reduced number of pods per bush. Number of pods per bush among yield components is more sensitive to drought stress. Drought stress reduces seed yield that this loss is due to the negative effects of stress on leaf area, photosynthetic vegetation, and crop growth rate and difference yield components [8]. Jamshidi *et al* [9] stated that drought stress has had a significant effect on the number of pods per canola bush.

About the effect of cultivar on number of pods per bush, maximum number of RGS 003 cultivar was found 149.9 numbers that rather to SG 2 cultivar that had the lowest values had 11 % increase (Table 2). Saiahfar *et al* [10] stated that effect of cultivar on the number of heads per bush of safflower was significant in Khorramabad area. The number of head of local cultivars in Esfahan (26.1) significantly was higher than cultivar harvest index in Zarghan. Jamshidi *et al* [9] stated that the cultivar had a significant impact on the number of pods per canola bush. Emami *et al* [11] also stated that the number of pods in canola was significantly affected by cultivars.

Table 1: Results of analysis of treatments variance, survived canola plant

| HI | Seed yield | Biologic yield | 1000 seed weight | Number of seed per pod | Number of pod per bush | Freedom degree | Change sources |
|---|---|---|---|---|---|---|---|
| $74.48^{**}$ | $23977^{ns}$ | $2756484^{ns}$ | $0.641^{ns}$ | $41.91^{ns}$ | $1115^{**}$ | 2 | Rep |
| $90.50^{**}$ | $243776^{*}$ | $11350564^{**}$ | $0.783^{*}$ | $72.12^{*}$ | $2490^{**}$ | 3 | Stress |
| 5.30 | 23977 | 611717.6 | 0.127 | 9.49 | 53.8 | 6 | Error of stress |
| $30.37^{ns}$ | $102965^{**}$ | $3623224^{**}$ | $0.231^{ns}$ | $30.20^{**}$ | $565.7^{*}$ | 3 | Hybrid |
| $39.19^{ns}$ | $63823^{ns}$ | $1191937^{ns}$ | $0.388^{ns}$ | $9.85^{ns}$ | $162.1^{ns}$ | 9 | Cultivar * stress |
| 19.19 | 29901 | 596447.8 | 0.190 | 6.04 | 120.2 | 24 | error |
| 14.07 | 8.49 | 11.5 | 11.93 | 13.42 | 7.62 | - | CV (%) |

$^{*}$,$^{ns}$ and $^{**}$:respectively no significant, significant in probable level 5 and 1 percent

Table 2: Effects of drought stress and hybrid on properties evaluated of Canola

| HI (%) | biologic yield (kg/ha) | Seed yield (kg/ha) | 1000 seed weight (g) | Number of seed per pod | Number of pod per bush | | |
|---|---|---|---|---|---|---|---|
| 27.99 b | 8096 a | 2244.67 a | 3.93 a | 20.90 a | 161.55 a | control | Number of seed per pod |
| 30.59 b | 5841.6 c | 2000.67 b | 3.67 ab | 17.64 b | 143.9 b | stemming | |
| 34.66 a | 6322.8 bc | 1956.67 b | 3.31 b | 15.22 c | 126.26 c | flowering | |
| 31.28 ab | 6597.1 b | 1936.67 b | 3.72 a | 19.47ab | 143.46 b | forming pods | |
| 33.43 a | 5897.2 b | 1899.33 b | 3.51 a | 16.03 b | 134.05 b | SG 2 | hybrid |
| 29.99 a | 6970.48 a | 2067.33 a | 3.73 a | 18.71 a | 144.55 a | SG 10 | |
| 30.16 a | 7081.52 a | 2062.67 a | 3.57 a | 19.71 a | 149.94 a | RGS 003 | |
| 30.94 a | 6908.4 a | 2109.33 a | 3.81 a | 18.78 a | 146.63 a | Hyola 401 | |

Related to each treatment in each column, means with common letters no significantly different by Duncan test at 5% level whatsoever.

**NUMBER OF SEEDS PER POD**

Results showed that drought stress and cultivar had significant effect on number of seeds per pod, but the interaction of experimental treatments was not significant on the character (Table 1). About the effect of drought stress on seed number per pod, the largest number in normal irrigation was obtained amount of 20.89 that ratio of drought stress had increased to 37% after flowering stage (Table 2). In pea a seed per pod is mainly controlled by genetic makeup and may be less affected by environmental factors. In addition, in this plant, number of seeds per pod, compared to number of pods per bush has very little impact on yield. Drought stress during the seed filling stage reduced seed weight because of the accumulation of assimilates in seeds takes place by two methods, one is photosynthesis during seed filling and second is the transfer of assimilates from other parts toward the seed .Drought stress can affect both sectors and by early plants, reduced the seed filling period that ultimately is reduced maize seed yield . Jamshidi *et al* [9] and Emami *et al* [11] stated that drought stress had a significant effect on the number of seeds per canola pod.

The effect of cultivar on number of seeds per pod, the maximum number obtained in RGS 003 cultivar to the 19.7 that compare to SG 2cultivar that had the lowest values, increase 22 % (Table 2). Fanaei *et al*, [12] stated that the effect of cultivar on number of seeds per pod was significant per canola bush. Jamshidi *et al* [9] stated that cultivar had significant impact on the number of seeds per canola pod. Shahbazi *et al* [13] also stated in a research on canola that seed number per pod significantly was affected by plant cultivars.

**THOUSAND SEED WEIGHT**

Results showed that drought stress had significant effect on thousands seed weight, but the effect of cultivars and experimental treatments was not significant on this treatment (Table 1). The effect of drought stress on seed weight, the maximum amount in normal irrigation stat obtained the amount of 3.93g that had 18 percent increase compared to drought stress after flowering stage (Table 2). Also, between the various stages of drought stress in impact on 1000 seed weight showed had no significant difference. Emami *et al* [11] stated that drought stress has had a significant effect on canola seed weight. 1000 seed weight directly is linked to seed yield and its loss can be decreased seed yield.

**SEED YIELD**

Results showed that drought stress and cultivar had significant effect on seed yield, but the interaction of the experimental treatments on these traits was not significant (Table 1). The effect of drought stress on seed yield, the highest amount obtained in normal mode of irrigation amount of 2244 kg ha that compared to the drought stress had 15 percent increase after forming pods stage ( Table 2 ). Between different stages of drought stress, there was no significant effect on seed yield. Richards [14] stressed the important role of seed yield as selection criteria argues that this treatments is influenced by a cultivar of known and unknown factors that are effective in drought tolerance. Thus, selection is important for it in stress conditions. However, [15] believes that, genotype based on the yield in stress condition selection has been used, it may not be in another condition don't have desirable yield. He knows the reason of this is the result of the environment role in making variety in stress conditions. So he knows seed yields, as an efficient Index for the selection of drought tolerance in stress condition. Emami *et al* [11] stated that drought stress has had a significant effect on yield of seed canola.

Bloom [16] believed that plant phenology explain the contradiction between production potential and adaptation to stress conditions. He has stated that the production potential increased with increasing the growth period to a certain extent. He also asserts that although Despite early genotypes, have fled from the drought, later genotypes, necessarily, are not considered susceptible to drought stress.

About the effect of cultivar on seed yield, the highest value on Hyola 401 cultivar obtained 2109.3 kg per hectare that less compare to SG 2 cultivar which had the lowest values increased 11 % (Table 2). Shahbazi

*et al* [13] stated in a research on canola plant that yield significantly was influenced by plants cultivars. Fanaei *et al* [12] also stated that cultivar effects were significant on seed yield of canola. Comparison of mean seed yield in treatments cultivars, suggesting that Hyola 308 hybrid with production of 3553 kg ha was higher about 21 percent rather than Sarigol cultivar with production of 2317 kg ha. Early flowering hybrid of Hyola 308 and fewer adverse reproductive period to inappropriate conditions during the harvest season finale is justification of this. Jamshidi *et al* [9] stated that the cultivar has significant effect on seed yield of canola.

**BIOLOGIC YIELD**

Results showed that drought stress and cultivar had significant effects on the biological yield but the interaction of the experimental treatments was not significant on these traits (Table 1). About the effect of drought stress on biological yield, the maximum amount in normalized irrigation obtained amount 8096.8 kg per hectare that compared to drought stress after stemming stage increased 38 percent (Table 2). Bahel and Jane [17] also stated that the most important part of plant to increase biological yield, are seeds. Pour-Abooghdareh *et al* [18] stated that drought stress significantly cause to significant decreased biological yield of canola plant.

About cultivar effect on biological yield, the highest amount obtained in RGS 003 cultivar that was 7081.5 kg per hectare which had increase 20 percent rather than SG 2 cultivar that had the lowest value (Table 2). Shabani *et al* [19] stated that the cultivar had a significant effect on dry matter of production of hay, so that the highest and lowest amount in cultivars of *Medicago rigidula* cv. Rigidula and *Medicago truncatula* cv. Orion respectively obtained 100 and 53 grams per square meter Azad-Marzabadi *et al* [20] stated that the biological yield of canola was significantly affected by tested cultivars.

**HARVEST INDEX**

Results showed that stress drought were significant on harvest index but the effect of cultivars and the interaction of experimental treatments was not significant on this treatment (Table 1). About the effect of drought stress on harvest index, the maximum amount in stress state after stemming was obtained 8096.8 kg per hectare that compared to the normal irrigation increase 38 % (Table 2). Indeed the drought stress at any stage of plant growth, increased harvest index. Based on the theory presented by Passioura [21] there is a direct relationship between seed yield and harvest index under stress in water stress conditions. According to this relation better development of plant in condition of water stress could be obtained in three ways, including: increasing Water uptake, increasing water use efficiency, and ultimately harvest index. Araus, *et al,* [22] in explaining the above relationship, are believed that absorbs moisture, is for the state that available water in the soil is sorption through deep and extensive roots of tolerant genotypes. But two other cases are important when all the available soil moisture can be used naturally and with the end of growth period. Pour-Abooghdareh *et al,* [21] stated that drought stress has had a significant effect on harvest index of canola seed.

**REFERENCES**


1. Wright, P.R., Moryan, J.M., and Jessop, K.S. (1996). Comparative adaptation of canola (*Brassica napus* L) and Indium mustard (Brassicajuncea) to soil water deficits: plant water relations and growth. Field crops .Res.49:51-49.
2. Amooaghaie, R., Mostajeran, A Emtiazi G. (2003). Effect of Azospirillum bacteria on some growth indices and yield of three wheat cultivars. Science and Technology of Agriculture and Natural Resources. Seventh year. 2, 127-138.
3. Shekari, F. (2001), Survey of effect of drought stress on phenology, water relations, growth, yield and quality of canola, Phd treatise of Agriculture, Agricultural Faculty of Tabriz university, p 180.
4. Soleymani, A., Moradi, M., Narenjani, L. (2011). Survey of effect of cutting irrigation at different growth stages on yield and yield components of seed and winter oil seed canola varieties, Journal of Soil and Water (Agricultural Sciences and Technology), Volume 25, Number 3, p. 435-426, Mashhad University.
5. Kumar, A., and sinyh, D.P. (1998). Use of physiological indices as a screening technique for drought tolerance in oilseed Brassic species. Annal Botany 81:413-420.
6. Mendham, N.J., and Salisbury, P.A. (1995). Physiology, crop development, growth and yield In:Kimber.,D. and McGreyor ,D.I. ( Eds) CAB International .Pp:11-64.
7. Daneshmand, A.R., Shiranyrad, A.H., Darvish, F., and Ardekani, M.R. (2002). Effect of drought stress on yield and chlorophyll content of canola, Eighth Congress, Crop Science, Iran, Faculty of Agriculture, University of Guilan.
8. Singh, D. P., Singh, P., Sharma, H.C., and Turner, N.C. (1987). Influence of water deficit on the water relation, canopy gas exchange and yield of chickpea. Field Crops Res. 16:231-241.
9. Jamshidi, N., Shirani Rad, A.H., Takht China. F. (2012). Survey of effect of drought stress on yield and some agronomic traits of winter canola cultivation. Twelfth Congress of Agronomy Iran. Islamic Azad University of Karaj. 14-16 September 2012.
10. Saiahfar, M., Moayedi, F., Mousavi, S.K., and Zeydali, A. (2009). Response of safflower (*Carthamus tinctorius* L.). Journal of Agricultural Research. 8 (3): 697-686.

11. Emami, T., Bazdar, S., Kazemi, A., Naseri, R., Moradi, M., and Mirzaei, A. (2012). Evaluation of agronomic traits and seed oil of canola cultivars under drought stress. Twelfth Congress of Agronomy Iran. Islamic Azad University of Kara. 14-16 September 2012.
12. Fanaei, H.R., Akbari Moghaddam, H., Kikha, Gh., Narouie radd , M.R., and Modaress Najafabdi, S.S. (2007) . Effect of harvest time on yield and yield components of canola cultivars in Sistan region. Seed and Plant. 23 (1): 74-59.
13. Shahbazi, M., Kiani, A., and Raisi, S. (2011). Determine of salinity tolerance in two cultivars of canola (Brassica napus L.). Iranian Journal of Crop Sciences. 13 (1): 18-31.
14. Richards, R.A. (1982). Breeding and selection for drought resistance in wheat. In: Drought resistance in crops with emphasis on rice. IRRI Report Manila, Philippines. p. 303-316.
15. Blum, A. (1990). Breeding plants for dry land farming. In: Challenges in Dry land Agriculture. A Global Perspective, Proc. Int. Conf .Dryland Farming, Amarillo Bushland, Texas. PP. 715- 717.
16. Blum, A. 2000. Plant Environmental Stress in Agriculture and Biology, http://www. Plant stress .com.
17. Bahl, P.N., and Jain, H.K. (1977). Association among agronomic character and plant ideotypes in chickpea.(Cicer arietinum L.), 79: 154-159.
18. Pour-Abooghdareh, A., Taghavi, M.R., and Khalili, M. (2012). Survey of Yield and components of yield of spring canola varieties under drought stress. Twelfth Congress of Agronomy Iran. Islamic Azad University of Karaj. 14-16 September 2012.
19. Shabani, Gh., Azizi, Kh., Chaichi, M.R., Amini deghi, M., and Ghelavand, A. (2005). Effect of harvest time on biological yield and store of soil seed in one-year forage cultivars in dry conditions. Research and development in agriculture and horticulture, No. 66, p. 39-29.
20. Azad-Marzabady, M., Mostafavi, M., and Faraji, S. (2012). Evaluation of growth, physiological traits and grain quality, advanced canola (*Brassica napus* L.) in winter in Arak.
21. Passioura, J.B. (1977). Grain yield, harvest index and water use of wheat, Journal Australia Inst. of Agriculture Science. 43: 117–120.
22. Araus, J.L., Slafer, G.A., Reynolds, M.P., and Royo, C. (2002). Plant breeding and drought in C3 cereals: what should we breed for? Ann. Bot.89: 925-940.