International Journal of Modern Agriculture, Volume 10, No.1, 2021
ISSN: 2305-7246

STUDY OF DIFFERENT DATES OF PLANTING CAMELINA (*CAMELINA SATIVA* (L.) *CRANTZ*)

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Abstract

In order to investigate the effect of the year and different planting dates (spring and autumn) of camelina, a factorial experiment was conducted in a randomized complete block design with three replications in Fasa city of Fars province during two cropping years. Different planting dates in 6 levels including February 20, March 1 and 11 (spring planting) and November 1, 11 and 21 (autumn planting) with seed line of 114 camelina oil-medicinal plants in the two cropping years 2018 - 2019 as Factors in this experiment were considered. Maximum and minimum grain yield (with averages of 2062 and 767.9 $kg.ha^{-1}$), biological yield (with averages of 4901 and 2611 $kg.ha^{-1}$) and oil yield (with averages of 614.4 and 173.8 $kg.ha^{-1}$)) Was observed in the November 1 and March 11 ships, respectively. The highest and lowest grain yield based on Water use efficiency were allocated to planting dates of February 20 and March 11 with averages of 0.4447 and 0.2552 $kg.ha^{-1}.m^{-3}$, respectively.

Keywords; Camelina, Planting date, Yield, Oil.

Introduction

Among crops, oilseeds are of special importance and have rich reserves of fatty acids (Kahrizi *et al*., 2016). Camelina (*Camelina sativa* (L.) Crantz) is an annual plant belonging to the Brassicaceae family and is believed to be native to northern Europe (McVay and Lamb, 2008), the Mediterranean region and Central Asia (Hurtaud and Peyraud, 2007). In addition, the availability of spring and winter biotypes to camelina shows the possibility of growing under different environmental conditions(Berti *et al*., 2011; Berti *et al*., 2015; Gesch *et al*., 2014; Hunsaker *et al*., 2011; Masella *et al*., 2014; .Zanetti *et al*., 2017). Camelina is a native plant known as a weed in flax farms called false flax. (Budin *et al*., 1995; Gugel and Falk, 2006). Camelina is a short-term crop that matures in 85 to 100 days (Putnam *et al*., 1993; Google and Falk 2006). This plant has no origin, and its cultivation technology is being researched (Daber *et al*., 2014). Camelina can be grown successfully in late fall (Gass and Archer, 2013) and spring (Bertie *et al*., 2011; Paulista *et al*., 2011). No research has been done on the summer cultivation of Camelina as a secondary crop (Daber *et al*., 2014). Determining the appropriate planting date is very important to match the emergence of plant phenological stages with environmental factors. Delayed planting causes plants to weaken in resistance to cold and leads to reduced yields (Jasilska *et al*., 1987). Camelina grain yield in different countries such as: Austria 1500 - 3250 $kg.ha^{-1}$ (Walman *et al*., 2007), Denmark 2600 - 3300 $kg.ha^{-1}$ (Zaber, 1997) and USA 600 - 2000 $kg.ha^{-1}$ (Francis *et al*., 2009; Putnam *et al*., 1993; McVeigh and Lamb, 2008). Francis *et al*. (2009) also showed that a 20% reduction in water supply reduced grain yield by 20% and the minimum water requirement during the growing season was 333 to 423 mm in Arizona, USA. The amount of camelina seed oil varies between 320 – 460 $g.kg^{-1}$. Seed oil 90% unsaturated fatty acids including 25 - 42% alpha-linolenic acid (18:3), 13 - 21% linoleic acid (18:2), 14 - 20% oleic acid (18:1), 12 -18 It has a percentage of exogenous acid (20:1) and 2-4% of erucic acid (22:1) (Walman et al., 2007). The purpose of this study was to investigate the trend of changes in different planting dates and to identify how and to what extent its effect in spring and autumn crops on grain, biological and camelina oil yields.

Materials and Methods

This experiment was carried out in the 2018-2019 crop year in the central part of Fasa city of Fars province, 145 km east of Shiraz. The above-mentioned region has geographical characteristics of 53 degrees and 24 minutes east longitude and 28 degrees and 58 minutes north latitude and an altitude of 1382 meters above sea level. The experiment was performed as a factorial experiment in a randomized complete block design with 3 replications. Factors included different planting dates at six levels, including three spring planting dates (February 20, March 1, and March 11), three fall planting dates (November 1, 11, and 21) and 114 camelina seed lines. Bed preparation operations for spring crops began on February 1 and for fall crops in mid-October. In this regard, from a deep plow and two discs perpendicular to each other to crush the lumps, the leveling operation was performed by a trowel. After testing the soil and soil according to the needs of the plant along with the disk, 40 $kg.ha^{-1}$ of nitrogen fertilizer from urea source and 30 $kg.ha^{-1}$ of phosphorus fertilizer from triple superphosphate source was uniformly applied to the ground for each planting date. Also, at the beginning of flowering, 20 $kg.ha^{-1}$ of urea was given to the land. Camelina seeds were planted manually in plots 4 m long and 2.40 m wide with a row spacing of 20 cm. The distance between each plot was 50 cm and the distance between the blocks was 100 cm. The first irrigation was carried out immediately after planting and the subsequent stages of irrigation during the growing season so that no signs of stress were observed in the plant. After ensuring the establishment of the plants, the density of 100 plants per square meter (the distance on the row of 4 cm) was achieved by thinning the additional plants completely in the 4-leaf stage. Also, all the weeds in the plots were weeded during the season. To control pests of larvae and moths, rice, larvae and moths of wheat and the age of wheat in May of diazinon at the rate of 1.5 per thousand were applied at one time only for spring planting. For grain yield, biological yield and oil extraction, return one square meter of each plot with respect to the margin (half a meter on both sides) of the floor. Also, to determine the yield of seed oil, first separate 200 g from the grain crop of each experimental unit and extract the oil by compressing machine by pencil meal method with a duration of 166 seconds at a temperature of 80 ° C and calculate it based on $kg.ha^{-1}$ Oil percentage was measured. In determining the yield based on water consumption, first, the water consumption of each plot is determined by determining the time for water filling in the plots and its proportionality with the filling time of water in a certain volume (20-liter container) with the equivalent flow of water to the plots. Then, this value was multiplied by the number of irrigation cycles performed and the amount of irrigation water consumption was calculated. Also, to add the amount of rainwater to the volume of water consumed, knowing that one millimeter of rainfall is equivalent to one liter, then the yield based on water consumption in each planting period for each line and each replication is calculated separately using Equation.

$WUE = 100 (Y / (VW + P))$

WUE: Yield based on water consumption ($kg.ha^{-1}.m^{-3}$); Y: Yield ($kg.ha^{-1}$)
VW: amount of water consumption (m^3);
p: Rainfall (m^3).

Finally, all statistical analyzes and regression calculations were performed using MSTAT-c software and a comparison of means by Duncan test method of 5% and Excel software was used to draw shapes and tables.

Results and Discussion

Grain yield

The results of comparing the means also show that the planting date of November 1 with an average of 2062 $kg.ha^{-1}$ had the highest and the planting date of March 11 with an average of 767.9 $kg.ha^{-1}$ had the lowest grain yield (Figure 1). Berti *et al*. (2011) reported that the effect of planting date and camelina cultivars, as well as grain yield components, had a significant effect on grain yield. Sintime *et al*. (2016), by examining the effect of planting date on the developmental stages of camelina, reported that with early planting, camelina seed yield increased and planting delay led to reduced yield and concluded that early planting yielded It is significant that it may be related to the amount of moisture available in the soil in rainy conditions.

Biological yield

The results of comparing the means also show that in the planting dates of November 1 and 21 with the average of 4901 and 4639 kg.ha^{-1}, respectively, and in the planting dates of March 11 and 1 with the average of 2611 And 2727 kg.ha^{-1}, respectively had the lowest biological yield (Figure 1). In this experiment, fall planting dates had the highest biological yield, which was quite similar to the results of grain yield. This can be due to the positive and significant correlation between biological yield and grain yield, which was also mentioned by Robertson *et al*., (2004).

Oil yield

The results of comparing the means show that the planting date of November 1 with an average of 614.4 kg.ha^{-1} had the highest and the planting date of March 11 with an average of 173.8 kg.ha^{-1} had the lowest oil yield (Figure 1). Suitable planting date with high grain yield and oil percentage produced the highest amount of oil yield per hectare and reduced oil yield with a delay in planting date can be justified because with delay in planting grain yield and oil percentage compared to timely planting Is reduced. Adamson and Kofelt (2005) also reported reduced oil yield due to delays in planting dates.

Grain yield based on Water use efficiency

The results of comparing the means show that the planting date of February 20 with an average of 0.4447 kg.ha^{-1}.m^{-3} was the highest and the date of planting on March 11 with an average of 0.2552 kg.ha^{-1}.m^{-3} was the lowest grain yield based on Water use efficiency (figure 2).

Hergert *et al*., (2011) stated that the difference in rainfall provides very good conditions for the development of production factors with average rainfall in drought and increases the yield of camelina and rapeseed. It was also reported that about 5 inches of water is required to produce camelina, and with each 150-160 pounds of irrigation, the yield of camelina's seeds increases, and 8.1 and 20.7 inches of water were used to increase the yield of camelina seeds by 520 to 2560 pounds per hectare, respectively. Maximum grain yield with maximum irrigation of 2300 – 2500 pounds per hectare and without irrigation (rainfed) was 500 – 1200 pounds per hectare.

Conclusion

These results showed that the delay in autumn and spring planting dates led to a reduction in the vegetative growth period and reduced photosynthetic material construction so that the characteristics of functional traits were affected. Also, increasing irrigation and average rainfall at the beginning of the vegetative growth period as well as changes in temperature and environmental conditions were effective in grain yield based on water consumption at different planting dates.

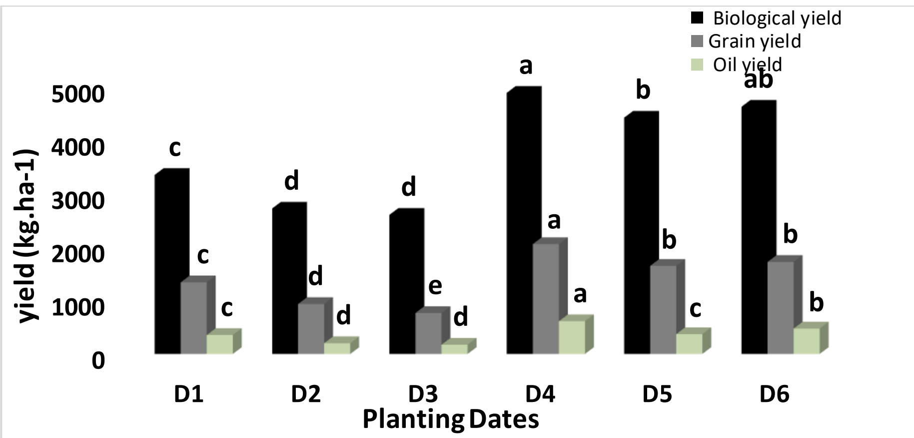

Fig 1. Average traits examined for Grain yield, Oil yield and Biological yield camelina in different planting dates. Means followed by the same letter within a Grain yield, Oil yield and Biological yield are not significantly different using the Duncan (*P* < 0.05). (D1=Feb.20; D2=Mar.1; D3=Mar.11; D4=Nov.1; D5=Nov.11; D6=Nov.21)

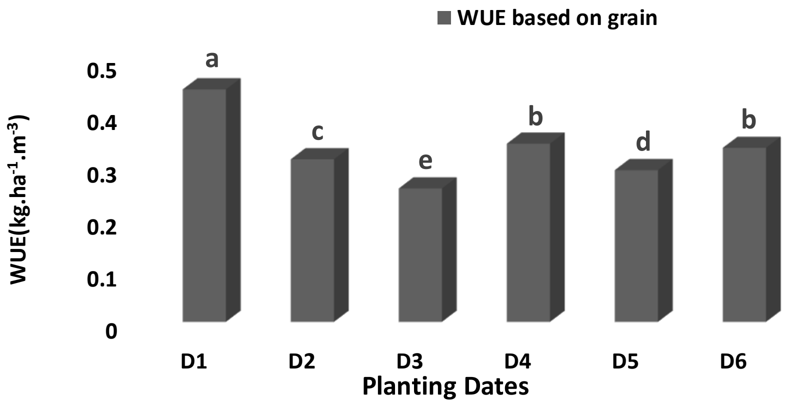

Fig 2. Water use efficiency based on camelina grain and oil in different dates planting (2018-2019). Means followed by the same letter within a Water use efficiency based on grain or oil are not significantly different using the Duncan (*P* < 0.05). (D1=Feb.20; D2=Mar.1; D3=Mar.11; D4=Nov.1; D5=Nov.11; D6=Nov.21).

References

1. Adamsen, F. J., and Coffelt, T. A. 2005. Planting date effects on flowering, seed yield, and oil content of rape and crambe cultivars. Ind. Crops Prod. 21:293–307.
2. Berti, M.T., Gesch, R., Johnson, B., Ji, Y., Seames, W., Aponte, A., 2015. Double- and relay-cropping of energy crops in the northern Great Plains USA. Ind. Crop. Prod. 75,26–34.
3. Berti, M. T., Wilckens, R., Fischer, S., Solis, A and Johnson, B. 2011. Seeding date influence on camelina seed yield, yield components,and oil content in Chile. Ind. Crops Prod. 34:1358–1365. doi:10.1016.j.ind crop.2010.12.008.
4. Budin, J.T., W.M. Breene, and D.H. Putnam. 1995. Some compositional properties of camelina (Camelina sativa L. Crantz) seeds and oils. J. Am. Oil Chem. Soc. 72:309–315. doi:10.1007/BF02541088.
5. Ciesielski, F., and Musnicki, C. Z. 1987. Growth regulators in winter oilseed rape cultivation. Proc. 7th Intern. Rapeseed Congr., Poznań, 4: 940-947.
6. Dobre, P., Jurcoane, S., Matei, F., Cristea, S., Farcas, N., Moraru, A. C. 2014. Camelina sativa as a double crop using the minimal tillage system, Romanian Biotechnological Letters, Vol.19, No.2, pg. 9190- 9195.
7. Francis, A., and Warwick, S. I. 2009. The biology of Canadian weeds. 142. Camelina alyssum (Mill.) Thell.; C. microcarpa Andrz. Ex DC.; C. sativa (L.) Crantz. Can. J. Plant Sci. 89: 791–810.
8. Gesch, R. W., Archer, D. W. 2013. Double-cropping with winter camelina in the northern Corn Belt to produce fuel and food, Industrial Crops and Products 44 , 718– 725.
9. Gesch, R., Archer, D., Berti, M., 2014. Dual cropping winter camelina with soybean in theNorthern Corn Belt. Agron. J. 106, 1735–1745.
10. Gugel, R. K., Falk, K. C. 2006. Agronomic and seed quality evaluation of Camelina sativa in western Canada. Canadian Journal of Plant Science, 86(4),1047, 1058.
11. Hurtaud, C., Peyraud, J.L., 2007. Effects of feeding camelina (seeds or meal) on milk fatty acid composition and butter spreadability. J. Dairy Sci. 90, 5134–5145.
12. Hunsaker, D.J., French, A.N., Clarke, T.R., El-Shika, D.M., 2011. Water use, crop coefficients, and irrigation management criteria for camelina production in arid regions. Irrig. Sci. 29,27–43.
13. Kahrizi, D., Kazemitabar, S.K., Soorni, J., Rostami-Ahmadvandi, H., Falah, F., Akbarabadi, A., Raziei, Z., Bakhsham, M. 2016. Introducing of camelina medicinal-oil plant for dryland conditions in Iran. National Conference on the Impact of Climate Change on Plant Production. 9 Sep. 2016. Sari, Iran.
14. Masella, P., Martinelli, T., Galasso, I., 2014. Agronomic evaluation and phenotypic plasticity of Camelina sativa growing in Lombardia, Italy. Crop Pasture Sci. 65,453–460.

15. McVay, K. A., and Lamb, P. F. 2008. Camelina production in Montana. MontGuide MT200701AG. Montana State Univ. Ext., Bozeman.
16. Pavlista, A. D., Isbell, T. A., Baltensperger, D. D., and Hergert, G. W. 2011. Planting date and development of spring-seeded irrigated canola, brown mustard and camelina. Ind. Crops Prod. 33:451–456. doi:10.1016/j. indcrop.2010.10.029.
17. Putnam, D.H., Budin, J.T., Field, L.A., Breene, W.M., 1993. Camelina: a promising low input oilseed. In: Janick, J., Simon, J.E. (Eds.), New Crops. Wiley, New York, pp. 314–322.
18. Robertson, M. J., Holland, J. F and Bambach, R. 2004. Response of canola and Indian Mustard to sowing date in the grain belt of north-eastern Australia. Australian Experimental Journal of Agriculture. 44: 43-52.
19. Vollmann, J., Moritz, T., Kargl, C., Baumgartner, S., Wagentristl, H. 2007. Agronomic evaluation of camelina genotypes selected for seed quality characteristics. Ind Crops Prod 26: 270-277.
20. W. Hergert, G., Margheim, J., Pavlista, A., Burgener, P., Lyon, D., Hazen, A., Derrel Martin, H., Supalla, R ., Thompson, C. 2011. yields and ET of deficit to fully irrigated canola and camelina. Proceedings of the 23rdAnnual
21. Central Plains Irrigation Conference, Burlington, CO., February 22-23, 2011Available from CPIA, 760 N. Thompson, Colby, Kansas.
22. Y.Sintim, H.,D.Zheljazkov, V., K.Obour, A., Y.Garcia, A.G., K.Foulke,T.2016. Evaluating Agronomic Responses of Camelina to Seeding Date under Rain-Fed Conditions. Published January 14, 2016.
23. Zubr, J., 1997. Oil-seed crop: Camelina sativa. Ind. Crops Prod. 6, 113–119.
24. Zanetti, F., Eynck, C., Christou, M., Krzyżaniak, M., Righini, D., Alexopoulou, E., Stolarski, M.J., Van Loo, E.N., Puttick, D., Monti,A.2017. Agronomic performance and seed quality attributes of Camelina (Camelina sativa L. Crantz) in multi-environment trials across Europe and Canada. Ind. Crop. Prod. 107, 602–608.