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Research Article

HOW NITROGEN FERTILIZER AND PLANTING DATES AFFECT AUTUMN COLZA YIELD AND YIELD COMPONENTS IN GILAN

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ABSTRACT
A split-plot experiment using randomized complete block design with 3 replications was conducted in the Fashtal village of Siahkal in the cropping year 2013-2014 to study the effects of various rates of nitrogen fertilizer and of planting dates on yield and yield components of the colza (Brassica napus L.) cultivar Hyola401. Four levels of the nitrogen fertilizer (urea at 0, 60, 120, and 180 kg/ha) were the main plots, and 4 planting dates (7, 17, 27 October and 6 November 2013) the subplots. Results showed the effects of the planting dates and rates of urea on biomass, seed yield, plant height were significant at the 1% probability level ($p<0.01$). The effects of the rates of fertilizer application, but those of the planting dates on harvest index and 1000-seed weight were not. The mutual effects of rate of urea application and planting date were not significant on any of the studied traits except for biomass and seed yield. The maximum yield was observed in the treatment with the 17 November planting date and urea application at 180 kg/ha, but it was not significantly different from the yield obtained by applying urea at 120 kg/ha.

Keywords: *Yield Components, Various Planting Dates, Yield, Colza, Nitrogen*

INTRODUCTION
Oil crops, the second most important foodstuff in the world after cereals, contain proteins besides being rich sources of fatty acids, and colza is one of the most important of them. At present, Brassica oil crops account for about 10% of the total world production of oil crops and produce about 14-15% of the total vegetable oil consumed in the world. Moreover, oil crops enjoy a special status among crop plants because they meet the food and industrial needs of human societies (Naseri, 1991). Colza has a special position among oil crops due to its unique agronomic features, and it has received greater attention in recent years (Ahmadi, 2000). Many parts of Iran have suitable climates for growing autumn colza (Saheb, 1998).
Selection of suitable planting date and determination of desirable rates of nitrogen application in growing colza are of special importance in increasing the productivity of this crop and in improving its qualitative and quantitative yields. It is known that seed yield in colza is strongly affected by planting date, and that determination of the desirable rate of applying nitrogen (and introducing a suitable strategy for its application), can lead to savings in fertilizers, and to reducing environmental damages caused by applying them. The purpose in determining the planting date is to find the best time for planting a cultivar or a group of cultivars so that conditions are suitable for seed germination and seedling growth and establishment and no growth stage of the crop meets unfavorable weather conditions (Khajehpour, 1993).
One of the factors limiting plant growth is nitrogen deficiency and colza requires large quantities of nitrogen: the quantities of soil nitrogen removed by one ton of colza seeds are twice those removed by one ton of wheat seeds (Ahmadi and Javidfar, 1996). Considering the expanded cultivation of colza in Iran, it is necessary that new cultivars suitable for climatic and soil conditions of each region be found, and experiments be conducted on nutritional needs of colza. Determination of these needs will increase the efficiency of fertilizer application and also will prevent environmental pollution and soil nutrient imbalances.

MATERIALS AND METHODS
The experiment was conducted in the village of Fashtal in Siahkal in an area of 650 m^2 in the cropping year 2013-2014. Samples at soil depths of 0-30 cm were taken from various places in the field to

determine soil characteristics and were sent to the Soil, Water, and Plant Laboratory for analysis. The results are presented in the following table:

The result of soil experience

Optimum	Unit	Amount	Element
6-7	***	8.30	pH
<1.5	ds m^{-1}	0.855	EC
>2	%	0.31	OC
<4	%	9	T.N.V
15	mg/kg	9.40	p
>250	mg/kg	174.52	k
>0.2	%	0.15	Total N
20-40		91	sand
40-60	%	6	silt
15-20		3	clay

The field was prepared first by a rotavator and then, at planting, by using a hoe. Sticks and plastic string were used to delineate the plots and facilitate planting. Seeds were sown by hand on 7, 17, and 27 October and 6 November 2013. Since planting was in autumn and rainfall in autumn and winter was sufficient in Gilan, irrigation was not needed. After seed germination, replanting was carried out where seeds had failed to germinate. Hand weeding was performed several times to control weeds. The split-plot experiment was conducted using the randomized complete block design with 3 replications. The main plots were rates of urea application (0, 60, 120, and 180 kg/ha) and the planting dates (7, 17, 27 October, and 6 November 2013) the subplots. The land area used was 650 m^2 with 16 treatments and 48 experimental plots. There were 6 cultivation lines in each 3 by 4 meter plot. At the end of the growing season, and depending on the planting dates and considering the border effect, 10 plants were randomly harvested from each plot. The plants were sent to the laboratory to determine features such as seed yield, harvest index, fresh weight, etc. Biomass was measured using an oven at 72 C° for 48 hours.
MSTAT-C, SAS, and Microsoft Office Exel were used to analyze data and draw diagrams, and Duncan's test was employed to compare the means.

Biomass

The second and fourth planting dates with 7874.42 and 7539.92 kg/ha had the maximum and minimum biomass, respectively. The 334.5 kg/ha reduction in biomass was due to delayed planting because plants had fewer days to reach maturity and finish their vegetative growth, and were forced to flower earlier and in a shorter flowering period. All of these contributed to the reduction in biomass. The second planting date resulted in plants having the maximum height, number of siliques per plant, and dry matter compared to the other planting dates (Table 2). Azizi *et al.*, (2003) reported delays in planting soybean reduced biomass. Application of urea at 180 and 0 kg/ha led to the highest and lowest biomass at 8993.67 and 6412.58 kg/ha, respectively (Table 2). Therefore, it can be concluded that increasing rates of urea enhanced vegetative growth and improved biomass because nitrogen stimulated growth (leading to increased biomass). Leng *et al.*, (1997) concluded that raising rates of nitrogen fertilizers increased stubble and biological yield (biomass). The mutual effects of fertilizer and planting date on biomass were positive and significant, with the maximum and minimum biomass belonging to the n_4t_1 and n_1t_1 treatments, respectively (Table 3).

Seed Yield

The fact that the mean squares of planting dates were significant for seed yield indicates differences in seed yields between the four planting dates. The second and fourth planting dates with the means of 2632 and 2537 kg/ha resulted in the maximum and minimum seed yields, respectively. The main reason for the increase in seed yield at the second planting date is that the relative diurnal temperatures were favorable during the growing season and, therefore, plants enjoyed greater heights and better yield components. In other words, the colza crop took advantage of the favorable and suitable temperatures during the vegetative growth and made maximum use of the environmental conditions and, with better vegetative growth and through forming more desirable yield components compared to the other three planting dates, entered the reproductive stage. During this stage, the flowering and pollination processes were not met with hot weather and, hence, the crop produced a higher yield. Siadat *et al.,* (2002) reported delays in planting colza significantly reduced seed yield. Comparison of the seed yields indicated that colza needed nitrogen fertilizers to produced suitable seed yields, and that seed yield declined when less than the required rate of the fertilizer was applied. Astare and Scarisbrick (1995) reported applying nitrogen at 240 kg/ha increased seed yield and dry matter.

Harvest Index

ANOVA on the experimental data showed that the effects of planting dates and the nitrogen fertilizer on harvest index were not significant; that is, different planting dates and various rates of urea had similar effects on harvest index. Lazemi *et al.,* (2005) reported that different planting dates had similar effects on harvest index.

Plant Height

Plant height increase in colza is accompanied by the formation of taller inflorescence axis and more flowers and pods. At seed filling stage when leaves drop, pods and branches perform photosynthesis. Therefore, longer stems improve plant photosynthesis rate and increase seed weight thereby enhancing yield. The second planting date with the mean plant height of 130.92 cm produced the tallest plants (Table 2). Delays in planting cause the plants to lose most of the chance for storing photosynthates and they will enter winter with weak rosettes. After winter cold and with increasing day length, the plants enter the flowering stage, while the vegetative growth at the end of the flowering stage will also be minimal and increases in height will not be tangible. Rabiei *et al.,* (2004) reported that delays in planting colza reduced plant height. Among the rates of urea application, the fourth level (180 kg/ha) yielded the tallest plants with the mean height of 143.83 cm (Table 2). Nitrogen fertilizers increase vegetative growth in colza leading to increases in plant height (and results we obtained confirmed this). The shortest plants were observed in the treatment in which no fertilizer was applied. Gulzar *et al.,* (2006) reported plant height in colza increased by raising the rate of nitrogen fertilizer application.

1000-seed Weight

The facts that the mean squares of planting dates for 1000-seed weight were not significant shows the 1000-seed weights of the four planting dates were not different from each other. The first to the fourth planting dates had 1000-seed weights of 2.86, 2.89, 2.88, and 2.85 grams, respectively, which were not significantly different from each other. Olsen and Carter (2004) found that soybean 1000-seed weight was not influenced by planting date.

Abadian *et al.,* (2008) reported that late planting of autumn canola caused plants to enter winter with weak rosettes so that they could not sufficiently utilize environmental conditions (radiation, temperature, etc.) for photosynthesis and sap production. Moreover, seed filling stage met high environmental temperatures and the high heat prevented seed filling, which led to reduced stored metabolic materials caused by increased respiration. This led to the production of pods containing small seeds and to low 1000-seed weight. Increased rates of nitrogen fertilizer application did not much influence colza 1000-seed weight either. Hatami *et al.,* (2005) reported nitrogen fertilizers did not affect soybean 1000-seed weight. Our results showed the highest 1000-seed weight was obtained at the 17 October planting date and urea application at 180 kg/ha, while the lowest was observed in the treatment of planting at the 6 November planting date with no urea application. Therefore, the most suitable rate of urea application and planting date for colza were found to be 180 kg/ha and 6 November, respectively.

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