Research Journal of Biological Sciences 3 (7): 729-732, 2008
ISSN: 1815-8846

Effect of Sowing Dates on Grain and Biological Yield, Oil and Meal Protein Percentage in Three Cultivars of Rape (*Brassica napus* L.)

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Abstract: The present study was carried out to investigate the influence of sowing date on grain and biological yield, oil and meal protein percentage of three cultivars of oilseed rape (*Brassica napus* L.) Serez, ACSN2 and SLMO46. The experiment was done in experimental farm of Islamic Azad university of Shabestar, East Azerbaijan, Iran. The experiment was split plot. Four sowing dates (21 September, 2, 12, 22 October) were applied as main factors and three cultivars were used as sub factors based on randomized complete block design in 4 replicates. Grain and biological yield in term of gram per square meter, harvest index ,oil and meal protein percentage of grain, number of days until to emerging and the number of days till 50% flowering of the examining treatments were determined and were analyzed. The results made it clear that planting date has significant effect on all treats ($p<0.01$), except the number of days for 50% flowering. The examined cultivars also show a significance effect ($p<0.01$) except in the treat of number of days till 50% flowering which is not significant ($p<0.01$) and this very different rates of significance shows a lot of genetic variety among them. While studying the interaction, it was observed that the two treats of grain and biological yield were significant ($p<0.05$) and the examined cultivars, they didn't indicate similar trend in different planting dates, however, the treats of oil percentage of grain, the percentage of meal protein and harvest index in different cultivars didn't indicate interaction which planting date. The treat of number of days till flowering is significant ($p<0.01$) and treat of number of days till 50% of flowering is not significant ($p<0.01$) and indicates the interaction between planting date and the cultivars in these treats.

Key words: *Brassica napus* L., biological yield, grain yield, harvest index, meal protein percentage, oil percentage, sowing date

INTRODUCTION

Oilseed rape (*Brassica napus* L.) which is an important crop in Iran has different conditions such as cold, cold temperate, humid warm and dry warm regions. There are also different soil textures and structures in these regions. Nowadays farmers use improved cultivars and they need new agronomic practices. Colza is a new crop with special characteristics that like winter plants can use seasonal precipitation and a good substitute for wheat and barley in rotation and high oil and protein production (Alyari *et al*., 2001). Canola yields increased greatly with increased availability of under water normal conditions. The new canola varieties have higher levels of oil and protein than the older varieties (Siddiqui *et al*., 2004). Supporting annual production of oil in Iran that is 86000 tons equal to 8% of need. Colza production area in 1994 was 135 Ha that increased to 99000 Ha in 2001. From 700 released colza cultivars in 1994, 425 were winter type and come from Canada, Australia, US, Europe. Most of Iranian cultivated colza is winter zero zero types. Oil and grain yield of colza are infected by planting date. Delay in planting date leads to decreased yield due to short growth stage and because early planting leads to flowering before winter. Colza is a long day plant and suitable planting date leads to better establishment of plantlet. Some suitable planting dates were estimated for Karaj (Sep 20 to Oct 10), Ghorghan and Mazandaran (Oct 17 to Nov 1) and Azerbaijan (Sep 1-10) (Alyari *et al*., 2001).

Grafius (1957) determined yield as yield components complex and showed that decrease in one component may be compensated by other components and yield stables. Each of these components not only time-sharing but also has different shares in yield. Harvest index is a unit-less measure and is a portion of photosynthetic assimilates division to economic and total yield and calculated as:

Economic yield = Harvest index * Biologic yield

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An increase in Harvest index or biologic yield may increase economic yield. Oil percent of colza is about 35-50%. But there are some reports that new improved cultivars have more than 60% oil and 35-40% linolenic acid. In the past, there were high urosic acid content cultivars. But today most improved cultivars have no urosic acid. About 50-58% of colza dry seed is squeezed. Protein in squeeze is compete able with other oil seed (Hashemi, 1996). The aim of this experiment was finding suitable planting date for winter colza in Shabestar region.

MATERIALS AND METHODS

This study was conducted at Islamic Azad University of Shabestar, agricultural research station. The climate of region is dry-temperate with 1460 m altitude. The experiment was split plot, laid out in Randomized Block Design with four replicates. Treatments were four planting dates (21st Sep, 2nd Oct, 12th Oct and 22nd Oct) as main plots summarized have been showed by (D1, D2, D3 and D4) and three cultivars (Serez, ACSN2 and SLMO46) as sub plot summarized have been showed by(Aw, A2, A1). Plot size was 6 m^2 that included in 4 rows with 50 cm distance and 30 cm length. Plant-plant distance in rows was 20 cm. Plant density was 100000 plant ha^{-1}. The site was ploughed after being followed for one year. Weeds were controlled with mechanical cultivation and hand weeding (no herbicides were used). Attributes like growing date, 50% of blooming, seed and biological, yield, harvest index, oil percentage and meal protein. For measuring the amount of oil and meal protein Soxhlet and Kjeldahl method was used respectively. Economic yield and Harvest index was determined by this formula:

Economic yield = Harvest index × Biologic yield

Data was analyzed by using MSTAT-C software. Duncan's multiple-range and LSD test was used to compare treatments means.

RESULTS AND DISCUSSION

Analysis of variance and mean comparison results are shown in Table 1 and 2. There is a significant difference between planting dates in all attributes except 50% blooming ($p<0.01$). Differences among cultivars were significant in all attributes except 50% blooming ($p<0.01$). This difference shows that, there is genetically variety between cultivars. Cultivar×planting date interaction showed that grain and biological yield, day to growing differences were significant.

Grain yield: Planting date mean comparison on yield showed that sowing date in D1 and D4 had maximum and minimum yield per g. m^{-2} 370.3 and 315.4, respectively and showed the sowing date had a significant difference with others. Other dates (D3 and D4) were in same group and had no difference among them. Fourth date had a significant difference with others ($p<0.01$). A decreased yield in delayed planting was reported by some researchers (Chay and Thurling, 1989; Taylor and Smith, 1992). Low LAI, less PAR absorption, low temperature in growth period, shorter generation period with high temperature in blooming period that led to decreasing fertile silique and disturbances in assimilate mobilization to grains and decreasing 1000 kernel weight, hollow kernel and finally yield (Allen and Morgan, 1975; Chay and Thurling, 1989).

Serez cultivar had highest yield compared to other cultivars and Slmo46 showed the least yield among all sowing dates.

Biologic yield: The first and third sowing date (D1 and D3) had the highest biological yield and there weren't significant difference among them. The least biologic yield related to D4. Results show that delaying in planting date led to decreased biologic yield because of little plants and damaged roots. Higher LAI and CGR in early planting dates led to accumulation of dry matter and increased biologic yield. Gross (1963) reported that in spring colza, by delaying planting date the vegetative and generation periods decreased and it led to decreasing total yield. Serez had the highest biologic yield than other cultivars and Slmo46 showed the least biologic yield in all planting dates.

Harvest index: Harvest index is a criterion for determining dry matter transportation from source to sink. In this research, there wasn't a significant difference between D1, D2 and D3 in H.I attribute, but H.I in D4 (22Oct) showed the least Harvest index and had significant difference with others ($p<0.01$).

Oil and meal protein percentage: Planting date had a significant effect on oil and protein percentage. The data of oil content of colza in different sowing date revealed that oil content values ranged between 33.59-34.8%, where D4 recorded the highest oil and protein percentage content (34.8 and 26.02%) and D1 had the least content(33.59 and 25.26%) among other dates. D4 had a significant difference with earlier planting dates ($p<0.01$). There wasn't significant difference between D2 and D3. Delaying in planting date increased oil and protein

Table 1: Mean square values for different traits in Rape

S.V	d.f	Grain yield	Oil percentage	Meal protein (%)	Biological yield	Harvest index	Day to growing
Replication	3	1158.325	9.455**	10.673**	5172.064	5.674**	10.688**
Planting date	3	7120.333**	3.001**	1.167**	50259.002**	1.072**	17.854**
Ea	9	364.034	0.064	0.023	2705.234	0.109	0.706
Cultivar	2	183805.216**	151.129**	128.309**	1617216.471**	2.631**	4.521**
Interaction	6	2602.349*	0.104	0.048	22035.981*	0.050	1.188**
Eb	24	810.353	0.082	0.063	7435.147	0.063	0.243
C.V%	---	8.19	0.84	0.98	8.16	0.76	5.20

Table 2: Mean comparision for different traits in Rape

S.V	Oil percentage	Meal protein (%)	Harvest index
Planting date			
D1	33.59c	25.26c	33.18a
D2	34.08b	25.60b	32.85ab
D3	34.20b	25.68b	32.86ab
D4	34.81a	26.02a	32.45b
Cultivar			
Aw	31.04c	22.73c	33.25a
A2	34.28b	25.81b	32.44c
A1	37.19a	28.38a	32.82b

S.V	Grain yield	Biological yield	Day to growing
Interactions			
D1Aw	502.5a	1499.0a	8.500de
D1A2	366.3cd	1114.0cd	8.500de
D1A1	242.1f	730.2e	7.500e
D2Aw	445.0b	1338.0b	9.000cd
D2A2	341.5de	1050.0cd	9.520cd
D2A1	240.5f	732.4e	9.000cd

percentage. Christensen (1985) and Hodgson (1979) resulted that delaying in planting spring colza decreased oil but increased protein. Hodgson (1979) also reported that in colder region, delaying planting date in winter colza, increased oil but decreased protein percentage. He concluded there was a negative correlation between oil percentage and weather day temperature during grain filling period.

Larsson (1978) pointed that delaying in harvesting led to decreased oil percent. Mendham *et al.* (1981) expressed that oil percentage in different cultivars is steady and planting date has very little effect on it unless it is affected by end season stress. Between three cultivars, Slmo46 showed the highest oil and protein percentage and Serez produced the least oil and protein percentage.

There was negative correlation between oil and protein percentage and it was proved by researchers.

Day to emergency: Delaying in planting led to increased days to emergency. The reason was decreasing soil temperature and plantlets decreasing growth speed. D1 and D2 with 8.17 and 9.08 and D4 with 11.08 mean days had the least and high to emergency respectively. Serez had the highest germination speed between the 3 cultivar.

Days to 50% blooming: Planting date had no effect on days to 50% blooming. Ghosh and Chatterjee (1988) reported that delaying in sowing date decreased days to 50% blooming and enhanced maturation in some species of *Brassica*. Late maturating cultivars had higher decrease in yield than early and mid maturating cultivars.

Mendham *et al.* (1990) reported that delaying in planting date increase vegetation speed and decreased 50% blooming. Delaying in planting date enhanced flowering. But Mendham and Scott (1975) reported that delaying in planting date delayed flowering and decreasing maturation period. Acsn2 had high delay in days to 50% blooming as compared with other cultivars.

AKNOWLEDGMENT

Here by, we are to appreciate the head of Islamic Azad University of Shabestar for supporting this project. The author also thanks Dr. Ahmadzadeh, Dr. Aghdam Shahriyar and Mr. Khanizadeh for correcting and their assistance to prepare this article.

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