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Effect of transplanting and direct seeding on seed yield & important agronomic traits in rapeseed (*Brassica napus* L.)

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Abstract

In order to compare the effect of transplanting and direct seeding methods on rapeseed (*Brassica napus* L.) in terms of agronomic traits, seed yield and yield components an experiment was conducted in a factorial arrangement in randomized complete block design with three replications during 2017-18. Investigating factors included rapeseed genotypes Zafar, L22, L17, and Hyola420 and culture methods were transplanting and direct seeding methods. The analysis of variance revealed significant effect of cultivars on all studied characteristics *viz.*, number of pods on main raceme, number of pods per plant, pod length, number of seeds per pod, 1000- seed weight, seed yield and oil content. The average seed yield of genotypes in transplanting and direct cultivation methods was 3114 and 2312 kg ha^{-1}, respectively which were classified in two distinct statistical classes. All the traits progressively increased in transplanting cultivation method. Correlation between seed yield and yield components were positive and significant indicating a positive and significant effect of these traits on seed yield in both cultivation methods.

Key words: *Grain yield & yield components, correlation, rapeseed, transplanting method*

Introduction

Rapeseed (*Brassica napus* L.) is cultivated worldwide and plays an important role in guaranteeing an adequate food supply (Akbar *et al.*,2007 and Rameeh, 2014a). Rapeseed from *Brassicaceae* provides a convenient alternative in cereal-based agricultural systems for its broad leaves and capacity to be a break crop in continuous run of cereals (Aytac and Kýnaci 2009; Faraji *et al.*, 2008; Diepenbrock, 2000; Junior *et al.*, 2012; Maia and Altisent, 2012; Smith *et al.*, 2004). It is also becoming a popular oilseed crop in Iran including north provinces due to its high oil and protein contents (Rameeh, 2014b). Breeding programmes over the years have been directed towards the development of varieties giving high, stable seed and oil yields (Rameeh, 2016). However, crop yields have been found to be affected not only by genetic inheritance and weather conditions but also by agronomic or management practices like plant density, seeding dates, fertilizer use (Leach *et al.*, 1994, Moore and Guy, 1997; Robertson *et al.*, 2004) direct seeding and transplanting methods. Seedlings transplanting in spring rapeseed is not a common cultivation practice especially in the north province of Iran where direct sowing is a general practice. The area under production of rapeseed has increased in the cereal-growing regions of the country. It is also grown in rotational cropping system after rice harvest. The rapeseed yield declined linearly with late sowing mainly due to shortened vegetative growth stages and varied significantly due to inter-annual climate variability (Rameeh, 2014b; Mendham *et al.*, 1981a). The yield potential at the study region is about 3 t ha^{-1} on an average however, this potential cannot be achieved in the rice–canola double-cropping system due to late sowing after rice harvest.Transplanting rapeseed may still be an effective measure against the restriction of season length to achieve higher yields of both rice and canola (Momoh and Zhou, 2001). The occurrence of unfavorable conditions such as rainfall, soil moisture and lack of drainage in rice paddies leads to difficulties in field preparations in time resulting into uneven seed germination and poor establishment of seedlings with poor planting density. In order to resolve these problems canola can be cultivated with seedling transplanting. Controlled treatment of seedlings, delayed crop compensation, water saving and easier weed control are the major advantages of canola cultivation with transplanting method (Mendham *et al.*, 1981a; Mulyati and Huang, 2009; Ren *et al.*, 2014; Yin *et al.*, 2004). Zhao

(1990) observed a decrease of 37 % in seedyield when transplanting was delayed by 18 days. Yin and Wang (1997) reported a progressive decrease in growth and yield parameters including plant height, number of effective branches, seed number per pod and total seed yield with delayed transplanting. The objective of the present study was to determine effects transplanting and direct seeding on seed yield and yield components of *B. napus*.

Materials and Methods

Experiment was conducted at Baykola Agriculture Research Station, located in Neka, Iran (53Ú, 13² E longitude and 36Ú 43² N latitude, 15 m above sea level) during 2017-18. The experiment was carried out in 2-factors factorial randomized complete block design with four genotypes (Zafar, L22, L17, and Hyola 420) and two cultivation methods direct seeding and seedling transplantation. The seedlings of genotypes for transplanting were grown in a special treasure including organic fertilizer, sand and soil. Seedlings were transplanted in the main plot when they had three real leaves according to the test map. The soil was classified as a deep loam soil (Typic Xerofluents,USDA classification) contained an average of 280 g clay kg^{-1}, 560 g silt kg^{-1}, 160 g sand kg^{-1}, and 22.4 g organic matter kg^{-1} with a pH of 7.3. Each plot was consisted of four rows of 5 m long and 30 cm apart. The distance between plants on each row was 10 cm resulting in approximately 200 plants per plot which were sufficient for statistical analysis. Crop management factors like land preparation, crop rotation, fertilizer and weed control were followed as recommended for local area. All the plant protection measures were adopted to make the crop free from insects. The data were recorded on ten randomly selected plants of each entry of each replication for number of pods on main raceme, number of pods per plant, pods length, seeds per pod and 1000-seed weight. Seed yield (adjusted to kg/ha) was recorded based on two middle rows of each plot. The Pearson correlation of coefficient was estimated for relationship of the traits in both cultivation methods. Oil content was determined with the help of nuclear magnetic resonance spectrometry (Madson, 1976).

Data were statistically analyzed using analysis of variance (ANOVA) techniques appropriate for randomized complete block design with factorial arrangement with the help of programmed excel worksheet. All the analyses were performed using SAS software version 9 (SAS Institute INC, 2004).

Results and Discussion

The results of factorial analysis of variance for the traits are peresented in Table 1. Significant effect of cultivation methods was detected for number of pods on main raceme, number of pods per plant, pod length, number of seeds per pod, 1000- seed weight and seed yield emphesized that these traits were differed in transplanting and direct seeding methods. The genotypes showed significant difference for all the traits. Interaction effects of genotypes with both planting methods were not significant for all the traits indicating the same trend of varition for a trait of genotypes in transplanting and direct seeding cultivation methods.

The mean performance of genotypes in transplanting and direct seeding methods of sowing are presented in Table 2. The results revealed that number of pods on main raceme, number of pods per plant, pod length, number of seeds per pod, 1000- seed weight, seed yield and percent oil content are significantly higher in seedling transplanting method. Earlier researchers (Rameeh, 2014b; Mendham *et al.*, 1981a) stressed that rapeseed yield declined linearly with late sowing mainly due to shortened vegetative growth period that varied significantly due to inter-annual climate variability in direct seeding method. The highest mean value for number of pods on main raceme was exhibited in L22 and it was lowest for Zafar and L17. Number of pods per plant varied from 129 and 153 in L17 and Zafar, respectively. The number of seeds per pod revealed non significant variation in different

Table1: Analysis of variance (Randomize complete block-RCBD) for seven traits in canola

S.O.V	df	Pods on main raceme	Pods $plant^{-1}$	Pod length (cm)	Seeds $siliqua^{-1}$	1000 seed weight (g)	Seed yield (kg/ha)	% Oil content
Replication	2	54.2ns	811*	3.8*	23	0.05ns	862144**	3.58ns
Cultivation method (C)	1	1441.5*	7776**	26.7**	80.7**	1.11**	3860026**	14.88ns
Genotypes(G)	3	349.5**	643**	1.2ns	7.7ns	0.70**	496944**	39.35**
G×C	3	256.2*	177ns	1.3ns	7.9ns	0.04ns	121825ns	0.53ns
Error	14	48.9	302	0.7	5.6	0.04	74619	4.24

*, ** Significant at p=0.05 and 0.01, respectively.

Table 2: Mean performance (two methods) of different canola varieties under transplanting and direct seeding methods

Treatments	Siliquae on main raceme	Siliqua plant^{-1}	Siliqua length (cm)	Seeds siliqa^{-1}	1000 seed weight (g)	Seed yield (kg/ha)	% oil content
Transplanting	50a	161a	9.1a	30.0a	4.31a	3114a	44.7a
direct seeding	35b	125b	7.0b	26.3b	3.88b	2312b	43.1b
Zafar	37b	153a	8.6a	29.8a	4.04b	3033a	42.7b
L22	53a	144b	7.8b	27.8b	4.58a	2787ab	44.8ab
L17	37b	129c	7.6b	27.3b	3.99b	2339b	47.1a
Hyola420	43ab	147b	8.2a	27.7b	3.78b	2693ab	41.2b

Mean in each column followed by at least one letter in common are not significantly different at Multiple Range Test the 1% level of probability-using Duncan's

Table 3: Performance of four *Brassica napus* varieties under transplanting and direct seeding methods individually.

Treatments	Genotypes	Pods on main Raceme	Pods plant^{-1}	Pod length (cm)	Seeds siliqua^{-1}	1000 seed weight (g)	Seed yield (kg/ha)	% Oil content
Transplanting	Zafar	38c	174a	10.2a	32.3a	4.21b	3562a	43.7abc
	L22	64a	167ab	8.3abc	28.0ab	4.91a	3289a	45.9abc
	L17	41c	147b	8.6abc	29.3ab	4.22b	2561bc	47.5a
	Hyola420	58ab	157ab	9.3ab	30.3ab	3.92bc	3043ab	41.8bc
Direct seeding	Zafar	36c	133b	7.0c	27.3ab	3.87bc	2504bc	41.6bc
	L22	42bc	121c	7.3bc	27.7ab	4.25b	2284c	43.7abc
	L17	34c	111c	6.5c	25.3b	3.76bc	2116c	46.6ab
	Hyola420	28c	136b	7.1bc	25.0b	3.65c	2342bc	40.6c

Means in each column followed by at least one letter in common are not significantly different at Multiple Range Test the 1% level of probability- using Duncan's

Table 4: correlation among the traits for rapeseed genotypes in transplanting and direct seeding methods cultivation

Traits	Pod on main raceme	Siliqua plant^{-1}	Pod length (cm)	Seeds siliqua^{-1}	1000 seed weight (g)	Seed yield (kg/ha)	Oil content (%)
Siliquae on main raceme	1						
Siliqua plant^{-1}	0.54	1					
Siliqua length	0.44	0.88**	1				
Seeds siliqua	0.41	0.76*	0.94**	1			
1000- seed weight	0.73*	0.55	0.38	0.38	1		
Seed yield	0.57	0.96**	0.87**	0.80*	0.57	1	
Oil%	0.21	-0.02	0.04	0.07	0.49	-0.01	1

*, ** Significant at p=0.05 and 0.01, respectively.

genotypes. The mean value of 1000-seed weight varied from 3.78 to 4.58g in Hyola420 and L22, respectively. Seed yield ranged from 2339 to 3033 kg ha^{-1} in L17 and Zafar, respectively. The highest oil content deteced for L17 and also this variety was matured earliest compared to others (data not shown).

Performance of various genotypes under individual seeding methods is shown in Table 3. The mean performance of all the genotypes for seed yield significantly increased under transplanting cultivation method. In transplanting method number of pods on main raceme varied from 41 to 64 in L17 and L22, respectively while it was ranged from 28 to 42 in direct seeding method. Pods per plant ranged from 147 to 174 in L17 and Zafar in transplanting method and it varied from 111 to 136 in L17 and Hyola420 in direct seeding. Zafar and Hyola420 exhibitted high mean values for pod length and seeds per pod in transplanting method. In direct seeding method Zafar and L22 had higher pod length. The highest mean value of 1000-seed weight observed for L22 in both the seeding methods.

Correlation of seed yield and other important attributes is shown in Table 4. Due to significant and positive correlation of seed yield with other yield components including pods per plant, pod length and seeds per pod the genotypes like Zafar had high values for seed yield and yield components in transplanting and direct seeding cultivation methods.The findings are in conformity with the earlier findings (Aytac and Kýnaci, 2009 and Akbar *et al.*,2007). High mean value of oil content determined for L17 and L22 in both cultivation methods. Significant positive correlation between number of pods on main raceme and 1000-seed weight indicating that higher number of pods on main raceme leads to increased in mean seed size in rapeseed.

Conclusion

In conclusion all the quantitative traits significantly affected by cultivation methods (transplanting and direct seeding) in *B. napus*. The genotypes exhibitted significant difference for all the seven traits studied. Although seedling transplanting in spring rapeseed is not a common cultivation practice, especially in the north province of Iran, but due to increasing seed yield and yield components under this method it may be recommended in some areas (districts) where situations like late planting of canola low seed yield especially in the rice–canola double-cropping system.

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