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Research Article

INVESTIGATING YIELD AND YIELD COMPONENT OF WINTER RAPESEED CULTIVARS AT BOJNORD-IRAN

Souri Khabazan, *Amir Behzad Bazrgar, Mohammad Samani and Ismael Mahmoud Abadi
Islamic Azad University, Neyshabur, Iran
**Author of Correspondence*

ABSTRACT
An experiment was conducted to investigate yield and yield components of 24 winter rapeseed cultivarsand inbred lines, at Bojnord during 2013 growing season. A randomized complete block design with three replication was carried out. Phonelogical, morphological and agronomic characteristics of different cultivars measured. There was significant different between cultivars in respect of all studied traits ($p<0.01$). Maximum and minimum flowering duration belonged to L 64 (21 days) and NK.KARIBIK (12 days) respectively. The highest (58) and lowest (37) pods per plant produced by L146 and L 101 respectively. The highest and lowest yield produced by L 146 and L 119 with 6533 and 3308 kg/ha seed yield. There was no significant difference between L 146, L 109, L 190 and L 5 in respect of seed yield.

Keywords: *Phonological, Morphological, Pod/Plant, Seed Yield*

INTRODUCTION
Oil seeds are the second great food source after cereals. Rapeseed (Brassica napus) is important seed oil belong to Brassicaceae. Between 93 to 95% ofIran need for cooking oil prepares via import. Thus producing seed oil in order to being self-sufficient (Ahmadi and Javidfar, 2001). Rapeseed shows high adoption to Iran environmental condition and could be a source of cooking oil production in Iran. Rapeseed oil is important in human nutrition due to preparing essential fatty acids and protein. The by-products of rapeseed oil are including animal feed, soap-making materials, and wax (Ilkaee and Emam, 2002). The seeds of rapeseed contain 40-48 percent oil and 38-45 percent protein (Anvari, 1998).
Seed yield can be determined by several components reflecting positive or negative effects upon this trait. It is important to examine the contribution of these components in order to give more attention to those having the greatest influence on seed yield (Ozer *et al.,* 1999). A positive correlation between rapeseed yield and dry matter reported by Kambel and Kondra (1977). Allen and Morgan (1972) showed a significant correlation between seed yield and plant leaf area at flowering stage. They showed that yield enhances by higher plant leaf area due to higher photosynthesis rate. Higher production of assimilates will result in higher yield production in plants. High leaf area index and leaf area duration results in higher yield due to increased pod growth in rapeseed. Decrease in one component of yield production makes increase in other yield components. Chark (1978) showed that rapeseed yield affect by seed number per pod and seed weight. Number of seeds and their weight is less in auxiliary branches compare with those of main branch. He declared that seed weight does not affect by environment while seed weight of different cultivars show significant differences. Shirani (1995) stated that rapeseed yield is correlated with plant height, seed number per podand dry seed weight. The highest correlation observed between seed yield and dry seed weight (r^2= 0.58). ToliatAbol-Hassani (1996) reported that about 95% of seed yield controls by dry seed weight. Rapeseed is a promising crop for cold and arid areas of Iran (such as north Khorasan). The present study was conducted to compare yield and stability of different rasped cultivars in order to determine the best cultivar for Bojnord environmental conditions.

MATERIALS AND METHODS
An experiment was conducted to investigate yield and yield components of 24 winter rapeseed cultivars and inbred lines, at north east of Bojnord during 2013 growing season. A randomized complete block design with three replication was carried out.

The experiment site located at 37° 28′ N and 57° 19′ E with 1090 m height above the sea level. Filed experiment was conducted on a loam sandy soil. Soil properties present at table 1.

Table 1: Soil properties of the study location

Soil depth	pH	ECdS/m	Total N %	Total P ppm	Total Kppm
0-30 cm	7.55	5.22	0.186	110.3	460

Each cultivar or inbred line, planted in four rows with 5m length and 30 cm row space. The final plant population was 90 plant/m2.
The list of planted cultivars presents at table 2.

Table 2: The name of planted cultivars

	Code	Code	Cultivar
1	L 73	13	L109
2	R 20	14	L237
3	L 201	15	L209
4	L 101	16	L146
5	L 63	17	R15
6	L 190	18	L69
7	L 173	19	NK.OKTNS
8	L 119	20	N.K.KARIBIK
9	L 118	21	OKAPI
10	L 5	22	Karaj 1 (K1)
11	L155	23	Karaj 2 (K2)
12	L192	24	Karaj 3 (K3)

Filed was irrigated after planting. Thinning performed by the mid-March. Weeds removed by hand. Cabbage aphid (*Brevicorynebrassicae*) controlled using Metasystox-R.
Yield components measured on five random plants in each treatmentBiomass and seed yield measured by harvesting total plot for each treatment. Plant sampleswas first air dried and then weighted.Seeds weighted at 12% humidity present. Data analyzed using SAS 9.1 and MSTAT-C. Comparison between means carried out applying LSD test.

RESULTS AND DISCUSSION

Phenological Characteristics

There was significant difference between cultivars in respect of the duration between planting and flowering ($p<0.01$) (table 3).

Table 3: Results of analysis of variance of measured traits at different cultivars

Source of variation	Degree of freedom	Mean squares				
		Days to germination	Days to flowering initiation	Days to flowering termination	Flowering duration	Days to Maturity
Replication	2	0.05**	0.12**	27.68**	0.0**	0.0 **
Treatment	23	2.81**	14.48**	2.97*	17.86**	9.21 **
Error	46	0.34	1.14	1.56	0.0	0.0
CV %		9.51	0.5	0.55	4	3.6

** and ** significant at 5 and 1 probability levels*

The shortest duration between planting to germination observed for L 146, NK.OKTNS, NK.KARIBIK, K1 and R 15 (table 4). Short duration between planting and germination results in rapid establishment and thus is a preferred characteristic for rapeseed. Early established plants reach the rosette stage before winter low temperatures and are tolerated to chilling injuries. Late established plants reach the winter cold temperature at the beginning of growth stage and are very sensitive to chilling stress.

Table 4: Means comparisons of measured characteristics

Cultivars	Days to germination	Days to flowering initiation	Days to flowering termination	Flowering duration	Plant height cm
L 73	6.3^{cdef}	211.0^{fg}	229.7^{b}	18.0^{d}	13.0^{i}
R 20	5.6^{efg}	211.3^{fg}	229^{b}	16.0^{f}	133.0^{i}
L 201	6.6^{bcde}	213.7^{cd}	229.7^{b}	16.0^{f}	123.0^{j}
L 101	7.3^{abc}	211.3^{fg}	230.3 ^{ab}	19.0^{c}	120.0^{j}
L 63	5.3^{fg}	210.7^{fg}	230.3^{ab}	19.0^{c}	134.0^{i}
L 190	7.3^{abc}	211.3^{fg}	229.7^{b}	20.00^{b}	138.0^{h}
L 173	6.6^{bcde}	213.3^{cde}	230.3^{ab}	17.0^{e}	122.0 ^{j}
L 119	5.3^{fg}	214.0^{bcd}	232.3^{a}	17.0^{e}	138.3^{h}
L 118	7.6^{ab}	213.7^{cd}	230.3^{ab}	15.0^{g}	131.0^{i}
L 5	7.0^{abcd}	211.7^{efg}	229.0 ^{b}	16.0 ^{f}	140.0^{fgh}
L 155	5.3 ^{fg}	212.3 ^{def}	229.0 ^{b}	18.0 ^{d}	145.0^{cde}
L 193	6.0 ^{defg}	217.0 ^{a}	229.0 ^{b}	13.0 ^{i}	148.0 ^{bc}
L 109	7.3 ^{abc}	215.3 ^{abc}	230.0 ^{ab}	14.0 ^{h}	146.0 ^{bcd}
L 237	8.0 ^{a}	211.3 ^{efg}	228.0 ^{b}	16.0 ^{f}	149.0 ^{ab}
L 209	6.0 ^{defg}	210.0 ^{g}	228.0 ^{b}	17.0 ^{e}	139.0^{gh}
L 146	5.0 ^{g}	214.7^{bc}	230.0^{ab}	14.0 ^{h}	141.0^{fgh}
R 15	5.0^{g}	216.7 ^{a}	229.0^{b}	13.0^{i}	152.0^{a}
L 64	6.0^{defg}	210.7^{fg}	230.0^{b}	210.0^{a}	142.0^{efg}
NK.OKTNs	5.0^{g}	216.0^{ab}	229.0^{b}	13.0^{i}	148.0^{bc}
NK.KARIBIK	5.0^{g}	216.0^{ab}	228.0^{b}	12.0 ^{j}	143.0^{def}
OKAPI	7.3 ^{abc}	214.0^{bcd}	214.0 ^{b}	13.0^{i}	/0139.0^{gh}
K 1	5.0^{g}	210.7^{fg}	229.0^{b}	17.0^{e}	121.0^{j}
K 2	6.0^{defg}	214.3^{bcd}	228.0^{b}	15.0^{g}	132.0^{i}
K 3	6.0^{defg}	216.0^{ab}	230.0^{ab}	14.0^{h}	141.3^{fgh}

Means with the same letters in each column are not different at 5% probability levels based on LSD test.

There was significant difference between cultivars in respect of days to flowering initiation ($p<0.01$), days to flowering termination ($p<0.05$) and flowering duration ($p<0.01$) (table 3). The longest (217 days) and shortest (210 days) duration between planting and flowering belonged to L 193 and L 209 respectively (table 4). The longer reproductive phase results in more for flower formation and fertilization.The longest flowering termination duration belonged to L 119 (table 4). The longest (21 days) and shortest (12 days) flowering duration observed for L 64 and NL.KARIBIK respectively (table 4). Long flowering period make plants sensitive to late season drought stresses and will result in low kernel weight and seed yield while short flowering periods results in lower fertilized flowers and lower seed number per plant. Thus cultivars with medium term flowering periods are more proper for the North-Khorasan environmental conditions. Cultivars such as R20, K2 and L 146 with 14-16 days of flowering duration are suitable cultivars for the region (table 4).

Significant difference observed for “days to maturity” ($p<0.01$) (table 3). The longest (270 days) and shortest (264 days) growth length belonged to K3 and L63 respectively (table 4). Medium season cultivars are proper for Bojnord, due to late season drought stresses. These cultivars matures earlier

compare with long season ones, and will escape from late season drought conditions. Cultivars coded L 146, L 201 and L 237 with 265-268 days maturity durations, are appropriate for Bojnord environmental conditions.

Morphological Characteristics

Analysis of variance showed that there was significant difference between cultivars in respect of plant height, pod number per plant, seed number per pod, 1000 seed weight and seed yield ($p<0.01$) (table 5).

Table 5: Results of analysis of variance of measured traits at different cultivars

Source of variation	Degree of freedom	Mean squares				
		Pod/plant	Seed/pod	Plant height	1000 seeds weight	Seed yield
Replication	2	149**	3.16**	14.34*	0.93**	36997**
Treatment	23	145**	65.33**	255**	0.72**	3320407**
Error	46	5.92	4.37	3.55	0.094	52490
CV%		5.31	8.09	1.37	7.47	4.67

** and ** significant at 5 and 1 probability levels*

The highest plant height produced by R 15 (figure 1). Results showed that higher plant height result in higher vegetative duration, and delayed reproductive phase.

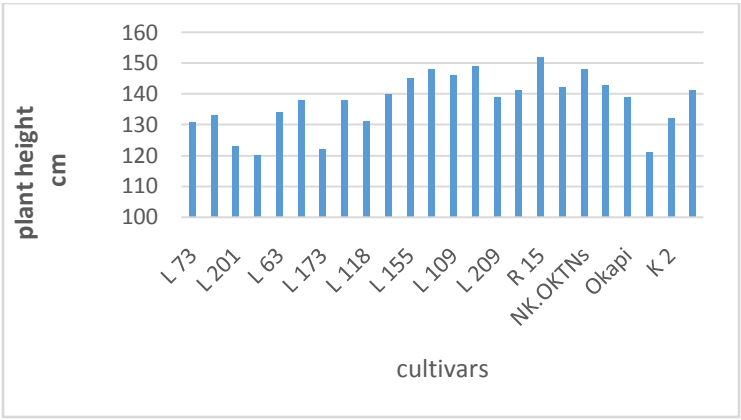

Figure 1: Plant height of different rapeseed cultivars

Pod number per plant was higher in L 146. The lowest pod numbers belonged to L 101 and L 73 (35 pods) (figure 2).

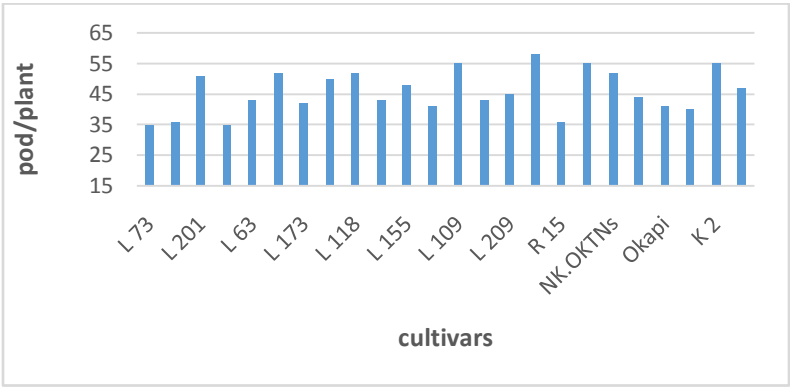

Figure 2: pod/plant at different rapeseed cultivars

Pod/plant isa crucial yield component in rapeseed. However it could be substantially vary between different cultivars. Significant correlations reported between seed yield and pod/plant in rapeseed (GhazianTafrishi *et al.*, 2009). Higher pod/plant is more proper for producing higher seed yield. The best cultivar in respect of this characteristic was L 146 with 58 pods per plant. The highest (34) and lowest (19) seed number per pod produced by L 201 and L 109 respectively. There was no significant difference between L 201 and L 146 in respect of seed/pod (figure 3).

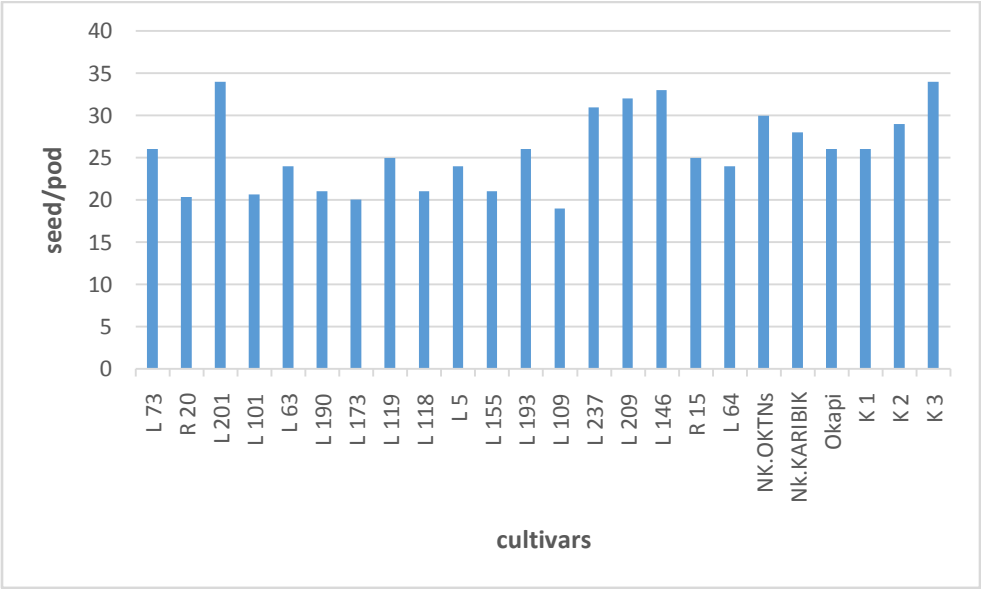

Figure 3: Seed/pod at different studied cultivars

The highest and lowest 1000 seed weight produced by NK.KARIBIK and L 201 (figure 4).

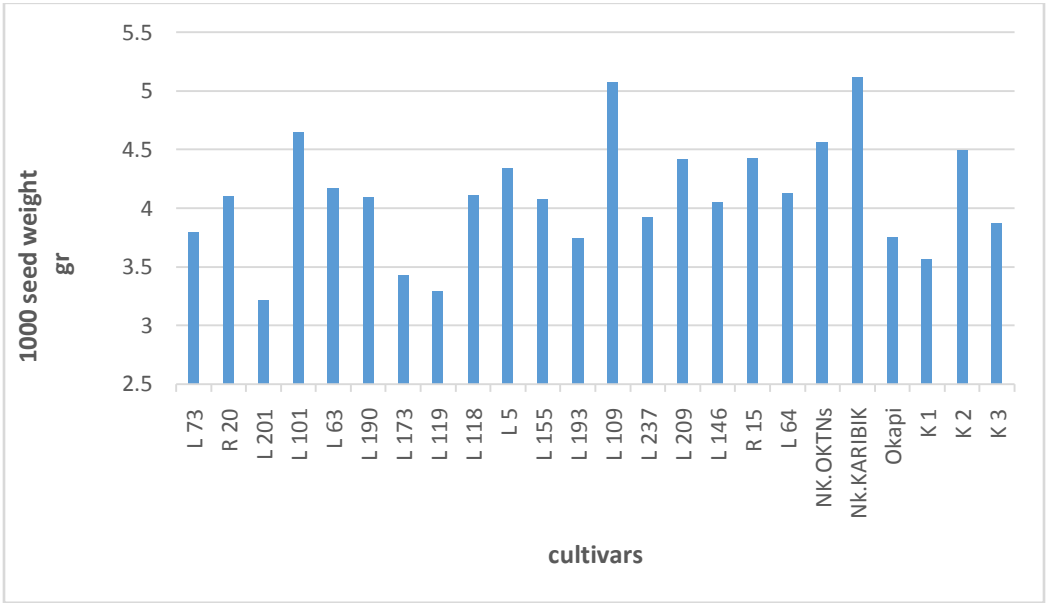

Figure 4: 1000 seeds weight at different studied cultivars

The highest seed yield produced by L 146, L 109, L 190 and L 5 with 6533, 6512, 6458 and 6322 kg/ha seed production. The lowest seed yield produced by L 119 with 3308 kg/ha seed production (figure 5).

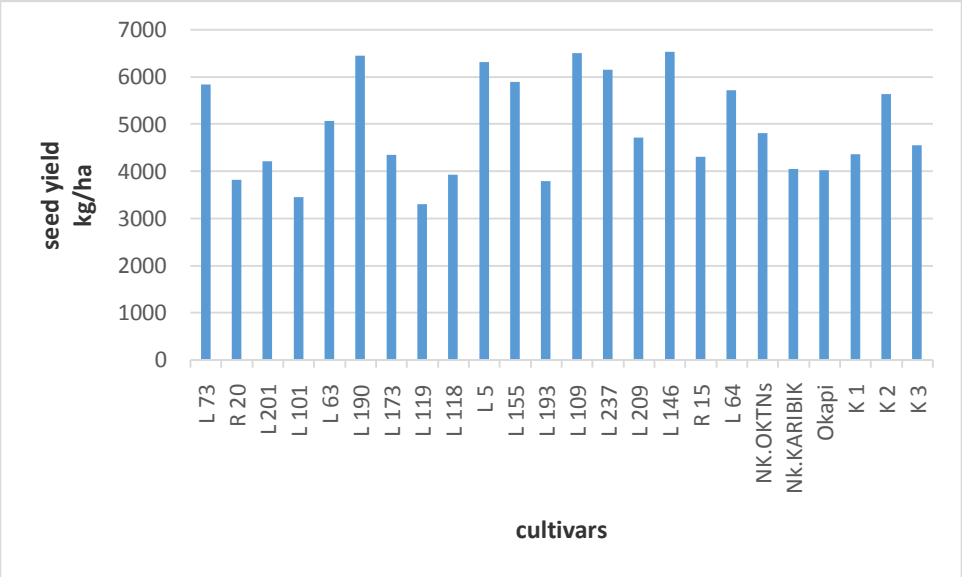

Figure 5: Seed yield at different studied cultivars

Seed yield was correlated with pod/plant (r2= 0.42**). The high seed yield of L 146 is due to its high yield components such as pod/plant and seed/pod.

Conclusion

Results showed that L 146 is a proper cultivar for Bojnord environmental conditions due to mid-term maturity duration, medium height and high pod/plant production. Mid-term maturity results in escaping from late season drought and short height results in reaching to reproductive phase sooner than higher plants. Pod/plant is an important seed yield component and higher pod/plant will result in higher seed yield.

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