SEED AND BIOLOGICAL YIELDS OF NARBON VETCH GENOTYPES UNDER CENTRAL ANATOLIA CONDITION, TURKEY

Onur Ileri, Suleyman Avci, Ali Koc

Eskisehir Osmangazi University, Faculty of Agriculture, Department of Field Crops, Eskisehir, Turkey

Abstract

Narbon vetch is an annual forage legume that can be successfully cultivated and used as both grain and hay in animal feeding in arid and semi-arid climates. Even though narbon vetch is not commonly grown in Turkey, the plant has a significant potential for the future because it is suitable for winter sowing and capable of enough production (forage or seed) capacity under shorten spring growing period. The study was conducted in Eskisehir plain (Central Anatolia Region of Turkey) between 2014 and 2015 years. In the study, 6 lines and 2 cultivars of narbon vetch that obtained from different sources were compared in terms of plant height, biological yield and grain yield. According to results, plant height did not show significant difference among cultivars but it was different between years. Plant height was 50.0 and 73.8 cm in 2014 and 2015, respectively. Average plant height was 61.8 cm, however, it varied between 44.7 and 77.5 cm among cultivars. Although there was no significant difference between cultivars with regard to biological yield, differences were significant between years ($P<0.05$). Overall biological yields were 5064 kg/ha^{-1} and it was 3896 and 6232 kg ha^{-1} in 2014 and 2015, respectively. Biological yield ranged from 2865 to 7967 kg ha^{-1} among cultivars. Grain yield was significantly different ($P<0.01$) between years, it was 1112 kg ha^{-1} in 2014 and 1754 kg ha^{-1} in 2015. The highest grain yield was 2274 kg ha^{-1} and it was obtained from line 2461. Year x cultivar interaction was significant ($P<0.05$). There was no difference recorded in Bozdag cultivar among years while genotypes 2391, 2461 and 2466 were produced more grain under better climatic conditions. Line 2466 showed satisfying grain production in the contrast experimental years. In conclusion, Bozdag cultivar is recommended to cultivation in the region and similar ecologic conditions however line 2466 have a prominent potential to developing new cultivar.

Keywords: *Semi-arid Climate, Narbon vetch, Plant Height, Seed Yield, Biological Yield*

1. INTRODUCTION

Due to global warming, seriously climatic changes occurred worldwide but the adverse effect of climatic changes are more pronounced in arid and semi-arid regions (Lioubimtseva & Henebry, 2009). The climatic change affects climate patterns in Central Anatolia Region, located semi-arid climatic zone of Turkey, as other areas of the world. Thus, moisture shortage is a critical factor for agricultural production, plant diversity and pattern. The commonly depicted or foreseeing effects of global warming in semi-arid zone is changing of annual rainfall amount and distribution pattern which cause shortening of spring growing period (Kizilelma et al, 2015). This change leads researchers to develop new cultivation patterns. In this context, plant species which can be able to sown as winter crop reaches harvest maturity earlier in spring, thus they can escape from the adverse effects of drought and provide benefit for producers.

Narbon vetch (*Vicia narbonensis* L.) is cultivated in arid and semi-arid regions on the world. It can be sown in either spring or autumn in the Central Anatolia Region (in Turkey) where semi-arid climate conditions prevail. In eco-friendly agriculture, narbon vetch has a reputation for its low requirements for chemical fertilizers and pesticides. Beside its high crude protein content (Iptas & Karadag, 2009), the plant is also capable of adapting to the shortened spring period. Narbon vetch has greater potential of grain production as livestock feed than other vetch species and the grain contains tanin and trypsin inhibitors that is directly affecting it’s feed efficiency (Berger et al, 2003; Larbi et al, 2010), therefore, narbon vetch is cultivated generally for grain production (Buyukburc & Iptas, 2001). Erect growth habit appears as an advantage for the plant due to facilitating mechanical harvest.

Buyukburc and Iptas (2001) stated that plant height and biological yield parameters should be primary breeding criteria for seed yield of narbon vetch. In the study performed with 15 lines of narbon vetch it was found that the highest seed and biological yields were 2122 and 8481 kg ha^{-1} respectively. Turk et al, (2008) determined that biological yield and harvest index had higher and positive direct effect on seed yield of narbon vetch based on path coefficient analyses. In the experiment conducted by Iptas and Karadag (2009) in Tokat province, Turkey, 15 narbon vetch lines which were sown in the spring were tested with respect to seed yield and yield components and it was determined that seed and biological yields changes from 1.11 to 1.16 t ha^{-1} and from 4.04 to 7.90 t ha^{-1}, respectively.

The aim of this study was to determine narbon vetch cultivars or lines suitable for spring sowing with respect to seed and biological yields for Central Anatolia region where semi-arid climatic conditions prevailed. Because producers do not sow any crop in the case of the winter crops exposed to frost damage under dryland condition in the region.

2. MATERIAL AND METHODS

This experiment was conducted in Eskisehir province ($39^0 47'$ N, $30^0 31'$ E), where is located in Central Anatolia region and prevailed semi-arid climatic conditions of Turkey under rainfed condition during years of 2014 and 2015. Total annual precipitation was 358 and 443 mm in 2014 and 2015 years, respectively, with a long term average of 339. Annual average temperature was 12.1 and 11.2 ^oC in the experimental years, respectively, and it was 9 ^oC in long term average. Monthly total precipitation and temperature values in experimental period were given in Table 1. As seen on the Table 1, warmer climatic conditions prevailed during the experimental period in both years compared to long term average and more precipitation were received during the period compared to long term average, however, second year's experimental period, especially in June, more precipitation were received.

According to Soil Laboratory Report of Faculty of Agriculture, Eskisehir Osmangazi University, the soil of experimental area was loamy with organic matter content of 1.97%, with lime of 3.63%, and corresponding available K_2O and Olsen plant P_2O_5 contents were 407.0 and 64.0 kg ha^{-1}, respectively (Anonymous, 2016).

Table 1. Monthly total precipitation and temperature averages of the experimental area in the growing period.

	2014		2015		Long Term Averages (1970-2011)	
Months	Precipitation (mm)	Temperature (^0C)	Precipitation (mm)	Temperature (^0C)	Precipitation (mm)	Temperature (^0C)
March	23,1	6,3	38,9	5,6	27,6	4,9
April	15,2	11,5	26,6	7,9	43,1	9,6
May	27,2	15,1	47,8	15,5	40,0	14,9
June	70,6	18,5	151,1	17,1	23,7	19,1
July	7,5	22,6	0	22,1	13,1	22,1

In the study, eight narbon vetch genotypes (*Vicia narbonensis* L.) were used. Two of them were certified cultivars (Bozdag and Dikili) and the others were lines (2277, 2380, 2391, 2461, 2466 and 2467). The experiments were established in 4^{th} March 2014 and 26^{th} March 2015. The experiments were arranged in a randomized complete block design with 3 replications. Narbon vetch seeds were sown by experiment drill with 50 seeds per m^2 (Turk & Tawaha, 2002). Plot size was 10.8 m^2 (6 m x 1,8 m) and consisted of 6 rows spaced 30 cm apart. Weed control was done by hand hoeing in the middle of May in both years. 46 kg ha^{-1} P_2O_5 and 18 kg ha^{-1} N were applied to soil in the form of Diammonium phosphate (DAP) before sowing (Firincioglu et al, 2012)

In order to determine plant height, 10 individual plants were randomly sampled from each plot before harvesting. Harvesting was performed after taking out one row from each side of the plots and a 0.5 m area from beginning or end of each row on July 10^{th} in the first year and on August 12^{nd} in the second year because climatic conditions alter reaching seed maturity stage between the years. All plots were harvested at ground level and dried in oven at 70 ^{o}C in two days. After drying, the plant samples were weighted to determine biological yields. Thereafter, the samples were threshed by hand to separate and calculate seed yields.

All data were subjected to analysis of variance based on general linear model for repeated measurement using the SPSS package (SPSS, 1999). Means were separated using Duncan's Multiple Range Test.

3. RESULTS AND DISCUSSION

Narbon vetch genotypes did not show significant differences in terms of plant height. Average plant height was 61.8 cm and it varied between56.1 and 65.2 cm among the genotypes (Table 2). However, there were significant differences with respect to plant height between the years. The plant height in the first year was shorter (50.0 cm) than second year (73.8 cm). Year x genotype interaction was not significant for plant height.

Biological yield changed between 3208 and 6011 kg ha^{-1} among genotypes with an average of 5064 kg ha^{-1} (Table 2) but this change was not statistically significant. The biological yield in the second year (6232 kg ha^{-1}) was higher than first year (3896 kg ha^{-1}). The effect of year x genotype interaction on biological yield was not statistically significant.

Table 2. Plant height, biological yield and seed yields of narbon vetch under Eskisehir ecological conditions

Genotypes	Plant height (cm)			Biological yield (kg ha^{-1})			Seed yield (kg ha^{-1})		
	2014	2015	Average	2014	2015	Average	2014	2015	Average
2277	53,7	73,1	63,4	3342	6867	5104	923	1350	1137 b
2380	44,7	67,5	56,1	3550	2865	3208	1288	982	1135 b
2391	50,8	70,3	60,5	3875	5281	4578	1148	1930	1539 ab
2461	53,5	76,9	65,2	4402	7107	5754	952	2274	1613 ab
2466	49,3	77,2	62,3	4055	7967	6011	1256	2246	1751 a
2467	51,3	72,5	61,9	3133	5552	4343	867	1538	1203 b
Bozdağ	48,3	77,5	62,9	4942	6274	5608	1382	1691	1537 ab
Dikili	48,8	75,1	61,9	3867	7944	5905	1080	2019	1550 ab
Average	50,0 B	73,8 A	61,8	3896 B	6232 A	5064	1112 B	1754 A	1433
F Test									
Years	**			**			**		
Genotypes	ns			Ns			*		
Years x Genotypes	ns			Ns			*		

F-test, ns: non-significant, *: significant at P≤0,05, **: significant at P≤0,01

Upper case and lower case letters indicates means differences at P≤0,01 and P≤0,05 respectively

The average seed yield was 1433 kg ha^{-1} and it changed significantly between1135 (Line 2380) and 1751 (Line 2466) kg ha^{-1} among genotypes (Table 2). Apart from lines 2380, 2277 and 2467, the other genotypes gave statistically similar yields to Line 2466, which had the highest yield performance in the study. As with plant height and biological yield, seed yield was also significantly affected by years. Seed yield was higher (1754 kg ha^{-1}) in the second experimental year compared to first experimental year (1112 kg ha^{-1}). Unlike the other investigated parameters, seed yield was significantly affected by year x genotype interaction, suggesting that the response of genotypes differed between years (Table 2). Line 2380 produced higher seed yield (1288 kg ha^{-1}) in the first year than the second year whereas the other genotypes had higher seed yield compared to first year's yield (Figure 1). However, the yield increase rates were different among genotypes; for example, the magnitude of the increase was 1.87 in cultivar Dikili while it was 1.22 in cultivar Bozdag. These different yield increase rates among genotypes were responsible for year x genotype interaction.

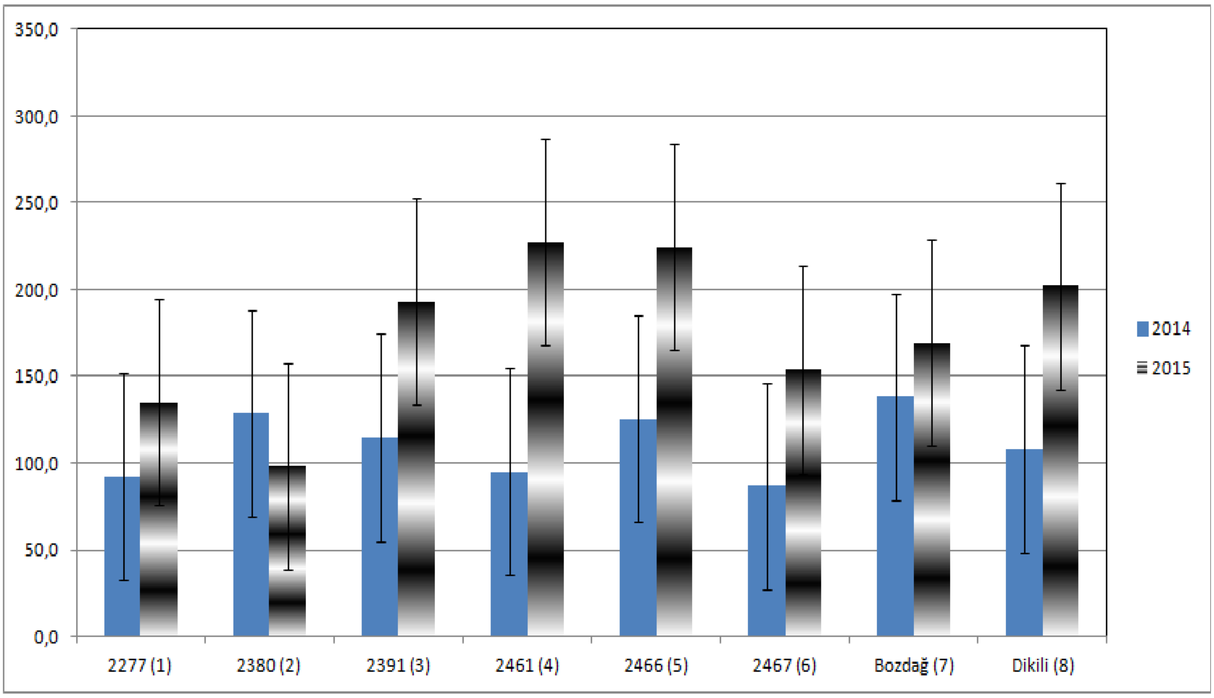

Figure 1. Years x Genotype interaction effects on seed yield of narbon vetch (LSD : 59,52).

The results of the experiment showed that the genotypes had genetically similar potential with respect to plant height and biological yield but their potentials were different with respect to seed yield (Table 2). An average plant height was 61.8 cm and it changed between 50.0 and 73.8 cm depending on the years. The changes in plant height between years were mainly related to the amount of received precipitation. Narbon vetch genotypes produced taller plants because of extending growing period depending on precipitation. This result recorded for plant height corroborates the previous reports (Buyukburc & Iptas, 2001; Yucel, 2004).

Biological yield did not show significant difference among genotypes with an average of 5064 kg ha^{-1}, but year's effect was significant. The effect of years on biological yield was mainly associated with moisture availability due to more precipitation, especially in June, in the second year (151.1 mm), which caused to extend growing period. As a result of extending growing period, the plant showed more photosynthetic activity and consequently produced more biological yield. Similar results were also reported by the other researchers (Buyukburc & Iptas, 2001; Tamkoc & Avci, 2004).

Although genotypes had similar plant height and biological yield, they differed with respect to seed yield. Differences in the seed yields of the lines and cultivars used in this study were resulted from genotypic differences. Similar results were reported previously by Thompson et al, (1997) who stated that the assimilate partitioning and differences in genetic potential were main reason for differences of seed yield among the narbon vetch genotypes. As mentioned earlier, the differences in seed yield between the years can be largely attributed to increasing moisture availability, which was due to more precipitation and prolonged growing period. Consequently, extending growing period led to more seed production. Similar results were also reported by the other researchers (Iptas & Karadag, 2008; Firincioglu et al., 2010).

In conclusion, narbon vetch sown in spring, can be grown successfully under dryland conditions in Central Anatolia Region, Turkey and produce reasonable seed yield even in the drought years. Therefore, narbon vetch can be recommended for dryland farmers in semi-arid climate regions as an alternative in the years when winter crops such as barley, wheat, canola, pea or safflower received frost hazard. Nevertheless, it is necessary to develop new cultivars to increase perceiving of the plant for this purpose.

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