

DETERMINATION OF YIELD AND YIELD COMPONENTS OF SOME VARIETY AND POPULATIONS ON FALSE FLAX (*Camelina Sativa* L. Crantz.) IN TURKEY

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Abstract

The aim of the study was to compare yield and yield components of a variety and populations of false flax obtained from Directorate of Thrace Agricultural Research Institute under Ankara ecological conditions. Although variations in number of branches attached to main stem and number of seeds in the pod among genotypes were found statically insignificant. Variations in blooming date, initial flowering date, plant height, number of pod, seed yield, thousand seed weight, crude oil content and oil yield among genotypes were found statistically significant. Number of branches attached to main stem ranged 8.00 (Giessen Nr.3 variety) to 10.66 (CSS-CAM37 genotype). The number pod in the main stem varied from 22.33 to 29.00 and the highest number of pod was noted on CR 476/65 and CS-163-2073-72 genotypes. The highest number of seeds per pod was determined as 13.33 (CS-CR1670 genotype). The seed yield of false flax genotypes ranged 107.20 to 149.50 kg/da (CR 476/65). Thousand seed weight of genotypes differed from 0.67 g to 0.87 g; and crude oil contents varied from 39.91 – 49.47 % (CR 476/65). Also, the highest oil yield (74.28 kg/da) was determined in the same genotype. In conclusion, CR 476/65 genotype showed the best performance in terms of seed yield, crude oil content and oil yield point of view among to genotypes. Moreover, Giessen Nr.3 false flax variety and CS-CR1676, CS-CR1670 and NE2006-1 genotypes also followed CR 476/65 genotype respectively.

Key Words: *False Flax, Camelina sativa L. Crantz., Crude Oil Content, Seed Yield, Oil Yield*

Introduction

Production of oil seed is inadequate and oil deficit is met through imports in Turkey. Although there exists suitable climatic and soil conditions for growing alternative oil crops. the desired production level has not reached in Turkey,. *Camelina (Camelina sativa L.)* grown in a warm climate zone, with 85 to 100-day vegetation is an oil plant. It is germinated at low temperatures and its freezing tolerance is high. Because its input are far less compared to many plants and it is easy to grow. The crop is resistant to drought conditions. Therefore, areas receiving low rainfall are more suitable for crop compared to other oilseed crops (Vollmann et al., 1996). It demands smaller amount of humidity and nutrients, so it can be also grown easily in fallow areas. False flax is extensively grown in the North West Montana of the United States of America (USA). The studies conducted in the USA, Germany, Estonia and England show that the seed yield of false flax varies between 80-400 kg/da depending on the climate and soil of the region, sowing density and nitrogen fertilization. (Agegneh and Honermei 1997; Akkar and Iluma 2005; Koncius and Karcauskı 2010; Pan et al., 2011). In addition, false flax, has a high adaptability, can be grown in different regions. The oil obtained from the seeds of false flax, contains high linolenic acid (35%) and omega-3 fatty acid. False flax seeds, meal and flour rich in protein is used in cattle feed. The seeds can be consumed as appetizer. Also, it is a valuable green manure crop (Jones and Valamot, 2005).

Short-chain fats in the presence of the catalyst reacts with an alcohol releases a product. The product is called as biodiesel fuel. In recent years, due to increase in world oil prices the developed countries have started to find alternative new fuel sources. False flax is a promising sustainable alternative energy crop. False flax is a promising sustainable alternative energy plant. The highly abundant oil of its seeds can be converted into high-quality diesel and jet fuel. Ataki i (1991) reported that, false flax plants grown in the summer season has vegetation period of 130-150 days, plant height (40-70 cm), around 32% of the oil in the seed, thousand seed weight of 0.7-1.6 g and seed yield of 100 kg /da.

Zuber (1997) stated that false flax could be grown in marginal areas and is adaptive to extreme climatic conditions and is also drought-resistant plant. Karahoca and Kırıcı (2005), investigated effects of different nitrogen and phosphorus doses on seed yield and oil content of false flax under Adana ecological conditions as an alternative oil plant. Up to applications of 15 kg / da nitrogen and 10 kg / da, seed and oil yield increases were not found. The highest seed yield (256 kg / da) was determined in to 20 kg / da nitrogen and 20 kg / da phosphorus applications. Kurt and Seyis (2008) reported that false flax thousand grain weights varied between 0.8-1.8 g, plant height fluctuates between 25-100 cm and number of seed per pod changed between 8-16 units. Johnson et al. (2008) studied optimal sowing density of false flax lines at different locations in Western Canada. This trial made use of 12, 25, 50, 100, 200, 400, 800, 1600 seeds / m² of false flax sowing. Seed yield increased with increasing sowing density, However when 400 seeds / m² was applied seed yield was stabilized. Seed yields dramatically decreased at 800 and 1600 seeds / m² applied.

Katar et al. (2012), determined the yield and some agronomic characters of 11 false flax varieties under Ankara conditions. In two years, the highest thousand seed weight and seed yield were obtained from a variety of Ames 26673, the highest values in other yield components were determined in Vniimk 17 varieties. Koç (2014), stated the highest seed yield of 5.78 g/ plant per plant on harvesting on 20th of September and the the lowest seed yield of 0.25 g / plant on 10th April sowing time. The highest oil percent (37.55 %) was determined on 19th of October sowing time and the lowest oil percent was 22.72 % planted on 10th of April. The aim of the study was to compare yield and yield components of a variety and populations of false flax obtained from Thrace Agricultural Research Institute under Ankara ecological conditions.

Materials and methods

In the study, one false flax cultivar (Giessen Nr.3) and 10 different false flax lines (Vniimk 17, No.402, C 476/65, CS-163-2073-72, CS-CR1670, CS -CR1676, CPS-CAM10, CSS-CAM30, CSS-CAM37, NE2006-1) were collected from different countries and conserved in USA. gene bank were used as material. The seeds were obtained from Thrace Agricultural Research Institute, Edirne, Turkey.

This research was conducted using randomized block design with 3 replications at the experimental fields of Ankara University, Faculty of Agriculture and Department of Field Crops, Ankara University, Turkey in 2013. The seed were sown to seed bed opened using marker at 35 cm row spacing. Each plot consisted of 3 m length and 4 row spacing's. Trial was conducted in 33 plots. The plants were harvested and threshed y hand.

Temperature and relative humidity values of 2013 were greater compared to average of long years. Although annual rainfall of 2013 is higher than long-term average low rainfall has been in May and June. Therefore irrigation has been required in May and June of 2013. Soil structure of trial areas is clay loam with slightly alkaline characteristics.

The seeds were sown by hand on 11 April 2013. The sown seeds were covered with soil and to provide better contact and to prevent bird damage, trial area was quenched by the cylinder. During the sowing, 4 kg /da pure nitrogen to be (DAP fertilizers applied) and 3 kg / da of

phosphorus (P₂O₅) as base fertilizer and prior to flowering and 4 kg / da pure nitrogen (ammonium nitrate fertilizers) top fertilizer by hand sprinkling were applied. The seed started to germinate from 27 April 2013. The plants were harvested on July 4 2013 considering cracking of pods and physiological maturity level. The data were analyzed with a randomized block pattern (Duzgunes et al., 1987) using the MSTAT-C statistical software package. Duncan's multiple comparison method was used in the determination of different groups. Variations in blooming date, initial flowering date, plant height, number of pods, seed yield, thousand seed weight, crude oil content and oil yield among genotypes were found to be statistically significant, although variations in number of branches attached to main stem and number of seeds in the pod among genotypes were statistically non significant.

Results and discussion

The measurement and observations related to the examined characters were performed according to the literatures (Dogan and Polity, 1985; Ozer 1996; Karahoca and Kırıcı 2005; Kurt and Seyis 2008; Mason, 2009). Analysis of variance of the results related to germination days, (day), beginning of flowering (days), plant height (cm), number of branches on the main stem (units); number of pod on the main stem, number of seed on the pod (unit), seed yield (kg / da); thousand grain weight (g); crude oil percent (%) and oil yield (kg / da) of different false flax genotypes sown under Ankara ecological conditions, are given in Table 1. Statistical differences among germination dates of genotypes were significant at p<0.01 level. The earliest germinated genotype was CSS –CAM with 15.67 days.

The latest germinated genotype is CS-CR1676 with 19.00 days. Statistical differences among beginning of flowering dates of the genotypes were statistically significant at p<0.01 level. The earliest days of the flowering is CSS with 45.67 days. The latest flowering genotype is CS-cr1676 with 48.67 days. Differences among the genotypes with respect to plant height were statistically significant at the 0.05 level. Vniimk has the longest plant height 17 (63.33 cm) and the shortest plant height (52.67 cm) was obtained from NE2006-1.

Genotype differences in terms of the number of branches on the main stem were not statistically significant. When compared to genotypes; The maximum number of branches on the main stem with 10.66 was obtained from CSS-CAM 37, least number of branches on the main stem with 8:00 was determined in Giessen Nr.3 variety. Number of branches on the main stem of the other genotypes was ranked between these two values.

Table 1 Variance analysis results in germination date (days), flowering date (days), plant height (cm), number of branches per main stem, number capsules of per main stem, number of seeds per capsule, seed yield (kg/da), 1000 seed weight (g), crude oil contents (%) and oil yield (kg/da) of false flax genotypes

Source of variation	DF	Date of germination	Flowering date	Plant height	Number of branches per main stem	Number capsules of per main stem
Blocks	2	0.758	1.121	54.758	1.909	3.364
Cultivars	10	3.024**	2.230**	29.455*	1.285	18.406*
Error	20	0.224	0.321	11.891	1.676	7.797
Grand total	32					
CV (%)		2.81	1.21	5.88	13.56	11.21

Source of variation	DF	Number of seeds per capsule	Seed yield	1000 seed weight	Crude oil contents	Oil yield
Blocks	2	0.121	2646.798	2646.798	14,825	692.526
Cultivars	10	3.352	501.850*	501.850* *	28,110*	170.356**
Error	20	2.888	162.323	162.323	9,172	41.535
Grand total	32					
CV (%)		15.16	10.13	7.10	6.60	11.16

*p<0.05

**p<0.01

Differences among genotypes in terms of number of pod on the main stem were statistically significant at the 0.05 level. Considering number of pod on the main stem; C 476/65 and CS-163-2073-72 genotypes had the maximum value of 29.00 and the least number of pod on the main stem (22.33) were identified in Vniimk 17. Differences among the genotypes number of seed in the pod were not statistically significant. Number of seed in the pod were obtained from genotype were CS-CR1670 with 13:33 and NO.402, NE2006-1 varieties with 10:00 unit. Seed yield differences among the genotypes were found to be statistically significant at $p < 0.05$ level. The highest seed yield (149.49 kg / da) was obtained from CR 476/65, while the lowest seed yield (107.24 kg) were determined in CSS-CAM30. Giessen R.3 (139.00 kg / da), CS-CR1676 (135.14 kg / da), CPS-CAM10 (132.72 kg / da), NE2006-1 (129.11 kg / da) and CS-CR1670 (126.33 kg / da) had genotypes with high seed yield when compared to other genotypes. NO.402 (123.23 kg / da), CS-163-2073-72 (115.82 kg / da), Vniimk 17 (114.41 kg / da) and CSS-CAM37 genotypes (111.45 kg / ha) had the less seed yield genotypes respectively. Thousand grain weight in terms of genotype differences were statistically significant at $p < 0.01$ level Vniimk 17 had the highest thousand seed weight (0.8733) g and the lowest thousand seed weight (0.6667 g) was determined in CSS-CAM37 genotype. Differences among the crude oil percent of genotypes were significant at the $p < 0.05$ level. The highest oil percent (49.47%) was found in C 476/65, the minimum oil percent (39.91%) was determined in NO.402 genotype. Other genotypes in terms of crude oil percent lied between these two values were ranked. CS-CR1670, (49.00%), NE2006-1 (48.11%), CSS-CAM30 (47.97 %), CS-163-2073-72 (46.39%), CS-CR1676 (46.32%) and CSS-CAM37 (46.18%) gave the best crude oil rate; whereas, Giessen Nr.3 (45.16%), Vniimk 17 (44.90%) and CPS-CAM10 (40.97%) were identified low oil content genotypes. Genotypes in terms of oil yield differences were also statistically significant at $p < 0.01$ level. The maximum oil yield (74.28 kg / da) was found in C 476/65 and the lowest oil yield (49.36 kg/da) was determined in NO.402. Genotypes which have high oil yield were CS-CR1676 (62.54 kg / da), Giessen Nr.3 (62.41 kg / da), NE2006-1 genotype (61.95 kg / da) and CS-CR1670 genotype (61.79 kg / da).

Conclusion

It can be concluded that CR476/65 genotype showed the best performance in terms of seed yield, oil content, oil yield, and crude oil percent compared to other genotypes tested under Ankara ecological conditions. Giessen Nr.3, CS-CR1676, CR1670 and NE2006-CS-1 genotypes had high seed yield followed by other genotypes.

As a result of the study, false flax was determined as a crop which was highly adaptive to extreme conditions in terms of plant nutrients deficiency. There is less need to use chemical herbicides, because it competes well with weeds. The crops can be grown as a good rotational crop with cereals such as wheat under Central Anatolia Region conditions. The high fat content in seeds can be too converted to high quality fuels such as diesel and jet fuel.

Considering all these advantages; the crop can be easily grown once suitable regions are determined for characteristics like sowing time, sowing, fertilizer doses and correct farming techniques. The best regions of false flax plant, sowing time, sowing, fertilizer doses, the correct farming techniques, and providing seeds of false flax varieties to farmers is desirable. Therefore, it is recommended that researches and studies should be done on false flax by the universities, both at public and private sector and local research organizations to determine suitable varieties, cultivation techniques and to induce strategies for increasing seed yield that will definitely end up in increased oil yield.

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