Original Research Article

EFFECT OF PLANTING DENSITY ON YIELD COMPONENTS OF FALSE FLAX

ABSTRACT

This research was carried out to determine the effect of population density on the performance components of false flax (*Camelina sativa* (L.) Crantz). This would allow to determine the effect of increasing the number of seeds of the false flax on the yield and also the appropriate sowing distance under Konya conditions. The research was developed in the experimental field of Çumra Vocational School, Konya, Turkey. The experimental design was randomized complete blocks design with three repetitions. . Analyzes were made using the Jump statistics program. A thousand seeds were weighed and 4 different planting population densities were used: 500, 750, 1000 and 1250 seeds per square meter. On May 2, 2014 it was sown and on August 10, 2014 it was harvested. Plant height, number of plants per m^2, biomass, root length, number of capsules, number of seeds per capsules, weight of a thousand seeds and other yield values were evaluated. The vegetative period of false flax under Konya ecological conditions was 100 days. The thousand-grain weight was 1.4 g (500) to 2 g (1000), plant height 58.3 cm (500) to 74 cm (750), and root length 9.6 cm (1000) to 16.3 cm (750). The number of capsules per plant and of seeds per capsule ranged from 152.6 (750) to 571.6 (500) and from 11 (1000) to 19.6 (500). In this study, It was found that applications of 1250 seeds per m^2 were the most suitable sowing density for yield.

Keyword: Konya, Yield, Thousand Grain Weight, The number of capsules

INTRODUCTION

The false flax (*Camelina sativa* (L.) Crantz) is also known as flax, German anemia, and Siberian oilseeds. False flax is a herbaceous species of the *Brassicaceae* family, it is native to Northern Europe and Central Asia, where it has been used for agriculture and human nutrition for about 3000 years (Zubr, 1997., Katar *et al*., 2012a) . The species *C. sativa*, *C. laxa*, *C. rumelica*, *C. microcarpa*, *C. hispida* and *C. anomalous* are better known (Davis, 1965). Among these species, *Camelina sativa* is the only species with economic importance. False flax (*Camelina sativa* (L.) Crantz) is an oily, annual and summer plant, it is also one of the plants resistant to harsh winter conditions (Crowley and Fröhlich, 1998).

The false flax varieties grown are all annuals. The height of the plant generally ranges from 25 to 100 cm and has a main stem. The latter is round with pores on the epidermis, and is usually branched from below. False flax leaves are lanceolate in shape and 5-8 cm long. The edges of the leaves are smooth. The flowers are composed of 4 green sepals forming the calyx, 4 yellow or yellowish white petals, 6 anthers (male organ) and 1 ovarian (female organ). False flax is a self-growing plant. However, it can be fertilized by insects (through pollination). The fruit has a capsule shape, varying in color from orange to brown with a diameter of 0.7 to 2.5 mm. The capsule contains 8-16 seeds. The length of the seed is greater than the width and has a shape similar to the wheat seed. The seeds of the cultivated varieties vary in color from dark yellow to light brown and are shiny. The

weight of one thousand grains varies from 0.8 to 1.8 g depending on factors such as development conditions, nutrient absorption (Seyis, 2008 and Onder 2013, Kurt).

Like many cultivated plants, yield factors are significantly influenced by the sowing period, the number of seeds sown and the area. The yields of seeds and oils in the plants that are sown in summer are significantly reduced as the sowing is late (Karcauskiene, 2010 and Katar *et al*., 2012b, Koncius).

To reduce the lack of vegetable oil it is necessary to increase the areas and the yield of the existing oily plants, also as an alternative, other oily plants that have the capacity to develop and produce in ecological conditions in which the existing ones do not resist. False flax is an oily plant that can be used as an alternative to reduce the lack of vegetable oil in Turkey. False flax seed is tolerant to cold and frost (Harrison, 2011 and Katar *et al*., 2012c). It is also tolerant to extreme drought and can grow in many areas with different climates and with different soil structure, except in soils with heavy clay and organic soils (Kurt and Seyis, 2008). This plant can easily grow in dry areas where other cultivated plants cannot grow, in poor soils, in places where the altitude is considerable (El Bassam, 2010). Due to the small size of the false flax seed, it is very important that the soil preparation for planting is well done.

Searches and jobs related to false flax production are limited in Turkey. That reveals the need for studies on this topic. There are not enough studies on the production of this plant in the harsh winter conditions of Konya and there are not enough studies on the population density of it. The objective of this study was to determine the most suitable sowing density of the false flax plant under Konya conditions. This study would allow to determine the effect of increasing the number of seeds of the false flax plant on the yield and also the adequate sowing distance under Konya conditions.

MATERIALS AND METHOD

Climate And Soil Properties

Cumra is located in a basin 43 km southeast of Konya, around the Konya-Karaman railway line, between 37-38 degrees east longitude and 33-34 north latitude with an altitude of 1009 m and an area of 2320 km^2. It is an important agricultural center with a wide pattern of products in which several plants are grown at the same time. The climate in Cumra and its surroundings is cold and snowy in the winters, the summers are hot and dry. Although there are no extreme cold in the winter months there are days below freezing. Fall and spring have rainy months. The summer temperature is suitable for growing most agricultural crops. During the summer months, the temperature increases as the humidity decreases. In Konya province for many years according to climate data, the average rainfall is 321.1 mm per year, the lowest temperature is in January (-14.4 ^oC) and the highest temperature is in July (35.8 ^oC), some years are arid with less rain (Tulukcu *et al*., 2005).

The material for the study was false flax seed (*Camelina sativa* (L.) Crantz). The research was carried out in the experimental field of the Çumra Vocational School belonging to the University of Selcuk. It was carried out in the vegetative period of 2014 with three repetitions according to the

experimental design of the random complete blocks. The plots were 4 m long and 1.50 m wide, and six rows were planted in each one. The plots are made manually, with a distance of 25 cm between the rows and a depth of 0.5 cm. A thousand seeds were weighed and 4 different planting population densities were used: 500, 750, 1000 and 1250 seeds per square meter. Sowing was done manually in spring on May 2, 2014. After sowing, the soil was slightly compacted to facilitate contact of the seeds with the soil and then sprinkler irrigation was carried out for germination. The harvest was also done by hand on August 10, when the seeds in the capsules dried up. After harvest, the capsules were spread for about a week in the sun and mixing them. No chemical fertilizers or phytosanitary product were used in the trial. Weed control was done manually by veneering. The observations have been taken in two meters of the four lines in the middle of each plot. In the study, the average of 5 plant observations was calculated for each false flax planting density. Then the average of the replications was calculated for each sowing frequency.

Measurement and weighing processes were carried out such as plant height, biomass, root height, number of capsules per plant, weight of a thousand grains, number of grains per capsules and yield per hectare.

Sowing was done in spring 2014 in experiment plots and this year there was a dry agricultural period throughout Turkey. This dry spell affected low rainfall regions like Konya the most. Especially the rainy spring season was drier than expected. This spring period received 50.4 mm of rain in the months of April, May and June, which represents half compared to the average of many previous years (105.7 mm) in the same region. Table 1 provides some climatic data for 2014. According to table 2, the soil of the experimental site has a clay structure and is slightly alkaline. In addition, the area of the test site is calcareous to medium level and has a low content of organic matter (According to the modified Walkley-Black method) (Walkley 1947)

RESULTS AND DISCUSSION

The height values of the plant obtained from the study of Kurt and Seyis (2008) are between 25-100 cm, between 40-70 cm according to those reported by Ilisulu (1972), between 54-95 cm according to those reported by Crowley and Fröhlick (1998); In this study, as seen in table 3, the results of the average height of the false flax plant coincide with those reported by Koncius and Karcauskiene (2010), which are values between 58.2-68.2.

In our study we have obtained that the number of capsules per plant varied from 137.2 to 366.4 and with an average of 248.65 capsules per plant. Our results coincide with what was reported by Koc (2014); The average number of capsules per plant for plants sown in the winter is 398.84 units / plant, for those sown in the summer it is 68.56 units / plant and the average of both is 233.71 units per plant. Our values are also close to those reported by Karahoca and Kırıcı, (2005), which are 319.87 units per plant.

In our study, the weight of 1000 grains per false flax ranged from 1.7 to 1.9 g and the average was 1.75 g. In the study carried out by Ilisulu (1972) the weight of a thousand grains in the false flax

varies from 0.7-1.6. The values reported by Kara (1994) are between 0.8-0.9 g; Also Koncius and Karcauskiene (2010) have reported results higher than 0.88-1.24 g.

In our experiment the number of grains per capsule was between 14 and 17.7 with a mean of 15.72. These results are superior to those reported by the following: Koc (2014) the number of grains per capsule was determined as 11.68 grains / capsule in the autumn sowing, 12.21 grains / capsule in the spring sowing and 11.95 grains / capsules in both . According to Agegnehu and Honermeier, 1997 the number of grains / capsule is 6.8, according to (Akk and Ilumae, 2005) they were found to be higher than 8-10 grains / capsule and according to (Karahoca and Kırıcı 2005) it is 9.35 grains / capsule.

In our study, the false flax yield per hectare varied between 292 kg / ha and 1150 kg / ha, the average yield was 798 kg / ha. The yield values that we have obtained are within the ranges obtained by Robinson (1987) and reported by Kara (1994) 250-1190 kg / ha, Gesch and Cermak (2011) reported that they were between 419-1317 kg / ha, according to the Ilisulu (1972) report is between 700-1400 kg / ha. It was found that the average obtained in our study is within the values reported by Incekara (1972) of 800-1300 kg / ha. As the number of seeds applied per square meter changes, differences occur in the measured properties.The lower the number of Seeds planted, the better some traits appear for false flax. However, the increase in the number of seeds planted per square meter for this plant causes an increase in biomass and yield. In this study, as the number of seeds applied per square meter increased, the yield also increased.

CONCLUSIONS

As a result of the study, it is observed that the performance and yield components improve as the density of the plant increases per square meter. The highest values of biomass and yield have been obtained with 1250 seeds per square meter. Also with this planting density in Konya ecological conditions, they yielded good results in this study. In places with variable characteristics of climate and soil, such as Konya, further studies are needed to determine the appropriate stocking density for each.

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Table 1. Data on precipitation and temperature for the year 2014 during the false flax cultivation cycle (Meteorology Regional Directorate).

	April	May	June	July	Augus
Precipitation (mm)	5.2	31.2	14.0	0	6.8
Maximum temperature (^{o}C)	28.6	28.7	34.8	36.9	37.4
Minimum temperature (^{o}C)	-4.1	4.0	7.5	10.5	12.8

Table 2. Results of the soil analysis of the experimental area.

Characterıstıcs	Results	Classification
Textura	37.23% Clay, 31.67 % Arena, 31.10% Loam	Clay
pH	7.46	Light alkaline
$CaCO_3$ (%)	14.61	Very chalky
Organic material (%)	1.01	Very little
P_2O_5(kg/kg)	6.83	Enough
K_2O(mg/kg)	459.8	Enough
Ca (mg/kg)	13040	Very high
Mg (mg/kg)	720	High
DTPA ext. Fe (mg/kg)	5.60	Enough
DTPA ext. Zn (mg/kg)	2.60	High
DTPA ext. Mn (mg/kg)	46.40	Enough
DTPA ext. Cu (mg/kg)	1.06	Enough

Ext: Extraction

Table 3. Average values of the observations and measurements determined in the false flax plant in Konya, Turkey.

Population Density (Unit/ m^2)	Plant Height (cm)	Biomass (g)	Root Length (cm)	Number of Capsules per Plant	Thousand Grain Weight (g)	Number of Grains per Capsule	Yield (kg / ha)
500	62.4	672	11.4	332.8	1.7	17.7	292
750	70.1	1393	15.2	366.4	1.7	14.0	844
1000	64.7	1747	11.0	137.2	1.9	14.0	906
1250	67.0	2249	11.6	158.2	1.7	17.2	1150
Average	**66.05**	**1515.25**	**12.3**	**248.65**	**1.75**	**15.72**	**798**
F Ratio	0,7336	1,9180	2,5078	1,6530	1,9743	3,4419	1,4220