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DETERMINATION OF YIELD AND YIELD COMPONENTS OF SOME CRAMBE GENOTYPES IN THE WORLD CRAMBE COLLECTION

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Abstract

This research was carried out in Samsun ecological conditions, 2016-2017 summer seasons. This study was conducted to determine the yield and some agricultural characteristics of some Crambe hispanica subsp. abyssinica genotypes in the World Crambe Gene Pool, which are the basis for adaptation. In the study, 71 crambe genotypes were evaluated. Research result: the length of the plant is between 51.9 and 90.7 cm; number of branches per plant is between 4.1 and 9.5; the number of seeds per plant is from 57.4 to 376.6; 1000 grain weight was found to vary between 5.13 and 12.24 g and grain yield per plant varied from 0.421 g to 2.717 g. The result of the research: it has been determined that the genotypes evaluated have a superior performance in terms of the characters evaluated in total 13 genotypes including 2, 7, 8, 16, 30, 34, 41, 44, 49, 51, 61, 65 and 66 genotype. As a result, it has been decided that these genotypes can be used as a genitor in the development of crambe varieties suited to the Samsun ecological conditions.

***Key words**: Crambe, Crambe abyssinica Hochst, agricultural characters, yield.*

INTRODUCTION

Crambe of the *Brassicaceae* family is originated from the Iranian-Turanian and Mediterranean regions of South-West Asia (Knights, 2002; Özyılmaz et al., 2017). Crambe seeds contain 35-60% oil, 20-40% protein and 12.3% crude fiber. After the oil is removed, the remaining oil cake contains 47.6% fat and 31.6% protein (Van et al., 1990). Crambe is not considered edible oil because it contains high erusic acid. Crambe oil is used in many industrial area such as lubricants, adhesives, plastics, textile industry, synthetic rubber, printer ink, detergent, perfume and motor oil. In addition, crambe is used as an alternative plant in the production of biodiesel, as a renewable energy source. Therefore, crambe is an important plant that contributes to reducing the global warming problem and reducing air pollution caused by fuels (Li et al., 2010).
New oil plants, such as cramble, have to be incorporated into the production system, which is suitable for multipurpose use in order to increase vegetable oil production. When considering climate and soil requirements, there is no factor that prevents the inclusion of crambe plant, which has high adaptability ability, into the agricultural production system. To be included in our agricultural system of crambe plant adaptation experiments in different ecological regions of Turkey must be done. It is extremely important that the suitable crambe genotypes that are eventually identified at the end of these adaptation experiments are introduced into the farm.
For this reason, this research was carried out to determine the yield and some yield components which will be the basis for the adaptation of the crambe genotypes in the "World Crambe Gen Collection" to the Samsun ecological conditions.

MATERIALS AND METHODS

This research was conducted in the Samsun Province, Alaçam District, Geyikkoşan location. The altitude of the experimental area is 4 meters. The soil structure is clay, lime, salt-free, pH is slightly alkaline, organic matter is moderate, phosphorus level is medium and potassium level is high. When the climate data are evaluated as the experiment season and the multiannual average for the experiment area, the data are the followig: the average relative humidity and monthly precipitation during the plant growing season is lower than the multiannual average. Especially the amount of rainfall in July is very low. The average monthly temperature in the plant growing season is approaching the temperature multiannual average.

In this research, as plant material, the 71 crambe genotypes were used (Table 1). The experiment was set up as 4 replications in the Augmented Experimental Design. In the experiment, each line was planted by hand on May 1, 2017, with a length of 2 m, 2 rows, a distance between rows of 30 cm and a distance of 5 cm between plants. Throughout the experiment period, weed control was made manually and mechanically. Because of the inadequate rainfall during the experiment period, irrigation was carried out in the field capacity on 01.07.2017. Harvest was carried out between 26.07.2017 and 12.08.2017, during the period when the varieties reached the stage of physiological maturity. For each lines 10 plants were sampled for analyze for the agronomic characters. Microsoft Computer program was used for evaluating the data and preparing the graphics.

Table 1. *Crambe hispanica* subsp. *abyssinica* lines and their origins

1-PI370747-Turkey	19-NSL74252-USA	37-PI384526-Ames1442-Etiopia	55-PI393515-Russia
2-PI392327-Turkey	20-NSL74251-USA	38-PI384525-Ames1441-Etiopia	56-PI393514-Russia
3-PI392326-Turkey	21-NSL74248-USA	39-PI384524-Ames1440-Etiopia	57-PI393513-Russia
4-PI189139-USA	22-PI378589-USA	40-PI384522-Ames1438-Etiopia	58-PI281736-Russia
5-NSL74278-USA	23-PI533668-USA	41-PI279346Indy-Etiopia	59-PI281735-Russia
6-NSL74272-USA	24-PI533667-USA	42-PI633195-Ames14938-Etiopia	60-PI281734-Russia
7-NSL74270-USA	25-PI533666-USA	43-PI326569BL1067-Etiopia	61-PI281731-Russia
8-NSL74269-USA	26-PI533665-USA	44-PI360893-Sweden	62-PI281730-Russia
9-NSL74267-USA	27-PI514650-USA	45-PI360892-Sweden	63-PI281729-Russia
10-NSL74266-USA	28-PI514649-USA	46-PI360891- Sweden	64-PI392071-Spain
11-NSL74265-USA	29-PI633196-NM 85-USA	47-PI360890- Sweden	65-PI372925-Spain
12-NSL74264-USA	30-NSL77602 PI 305285-USA	48-PI360889- Sweden	66-PI284861-Poland
13-NSL74261-USA	31-PI384533-Ames1435-Etiopia	49-PI305288- Sweden	67-PI311740-Ames1044-Poland
14-NSL74259-USA	32-PI384532-Ames1434-Etiopia	50-PI305287- Sweden	68-PI281737-Ukraina
15-NSL74258-USA	33-PI384531-Ames1433-Etiopia	51-PI305285- Sweden	69-PI337110-Romania
16-NSL74257-USA	34-PI384530-Ames1432-Etiopia	52-PI305284- Sweden	70-PI633198CRA 8/75-Kenya
17-NSL74254-USA	35-PI384529-Ames1431-Etiopia	53-PI305283- Sweden	71-PI633197CR1699-Germany
18-NSL74253-USA	36-PI384527-Ames1429-Etiopia	54-PI247310-Ames1144-Sweden	

RESULTS AND DISCUSSIONS

Plant Height

The distribution of plant lengths of crambe lines evaluated in this study is given in Figure 1. As can be understood from the analyze of Figure 1, average plant height is 68.3 cm; the longest plant height was obtained from genotype 16 with 90.7 cm, while the shortest plant height was obtained from genotype 47 with 51.9 cm. It was determined that as the average of the 71 lines evaluated, 29 genotypes were above the plant length average. These genotypes are; 2, 5, 7, 8, 13, 15, 17, 23, 24, 25, 26, 27, 28, 29, 30, 33, 34, 35, 36, 37, 39, 41, 49, 64, 65, 66 and 68 genotypes. In previous researches in *Crambe hispanica*, plant height was reported to be 40-120 cm (Davis, 1965), 68-128 cm (Weiss, 2000) and 71.40 cm (Tansı et al., 2003). These results are in parallel with the results obtained from this study. However, it is shorter than the reported values of 163.7 cm (Laghetti et al., 1995) and 93.07-103.9 cm (Huang et al., 2013). Differences in plant length are given by the genotype, environmental conditions, sowing time, sowing norm, soil characteristics, cultivation techniques and variety.

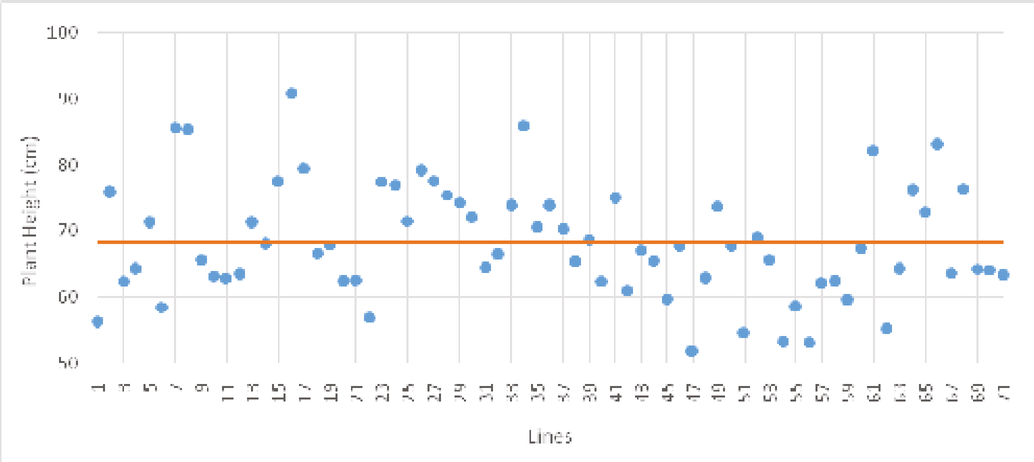

Figure 1. Distribution of plant length data of the lines evaluated in the research

Number of Branches
The distribution of the number of branches per plant in the crambe lines evaluated in this research is given in Figure 2. As can be understood from the analyze of Figure 2, the average number of branches per plant is 6.7. Although the maximum number of branches was obtained from genotype 66 with 9.5, the minimum number of branches was obtained from genotype 54 with 4.1. It was determined that as the average of the 71 lines evaluated, 35 genotypes were above the number of branches average. These genotypes are: 2, 5, 7, 8, 9, 10, 13, 14, 15, 16, 17, 19, 23, 24, 26, 28, 30, 31, 32, 34, 35, 36, 37, 46, 49, 52, 53, 57, 59, 60, 61, 64, 65, 66, 67 and 69 genotypes. The number of branches per plant obtained in this study is higher than the 1.82 (Tansı et al., 2003) reported in previous studies. However, it is lower than 14.1 (Laghetti et al., 1995), 15.0 (Gökçe, 2015) and 16.23-23.8 (Huang et al., 2013). Plant genotype, fertility status of soil, precipitation and number of plants per unit soil determine number of branches per plant.

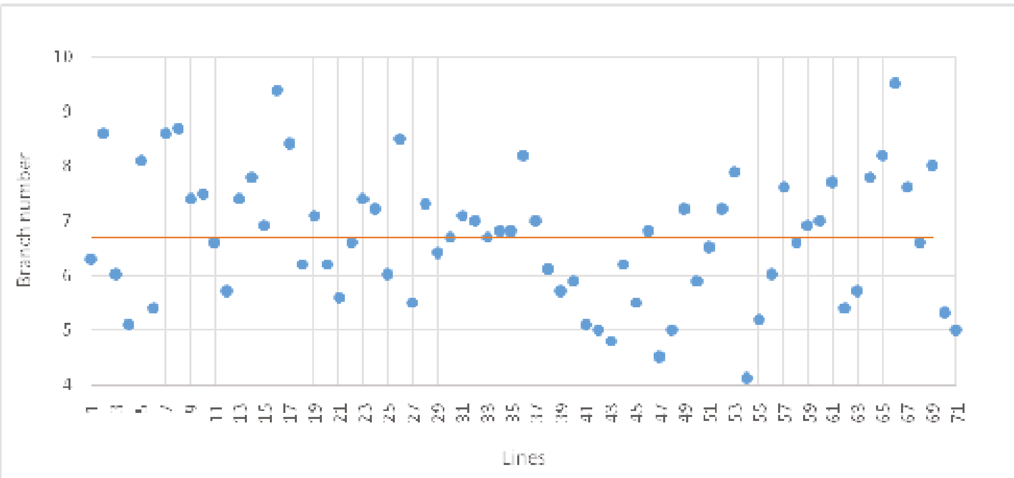

Figure 2. Distribution of data related to branch numbers per plant of the lines evaluated in the research

Seed Number

The distribution of the number of seeds per plant in the crambe lines evaluated in this research is given in Figure 3. As can be understood from the analyze of Figure 3, the average number of seeds per plant is 165.1. Although the maximum number of seeds per plant was obtained from genotype 66 with 376.6, the minimum number of seeds was obtained from genotype 54 with 57.4. It was determined that as the average of the 71 lines evaluated, 29 genotypes were above the number of seeds average. These genotypes are: 2, 5, 7, 8, 10, 13, 14, 15, 16, 17, 18, 19, 32, 33, 35, 36, 41, 49, 50, 53, 54, 57, 58, 61, 64, 65, 66, 68 and 69 genotypes. In previous studies, the number of seeds per plant was reported to be 379 (Köybaşı, 2008), 5250.2 (Tansı et al., 2003) and 1003.71-2397.8 (Huang et al., 2013). These reported values are higher than the values obtained from this research. It has been determined that there is a wide variation in the number of seeds per plant. This variation and the wide range of geographical distribution of cramba lines evaluated is the result of differences in adaptation to growing conditions as well as genetic factors and differences in environmental factors. Besides the environmental conditions, the number of seeds per plant also affects the flowering and branching of the plant. Although thousands of flowers per plant are formed in crambe and mostly self fertilization is observed, fertilization is adversely affected especially due to external factors in summer sowing.

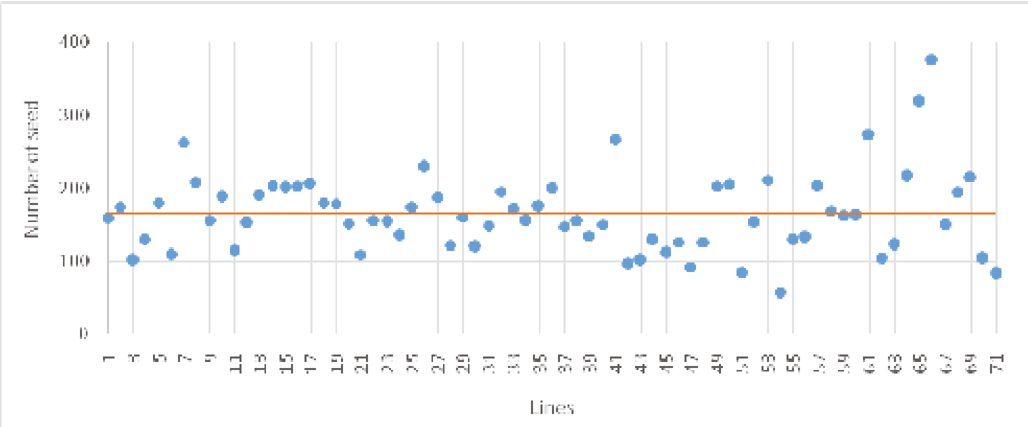

Figure 3. Distribution of data related to seeds numbers per plant of the lines evaluated in the research

1000-Grain Weight

The distribution of the 1000-grain weight in the crambe lines evaluated in this research is given in Figure 4. As can be understood from the analyze of Figure 4, the average 1000-grain weight is 6.93 g. Although the maximum 1000-grain weight was obtained from genotype 30 with 12.24 g, the minimum 1000-grain weight was obtained from genotype 26 with 5.13 g. It was determined that as the average of the 71 lines evaluated, 30 genotypes were above the number of seeds average. These genotypes are: 3, 5, 6, 8, 9, 12, 13, 18, 19, 20, 27, 28, 30, 36, 37, 42, 43, 44, 45, 49, 50, 51, 53, 55, 59, 61, 62, 64, 65 and 66 genotypes. In previous studies, the 1000-grain weight was reported to be 6.8 g (Fontana et al., 1998), 5.7 g (Wang et al., 2000), 6.3 g (Lara-Fioreze et al., 2013), 4.86-6.86 g (Huang et al., 2013) and 2.6-8.5 g (Arslan et al., 2014). These reported values are in parallel with the results obtained in this study.

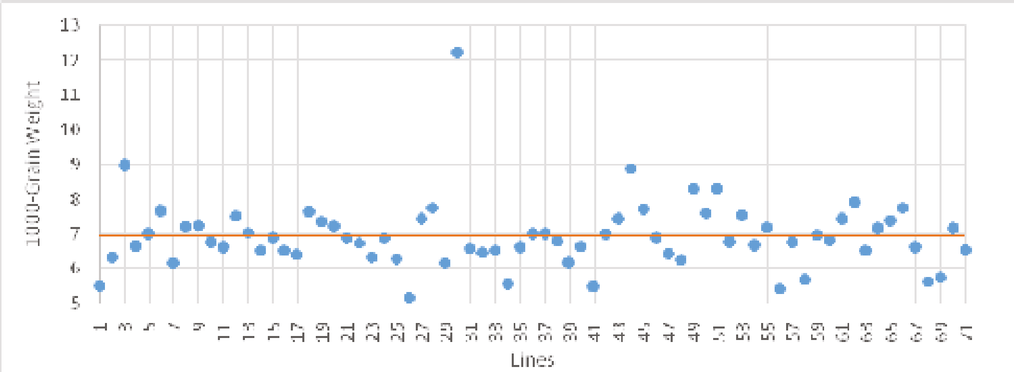

Figure 4. Distribution of data related to 1000-grain weight of the lines evaluated in the research

Grain Yield

In our experiment, the crambe lines showed great variations with respect to grain yield per plant as well as to the agronomic traits. The distribution of the grain yield in the crambe lines evaluated in this research is given in Figure 5. As can be understood from the analyze of Figure 5, the average grain yield is 1.138 g. Although the highest grain yield was obtained from genotype 66 with 2.717 g, the lowest grain yield was obtained from genotype 54 with 0.421 g. It was determined that as the average of the 71 genotypes evaluated, 31 genotypes were above the grain yield average. These genotypes are: 2, 5, 7, 8, 10, 12, 13, 14, 15, 16, 18, 19, 25, 26, 28, 32, 34, 35, 36, 41, 49, 50, 53, 57, 58, 61, 64, 65, 66, 68 and 69 genotypes. The grain yield obtained in this study was lower than the reported value of 4.98-13.91 g (Huang et al., 2013), although it is consistent with the previously reported values of 0.8-5.1 g (Arslan et al., 2014).

Grain yield is the most important herbal character in agricultural terms.

Genotype, environmental conditions and cultivation techniques have direct effects on grain yield.

Therefore, the positive or negative situation that affects any one of these yield components directly affects the grain yield.

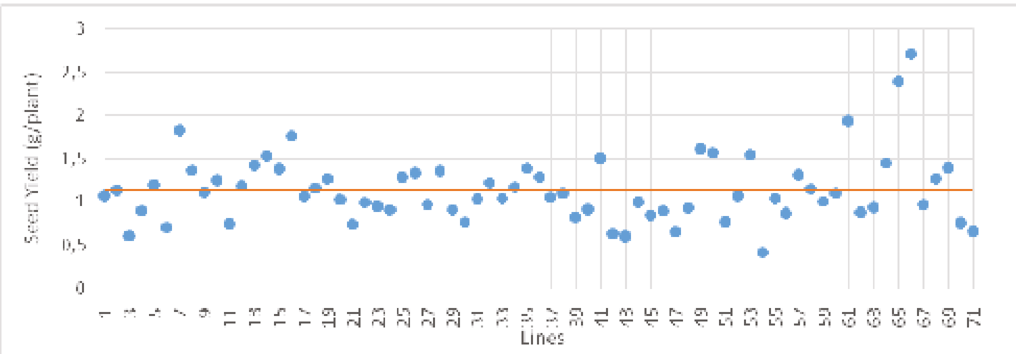

Figure 5. Distribution of data related to seed yield of the lines evaluated in the research

CONCLUSIONS

Research result: the length of the plant is between 51.9 and 90.7 cm; number of branches per plant is between 4.1 and 9.5; the number of seeds in the plant is from 57.4 to 376.6; 1000 grain weight was found to vary between 5.13 and 12.24 g and grain yield varied from 0.421 g to 2.717 g. It has been determined that the genotypes evaluated have a superior performance in terms of the characters examined in total 13 lines including 2, 7, 8, 16, 30, 34, 41, 44, 49, 51, 61, 65 and 66 genotype. As a result, it has been decided that these genotypes can be used as a genitor in the development of crambe varieties suited to the Samsun ecological conditions.

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