

## Investigation of some Yield Characteristics of Hemp (*Cannabis sativa* L.) in Tokat Ecology

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**Abstract:** The hemp plant has two important products in terms of use, one is the stems and fibers obtained from them, the other is the seeds and oil. In this study was aimed to determine some yield characteristics of hemp varieties and populations in Tokat ecological conditions. In the experiment, five local hemp populations and two industrial type hemp cultivars were used as materials. The trial was carried out in 2019 with three replications according to the Randomized Block Trial Design. According to the research results; plant height values ranged from 50.40 cm to 363.35 cm, stem thickness from 4.32 to 16.77 mm, technical stem length from 5.10 cm to 246.60 cm, dry stem yield from 82.54 kg da<sup>-1</sup> and 3143.75 kg da<sup>-1</sup>, fiber yield from 29.64 kg da<sup>-1</sup> and 638.76 kg da<sup>-1</sup>, seed yield from 72.98 kg da<sup>-1</sup> and 474.87 kg da<sup>-1</sup>. According to the average findings, the populations Narlısaray were identified as the best in a result of investigated all traits.

**Keywords:** *Cannabis sativa* L., hemp, population, variety, stem yield, fiber yield

### Introduction

The hemp is a one-year industrial plant of *Cannabis sativa* L. species and *Cannabis* genus belonging to the *Cannabinaceae* family. Hemp can be grown as a fiber, seed, or dual-purpose crop. Hemp, whose homeland is Central Asia, is widely found in nature (Warf, 2014). Fiber is obtained from the stems of the plant and oil from the seed. It is one of the oldest fiber plants used by humans since ancient times in various parts of the world. The hemp has a tap root. Tap roots can reach a depth of 3-4 m under suitable moisture and soil conditions. Cannabis stems have a structure that is 4-25 mm thick and its length can vary up to 0.5-6 meters depending on the climate and variety characteristics. Female plants have thicker stems, longer plants and higher fiber yields than male plants. The highest quality fibers in hemp are obtained from the part called technical handle length. Hemp leaves are composed of 3-11 narrow leaflets joining together on a stalk at the bottom and the same point with their shorter lengths, the longest in the middle. The edges of the leaves are toothed. Leaflets are the most in the middle of the stem. Hemp is a dioecious plant. So male and female flowers are found in separate plants. However, it also exists in monoecious forms. In male flowers, there are 3 outer (protective) leaves, 5 male organs (stamens) in them. Female flowers are located on short stalks from the leaf seats at the top of the stem in female plants. Foreign fertilization is observed in the cannabis plant. Cannabis seeds can be 3-6 mm long, 2-4 mm wide, grayish-brown, blackish-brown, greenish-brown, and have a very thin skin. Hemp has a grain weight of 9-27 g and contains 20-30% oil in its seed. (Ronde, 2013; NASEM, 2017; Baldini *et al.*, 2018; ORAN, 2019; Gizlenci *et al.*, 2019; Anonymous, 2020). In the study conducted in 2015 to determine the adaptation and yield potentials of cannabis varieties in the South-western Colorado Research Centre, the biomass yield of 12 cannabis varieties is 3789 lb/acre, the seed yield is 25-519 lb/acre, the stem yield is 2415- 4848 lb/acre, stalk thickness is determined as 4.8-8.0 mm, plant height is 44-77 inches. (Berrada *et al.*, 2019).

Hemp fibers are most often used in fabrics and textiles, making rope, tether, sack, yarns, paper, carpeting, home furnishings, construction and insulation materials, auto parts, and composites. Weaves with touristic value are knitted from finer hemp fibers. The leftovers after the fibers are removed can be used as fuel. Hemp seed and oil obtained from the seeds are used in a range of foods and beverages also in soap, cosmetics and dyeing. The pulp leftover from the seeds after the oil is taken is used in animal nutrition. Hemp is also used as biodiesel raw material. (Gurel *et al.*, 2000; CRS, 2017).

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Tetrahydrocannabinol (THC) and cannabidiol (CBD) are the two naturally occurring cannabinoids. In hemp produced for industrial purposes, the THC rate should be legally below 0.3% (Canada) and below 0.2% in the European Union. The use of THC and CBD in medicine has been used in the treatment of cancer pain, depression, anxiety disorders, sleep disorders, neurological disorders, childhood epilepsy, AIDS-related appetite-enhancing and intestinal diseases or relieving symptoms (EMCDDA, 2018; NASEM, 2017). This study was carried out to determine the some yield characteristics of hemp varieties and populations in Tokat ecological conditions.

### Material and Method

Five local hemp populations of our country (Narlısaray, Kavacık, Kartal, Maltepe and Van) and two industrial type hemp cultivars (Fedora 17 and Finola) were used as materials in this experiment. The trial was carried out in the trial field of Gaziosmanpaşa University, Agricultural Application and Research Center under the conditions of Tokat in 2019 vegetation period. Soil preparation was done by the conventional method with plow and harrow. The trial was carried out in three replications according to the Randomized Block Trial Design with 5 meter length, 3 rows, 20 cm row spacing and approximately 150 plants per m<sup>2</sup>. Sowing was done manually to the rows opened with the marker. Fertilizer was applied in the amount of 10 kg da<sup>-1</sup> of nitrogen (N) and 8 kg da<sup>-1</sup> phosphorus fertilizer P<sub>2</sub>O<sub>5</sub> (Ozdemir, 1993). Nitrogen was accomplished in two equal doses. At sowing half and the other half was given in the middle of May. The crop was irrigated 4 times with a drip system, the harvest was done by hand, at the stage of seed maturity. The data of the properties examined in the study were taken from male and female hemp plants during the plant seed maturity period. During the growing season of hemp (May to October), the sum of precipitation amounted to 149.7 mm in 2019. Air temperatures were mean 20.48 °C during the growing season (Table 1). In the sample the soil taken from the experiment area, organic matter is 0.97% (less), lime is 10.38% (medium-lime), phosphorus is low with 3.03 (kg da<sup>-1</sup>), potassium is sufficient (Table 2). Analyses of variance were performed with the statistical program JMP. In the study, plant height, stem thickness, technical stem length, dry stem yield, fiber yield and seed yield values were determined.

**Table 1.** Climatic conditions during the growing season of hemp at Tokat in 2019\*

Month	May	June	July	August	September	October	Mean	Total
Total rainfall (mm)	49.1	26.2	16.9	52.2	1.6	3.7	-	149.7
Minimum temperature (°C)	6.7	14.9	9.7	12.2	4.1	5.9	8.9	
Maximum temperature (°C)	34.8	33.5	38.7	38.0	30.9	31.3	34.5	
Mean temperature (°C)	19.1	23.1	21.9	22.4	19.0	17.4	20.4	

\*Tokat Meteorology Directorate, (2019)

**Table 2.** Physical and chemical properties of soil of the trial area\*

Years	Soil depth (cm)	Total salt (%)	Lime (%)	Organic Matter (%)	Phosphorus P <sub>2</sub> O <sub>5</sub> (kg/da)	Potassium K <sub>2</sub> O (kg/da)	Structure	pH	EC
2019	0-30	0.02	15.38	0.97	3.03	50.11	Clayey	7.62	0.47

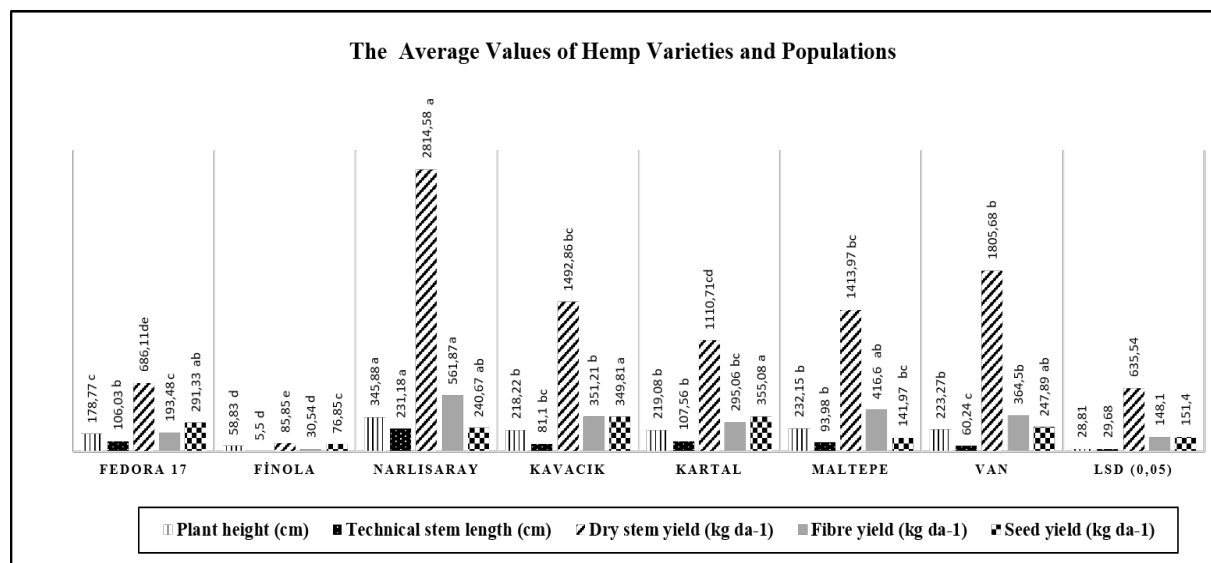
\*The analyses were carried out in the soil analysis laboratory of the Directorate of Middle Black Sea Transition Zone Agricultural Research Institute

### Results and Discussion

The results of the variance analysis showed that plant height, stem thickness, technical stem length, dry stem yield, fiber yield and seed yield values were found to be significant at (p ≤ 0.01 and 0.05) differences among hemp cultivars and populations. This indicated that there was a variation in varieties and populations (Table 3).

Plant height values ranged from 50.40 cm to 363.35 cm, with an average of 206.69 cm in hemp cultivars and populations. The average plant height was found as 118.80 cm in the varieties and 247.71 cm in the populations (Table 4). The highest plant height was found in population Narlısaray, while the lowest was in Finola varieties (Figure 1). Ceh (2018) reported that plant height was found to be 1.0-2.3 m in seed maturation period of USO 31 and 55-80 cm in the cultivar Finola. The highest were varieties of Carmagnola and KC Dora, which reached up to 3.4 m and 3.0 m, respectively. These results were similar to the data of our study. In a two-year study conducted in eight monoecious

cannabis varieties, the plant height average was 134-237 cm, the 1000 seed weight was 5.7-9.8 g, and the seed yield was 0.36-0.79 t / ha<sup>-1</sup> (Baldini *et al.*, 2018).



**Figure 1.** The average values of hemp varieties and populations

**Table 3.** Results of statistical analysis related to the mean squares and significance levels in hemp varieties and populations

Variation Sources	SD	Plant height (cm)	Stem thickness (mm)	Technical stem length (cm)	Dry stem yield (kg da <sup>-1</sup> )	Fiber yield (kg da <sup>-1</sup> )	Seed yield (kg da <sup>-1</sup> )
C. Total	20	6630.3	15.96	4414.1	764318.7	30364.8	14309.7
Var/Pop	6	21551.1**	50.20**	14088.7**	2236507.3**	85550**	32073.5*
Repeats	2	62.95	1.10	188.6	161627.5	5064.5	3062.5
Error	12	264.6	1.32	281.1	128673	6988.9	7302.2
CV(%)		7.71	9.53	17.11	26.68	26.43	35.11

**Table 4.** The mean values and groupings of hemp varieties and populations for each property

Varieties/Populations	Plant height (cm)	Stem thickness (mm)	Technical stem length (cm)	Dry stem yield (kg da <sup>-1</sup> )	Fiber yield (kg da <sup>-1</sup> )	Seed yield (kg da <sup>-1</sup> )
Means						
Fedora 17	178.77c	8.67c	106.03b	686.11de	193.48c	291.33ab
Finola	58.83d	4.41d	5.50d	85.85e	30.54d	76.85c
Narlisaray	345.88a	14.88a	231.18a	2814.58a	561.87a	240.67ab
Kavacık	218.22b	14.48a	81.10bc	1492.86bc	351.21b	349.81a
Kartal	219.08b	12.31b	107.56b	1110.71cd	295.06bc	355.08a
Maltepe	232.15b	13.97ab	93.98b	1413.97bc	416.60ab	141.97bc
Van	223.27b	15.66a	60.24c	1805.68b	364.50b	247.89ab
LSD (0.05)	28.81	2.01	29.68	635.54	148.10	151.40

In the study, stems thickness values ranged between 4.32-16.77 mm, and 14.25 mm on average. The average values of the populations were found higher than the varieties. Average stems thickness was found as 6.54 cm in the varieties and 11.80 mm cm in the populations (Table 4). The highest and the lowest stem thickness were found in population Van followed by Kavacık and variety Finola, respectively.

Technical stem length was found to range between 5.10 cm and 246.60 cm and the average was determined as 114.81 cm. The values of technical stem length in populations and varieties were determined as 96.02 and 55.76 cm, respectively. The highest technical stem length was found in population Narlısaray followed by Kartal, while the lowest was in Finola varieties (Figure 1).

Dry stem yield values ranged between 82.54 kg da<sup>-1</sup> and 3143.75 kg da<sup>-1</sup> with an average of 1727.56 kg da<sup>-1</sup>. The stem yield in the varieties was found to vary between 82.54 kg da<sup>-1</sup> and 718.75 kg da<sup>-1</sup>. In populations ranged from 810.64 kg da<sup>-1</sup> to 3143.75 kg da<sup>-1</sup> (Table 4). The highest stem yield

was found in population Narlısaray followed by Van, while the lowest was in Finola varieties. Ceh (2018) determined the highest yield of Carmagnola as 18 t ha<sup>-1</sup>, KC Dora as 14 t ha<sup>-1</sup>, and Kompolti Hybrid TC as 11.5 t ha<sup>-1</sup>. Flajman *et al.* (2016), identified the highest stem yield in Cannabis varieties (Fedora 17, Santhica 27, Futura 75, KC Dora, Finola, Kompolti hybrid TC and Monoica) as 3248 kg ha<sup>-1</sup> (dry matter) and seed yield 1573 kg ha<sup>-1</sup>. Kocjan Acko *et al.* (2002) reported that the effect of variety and seed amount on cannabis in hemp is important. Incekara (1971) determined the seed yield as 25-50 kg da<sup>-1</sup> in fiber hemp and 80-100 kg da<sup>-1</sup> in seed type hemp. Berrada *et al.* (2019) carried out to determine the adaptation and yield potentials of cannabis varieties, biomass yield of 13 cannabis varieties carried out in 2015 is between 4185-8283 lb/acre, stalk yield is 2577-5707 lb/acre, seed yield is 240-1041 lb/acre, plant height is 44 -78 inch, handle thickness was determined as 5-9 mm.

Fiber yield ranged between 29.64 kg da<sup>-1</sup> and 638.76 kg da<sup>-1</sup>, and 397.84 kg da<sup>-1</sup> on average. Average fiber yield was found as 112.01 kg da<sup>-1</sup> in the varieties and 306.89 kg da<sup>-1</sup> in the populations. The highest fiber yield was found in population Narlısaray followed by Van, while the lowest was in Finola varieties (Figure 1).

Seed yield was determined between 72.98 kg da<sup>-1</sup> and 474.87 kg da<sup>-1</sup>, with an average of 267.08 kg da<sup>-1</sup>. Average seed yield in populations and varieties was found to be 184.09 kg da<sup>-1</sup> and 240.67 kg da<sup>-1</sup> respectively. The highest seed yield was found in population Kavacık followed by Kartal, while the lowest was in Finola varieties. Deleuran and Flengmark (2005) reported that the total average dry matter yield of the cultivars Fedora, Fedrina, Felina, and Futura was approximately 13 t ha<sup>-1</sup> and for Fasamo approximately 9 t ha<sup>-1</sup>. The average fiber yields were 2.9 and 1.7 t ha<sup>-1</sup>, respectively, the average seed yield over a period of 3 years was approximately 500 kg ha<sup>-1</sup>.

## Conclusion

In this study, were used two standard varieties and five local populations. The experiment was conducted in 2019. In this study were examined some yield characteristics of hemp varieties and populations and appropriate populations and varieties were determined according to some yield characteristics in Tokat ecological conditions. The research findings in this paper indicate that hemp has the potential to be grown in Tokat for both fiber and seeds. The performance of the populations was found to be higher than the varieties in all the characteristics studied. According to the average findings, the populations Narlısaray were identified as the best in a result of investigated all traits. Plant length, stem thickness, technical stem length, dry stem yield and fiber yield values of the Narlısaray population showed superior performance compared to others. The seed yield values of Kartal and Kavacık populations were higher. Therefore, they could be considered in cultivation and further breeding studies.

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