The Determination of Plant Nutrients Taken from Soil of Black Cumin (*Nigella sativa* L.) as Traditional Spice

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Abstract: This study was carried out under Çumra-Konya conditions, in 2007, for the determination of consumption of the plant nutrients from soil by black cumin plants. The soil samples were taken before sowing and after harvest from the field that was sown black cumin and determined the rate of major and minor plant nutrients. For this reason, soil samples were taken from the depth of 30 cm as 2-3 kg and analyzed. The harvested black cumin yielded approximately 1,350 kg/ha seed. The analyses made in soil samples were pH, salinity, organic matter and lime, P, K, Ca, Mg, Na, Cu, Fe, Zn and Mn. According to the results, the parcel soil has not salt problem, and is little alkaline, more limy and little humic, good for phosphorus and very rich with respect potassium before sowing. At the same time, the parcel soil samples after harvest were little saline, little alkaline, more limy, poor humic, good for phosphorus and very rich with respect potassium.

Key words: Black cumin, soil analyses, plant nutrient, Konya.

1. Introduction

The black cumin, *Nigella sativa* L. has been shown to contain 30% of fixed oil and 0.4%-0.45% volatile oil. The volatile oil has been shown to contain 18.4%-24% thymoquinone and 46% monoterpenes such as p-cymene and α -piene [1]. This plant which grows to a maximum height of about 60 cm, has finely divided foliage and blue flowers from which are produced small caraway-type black seeds [2]. The plant has been found to be salt tolerant and may be considered as glycophyte [3].

Black cumin tastes slightly bitter and peppery with a crunchy texture. Seeds are angular of generally small size (1-5 mg), dark grey or black color [4]. *N. sativa* seeds are used for edible and medicinal purposes in many countries like Turkey.

Black cumin seeds have been used as a condiment in bread and other dishes, and they have also been used in the preparation of a traditional sweet dish, composed of

black cumin paste, which is sweetened with honey or syrup, and in flavoring of foods, especially bakery products and cheese. *N. sativa* seed oil is considered as one among newer sources of edible oils, thanks to its important role in human nutrition and health [5-7].

Seed of *Nigella sativa* L., an annual spice which is also known as black cumin or black caraway, is a member of the Ranunculaceae family and native to some parts of the Mediterranean region. These seeds are not related to cumin or caraway, both of which belong to the Umbelliferous family [8]. The seeds are used for edible and medicinal purposes in many countries including India, Egypt and Syria. Recently, many medicinal properties have been attributed to the black cumin seeds and/or its oil, including antineoplastic (antitumor), antibacterial, antifungal and antihelmenthic properties [9-11]. More recently, a great deal of attention has been given to the black cumin seeds and their oil, and their consumption has thus increased, especially in Middle East countries. But there are few studies of the oil characteristics and fatty acid composition of black cumin.

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Gad et al. [12] studied the physical and chemical characteristics and fatty acid composition of the oil extracted from the Egyptian *Nigella sativa* L.. According to their study, the saturated fatty acids constituted 11.8% of total fatty acids and consisted of myristic, palmitic and stearic acids, while the spectrophotometric determination of the unsaturated acids showed the presence of oleic (48.76%), linoleic (37.56%) and linolenic (1.88%) acids.

The spicy seeds from this plant have proclaimed medicinal usage dating back to the ancient Egyptians, Greeks and Romans. In his Canon of Medicine, Avicenna stated that the black seed acts as an expectorant, it stimulates the body's energy and helps recovery from fatigue and dispiritedness. In Islamic medicine, however, the use of the seeds is recommended in daily use because it has prophesised cure for all known diseases [13, 14].

The aim of this study was to determine which and how many major and minor plant nutrients were taken from soil by black cumin under Konya (Central Anatolia) conditions. Accordingly, some recommendations will be done to the black cumin producers in Konya and other regions.

2. Materials and Methods

2.1 Materials

Black cumin samples were taken as material from different regions which produce black cumin via Konya Commerce Chamber. This study was planned on the experimental plots at the Selcuk University, Cumra Vocational College in Konya, in 2007.

2.2 Methods

The seed samples were sown regarding to randomized block design with three replications. Before sowing, the soil samples were taken from the planned parcels to sow black cumin.

The soil samples were taken according to the soil sampling rules. Therefore, first of all, upper layer by 4-5 cm of soil was removed and a soil layer by 30 cm

depth was taken by a shovel. All the samples were mixed and filled to plastic bags. Then, these samples were transferred for analysing to the laboratory. This process was replicated after harvest.

2.3 Data Analysis

The data related to plant yield collected from all the parcels, were evaluated as mean value and represented in this paper. Other data related to soil sample analysis were collected and evaluated separately before sowing and after harvest. Then, the data collected from soil parcel before sowing were compared with the data from after harvest.

3. Results and Discussion

As it is understood in Tables 1 and 2, there is not salt problem on this parcel soil. It is little alkaline, but more limy and little humic. The phosphorus level among essential plant nutrients is good and potassium level is very high. Because it is more limy, it is expected that calcium is rich in the soil. Also, the soil is good in terms of magnesium, it has enough copper and manganese, which are minor plant nutrients, but it has deficiency in terms of iron and zinc elements.

As it is seen in Table 2, the soil of this parcel has no salt problem, it is little alkaline, more limy and little humic with regards to organic matter. The phosphorus level among essential plant nutrients is good and very rich with respect potassium. Because the soil is more limy, it is rich with regard calcium. It is seen that the soil with good level of magnesium, has enough copper and manganese, but the iron level is middle and it has not enough zinc.

Cheikh-Rouhou et al. [7] conducted some trials related to the chemical components of both Tunisian and Iranian black cumin seeds. According to the results, some characters and minerals ratio in the seeds are: dry matter (91.35 ± 0.26 %)-(95.92 ± 0.70)%; oil (28.48 ± 0.05 %)-(40.35 ± 0.16)%; crude protein (26.7 ± 0.35 %)-(22.6 ± 0.24)%; ash (4.86 ± 0.06 %)-(4.41 ± 0.01)%; K (783 ± 6.61) ppm-(708 ± 7.98) ppm; Mg (235 ± 4.87) ppm-(260 ± 48.70) ppm;

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Table 1 The analysis results of soil samples of black cumin parcels before sowing (30 cm depth).

Parcel 7				2007.03.16
Analysis	Unit	Method	Result	Comment
pH (1:2.5, soil:water)		1:2.5	7.62	Little alkaline
EC (salt) (1:5, soil:water)	μS/cm	1:5	168	No salt
CaCO ₃ (lime)	%	Calsimeter	19.1	More limy
Organic matter	%	W. Black	1.113	Little humic
Phosphor (P ₂ O ₅)	mg/kg	NaHCO ₃ ext.	8.95	Good
Potassium (K)	mg/kg	A.Ac. ext.	744.96	Very rich
Calcium (Ca)	mg/kg	A.Ac. ext.	6,513	Rich
Magnesium (Mg)	mg/kg	A.Ac. ext.	1,070	Good
Sodium (Na)	mg/kg	A.Ac. ext.	58.31	Low
Copper (Cu)	mg/kg	DTPA ext.	1.165	Enough
Iron (Fe)	mg/kg	DTPA ext.	2.201	Deficient
Zinc (Zn)	mg/kg	DTPA ext.	0.191	Deficient
Manganese (Mn)	mg/kg	DTPA ext.	3.411	Enough

Table 2 The analysis results of soil samples of black cumin parcels before sowing (30 cm depth).

Parcel 8				2007.03.16
Analysis	Unit	Method	Result	Comment
pH (1:2.5, soil:water)		1:2.5	7.83	Little alkaline
EC (salt) (1:5, soil:water)	μS/cm	1:5	162	No salt
CaCO ₃ (lime)	%	Calsimeter	20.5	More limy
Organic matter	%	W. Black	1.26	Little humic
Phosphor (P ₂ O ₅)	mg/kg	NaHCO ₃ ext.	14.03	Rich
Potassium (K)	mg/kg	A.Ac. ext.	738.72	Very rich
Calcium (Ca)	mg/kg	A.Ac. ext.	7,860	Rich
Magnesium (Mg)	mg/kg	A.Ac. ext.	1,197	Good
Sodium (Na)	mg/kg	A.Ac. ext.	97.12	Low
Copper (Cu)	mg/kg	DTPA ext.	1.196	Enough
Iron (Fe)	mg/kg	DTPA ext.	3.939	Middle
Zinc (Zn)	mg/kg	DTPA ext.	0.171	Deficient
Manganese (Mn)	mg/kg	DTPA ext.	3.614	Enough

Ca (572 ± 21.5) ppm-(564 ± 33.4) ppm; P (48.9 ± 0.04) ppm-(51.9 ± 0.01) ppm; Na (20.8 ± 2.21) ppm-(18.5 ± 3.17) ppm; Fe (8.65 ± 0.65) ppm-(9.42 ± 0.88) ppm; Cu (1.65 ± 0.03) ppm-(1.48 ± 0.21) ppm; Zn (8.04 ± 0.21) ppm-(7.03 ± 0.49) ppm and Mn (4.43 ± 0.11) ppm-(3.37 ± 0.21) ppm, respectively.

The information expressed till here was for seeing the plant nutrients in the soil before sowing black cumin. The soil samples were taken after harvest as well, to understand if the amounts of the plant nutrients changed or not, and if they changed, which direction was realized for this changing. According to soil sample rules, all the soil samples from parcels were

mixed and packed as 2-3 kg in the nylon bags. These samples were transferred to the Sample Analyse Laboratory at the Konya Commodity Exchange Market. The data taken from the analyses were represented in the tables below (Tables 3 and 4).

As it is seen in Table 3, according to the analyse results, it is understood that the soil is little saline and little alkaline. It is more limy and poor humic as well. The phosphorus level among essential plant nutrients is good and very rich with respect potassium. The soil, which is rich with regards calcium, is good in terms of magnesium, enough for copper and manganese, but is also poor with respect iron and zinc.

Table 3 The analysis results of soil samples of black cumin parcels after harvest.

Parcel 7				2007.09.10
Analisis	Unit	Method	Result	Comment
pH (1:2.5, soil:water)		1:2.5	7.66	Little alkaline
EC (salt) (1:5, soil:water)	μS/cm	1:5	232	Little saline
CaCO ₃ (lime)	%	Calsimeter	20.24	More limy
Organic matter	%	W. Black	0.54	Poor
Phosphor (P ₂ O ₅)	mg/kg	NaHCO ₃ ext.	10.22	Rich
Potassium (K)	mg/kg	A.Ac. ext.	630.6	Very rich
Calcium (Ca)	mg/kg	A.Ac. ext.	7,429	Rich
Magnesium (Mg)	mg/kg	A.Ac. ext.	836.8	Good
Sodium (Na)	mg/kg	A.Ac. ext.	52.72	Low
Copper (Cu)	mg/kg	DTPA ext.	1.765	Enough
Iron (Fe)	mg/kg	DTPA ext.	1.278	Deficient
Zinc (Zn)	mg/kg	DTPA ext.	0.438	Deficient
Manganese (Mn)	mg/kg	DTPA ext.	4.625	Enough

Table 4 The analysis results of soil samples of black cumin parcels after harvest.

Parcel 8				2007.09.10
Analisis	Unit	Method	Result	Comment
pH (1:2.5, soil:water)		1:2.5	7.49	Little alkaline
EC (salt) (1:5, soil:water)	μS/cm	1:5	191	Little saline
CaCO ₃ (lime)	(%)	Calsimeter	21.45	More limy
Organic matter	(%)	W. Black	0.97	Poor
Phosphor (P ₂ O ₅)	mg/kg	NaHCO ₃ ext.	12.76	Rich
Potassium (K)	mg/kg	A.Ac. ext.	697.44	Very rich
Calcium (Ca)	mg/kg	A.Ac. ext.	7,578	Rich
Magnesium (Mg)	mg/kg	A.Ac. ext.	967.2	Good
Sodium (Na)	mg/kg	A.Ac. ext.	82.78	Low
Copper (Cu)	mg/kg	DTPA ext.	1.507	Enough
Iron (Fe)	mg/kg	DTPA ext.	1.055	Deficient
Zinc (Zn)	mg/kg	DTPA ext.	0.335	Deficient
Manganese (Mn)	mg/kg	DTPA ext.	4.037	Enough

Comparing the soil analysis before sowing with that after harvest, it is seemed that black cumin used up more iron and manganaese, which are minor plant nutrients, and not more phosphorus and potassium, which are essential plant nutrients.

As it is understood from Table 4, according to the results of another after harvest parcel, the soil is little alkaline, little saline, more limy and enough for organic matter. The phosphorus level among essential plant nutrients is very good and very rich with respect potassium. The soil is determined rich in terms of calcium and magnesium, enough for copper and manganese, but poor for iron and middle for zinc.

The analysis results of soil sample before sowing and after harvest were represented as a table below. Some comments were done regarding droughtness in Turkey, in 2007. The best black cumin line yielded 1,350 kg/ha and this yield was realized with one time irrigation. The rainfall is almost not seen during, before and after blooming including sowing time. This situation came into being huge yield problem by cultivated plants including black cumin in the whole country. But the enough plant samples having parcels were selected and yields were measured on these parcels. Because the soil samples were taken from each parcel, and the experimental error related to soil

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sample analysis was reduced to minimum.

As a conclusion, Tables 5 and 6 would give some information about some plant nutrients taken from soil by black cumin.

As seen in Table 5, the phosphorus among basic plant nutrients decreased to 7.68 mg/kg after harvest, while it was found 8.95 mg/kg in the soil before sowing. Also potassium decreased to 732.24 mg/kg from 744.96 mg/kg, and the iron among minor plant nutrients decreased to 1.405 mg/kg from 2.201 mg/kg, too.

As it is understood from Table 6, some elements such as phosphorus, potassium and calcium taken by

black cumin came to the fore as regards other plant nutrients comparison to other parcels. Among the plant nutrients, phosphorus, potassium and calcium decreased from 14.03 mg/kg to 13.61 mg/kg, 738.72 mg/kg to 561.84 mg/kg and 7,860 mg/kg to 7,724 mg/kg, respectively. The minor plant nutrients, iron and manganese decreased from 3,939 mg/kg to 1.650 mg/kg and 3,614 mg/kg to 2.424 mg/kg, respectively.

As a conclusion, in comparison of soil analyses before sowing and after harvest, it is understood that the black cumin took more iron and manganese from soil, and phosphorus and potassium were taken more

Table 5 The situation of plant nutrients in the black cumin sown soil before sowing and after harvest.

Analysis	2007.03.16			2007.09.10	
	Before sowing			After harvest	
	Unit	Result	Comment	Result	Comment
pH (1:2.5, soil:water)		7.62	Little alkaline	7.5	Little alkaline
EC (salt) (1:5 soil:water)	µS/cm	168	No salt	210	Little saline
CaCO ₃ (lime)	%	19.1	More limy	21	More limy
Organic matter	%	1.113	Low humic	1.38	Low humic
Phosphorus (P ₂ O ₅)	mg/kg	8.95	Good	7.68	Good
Potassium (K)	mg/kg	744.96	Very rich	732.24	Very rich
Calcium (Ca)	mg/kg	6,513	Rich	7,752	Rich
Magnesium (Mg)	mg/kg	1,070	Good	1,155	Good
Sodium (Na)	mg/kg	58.31	Low	175.2	Low
Copper (Cu)	mg/kg	1.165	Enough	1.838	Enough
Iron (Fe)	mg/kg	2.201	Deficient	1.405	Deficient
Zinc (Zn)	mg/kg	0.191	Deficient	0.386	Deficient
Manganese (Mn)	mg/kg	3.411	Enough	6.936	Enough

Table 6 The situation of plant nutrients in the black cumin sown soil before sowing and after harvest.

Analysis	2007.03.16			2007.09.10	
	Before sowing			After harvest	
	Unit	Result	Analysis	Result	Analysis
pH (1:2.5, soil:water)		7.83	Little alkaline	7.55	Little alkaline
EC (salt) (1:5, soil:water)	µS/cm	162	No salt	455	Saline
CaCO ₃ (lime)	%	20.5	More limy	52.72	More limy
Organic matter	%	1.26	Low humic	1.31	Low humic
Phosphorus (P ₂ O ₅)	mg/kg	14.03	Rich	13.61	Rich
Potassium (K)	mg/kg	738.72	Very rich	561.84	Very rich
Calcium (Ca)	mg/kg	7,860	Rich	7,724	Rich
Magnesium (Mg)	mg/kg	1,197	Good	1,411	Good
Sodium (Na)	mg/kg	97.12	Low	412.4	Little
Copper (Cu)	mg/kg	1.196	Enough	1.682	Enough
Iron (Fe)	mg/kg	3.939	Middle	1.650	Deficient
Zinc (Zn)	mg/kg	0.171	Deficient	0.602	Middle
Manganese (Mn)	mg/kg	3.614	Enough	2.424	Enough

by black cumin among essential plant nutrients.

But this experiment does not represent all central Anatolia conditions. Therefore, the same experiments related this topic should replicate under other similar ecological conditions. Because the soil properties may change even in the same field and therefore this experiment should carry out under dry and irrigated conditions.

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