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The Effects of Microbial Fertilizer Applications on Yield and Some Yield Elements of Peanut in Çukurova Region in Turkey

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ABSTRACT

This study was performed so as to do investigate in terms of yield and any of yield properties in peanut which is basic crop of different forms of microbial fertilizer and chemical fertilizer application regarding Çukurova Region of Turkey in 2008. The experimental design was randomized block with four replications. There are three meters spaces between each parcel and blocks. There were five different methods: zero doze control application, traditional fertilizing application (30 kg/ha (N), 80 kg/ha (P_2O_5). The other application were done with three different forms of microbial fertilizer; 3000 cc/ha Microbial fertilizer + 50 kg/ha sugar beet molasses, 3000 cc/ha Microbial fertilizer + 50 kg/ha sugar beet molasses + high fertilizer 1500 cc/ha Microbial fertilizer + 20 kg/ha sugar beet molasses and 3000 cc/ha Microbial fertilizer + % 25 traditional fertilizing application. The highest yield was 4504 kg/ha in 3000 cc/ha Microbial fertilizer + 50 kg/ha sugar beet molasses application and the least yield was determined as 3794 kg/ha in traditional fertilizer application.

Key words: Peanut, Microbial fertilizer, chemical fertilizer, yield, yield elements

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INTRODUCTION

To provide vegetable production in plants sufficiently, applying appropriate and sufficient amounts of nutrients to the soil has gained importance. Today, agricultural production in the world, resolving nutrient deficiency has become important so that culture plants can reach the maximum level in terms of genetic [1,2]. Therefore, to provide the expected benefit from fertilizers used, it is important to know the fertilizers well, to determine micro and macro nutrients required for plants and to determine nutrient needs of cultivated plants, the way and the time of manuring appropriately. There is organic matter deficiency in the important part of the territory of Turkey. For this purpose, it is tried to overcome this deficiency by mixing organic matters into the soil on which agricultural production is done [3].

Peanut plays an important role in feeding, thanks to such valuable nutrients as fat, protein, carbohydrate and vitamins it contains. Peanut, being in tropical and subtropical regions, is grown successfully in many countries in the world. In the world, after soy peanut (36,1 million tons) is mostly produced [4] as oily seed. It has an important place in the vegetable oil industry due to the high ratio of oil in the seed (% 40-60). According to the 2002 value, peanut supply 5.6 percent of the vegetable crude oil of the world [5]. The fundamental reason, why there is not much increase in the peanut production areas in Turkey; is that harvesting is not mechanized enough. Therefore, until recently, the production of peanut could not get out of the family agriculture. In recent years, especially in our region, peanut production has been mechanizing, it has been planted in large areas and so there has been a significant increase in the production of peanut. In our region, peanut is the main product and after wheat harvest, it can be grown successfully as a second product and very high yield can be obtained in per unit area. Thanks to the Rhizobium bacteria living in the seeds and due to binding the released nitrogen of the air to the soil, it is an important rotation crops for the agriculture of the region. In addition, owing to the low production costs and the high revenue obtained from per unit area, the production of peanut has begun to increase rapidly in our region. Today, Çukurova is one of the regions that produce peanut most Çukurova meets 80 percent of peanut need in Turkey [6]. To obtain higher yields from per unit area and to make a profitable production; the selection of appropriate varieties and making cultural practices should be done on time and according to the technique. NC-7 variant forms 90 percent of peanut cultivars that are still produced in our country [5].

A great many researches explain that fertilizers in agriculture have negative effects on soil and water sources as well as increasing production. In addition, due to the use of pesticides and chemical fertilizers, the natural balance is damaged and the number of microorganisms that feed plants in the soil decrease [7]. Microbial fertilizers used to prevent this negativity and increase production, aim at increasing natural microorganisms. Some microorganisms living in the soil, settle on the plant roots and multiply. It has been observed that due to living there, these microorganisms supply such benefits as providing the control of diseases on the soil root, evaluating organic wastes left in the soil, improving of the soil structure and increasing the use of active matters, raising the soil's water holding capacity and the use of fertilizers goes on increasing especially in developing countries [8,9]. For this reason, natural fertilizers which do not harm environment and are the most economic

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method should be used commonly in such areas as Çukurova where agriculture is done intensively.

In this study, the effect of chemical and microbial fertilizer applications on yield and some yield elements of peanut have been investigated in Çukurova Region where peanut is produced intensively and it is tried to determine that microbial fertilizers are more advantageous than chemical fertilizers.

MATERIALS AND METHODS

Description of Study Area

Cukurova Region is one of the most important agricultural areas of Turkey (Fig.1.). The area is characterized by xeric climate. The average amount of annual rainfall is 670.8 mm and total potential evaporation is 1536.0 mm. The mean annual air temperature is 19.1 ^{o}C. The mean annual soil temperature at 50 cm depth is 20.8 ^{o}C. All the soils are xeric moist regime. The vegetation in the study area are grasses, cereal and leguminous crops. The vegetation was dominated by cereal and leguminous grasses. Wheat, cotton, maize, grape and soybean have been commonly growing in Cukurova Region as industrial crops in Turkey.

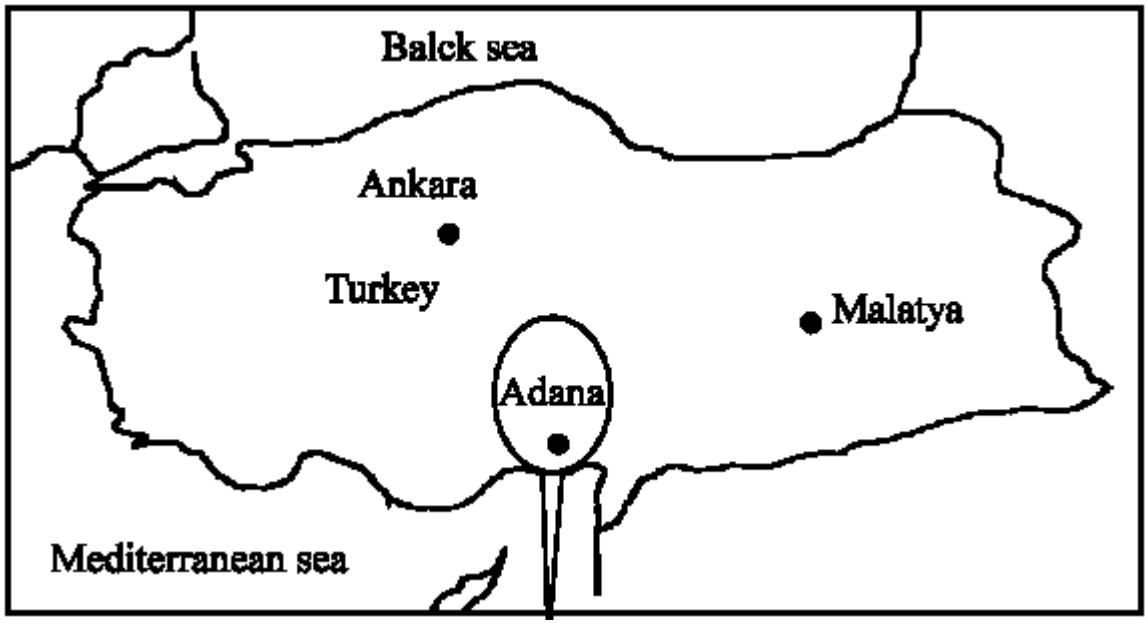

Fig.1- The Study Area in Cukurova Region of Turkey

Materials

In the study, while Bio-One was used in microbial fertilizer applications as commercial named fertilizer, it was used as base fertilizer (20-20-0) in the traditional fertilizer application. Experiment was used in terms of major product in 2008 and NC-7 type was used as material. Adana where the experiment is conducted has a typical Mediterranean climate that is rainy and warm in winter and is hot and dry in summer. Some climate values recorded

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in the growing period in which the experiment is conducted and the average of these values for many years is given in Table-1 [10]. In Table–1, it has been seen that average temperature values measured between April and September months in which the experiment is conducted are close to the average values of the long years. Groundnut crop has not more selective in terms of soil structure and generally, it grows in loam, sandy, loam sandy soil.

Table-1. Some Climatic Data in the Study Area (Cukurova Agricultural Research Institude Meteorology Center, 2008)

Month	Average heat (°C)		Total rainfall (mm)		Relative moisture (%)	
	Average of long years*	2008	Average of long years*	2008	Average of long years*	2008
April	16,6	17,8	45,8	4,0	64,6	70,8
May	20,6	20,2	42,1	10,2	63,5	71,0
June	24,3	25,5	16,1	22,6	64,5	65,6
July	26,7	27,6	9,8	0,2	68,1	71,8
August	27,1	29,0	7,5	2,6	68,1	63,7
September	24,9	25,7	15,1	37,6	62,2	63,0
Total	19.1		670.8			

Methods

Experiment Randomized Blocks was established as four repetitive according to the Experiment Design. The experiment totally consists of 20 parcels and 4 blocks. Parcels were established in 4 rows and 5 feet tall. 5 meter space was left between each parcel and block not to affect trial plots. Row space is 70 cm and above the row is 25 cm in the parcels that are cultivated. In the study, 5 different application methods were tried. Application methods used have been listed below:

First Application (control plots) :zero doze (not made any application).
Second Application (traditional methods): 30 kg/ha nitrogen (N) + 80 kg/ha phosphorus (P2O5)
Third Application : 3000 cc/ha Microbial Fertilizer + 50 kg/ha sugar beet molasses.
Fourth Application : 3000 cc/ha Microbial Fertilizer + 50 kg/ha sugar beet molasses + 1500 cc/ha Microbial Fertilizer as Top Fertilizer + 20 kg/ha sugar beet molasses.
Fifty Application: 3000 cc/ha Microbial Fertilizer + % 25 Traditional Fertilizer Application

In the trial field, as well as fertilizer application, all machinery processing was carried out timely and completely in terms of growing peanut. In the research, agronomic improvements which will occur between fertilizer applications were investigated. For this purpose, such properties as yield, the number of fruit in per plant, 100 grain weight were observed and the data was collected. Moreover, by making fat and protein analysis of seed, if there is an effect of applications on the fat and protein content of grain were investigated. After harvest, taking soil samples from plot trials, cation exchange capacity, total soluble salt, pH, lime, organic matter, Extractable P2O5, Extractable K2O and texture analysis were made by means of known methods [11-13].

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In the harvest of the experiment, 2 rows in the middle of the 4 rows planted in each parcel were evaluated by being harvested by hand and their statistical analysis was made. By using JUMP 5.0 statistical program, evaluations were made dependent on variance analysis and significant averages obtained were compared with LSD tests.

Table-2. Some Pyhisical and Chemical Properties of Soils in Study Area

CEC $mgkg^{-1}$	Total soluble salt %	pH 1/1	CaCO3 %	Organic matter %	Extractable P2O5 kg/ha	Extractable K2O kg/ha	Sand %	Silt %	Clay %
27.05	0.024	7.79	13.00	1.58	36	960	33.0	36.5	30.5
25.06	0.025	7.76	15.00	1.33	33	960	33.8	37.7	28.5
23.42	0.023	7.77	16.00	1.33	40	960	33.6	38.0	28.4
22.47	0.022	7.88	15.00	1.50	47	990	36.5	35.1	28.4
18.74	0.017	7.86	18.00	1.13	40	740	48.9	28.7	22.4

RESULTS AND DISCUSSION

Some Physical and Chemical Properties of Soil

Some physical and chemical properties of the soil which is the field where the experiments founded are given in Table-2. Cation exchange capacity of the soil ranged from 18.74 $mgkg^{-1}$. pH of the soil is neutral and slightly alkali and ranges from 7.88 to 7.62. Soil generally has no salt; and their total soluble content is between % 0.025 and % 0.017. While CaCO3 contents range from % 13.00 to % 18.00, organic matter contents are between % 1.13 and % 1.58. Extractable P2O5 content range from 33 kg/ha to 47 kg/ha. Extractable K2O contents are very high and they vary between 740 kg/ha and 990 kg/ha. Sand content varies between % 33.0 and % 48.9, silt content varies between % 28.7 and % 38.0, while clay content varies between % 22.4 and % 30.5 (Table-2)

The Effect of Applications on Plot Yield

Yield results of different application are given in Table-3. When Table-3 is examined, it is seen that the highest yield is 4504 kg/ha with 3. application which is 3000 cc/da Microbial Fertilizer + 50 kg/ha sugar beet molasses.. The lowest yield, 3794 kg/ha, was obtained from traditional methods which is 30 kg/ha nitrogen, 80 kg/ha phosphorus (P2O5) applied. While the yield average in the 4. application, to which 3000 cc/ha Microbial Fertilizer + 50 kg/ha sugar beet molasses + 1500 cc/ha Microbial Fertilizer as Top Fertilizer + 20 kg/ha sugar beet molasses applied, is 3893 kg/ha; the yield average in the 5. application, which is 3000 cc/ha Microbial Fertilizer + % 25 Traditional Fertilizer Application, is 3953 kg/ha. Yield was measured as 4031 kg/ha in the control plots not made any application.

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Table-3. Yield And Some Yield Elements Of Peanut

Application	Yield (kg/ha)	Number of fruit in per plant (number/per plant)	100 Grain weight (gr)	Oil contents (%)	Protein Contents (%)
1	4031	53.33	112,0	46,7	29,14
2	3794	41.66	111,0	46,9	29,18
3	4504	45,20	113,5	47,3	29,05
4	3893	51.66	109,5	47,5	29,43
5	3953	65,46	107,5	47,2	29,65
C.V.	% 13.99	% 19.81	% 4.11	%) 2.12	% 1,47
LSD	87,06	14.71	7,11	1,53	0,66

1: First Application (control plots) :zero doze (not made any application).
2: Second Application (traditional methods): 30 kg/ha nitrogen (N) + 80 kg/ha phosphorus (P_2O_5)
3: Third Application : 3000 cc/ha Microbial Fertilizer + 50 kg/ha sugar beet molasses.
4: Fourth Application : 3000 cc/ha Microbial Fertilizer + 50 kg/ha sugar beet molasses + 1500 cc/ha Microbial Fertilizer as Top Fertilizer + 20 kg/ha sugar beet molasses.
5: Fifty Application: 3000 cc/ha Microbial Fertilizer + % 25 Traditional Fertilizer Application

While the yield of control plots needs to be the lowest as theoretical, it is found that it is higher than some application parcels to which microbial fertilizers applied. Plant nutrient of the plots not made any application are accepted as zero dose but in fact they are not really zero. An amount of plant nutrients are available from the previous years. As seen in Table-2, here, the soil's own properties affect the yield more than the application. Even if plant nutrient not given to the control parcel, plant nutrient reserve of the control parcel remains as a healthy way to make plants grow. Control parcel is one whose organic matter content is the highest in the application parcel. Organic matter content of control parcel is % 1,58. It means % 0,90 organic carbon. It is known that organic carbon decompose over time and provide nitrogen to the soil [1,8, 14]. It means control parcel has enough nitrogen. In addition, it is known that, like other legumes, peanut binds the released nitrogen of the air to the soil, it leaves a rich soil in terms of nitrogen and organic matters to the plants that will planted after it. Researches made before shows that in a growing season, thanks to Rhizobium bacteria, peanut fixes 45-150 kg/ha nitrogen (NH_3) from the released nitrogen of the air [5]. As seen, even if control parcel is accepted as zero dose, it has enough nitrogen for plant growth.

Moreover, organic matter content of other application parcels is lower and while organic matter content of 2. and 3. application % 31.33, organic matter content of application parcel is % 1.13. An the same time, while beneficial P_2O_5 content of control parcel is 36 kg/ha, beneficial K_2O content is 960 kg/ha. In addition, lime content is the lowest control parcel in the application parcel. Due to increasing of the lime content into the soil, such nutrients as

phosphorus, iron and zinc intake of plants is difficult [15]. Therefore, that the lime content of control parcel is low is seen as an advantage in terms of plant nutrient intake.

In addition, soil texture also plays an important role in terms of nutrient retention into the soil and nutrient intake of plants. It is expected that in theory, the yields of 3., 4., and 5. applications in which microbial fertilizer application is made should be higher than the yields of parcels in which control and traditional applications are made. Actually, 3. application which is one of the microbial applications has the highest yield among the applications. Although 3. application in which microbial application is made has the highest yield, in the 4. and 5. applications, in which microbial applications are made, parcel yields may be lower because of the soil properties. Because the organic matter content of these parcels is lower than the other application parcels. Likewise, 4. and 5. application parcels have the highest lime content among the application parcels (% 18). High lime content of these parcels may have restrained especially such nutrients as beneficial P2O5, iron and zinc intake of the plants and caused yield loss [16,17].

Moreover, the other soil property affecting yield is texture and accordingly cation exchange capacity. The clay content of the control parcel is % 30.5 and it has the highest value within the application parcels. Accordingly, control parcel also has the highest cation exchange capacity (27.05 $mgkg^{-1}$). However, control parcel has the lowest sand content within the application parcels (% 33.0). In addition, the sand content of the 4. and 5. applications are very high (% 36.5 and % 48.9). Accordingly, cation exchange capacities are low, too and they are 22.47 $mgkg^{-1}$ and 18.74 $mgkg^{-1}$. Because of all these reasons, while the yield of the application parcels within microbial application should be higher than control parcel, it is low. In such applications, before the experiment is established, by doing soil analysis, soil properties of the different application should be the same or similar. Otherwise, as in this experiment, soil properties may overshadow the effects of the different applications and while the yield of the control parcel should be the lowest, sometimes it may be higher.

The Effect of Applications on Some Agronomic Features

The highest single number of fruits is obtained from 5. application parcel and there are 65.46 fruit for per plant. Control parcel follows it with 53.33 fruits for per plant. The lowest number of fruit is obtained from parcels on which traditional applications are made and they are 41.66 pieces. While, in 300 cc/ha Microbial Fertilizer + 5 kg/ha sugar beet molasses which is the 3. application, there are 45.20 fruit for per plant, in the 4. application there are 51.66 fruit for per plant. Except for control parcel, by means of microbial application, fruit number of a single plant has showed a significant increase according to the traditional application, and fruit number rose from 41.66 to 65.46 in the 5. application.

The weight of 100 grain is 112.0 g in the control parcel, 111.0 g in the traditional parcel and 113.5 g which is the highest value in the 3. application parcel to which 3000 cc/ha Microbial Fertilizer + 50 kg/ha sugar beet molasses is applied. However, the differences of 100 grain weight among these applications have not been found statistically important.

It can be seen that the oil content of grain has increased in a small extent, thanks to the usage of microbial fertilizer. While the oil content of grain is measured as % 46.7 in the control parcel, the oil content of grain is as % 46.9; in the 3. application to which 3000 cc/ha Microbial Fertilizer + 50 kg/ha sugar beet molasses applied is as % 47.3; in the 4. application to which 3000 cc/ha Microbial Fertilizer + 50 kg/ha sugar beet molasses + as Top Fertilizer 1500 cc/ha Microbial Fertilizer + 20 kg/ha sugar beet molasses is applied, is as % 47.5 and in the 5. application in which 3000 cc/ha Microbial Fertilizer + % 25 Traditional Fertilizer Application is applied, is as % 47.2. Any changes are not seen in the protein content of grain among applications. The protein content of grain range from % 29.65 to % 29.05 in the application parcels.

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