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Original Research Article

The Advantages of Microbial Fertilizer on Watermelon in Çukurova Region in Turkey

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Abstract

This study investigated the advantages of microbial fertilizer to chemical fertilizers (N and P) on watermelon in Çukurova Region in Turkey. The experimental design was randomized block with four replications. There were five different methods: zero doze control application, traditional fertilizing application (160 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 36388.9 kgha^{-1} in 3000 cc/ha Microbial fertilizer + 50 kgha^{-1} sugar beet molasses application and the least yield was determined as 31388,9 kgha^{-1} in traditional fertilizer (160 kgha^{-1} (N) + 80 kg ha^{-1} P2O5) application. The yield was 35972,2 kgha^{-1} in 3000 cc/ha Microbial fertilizer + 50 kg/ha sugar beet molasses + high fertilizer 1500 cc/ha Microbial fertilizer + 20 kg/ha sugar beet molasses. Also yield was 34861,1 kgha^{-1} in 3000 cc/ha Microbial fertilizer + % 25 traditional fertilizing application. There was no significant difference between chemical fertilizer application and microbial fertilizer application. Also in plants treated with microbial fertilizers, fusarium diseases were also less observed than chemical fertilizers parcels. According to these results, it is advisable to use microbial fertilizer which does not pollute the environment.

Key words: Watermelon, microbial fertilizer, chemical fertilizer, yields.

INTRODUCTİON

Today in world for agricultural production was been used as chemical fertilizers are industrially manipulated, substances composed of known quantities of nitrogen, phosphorus and potassium, and their exploitation causes air and ground water pollution by eutrophication of water bodies (Bhardwaj et al., 2014). Maintaining and improving soil quality is crucial if agricultural productivity and environment quality are to be sustained for future generations (Barmaki et al., 2008; Issaka et al., 2009). 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. 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, we have tried to overcome this deficiency by mixing organic matters into

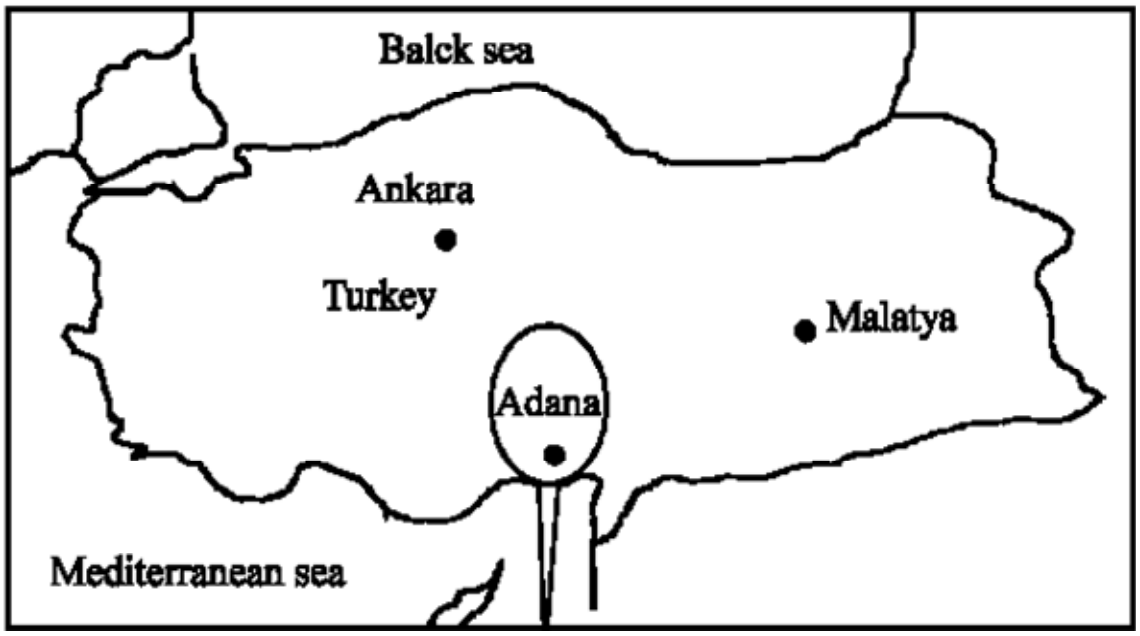

Figure 1. The Study Area in Cukurova Region of Turkey

the soil on which agricultural production is done (Bolat et al., 2009).

Intensive agriculture has had negative effects on the soil environment over the past decades (*e.g.* loss of soil organic matter, soil erosion, water pollution) (Reeves, 1997; Zhao et al., 2009; Uygur and Karabatak, 2009). Management methods that decrease requirements for agricultural chemicals are needed in order to avoid adverse environment impacts (Bilalis et al., 2009). The use of manure and mulching are two of the basic cultivation techniques of organic agriculture (Efthimiadou et al., 2009). Moreover, emerging evidence indicates that integrated soil fertility management involving the judicious use of combinations of organic and inorganic resources is a feasible approach to overcome soil fertility constraints (Mugwe et al., 2009; Abedi et al., 2010; Kazemeini et al., 2010). Some researcher claimed that slow-release of inorganic fertilizers have been developed mainly for agricultural use and are slowly dissolved or degraded by continual or intermittent contact with water to provide a sustained release of nutrients (Lessard et al., 1995).

Different nutrient amendments have their own distinct merits, and a combination of different fertilizer types may further enhance the effectiveness of oil bioremediation additives (Aspasia et al., 2010). This is based on the principle that the indigenous microbial biomass, in the presence of petroleum hydrocarbons, benefits from a source of nutrients that can be readily assimilated before the onset of nutrient release from SRIFs or oleophilic fertilizers. For this reason, natural fertilizers which do not harm environment and are the most economic method should be used commonly in such areas as Çukurova where agriculture is done intensively.

The main objective of this study was to determine the effect of chemical and microbial fertilizers on yield and yield components of watermelon. We also intended to evaluate the sustainability of watermelon crop under different chemical and microbial fertilization treatments.

MATERIALS AND METHODS

Description of Study Area

Cukurova Region is one of the most important agricultural areas of Turkey (Figure 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 (Soil Survey Staff, 2014). The vegetation in the study area are melones, grasses, cereal and leguminous crops. The vegetation was dominated by cereal and leguminous grasses. Cukurova Region is one of the most important agricultural areas of Turkey (Irmak et al., 2011). Wheat, cotton, maize, grape and soybean have been commonly growing in Cukurova Region as industrial crops in Turkey (Figure 1).

Materials

In the study, while Bio-One was used in microbial fertilizer applications as commercial named fertilizer, it

was used as base fertilizer (20 N -20 P -0) in the traditional fertilizer application. Experiment was used in terms of major product Crimson Tide variety 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 in the growing period in which the experiment is conducted and the average of these values for many years.

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 70 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 application): 160 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 watermelon. In the research were investigated some agronomic properties such as yield, average fruit number for each parcels, average fruit number, fruit weight, the number of fruit in per plant, root diameter, number of plant arms, number of plant arms, main plant length, number of existence of the first female flowers, total number of node, average fruit weight, fruit diameter, fruit height, fruit shell thickness, albedo thickness, seed number and seal size. Besides these was made fusarium observation according to 1-5 scale.

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.

RESULTS AND DİSCUSSİON

The Effect of Microbiyal Fertiziler Applications on Some Plant Growth Measurements

Some plant observations results of different application are given in Table 1. The root diameter of plant of the first application parcel is 1.017 mm while the root diameter of plant of the second application parcel is 1.042 mm. The root diameter of plant of the third application parcel is 1.050 mm while the root diameter of plant of the fourth application parcel is 0.975 mm. The root diameter of plant of the fifty application parcel is 1.025 mm. The highest root diameter was 1.050 mm in Third Application and the least root diameter was determined as 0.975 mm in Fourth Application. There is no significant difference between the root diameters of plants of the different applications.

The number of plant arms of the different applications changes between 3,58 and 3,92. The maximum number of plant arms was found 3,92 in the Fifty Aapplication parcels and the least number of plant arms as 3,58 in the Second Application parcels. There is no significant difference between the numbers of plant arms of the different applications.

The main body length of plants of the different applications parcels changes between 162,00 cm and 172,58 cm. The highest main body length was 172,58 cm in Second Application parcels and the least main body length of plants was determined as 162,00 cm in First Application parcels. There is no significant difference between the main body lengths of plants of the different applications parcels.

The number of existence of the first female flowers of plants of the different applications parcels changes between 13,92 and 15,42. The maximum number of existence of the first female flowers of plants was found 15,42 in the Fourth application parcels and the least number of plant arms as 13,92 in the Second Application parcels. There is no significant difference between the numbers of existence of the first female flowers of plants of the different applications.

The total number of node of plants of the different applications parcels changes between 26.50 and 28.75. The maximum total number of node of plants was found 28.75 in the Third Application parcels and the least total number of node plant as 26.50 in the First Application parcels. There is no significant as statistical difference between the total numbers of node of plants of the different applications.

The Effect of Microbiyal Fertiziler Applications on Yield and Some Fruit Properties

Parcel yields and some fruit properties are given in

Table 1. Plant Growth Measurements in Crimson Tide Variety

Applications	Root Diameter (mm)	Number of plant arms	Main Body Length (cm)	Number of Existence of the First Female Flowers	Total number of node
First Application (control plots)	1.017	3.79	162.00	14.42	26.50
Second Application (traditional application)	1.042	3.58	172.58	13.92	27.08
Third Application	1.050	3.70	171.75	15.25	28.75
Fourth Application	0.975	3.67	165.75	15.42	27.33
Fifty Application	1.025	3.92	171.75	15.00	28.08
D(% 5)	**N.I.**	**N.I.**	**N.I.**	**N.I.**	**N.I.**

Table 2. Yield Values Obtained at Fruit Harvest in Crimson Tide Variety.

Applications	Average Fruit Number	Fruit Weight (Kg)	Yield ($Kgha^{-1}$)	Fusarium Observation (1-5 Scale)
First Application (control plots)	25.00	95.33	37922.20	1.33
Second Application (traditional application)	25.67	75,33	31388.90	2.00
Third Application	24.33	87.33	36388.90	1.83
Fourth Application	24.67	86.33	35972.20	1.58
Fifty Application	24.00	83.67	34861.10	1.67
D(% 5)	**N.I.**	**N.I.**	**N.I.**	**N.I.**

Table 2. The average fruit number of the different applications changes between 24,00 and 25,67. The maximum number of average fruit was found 25,67 in the Second Application parcels and the least number of plant arms as 24,00 in the Fifty Application parcels. There is no significant difference between the average fruit number of the different applications.

The fruit weight of the different application parcels changes between 75,33 kg and 95.33 kg. The maximum fruit weight was found 95.33 kg in the First Application parcels and the least fruit weight as 75,33 kg in the Second Application parcels. There is no significant difference between the fruit weight of the different applications.

The parcel yield of the different applications changes between 31388,90 $kgha^{-1}$ and 3792.22 $kgha^{-1}$. The maximum yield was found 37922,20 $kgha^{-1}$ in the First Application parcels and the least parcel yield as 31388,90 $kgha^{-1}$ in the Second Application (traditional application) parcels. Some researchers claimed that biological activity increases yield of some horculture plants (Bhardwaj et al., 2014; Irmak et al., 2011; Sürücü and Demirkiran, 2013). There is no significant difference between the yields of the different applications. According to these results, it is advisable to use microbial fertilizer which does not pollute the environment. Also in plants treated with microbial fertilizers, fusarium diseases were also less observed than chemical fertilizers parcels. Some researchers that watermelons are grafted in order to be protected from Fusarium wilt, to increase low soil temperature tolerance and to increase yield by enhancing water and plant nutrients uptake (Yetisir and Uygur, 2010).

The Effect of Microbiyal Fertiziler Applications on Fruit Pomological Properties

Some fruit pomological analysis results are given in Table 3. The average fruit weight of the different applications changes between 4491.75 g and 5709.34 g. The maximum average fruit weight was found 5709.34 g in the Third Application parcels and the least average fruit weight as 4491.75 g in the Second Application parcels. There is no significant difference between the average fruit weight of the different applications.

The fruit diameter of the different applications changes between 19,90 cm and 21,29 cm. The maximum fruit diameter was found 21,29 cm in the Third Application parcels and the least fruit diameter as 19,90 in the Second Application (*traditional application*) parcels.

The fruit height of the different applications changes between 22.58 cm and 24.75 cm. The maximum fruit height was found 24.75 cm in the Fifty Application parcels and the least fruit height as 22.58 cm in the Second Application (*traditional application*) parcels. There is no significant difference between the fruit height of the different applications.

Table 3. Results of Fruit Pomological Analysis in Crimson Tide Variety.

Applications	Average Fruit Weight (g)	Fruit Diameter (cm)	Fruit Height (cm)	fruit shell thickness (cm)	Albedo thickness (cm)	Seed number	Seal Size (cm)
First Application (control plots)	5629.75	21.13	24.70	0.82	0.68	449.17	0.52
Second Application (*traditional application*)	4491.75	19.90	22.58	0.66	0.82	441.72	0.51
Third Application	5709.34	21.29	24.55	0.84	0.90	584.42	0.48
Fourth Application	5684.42	21.09	24.29	0.83	0.94	522.64	0.50
Fifty Application	5672.83	20.92	24.75	0.76	0.62	507.67	0.45
D (%5)	**N.I.**	**N.I.**	**N.I.**	**N.I.**	**N.I.**	**N.I.**	**N.I.**

The fruit shell thickness of the different applications changes between 0.66 cm and 0.84 cm. The maximum fruit shell thickness was found 0.84 cm in the Third Application parcels and the least fruit shell thickness as 0.66 cm in the Second Application (*traditional application*) parcels. There is no significant difference between the fruit shell thickness of the different applications.

The albedo thickness of the different applications changes between 0.62 cm and 0.94 cm. The maximum albedo thickness was found 0.94 cm in the Fourth Application parcels and the least albedo thickness as 0.62 cm in the Fifty Application parcels.

The seed number of the different applications changes between 441.72 and 584.42. The maximum seed number was found 584.42 in the Third Application parcels and the least seed number as 441.72 in the Second Application (*traditional application*) parcels.

The seal size of the different applications changes between 0.45 cm and 0.52 cm. The maximum seal size was found 0.52 cm in the First Application parcels and the least seal size as 0.45 cm in the Fifty Application parcels.

CONCLUSION

This study clearly showed that microbial fertilizer increased watermelon yield significantly. This yield increase may be attributed to the increase in microbial activity in soil. However, similar yield increase due to chemicel fertilizer applications via increased nutrient element. But chemical fertilizers both pollute the environment and are more expensive than microbial fertilizer. According to the results of this study, it is advisable to use microbial fertilizer instead of chemical fertilizer in watermelon production in Çukurova Plain.

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