Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 23, Issue 1, 2023
PRINT ISSN 2284-7995, E-ISSN 2285-3952

RESEARCH ON THE ADOPTION OF SOIL ANALYSIS APPLICATIONS IN AGRICULTURAL ENTITIES

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Abstract

The main purpose in agricultural production is to get the highest yield from the unit area. The prerequisite for obtaining high efficiency is the right fertilizer consumption. The basic element of obtaining the highest income from production is balanced fertilization. Factors such as the type, amount and time of use of the fertilizer directly affects yield. Thus, in order for the producer to use fertilization in a balanced method, it is necessary to give the soil an appropriate amount and type of fertilizer by making a soil analysis. This research aims to determine the tendencies of the producers in Bursa to have soil analysis performed. For this purpose, a face-to-face survey was conducted with 388 producers. The data obtained were analyzed and interpreted with SPSS 25.0. 38.9% of the producers are between the ages of 36-45. Educational status is only literate at the rate of 66.8%. According to the test results, 82.2% of the producers do not use soil analysis for their lands. It is seen that the producers who have soil analysis have the analysis done to learn the fertilizer need of the crop they will plant the most and they trust the results of the analysis. It has also been observed that the producers do not have sufficient information about soil analysis. This is due to the low level of education of the producers. The increase in the trainings that will raise the awareness of the producers and free soil analysis will encourage the producers to analyze. The main thing is that this factor, which directly affects production, such as soil analysis, should be made compulsory for all producers.

Key words**:** *fertilizers, soil analysis, yield, agricultural production*

INTRODUCTION

The most important aim of agricultural policies is to increase the efficiency in agricultural production. Sustainable methods are used to increase agricultural efficiency and ensure the continuity of production. Especially the increase in the population rate carries the agriculture sector to a more important position [3]. There is a linear relationship between the agricultural sector and the population. The increase in the population requires an increase in the yield obtained from the unit area. Agricultural production is very important not only for the agricultural sector, but also for other sectors. Along with a 1% increase in agricultural production, a 1.5% increase occurs in non-agricultural sectors [40].

Provided that all these conditions remain constant, the world population according to the United Nations; It is estimated to be 8.6 billion in 2030, 9.8 billion in 2050 [25] and 11.2 billion in 2100 [37]. The fact that the world population will increase at this level puts agricultural lands at risk [9]. For this reason, sustainable use of agricultural lands is at the top of the measures to be taken against population growth in the coming years [17, 29, 39]. In addition, the wrong and unconscious use of agricultural lands threatens the agricultural sector. Also, [28] pointed out the importance of systematic fertilizer application for preserving and/or increasing soil fertility, as a sustainable development measure.

Excessive fertilization, spraying and irrigation reduce soil fertility [1]. Fertilization and irrigation are the most effective factors that reduce the dependence of agricultural activities on natural conditions. For this reason, fertilizer production and consumption is one of the main signs of agricultural development of a country, as well as increasing the yield obtained from the unit area [23].

Fertilizer Use in Agriculture

Chemical fertilizers basically consists of three types: nitrogen (N), phosphorus (P) and potassium (K) [14,18]. Mostly nitrogenous chemical fertilizers are used in all countries, including Turkey. Since 1950, global fertilizer use has increased by 800% [30].

During agricultural production various damages are done to the environment [11]. Chemical fertilizers, in particular, is an issue that needs to be thoroughly planned and studied. Damages in agricultural production are not short-term, but long-term and permanent [3]. Excessive fertilizing pollutes the environment, soil, underground and surface waters and causes harmful accumulations in plants. If the fertilization is not used enough, the nutrients in the soil and the plant are reduced [24]. Doubling the amount of agricultural production activities until the 1990's is directly related to the 6.9 times increase in nitrogen fertilizers and 3.5 times the increase in phosphorus fertilizers [34].

It has been known since ancient times that productivity is increased by fertilization in plant production [4]. Despite this, the widespread use of chemical fertilizers in Turkey dates back to the 1970s [2]. Production and consumption of chemical fertilizers is quite problematic in Turkey. Therefore, contrary to the expected increase in product yield as a result of fertilization, environmental problems are observed [26]. Although the tendency of producers to use chemical fertilizers increases, their habits of making their own fertilizers reduce product yield and increase costs [8].

With the increase in industrial and agricultural production, pesticide, heavy metal and fertilizer residues in the soil are also increasing [10]. These residues in the soil are absorbed by plants over time and indirectly harm consumer health. In addition to human health, environment is also affected negatively, and plants and animals are also affected by this situation [41]. In order for the correct fertilization to take place, the type of fertilizer, the amount of fertilizer and the fertilizer content that the plant needs should be determined by soil analysis.

Table 1 shows the chemical fertilizer consumption data between 2015 and 2021 in Turkey. Consumption of nitrogen fertilizers is higher than phosphorus and potassium fertilizers. The year with the highest nitrogen fertilizer consumption is 2020, phosphorus fertilizers in 2016 and potassium fertilizers in 2021. The year with the highest total consumption of N-P-K is 2020.

Table 1. Chemical fertilizer consumption in Turkey by years (tons) (ten thousand)

Fertil-izer	2015	2016	2017	2018	2019	2020	2021
N	148.7	189.6	176.5	152.8	168.3	205.3	178.7
P	25.5	34.6	33.0	27.7	29.1	33.3	27.7
K	10.9	9.8	10.4	9.6	9.7	9.5	12.8
N-P-K Total	185.1	234.1	219.8	190.1	207.1	248.1	219.2

Source: [35].

Soil Analysis

Soil analysis is a method that shows which plant nutrients the soil needs by taking samples 1-2 months before planting or fertilizing [9,15]. The samples taken are analyzed in the laboratory. It has been proven by scientific studies that soil analysis provides many benefits to the producer, environment and economy [12, 19, 21, 27]. This analysis prevents unnecessary nutrient loadings to the soil, the plants are not fed poorly and the product quality is increased. Choosing the wrong type of fertilizer and using the fertilizer at the wrong time reduces the expected yield of the product [15]. In Taşpınar and Ertek [32], which studied the sustainability of soil and water usage of farmers in Konya province in Turkey, it has been observed that 100% of the farmers participating in the research conducted did not have soil analysis.

Producers are not sufficiently aware of the benefits of soil analysis. According to the research of Kucukkaya and Ozcelik [15] soil analysis in wheat production reduces costs and increases the income of the enterprise. Celik and Urhan [6] stated that many elements, especially N, P, K, are at low levels in their research in the Keles district of Bursa province. In the research, the results were obtained that the local producers did not have

soil analysis and unconsciously consumed fertilizer.

There is no obligation for producers to have soil analysis. According to the research conducted by Guldal and Ozçelik [8] one of the reasons why producers do not have soil analysis is that they do not have to have an analysis done. Not being aware of the soil analysis subsidies, insufficient subsidies and not trusting the results of the analysis are among the other reasons for not having the analysis done.

In this research, it is aimed to determine the tendencies of the producers in Bursa to have soil analysis. Analysis that are directed by the data obtained from the farmers have been performed and the results were interpreted.

MATERIALS AND METHODS

Bursa province, which is the research area, is located in the northwest of Turkey and southeast of the Sea of Marmara. Bursa province is the 4th largest province of Turkey and its population was announced as 3,147,818 as of 2021 [35]. Bursa, which has a total area of 11,027 km^2, has 17 districts in total [5,16]. Bursa has a very high agricultural potential. Agricultural soils have high pH and lime and low organic matter contents [36]. Within the scope of the research, a face-to-face questionnaire was applied to 388 farmers in the rural areas of Bursa province Keles and Orhaneli.

While preparing the survey questions, previous studies on similar topics were examined and the questions were adapted to the current research. The prepared questionnaire was tested by conducting a pilot study with a focus group of 12 people. Data from farmers participating in the pilot study were not included in the study. In the research, primary data was obtained from producers in March and April 2022 and statistical data from the Ministry of Agriculture and Forestry were used. The data than was analyzed with SPSS 25.0. In order to test the reliability of the research data, Cronbach's Alpha analysis was performed and α=0.82 was obtained. Research data is in the high reliability group [33]. Frequency analysis and Chi-square test were used in the analysis of the data.

The following formula was used to calculate the sample size (n).

$$n = [z^2 * p * (1 - p) / e^2] / [1 + (z^2 * p * (1 - p) / (e^2 * N))]$$

For 95% confidence level (α), z = 1.96, p = ratio (expressed as decimal), N = population size, e = margin of error [7, 20].

z = 1.96, p = 0.5, N = 3,147,818, e = 0.05 n = [1.962 * 0.5 * (1 - 0.5) / 0.052] / [1 + (1.962 * 0.5 * (1 - 0.5) / (0.052 * 3,147,818))] n = 384.16 / 10,001 = 384.113, and 388 people were surveyed in the research.

RESULTS AND DISCUSSIONS

In this part of the research, the data obtained from the producers and the analysis results are included. The results of the analysis were compared with the results of the previous researches.

Demographic indicators

When the demographic data of the producers are examined, 38.9% are in the 36-45 age range and 29.9% are in the 56-65 age range. The ratio of producers with 3-5 people in the household is 47.6% and 34.6% for those with 6-8 people (Table 2).

Table 2. Demographic indicators

Age	**N**	**%**
25-35	39	10,1
36-45	151	38,9
46-55	56	14,4
56-65	116	29,9
65+	26	6,7
Total	338	100,0
Household size	N	%
1-2	24	6,2
3-5	185	47,6
6-8	134	34,6
8+	45	11,6
Total	388	100,0
Education	N	%
Literate	259	66,8
Primary Education	75	19,3
High School	37	9,5
University	17	4,4
Total	388	100
Marital Status	N	%
Married	341	87,9
Single	47	12,1
Total	388	100,0

Source: Own results.

When the marital status is examined, the number of married producers is 341 and the number of single ones is 47. Majority of the producers (66.8%) are only literate, 19.3% are primary school graduates and 4.4% are university graduates.

Table 3 shows the Chi-square test results for the status of producers having soil analysis and their agricultural production areas.

Table 3. Status of producers having soil analysis

Agricultural production area (da)	Soil Analysis			**Chi-Square (X^2)**
	Yes	No	Total	
20	16	22	38	56,270
21-50	8	134	142	
51-100	22	133	155	
101-200	15	23	38	
201+	8	7	15	
Total	69	319	388	

Source: Own results.

According to the results of the chi-square test, the relationship between the groups was significant at the p=0.006, p<0.05 level. 134 of the producers with an agricultural production area of 21-50 decares and 133 of the producers with an agricultural production area of 51-100 decares do not have soil analysis. Of the 15 producers with a production area of 201 da and above, 8 have soil analysis and 7 do not. Regardless of the size of the agricultural production area, 82.2% of the producers do not have soil analysis. It is thought that it is unnecessary to have soil analysis done due to both the education level of the producers and their traditional approaches.

Kart and Gul [13] stated that only 10.4% of the producers they interviewed had regular soil analysis. They have determined that there is a positive relationship between the size of the farm and the soil analysis of the producers. As the size of the enterprises increases, the rate of soil analysis also increases. In the current study, there is no relationship between the increase in the size of the farm and the situation of having soil analysis. It is thought that the different results obtained between the studies are due to the difference in the number of samples. In the research of Uyak and Dogan [37], 74% of the producers do not have soil analysis. 67% of those who have a soil analysis have a soil analysis only once every 3 years. 80% of the producers stated that the tools and equipment used were not sufficient. In Ozden et al., [22] research, only 15.63% of the enterprises have soil analysis done.

According to the results of the research, one of the reasons why the enterprises have such a small percentage of soil analysis is that the laboratories are established in urban areas. For this reason, producers are not willing to have soil analysis. The rate of soil analysis in all studies is quite low. Although that are many studies that soil analysis increases product yield, producers do not have soil analysis.

Table 4. Reasons of producers for soil analysis and their trust in the results

Reasons for soil analysis	**Producers trust in the results**			**Chi-Square (X^2)**
	Yes, I trust the results	No, I don't trust the results	Total	
To get diesel-fertilizer support, due to obligation	21	4	25	18,661
To find out the fertilizer requirement of the crop that will be planted	37	7	44	
Total	58	11	69	

Source: Own results.

Chi-square test was applied to determine the reasons of the 69 producers who had soil analysis and whether they trusted the soil analysis results. According to the chi-square test, the relationship between the groups was significant at the p=0.001, p<0.05 level. As a result of the test, it was determined that the producers who had soil analysis performed both because of the necessity to get diesel-fertilizer support and to learn the fertilizer need of the product they would plant, trusted the soil analysis results.

Tanriverdi and Celik [31] in their research, determined that 90.48% of the farms that they have interviewed have had soil analysis done. It was stated that 85.71% of these farm enterprises had soil analysis after the subsidies have been offered and 54.76% of them reported increased yields after soil analysis. The rate of farms suggesting soil analysis to other businesses is 52.6%.

Yuzbasioglu [42] stated that only 23.82% of the producers benefit from fertilization subsidies and the reason for having soil analysis is to benefit from these subsidies. The reason for the low number of producers benefiting from the subsidy is that they are not aware of these government subsidies. The reasons for the producers who did not have soil analysis done was mainly because they rely on their own experience, their land is small and they do not know how to take soil samples.

In the studies that were examined, it is seen that the producers are not aware of the subsidies and soil analysis. Similar results were obtained in the present study. Also this study shoes that producer that have soil analysis trust to the results of the analysis. Thus, producers should be made more aware of the benefits of soil analysis and the subsidies offered.

CONCLUSIONS

Agriculture is a sector that faces many risks and uncertainties. In addition to these risks and uncertainties, the uncontrolled production of products reduces product yield and causes irreversible damages to the environment. For this reason, the nutrients needed by the soil should be determined before production and production should be made in this direction. Soil analysis helps determine the current situation of the soil and the plants and what they need for a healthier and sustainable production cycle. In this study, it has been aimed to determine the status of the producers in Bursa province to have soil analysis.

According to the results of the research, only 17.8% of the producers have had soil analysis performed. Producers who had soil analysis, on the other hand, stated that they trusted the results of the soil analysis. In this case, producers rely on soil analysis but do not have a deterrent to analyze. Manufacturers, who see analysis as unnecessary, continue with the production method they are accustomed to and oppose innovations. The main reason for this situation is the low level of education of the producers. Soil analysis should become mandatory for all producers. Producers consider soil analysis to be costly. In addition, they consider soil analysis unnecessary because they rely on their own experience.

In many studies, it has been stated how much the world population will increase in the future. Research shows that the needs of the population in the coming years can only be met with sustainable systems. Despite the daunting results of the researches, agricultural lands are still not adequately protected today. The inadequacy of the measures taken at present is also obvious. In particular, policy makers need to take measures to protect agricultural lands and encourage correct fertilization. In this direction, free soil analyzes will enable producers to use the right fertilizer at the right time and in the right amount.

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