ICOCEM
4. International Conference on Civil and Environmental Geology and Mining Engineering
Trabzon - TURKEY
20 - 22 APRIL 2019

Using Of Pumice And Corbonification Sludge For Sustainable Agriculture

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Abstract

The recovery of wastewater sludge in agriculture is an opportunity for minimization of waste. Sustainable production approach will be provided by using sugar wastes in agriculture. The aim of this study is to research the effects of sugar industry sludge and pumice on soil properties and the plant growth characteristics as a soil conditioner. For this purpose, a greenhouse experiment was conducted on the soil samples taken from three different locations in Konya where the corn is a primary crop grown. The experiment was established in randomized plots experimental design with three replications. The sludge and pumice were mixed into the soil at four doses (0, 40, 80, 160 tons/ha). The silage corn, Pionner 32K61 variety, were used as a test plant. After the harvest, the growth characteristics of corn, such as plant height, plant weight, stalk diameter, stalk weight, number of leaves, leaf weight, leaf dry matter and stalk dry matter were determined. The relationships between the treatments and some plant growth characteristics were evaluated by statistical analysis. Statistically significant relationships were found between the treatments and growth characteristics. The soil properties determined were much better than control application with increasing doses in the three soil samples. The highest productivity was obtained in Atlantı and Hayıroğlu soils with pumice of 160 tons/ha dose, in Karapınar soil with pumice + sludge of 160 tons/ha dose.

Keywords: Soil, waste, sustainability, plant, recycling

Introduction

The worldwide production increased at tremendous rate after industrial revolution in line with population growth by the natural resources are rapidly been depleted. A great deal of research is being done to protect the environment. Many efforts have increased to benefit from recyclable waste. The wastewater occurs as a result of change of water properties by using water for a variety of activities. The resulting wastewater has been treated by physical and biological methods to reduce any risks that may affect public health and environment. All over the world sewage sludge occurred because of wastewater treatment has been used for a variety of purposes. Most of authorities moderately met the recovery of stabilized sewage sludge and treated wastewater for agricultural purposes. The recovery of treated wastewater and sewage sludge in agriculture are an opportunity to reduce rapidly depletion of usable surface water and groundwater and plant nutrient deficiency of soil. Stabilized sludge can be used in agriculture without creating a negative impact on land reclamation, vegetation, soil and water quality as environmentally safety way (Sopper, 1989). American United States Environmental Protection Agency (EPA) supports the use of sewage sludge in agriculture because of macro and micro nutrients in the sludge to give a useful fertilizer effect and the organic matter in the sludge to give a good soil amelioration effect (During and Gath, 2002). Organic waste sludge is used in agriculture for covering the deficit of reducing organic and inorganic plant nutrients and organic materials content in soil products widely grown (Sosnowski et al., 2003). Application of sugar beet vinasse in agriculture has an enhancing effect on crop yield and improves the soil's quality (Vadivel et al., 2014). 177938000 tons of sugar is produced per year all over the world Turkey's sugar production is 1.15% of the world sugar production (Pancar Ekicileri Kooperatifleri Birliği, 2017). 200000 tons of crystal white sugar, which is 13.53% of Turkey's sugar production is produced by Konya Sugar Factory (Konya Şeker, 2017). Sludge resulting from the settling of beet washing water in the sedimentation tank was used in the research. The sludge is non-hazardous waste according to Turkish Environmental Legislation. There is 21500 tons of carbonation sludge arising from a sugar factory that produces 58300 tons of sugar per year (Krajnc et al., 2007). If we make a proportioning according to the amount of sugar produced in 2016 in the world, the amount of carbonation sludge formed in a year will be about 65620360 tons. The amount of carbonation sludge that approximately occurred in 2016-2017 production period will be approximately 758953 tons from sugar plants in Turkey. The storage of sludge is big problem. Disposal of sludge in land field will brings land shortage. Treatment cost of the sludge is increasing worldwide. Such reasons have increased attentions to the agricultural use of sludge. On other hand, the waste sludge is discharged into sea and stream beds usually where there is not enough vacant area for storage. Özyazıcı and colleague have investigated the effects of sugar industry carbonification sludge on tea plant yield. Carbonification sludge for the use of which constitutes the environmental problems for sugar factories will be assessed as soil conditioner in acid soils in their study (Özyazıcı et al., 2014). Use of sugar carbonification sludge in agricultural propose also brings a solution to environmental problems. Recycling the sugar waste as soil conditioner contributes sustainable agriculture and environment. Some of the natural minerals are also used for enhancing the soil properties in all over the world. One of natural minerals is pumice. Turkey's pumice reserve with calculated to be over one million tons (1479556876 m^3), rank in second in the world (MTA, 2017). Pumice regulates the air and water permeability of the soil, increases infiltration and reduces evaporation. Therefore, the soil available water capacity for plant becomes better level when the pumice is mixed into soil. Pumice doesn't contain weed seeds and disease elements with reason to be an inorganic material. Improving plant growth and increasing yield are reduced by pumice mixed into soil. With this characteristic, pumice provides growing irrigated crops with very little amount of water. Pumice increases salinity and soil sodicity applied since the soluble ion capacity is very low. Therefore, pumice has a neutral pH. In addition, it increases the usefulness of the nutrients and microorganism's activities in the soil mixed. Pumice's thermal conductivity is low, so the damage given to plants caused by temperature transitions will be minimized. Pumice can be used without any treating process, so it's economic and easy to move material (Gür et al., 1997). In this study, silage corn has been chosen as a trial plant to monitor the differences on soil properties were made by the pumice and sludge being used. Researching the effects of sugar industry sludge and pumice on soil properties and the plant growth characteristics as a soil conditioner is aim of this study. The hypothesis of the study is that "Sustainability in agriculture is possible by using the sugar plant sludge mixed with pumice as soil conditioner".

Material and Method

Experiment design

Pumice is a volcanic rock which has a porous, spongy structure. Pumice has numerous pores because of leaving the gas within suddenly during they are forming. There is often no connect among pores, so its permeability is low. Its heat and sound insulation are quite high (Özkan and Tuncer, 2001). Pumice was brought from a quarry at Nevsehir Province and Bekdik District used in the experiment. The sewage sludge of sugar plant has been dried at large drying bed. According to analyze results, sludge is lime-rich, has neutral pH, moderates containing organic matter, is a material that will not create any salinity problem. The sludge doesn't cause heavy metal pollution hence originated from food industry. The heavy metal analysis results are well below the maximum limit values of Soil Pollution Control Regulation for heavy metal content for stabilized wastewater treatment sludge that can be used in soil (Toprak Kirliliği Kontrolü Yönetmeliği, 2005)

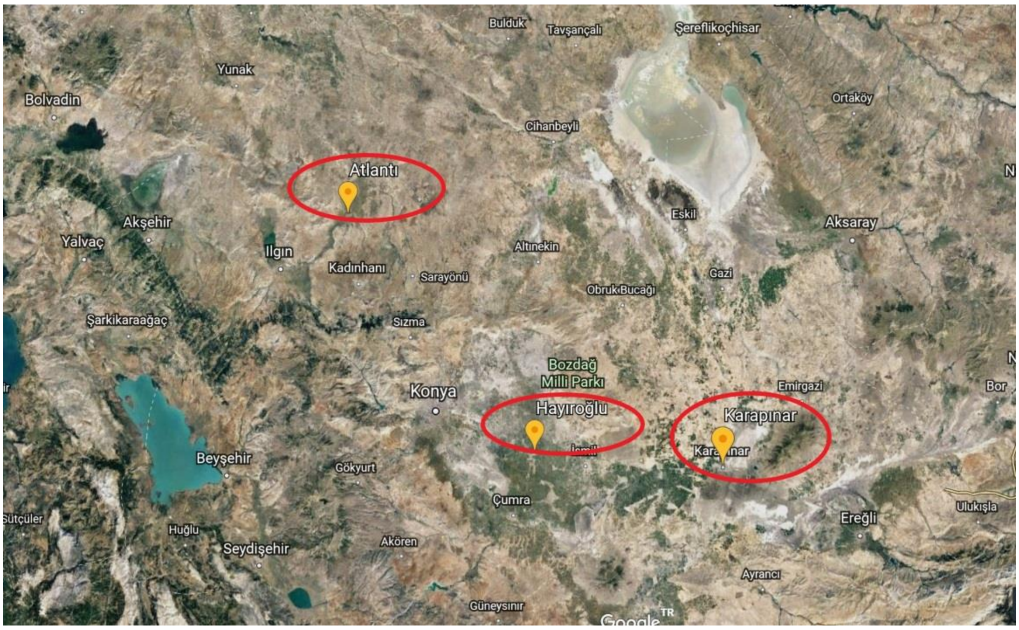

Figure1 Map showing places of soil samples collected

The soil has been used in the experiment, brought from three different regions named Karapınar, Hayıroglu and Atlantı which have different properties. The soil is brought from Karapınar which is east of Konya, 100 km away. Karapınar district is an erosion region. The soil is in the salty, alkali and salty-alkali class. Hayıroglu Town is at southeast of Konya, 25 km away. Vertical permeability is low in thin physique alluvial soils so it has shallow ground water. Hayıroglu's surface soil is damp and rich in organic matter and has easy–drained on the sub-surface and up surface of soil which will be dry faster. Atlantı Town is 15 km away from Kadınhanı District. The soil of Atlantı is in the soils colluvial class. Kadınhanı soil is young soil and in alluvial class (Konya İli Çevre Durum Raporu, 2006). Soils samples were taken from virgin areas weren't used for agricultural application in order to better observe the results of the study. The research is set up as randomized block design with split-split plot arrangement with three replications. The sludge, pumice and pumice and sludge are mixed into the soil at four doses (0, 40, 80, 160 tons/ha). The mixtures are settled in 10 kg pots. The fertilization hasn't been done to monitor the impact of pumice and sludge used in the experiment. The trial is settled in 108 pots with three different soils x four doses of substrates x three reiterations. Prepared pots are in placed in greenhouse of the Konya Environmental Directory. Silage corn is used experimental plant (Tunçez, 2007). Plants are harvested when they have finished their vegetative growth after the removal of tassels from the line followed by soil. After the harvest, the soil analyses and plant measurements are done. Plant measurements are carried out as reported by Sade after harvesting. Plant Height, number of leaves, stem weight, leaf weight, leaf length, stem diameter, dry matter of stem, and dry matter of leaf are determined (Sade, 1987).

Statistical analysis

The data obtained is analyzed by using SAS Software Hangen and Enhanced programs. The research is set up as randomized block design and variance analysis of the data obtained in STAT package software, the comparison of averages is made by Duncan test at SAS package software (SAS, 1985).

As a result of the analysis of variance, it was seen that there were differences among the groups. The Duncan test was used to compare the differences between the groups. The Duncan test is a widely used test where the magnitude order of comparative averages is important. In trials with increasing dose levels, the duncan test is applied to experiments in which factor levels are increasingly assayed and factorial ordering is considered important.

Research Findings and Discussion

Number of leaf

Table 1 Number of leaf (pcs) (Tunçez 2007)

	Dose tons/hectares (t/ha)	0	40	80	160	Average
Karapınar	Pumice	12.00	12.92	13.42	13.58	12.98
	Soil	12.50	13.00	13.00	13.33	12.88
	Pumice+Soil	12.38	12.83	13.42	13.83	13.20
	Average	12.20	12.92	13.41	13.58	
Atlantı	Pumice	12.50	13.17	13.42	14.00	13.27
	Soil	12.17	13.08	13.25	13.33	12.96
	Pumice+Soil	12.50	12.83	13.25	13.58	13.04
	Average	12.39	13.03	13.31	13.64	
Hayıroğlu	Pumice	12.25	13.17	13.58	14.17	13.29
	Soil	12.17	13.08	13.33	13.42	13.00
	Pumice+Soil	12.25	12.67	13.42	14.00	13.08
	Average	12.22	12.97	13.44	13.86	

While the effects of application and dose x application interactions on Karapınar soil are statistically significant at 5% level, the effect of doses is significant at 1% level. While the effects of application and dose x application interactions on the soil and Hayıroğlu regional soil are statistically insignificant, the effect of doses is significant at 1% level. The highest number of leaves is obtained in pumice-sludge mix (PS) application in Karapınar soil (13.20 pcs / plant), in pumice (P) applications Atlantı (13.27 pcs / plant) and Hayıroğlu (13.29 pcs / plant) soils in P application. The highest number of leaves is obtained in dosed 160 tons pumice-sludge mix/ha (PS160) application in Karapınar soil (13.83 pcs / plant), dosed 160 tons pumice/ha (P160) application in Karapınar soil (14.00 pcs / plant) and Hayıroglu soil (14.17 pcs / plant) when the dose x application interactions are analyzed. As the dose amounts increased for pumice, sludge and pumice-sludge applications number of leaf increased in all three soils. This shows that the plant's leaf numbers response to the dose and application positively. It is seen that leaf numbers detected in this study are parallel to Keskin's studies. The number of leaves is an important factor in silage corn Keskin found that leaf numbers in corn plants have grown between 11 and 13 per plant (Keskin, 2001). The highest number of leaves in the Karapınar and Hayıroğlu soils can be attributed to the fact that the pumice has a positive effect on the aeration of soil and the sugar plant sludge may have had a positive effect on the amount of plant nutrients in the soil. It is possible to refer to the fact that the highest yield obtained from the application of P160 in the Atlantı soil may have had a positive effect on the application of the pumice. It is seen that the highest increase is at soil of Karapınar region by comparing the highest values obtained from the soil in the research field to the values obtained from the control process. This can be attributed to the fact that soil of Karapınar region, which is inefficient compared to other regions, is more affected from the applications. In a study on the relationship between the number of leaves and the content of plant nutrients in the soil, it is determined that plant nutrients have increased the number of leaves in the plant (Lynch et al., 1991).

Plant height

Table 2 Plant height (cm) (Tunçez 2007)

	Dose (t/ha)	0	40	80	160	Average
Karapınar	Pumice	175.25	188.33	222.58	230.67	204.20
	Soil	174.00	196.42	214.00	220.25	201.17
	Pumice+Soil	175.33	186.25	222.83	232.33	204.19
	Average	174.86	190.33	219.80	228.42	
Atlantı	Pumice	184.00	219.17	226.83	240.74	217.69
	Soil	193.58	203.83	213.75	220.67	205.46
	Pumice+Soil	184.92	190.33	219.17	228.92	205.84
	Average	184.17	204.44	219.92	230.11	
Hayıroğlu	Pumice	179.75	203.08	231.42	244.67	214.73
	Soil	177.92	201.92	219.25	223.67	205.69
	Pumice+Soil	179.25	188.75	225.25	241.75	208.75
	Average	178.97	197.92	225.36	236.70	

The effects of dose and dose x application interactions on Karapınar soil are statistically significant at 1% level while the effect of applications is statistically junk. The dose effect on Hayıroglu soil is statistically significant at 1% level while application and dose application are statistically significant at 5% level. The highest plant height is obtained in Karapınar (204.20 cm), in Atlantı (217.69 cm) and Hayıroğlu (214.73 cm) soil at pumice (P) application as the mean of the doses. When the dose x application interactions are examined, the highest plant height is obtained in PS160 application in Karapınar soil (232.33 cm), in P160 application in Karapınar (14.00 pcs / plant) and Hayıroğlu (14.17 pcs / plant) soil.

The plant height increases as the dose amount increase at Table 2. This shows that the materials used have a positive effect on plant height. It is observed that pumice application gives the highest plant height in all soils used in experiment. According to this, it can be said that pumice application has more positive effect on plant height than the other applications.

Pumice has a positive effect on the aeration property of the soil and thus increases the availability of plant nutrients. As the dose amounts increased for pumice, sludge and pumice-sludge applications the plant’s height increased in all three soils. This shows that the plant's height response to the dose and application positively.

Stalk diameter

Table 3 Stalk diameter (mm) (Tunçez 2007)

	Dose (t/ha)	0	40	80	160	Average
Karapınar	Pumice	11.50	13.67	15.17	16.67	14.25
	Soil	11.42	13.42	14.00	14.33	13.29
	Pumice+Soil	11.25	12.92	15.33	16.58	14.02
	Average	11.39	13.34	14.83	15.86	
Atlantı	Pumice	12.75	15.00	16.42	17.17	15.34
	Soil	12.25	13.83	14.33	15.08	13.87
	Pumice+Soil	12.42	13.00	14.58	16.58	14.15
	Average	12.47	13.94	15.11	16.28	
Hayıroğlu	Pumice	12.33	13.92	16.05	17.25	14.89
	Soil	13.17	13.33	14.33	15.00	13.96
	Pumice+Soil	12.25	12.83	14.83	17.08	14.25
	Average	12.58	13.36	15.07	16.44	

The effects of dose, application and dose x application interactions in Karapınar, Atlantı and Hayıroğlu regional soils are statistically significant at 1% level. The highest stalk diameter as the mean of the different doses is obtained in application of P in Karapınar regional soil (14.25 mm), in P application in Atlantı (15.34 mm) and Hayıroğlu (14.89 mm) regional soils. When the dose x application interaction is examined, the highest stalk diameter is obtained with P160 application on Karapınar (16.67 mm), Atlantı (17.17 mm) and Hayıroğlu (17.25 mm) regional soils. It can be said that when the dose amount is increased, the plant stalk diameters are increased as well, accordingly to Table 3. Stalk diameter is positively affected by the applied materials. As the dose amounts increased for pumice, sludge and pumice-sludge applications the plant’s stalk diameters increased in all three soils. This shows that the plant's stalk diameters response to the dose and application positively. Güneş determined the stalk diameter as 23-24 mm in cultivated corn plants. When examined from the point of view of applications, it can be argued that the application of pumice only gives the highest stalk diameter et all locations, which may be caused by the application of pumice to the aeration and growth of the plant by providing better aeration than the sludge and pumice + sludge. The pumice increases the useful water and aeration properties of soils, thereby increasing plant yield (Güneş, 2004). Çokkızgın reported that in a study on corn, the plant nutrients were effective on the stalk diameter and the stalk thickened as the amount of plant nutrients increased (Çokkızgın, 2001).

Dry matter of leaf

Table 5 Dry matter of leaf (g) (Tunçez 2007)

	Dose (t/ha)	0	40	80	160	Average
Karapınar	Pumice	42.50	47.33	51.08	54.50	48.85
	Soil	41.50	51.83	53.25	54.33	50.23
	Pumice+Soil	42.08	47.42	53.33	57.33	50.04
	Average	42.03	48.86	52.55	55.39	
Atlantı	Pumice	46.00	53.33	55.92	60.42	53.92
	Soil	46.25	52.92	53.67	55.08	51.73
	Pumice+Soil	46.67	48.83	52.58	53.42	50.38
	Average	46.31	51.36	54.06	56.31	
Hayıroğlu	Pumice	44.08	49.92	56.42	62.75	53.29
	Soil	43.33	49.42	52.00	56.08	50.21
	Pumice+Soil	43.75	47.58	53.67	60.75	51.44
	Average	43.72	48.97	54.03	59.86	

The effects of dose, application and dose x application interactions in Karapınar, Atlantı and Hayıroğlu soils are statistically significant at 1% level. The highest dry matter as the average of the doses is obtained in the application of P (53.92 g / plant) and Hayıroğlu (53.29 g / plant) regional soil P in the application of Karapınar soil (50.23 g / plant) When the dose x application interaction is examined, the highest dry matter is obtained in the application of PS160 in Karapınar soil (57.33 g / plant), in the application of P in Atlantı (60.42 g / plant) and Hayıroğlu (62.75 g / plant) soil. As the dose amounts increased for pumice, sludge and pumice-sludge applications the plant's leaf dry matter increased in all three soils. This shows that the plant's leaf dry matter reply to the dose and application positively. It is seen from Table 5 that dry matter increases in all applications as the dose amount increases when the values of dry matter amount on the greenhouse experimental are compared with each other. This is an expected result if leaf weight is considered. Dry matter accumulation is essential for growth. As leaf weight increases, the amount of dry matter in general will increase accordingly.

Dry matter of stalk

Table 4 Dry Matter of Stalk (g) (Tunçez 2007)

	Dose (t/ha)	0	40	80	160	Average
Karapınar	Pumice	117.50	126.58	135.92	149.00	132.25
	Soil	117.75	139.17	141.25	143.42	135.39
	Pumice+Soil	117.67	131.42	141.92	150.50	135.38
	Average	117.64	132.39	132.39	147.95	
Atlantı	Pumice	120.50	135.25	142.00	147.58	136.33
	Soil	122.00	139.50	143.50	145.25	137.31
	Pumice+Soil	122.17	126.08	137.67	146.17	133.02
	Average	121.22	133.60	141.10	146.33	
Hayıroğlu	Pumice	117.17	135.58	151.83	159.83	140.94
	Soil	117.00	133.00	133.33	140.83	131.04
	Pumice+Soil	117.83	124.17	138.08	157.50	134.39
	Average	117.33	130.92	142.08	153.50	

The effects of dose and dose x application interactions on Karapınar soil are statistically significant at 1% level while the effect of applications is significant at 5% level. The effects of application, dose and dose x application interactions in Atlanti and Hayiroglu soils are statistically significant at 1% level. The highest determined dry matter as an average of the doses is obtained in the application of sludge (S) (135.39 g / plant) in Karapınar soil (137.31 g / plant) and in the application of pumice (P) in Hayiroglu (140.94 g / plant) soil. When the dose x application interaction is examined, the highest dry matter is obtained in the application of PS160 in Karapınar soil (150.50 g / plant), in the P application in Atlantı soil (147.58 g / plant) and Hayıroğlu (159.83 g / plant) soil.

When the results of the research are evaluated, it is seen that the amount of dry substance is increased with the amount of dose increasing in applications. It can be said that the pumice Atlantı and Hayıroglu soils. It can be said that the number of nutrients needed for the plant increases with sludge while pumice improve and soil structure of Karapınar. Aşık and Katkat reported that the amount of dry matter in the stalk increased with the application of sludge at increasing doses (Aşık et al., 2004).

Leaf weight

Table 6 Leaf weight (g) (Tunçez 2007)

	Dose (t/ha)	0	4	8	16	Average
Karapınar	Pumice	146.58	163.42	176.00	187.25	168.31
	Soil	146.58	168.00	170.33	175.33	165.56
	Pumice+Soil	146.33	164.50	178.00	191.08	169.98
	Average	147.16	165.31	174.78	184.55	
Atlantı	Pumice	152.42	174.58	183.42	194.92	176.34
	Soil	154.50	167.75	173.08	177.75	168.45
	Pumice+Soil	152.42	162.83	171.67	187.00	168.48
	Average	153.11	168.39	176.05	186.56	
Hayıroğlu	Pumice	153.58	170.33	184.67	199.17	176.94
	Soil	148.17	165.83	172.50	179.00	166.38
	Pumice+Soil	154.00	160.33	177.00	196.83	172.04
	Average	151.92	165.50	178.06	191.67	

The effects of dose, application and dose x application interactions in Karapınar, Atlantı and Hayıroğlu regional soils are statistically significant at 1% level. The highest leaf weight as a mean of the doses is obtained in PS application in Karapınar soil (169.98 g / plant), in P application in Atlantı (176.34 g / plant) and Hayıroğlu (176.94 g / plant) regional soil. When the dose x application interaction is examined, the highest leaf weight is obtained in the application of P160 in Karapınar regional soils (191.08 g / plant) and in the P (194.92 g / plant) application on Hayıroğlu soil (199.17 g / plant).

When all applications are evaluated in general, it is seen that the leaf weight increases in the plant as the dose amount increases. Acar found leaf weight between 84-105 g / plant, Güneş and collogue found leaf weight between 247-297 g / plant, and Sade found leaf weight between 139-186 g / plant (Acar, 2004; Güneş, 2002; Sade, 2002). The leaf weights obtained from the current study are in accordance with the values obtained in other studies. The basic functions of growth and growth of leaf plants play an essential role in the realization of many physiological and morphological functions such as photosynthesis, plant growth rate and net assimilation rate. For this reason, leaf growth is desirable as long as it does not harm plant growth. Leaf weight is generally positively affected by the applied materials. As the dose amounts increased for pumice, sludge and pumice-sludge applications the plant's leaf weight increased in all three soils. This shows that the plant's leaf weight reply to the dose and application positively.

Stalk weight

Table 7 Stalk weight (g) (Tunçez 2007)

	Dose (t/ha)	0	40	80	160	Average
Karapınar	Pumice	395.00	437.25	468.17	495.42	448.96
	Soil	394.92	415.42	455.75	462.08	432.04
	Pumice+Soil	396.83	438.67	472.75	505.75	453.50
	Average	395.58	430.45	465.55	487.75	
Atlantı	Pumice	417.83	466.17	488.42	515.83	472.06
	Soil	417.67	449.92	462.92	468.58	449.77
	Pumice+Soil	419.82	435.17	458.42	496.58	452.00
	Average	418.44	450.42	469.92	493.66	
Hayıroğlu	Pumice	408.83	454.67	490.42	516.33	470.06
	Soil	412.45	443.42	459.83	470.08	446.55
	Pumice+Soil	412.92	430.17	470.75	519.67	458.38
	Average	411.40	442.75	473.66	502.03	

The effects of dose, application and dose x application interactions in Karapınar, Atlantı and Hayıroğlu regional soils are statistically significant at 1% level. The highest stalk weight as the average of the doses is obtained in PS application in Karapınar soil (453.50 g / plant), in P application on Atlantı (472.06 g / plant) and Hayıroğlu (470.06 g / plant) soil. When the dose x application interaction is examined, the highest stalk weight is obtained in the application of PS160 in Karapınar (505.75 g / plant) and Hayıroğlu (519.67 g / plant) soils, in the application of P in Atlantı soil (515.83 g / plant). Leaf weight is generally positively affected by the applied materials. As the dose amounts increased for pumice, sludge and pumice-sludge applications the plant's stalk weight increased in all three soils. This shows that the plant's stalk weight reply to the dose and application positively. It is observed from evaluating the values of stalk weights that the weight of stalk increases with the number of doses increasing in applications. It can be said that increasing aeration in the Atlanti and Hayiroğlu soils leads to better nutrition of the plant consequently higher stalk weight by application of the pumice. In the Karapınar soil, the number of nutrients needed for the plant is increased by the sludge, while the aeration of the soil is increased by the pumice. Aşık and Katkat stated the increase in the weight of the stalk with the application of waste at increasing doses in the study they performed (Aşık and Katkat, 2004). Nitrogen, phosphorus and potassium elements have been reported to increase body growth in the researches on the growth of plant nutrients.

Results and Suggestions

It is seen that the results are close to each other in three different soils when the results obtained from the research are evaluated in general. From the characters of corn plant; plant height, stalk diameter and number of leaf are taken into consideration, the lowest values are obtained from the control doses and the highest values are obtained from pumice, sludge and pumice + sludge applications at doses of 160 t/ha. It can be argued that the same changes in three soil samples used in the research are due to the fact that these factors have positive effect on the plant growth. It is expected that all applications, especially in control doses, have similar results. A linear increase in the values of the parameters as the applied dose increased indicates that the application responses of the plants are in the positive direction. According to the results obtained in the study, it can be said that the study has a positive effect on plant growth and growth during the first growth periods of corn. It will be useful to determine how these applications affect yield and how dose quantities should be determined in more detail with different plants and with longer durations in future studies. Therefore, the main thing in agricultural production is productivity continuity. The results are quite promising when the obtained results were physiologically examined. The first growth periods are very important for the future periods of the plant. The plant which improves well during the first growth period is less affected by stress factors that may occur in future growth periods. In the later stages of the plant growth period, no matter how good growth environment is found it will not be possible to reach the actual yield if the plant is weak in the first plant growth period. Pumice and sludge application can able to rehabilitate the soil has usually poor organic matter and plant nutrients, poor drainage, poor utility water volume and low porosity.

A third of the world's land is inefficient due to unsustainable land management practices such as erosion, concretion, salinity, reduction of organic and nutritious materials in the ground, and cynicism.

One of the main measures that can be taken for sustainable agriculture is ensuring sustainable land management. Sustainable soil management will be provided if sludge and pumice are used as soil remediation.

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