Gesunde Pflanzen (2023) 75:2879–2887
https://doi.org/10.1007/s10343-023-00865-w

ORIGINAL ARTICLE / ORIGINALBEITRAG

The Effects Of Potassium Applied at Different Doses and Times on The Yield and Nutrient Content of Pumpkin Seed (*Cucurbita pepo* L.)

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Received: 19 December 2022 / Accepted: 21 February 2023 / Published online: 4 April 2023

Abstract

Potassium is an important nutrient in plant yield and fruit quality. Significant yield losses and quality defects can be seen in potassium deficiency. For this purpose, it was tried to examine the yield and yield parameters of potassium applied at different concentrations and from different sources, the yield and yield parameters of the pumpkin seed plant, and the changes in the leaf and grain nutrient content. In this study carried out in field conditions, After planting, 3 different sources of potassium fertilizer were used as potassium sulfate, potassium nitrate and potassium chloride at 0, 10 and 20 kg da^{-1} K_2O. The second different application was applied 40 days before the harvest with 3 different sources of potassium fertilizer as potassium sulfate, potassium nitrate and potassium chloride at 0, 2 and 4 kg da^{-1} K_2O from the leaf. This application is given in 2 parts. The first application was applied 40 days before the harvest, the second application was applied 15 days before the harvest. At the end of the plant vegetation period, the plants were harvested and the seeds in the fruit were removed. In this study, as a result of potassium fertilizer applications, statistically significant increases occurred in yield and nutrient content compared to the control group. The highest seed grain yield was obtained from 20 kg/da application of potassium sulfate (279.0 kg da^{-1}) after sowing. The lowest seed grain yield was obtained from the control group (151.0 kg da^{-1}). The highest grain potassium content was obtained with the application of potassium sulfate at 2 kg da^{-1} before 40 days harvest (8400 mg kg^{-1}). As a result of the PCA analysis, it was seen that especially potassium sulfate and potassium nitrate were applied to the pumpkin plant, resulting in a significant increase in yield. It is recommended to test the effectiveness of these results by applying them in different soil conditions and climatic regions.

Keywords Pumpkin seed · Fertilization · Potassium · Nutrient contents

Introduction

Pumpkin (*Cucurbita pepo* L.) is a plant that contains relatively large amounts of biologically active substances. This vegetable is best known as a source of carotenoids and dietary fibers. It also has a significant accumulation of mineral substances Humic acid-containing fertilizers applied to the pumpkin plant can positively affect the dry matter content of the pumpkin fruit. Depending on the content of the fertilizer used in these applications, the macro-micro element contents of the plant fruit may differ. In general, as a result of fertilizer applications, an increase is observed in the macro-micro element contents of pumpkin fruit (Paulauskiene et al. 2018).

Pumpkin is an important source of many mineral substances. In addition to potassium, iron, calcium and phosphorus, pumpkin pulp contains plant nutrients such as magnesium and copper (Lott et al. 2000; Biesiada et al. 2009; Pandya and Rao 2010; Adebyo et al. 2013). Adequate and balanced fertilization, irrigation and soil properties are of great importance in a good pumpkin cultivation. Although the optimum pH is between 6.0–7.5, it is very sensitive to nitrogen, phosphorus and potassium fertilization (Akanbi et al. 2007; Kulaitiene et al. 2007; Biesiada et al. 2009). However, nutrient content and quality of pumpkin fruit may decrease in excessive fertilization, especially in nitrogen fertilization (Oloyede et al. 2012). Farmers in the Central Anatolian Region, which is located in the arid and semi-arid regions of Turkey, prefer to grow the pumpkin seed

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plant in dry conditions due to its marketing and profitability advantages (Kırnak et al. 2019).

According to Ünlükara et al. (2022) investigated the effects of compost, mineral fertilizers, and organo-mineral fertilizers on the yield and yield parameters of pumpkin seeds. As a result of the study, it was stated that organic fertilizer applications significantly increased the average fruit weight and yield. In addition, they stated that increasing soil organic matter and applying 120 kg ha^{-1} nitrogen in pumpkin seed agriculture would have a positive effect on yield. Şeker (2012) carried out molecular characterization in order to determine the quality characteristics and differences between genotypes of 10 pods of pumpkin seed genotypes of the Cucurbita pepo species; According to the results of the research, 1000-grain weight is 162.05–270.75 g, moisture content of seeds is 5.67–6.81%, seed width is 8.08–10.76 mm, seed length is 17.54–26.13 mm, seed thickness is 2.06–2.73 mm, inner shell ratio is 77.90–82.21 mm, protein content 21.88–25.50%, oil content 36.94–40.63%.

In a study, while the hybrids of Cucurbita moschata with C. maxima and C. pepo were able to obtain seeds, they could not produce fertile seeds in both crosses with C. maxima and C. pepo. Yield per decare is around 20–40 kg da^{-1} in arid conditions and 100–150 kg da^{-1} in irrigated conditions. Approximately 1/3 of the seeds obtained as a result of harvest were determined as empty. This has been accepted as a productivity-reducing factor (Şensoy 2012).

According to the literature study, a fertilization rate of about 500–700 kg ha^{-1} from fertilizers containing 10:10:20 N:P:K is recommended for a good pumpkin cultivation (MacCarthy and Clapp 1990; Lundegardh and Martensson 2003; Paulauskiene et al. 2018). The contents of the applied fertilizers can significantly affect the quality components of the pumpkin plant. The mixture of complex and humic acid fertilizers significantly reduced the amount of crude oil in the pumpkin plant, while it was stated that the accumulation of crude protein in the seeds was stimulated (Jariene et al. 2007a).

Potassium is a plant nutrient that is important in plant growth and nutrition. Depending on the potassium application, an increase in yield can be seen in plants (Demirkaya and Gunes 2019; 2020). In the pumpkin plant, where potassium fertilizer was applied in nano form, the highest branch diameter, number of leaves and number of branches were obtained from the application of potassium fertilizer (Gerdini 2016). The ratios and balances of plant nutrients such as NPK in fertilizers can cause significant increases in pumpkin yield (Li et al. 2013). It was stated that especially K fertilization is important in optimum pumpkin yield. Studies have shown that 81 kg · ha^{-1} potassium fertilizer application is sufficient for optimum pumpkin yield (Huang et al. 2006).

This study was carried out to determine the changes in yield and grain nutrient content of pumpkin seed plant (*Cucurbita pepo* L.) as a result of the application of potassium fertilizer in different forms and at different doses.

Material and Methods

The experiment was carried out in the agricultural land of Gemerek district of Sivas province in Turkey. The experiment was carried out in the agricultural land of Gemerek district of Sivas province in Turkey. The province of Sivas, where the experiment was conducted, is located in the middle of the Anatolian peninsula, in the Upper Kızılırmak section of the Central Anatolian Region of Turkey. It is located between 36 and 39° east longitudes and 38° and 41° north latitudes. The annual average temperature of the experimental area is 9.03 °C, the annual average precipitation is 36.69 mm, and the annual average total precipitation is 440.28 mm. In the trial; Nevşehir Type (Tombak, Framed) pumpkin seed (*Cucurbita pepo* L.) for snacks was used. Nevşehir Type (Tombak, Framed) is a more oval and broad core type. It is currently the most cultivated type. It is mostly preferred in aquaculture in dry areas. Seed sowing was sown in May as 90 × 90 cm. Seed was sown at 600 g/da in sowing with seeder. When the plants reach the 3–4 leaf stage, the first hoe is made. Harvesting was done in the full maturity period, approximately 110 days after planting, when the leaves and stem of the plant turned completely yellow and brown, the fruit stalk dried up and could be easily separated from the plant body.

Potassium Fertilizer Application

The field on which the bean squash will be grown was plowed deeply in autumn. In autumn, 4–6 tons of well-burned barn manure was given per decare and soil analysis was performed before planting in the spring; Fertilization was made at 11 kg da^{-1} pure N and 4 kg da^{-1} pure P. Depending on the trial model, potassium was applied in two different periods, after sowing and 40 days before harvest.

After planting, 3 different sources of potassium fertilizer were used as potassium sulfate (50% K_2O), potassium nitrate (13% N and 46% K_2O) and potassium chloride (62% K_2O) at 0, 10 and 20 kg da^{-1} K_2O. The second different application was applied 40 days before the harvest with 3 different sources of potassium fertilizer as potassium sulfate, potassium nitrate and potassium chloride at 0, 2 and 4 kg da^{-1} K_2O from the leaf. This application is given in 2 parts. The first application was applied 40 days before the harvest, the second application was applied 15 days before the harvest.

Determination of Total Nitrogen in Grain and Leaf

The nitrogen content of the plant samples was calculated by the Mikrokjheldahl method after the plant was wet burned with a salicylic acid-sulfuric acid mixture (Bremner and Mulvaney 1982).

Determination of Other Elements (Na, Ca, K, P, Mg, Mn, Zn, Cu, Fe) in Grain and Leaf

After the macro-micro element contents of leaf and grain samples were burned in a microwave digestion unit with nitric acid-hydrogen peroxide (2:3) acid, they were filtered in the ICP OES spectrophotometer (Mertens 2005a) (Inductively Coupled Plasma Spectrophotometer, Agilent ICP-OES), determined by reading (Mertens 2005b).

Statistical Analysis

The results obtained in order to evaluate the effects of different potassium fertilizers and their doses on the pumpkin seed plant were tested according to the SPSS program. The results that were found to be important with the analysis of variance were grouped with the Duncan Multiple Comparison Test. The results that were found to be important with the analysis of variance were grouped with the Duncan Multiple Comparison Test. Principal components analysis (PCA) was performed with the help of the XLSTAT Addinsoft 2021 program to determine the relationship between the variables (Boston, MA, USA, https://www.xlstat.com) (Addinsoft 2021).

Results and Discussions

Effects of Potassium On Pumpkin Yield

When the parameters of the number of fruits per parcel were examined, it was determined that the highest amount of fruit was taken from the unit area after planting, with 20 kg of potassium sulfate application per decare, and the parcel with the least amount of fruit formation from the unit area was in the parcel where 4 kg of potassium chloride per decare was applied 40 days before the harvest. Fruits were obtained with the application of potassium sulfate fertilizer with an application dose of 2 kg da^{-1} 40 days before the harvest in the parcel with the highest fruit weight in the fresh weight measurements (Table 1). While the fruit with the lowest weight in fruit weight was found in the control plots, it was determined that the plots with potassium-containing fertilization had higher fruit formations compared to the control plots, regardless of application time, source and dose. When the seeds, which are the production purpose of the pumpkin plant, were examined, it was found that the most seed formation in the fruit was observed in the application parcel with 20 kg da^{-1}, and in the parcels where potassium sulfate was applied after planting. At the same time, as in the fruit weight parameter, it was determined that the least seed formation in the least unit area was observed in the control plots.

In similar studies, it was determined that the foliar application of potassium increased the growth and yield of the pumpkin seed plant, although it was not an important one in the yield (El-Hamed and Elwan 2011). If the amount of potassium in the plant is low or not in sufficient quantities, growth becomes stunted and yield loss is experienced (Romheld and Kirkby 2010). There are impor-

Table 1 The effect of different potassium doses on the pumpkin yield

Application time	Applications	Dose, kg da^{-1}	Number of fruits in the parcel	Fresh weight kg da^{-1}	Grain yield
After sowing	Control	0	29.67	2472.00c	151.00f
	Potassium Sulfate	10	33.67	2805.00bc	235.67abc
		20	37.67	2638.33c	279.00a
	Potassium chloride	10	31.00	2555.33c	157.33ef
		20	34.67	2583.00c	233.67abc
	Potassium nitrate	10	35.33	2833.00bc	247.00abc
		20	32.33	3083.00abc	221.00bcd
40 days before harvest	Potassium Sulfate	2	36.67	3528.00a	272.33ab
		4	31.33	3444.33ab	209.33cde
	Potassium chloride	2	29.33	2666.67c	169.67def
		4	26.33	3000.00abc	172.67def
	Potassium nitrate	2	30.67	2972.33abc	221.00bcd
		4	35.00	2527.67c	200.00cdef
Adjusted R^2			*0.350*	*0.363*	*0.638*
LSD			*4.459*	*299.407*	*23.985*

Table 2 The effect of different potassium doses on the grain macro nutrient content of pumpkin plant

Application time	Applications	Dose, kg da^{-1}	N %	Protein	P mg kg^{-1}	K	Ca	Mg	Na
After sowing	*Control*	*0*	*5.61de*	*35.04de*	*3528de*	*6622h*	*8740a*	*1120a*	*323a*
	Potassium Sulfate	10	6.59a	41.19a	3712b	8230bcd	8010fg	1040b	235e
		20	6.43a	40.19a	3912a	8177d	8020f	980cde	234e
	Potassium chloride	10	5.92c	37.00c	3455ef	7860f	8030f	940ef	250d
		20	5.87c	36.69c	3612bcd	7450g	8210de	860h	236e
	Potassium nitrate	10	6.55a	40.94a	3600	8100de	7900g	970de	244de
		20	6.51a	40.69a	3867a	7769f	8430b	890gh	276b
40 days before harvest	Potassium Sulfate	2	5.40f	33.72f	3544cde	8400a	7900g	920fg	250d
		4	5.44ef	34.00ef	3642bc	8320abc	8100ef	1020bc	244de
	Potassium chloride	2	5.79cd	36.20cd	3410f	8010e	8340bc	1010bcd	234e
		4	5.65d	35.31d	3544cde	7769f	8320bcd	940ef	265c
	Potassium nitrate	2	6.44a	40.26a	3644bc	8200cd	8110ef	1030b	244de
		4	6.12b	38.25b	3611bcd	8340ab	8240cd	960ef	241de
Adjusted R^2			*0.892*	*0.892*	*0.824*	*0.974*	*0.924*	*0.837*	*0.952*
LSD			*0.843*	*0.527*	*39.915*	*52.475*	*47.048*	*18.912*	*4.205*

tant relationships between potassium and fruity vegetables such as pumpkin plant (Marschner 1995). In the literature studies, it has been determined that optimum potassium nutrition of plants can contribute to plant development and yield by reducing the harmful formation of reactive oxygen species (ROS) caused by various environmental stress factors. In addition, it is seen that sufficient potassium levels in the plant have a positive effect on yield by reducing the incidence of diseases and pests (Amtmann et al. 2008; Romheld and Kirkby 2010). Similar to the literature studies, as a result of this study, the potassium fertilizers applied, significant increases were found in the yield of pumpkin seed plants.

However, in different studies, it was determined that foliar potassium applications did not have much effect on yield. In these studies, it was stated that especially the pumpkin seed plant had hard hairs on the leaf surface and therefore the effect of foliar applications was insignificant. They stated that the partial increase resulting from the application of potassium may be due to the increase in plant tolerance to biotic and abiotic stresses (Perrenoud 1990; Hermans et al. 2006).

The Effect of Potassium On the Grain Macro and Micro Nutrient Content of Pumpkin Plant

The effects of different potassium sources and doses on the macronutrients of pumpkin seed after planting and 40 days before harvest were examined in Table 2. According to the results of the examination, it is seen in this study that the highest amounts of nitrogen and protein content were obtained in plants with the application of 10 kg da^{-1} of potassium sulfate after planting. However, the lowest nitrogen and protein content was obtained by applying 2 kg da^{-1} of the same fertilizer source 40 days before the harvest. As the application time, the highest amount of phosphorus was obtained in the plant with the application of 20 kg da^{-1} potassium sulfate and potassium nitrate after planting, while the lowest phosphorus content was observed with the application of potassium chloride at 2 kg da^{-1} 40 days before the harvest. When the potassium content in the plant was examined, the highest potassium content was determined with the last application 40 days before the harvest and the application of potassium sulfate fertilizer in the amount of 2 kg da^{-1}. On the contrary, it is seen in Table 2 that the potassium chloride fertilizer has the lowest potassium content in the plant content with the application of 4 kg da^{-1} that 40 days before the harvest. Calcium, magnesium and sodium nutrient elements were determined in the highest amounts in control plants without any potassium fertilization. However, after planting, potassium sulfate fertilizer and the lowest amount of calcium are applied 40 days before the harvest, the lowest magnesium amount of potassium sulfate fertilizer is applied at 2 kg da^{-1}, and potassium sulfate is applied at 20 kg da^{-1} after sowing or potassium chloride is applied at 2 kg da^{-1} 40 days before harvest. It appears to have the lowest sodium content.

When the micro element content of the pumpkin seed plant is examined, it is seen that the highest iron nutrient content is obtained with the application of 20 kg kg da^{-1} of potassium chloride fertilizer after planting, while the application with the lowest amount of iron content is obtained with 10 kg kg da^{-1} of potassium sulfate. It was determined that the application of potassium nitrate 40 days before the harvest, at a rate of 4 kg da^{-1}, had the highest amount in terms of copper content (Table 3). However, the least

Table 3 The effect of different potassium doses on the grain micro nutrient content of pumpkin plant

Application time	Applications	Dose, kg da^{-1}	Fe mg kg^{-1}	Cu	Mn	Zn
After sowing	*Control*	*0*	*45.60de*	*30.89de*	*51.26ef*	*31.55def*
	Potassium Sulfate	10	43.45e	33.42bcd	56.45ab	34.23bc
		20	51.53b	32.45bcde	51.23ef	32.33cde
	Potassium chloride	10	50.12bc	33.26bcd	52.33def	33.24cde
		20	55.46a	34.21ab	54.35bcd	30.12f
	Potassium nitrate	10	54.46a	30.12e	57.43a	36.75a
		20	54.88a	31.28cde	54.11bcd	34.12bc
40 days before harvest	Potassium Sulfate	2	47.57cd	32.44bcde	53.44cde	32.44cde
		4	45.66de	31.76bcde	50.56f	31.22ef
	Potassium chloride	2	51.23b	34.25ab	55.43abc	33.44bcd
		4	48.67bc	34.26ab	53.44cde	32.24cde
	Potassium nitrate	2	50.23bc	34.11abc	52.36def	35.46ab
		4	54.36a	36.54a	51.24ef	33.90bc
Adjusted R^2			*0.854*	*0.506*	*0.688*	*0.650*
LSD			*1.046*	*0.837*	*0.875*	*0.640*

Table 4 The effect of different potassium doses on the leaf macro nutrient content of pumpkin

Application time	Applications	Dose, kg da^{-1}	N %	Protein	P mg kg^{-1}	K	Ca	Mg	Na
After sowing	Control	0	3.86l	24.10l	1737g	12,107g	9857a	2133a	537a
	Potassium Sulfate	10	5.02g	31.38g	1780fg	14,560d	9560de	2010b	510ab
		20	4.88h	30.50h	1980bc	14,890c	9610cd	1950bc	480bc
	Potassium chloride	10	5.45e	34.07e	1920d	14,500de	9450ef	2020b	450cd
		20	5.67d	35.44d	1800f	15,230b	9670bcd	1890cd	500ab
	Potassium nitrate	10	6.04b	37.75b	2010b	15,640a	9340f	1670f	380e
		20	5.78c	36.13c	1890de	15,230b	9750abc	1970bc	450cd
40 days before harvest	Potassium Sulfate	2	4.72i	29.50i	1890de	13,760f	9560de	1980bc	450cd
		4	4.22j	26.38j	1900de	14,900c	9620bcd	1820de	400de
	Potassium chloride	2	4.08k	25.50k	2010b	14,500de	9540de	1940bc	540a
		4	5.30f	33.13f	2100a	13,780f	9620bcd	2030b	420de
	Potassium nitrate	2	6.50a	40.63a	1940cd	14,350de	9760ab	1760ef	430d
		4	4.88h	30.50h	1860e	14,300e	9450ef	1840de	410de
Adjusted R^2			*0.996*	*0.996*	*0.889*	*0.984*	*0.772*	*0.805*	*0.787*
LSD			*0.138*	*0.087*	*10.670*	*40.000*	*47.405*	*34.663*	*8.772*

amount of copper was detected with the application of 10 kg da^{-1} K_2O after planting. When the amounts of manganese and zinc micronutrients were examined, it was determined that the highest amount of application time was observed after planting, and the amount of fertilizer applied and its source were 10 kg da^{-1} potassium nitrate. While the lowest amount of manganese content was observed 40 days before the harvest, 4 kg da^{-1} potassium sulfate fertilizer was observed, while the lowest amount of zinc content was obtained by applying 20 kg da^{-1} potassium chloride fertilizer after planting.

In fertilizer studies, fertilizer application over 100 kg NPK ha^{-1} decreased seed oil yield, fiber and protein (Oloyede et al. 2012). However, Jariene et al. (2007b) reported an increase in seed protein due to fertilizer application.

The Effect of Potassium On the Leaf Macro and Micro Nutrient Content of Pumpkin Plant

When the nutrient content of the leaves of the pumpkin plant is examined, it is seen in Table 4 that the highest nitrogen and protein content was obtained with the application of potassium nitrate at a dose of 2 kg da^{-1} at 40 days before the harvest. However, with the application of 2 kg da^{-1} potassium chloride at 40 days before the harvest, the

Table 5 The effect of different potassium doses on the leaf micro nutrient content of pumpkin plant

Application time	Applications	Dose, kg da^{-1}	Fe mg kg^{-1}	Cu	Mn	Zn
After sowing	Control	0	91.28cde	35.43d	53.44f	43.60gh
	Potassium Sulfate	10	89.45e	37.34bcd	55.46de	46.45ef
		20	92.32abc	38.76abc	58.63bcd	45.46 fg
	Potassium chloride	10	91.23cde	36.55 cd	54.34f	55.43a
		20	90.35de	37.12bcd	62.32a	48.78 cd
	Potassium nitrate	10	94.30ab	39.22ab	58.79bcd	42.35h
		20	91.20cde	37.55bcd	59.88ab	47.88de
40 days before harvest	Potassium Sulfate	2	94.53ab	35.44d	56.47cde	46.57ef
		4	90.12de	40.12a	55.66de	45.66f
	Potassium chloride	2	92.34bcd	38.67abc	59.78abc	48.77 cd
		4	91.23cde	38.79abc	58.80bcd	55.45a
	Potassium nitrate	2	95.40a	36.77bcd	57.82bcd	50.12c
		4	93.50abc	40.11a	60.23ab	52.34b
Adjusted R^2			*0.610*	*0.553*	*0.609*	*0.909*
LSD			*0.427*	*0.438*	*0.586*	*0.382*

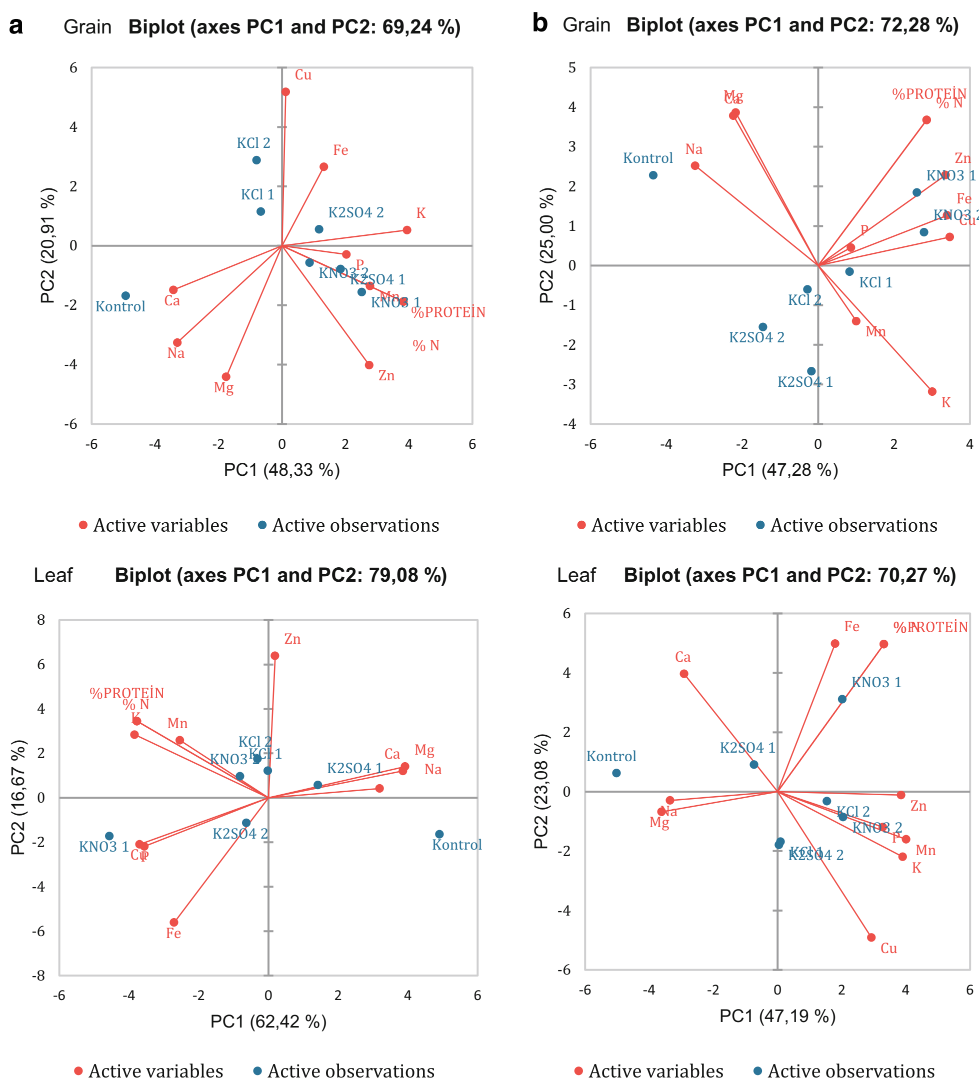

Fig. 1 Evaluation of plant grain and leaf nutritions contents by PCA analyses, **a** After sowing; **b** 40 days before harvest

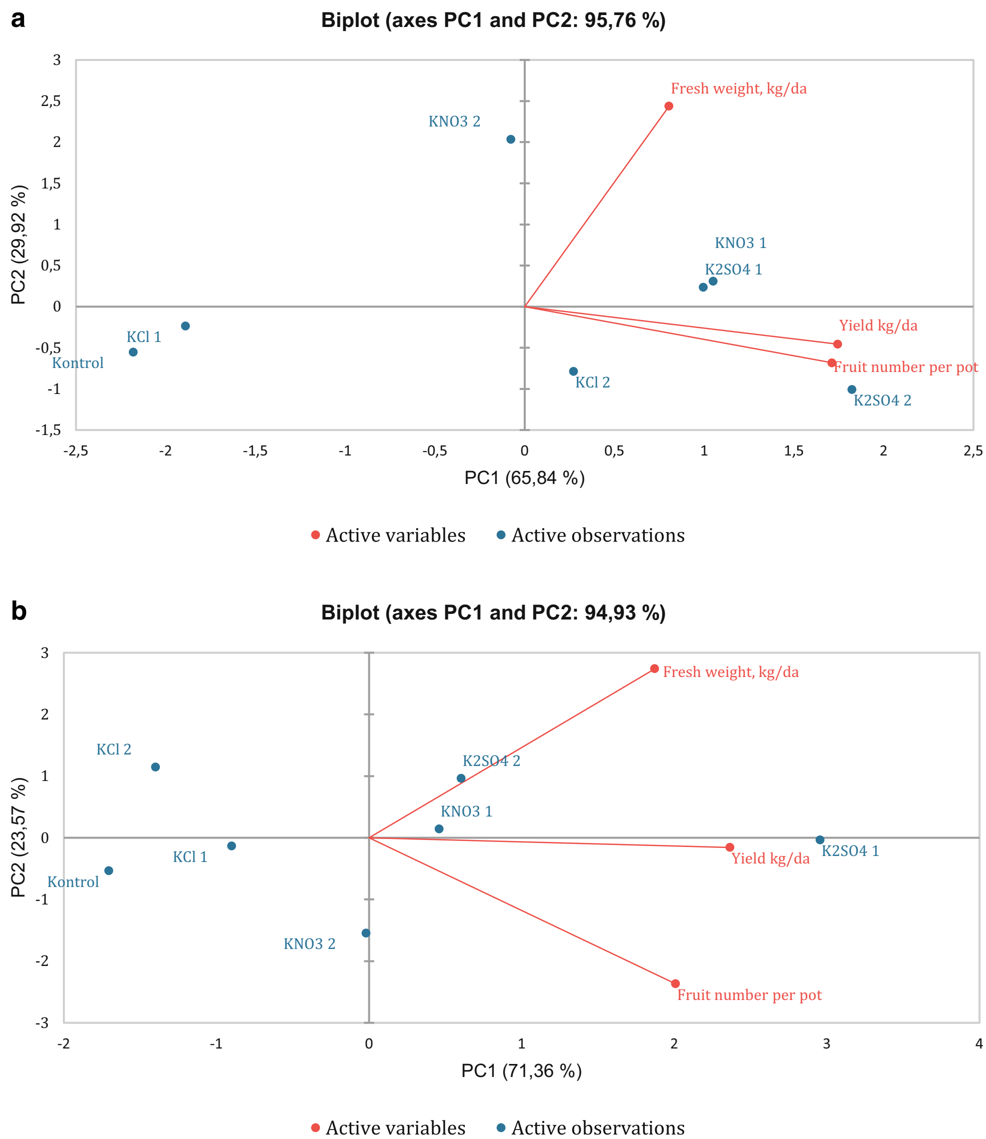

Fig. 2 Evaluation of yield and yield parameters of pumpkin by PCA analyses, **a** After sowing; **b** 40 days before harvest

nitrogen and protein amounts were found to be at the lowest level in the leaves. The highest amount of phosphorus content in the leaves was obtained by applying 4 kg da^{-1} of potassium chloride at 40 days before the harvest as the application time. Phosphorus content was found to be at the lowest level in control plants. When the potassium content was examined on the leaves, the most effective application time was found to be the most effective application after planting and the application of 10 kg da^{-1} potassium nitrate as the fertilizer source. The lowest potassium content in the leaves appears to be in the leaves of the control plants. Calcium, magnesium and sodium macronutrients were found at the highest levels in the leaves of control plants. Similarly, the amount of sodium in the leaves of the pumpkin plant was found to be higher with the application of 2 kg da^{-1} potassium chloride at 40 days before the harvest. The application time when the leaves are at the lowest level in terms of calcium, magnesium and sodium macro elements is after planting, the application source is potassium nitrate and the application amount is 10 kg da^{-1}.

The application time, which is encountered at the highest level in terms of Fe content, was found with the application of 2 kg da^{-1} of potassium nitrate applied 40 days before the harvest. However, with the application of potassium sulfate, which is a different potassium source, at an amount of 20 kg da^{-1} after planting, it was determined that the Fe content was at the lowest level in the leaves. When the Cu content in the leaves was examined, the applications with the highest amount of Cu were determined to be 4 kg da^{-1} potassium sulfate and potassium nitrate applications at 40 days before the harvest, while the lowest amount of Cu content in the leaves was in the leaves of the control plants. As a result of the examinations made on the leaves, it was observed that the leaves with the highest Mn content were in the plants that were applied 20 kg da^{-1} of potassium chloride after planting and in the control plants. It was determined that the plots where the same application time and source were used in plants with a lower dose amount had the lowest Mn content in the plant leaves. When the plant leaves were evaluated in terms of Zn, it was determined that the plant leaves containing more Zn than the other application plots were grown in the plots where the potassium chloride source applied 40 days before the harvest was applied at 4 kg da^{-1}. It is seen that the application plots, in which the zinc content of the plant leaves is found to be lower than the other applications, are in the plots where no potassium source is used with the control applications (Table 5).

In similar studies, the highest average content of macro and micro elements was found in pumpkin seed plants fertilized with mixed fertilizers. As a result of the application of these potassium-containing fertilizers, it was determined that while the calcium, iron, manganese, sodium and zinc content of pumpkin fruit increased, the amount of copper decreased (Paulauskiene et al. 2018). Danilchenko (2002) reported that higher levels of macro-micro elements accumulate in pumpkins fertilized with mixed fertilizers. Since the fruits of pumpkin plants fertilized with mixed fertilizers generally have the highest macro-micro element content, our study results were found to be compatible with these data.

Evaluation of Yield Parameters by PCA Analyses

PCA (Principal Component Analysis) analysis of the effects of potassium applied at different doses and in different forms on plant yield and plant nutrient element are given in Figs. 1 and 2. Accordingly, in terms of grain nutrient content, PC-A explains 69.24% and PC-B 72.28% of the total variance. In terms of leaf nutrient content PC-A explains 79.08% and PC-B 70.27% of the total variance (Fig. 1). In terms of plant yield, PC-A explains 95.76% of the total variance and PC-B explains 94.93% of the total variance.

In the literature study, it was reported that variance explanation rates above 70% were sufficient for the evaluation of the study results (Larrigaudiere et al. 2004). As a result of the study, it was concluded that the application of potassium nitrate and potassium sulfate after planting or 40 days before harvest was effective in terms of grain yield, fresh weight and fruit number (Figs. 1 and 2).

Conclusions

The yield and yield parameters of potassium applied at different concentrations and from different sources, the yield and yield parameters of the pumpkin seed (*Cucurbita pepo* L.) plant, and the changes in the leaf and grain nutrient content were tried to be investigated. As a result of this study, as a result of potash fertilizer applications, significant increases occurred in yield and nutrient content compared to the control group. As a result of the PCA analysis, it was seen that especially potassium sulfate and potassium nitrate were applied to the pumpkin plant, resulting in a significant increase in yield. It has been determined that it is important to give potassium to plants from sources such as potassium nitrate and potassium sulfate 40 days before planting or 40 days before harvest in order to increase the amount and quality of the product to be taken from the unit area.

Conflict of interest E. Budak and A. Güneş declare that they have no competing interests.

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