Effect of chelated potassium fertilizer and humic acid on quality traits of two industrial potato (Solanum tuberosum L(.

1Dawan Sardar Hama Ali 1Luqman Gharib Karim Barznjy
1University of Sulaimani, College of Agricultural Engineering Sciences, Department of Horticulture, Kurdistan Region, Iraq
dawan.hama@univsul.edu.iq luqman.karim@univsul.edu.iq

ABSTRACT

The study was carried out to response of chelated potassium fertilizer and humic acid on quality traits of two industrial potato cultivars (Hermes, and Challenger) New Zealand origin in the fall season, planted in an open field of the educational field of Horticulture Department, College of Agricultural Engineering Sciences, University of Sulaimani, during the fall season of 2024. A factorial-completely randomized block design RCBD with three replications was used in this study. The important results can be exhibited as the 3g L-1 chelated potassium achieved the highest values of total soluble souled, tuber hardness, ascorbic acid, dry matter and starch content in the tuber with (3.900%, 11.908 kg cm2, 241.873 µg g-1 FW, 26.113%, and 19.273%) respectively. 10g L-1. Humic acid obtained the highest values of the total soluble souled (0.257%), dry matter (24.652%), and starch content in the tuber (17.971%). 0g L-1 Humic acid obtained the highest values of the total acidity (0.412%), and carotenoid content (5.092 µg g-1 FW). About the cultivars the Hermes cultivar obtained the maximum values of total acidity (0.384%), ascorbic acid (229.996 µg g-1 FW), dry matter (24.164%), and starch (17.536%), Challenger cultivar achieved the maximum value of carotenoid (5.063 µg g-1 FW).About interaction between chelated potassium and varieties 3g L-1 chelated potassium with Hermes variety achieved tubers hardness, ascorbic acid, and carotenoid in tuber with (12.022Kg cm2, 255.072, and 5.517 µg g-1 FW).For the more the interaction 0g L-1 Humic acid with challenger variety achieved the maximum value of carotenoid with (6.008 µg g-1 FW).Abut triple interaction the 3 g L-1 chelated potassium with 5 g L-1 humic acid and challenger variety obtained the maximum value tuber hardness and carotenoid content with (12.800kg cm-2 and 6.477 µg g-1 FW) respectively.

Keywords: Solanum tuberosum, chelate potassium, Organic fertilizer, manufacturing potatoes, cultivars

INTRODUCTION

Potato (Solanum tuberosum L.) is a globally significant staple crop, ranking fourth in production after wheat, maize, and rice (FAOSTAT, 2023). As a principal industrial crop, its quality traits such as starch content, dry matter, and tuber uniformity, directly affect the efficiency of the processing and the quality of the end product (Jaspreet Singh, 2009). According to the (FAOSTA, 2024), It

ISSN 2072-3857

serves as a vital food crop consumed by more than one billion people worldwide. Potatoes are one of the agricultural products with high nutritional value and there are hundreds of ways of using them and making a variety of meals (Jensi, 2025). In 2023, more than 383 million tons of potatoes will be produced worldwide (FAOSTAT, 2023). (Kabira et al., 2023). Industrial potatoes are in high demand for chip French fry factories, which produce more than 11 million tons of potatoes annually (NeBambi Lutaladio, 2009 .(

Potassium (K) is very important nutrient for potato growth, tuber bulking, stimulates starch formation, and increases stress resistance (Al-Kazemi, 2017).Potatoes are a crop that requires a lot of K among the fertilizers used (Ayalew et al., 2011). Giving adequate amounts of K to potato plants improves tuber quality, and increases total yield. It also reduces the risk of black spots and hollow heart. On the other hand, it enhances processing characteristics, gives potato chips a suitable color, and increases plant resistance to diseases, environmental stresses, and pathogens (Römheld, 2010). Spraying potatoes with potassium humate or potassium silicate significantly improves growth, yield, and yield components in both growing seasons (Kabira and Lemaga, 2023) . Spray potassium also significantly improves chlorophyll and sugar levels in potato tuber (Hadia Hassan, 2024). (Hadia Hassan, 2024). Foliar application of k2O at 1% has significantly improved tuber yield and quality of potatoes (Sayed, 2016.(

Humic acid, as an organic fertilizer, can potentially improve soil structure, fertility, and crop growth. Although the efficiency of humic acid varies according to previous studies, the mechanism of action of humic on the regulation of weather conditions, soil characteristics, and fertilizer programs is constantly being studied. Humic acid increases yield by 12%, nitrogen absorption by 17%, and nitrogen utilization by 27%. (Yunqi Ma, 2024). The use of humic acids had a beneficial effect on nutrient uptake and soil condition which in turn enhanced the growth, yield, and quality of potatoes. Enhanced levels of humic acids promoted marked increases in tuber weight, dry matter, and productivity (Al-Zubaidi, 2018). The uptake and use of N, P, and K by plants was improved by humic acid based fertilizers in comparison to inorganic fertilizers (Du HuiYing et al., 2007).Application of humic acid-based (bio-stimulant) significantly improved several quality parameters of potato tubers, such as specific gravity, total soluble solid, total acidity, and tuber hardness (Shabana, 2023.(

The quality of potato tubers refers to internal and external quality. Several characteristics determine the internal quality of the potato, the most important of which are the amount of dry matter, starch content, and sugar (Van Eck, 2007).High specific gravity, dry matter, and starch content are crucial in processing to improve chip products in terms of yield and crispness and minimize oil uptake during frying (Bohl, 2010; de Freitas, 2012.(

Industrial potato varieties should have a high starch content above (>13%) and have an

ISSN 2072-3857

exemplary dry matter for processing into chips, fries, and other products (Asefa et al., 2016; Kirkman, 2007). However achieving consistent quality depends on both genetic potential and agricultural management, especially in the supply of nutrients (Kabira et al., 2023.(

Potato tubers' quality and chemical composition are significantly affected by factors such as genetic factors, soil fertility, climatic conditions, and chemical treatments (Muthoni et al., 2014). Obtaining development potato varieties with improved quality after harvesting is an important point for all aspects of the potato industry. Potato processors and other potato consumers benefit from hybrid yields when varieties have the same specific gravity in different growing climates (Kabira and Lemaga, 2003(. Despite its economic importance and many benefits, potatoes are one of the vegetable products that are rich in minerals and palatable (Fabbri and Crosby, 2016). The existence of wide differences among potato varieties in specific gravity, dry matter and starch content is evidence that genetic and environmental factors influenced tuber internal quality attributes. In general, a starch content of 13% or more is considered suitable for processed potato products. (Kirkman, 2007; Mohammed, 2016.(

The study aims to evaluate the effect of chelated fertilizers containing potassium and humic acid on the quality characteristics of two industrial potato varieties, Hermes and Challenger, in the autumn season, and to determine the best levels suitable for increasing and improving quality.

MATERIALS AND METHODES

The study was conducted from August to December 2024 in the Horticulture Department of the College of Agricultural Engineering Sciences at the University of Sulaimani. The GPS coordinates were 35º 53' 7.9'' N, 45º 36' 4.5'' E, 741masl, (Najmaddin et al., 2017). The study conducted to effect of spray three levels of chelated potassium (0, 1.5, and 3 gL-1), soil application of three levels of humic acid (0, 5, and 10 gL-1) and two industrial potato cultivars (Hermes and challenger). The metrological data was showed in the Table 1. Before planting, the soil samples were collected to determine the physical and chemical properties of the soil, as shown in Table 2. The tubers were planted in 20/8/2024 in the open field, The experimental unit area was 4m2 (1width ×4 length) number of experimental units was 54 (3×3×2×3) distance between to plant was 0.25m, number of plant in each (furrow) experiment units were 16 plants and drip irrigation was used to irrigated plants, after 45 days of planting tuber the chelated potassium spray and humic acid added to plants according to their levels by three times 15 days intervals between them. Finally, after 105 days of tuber planting the tuber were mature and harvested, the data were collected and analysis statically .

Experimental design

The Randomized Complete Block Design (RCBD-Factorial) with three replications was used to analysis of variance (ANOVA). All possible comparisons among the means were carried out by using Least Significant Difference (L.S.D) test at a significant level of

5% after they show their significance in the general test (AL-Rawi and Khalafallah, 1980 .(

Table 1: Meteorological information Sulaimani city from May to December 2024

Months	Temp. (C)			Humidity (%)			Rainfall (mm)	Avg. Pan Evaporation (mm)	Avg. Sunshine Duration Hours	Soil Temp. (°C) 20cm
	Avg.	Max.	Min.	Avg.	Max.	Min.				
May	22.1	27.8	16.3	56.2	74.6	37.8	99.6	5.1	8.0	22.8
June	32.3	38.3	26.3	29.5	39.7	19.3	-	12.2	11.5	33.2
July	33.9	40.4	27.5	30.3	42.0	18.6	-	14.9	11.7	36.7
Augusts	34.1	41.1	27.1	28.8	43.1	14.5	-	11.6	11.0	36.9
September	29.3	35.8	22.8	35.4	50.6	20.1	-	7.9	9.9	32.9
October	21.4	27.7	15.1	39.2	54.3	24.2	0.8	6.6	8.3	24.8
November	13.8	18.3	9.3	69.0	87.0	51.0	135.2	2.0	5.0	14.8
December	9.5	14.6	4.5	60.9	81.9	39.8	43.5	2.3	5.7	8.4

Table 2: The physical and chemical profile of the soil.

Characters	**Sand**	**Silt**	**Clay**	**Texture**	**pH**	**$CaCO_3$**	**O.M.**	**EC**	**Total N^+**	**Available $P^=$**	**Soluble K^+**
Values	10	47	43	Silty Clay	7.29	38.2	1.5	0.14	175.6	3.4	300.8
Unites	%	%	%			%	%	ms cm^{-1}	mg kg^{-1}	mg kg^{-1}	mg kg^{-1}

Qualitative Yield Parameters were determined in the tubers

Total Soluble Solid (%), According to (A.O.A.C, 1986.(

Total Acidity (%), was determined according to (Tahir et al., 2022 .(

Tuber hardness (kg cm-2): was measured according to (Barznjy., 2019.(

Dry matter (%), was calculated according to (Rasul et al., 2022.(

Starch content (%): The percentage of starch was estimated based on the dry weight of the tuber according to the (A. O. A. C. 1970). Starch in Tuber (%) =17.55+0.891(Tuber dry matter percentage – 24.18(

ISSN 2072-3857

Ascorbic acid content (µg g-1 FW), according to (Halshoy et al. 2024.(

Carotenoids content and Total phenolic content (µg g-1 FW), according to (Rasul, 2023.(

RESULTS AND DISCUSSION

Table 3 shows the effects of different levels of chelated potassium on the qualitative characteristics of potato tubers, the 3g L-1 of chelated potassium increase each of total soluble solid, tuber hardness, ascorbic acid content, dry matter and starch content with (3.900%, 11.908 Kg cm-2, 241.873 µg/g FW, 26.113%, 19.273%) respectively. While the control treatment (0 g L^{-1} chelated potassium) gave the lowest values for total soluble solids, tuber hardness, dry matter, and starch content (3.099%, 9.839 Kg cm-2, 20.664%,14.417%) respectively. Total acidity observed the highest value with (0.422%) in the control treatment (0 g L^{-1} chelated potassium), while (1.5 g L^{-1}) chelated potassium application, gave the lowest values of total acidity and ascorbic acid with (0.359% and 194.025 µg/g FW) respectively. The carotenoid content and total phenolic content in the tuber were not significantly influenced by chelated potassium application. The addition of potassium sources by foliar spraying has resulted in significantly. increased dry matter, and increased starch content and yield reported by (Ali et al., 2021). Another study also indicated that the use of potassium sources such as potassium nitrate and potassium humate had a significant effect on the quality of parameters such as dry matter, starch content and specific gravity (Ewais et al., 2020.(

Table 3: Effect of different levels of chelated potassium on qualitative characteristics of potato tubers.

Chelated Potassium levels	Total Soluble Solid (%)	Total Acidity (%)	Tuber Hardness (Kg cm^{-2})	Ascorbic acid content (µg/g FW)	Carotenoid content (µg g^{-1} FW)	Total phenolic content (µg g^{-1} FW)	Dry matter (%)	Starch in tuber (%)
0 g L^{-1}	3.099	0.422	9.839	223.634	4.830	785.818	20.664	14.417
1.5 g L^{-1}	3.889	0.359	9.869	194.025	4.587	872.959	24.673	17.989
3 g L^{-1}	3.900	0.361	11.908	241.873	4.593	860.849	26.113	19.273
LSD ($P \leq 0.05$)	0.257	0.042	0.585	33.223	n.s	n.s	1.298	1.157

Table 4 shows the effect of different levels of humic acid on the qualitative characteristics, Humic acid had a great effect on traits except tuber hardness, ascorbic acid content, and total phenolic content. The control treatment (0 g L-1) obtained the maximum values of total acidity and carotenoid content with (0.412% and 5.092 µg/g FW) respectively. On the other hand, the (10 g L-1) soil application of humic acid achieved the maximum values of total soluble solid, dry matter, and starch content with (3.889%, 24.652%, 17.971%) respectively. While (0 g L-1) treatment obtained the lowest values of total soluble solids, dry matter, and starch content with (3.354%, 22.180%, and 15.768%) respectively. Whereas the (10 g L-1) soil application of humic acid archived the minimum values of total acidity and carotenoid content with (0.359% and 3.909µg/g FW) respectively. Application of humic acid at different levels (0, 3, 6, 9 L da-1(1000m2)) on different varieties of potatoes has resulted in improved quality parameters of potato tubers such as starch content (ranging from 11.7% to 17.3%), dry matter, and oil holding capacity of potato chips (Çöl Keskin, 2021). Another study also showed that the use of higher concentrations of humic acid (18 ml/L) compared to two concentrations of (0, 9 ml/L) significantly improved yield and quality characteristics of potatoes for all potato cultivars used (Saeid, 2017.(

Chelation is a process where a molecule, typically an organic compound, binds to a metal ion, in this case, potassium (K+). This binding process forms a stable, ring-like structure that protects the potassium ion. (Gulcin and Alwasel, 2022). Inside the plant, the chelating agent releases the potassium ion, making it available for various physiological processes (Madhupriyaa et al., 2024). Chelated potassium is more easily absorbed by plants, reducing the risk of potassium deficiency. and Enhanced Plant Growth: Adequate potassium nutrition promotes healthy plant growth, fruiting, and flowering (Huang et al., 2022.(

Table 4: Effect of different levels of humic acid on qualitative characteristics on potato tubers

Humic acid levels	Total Soluble Solid (%)	Total Acidity (%)	Tuber Hardness (Kg cm^{-2})	Ascorbic acid content (µg g^{-1} FW)	Carotenoid content (µg g^{-1} FW)	Total phenolic content (µg g^{-1} FW)	Dry matter (%)	Starch in tuber (%)
0 g L^{-1}	3.354	0.412	10.600	214.247	5.092	867.216	22.180	15.768
5 g L^{-1}	3.645	0.372	10.422	225.173	5.010	796.429	24.618	17.940
10 g L^{-1}	3.889	0.359	10.594	220.111	3.909	855.980	24.652	17.971
LSD ($P \leq 0.05$)	0.257	0.042	n.s	n.s	0.318	n.s	1.298	1.157

ISSN 2072-3857

Table 5 show the effect of different potato varieties on qualitative characteristics the cultivars have significantly differences on total acidity, ascorbic acid content, dry matter, and starch in the tubers. The Hermes cultivar obtained the maximum values of total acidity, ascorbic acid content, dry matter, and starch in the tubers with (0.384%, 229.996 µg/g FW, 24.164% and 17.536%) respectively. Furthermore, the challenger cultivar achieved the maximum value of carotenoid content with (5.063 µg/g FW). While challenger cultivar obtained the minimum values of total acidity, ascorbic acid content, dry matter, and starch in the tubers with (0.378%, 209.692 µg/g FW, 23.469% and 16.917%) respectively. While the Hermes cultivar achieved the lowest value of carotenoid content with (4.278 µg/g FW). On the other hand, each of the characters total soluble solid, tuber hardness, and total phenolic acid were non-significant differences by both Hermes and Challenger cultivars. Variety significantly affects specific gravity, dry matter and starch content, as shown in a study of 17 potato cultivars (Mohammed, 2016). Also, Barznjy et al. (2023) conducted a study on four types of potato jelly, Donata, Hermes, and Caruso. The results obtained show that the Hermes cultivar recorded the highest values of dry matter (30.79%) and starch content (23.44%). These results confirm that Hermes has a high qualitative trait. Genetic architecture has great influence on yield and quality of potato. Various varieties of potato having wide variation in their yield potential and quality attributes have been evolved. These varieties further show variation in their attributes under different agroclimatic conditions. Different variety of potato has different nitrogen use efficiency (Trehan, 2003). Different varieties of potato were evaluated to see the effect on dry matter accumulation, chlorophyll content, grade wise potato tuber yield and postharvest nutrient content in plant and soil (Singh et al., 2022 .(

Table 5: Effect of different potato varieties on qualitative characteristics

potato varieties	**Total Soluble Solid (%)**	**Total Acidity (%)**	**Tuber Hardness (Kg cm^{-2})**	**Ascorbic acid content (µg g^{-1} FW)**	**Carotenoid content (µg g^{-1} FW)**	**Total phenolic content (µg g^{-1} FW)**	**Dry matter (%)**	**Starch in tuber (%)**
Hermes	3.607	0.384	9.946	229.996	4.278	916.613	24.164	17.536
Challenger	3.652	0.378	11.131	209.692	5.063	763.138	23.469	16.917
LSD **($P \leq 0.05$)**	n.s	0.034	n.s	27.127	0.260	n.s	1.060	0.945

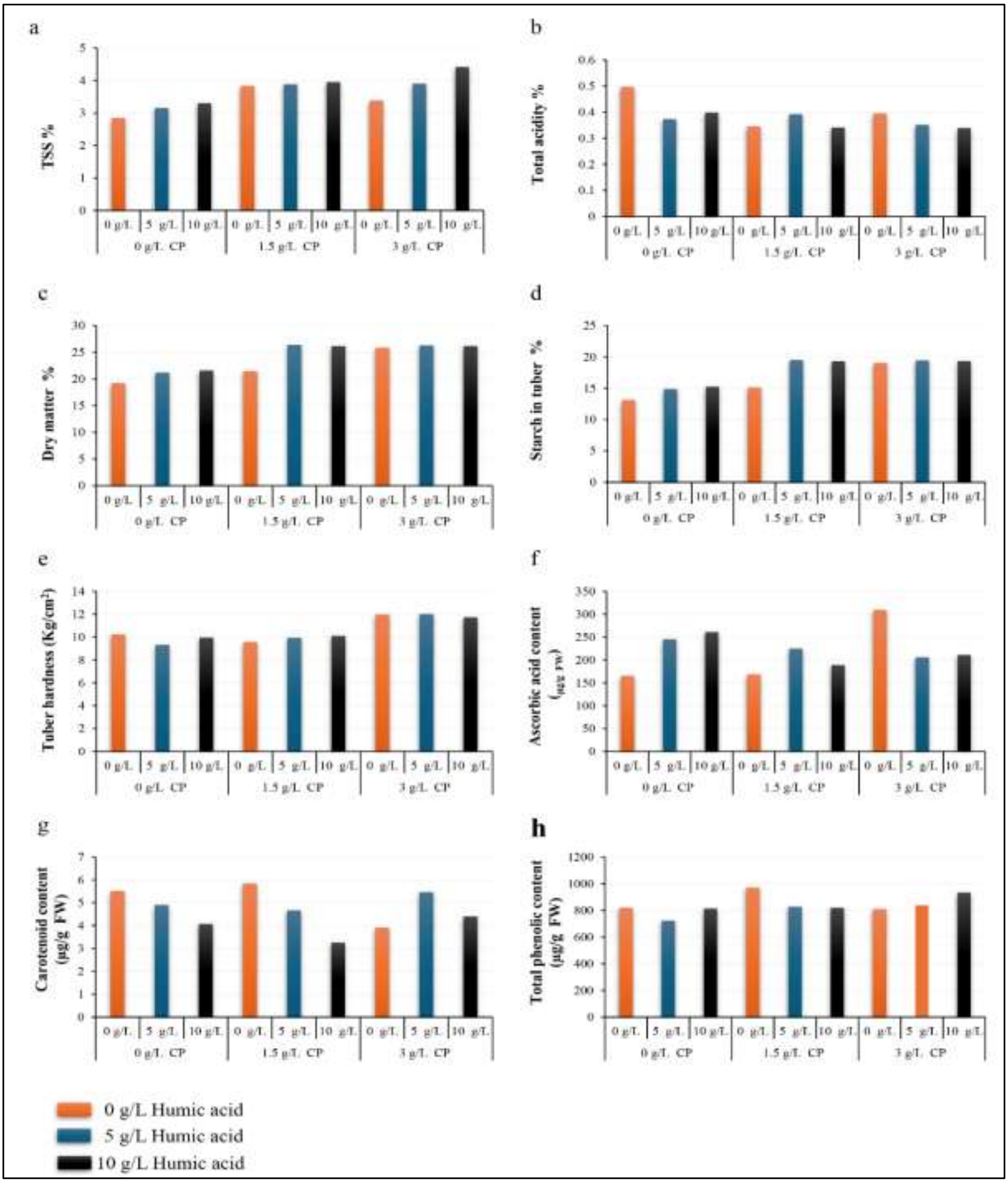
ISSN 2072-3857

Effect of the interaction of chelated potassium and humic acid on potato qualitative characteristics

According to the results shown in Figar. 1 the interaction of different levels of chelated potassium with humic acid significantly affected the tuber hardness and carotenoid content, whereas the total soluble solids, total acidity, ascorbic acid, total phenolic content, dry matter, and starch content were not significantly affected. The spray (3 g L-1) chelated potassium with (5 g L-1) soil application of humic acid resulted in a maximum value of tuber hardness of 12.017 kg cm-2, whereas the interaction of 0 g L-1 chelated potassium and 5 g L-1 humic acid resulted in the lowest value (9.317 kg cm-2). The interaction of 1.5 g L-1 chelated potassium with 0 g L-1 humic acid resulted in a maximum carotenoid content of 5.844 µg/g FW, and the lowest value was recorded for the interaction between 1.5 g L-1 chelated potassium and 10 g L-1 humic acid, which was 3.255 µg/g FW.

On the other hand, as shown in Figar. 2 the interaction between the chelated potassium level and potato variety significantly affected the total soluble solid content, total acidity, tuber hardness, ascorbic acid content and carotenoid content in the tubers. Whereas, the interaction effect between chelated potassium and potato variety had no significant effect on the total phenolic, dry matter, or starch content. The maximum value of total soluble solids (0.451%) was recorded for the Hermes variety (1.5 g L^{-1}), whereas the minimum value of total soluble solids (2.931%) was recorded for the Hermes variety (0 g L^{-1}). The (0 g L^{-1}) chelated potassium with the challenger variety had the highest total acidity (0.451%), whereas the (1.5 g L^{-1}) chelated potassium with the challenger variety had the lowest total acidity (0.336%). In addition, (3 g L^{-1}) chelated potassium with Hermes variety yielded the highest amount of tuber hardness with (12.022 kg cm^{-2}), the minimum value obtained by interaction of (1.5 g L^{-1}) chelated potassium with Hermes variety with (8.572 kg cm^{-2}), for ascorbic acid and carotenoid content, (3 g L^{-1}) chelated potassium with the challenger variety yielded the highest values with (255.072 and 5.517 µg/g FW), and the lowest value was observed in (1.5 g L^{-1}) chelated potassium with the challenger variety with (163.523 µg/g FW), and the lowest value of carotenoid content achieved by interaction chelated potassium with the Hermes variety with (3.669 µg/g FW). Potassium is a mobile element in plant tissue and plays an important role in photosynthesis through carbohydrate metabolism, osmotic regulation, nitrogen uptake and the translocation of assimilates. It also plays a role in physiological processes such as plant respiration, transpiration, the translocation of sugars and carbohydrates and enzyme transformation (Sardans and Peñuelas, 2021.(

ISSN 2072-3857



Figar. 1 Effects of interactions between different levels of chelated potassium and humic acid on the qualitative characteristics of potato tubers

ISSN 2072-3857

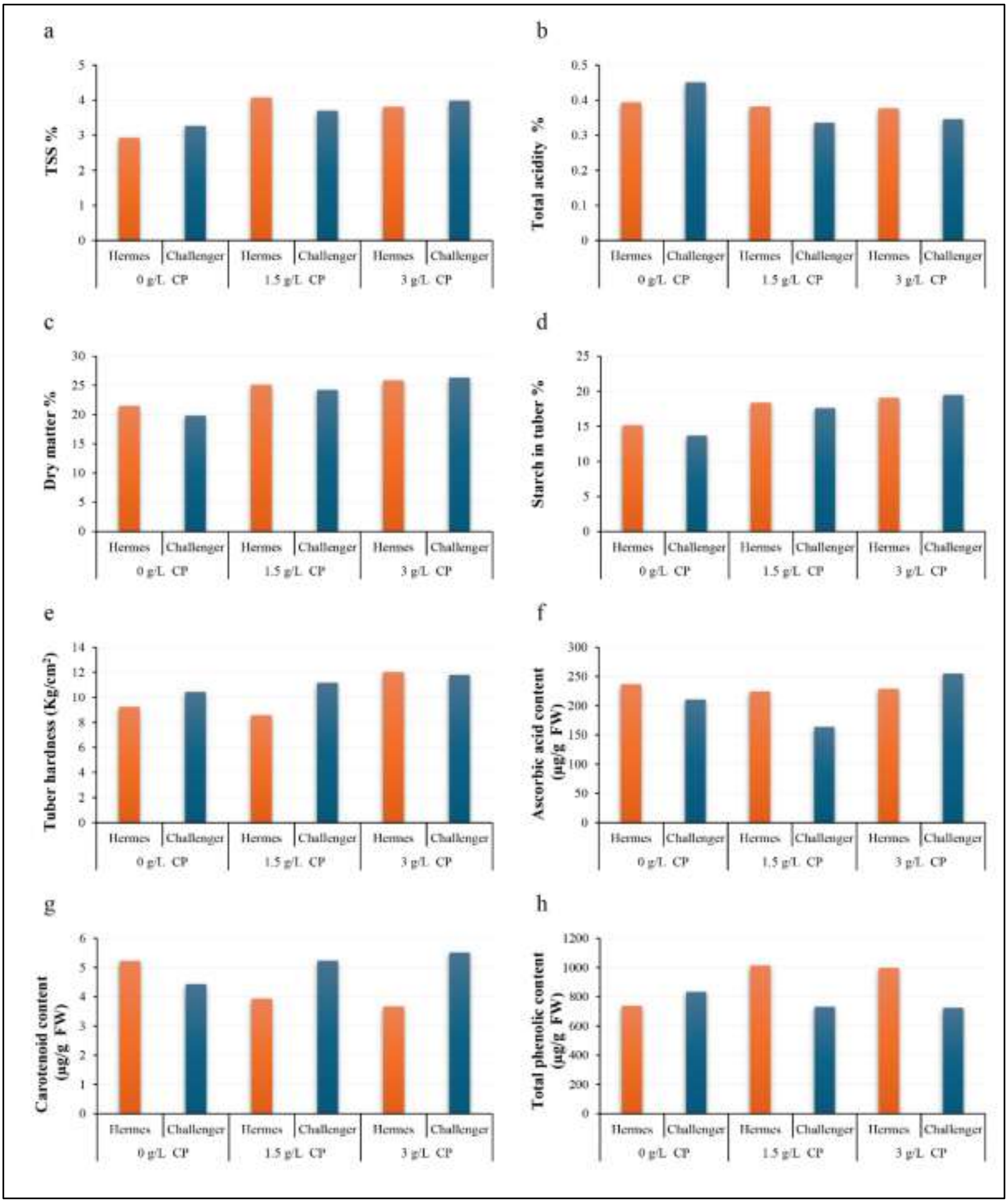
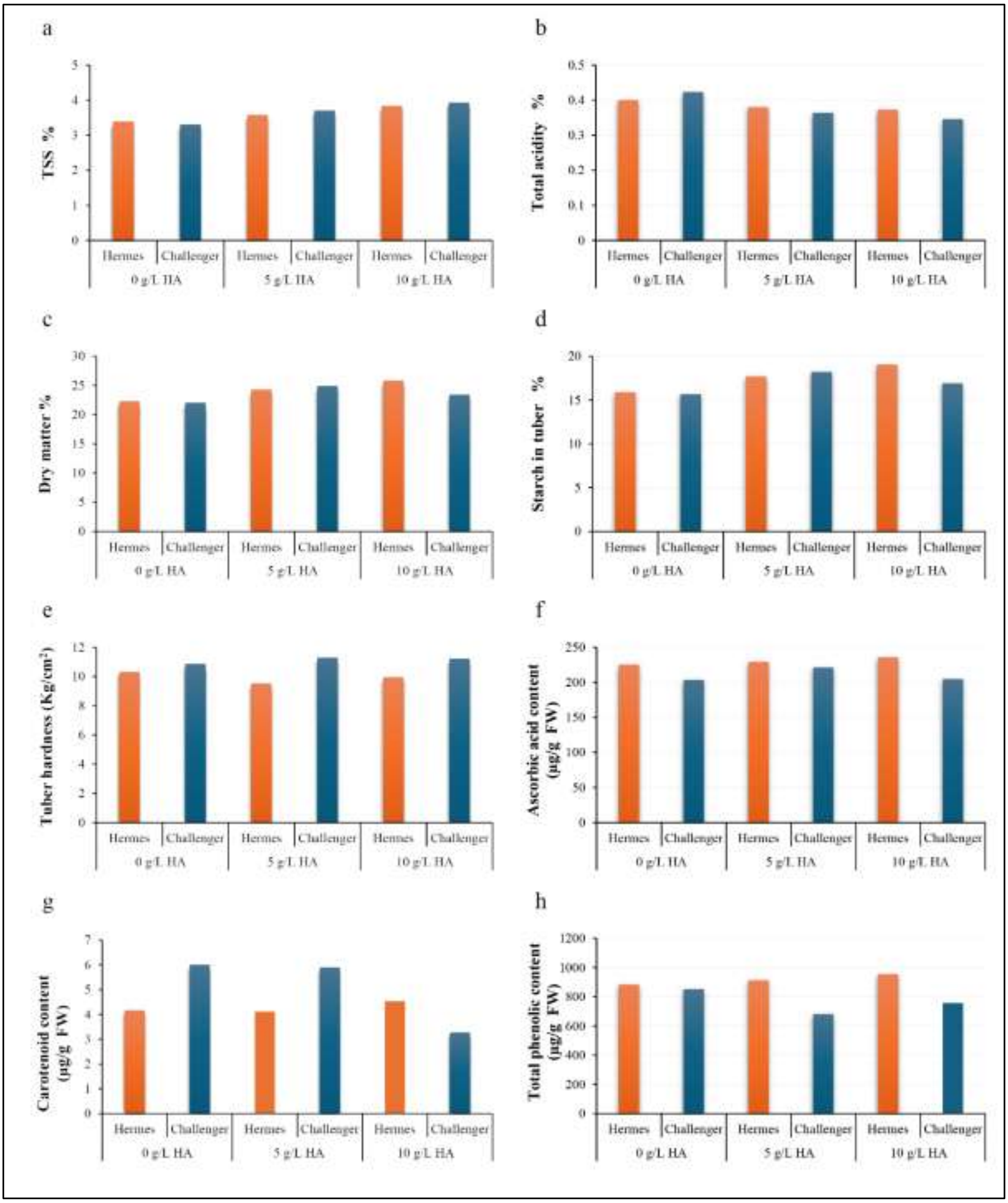


Fig. 2 Effects of interactions between different levels of chelated potassium and varieties on the qualitative characteristics of potato tubers

ISSN 2072-3857

Figar. 3 show that the interaction between humic acid and potato variety had no significant effect on any of the parameters except the carotenoid content in the tubers. The highest carotenoid content was recorded for 0 g L^{-1} of humic acid, and the most challenging carotenoid content was 6.008 µg/g FW. The minimum carotenoid content was obtained with 10 g/L humic acid, and the lowest carotenoid content was 3.278 µg/g FW.

ISSN 2072-3857



Figar. 3 Effects of interactions of different levels of humic acid and varieties on the qualitative characteristics of potato tubers

ISSN 2072-3857

Table 6 show the triple interference between chelated potassium, humic acid and potato variety they had significant differences on parameters total acidity, tuber hardness, and carotenoid content in tubers. The highest value of total acidity obtained by (0 g L^{-1} chelated potassium with 0 g L^{-1} humic acid, and Challenger variety) with 0.587%, and highest values of tuber hardness and carotenoid content was recorded by)3 g L^{-1} chelated potassium with 5 g L^{-1} humic acid, and Challenger variety with (12.800 kg cm-2 and 6.008 µg/g FW) respectively. While the minimum values of total acidity and tuber hardness achieved by triple interaction (1.5 g L-1 chelated potassium with 0 g L-1 humic acid and Hermes variety with (0.331% and 8.033 kg cm-2) respectively. by carotenoid content obtained by (1.5 g L^{-1} chelated potassium with 10 g L^{-1} humic acid, and Hermes variety with (2.629 µg/g FW). While the triple interference among chelated potassium, humic acid and potato variety they had no-significant differences shown on parameters total soluble solid, ascorbic acid content, phenol content, dry matter and starch content in the tubers .

Table 6: Effect of Interaction of different levels of Chelated potassium, Humic acid, and Varieties on qualitative characteristics of potato tubers

Chelated Potassium levels	Humic acid levels	Varieties	Total Soluble Solid (%)	Total Acidity (%)	Tuber Hardness (Kg cm^{-2})	Ascorbic acid content (µg g^{-1} FW)	Carotenoid content (µg g^{-1} FW)	Total phenolic content (µg g^{-1} FW)	Dry matter (%)	Starch in tuber (%)
0 g L^{-1}	0 g L^{-1}	Hermes	2.657	0.405	10.200	163.612	4.704	683.071	18.719	12.684
		Challenger	3.033	0.587	10.300	166.288	6.335	957.228	19.687	13.547
	5 g L^{-1}	Hermes	3.070	0.363	9.033	265.686	4.799	728.015	21.894	15.513
		Challenger	3.233	0.384	9.600	224.482	5.005	717.528	20.473	14.247
	10 g L^{-1}	Hermes	3.067	0.415	8.500	281.070	6.176	802.921	23.872	17.276
		Challenger	3.533	0.381	11.400	240.669	1.964	826.142	19.336	13.234
1.5 g L^{-1}	0 g L^{-1}	Hermes	4.000	0.331	8.033	232.375	6.081	1083.071	22.617	16.157
		Challenger	3.667	0.341	11.100	104.749	5.606	860.599	20.339	14.127

ISSN 2072-3857

	5 g L^{-1}	**Hermes**	4.100	0.436	8.367	224.080	3.104	987.940	25.776	18.972
		Challenger	3.667	0.347	11.500	225.552	6.224	666.592	26.968	20.034
	10 g L^{-1}	**Hermes**	4.133	0.363	9.317	217.124	2.629	972.210	26.933	20.003
		Challenger	3.767	0.320	10.900	160.268	3.880	667.341	25.406	18.642
3 g L^{-1}	**0 g L^{-1}**	**Hermes**	3.533	0.448	12.750	279.465	1.742	883.071	25.592	18.808
		Challenger	3.233	0.341	11.217	338.997	6.081	736.255	26.127	19.285
	5 g L^{-1}	**Hermes**	3.567	0.341	11.233	197.860	4.450	1020.899	25.299	18.547
		Challenger	4.233	0.360	12.800	213.378	6.477	657.603	27.295	20.325
	10 g L^{-1}	**Hermes**	4.333	0.348	12.083	208.696	4.814	1088.315	26.772	19.860
		Challenger	4.500	0.336	11.367	212.843	3.991	778.951	25.594	18.810
LSD **($P \leq 0.05$)**			n.s	0.103	1.432	n.s	0.780	n.s	n.s	n.s

Conclusion

This research assessed the effect of chelated potassium and humic acid on the quality attributes of the Hermes and Challenger industrial potato cultivars in the fall season. Based on the findings, it is evident that total soluble solids, tuber hardness, dry matter, and starch content, increased per the aforementioned ranges of potassium and humic acid, whereas total acidity and carotenoid content decreased. In most quality parameters, Hermes consistently surpassed Challenger, indicating clear industrial processing of Hermes's yield quality. The best quality results were achieved by combining 3 g L^{-1} chelated potassium and 5 g L^{-1} humic acid. This study underscores the need for tailored fertilization approaches to meet the requirements of the processing industry with tuber quality, while simultaneously suggesting more cultivars as well as exploring the prolonged impacts of these cultivars for future studies.

Recommendations

.1Use more than two varieties in the regulation studies.

.2Use different concentrations of potassium and humic acid in future studies.

ISSN 2072-3857

.3Repeat the study in other locations and seasons to develop more positive recommendations .

Acknowledgements
We extend our thanks and appreciation to the Dean of Al-Qasim Green University, the editorial board of Al-Furat Journal of Agricultural Sciences, and the reviewers. Thanks, and gratitude to Assistant Professor Dr. Muhammad Mustafa Allawi, Dr. Kamaran Salih for helping us in completing the research.

REFERENCES

A.O.A.C. (1970). Official methods of analysis, 11th ed. Washington D.C. Association of Official Analytical Chemistry, 101 P.
A.O.A.C. (1986). Association of Official Agricultural Chemists. Official and Tentative Methods of Analysis 13th ed. Association of Officinal Agricultural Chemists, Washington, D.C., U.S.A .
Al-Kaze AL-Jabary, A. M., & Fadil, N. N. (2017). Effect of immersion in calcium chloride and neem extract on storability of plum fruits (Prunus domestica) cv. Damson. Kirkuk University Journal For Agricultural Sciences (KUJAS), 8(3 .(
Al-Kazemi, N. A. S. (2017). Effect of organic fertilizer source and mineral fertilizer level on growth and yield of potatoes [Master Thesis, Baghdad University]. Faculty of Agricultural Engineering Sciences
Al-Zubaidi, A. H. A. (2018). Effect of Humic Acids on Growth, Yield and Quality of Three Potato Varieties. Plant Archives, 18(2), 1533–1540 .
Ali, M. M. E., Petropoulos, S. A., Selim, D. A. F. H., Elbagory, M., Othman, M. M., Omara, A. E.-D., & Mohamed, M. H. (2021). Plant Growth, Yield and Quality of Potato Crop in Relation to Potassium Fertilization Agronomy, 11(4), 675. https://doi.org/10.3390/agronomy11040675
Asefa, G., Mohammed, W., & Abebe, T. (2016). Evaluation of potato (Solanum tuberosum L.) genotypes for resistance to late blight at Sinana Southeastern Ethiopia. International Journal of Agricultural Research, Innovation and Technology, 6(1), 21-25 .
Ayalew, A., & Beyene, S. (2011). The influence of potassium fertilizer on the production of potato (Solanum tuberosum L.) at Kembata in southern Ethiopia. Journal of Biology, Agriculture and Healthcare, 1(1), 1-13 .
Bohl, W. H. J., Steven B. (Ed.). (2010). Commercial Potato Production in North America (Second Revision ed.). The Potato Association of America. https://vric.ucdavis.edu/pdf/POTATOES/Commercial%20Potato%20Production%20in%20North%20America%202010.pdf .
Çöl Keskin, N. A., Fikret. (2021). The Effect of Humic Acid Applications on Growth and Quality Properties of Potato (Solanum tuberosum L.). Journal of the Institute of Science and Technology, 11(2), 1559–1567. https://doi.org/10.21597/jist.840082
de Freitas, S. T. P., Engil Isadora Pujol; Gomez, Ana Cecilia S.; Brackmann, Auri;

Nicoloso, Fernando; Bisognin, Dilson A. (2012). Processing quality of potato tubers produced during autumn and spring and stored at different temperatures. Horticultura Brasileira, 30(1), 91–98. https://doi.org/10.1590/S0102-05362012000100016

Du HuiYing, D. H., Xue ShiChuan, X. S., & Sun ZhongFu, S. Z. (2007). Effects of different application rates of humic acid compound fertilizer on leaf nutrient accumulation and physiological mechanism of grape .

Ewais, A. A. M., Abd El-Rahman, G. M., & Sayed, D. A. (2020). Effect of Foliar Application of Boron and Potassium Sources on Yield and Quality of Potato (Solanum tuberosum L.). Middle East Journal of Agriculture Research, 10(1), 113–121. https://www.curresweb.com/mejas/mejas/2020/mejas.2020.10.1.15.pdf

Fabbri, A. D. T., & Crosby, G. A. (2016). A review of the impact of preparation and cooking on the nutritional quality of vegetables and legumes. International Journal of Gastronomy and Food Science, 3, 2–11. https://doi.org/10.1016/j.ijgfs.2015.11.001

FAOSTA, F. a. A. O. o. t. U. N.-. (2024). Announcing the theme of the first International Day of Potato. https://www.fao.org/plant-production-protection/news-and-events/news/news-detail/announcing-the-theme-of-the-first-international-day-of-potato/en

FAOSTAT, F. a. A. O. o. t. U. N. F.-. (2023). FAOSTAT - Food and Agriculture Data. https://www.fao.org/faostat/en/#data/QCL

Hadia Hassan, S. S., Maher Dais. (2024). Effect of potassium humate spray on some biochemical characteristics in potato leaves Solanum tuberosum under water stress conditions. Baghdad Science Journal, 21(5), 1483-1493. https://doi.org/https://dx.doi.org/10.21123/bsj.2023.8002

Jaspreet Singh, L. K., Owen J. McCarthy. (2009). Potato Starch and its Modification. Elsevier Inc .

Jensi, V. P. N. T. J. B. H. L. R. J. B. D. A. N. (2025). Value Chain of Potato in India: An Overview. Plant Archives, 25, 608-612. https://doi.org/10.51470/PLANTARCHIVES.2025.SP.ICTPAIRS-086

Kabira, J. N., & Lemaga, B. (2023). Potato processing, Quality evaluation procedure for research and food industry in east and central Africa. Nairobi, Kenya .

Kirkman, M. A. (2007). Global markets for processed potato products. In Potato biology and biotechnology (pp. 27-44). Elsevier .

Mohammed, W. (2016). Specific gravity, dry matter content, and starch content of potato (Solanum tuberosum L.) varieties cultivated in eastern Ethiopia. East African Journal of Sciences, 10(2), 87–102 .

Muthoni, J., Kabira, J., Shimelis, H., & Melis, R. (2014). Regulation of potato tuber dormancy: A review. Australian Journal of Crop Science, 8(5), 754-759 .

NeBambi Lutaladio, O. O., Anton Haverkort, Daniel Caldiz. (2009). Sustainable Potato Production: Guidelines for Developing Countries. Food and Agriculture Organization of the United Nations (FAO).

https://www.researchgate.net/publication/41193805_Sustainable_potato_production_guidelines_for_developing_countries
Römheld, V. K., Ernest A. (2010). Research on potassium in agriculture: needs and prospects. Plant and Soil, 335(1–2), 155–180. https://doi.org/10.1007/s11104-010-0520-1
Saeid, A. I. Y., Kurdistan Hassan. (2017). Response of four Variety of Potato (Solanum tuberosum L.) to Different Concentrations of Humic Acid under Plastic House Condition. Kufa Journal for Agricultural Sciences, ,(2)9 .38–23 https://journal.uokufa.edu.iq/index.php/kjas/article/view/104/81
Sayed, D. A. (2016). Response of Potato Plants to Potassium and Micronutrient Fertilization. Menoufia Journal of Soil Science, 1(August), 117–129 .
Shabana, M. M. A. K. A. A. E.-N. M. G. Z. a. R. M. K. (2023). Potassium Humate and Silicate Combined with Compost Application to Reduce the Harmful Effects of the Irrigation Water Salinity on Potato Plants and on the Soil Available Nutrient NPK. Journal of Soil Sciences and Agricultural Engineering14(3), 104-112. www.issae.journals.ekb.eg
Tomadoni, B., Viacava, G. C., L., & Moreira, M. R. P., A. (2016). Novel biopreservatives to enhance the safety and quality of strawberry juice. Journal of Food Science and Technology, 53(1), 281–292. https://doi.org/10.1007/s13197-015-2068-9
van Eck, H. J. (2007). Genetics of morphological and tuber traits. In D. Vreugdenhil (Ed.), Potato Biology and Biotechnology: Advances and Perspectives (pp. 91–111). Elsevier. https://doi.org/10.1016/B978-044451018-1.50048-8
Yunqi Ma, X. C., Yuyang Zhang. (2024). The Impact of Humic Acid Fertilizers on Crop Yield and Nitrogen Use Efficiency: A Meta-Analysis. Agronomy, 14(12), 2763. https://doi.org/https://doi.org/10.3390/agronomy14122763
Tahir, N. A.-r., Rasul, K. S., Lateef, D. D., & Grundler, F. M. W. (2022). Effects of Oak Leaf Extract, Biofertilizer, and Soil Containing Oak Leaf Powder on Tomato Growth and Biochemical Characteristics under Water Stress Conditions. Agriculture, 12(12), 2082. https://doi.org/10.3390/agriculture12122082 .
Rasul, K. S. (2023). Response of Different Tomato Accessions to Biotic and Abiotic Stresses (Doctoral dissertation, University of Sulaimani.(
Rasul, K. S., Grundler, F. M., & Abdul-razzak Tahir, N. (2022). Genetic diversity and population structure assessment of Iraqi tomato accessions using fruit characteristics and molecular markers. Horticulture, Environment, and Biotechnology, 63(4), 523-538.
Halshoy, H. S., Rasul, K. S., Ahmed, H. M., Mohammed, H. A., Mohammed, A. A., Ibrahim, A. S., & Braim, S. A. (2024). Effect of nano titanium and organic fertilizer on broccoli growth, production, and biochemical profiles. Journal of Plant Nutrition, 48(8), 1344–1363. https://doi.org/10.1080/01904167.2024.2442726

ISSN 2072-3857

Barznjy, L. G. K.., Kasnazany, S. A. S., & Ahmed, A. S. (2023). Evaluation of yield and some physiochemical traits in four cultivars of potatoes (Solanum tuberosum L.). Diyala Agricultural Sciences Journal, 15(1), 72-80.

Barznjy, L. G. K. (2019). influence of licorice extract, kcl, and mycorrhizal inoculation on growth, yield and quality of potato under two irrigation intervals in sulaimani governorate. PhD thesis University of Sulaimani – College of Agricultural Engineering Sciences .

Al-Rawi, K. M., & A. M. Khalafallah. (1980). Design and Analysis of Agricultural Experiments, College of Agriculture and Forestry, Mussel University. pp.361-363. (In Arabic.(

Gulcin, İ., & Alwasel, S. H. (2022). Metal ions, metal chelators and metal chelating assay as antioxidant method. Processes, 10(1), 132 .

Madhupriyaa, D., Baskar, M., Sherene Jenita Rajammal, T., Kuppusamy, S., Rathika, S., Umamaheswari, T., ... & Mohanapragash, A. G. (2024). Efficacy of chelated micronutrients in plant nutrition. Communications in Soil Science and Plant Analysis, 55(22), 3609-3637.

Huang, W., Lin, M., Liao, J., Li, A., Tsewang, W., Chen, X., ... & Zheng, P. (2022). Effects of potassium deficiency on the growth of tea (Camelia sinensis) and strategies for optimizing potassium levels in soil: A critical review. Horticulturae, 8(7), 660.

Singh, B., Sharma, J., Bhardwaj, V., Sood, S., Siddappa, S., Goutam, U., ... & Kumar, V. (2022). Genotypic variations for tuber nutrient content, dry matter and agronomic traits in tetraploid potato germplasm. Physiology and Molecular Biology of Plants, 28(6), 1233-1248.

Sardans, J., & Peñuelas, J. (2021). Potassium control of plant functions: Ecological and agricultural implications. Plants, 10(2), 419