



EFFECT OF ADDITION OF BIOFERTILIZERS, NILE FLOWER PEAT FERTILIZER AND SPRAYING WITH ITS EXTRACT ON QUALITATIVE CHARACTERISTICS OF POTATO YIELD

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ABSTRACT

The field experiment was carried out in Horticulture Development Station in the Kut district of the Directorate of Agriculture of Wasit Governorate at spring season 2022, This study was aimed to demonstrate the effect of inoculation some Bio-fertilizers, adding Nile flower peat fertilizer and spraying with its extract on qualitative characteristics potato yield, The experiment was implemented using factorial experiment(4×3×2) within Randomized Complete Block Design with three replicates, The First factor included the inoculation with Biofertilizers and cod it (M), which is (M₀) Don't be discouraged, (M₁) inoculation the Mycorrhiza in pollen density of 25 g.tuber⁻¹, (M₂) inoculation the Trichoderma pollen density of 4 g.tuber⁻¹ and (M₃) Mixture Mycorrhiza and Trichoderma fungi together, The second factor included the addition of Nile flower peat fertilizer and cod it (N), which is (N₀) without adding, (N₁) added 15 ton.ha⁻¹ and (N₂) added 30 ton.ha⁻¹, The third factor included spraying with Nile flower peat fertilizer extract and cod it (E), spraying with distilled water (E₀) and spraying with extract 2 ml.L⁻¹ (E₁), The results showed that biofertilization was significantly superior in qualities characteristics of the yield represented by dry matter percentage, starch percentage, specific density, soluble solids percentage and tuber hardness, compared with control (M₀), M₃ treatment produced greatest value of this characteristics which reached 16.84%, 11.01%, 1.0640 g cm⁻², 6.459%, 8.167 kg cm⁻². Organic fertilization showed significant increase in the above characteristics, N₂ treatment produced greatest value which reached 17.20%, 11.33%, 1.0657g cm⁻², 6.633%, 8.179, kg cm⁻². Spraying treatment had amoral superiority on above characteristics if produced 16.50%, 10.70%, 1.0623 g cm⁻², 6.407%, 7.944 kg cm⁻².

Keywords: Starch, Specific Density, Trichoderma, Tuber hardness.

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تأثير إضافة الاسمدة الحيوية وسماذ خث زهرة النيل والرش بمستخلصه في الصفات النوعية لحاصل البطاطا

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الخلاصة

نفذت تجربة حقلية في مشروع محطة تطوير البستنة في الكوت التابع الى مديرية الزراعة في محافظة واسط للموسم الربيعي لسنة 2022 ، بهدف دراسة تأثير التلقيح ببعض الاسمدة الحيوية وإضافة سماذ خث زهرة النيل والرش بمستخلصه في الصفات النوعية لحاصل البطاطا، نفذ البحث كتجربة عاملية (2×3×4) وفق تصميم القطاعات الكاملة المعشاة وبتلات مكررات، شمل العامل الاول التلقيح بالاسمدة الحيوية ورمز لها (M) ، وهي (M₀) عدم التلقيح و (M₁) التلقيح بفطر المايكورايزا بكثافة لقاحية 25 غم/درة-1 و (M₂) التلقيح بفطر الترياكوديرما بكثافة لقاحية 4غم/درة-1 و (M₃) التلقيح بخليط فطري المايكورايزا والترياكوديرما معا، وشمل العامل الثاني إضافة سماذ خث زهرة النيل ورمز لها (N) ، هي (N₀) عدم الاضافة و (N₁) إضافة 15 طن هـ-1 و (N₂) إضافة 30 طن هـ-1، وشمل العامل الثالث الرش بمستخلص سماذ خث زهرة النيل ورمز له (E) ، هي الرش بالماء المقطر (E₀) والرش بالمستخلص 2 مل لتر-1 (E₁) ، أظهرت النتائج تفوق التسميد الحيوي معنويا في الصفات النوعية للحاصل المتمثلة بنسبة المادة الجافة ونسبة النشا ونسبة المواد الصلبة الذاتية الكلية والكثافة النوعية وصلابة الدرنات مقارنة بمعاملة القياس M₀ ، وتميزت المعاملة M₃ بإعطائها أعلى القيم لهذه الصفات بلغت 16.84% و 11.01% و 1.0640 غم سم-2 و 6.459% و 8.167 كغم سم-2، وأظهرت معاملات التسميد العضوي زيادة معنوية في الصفات اعلاه، واعطت المعاملة N₂ أعلى القيم بلغت 17.20% و 11.33% و 1.0657 غم سم-2 و 6.633% و 8.179 كغم سم-2، وتفوقت معاملة الرش E₁ معنويا في الصفات اعلاه إذ اعطت 16.50% و 10.70% و 1.0623 غم سم-2 و 6.407% و 7.944 كغم سم-2

الكلمات المفتاحية: نشأ، كثافة نوعية، ترياكوديرما، صلابة الدرنات.

INTRODUCTION

The potato crop (*Solanum tuberosum* L.) belongs to the Solanaceae family, which includes about 90 species and 2000 species. Potato is one of the most important vegetable crops in the world, especially in the Americas, Europe and some Arab countries, due to its abundance of productivity and the diversity of environmental conditions in which it grows and its value. As potatoes are grown on a large scale and in various parts of the world, it is also a strategic crop, as it lead to important role in food security and has a high nutritional value because of the elements and food compounds it contains and is involved in many food industries. Economically, the potato crop returns to farmers with a return economically in a short period of time not exceeding 120 days, and it also provides job opportunities for many other sectors and employment of the labor force, which contributes to the national income of many countries (Andrison, 2017; Cirocki & Golebiewska, 2019).

The total cultivated area in Iraq amounted to 24.12 hectares, with a total production of 674.8 thousand tons, with a yield of 27.978 ton.ha-1 (Agricultural Statistics Directorate, 2021), which are low rates in relation to the cultivated area unit due to the fact that the soil conditions are not ideal and the insufficient or lack of readiness of plant nutrients. And lack of interest in service and fertilization operations, and from here it was necessary to think scientifically and deliberately to increase production per unit area with the introduction of the principle of recycling and preserving the environment, as the steady increase in the use of chemical fertilizers to achieve high production per unit area leads to negative results reflected in soil pollution Groundwater as a result of washing and air pollution through volatilization, which in turn leads to economic losses as a result of the loss of the bulk of fertilizers and severe damage to human, animal and microorganism health, as well as the high cost of



manufacturing, which prompted scientists to search for methods that are safe for human health and do not cause environmental pollution. Environment through sustainable and environmentally friendly agricultural practices. Therefore, many studies have suggested trying to use beneficial microorganisms in the rhizosphere to enhance plant productivity, rehabilitate degraded lands, as well as reclaim contaminated soil and produce healthy and safe food, and its role in removing heavy elements from the soil (**Adesemoy *et al.*, 2008; Singh *et al.*, 2017; Mohammed & Al-Shamary, 2017**). Diab (2012) found that inoculation with mycorrhiza fungus as a biofertilizer to the potato plant led to an increase in the tubers content of the percentage of dry matter, total soluble solids, and amino acids compared to uninoculated plants, Saniet al. (2020) showed that the inoculation of the tomato plant with *Trichoderma* fungus increased the yield and improved its quality.

From the results of the research, it was found that there is a linear relationship between the components of organic soil matter and functions of soil microorganisms. Hence, the use of biofertilizers complements the action of organic fertilizers in increasing agricultural production, improving its quality, and reducing environmental pollution (**Munda *et al.*, 2016**). Therefore, the concerns in many countries of the world tended to encourage organic production and take advantage of the natural resources available for the production of organic fertilizers by recycling them for the purpose of improving the physical, chemical and biological properties of the soil and the nutrients it contains for the purpose of increasing production and improving its quality., if found **Al-Halfi & Al-Azzawi (2022)** that the addition of organic fertilizer (palm fronds waste) has improved soil properties represented by increasing the stability of soil aggregates and increasing the available water. **And Al-Dulaiml & Al-Amri (2020)** showed that the addition of Monocarps plant residues had a significant effect on the vegetative growth rate and yield and the increase in the percentage of starch in potato tubers, **Saaseea & Al-Amry (2018)** noted that the addition of organic fertilizers (humic acid) to potatoes It increased the yield and improved its quality by increasing the percentage of dry matter and the percentage of protein.

Recent research focused on the use of organic nutrients that are sprayed on the shoots according to the foliar feeding method, which is an effective method in increasing the yield and improving its quality (**Abdulrasool & Al-Malikshah, 2022; Al-Mharib *et al.*, 2022**). **And Majeed (2010)** found that when spraying potato plants with the organic nutrient Vit-org, it increased the yield and improved its quality represented by increasing the number of tubers, tuber weight, tuber content of percentage of dry matter, total soluble solids, and tuber hardness. This study was aimed to investigate the effect of adding biofertilizers and Nile flower peat fertilizer and spraying with its extract and the interaction between them on the quality of potato yield.

MATERIALS AND METHODS

The research was carried out in the project of the Horticultural Development Station in the Kut district of the Directorate of Agriculture of Wasit Governorate, with the aim of studying the effect of adding some biofertilizers and Nile flower peat fertilizer and spraying with its extract on the qualitative characteristics of the yield of potato plant, Arizona variety, for the spring season 2022.

The study was carried out using the factorial experiment with three factors within the Randomized Complete Block Design (RCBD) and with three replications.

The first factor included four treatments for adding biofertilizers and cod it (M), which are M0 (without addition), M1 (inoculation *Glomus mosseae* at a pollen density of 25g tuber-1), M2 (inoculation *Trichoderma harzianum* fungus in at a pollen density 4g tuber-1) and M3 (Mycorrhiza + *Trichoderma*), biological fertilizers were added at the bottom of the tubers during cultivation, The second factor included three treatments for adding organic fertilizer (Nile flower peat fertilizer, and is symbolized by and cod it N, N0 (without addition), N1 (adding 15 ton ha-1 of organic fertilizer) and N2 (adding 30 ton ha-1 of organic fertilizer), organic fertilizers were added before planting by digging a 20 cm deep incision at the top of the meadow and then mixed well with the soil, The third factor included two treatments of spraying Nile flower peat extract (E), which was prepared from organic fertilizer Nile flower peat, following the method of Page et al. (1982), and its treatments are E0 (spraying with distilled water) and E1 (spraying the extract). at a concentration of 2 ml L-1), and with three sprays, the first spray is in the vegetative growth stage, the second spray is in the tuber emergence stage, and the third spray is in the tuber size increase stage.

RESULTS AND DISCUSSION

Percentage of dry matter in tubers%

The results of (table, 1) showed that biofertilization had a significant effect on the percentage of dry matter in potato tubers, the double inoculation treatment (M3) produced the highest percentage of 16.84 % compared to the control treatment, which recorded the lowest rate of 15.56%. The organic fertilization treatments also affected this characteristic significantly compared to the control treatment, which produced the lowest percentage of 15.18 %, as the treatment N2 recorded the highest percentage of 17.20 %, and the spraying treatment with Nile flower peat extract (E1) significantly affected it produced the highest percentage of 16.50%, compared to the control treatment (E0), which produced 15.89%.

Achieved the interaction coefficients between biofertilizers and organic fertilizers had a significant effect on the percentage of dry matter in tubers, as the treatment M3 N2 recorded the highest percentage of 18.06%, and the control treatment M0N0 recorded the lowest percentage of 14.65%.

The results also showed that the interaction of biofertilizers with spraying with peat extract of Nile flower had a significant effect on this trait, as the treatment M3E1 recorded the highest rate of 17.13 %, and the control treatment (M0E0) recorded the lowest rate, amounting to 15.28%.

Also, the interaction treatments of organic fertilizers and spraying with peat extract of Nile flower had a significant effect on this characteristic compared to the control treatment (N0E0), which produced the lowest percentage of 14.89 %, as the treatment N2 E1 recorded the highest percentage of 17.48%.

The results of the triple interaction also showed a significant effect on this trait, as the treatment M3N2E1 gave the highest percentage of 18.33 %, the control treatment produced the lowest percentage of 14.38 %.



Table (1): Effect of adding biofertilizers, Nile flower peat fertilizer, spraying with its extract and the interaction between them on Percentage of dry matter in tubers % for spring seasons 2022.

M1- Myco	N	E		M
M2- Tricho	(Ton.ha ⁻¹)	(ml.l ⁻¹)		×
		E0(0)	E1(2)	N
M0 (0)	N0 (0)	14.38	14.93	14.65
	N1 (15)	15.39	15.88	15.63
	N2 (30)	16.06	16.75	16.40
M1 (25g)	N0 (0)	14.88	15.53	15.21
	N1 (15)	15.75	16.54	16.14
	N2 (30)	16.89	17.42	17.15
M2 (4 g)	N0 (0)	14.91	15.49	15.20
	N1 (15)	15.80	16.57	16.19
	N2 (30)	16.93	17.45	17.19
M3 (M1+M2)	N0 (0)	15.39	15.90	15.64
	N1 (15)	16.48	17.17	16.83
	N2 (30)	17.79	18.33	18.06
		1.037		0.733
E		15.89	16.50	
LSD(0.05)		0.299		
				M
M	M0	15.28	15.85	15.56
×	M1	15.84	16.50	16.17
E	M2	15.88	16.50	16.19
	M3	16.55	17.13	16.84
LSD(0.05)		0.598		0.423
				N
N	N0	14.89	15.46	15.18
×	N1	15.85	16.54	16.20
E	N2	16.92	17.48	17.20
LSD(0.05)		0.518		0.366

Starch percentage in tubers(%)

The results of table (2) indicated that the biofertilization treatments had a significant effect on increasing the percentage of starch in potato tubers, compared to the control treatment, which produced the lowest percentage of 9.871 %, as (M3) produced the highest percentage of 11.01 %, and organic fertilization treatments significantly affected this characteristic compared to the control treatment, which produced the lowest percentage of 9.525 %, as the N2 treatment produced the highest percentage of 11.33, and the treatment of spraying with peat extract of the Nile flower affected (E1) was significant, as it produced the highest percentage of 10.70%, compared to the control treatment (E0), which produced 10.15% .

From the data from the same table, it was found that the interaction coefficients between M and N had a significant effect on the percentage of starch in tubers, as the treatment M3N2 produced highest percentage of 12.09 %, and control treatment M0N0 produced lowest percentage of 9.058 %.

The interaction of biofertilizers with spraying Nile flower peat extract also achieved a significant effect on this trait, as the treatment M3E1 produced the highest percentage of 11.26 %, and control treatment (M0E0) produced the lowest percentage of 9.615 %.



It was also found that the overlapping treatments of N and E had a significant effect on this characteristic compared to the control treatment (N0E0), which produced the lowest percentage of 9.272 %, as the treatment N2E1 produced highest percentage of 11.58 %.

The results of the triple interaction had a significant effect on increasing the percentage of starch in the tubers, as the treatment M3N2E1 produced the highest rate of 12.33%, and control treatment produced the lowest rate of 8.813%.

Table (2): Effect of adding biofertilizers, Nile flower peat fertilizer, spraying with its extract and the interaction between them on the Starch percentage in tubers (%) for spring seasons 2022.

M1- Myco	N	E		M
M2- Tricho	(Ton.ha ⁻¹)	(ml.l ⁻¹)		×
		E0(0)	E1(2)	N
M0 (0)	N0 (0)	8.813	9.303	9.058
	N1 (15)	9.714	10.15	9.933
	N2 (30)	10.31	10.92	10.62
M1 (25 g)	N0 (0)	9.266	9.844	9.555
	N1 (15)	10.03	10.74	10.38
	N2 (30)	11.05	11.52	11.28
M2 (4 g)	N0 (0)	9.291	9.803	9.547
	N1 (15)	10.08	10.77	10.42
	N2 (30)	11.08	11.55	11.31
M3 (M1+M2)	N0 (0)	9.718	10.16	9.942
	N1 (15)	10.69	11.30	10.99
	N2 (30)	11.85	12.33	12.09
LSD _(0.05)		0.924		0.653
E		10.15	10.70	
LSD _(0.05)		0.266		
				M
M	M0	9.615	10.12	9.871
×	M1	10.11	10.70	10.41
E	M2	10.15	10.70	10.43
	M3	10.75	11.26	11.01
LSD _(0.05)		0.533		0.377
				N
N	N0	9.272	9.779	9.525
×	N1	10.13	10.74	10.43
E	N2	11.07	11.58	11.33
LSD _(0.05)		0.462		0.326

Specific density of tubers (gcm-2)

In the results of (Table, 3) it was found that the biofertilization treatments had a significant effect on the specific density of potato tubers, as the M3 treatment gave the highest value of 1.0640 gcm-2, compared to the M0 that produced the lowest value of 1.0579 gcm-2. As for the effect of the organic fertilization treatments, it was significant in this respect compared to the control treatment, which produced the lowest value of 1.0561 gcm-2, as the N2 treatment produced the highest value of 1.0657 gcm-2, and the spraying treatment with peat extract affected the flower Nile (E1) was significant, as it produced highest specific gravity of 1.0623 gcm-2, compared to the control treatment (E0), which produced 1.0595 gcm-2



With regard to the effect of the interaction between biofertilizers and organic fertilizers, it was significant in increasing the specific density of potato tubers, as the treatment M3N2 produced the highest value of 1.0697 g.cm⁻², and control treatment M0N0 gave the lowest value of 1.0536 gcm⁻².

Also, the interaction of biofertilizers with spraying with peat extract of Nile flower had a significant effect on this trait, as the treatment M3E1 gave the highest value of 1.0653 gcm⁻², and control treatment M0E0 recorded the lowest value of 1.0566 gcm⁻².

The overlapping treatments of organic fertilizers and spraying with Nile flower peat extract also achieved a significant effect on this trait, as treatment N2E1 produced the highest value of 1.0670 gcm⁻², and control treatment (N0E0) produced the lowest value of 1.0547 gcm⁻².

The results of the same table indicated that triple interaction coefficients had a significant effect on increasing the specific density in tubers compared to control treatment, which produced the lowest value of 1.0523 gcm⁻², as the treatment M3N2E1 gave the highest value of 1.0710 gcm⁻².

Table (3): Effect of adding biofertilizers, Nile flower peat fertilizer, spraying with its extract and the interaction between them on Specific density of tubers (g.cm⁻²) for spring seasons 2022.

M1- Myco	N	E		M
M2- Tricho	(Ton.ha ⁻¹)	(ml.l ⁻¹)		×
		E0(0)	E1(2)	N
M0(0)	N0 (0)	1.0523	1.0549	1.0536
	N1 (15)	1.0571	1.0594	1.0582
	N2 (30)	1.0603	1.0635	1.0619
M1(25 g)	N0 (0)	1.0547	1.0578	1.0562
	N1 (15)	1.0588	1.0626	1.0607
	N2 (30)	1.0642	1.0667	1.0655
M2 (4 g)	N0 (0)	1.0548	1.0576	1.0562
	N1 (15)	1.0590	1.0627	1.0609
	N2 (30)	1.0644	1.0668	1.0656
M3 (M1+M2)	N0 (0)	1.0571	1.0595	1.0583
	N1 (15)	1.0623	1.0655	1.0639
	N2 (30)	1.0684	1.0710	1.0697
LSD _(0.05)		0.0049		0.0034
E		1.0595	1.0623	
LSD _(0.05)		0.0014		
M				
M	M0	1.0566	1.0593	1.0579
×	M1	1.0592	1.0623	1.0608
E	M2	1.0594	1.0624	1.0609
	M3	1.0626	1.0653	1.0640
LSD _(0.05)		0.0028		0.0020
N				
M	N0	1.0547	1.0574	1.0561
×	N1	1.0593	1.0626	1.0609
E	N2	1.0643	1.0670	1.0657
LSD _(0.05)		0.0024		0.0017



Total soluble solids T.S.S (%)

Through the results of table (4) it was found that the biofertilizers treatments had a significant effect on the percentage of T.S.S in potato tubers for the season, compared to the M0, which produced the lowest rate of 6.017%, as the M3 treatment produced the highest rate of 6.459%, the organic treatments showed a significant effect on this trait compared to the control treatment, which produced the lowest percentage of 5.866%. the N2 treatment produced the highest rate of 6.633%, and the spraying treatment with Nile flower peat extract (E1) had a significant effect as it produced the highest percentage of 6.407% compared to the control treatment (E0), which produced 6.147%.

The results of the same table showed that the M3N2 was significantly superior by produced it a rate of 6.791%, and M0N0 produced the lowest of 5.528%. With regard to the coefficients of interaction of M with E, the treatment M3E1 was significantly superior by producing it the highest rate of 6.562%, compared to the M0E0, which produced the lowest rate of 5.851%.

The treatment of interaction N and E, N2E1 showed a significant effect on this trait, as it produced the highest rate of 6.756 %, compared to the N0E0, which produced the lowest rate of 5.745 %.

The treatment M3N2E1 produced the highest percentage of 6.907 %, compared to control treatment M0N0E0 which produced the lowest percentage of 5.337 %.

Table (4): Effect of biofertilizers, Nile flower peat fertilizer, spraying with its extract and the interaction between them on Total soluble solids T.S.S (%) for spring seasons 2022.

M1- Myco	N	E		M
M2- Tricho	(Ton.ha ⁻¹)	(ml.l ⁻¹)		×
		E0(0)	E1(2)	N
M0 (0)	N0 (0)	5.337	5.718	5.528
	N1 (15)	5.912	6.275	6.094
	N2 (30)	6.304	6.557	6.431
M1(25 g)	N0 (0)	5.780	5.994	5.887
	N1 (15)	6.206	6.506	6.356
	N2 (30)	6.535	6.775	6.655
M2 (4 g)	N0 (0)	5.837	6.030	5.933
	N1 (15)	6.250	6.558	6.404
	N2 (30)	6.525	6.783	6.654
M3 (M1+M2)	N0 (0)	6.025	6.203	6.114
	N1 (15)	6.372	6.575	6.473
	N2 (30)	6.675	6.907	6.791
LSD(0.05)		0.683		0.483
E		6.147	6.407	
LSD(0.05)		0.197		
M				
M	M0	5.851	6.183	6.017
×	M1	6.174	6.425	6.299
E	M2	6.204	6.457	6.331
	M3	6.357	6.562	6.459
LSD(0.05)		0.394		0.279
N				
N	N0	5.745	5.986	5.866
×	N1	6.185	6.478	6.332
E	N2	6.510	6.756	6.633
LSD(0.05)		0.341		0.241



Tuber hardness (kgcm-2)

The rates presented in table (5) show that the M3 and M2 biofertilization treatments had a significant effect on increasing the hardness of potato tubers, as M3 produced the highest hardness score of 8.167, kgcm-2, while the M1 treatment caused a non-significant increase in this respect, compared with control treatment that produced the lowest hardness score of 7.544 kg cm-2. As for the effect of organic fertilization treatments It was significant in this respect, as the N2 treatment produced the highest value of 8.179 kg cm-2 compared to the control treatment, which produced the lowest value of 7.458 kg cm-2, and spraying treatment with Nile flower peat extract (E1) achieved a significant effect it produced the highest hardness score of 7.944 kgcm-2 compared to the control treatment (E0), which produced 7.657 kgcm-2 .

The results of the same table showed that the interaction between M and N had a significant effect, as the treatment M3N2 produced highest value of 8.640kgcm-2, compared to the M0N0, which recorded the lowest value of 7.236kgcm-2.

The interaction of M with E had a significant effect on this trait, as the treatment M3E1 produced the highest value of 8.333kgcm-2 compared to the control treatment M0E0, which gave the lowest value of 7.406kgcm-2. The interaction of N and E significantly increased tuber hardness compared to the control treatment, which produced the lowest value of 7.304 kgcm-2, as treatment N2E1 produced the highest value of 8.316 kgcm-2.

The results of the same table showed that the M3N2E1 produced a significant increase in tuber hardness, compared to the M0N0E0, which produced the lowest value of 7.036kgcm-2, as the treatment M3N2E1 produced highest value of 8.768kgcm-2.

Table (5): Effect of adding some biofertilizers, Nile flower peat fertilizer, spraying with its extract and the interaction between them on the Tuber hardness (kgcm-2) for spring seasons 2022.

M1- Myco	N	E		M
M2- Tricho	(Ton.ha ⁻¹)	(ml.l ⁻¹)		×
		E0(0)	E1(2)	N
M0(0)	N0 (0)	7.036	7.437	7.236
	N1 (15)	7.429	7.648	7.539
	N2 (30)	7.754	7.958	7.856
M1 (25 g)	N0 (0)	7.260	7.464	7.362
	N1 (15)	7.528	7.715	7.621
	N2 (30)	7.852	8.215	8.034
M2 (4 g)	N0 (0)	7.337	7.668	7.502
	N1 (15)	7.637	7.908	7.773
	N2 (30)	8.046	8.323	8.184
M3 (M1+M2)	N0 (0)	7.583	7.877	7.730
	N1 (15)	7.908	8.353	8.130
	N2 (30)	8.512	8.768	8.640
LSD(0.05)		0.639		0.452
E		7.657	7.944	
LSD(0.05)		0.184		
				M
M	M0	7.406	7.681	7.544
×	M1	7.547	7.798	7.672
E	M2	7.673	7.966	7.820
	M3	8.001	8.333	8.167
LSD(0.05)		0.369		0.261

				N
N	N0	7.304	7.611	7.458
×	N1	7.626	7.906	7.766
E	N2	8.041	8.316	8.179
LSD _(0.05)		0.319		0.226

Interpretation Results

The increase in the percentage of indicators of the qualitative characteristics of the potato plant yield, represented by the percentage of dry matter, starch, specific density, total dissolved solids, and tuber hardness, may be attributed to the role of biofertilizers (mycorrhiza fungus) in improving the physical, chemical, and biological soil characteristics, the secretion of organic acids, enzymes, antibiotics, and the production of some plant growth regulators. Increasing the readiness and availability of nutrients, increasing the surface area of the roots, and increasing plant resistance to stress (Al-Badawi, 2008; Al-Gamas, 2018; Al-Mamori & Abdul-Ratha, 2020)

All this prompted the plant to produce a strong vegetative system, an increase in the efficiency and outputs of the carbon metabolism process, and a better accumulation of nutrients and complex compounds such as carbohydrates, proteins, amino acids, and organic acids in the tubers, which led to an increase in the percentage of dry matter in the tubers, and this leads to a higher dry matter index in the tubers. In tubers, an increase in the percentage of starch, total soluble solids and specific density, and these characteristics are among the quality measures of potato tubers (Alisdair & Willmitzer, 2001; Nora *et al.*, 2017).

The reason for the increase in the proportions of the qualitative traits of tubers of potato plants inoculated with the Trichoderma fungus may be attributed to its role in the decomposition of organic matter in the soil to its simple components beneficial to the plant, microorganisms and soil (Bhuvaneswari *et al.*, 2014), and works to protect and strengthen host plants as a biological resistance factor (parasitism, competition, Antagonism, decomposition) against pathogens and insects (Saleh & Farhan, 2022), and it works to increase the availability and readiness of the elements in the soil and increase their accumulation in plant tissues (Fadhl & Al-Hadithi, 2016), and it has the ability to secrete auxins and cytokines and to build a dense root complex and total Strong vegetative, characterized by plant length, wide leafy area, a high concentration of chlorophyll, which allowed for a high build-up of carbohydrates, which led to an increase in yield and an improvement in its quality (Saeed, 2015; Yasir & Al-Salihy, 2022).

As for the increase in the proportions of the specific characteristics of potato tubers when organic fertilizers are added, the reason may be attributed to their content of macro and micro nutrients as well as their role in increasing the readiness of the elements in the soil solution and protecting them from washing and fixing and then the ease of plant access to them, through which the plant can build A strong root system that enables it to absorb the largest amount of elements in the soil to build a dense green vegetation that results in an increase in the level of synthetic carbohydrates, proteins, amino acids, nucleic acids (RNA and DNA) and growth regulators that the plant needs for its growth and development and storing the excess in tubers, which leads to Increasing its content of carbohydrates and proteins, and then increasing its dry weight, as the tubers in their stages of development become one of the most stored parts of the plant for carbohydrates and protein, especially when nutrients are continuously available and along the growth period (Smita *et al.*, 2017; ShaniRaj *et al.*, 2019).

Organic fertilizers have a role in increasing the permeability of cell membranes and facilitate the transfer of nutrients, especially nitrogen, phosphorus and potassium, to other parts of the plant. The element nitrogen leads to an increase in protein as a result of its union with cationic organic acids to produce amino acids that are the building blocks of protein, and the element phosphorus is included in the composition of energy compounds ATP, NADPH, and some important organic compounds in the oxidation and reduction processes during the vital activities of the plant, such as carbon metabolism, respiration, and carbohydrate metabolism. And proteins through its activation of the enzyme nitrate reductase, as well as the elements calcium and magnesium have an active participation in the pathways of formation of sugars and protein (Taiz & Zeiger, 2010; Sawickaetal., 2019; Ilyas *et al.*, 2021).

The high indicators of the qualitative characteristics of potato tubers when spraying plants with Nile flower peat extract may be attributed to what it contains of nutrients (macro and micro), organic acids, amino acids, sugars and vitamins, and their effect on improving vegetative growth indicators, especially increasing levels of total chlorophyll and leafy area, which stimulated the plant to seize the largest amount From the light and then increasing the rates of the carbon metabolism process, which led to an increase in the amount of processed carbohydrates, from which the surplus is transferred to the stored part (tubers) (Al-Sahaf, 1989), which in turn led to a high response of the chemical characteristics of the tubers, especially the dry matter that forms the product. The final process of metabolism and metabolism, and the increase in the percentage of dry matter in the tubers results in an increase in the qualitative indicators (Al-Zaidy & Al-Ubaidy, 2017; Al-Ubaidy *et al.*, 2019; Shayaa & Hussein, 2019; Al-Mharib *et al.*, 2021).

CONCLUSIONS

Biofertilizers improved the quality of potato tubers, the double inoculation treatment gave the best results, also organic fertilization improved the quality of potato tubers, the treatment at a level of 30 ton. ha⁻¹ gave best results, spraying with Nile flower peat extract improved the quality characteristics of potato tubers, the treatment of three factors interaction achieved the highest results.

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