J. of Plant Production, Mansoura Univ., Vol. 14 (3):141 - 147, 2023

Journal of Plant Production

Journal homepage & Available online at: www.jpp.journals.ekb.eg

Response of Feverfew Plant to Different Plant Residues Compost and Amino Acids

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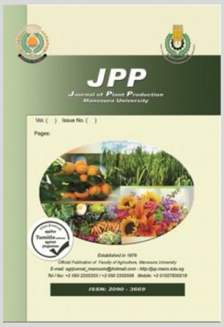

ABSTRACT

Medicinal and aromatic plants are the forgotten wealth of Egypt, as the importance of expanding their cultivation comes after the increasing demand for them locally and globally, due to their economic importance and export revenue. So, a field experiment was implemented aiming at evaluating different plant residues compost as main plots [Sn-C: Snap bean compost (foliage), So-C**:** Soya bean compost (stover) and W-C**:** Wheat compost (straw), at a rate of 25.0 m^3 ha^{-1} for each source plus control treatment (without compost)] and various amino acids as sub-main plots [control (without), lysine (100 mg L^{-1}), arginine (100 mg L^{-1}) and proline (100 mg L^{-1}) with the volume of 900 L ha^{-1} for each studied amino acid] on the performance of feverfew plant. The results show that the Sn-**C** treatment was superior for obtaining the best performance [*i.e.*, plant height, No. of branches, herb fresh and dry weights, flower fresh and dry weights, No. of flower $plant^{-1}$, essential oil, photosynthetic pigments (chlorophyll and carotene) and chemical constituents (N, P, K)] followed by So-C treatment then W-C treatment, whilst control treatment came in the last order. Regarding the amino acids treatments, the results illustrate that the sequence order of amino acids for obtaining the best performance from top to less was proline, arginine, lysine and control treatment, respectively. Generally, it can be concluded that treating the soil with plant residues compost and simultaneously spraying the plants with amino acids will achieve improvement in the performance of medicinal and aromatic plants.

Keywords: Snap bean compost, lysine, arginine, proline

INTRODUCTION

Feverfew is a medicinal plant that belongs to the daisy family (Asteraceae). The scientific name of feverfew is *Tanacetum parthenium*, although it was previously known as Chrysanthemum parthenium (Pourianezhad *et al.*, 2016). It is native to Europe and has been used for centuries in traditional medicine to treat a variety of ailments, including headaches, fever, arthritis, digestive problems, and menstrual irregularities. Feverfew plants have a bushy growth habit and can reach a height of 24-36 inches (60-90 cm) (Hordiei *et al.*, 2018). The leaves are green and deeply lobed, with a slightly bitter taste and a pungent odor. The flowers are small and daisy-like, with white petals and a yellow center, and bloom in clusters from mid-summer to early fall. Feverfew is available in various forms, including fresh or dried leaves, capsules, tablets, and extracts. It is often used as a natural remedy for migraine headaches, and some research suggests that it may be effective in reducing the frequency and severity of migraines (Mallahi *et al.*, 2018).

Generally, medicinal and aromatic plants are the forgotten wealth of Egypt, as the importance of expanding their cultivation comes after the increasing demand for them locally and globally, due to their economic importance and export revenue. Therefore, maximizing the productivity of medicinal and aromatic plants under Egyptian conditions has become an imperative matter (Shams *et al.*, 2015).

Plant residue compost is an excellent organic fertilizer that is commonly used in agriculture to improve soil fertility and enhance plant growth performance. It is made from the leftover parts of plants that have been harvested, such as leaves, stems, roots, and other plant debris (Khater, 2015). The use of plant residue compost has several benefits in agriculture such as improving soil fertility, soil structure and nutrient retention capacity, adding nutrients and organic matter to the soil, enhancing soil water-holding capacity, reducing the need for frequent irrigation, reducing chemical fertilizer use and thus reducing the environmental impact of agriculture (Naher *et al.,* 2018). On the other hand, the beneficial microorganisms in compost can suppress harmful pathogens in the soil, reducing the risk of soil-borne diseases (Xie *et al.*, 2022).

Amino acids play an important role in agriculture as they are essential building blocks for proteins and are involved in many biochemical processes in plants. Amino acids are organic compounds that contain a carboxyl group (-COOH) and an amino group ($-NH_2$) which are linked to a central carbon atom (Noroozlo *et al.*, 2019).There are 20 amino acids that are commonly found in proteins such as lysine, arginine, proline and tryptophan. Amino acids can be used as a source of nitrogen and carbon for plants. Amino acids can improve nutrient uptake and stimulate

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DOI: 10.21608/jpp.2023.198609.1225

plant growth (Abd El-Hady *et al.*, 2016). Amino acids are involved in many plant defense mechanisms against pests and diseases. Also, they can be used as natural biocontrol agents to enhance plant resistance against biotic and abiotic stressors (Dellero, 2020).

Due to the positive expected effect of the interaction among different compost sources and various amino acids on the feverfew plants, the current research work was executed to evaluate the effect of different plant residues compost and various amino acids on the performance of feverfew plants.

MATERIALS AND METHODS

1. Experimental location

The coordinates of the experimental location was 31°2' 27" N latitude and 31°22' 42" E longitude (private farm in Dakahlia Governorate, Egypt).

2. Soil Sampling, studied plant residues compost and amino acids

Table 1 illustrates the initial soil attributes before feverfew cultivation in addition to the characteristics of the plant's residues compost (average of two seasons), while Table 1 shows soil and compost standard analytical methods references.

Snap bean compost (foliage), soya bean compost (stover) and wheat compost (straw) were obtained from the agricultural research center, Egypt, where they were prepared. Amino acids were purchased from the Techno-Green Company (Egyptian commercial market).

Table 1. Initial soil attributes before feverfew cultivation in addition to the characteristics of the plant's residues compost (average of two seasons)

Initial saline soil characteristics		Plant's residues compost characteristics			
Parameters	Values	Parameters	Values		
			Sn-C	So-C	W-C
Chemical traits					
		C:N ratio	12.09	14.78	14.8
EC(dSm^{-1})	6.10	EC, dSm^{-1}	4.34	4.45	4.45
pH	7.90	K, mg kg^{-1}	7.17	4.37	2.48
O.M (%)	1.22	P , mg kg^{-1}	0.92	0.67	0.45
N	58.5	pH	6.76	6.85	7.00
P (mgKg^{-1})	8.25	N	2.60	1.66	0.75
K	210				
Particle size distribution					
Clay	50.0				
Silt (%)	21.0				
Sand	29.0				
Textural class is clayey					

Sn-C : Snap bean compost (foliage), So-C : Soya bean compost (stover) and W-C : Wheat compost (straw)

Table 2. Soil and compost standard analytical methods references.

Characteristics	References	Notes
Particle size distribution	Dane and Topp, (2020)	Soil sample was taken at depth of 0.0-30 cm. Soil pH was measured in 1:2.5 soil suspension, while compost pH was measured in 1:10 soil suspension.
Chemical analyses and available nutrients	Sparks *et al.*, (2020); Richards, (1954)	

3. Feverfew seedlings

Seedlings were obtained from a private nursery in El-Mansoura City, Egypt.

4. Experimental design and Setup

A field experiment was implemented during seasons of 2020/2021and 2021/2022 aiming at evaluating different plant residues compost as main plots [Sn-C: Snap bean compost (foliage), So-C: Soya bean compost (stover) and W-C: Wheat compost (straw), at a rate of 25.0 m^3 ha^{-1} for each source plus control treatment (without compost)] and various amino acids as sub-main plots [control (without), lysine (100 mg L^{-1}), arginine (100 mg L^{-1}) and proline (100 mg L^{-1}) with the volume of 900 L ha^{-1} for each studied amino acid as foliar application] on the performance of feverfew plant. The used experimental design was split plot with three replicates. Fe\verfew seedlings (75 days old) were transplanted on 7th December, as seedlings were transplanted on one side of the ridges with a spacing of 35.0 cm between each feverfew plant and the other. A month before transplanting, compost additions were added according to the studied treatments. The feverfew plants received the studied amino acids as a foliar application by hand sprayer 4 times, after 30 days from transplanting with 7 days intervals.

The mineral fertilizers (N, P, K) were added using calcium superphosphate (6.6%P) which was added before transplanting with soil preparation, ammonium sulfate (20.6 % N) which was divided into three equal doses; the first dose was added after 25 days from transplanting and the others doses every 20 days and potassium sulphate (39.8 % K) which was added in one dose with the second nitrogen dose.

5. Measurement traits

Picking of inflorescences started on 2nd June and it continued for one month with 8 days intervals. After the last pick, vegetative growth criteria (*i.e.*, plant height, No. of branches, herb fresh and dry weights), photosynthetic pigments (*i.e.*, chlorophyll and carotene) and chemical constituents (*i.e.*, N, P, K)] in leaves were measured. When feverfew plants started to flower (starting from the 3rd week of May in both seasons), the inflorescences showed up on the plants were collected and the flower fresh and dry weights, No. of flowers were determined. Also, The essential oil percentage was calculated.

Table 3. Chemical analysis methods and references

Parameters	Methods	References
Chlorophyll content	Using organic solvent (methanol 100%) using spectroscopic methods	Aminot and Rey (2000)
Carotene content	Spectrophotometric method	Luterotti et al.(2013)
Digested leaves for N,P,K determination	Mixed of $HClO_4 + H_2SO_4$	Peterburgski (1968)
N content	Micro-kjeldahl	Walingaet al. (2013)
P content	Using spectrophotometer	
K content	Using flam photometer	
Essential oil,%	$\text{Oil \%} = \frac{\text{Volume of oil in gradated tube (ml)}}{\text{Weight of sample}} \times 100$	British Pharmacopoeia (2000)

6.Statistical analyses

Data were statistically analyzed according to Gomez and Gomez, (1984) using CoStat version 6.303 copyright (1998-2004).

RESULTS AND DISCUSSION

Data illustrated in Tables 4 to 7 indicate the effect of the plant's residues compost (snap bean compost, soya bean compost and wheat compost) and various amino acids (lysine, arginine and proline) on the performance of feverfew plant that was expressed by plant height (cm), No. of branches, herb fresh and dry weights (g plant^{-1}), (Table 4), flower fresh and dry weights (g plant^{-1}), No. of flower, essential oil (%) (Table 5), photosynthetic pigments (chlorophyll and carotene, mg.g^{-1} F.W) (Table 6) and chemical constituents (N, P, K, %) (Table 7) during seasons of 2020/2021and 2021/2022.

Table 4. Effect of the plant's residues compost and various amino acids on plant height, No. of branches and herb fresh and dry weights of feverfew plants during seasons of 2020/2021and 2021/2022

Treatments		Plant height, cm		No. of branches		Herb fresh weight, g		Herb dry weight, g	
		1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Organic fertilization									
Snap bean compost (foliage)		70.14a	71.52a	15.25a	18.33a	1416.61a	1460.07a	299.84a	302.97a
Soya bean compost (stover)		68.56b	69.86b	13.83b	16.33b	1404.85b	1450.18b	295.54b	299.58b
Wheat compost (straw)		66.33c	67.76c	12.50c	14.92c	1393.03c	1434.05c	289.68c	293.40c
Control (without)		64.50d	65.63d	10.75d	12.75d	1383.69d	1428.66d	284.48d	288.21d
LSD at 5%		0.72	0.59	0.97	1.33	3.84	4.72	0.98	1.08
Amino acid applications									
Control (without)		66.86b	68.13b	12.33c	14.83b	1396.21b	1436.97b	290.93c	294.56c
Lysine		67.21b	68.58ab	12.92b	15.17b	1398.32ab	1443.73a	292.04b	295.52bc
Arginine		67.51ab	68.86ab	13.33ab	16.08a	1400.53ab	1445.61a	292.94ab	296.44b
Proline		67.95a	69.19a	13.75a	16.25a	1403.11a	1446.66a	293.63a	297.64a
LSD at 5%		0.67	0.76	0.57	0.85	5.20	5.22	1.03	1.07
Interaction									
	Control	69.67	71.00	14.33	17.67	1412.27	1458.09	298.13	301.51
Snap bean	Lysine	70.13	71.43	15.00	18.00	1416.23	1459.64	299.55	302.24
compost	Arginine	70.43	71.77	15.67	18.67	1417.18	1459.69	300.46	303.62
	Proline	70.33	71.87	16.00	19.00	1420.76	1462.85	301.21	304.50
	Control	67.90	69.33	13.00	15.67	1401.52	1439.13	293.72	298.11
Soya bean	Lysine	68.33	69.77	13.67	15.67	1402.73	1455.99	295.22	299.74
compost	Arginine	68.67	69.90	14.00	16.67	1405.80	1456.46	296.15	299.63
	Proline	69.33	70.43	14.67	17.33	1409.33	1449.14	297.06	300.84
	Control	65.83	66.97	12.00	14.00	1388.53	1427.08	288.44	292.01
Wheat straw	Lysine	66.10	67.73	12.33	14.33	1391.59	1433.96	289.03	292.55
compost	Arginine	66.33	68.03	12.67	16.00	1395.91	1436.16	290.26	293.32
	Proline	67.03	68.30	13.00	15.33	1396.08	1439.00	291.00	295.71
	Control	64.03	65.23	10.00	12.00	1382.51	1423.55	283.43	286.60
Control	Lysine	64.27	65.40	10.67	12.67	1382.75	1425.33	284.37	287.53
(without)	Arginine	64.60	65.73	11.00	13.00	1383.22	1430.11	284.90	289.20
	Proline	65.10	66.17	11.33	13.33	1386.26	1435.64	285.23	289.51
LSD at 5%		1.34	1.52	1.15	1.69	10.40	10.51	2.06	2.13

Means within a row followed by a different letter (s) are statistically different at a 0.05 level

Concerning the individual effect of plant's residues compost, the results show that the addition of snap bean compost to the soil before transplanting was more effective than other compost sources. In other words, the Sn-C treatment was superior for obtaining the highest values of plant height (70.14 and 71.52,cm for 1st and 2nd seasons , respectively), No. of branches plant^{-1} (15.25 and 18.33 for 1st and 2nd seasons , respectively), herb fresh weight (1416.61 and 1460.07,g plant^{-1} for 1st and 2nd seasons , respectively), herb dry weight (299.84 and 302.97,g plant^{-1} for 1st and 2nd seasons , respectively), flower fresh weight (302.84 and 308.88,g plant^{-1} for 1st and 2nd seasons , respectively), flower dry weight (50.78 and 51.64,g plant^{-1} for 1st and 2nd seasons , respectively), No. of flower plant^{-1} (326.33 and 330.75 for 1st and 2nd seasons , respectively), essential oil (0.93 and 0.99% for 1st and 2nd seasons , respectively), photosynthetic pigments *i.e.*, chlorophyll a (0.784 and 0.799, mg.g^{-1} F.W for 1st and 2nd seasons , respectively), chlorophyll b (0.573 and 0.581, mg.g^{-1} F.W for 1st and 2nd seasons , respectively) and carotene (2.95 and 0.301, mg.g^{-1} F.W for 1st and 2nd seasons , respectively), as well as chemical constituents *i.e.*, N (3.03 and 3.06% for 1st and 2nd seasons , respectively), P (0.305 and 0.311% for 1st and 2nd seasons , respectively) and K (2.69 and 2.75 % for 1st and 2nd seasons , respectively) followed by So-C treatment then W-C treatment, whilst control treatment came in the last order.

Regarding the amino acids treatments, the results illustrate that the sequence order of amino acids for obtaining the best performance from top to less was proline, arginine, lysine, while the control treatment (without amino acids) achieved the lowest plant performance.

Concerning the interaction effect, it can be noticed that treating the soil with snap bean compost at rate of 25.0 m^3 ha^{-1} before feverfew transplanting and simultaneously spraying the plants with proline at rate of 100 mg L^{-1} through their life period is the best-combined treatment which achieved the maximum values of plant height, No. of branches, herb fresh and dry weights, flower fresh and dry weights, No. of flower plant^{-1}, essential oil, photosynthetic pigments (chlorophyll and carotene) and chemical constituents (N, P, K). The same trend was found for both studied seasons.

The soil treated with the different plant's residues compost (snap bean compost, soya bean compost and wheat compost) before transplanting was more fertile than that without plant's residues compost, as this positively reflected on the feverfew plant performance. In other words, plant residue compost (leftover parts of plants that have been harvested, such as leaves, stover, stems, roots, and other plant debris) may have nutritional value that may be reflected in the soil fertility and plant's performance. The studied different compost led to improve soil structure and nutrient retention capacity, increase organic matter content in soil and enhance the soil water-holding capacity thus, all of these positively affected the performance of feverfew. The plant's residues compost (snap bean compost, soya bean compost and wheat compost) supplied the soil with nutrients including nitrogen, phosphorus and potassium, therefore, improving the feverfew plant's health.

The pronounced promotional effect of snap bean compost compared to soya bean compost and wheat compost may be due to that the plant's residues may contain more nutrients, especially nitrogen element in addition to its low C/N ratio compared to soya bean compost and wheat compost (Table 1). For the same reasons, the soya bean compost was more effective than wheat compost. The obtained results are in agreement with Diacono *et al.,* (2019) who reported that farm residues or agricultural by-products could improve soil properties.

On the other hand, the findings also help in understanding the amino acid's role in improving feverfew plant performance, where the performance improved with all studied amino acids compared to the corresponding plants grown without amino acids. This may be attributed to its critical role in increasing the rate of photosynthesis, regulating osmotic pressure in the guard cells in the stomata, improving nutrient uptake and stimulating plant growth, defining against pests and diseases and enhancing feverfew plant resistance against biotic and abiotic stressors. The superiority of proline may be due to that proline acted as an osmoprotectant in feverfew plants, helping them to survive under conditions of drought (EL-Bauome *et al.,* 2022), salinity (Hamail *et al.* 2015), and other environmental stresses. It might help to maintain the water balance in feverfew plants cells and protect them from damage due to dehydration. It is involved in the synthesis of proteins, which are essential for plant growth and development. It helps to stabilize the structure of proteins and prevent their denaturation under stressful conditions. It is also involved in energy production in plants. It is a precursor for the biosynthesis of the amino acid arginine, which is used to produce nitric oxide, a signalling molecule involved in many metabolic processes. Also, proline is involved in cell division and differentiation, and it also helps to maintain the structural integrity of plant cells.in addition,it helps to activate the plant's immune response and promote the production of defense-related proteins.

Table 5. Effect of the plant's residues compost and various amino acids on flower fresh and dry weights, No. of flower and essential oil of feverfew plants during seasons of 2020/2021and 2021/2022

Treatments		Fresh weight of flower, g plant^{-1}		Dry weight of flower, g plant^{-1}		No. of flower plant^{-1}		Essential oil, %	
		1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Organic fertilization									
Snap bean compost (foliage)		302.84a	308.88a	50.78a	51.64a	326.33a	330.75a	0.93a	0.99a
Soya bean compost (stover)		295.74b	301.04b	48.07b	48.88b	311.67b	315.42b	0.87b	0.93b
Wheat compost (straw)		288.48c	294.44c	45.48c	46.29c	296.75c	301.08c	0.80c	0.84c
Control (without)		280.16d	284.89d	42.75d	43.48d	287.25d	290.75d	0.75d	0.77d
LSD at 5%		2.04	4.33	0.57	0.93	3.63	5.08	0.02	0.02
Amino acid applications									
Control (without)		289.41b	294.50b	46.01c	46.81d	300.83b	305.08b	0.82c	0.86c
Lysine		291.01ab	296.85ab	46.45c	47.27c	304.50ab	308.00ab	0.83bc	0.87c
Arginine		292.66ab	298.37a	47.04b	47.84b	307.17ab	311.17ab	0.85ab	0.89b
Proline		294.14a	299.52a	47.57a	48.36a	309.50a	313.75a	0.86a	0.92a
LSD at 5%		3.41	3.54	0.51	0.46	6.59	8.25	0.02	0.02
Interaction									
Snap bean compost	Control	300.22	306.14	50.00	50.89	321.33	327.00	0.92	0.97
	Lysine	302.18	308.03	50.42	51.23	325.67	329.67	0.93	0.98
	Arginine	303.90	309.99	51.09	51.88	327.33	331.33	0.94	0.99
	Proline	305.05	311.37	51.61	52.53	331.00	335.00	0.95	1.02
Soya bean compost	Control	293.90	299.24	47.35	48.06	307.67	310.67	0.84	0.89
	Lysine	294.95	301.05	47.67	48.55	310.67	313.33	0.86	0.90
	Arginine	296.69	301.37	48.34	49.19	313.00	317.00	0.89	0.95
	Proline	297.43	302.49	48.91	49.73	315.33	320.67	0.90	0.97
Wheat straw compost	Control	285.86	290.19	44.69	45.58	291.67	296.00	0.79	0.82
	Lysine	287.79	294.55	45.24	46.09	295.67	300.00	0.79	0.83
	Arginine	289.18	296.16	45.75	46.51	299.00	302.67	0.81	0.85
	Proline	291.07	296.85	46.24	46.97	300.67	305.67	0.82	0.87
Control (without)	Control	277.67	282.45	41.99	42.70	282.67	286.67	0.74	0.74
	Lysine	279.10	283.77	42.47	43.22	286.00	289.00	0.74	0.77
	Arginine	280.86	285.95	43.00	43.77	289.33	293.67	0.74	0.78
	Proline	283.02	287.38	43.52	44.22	291.00	293.67	0.77	0.81
LSD at 5%		6.81	7.11	1.02	0.92	13.18	16.50	0.04	0.03

Means within a row followed by a different letter (s) are statistically different at a 0.05 level

Table 6. Effect of the plant's residues compost and various amino acids on photosynthetic pigments of feverfew plants during seasons of 2020/2021and 2021/2022

Treatments		Chlorophyll a, mg.g^{-1} F.W		Chlorophyll b, mg.g^{-1} F.W		Carotene, mg.g^{-1} F.W	
		1st season	2nd season	1st season	2nd season	1st season	2nd season
Organic fertilization							
Snap bean compost (foliage)		0.784a	0.799a	0.573a	0.581a	2.95a	3.01a
Soya bean compost (stover)		0.760b	0.771b	0.549b	0.558b	2.74b	2.79b
Wheat compost (straw)		0.734c	0.749c	0.528c	0.537c	2.47c	2.51c
Control (without)		0.705d	0.718d	0.502d	0.509d	2.16d	2.22d
LSD at 5%		0.019	0.012	0.003	0.013	0.03	0.03
Amino acid applications							
Control (without)		0.738d	0.753b	0.531d	0.539d	2.50d	2.55d
Lysine		0.743c	0.756b	0.536c	0.544c	2.56c	2.60c
Arginine		0.748b	0.760b	0.540b	0.549b	2.61b	2.66b
Proline		0.753a	0.769a	0.545a	0.553a	2.65a	2.71a
LSD at 5%		0.004	0.007	0.003	0.003	0.03	0.03
Interaction							
Snap bean compost	Control	0.776	0.792	0.565	0.574	2.88	2.95
	Lysine	0.782	0.798	0.571	0.580	2.94	3.00
	Arginine	0.787	0.799	0.575	0.585	2.98	3.04
	Proline	0.790	0.807	0.580	0.587	3.01	3.07
Soya bean compost	Control	0.753	0.768	0.543	0.552	2.65	2.70
	Lysine	0.758	0.767	0.548	0.556	2.72	2.77
	Arginine	0.762	0.769	0.551	0.560	2.77	2.83
	Proline	0.766	0.782	0.555	0.564	2.81	2.85
Wheat straw compost	Control	0.727	0.741	0.521	0.529	2.38	2.41
	Lysine	0.731	0.745	0.527	0.536	2.44	2.48
	Arginine	0.735	0.751	0.530	0.539	2.49	2.53
	Proline	0.742	0.758	0.534	0.545	2.56	2.61
Control (without)	Control	0.697	0.710	0.494	0.500	2.08	2.13
	Lysine	0.701	0.714	0.498	0.505	2.13	2.17
	Arginine	0.708	0.722	0.506	0.514	2.22	2.26
	Proline	0.714	0.728	0.510	0.517	2.23	2.32
LSD at 5%		0.009	0.014	0.007	0.006	0.06	0.06

Means within a row followed by a different letter (s) are statistically different at a 0.05 level

Table 7. Effect of the plant's residues compost and various amino acids on chemical constituents of feverfew plants during seasons of 2020/2021and 2021/2022

Treatments		N,%		P,%		K,%	
		1st season	2nd season	1st season	2nd season	1st season	2nd season
Organic fertilization							
Snap bean compost (foliage)		3.03a	3.06a	0.305a	0.311a	2.69a	2.75a
Soya bean compost (stover)		2.87b	2.90b	0.289b	0.295b	2.59b	2.64b
Wheat compost (straw)		2.73c	2.77c	0.274c	0.280c	2.44c	2.49c
Control (without)		2.62d	2.65d	0.253d	0.258d	2.26d	2.30d
LSD at 5%		0.03	0.04	0.004	0.007	0.02	0.02
Amino acid applications							
Control (without)		2.76c	2.79c	0.274c	0.279d	2.45c	2.50c
Lysine		2.80b	2.84b	0.278b	0.284c	2.49b	2.54b
Arginine		2.83a	2.87a	0.283a	0.288b	2.51ab	2.56ab
Proline		2.86a	2.89a	0.286a	0.292a	2.53a	2.58a
LSD at 5%		0.03	0.03	0.003	0.002	0.03	0.03
Interaction							
Snap bean compost	Control	2.97	3.00	0.300	0.305	2.67	2.72
	Lysine	3.01	3.06	0.303	0.309	2.70	2.75
	Arginine	3.05	3.08	0.307	0.313	2.70	2.75
	Proline	3.08	3.11	0.309	0.316	2.71	2.77
Soya bean compost	Control	2.82	2.86	0.285	0.288	2.55	2.60
	Lysine	2.86	2.89	0.287	0.293	2.59	2.64
	Arginine	2.88	2.91	0.291	0.297	2.60	2.65
	Proline	2.91	2.95	0.294	0.300	2.63	2.67
Wheat straw compost	Control	2.67	2.70	0.269	0.274	2.38	2.42
	Lysine	2.71	2.75	0.271	0.278	2.42	2.48
	Arginine	2.75	2.81	0.276	0.282	2.47	2.53
	Proline	2.78	2.83	0.279	0.285	2.50	2.55
Control (without)	Control	2.58	2.61	0.243	0.248	2.22	2.26
	Lysine	2.61	2.65	0.252	0.257	2.25	2.29
	Arginine	2.64	2.67	0.258	0.261	2.27	2.31
	Proline	2.65	2.68	0.261	0.267	2.30	2.34
LSD at 5%		0.06	0.06	0.007	0.003	0.05	0.05

Means within a row followed by a different letter (s) are statistically different at a 0.05 level

The superiority of arginine compared to lysine and control treatments may be due to that arginine is a precursor for the synthesis of nitric oxide (NO), a signaling molecule that regulates a wide range of physiological processes in plants. NO is involved in many important processes, including root growth, and stress responses. Arginine is also involved in protein synthesis in plants. It plays a role in stress tolerance and other physiological processes. It is involved in the biosynthesis of polyamines. It is involved in the biosynthesis of ethylene, a plant hormone that regulates root growth and other physiological processes. It is a precursor for the biosynthesis of several compounds that help plants cope with environmental stresses such as polyamines.

The amino acid lysine came in third place because its main role is concentrated in the pollination process as well as its vital role in phenolic compounds biosynthesis, in addition to its other positive qualities as any amino acid.

The findings are in compatibility and harmony with those of Akladious and Hanafy (2018); Soroori *et al.* (2021); Zhang *et al.* (2023).

CONCLUSION

The current paper provides evidence that treating the soil with snap bean compost at a rate of 25.0 m^3 ha^{-1} before feverfew cultivation and simultaneously spraying the plants with proline at a rate of 100 mg L^{-1} through their life period is the best-combined treatment.

Generally, it can be concluded that the use of plant residue compost as well as the exogenous application of amino acids in the agriculture sector can be an effective way to improve soil fertility and enhance plant performance while reducing the environmental impact of agriculture, therefore achieve improvement in the performance of medicinal and aromatic plants.

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استجابة نبات أقحوان الذهب لسماده المكمورة لبقايا نباتيه مختلفة والأحماض الامينية

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الملخص

النباتات الطبية والعطرية هي ثروة مصر المنسية، حيث تأتي أهمية التوسع في زراعتها بعد تزايد الطلب عليها محلياً وعالمياً، نظراً لأهميتها الاقتصادية وعائدات التصدير لها. لذلك، تم تنفيذ تجربة حقلية تهدف إلى تقييم سماد المكمورة لمخلفات نباتية مختلفة كعامل دراسة رئيسي [بقايا نبات الفاصوليا (مجموع خضري) وبقايا نبات فول الصويا (سيقان) وبقايا نبات القمح (قش) بمعدل 25 م^3 للهكتار لكل مصدر بالإضافة لمعامله الكنترول (بدون سماد المكمورة)] وأحماض أمينية مختلفة تمثل القطع المنشقة الاولي [كنترول (بدون)، ليسين (100 مجم /لتر)، أرجانين (100 مجم /لتر) والبرولين (100 مجم /لتر) بحجم 900 لتر للهكتار لكل حمض أميني] على أداء نبات أقحوان الذهب. أظهرت النتائج أن سماد مكمورة بقايا نبات الفاصوليا كان متفوقًا في الحصول على أفضل أداء من حيث ارتفاع النبات، عدد الفروع، أوزان العشب الطازجة والجافة، أوزان الأزهار الطازجة والجافة، عدد الأزهار للنبات، الزيت العطري، صبغات البناء الضوئي (الكلوروفيل والكاروتين) والمكونات الكيميائية (النيتروجين والفسفور والبوتاسيوم) يليه سماد مكمورة مخلفات نبات فول الصويا ثم كومبوست مخلفات القمح بينما جاءت معاملة الكنترول بالترتيب الأخير. فيما يتعلق بمعاملات الأحماض الأمينية، أوضحت النتائج أن الترتيب التسلسلي للأحماض الأمينية للحصول على أفضل أداء من الأعلى إلى الأقل كان البرولين ثم الأرجانين ثم الليسين بينما جاءت معاملة الكنترول بالترتيب الأخير. بشكل عام، يمكن الاستنتاج أن معاملة التربة بكومبوست مخلفات النباتات والرش الورقي في نفس الوقت بالأحماض الأمينية سيحقق تحسنًا في أداء النباتات الطبية والعطرية.

الكلمات الدالة: مكمورة بقايا الفاصوليا، ليسين، أرجانين، برولين