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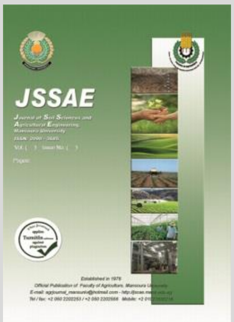
# Effect of Different Sources of Organic Fertilizers and Foliar Application of some Amino Acids on Wheat Productivity and some Soil Properties

Cross Mark

**Marwa A. Kany***

Soil, Water and Environment Research Institute, Agriculture Research Center, El-Gama St., Giza, Egypt.




## ABSTRACT

Egypt relies heavily on wheat as one of the major agricultural crops, accounting for the largest share of the country's agricultural output. As a result, it is crucial to enhance wheat productivity in Egypt to support the economy and society. Therefore, this study aimed to evaluate the impact of applying different organic fertilizers, including plant residue compost, cow waste compost, and a combination of both at the dosage of 10 ton $ha^{-1}$, besides the foliar application of amino acids (arginine, glycine, and tryptophan) at a rate of 100 mg $L^{-1}$ on wheat growth and productivity, as well as some soil properties. The study compares the treatments to a control group with no organic fertilizers addition and no foliar application. The compost from a combination of plant residue and cow waste was found to be the most effective treatment for promoting growth performance and productivity. The second most effective treatment was using the compost of plant residue alone, followed by the compost of cow waste alone. In contrast, the control treatment gave the lowest growth performance and productivity. In terms of amino acids, arginine, glycine, and tryptophan were all found to significantly enhance growth performance and productivity compared to the control treatment. Arginine was found to be the most effective, followed by glycine and then tryptophan. Therefore, the use of the mixed compost of plant residue and cow waste and amino acids (especially arginine) is recommended for wheat cultivation in Egypt to enhance productivity and support the economy and society.

***Keywords***: Compost, arginine, glycine, tryptophan

## INTRODUCTION

Wheat is regarded as a strategic crop owing to its importance in ensuring food security and economic stability in various countries, including Egypt. Besides its strategic importance, wheat also possesses considerable nutritional value, being a rich source of complex carbohydrates, dietary fiber, essential nutrients, vitamins, proteins and minerals (El-Mantawy et al. 2022). Attaining self-sufficiency in wheat is a crucial strategic objective for Egypt, and it demands consistent and unified endeavors from all individuals working in the domain of scientific research, agriculture, and the food industry. Sustainable development must be achieved in this field, by enhancing soil quality, amplifying productivity, and improving wheat quality, through robust fertilization programs (El-Shamy et al. 2022).

Incorporating organic fertilization from diverse sources and foliar spraying of amino acids is crucial in crop fertilization programs for improving soil and plant properties and enhancing crop productivity. Organic substances such as animal manure and plant residues are important for enriching the soil with organic matter and essential nutrients, improving soil quality, and increasing crop yields. Additionally, organic fertilization enhances soil properties, such as nutrient-holding capacity, moisture, and air, resulting in better crop yields (El-Sherpiny et al. 2023).

Amino acids serve as the fundamental building blocks. In proteins, there are commonly 20 different amino acids, each possessing distinct chemical structures and properties. Among these amino acids are alanine, glycine, arginine, asparagine, aspartic acid, cysteine, glutamic acid, glutamine, histidine, leucine, lysine, methionine, phenylalanine, isoleucine, proline, serine, threonine, tryptophan, tyrosine, and valine (Kumar et al. 2017). Foliar application of amino acids is a contemporary plant fertilization technique that involves spraying amino acids directly on plant leaves. Amino acids contribute to the growth, development, and productivity of plants as they serve as sources of amino nitrogen for protein and nucleic acid formation. Amino acids also stimulate metabolic processes and promote root growth, leading to improved crop yields and quality (Ibrahim et al. 2023).

Therefore, the primary objective of this study was to assess the effect of various compost sources and foliar application of different amino acids on wheat growth performance and productivity, along with certain soil properties.

## MATERIALS AND METHODS

To improve the growth performance and productivity of wheat plants (Cv. Sakha 95), a field trial was conducted aiming to evaluate the impact of applying different organic fertilizers, including plant residue compost, cow waste compost, and a combination of both (1:1 by weight) at the dosage of 10 ton $ha^{1}$, beside the foliar application of amino acids (arginine, glycine, and tryptophan) at a rate of 100 mg $L^{-1}$ on wheat growth and productivity, as well as some soil properties, over two consecutive seasons (2021/2022 and 2022/2023) in the Tag El-Ezz Experimental Farm (31°31' 47.64'' N latitude and 30°56' 12.88'' E longitude ). Table 1 presents the characteristics of the soil prior to any treatment (initial soil), while Table 2 displays the properties of the composts examined in this study.

* **Corresponding author.**
**E-mail address: marwakaney@gmail.com**
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**Table 1. Properties of initial soil**

| Property | Values |
|---|---|
| Clay,% | 48.50 |
| Sand,% | 22.50 |
| Silt ,% | 29.00 |
| Textural | Clayey |
| pH (suspension 1:2.5) | 8.10 |
| Organic matter,% | 1.25 |
| N, $mgKg^{-1}$ | 40.04 (available) |
| P , $mg\ kg^{-1}$ | 8.07 (available) |
| K, $mg\ kg^{-1}$ | 202.31 (available) |
| EC, $dSm^{-1}$ | 7.30 |

**Table 2. Properties of the studied compost**

| Property | A | B |
|---|---|---|
| EC, $dSm^{-1}$ | 3.60 | 3.73 |
| pH (suspension 1:10) | 6.33 | 6.40 |
| P , $mg\ kg^{-1}$ | 0.75 | 0.69 |
| K, $mg\ kg^{-1}$ | 0.82 | 0.66 |
| Organic matter,% | 32.2 | 33.1 |
| Total C, % | 18.7 | 19.20 |
| Total N, % | 1.46 | 1.29 |
| C:N ratio | 12.80 | 14.8 |

**A: Plant residue compost, B:Cow waste compost**

Seeds were planted on November 19th with rate of 140 kg $ha^{-1}$. The sub-plot area for the experiment was measured at 9.0 $m^2$ (3.0 m × 3.0 m). One month prior to planting, the designated compost treatments were applied to the plots. Calcium superphosphate (15% $P_2O_5$) was incorporated before plowing at a rate of 36 kg $P_2O_5$ $ha^{-1}$, and potassium sulphate (48% $K_2O$) was also added at a rate of 60 kg $K_2O$ $ha^{-1}$ after 50 days from sowing. Urea (46% N) was applied in two equal portions during cultivation (30 and 50 days after planting) at a rate of 180 kg N $ha^{-1}$. All the designated amino acids were sprayed three times throughout the experimental period (after 30, 45, and 60 days from sowing) at a volume of 600 L $ha^{-1}$, according to the respective treatments. Standard agricultural practices were followed, including irrigation with six flood system applications. Harvesting was conducted on May 10th during both seasons.

At 70 days after sowing, plant height (cm), fresh and dry weights (g $plant^{-1}$), and leaf area ($cm^2$ $plant^{-1}$) were manually and visually measured. Additionally, the chlorophyll content was determined using SPAD (Castelli et al. 1996), and the carotene content (mg $g^{-1}$) was spectrophotometrically measured (Hornero-Méndez and Mínguez-Mosquera 2001).

Furthermore, the nitrogen (N), phosphorus (P), and potassium (K) contents in the wheat plant samples were evaluated using Kjeldahl, spectrophotometric, and flame photometer methods, respectively (Ashworth et al. 1997). These measurements were taken at the same time as the assessment of the photosynthetic pigments.

At the harvest stage, spike length (cm), spike weight (g), the weight of 1000 grains (g), the number of grains per spike, straw and biological yield (Mg ha-1) were visually and manually measured. Harvest index (HI, %) was calculated using the formula HI = (Economic yield/Biological yield) × 100. Moreover, the total carbohydrate and protein content (%) were determined according to AOAC (2000) guidelines, with protein (%) calculated as (N) × 5.75.

The aforementioned measurements offer significant insights into the growth, development, and nutritional composition of wheat plants. Such insights can inform and guide future agricultural interventions and practices aimed at enhancing crop yield and quality.

The soil nutrient availability, specifically nitrogen (N), phosphorus (P), and potassium (K), were evaluated after the harvest of wheat plants, with data averaged across both studied seasons. Kjeldahl, spectrophotometric, and flame photometer methods were used to measure the N, P, and K contents, respectively as described by Jackson (1967). Statistical analysis of the data was conducted following the guidelines outlined by Gomez and Gomez (1984) and analyzed using CoStat version 6.303 copyright (1998-2004).

## RESULTS AND DISCUSSION

**- Growth traits and productivity**

Data in Table 3 present the observations of various growth parameters of wheat plants, such as plant height (cm), fresh and dry weights (g $plant^{-1}$), and leaf area ($cm^2$ $plant^{-1}$), to evaluate the impact of composts and amino acids at 70 days from sowing during the seasons of 2021/22 and 2022/23. While the effects of the studied treatments on photosynthetic pigments (chlorophyll, SPAD and carotene, mg $g^{-1}$) and chemical constituents (N, P, K, %) in plant, at 70 days from sowing, are listed in Table 4.

Also, data in Tables 5 to 7 illustrate the influence of the studied composts and amino acids on the yield measurements, including spike length (cm), spike weight (g), the weight of 1000 (g), No. grain $spike^{-1}$ (Table 5) as well as grain, straw and biological yield (Mg $ha^{-1}$), harvest index (%) (Table 6), and grain quality, such as carbohydrates and protein (%) (Table 7) at the harvest stage during the seasons of 2021/22 and 2022/23.

The findings show that the compost from a combination of plant residue and cow waste was found to be the most effective treatment for promoting growth performance (including plant height, fresh and dry weights, leaf area, chlorophyll, carotene, N,P,K, at period of 70 days from sowing) and yield and its components (spike length, spike weight, the weight of 1000, No. grain $spike^{-1}$, grain, straw and biological yield and harvest index as well as grain content of carbohydrates and protein, at harvest stage). The second most effective treatment was using the compost of plant residue alone, followed by the compost of cow waste alone. In contrast, the control treatment, which did not receive any organic fertilization, showed the lowest growth performance and productivity.

This study compared the effectiveness of three different composts on the growth performance and yield of wheat plants. The results showed that the compost made from a combination of plant residue and cow waste was the most effective treatment, followed by the compost made from plant residue alone, and then the compost made from cow waste alone. This can be attributed to the higher availability of nutrients, such as nitrogen, phosphorus, and potassium, in the compost from a combination of plant residue and cow waste. Moreover, the compost from the combination of plant residue and cow waste also led to higher yield and yield components. This treatment also resulted in a higher harvest index, indicating that more resources were directed towards grain production, which is the desired outcome in wheat farming. Furthermore, the compost from the combination of plant residue and cow waste resulted in a higher grain content of carbohydrates and protein compared to the other treatments. This is an important finding as it indicates that the use of this compost can result in higher-quality grain.The compost made from a combination of plant residue and cow waste was found to be the most effective treatment for promoting growth performance and yield in wheat plants. This superiority can be attributed to several reasons:

**Table 3. Effect of composts and amino acids on the wheat growth traits at 70 days from sowing during the seasons of 2021/22 and 2022/23**

| Treatments | | Plant height,cm | | Fresh weight, g plant$^{-1}$ | | Dry weight, g plant$^{-1}$ | | Leaf area,cm$^2$ plant$^{-1}$ | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| Organic fertilization treatments | | | | | | | | | |
| $T_1$ | | 88.35d | 91.23d | 33.24d | 33.60d | 9.27d | 9.37d | 93.79d | 94.88 d |
| $T_2$ | | 108.37a | 112.10a | 39.68a | 40.11a | 13.12a | 13.28a | 116.97a | 118.38a |
| $T_3$ | | 104.39b | 107.65b | 38.43b | 38.90b | 12.58b | 12.75b | 111.40b | 113.22b |
| $T_4$ | | 97.58c | 101.19c | 37.49c | 37.83c | 11.81c | 11.95c | 107.39c | 108.77c |
| LSD at 5% | | 0.35 | 178 | 0.34 | 0.74 | 0.15 | 0.09 | 0.14 | 0.86 |
| Amino acids treatments | | | | | | | | | |
| $F_1$ | | 93.40d | 96.29d | 35.27d | 35.68d | 10.60d | 10.73d | 98.17d | 99.32c |
| $F_2$ | | 103.13a | 106.55a | 38.91a | 39.19a | 12.42a | 12.57a | 111.92a | 113.43a |
| $F_3$ | | 102.05b | 105.70b | 37.57b | 38.05b | 11.97b | 12.11b | 110.64b | 112.23a |
| $F_4$ | | 100.11c | 103.62c | 37.09c | 37.53c | 11.79c | 11.94c | 108.82c | 110.27b |
| LSD at 5% | | 0.30 | 1.03 | 0.40 | 0.40 | 0.12 | 0.08 | 0.41 | 1.32 |
| Interaction | | | | | | | | | |
| $T_1$ | $F_1$ | 86.32n | 89.02i | 31.07k | 31.45j | 8.54k | 8.64l | 92.81k | 93.95g |
| | $F_2$ | 90.07k | 92.87h | 35.69i | 36.05h | 10.31h | 10.39i | 95.03i | 96.37efg |
| | $F_3$ | 88.83l | 91.93h | 33.13j | 33.45i | 9.31i | 9.41j | 94.00j | 94.94fg |
| | $F_4$ | 88.15m | 91.09hfg | 33.07j | 33.47i | 8.93j | 9.03k | 93.32jk | 94.27fg |
| $T_2$ | $F_1$ | 99.09i | 102.21a | 36.91gh | 37.27fg | 11.81e | 11.93f | 106.83g | 108.10d |
| | $F_2$ | 113.20a | 117.18a | 42.29a | 42.64a | 13.88a | 14.08a | 121.78a | 123.10a |
| | $F_3$ | 112.07b | 116.11b | 40.18b | 40.78b | 13.51b | 13.65b | 119.74b | 121.18ab |
| | $F_4$ | 109.13c | 112.91g | 39.32c | 39.76c | 13.30b | 13.44c | 119.54b | 121.15ab |
| $T_3$ | $F_1$ | 98.11j | 100.91bc | 36.88gh | 37.23fg | 11.23f | 11.40g | 97.51h | 98.62e |
| | $F_2$ | 108.18d | 111.24c | 39.16cd | 39.69c | 13.31b | 13.51bc | 117.50c | 119.33b |
| | $F_3$ | 107.19e | 110.69d | 39.10cd | 39.68c | 12.93c | 13.07d | 117.12c | 119.45b |
| | $F_4$ | 104.06f | 107.76d | 38.58cde | 39.01cd | 12.83c | 13.02d | 113.45d | 115.47c |
| $T_4$ | $F_1$ | 90.09k | 93.03h | 36.22hi | 36.76gh | 10.83g | 10.94h | 95.55i | 96.61ef |
| | $F_2$ | 101.07g | 104.93e | 38.48de | 38.37de | 12.19d | 12.31e | 113.36d | 114.91c |
| | $F_3$ | 100.09h | 104.07ef | 37.87ef | 38.30de | 12.12d | 12.30e | 111.67e | 113.35c |
| | $F_4$ | 99.07i | 102.73fg | 37.37fg | 37.90ef | 12.11d | 12.27e | 108.96f | 110.19d |
| LSD at 5% | | 0.60 | 2.05 | 0.80 | 0.80 | 0.24 | 0.15 | 0.82 | 2.65 |

**Means within a row followed by a different letter (s) are statistically different at a 0.05 level T1:Control (without organic fertilizer), T2: Plant residue and cow waste (compost from a combination of both), T3: Plant residue compost, T4:Cow waste compost, F1: Control , F2: Arginine, F3: Glycine, and F4: Tryptophan**

**Table 4. Effect of composts and amino acids on the photosynthetic pigments and chemical constituents in the straw of wheat plants at 70 days from sowing during the seasons of 2021/22 and 2022/23**

| Treatments | | Chlorophyll, SPAD reading | | Carotene, mg g$^{-1}$ | | N, % | | P, % | | K, % | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| Organic fertilization treatments | | | | | | | | | | | |
| $T_1$ | | 35.23d | 35.91d | 0.347d | 0.354d | 2.67d | 2.72d | 0.321d | 0.327d | 2.53d | 2.56d |
| $T_2$ | | 39.37a | 40.13a | 0.448a | 0.456a | 3.24a | 3.31a | 0.386a | 0.391a | 3.17a | 3.22a |
| $T_3$ | | 38.41b | 39.21b | 0.406b | 0.412b | 3.11b | 3.17b | 0.370b | 0.377b | 3.01b | 3.05b |
| $T_4$ | | 37.60c | 38.31c | 0.391c | 0.399c | 2.95c | 3.00c | 0.355c | 0.361c | 2.89c | 2.92c |
| LSD at 5% | | 0.12 | 0.14 | 0.005 | 0.003 | 0.02 | 0.03 | 0.005 | 0.003 | 0.03 | 0.04 |
| Amino acids treatments | | | | | | | | | | | |
| $F_1$ | | 36.21d | 36.90d | 0.367d | 0.374d | 2.79d | 2.84c | 0.336c | 0.341d | 2.68d | 2.71c |
| $F_2$ | | 38.46a | 39.26a | 0.429a | 0.436a | 3.12a | 3.19a | 0.372a | 0.375a | 3.04a | 3.08a |
| $F_3$ | | 38.13b | 38.89b | 0.401b | 0.410b | 3.06b | 3.12ab | 0.363b | 0.369b | 2.96b | 2.99b |
| $F_4$ | | 37.81c | 38.51c | 0.395c | 0.403c | 3.00c | 3.05b | 0.361b | 0.370c | 2.92c | 2.96b |
| LSD at 5% | | 0.14 | 0.11 | 0.004 | 0.004 | 0.03 | 0.07 | 0.004 | 0.002 | 0.03 | 0.07 |
| Interaction | | | | | | | | | | | |
| $T_1$ | $F_1$ | 34.39k | 35.04j | 0.335l | 0.342k | 2.62j | 2.67i | 0.315h | 0.321l | 2.39k | 2.42j |
| | $F_2$ | 35.99h | 36.63g | 0.359j | 0.367i | 2.76i | 2.81gh | 0.330g | 0.334j | 2.65i | 2.68hi |
| | $F_3$ | 35.61i | 36.32h | 0.351k | 0.357j | 2.65j | 2.70hi | 0.322h | 0.326k | 2.56j | 2.59i |
| | $F_4$ | 34.90j | 35.64i | 0.345k | 0.352j | 2.64j | 2.68hi | 0.319h | 0.326k | 2.53j | 2.56i |
| $T_2$ | $F_1$ | 37.61f | 38.48e | 0.386h | 0.394g | 2.89fg | 2.96ef | 0.350ef | 0.357h | 2.82fg | 2.86fg |
| | $F_2$ | 40.27a | 41.07a | 0.531a | 0.540a | 3.44a | 3.50a | 0.404a | 0.410a | 3.36a | 3.41a |
| | $F_3$ | 39.87b | 40.54b | 0.441b | 0.449b | 3.33b | 3.39ab | 0.396b | 0.402b | 3.27b | 3.31ab |
| | $F_4$ | 39.74b | 40.43b | 0.434b | 0.443b | 3.32b | 3.38ab | 0.394b | 0.396c | 3.25b | 3.29ab |
| $T_3$ | $F_1$ | 36.80g | 37.35f | 0.378i | 0.382h | 2.85gh | 2.90efg | 0.344f | 0.349i | 2.79g | 2.83fg |
| | $F_2$ | 39.15c | 40.13c | 0.423c | 0.427c | 3.24c | 3.32b | 0.383c | 0.389d | 3.17c | 3.20bc |
| | $F_3$ | 39.05c | 40.00c | 0.415d | 0.423cd | 3.21c | 3.29bc | 0.379cd | 0.388de | 3.05d | 3.08cd |
| | $F_4$ | 38.65d | 39.37d | 0.410de | 0.418de | 3.13d | 3.19cd | 0.376cd | 0.384ef | 3.03d | 3.07cd |
| $T_4$ | $F_1$ | 36.06h | 36.73g | 0.370i | 0.377h | 2.79hi | 2.83fg | 0.334g | 0.339j | 2.72h | 2.75gh |
| | $F_2$ | 38.42d | 39.21d | 0.404ef | 0.412ef | 3.05e | 3.11d | 0.373d | 0.382f | 3.00de | 3.03de |
| | $F_3$ | 37.99e | 38.70e | 0.397fg | 0.409f | 3.05e | 3.10d | 0.357e | 0.362g | 2.96e | 3.00de |
| | $F_4$ | 37.94e | 38.58e | 0.392gh | 0.400g | 2.92f | 2.97e | 0.356e | 0.360gh | 2.86f | 2.90ef |
| LSD at 5% | | 0.27 | 0.23 | 0.008 | 0.007 | 0.07 | 0.13 | 0.007 | 0.005 | 0.05 | 0.13 |

**Means within a row followed by a different letter (s) are statistically different at a 0.05 level T1:Control (without organic fertilizer), T2: Plant residue and cow waste (compost from a combination of both), T3: Plant residue compost, T4:Cow waste compost, F1: Control , F2: Arginine, F3: Glycine, and F4: Tryptophan**

**Table 5. Effect of composts and amino acids on the physical measurements of wheat plants at harvest stage during the seasons of 2021/22 and 2022/23**

| Treatments | | Spike length, cm | | Spike weight, g | | Weight of 1000 grain, g | | No. grain spike$^{-1}$ | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| Organic fertilization treatments | | | | | | | | | |
| $T_1$ | | 15.01d | 15.17d | 3.26d | 3.33d | 45.77d | 46.65d | 24.92c | 25.75d |
| $T_2$ | | 19.24a | 19.47a | 4.20a | 4.28a | 49.20a | 50.27a | 35.50a | 36.17a |
| $T_3$ | | 18.45b | 18.71b | 3.98b | 4.07b | 48.03b | 48.90b | 33.83a | 33.58b |
| $T_4$ | | 17.64c | 17.87c | 3.78c | 3.85c | 47.48c | 48.35c | 31.42b | 30.83c |
| LSD at 5% | | 0.14 | 0.15 | 0.05 | 0.04 | 0.09 | 0.09 | 2.25 | 1.13 |
| Amino acids treatments | | | | | | | | | |
| $F_1$ | | 16.53c | 16.72c | 3.54c | 3.61c | 46.49c | 47.45c | 27.42c | 27.92c |
| $F_2$ | | 18.30a | 18.54a | 3.99a | 4.07a | 48.31a | 49.19a | 33.75a | 33.67a |
| $F_3$ | | 17.83b | 18.05b | 3.87b | 3.95b | 47.89bb | 48.84b | 32.67ab | 33.00a |
| $F_4$ | | 17.67b | 17.90b | 3.81b | 3.88b | 47.79b | 48.68b | 31.83b | 31.75b |
| LSD at 5% | | 0.21 | 0.22 | 0.08 | 0.08 | 0.18 | 0.18 | 1.42 | 1.16 |
| Interaction | | | | | | | | | |
| $T_1$ | $F_1$ | 14.58i | 14.74k | 3.14i | 3.20j | 45.56i | 46.47k | 21.67k | 24.00i |
| | $F_2$ | 15.63h | 15.79j | 3.42h | 3.48h | 46.03gh | 46.86ij | 27.33hij | 27.67gh |
| | $F_3$ | 14.95i | 15.11k | 3.30hi | 3.37hi | 45.77hi | 46.68jk | 26.00ij | 26.00hi |
| | $F_4$ | 14.87i | 15.03k | 3.18i | 3.26ij | 45.72hi | 46.59jk | 24.67j | 25.33i |
| $T_2$ | $F_1$ | 17.41efg | 17.57ghi | 3.73efg | 3.83efg | 47.23f | 48.36g | 30.00gh | 30.33ef |
| | $F_2$ | 20.08a | 20.38a | 4.44a | 4.53a | 50.71a | 51.56a | 38.00a | 39.00a |
| | $F_3$ | 19.78a | 20.02ab | 4.32ab | 4.40ab | 49.47b | 50.71b | 37.33ab | 38.33a |
| | $F_4$ | 19.70a | 19.90bc | 4.30ab | 4.37ab | 49.40b | 50.44b | 36.67abc | 37.00ab |
| $T_3$ | $F_1$ | 17.11fg | 17.37hi | 3.69fg | 3.75fg | 47.00f | 47.89h | 30.00gh | 29.33fg |
| | $F_2$ | 19.18b | 19.47cd | 4.22b | 4.32b | 48.48c | 49.45c | 36.00a-d | 36.00b |
| | $F_3$ | 18.91bc | 19.12de | 4.04c | 4.14c | 48.33cd | 49.19cd | 35.00b-e | 35.33bc |
| | $F_4$ | 18.58cd | 18.86ef | 3.99cd | 4.06cd | 48.31cd | 49.07de | 34.33c-f | 33.67cd |
| $T_4$ | $F_1$ | 17.02g | 17.21i | 3.61g | 3.68g | 46.17g | 47.09i | 28.00hi | 28.00gh |
| | $F_2$ | 18.30d | 18.49f | 3.89cde | 3.97de | 48.03de | 48.89def | 33.67def | 32.00de |
| | $F_3$ | 17.70e | 17.97g | 3.83def | 3.90def | 48.01de | 48.78ef | 32.33efg | 32.33de |
| | $F_4$ | 17.53ef | 17.79gh | 3.77efg | 3.83efg | 47.72e | 48.63fg | 31.67fg | 31.00ef |
| LSD at 5% | | 0.43 | 0.43 | 0.16 | 0.17 | 0.36 | 0.36 | 2.85 | 2.32 |

**Means within a row followed by a different letter (s) are statistically different at a 0.05 level T1:Control (without organic fertilizer), T2: Plant residue and cow waste (compost from a combination of both), T3: Plant residue compost, T4:Cow waste compost, F1: Control , F2: Arginine, F3: Glycine, and F4: Tryptophan**

**Table 6. Effect of composts and amino acids on the yield of wheat plants at harvest stage during the seasons of 2021/22 and 2022/23**

| Treatments | | Grain yield, ton ha$^{-1}$ | | Straw yield, ton ha$^{-1}$ | | Biological yield, ton ha$^{-1}$ | | Harvest index, % | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1st | 2nd | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| Organic fertilization treatments | | | | | | | | | |
| $T_1$ | | 4.89d | 5.00d | 8.21d | 8.39d | 13.10d | 13.39d | 37.31b | 37.30c |
| $T_2$ | | 6.27a | 6.38a | 9.99a | 10.18a | 16.26a | 16.57a | 38.52a | 38.51a |
| $T_3$ | | 5.90b | 5.99b | 9.70b | 9.86b | 15.59b | 15.85b | 37.79b | 37.76b |
| $T_4$ | | 5.63c | 5.75c | 9.28c | 9.49c | 14.91c | 15.24c | 37.76b | 37.75b |
| LSD at 5% | | 0.12 | 0.05 | 0.16 | 0.11 | 0.22 | 0.13 | 0.55 | 0.30 |
| Amino acids treatments | | | | | | | | | |
| $F_1$ | | 5.23d | 5.34d | 8.80d | 8.98c | 14.03d | 14.32d | 37.24c | 37.28c |
| $F_2$ | | 5.96a | 6.08a | 9.61a | 9.81a | 15.57a | 15.88a | 38.25a | 38.23a |
| $F_3$ | | 5.81b | 5.92b | 9.44b | 9.61b | 15.25b | 15.53b | 38.07ab | 38.08ab |
| $F_4$ | | 5.68c | 5.78c | 9.33c | 9.53b | 15.01c | 15.32c | 37.82b | 37.73b |
| LSD at 5% | | 0.05 | 0.06 | 0.10 | 0.09 | 0.11 | 0.10 | 0.36 | 0.38 |
| Interaction | | | | | | | | | |
| $T_1$ | $F_1$ | 4.59j | 4.69k | 7.98j | 8.17j | 12.58l | 12.86n | 36.52f | 36.48g |
| | $F_2$ | 5.20g | 5.32h | 8.46h | 8.68h | 13.66i | 13.99k | 38.04bc | 37.99be |
| | $F_3$ | 4.95h | 5.06i | 8.27hi | 8.44i | 13.22j | 13.50l | 37.47cde | 37.def46 |
| | $F_4$ | 4.81i | 4.92j | 8.12ij | 8.28ij | 12.94k | 13.20m | 37.21def | 37.2ef6 |
| $T_2$ | $F_1$ | 5.65e | 5.77f | 9.28f | 9.47ef | 14.93f | 15.24h | 37.83bcd | 37.86be |
| | $F_2$ | 6.61a | 6.73a | 10.36a | 10.55a | 16.97a | 17.28a | 38.96a | 38.96a |
| | $F_3$ | 6.51a | 6.63a | 10.23ab | 10.40ab | 16.74b | 17.03b | 38.90a | 38.93a |
| | $F_4$ | 6.29b | 6.40b | 10.09bc | 10.31b | 16.38b | 16.72c | 38.40ab | 38.31abc |
| $T_3$ | $F_1$ | 5.37f | 5.48g | 9.23f | 9.37f | 14.60g | 14.85i | 36.78ef | 36.88fg |
| | $F_2$ | 6.20b | 6.30b | 9.96cd | 10.11c | 16.16c | 16.41d | 38.37ab | 38.39ab |
| | $F_3$ | 6.05c | 6.14c | 9.84de | 10.00cd | 15.89d | 16.14e | 38.09bc | 38.03bcd |
| | $F_4$ | 5.96c | 6.04cd | 9.76de | 9.96cd | 15.72d | 16.00ef | 37.93bcd | 37.75be |
| $T_4$ | $F_1$ | 5.31f | 5.43gh | 8.72g | 8.89g | 14.03h | 14.32j | 37.82bcd | 37.90be |
| | $F_2$ | 5.83d | 5.95de | 9.66e | 9.88d | 15.49e | 15.84f | 37.64cd | 37.59cf |
| | $F_3$ | 5.72e | 5.86ef | 9.40f | 9.60e | 15.13f | 15.46g | 37.84bcd | 37.92be |
| | $F_4$ | 5.66e | 5.77f | 9.34f | 9.57e | 15.00f | 15.34gh | 37.74bcd | 37.59cf |
| LSD at 5% | | 0.10 | 0.12 | 0.20 | 0.18 | 0.22 | 0.19 | 0.72 | 0.75 |

**Means within a row followed by a different letter (s) are statistically different at a 0.05 level T1:Control (without organic fertilizer), T2: Plant residue and cow waste (compost from a combination of both), T3: Plant residue compost, T4:Cow waste compost, F1: Control , F2: Arginine, F3: Glycine, and F4: Tryptophan**

**Table 7. Effect of composts and amino acids on the quality traits of wheat grain of wheat plants at harvest stage during the seasons of 2021/22 and 2022/23**

| Treatments | | Carbohydrates, % | | Protein, % | |
|---|---|---|---|---|---|
| | | 1st | 2nd | 1st | 2nd |
| Organic fertilization treatments | | | | | |
| $T_1$ | | 65.29c | 65.58d | 9.01d | 9.18d |
| $T_2$ | | 69.02a | 69.39a | 10.06a | 10.26a |
| $T_3$ | | 68.06ab | 68.41b | 9.89b | 10.07b |
| $T_4$ | | 67.22b | 67.50c | 9.60c | 9.77c |
| LSD at 5% | | 1.14 | 0.53 | 0.17 | 0.17 |
| Amino acids treatments | | | | | |
| $F_1$ | | 65.85c | 66.13c | 9.29c | 9.49c |
| $F_2$ | | 68.35a | 68.68a | 9.88a | 10.06a |
| $F_3$ | | 68.03ab | 68.30ab | 9.71b | 9.90b |
| $F_4$ | | 67.37b | 67.78b | 9.67b | 9.84b |
| LSD at 5% | | 0.67 | 0.82 | 0.11 | 0.10 |
| Interaction | | | | | |
| $T_1$ | $F_1$ | 64.03i | 64.26g | 8.87g | 9.04h |
| | $F_2$ | 66.14gh | 66.38ef | 9.28f | 9.45g |
| | $F_3$ | 65.96gh | 66.16ef | 8.94g | 9.12h |
| | $F_4$ | 65.04hi | 65.51fg | 8.93g | 9.09h |
| $T_2$ | $F_1$ | 66.73efg | 67.15de | 9.55e | 9.78f |
| | $F_2$ | 70.18a | 70.58a | 10.29a | 10.47a |
| | $F_3$ | 70.15a | 70.31a | 10.24ab | 10.44ab |
| | $F_4$ | 69.03ab | 69.53ab | 10.16abc | 10.37abc |
| $T_3$ | $F_1$ | 66.34fgh | 66.53ef | 9.45ef | 9.64fg |
| | $F_2$ | 69.02ab | 69.43ab | 10.08a-d | 10.27bcd |
| | $F_3$ | 68.52bc | 69.04abc | 10.06bcd | 10.24cd |
| | $F_4$ | 68.36bcd | 68.64bcd | 9.97cd | 10.13de |
| $T_4$ | $F_1$ | 66.30fgh | 66.57ef | 9.30f | 9.50g |
| | $F_2$ | 68.05be | 68.31bcd | 9.87d | 10.03e |
| | $F_3$ | 67.49cf | 67.70cde | 9.60e | 9.79f |
| | $F_4$ | 67.05dg | 67.42cde | 9.60e | 9.76f |
| LSD at 5% | | 1.35 | 1.64 | 0.21 | 0.19 |

**Means within a row followed by a different letter (s) are statistically different at a 0.05 level T1:Control (without organic fertilizer), T2: Plant residue and cow waste (compost from a combination of both), T3: Plant residue compost, T4:Cow waste compost, F1: Control , F2: Arginine, F3: Glycine, and F4: Tryptophan**

**Nutrient availability:** The compost made from a combination of plant residue and cow waste provides a balanced combination of nutrients that are essential for plant growth and development, such as nitrogen, phosphorus, and potassium. Plant residues provide carbon and other essential nutrients, while cow waste is a rich source of nitrogen and other minerals. This balanced nutrient composition may have contributed to the better growth and yield of wheat plants. Soil quality improvement: The compost made from a combination of plant residue and cow waste improves soil quality by increasing soil organic matter content and improving soil structure. This enhances the soil's ability to retain water and nutrients, leading to improved plant growth and yield. Microbial activity: The compost made from a combination of plant residue and cow waste may have a higher microbial activity, which can contribute to nutrient cycling and availability for plants. Microorganisms in the compost can break down organic matter and release nutrients that are essential for plant growth.In summary, the superiority of the compost made from a combination of plant residue and cow waste can be attributed to its balanced nutrient composition, soil quality improvement and microbial activity. The obtained results are in in tune and compatible with those of Goyal *et al.* (2005); Paredes *et al.* (2012); Mikanova and Eichlerova (2015); Shabbir *et al.* (2016).

In terms of amino acids, arginine, glycine, and tryptophan were all found to significantly enhance growth performance and productivity compared to the control treatment. Arginine was found to be the most effective, followed by glycine and then tryptophan.

Arginine was found to be the most effective amino acid in promoting the growth performance and productivity of plants. This can be attributed to the fact that arginine is a precursor for the synthesis of polyamines, which are essential for cell division and growth (Kaur and Gupta 2021). In addition, arginine is involved in the synthesis of nitric oxide, which is important for plant growth and development. These factors may have contributed to the better growth and productivity of plants treated with arginine (Cao *et al.* 2019). Glycine was the second most effective amino acid in promoting the growth performance and productivity of plants (Hasanuzzaman and Fujita 2013). Glycine is involved in the synthesis of several important compounds, including chlorophyll, nucleic acids, and proteins. These compounds are essential for plant growth and development, and their increased synthesis may have contributed to the better growth and productivity of plants treated with glycine (Nouri *et al.* 2020). Tryptophan was the least effective amino acid in promoting the growth performance and productivity of plants. Tryptophan is involved in the synthesis of auxins, which are plant hormones that promote cell division and growth. However, the low effectiveness of tryptophan may be due to its limited availability or low uptake by plants (Scherer 2018).

Regarding the interaction effect, the same Tables illustrated that the use of the compost of plant residue and cow waste and arginine amino acid led to the maximum values of plant growth performance and productivity.

**-Soil analysis at harvest time.**

Data of Table 8 present the impact of composts and amino acids on the soil's available nitrogen (N), phosphorus (P), and potassium (K) values at the harvest stage, based on combined data over two seasons. While the effect of amino acids on the soil nutrient content was not clearly determined.

The results showed that all of the compost treatments increased the values of soil available N, P, and K compared to the corresponding soil without compost (control). Specifically, at the harvest stage, the soil treated with the compost of plant residue and cow waste had the highest values of N, P, and K (mg kg-1), followed by the soil treated with compost of plant residue alone, and then the soil treated with compost of cow waste alone. In contrast, the corresponding soil without compost (control) possessed the lowest values of these nutrients.

This trend was observed under all of the studied amino acids. The results suggest that composts can significantly improve the soil nutrient content and that the compost of plant residue and cow waste may be particularly effective in increasing the availability of N, P, and K in the soil. These findings are consistent with previous studies that have shown the positive impact of composts on soil fertility and plant growth.

**Table 8. Effect of composts and amino acids on the soil available N, P and K values at harvest stage (combined data over both seasons)**

| Treatments | | N, mg $kg^{-1}$ | P, mg $kg^{-1}$ | K, mg $kg^{-1}$ |
|---|---|---|---|---|
| | **Initial soil** | **40.04** | **8.07** | **202.31** |
| $T_1$ | $F_1$ | 41.74 | 9.32 | 209.22 |
| | $F_2$ | 40.93 | 9.03 | 206.23 |
| | $F_3$ | 41.06 | 9.14 | 207.62 |
| | $F_4$ | 41.27 | 9.22 | 208.48 |
| Mean | | 41.3 | 9.2 | 207.9 |
| $T_2$ | $F_1$ | 46.86 | 10.50 | 228.69 |
| | $F_2$ | 45.51 | 10.18 | 221.63 |
| | $F_3$ | 45.86 | 10.29 | 223.55 |
| | $F_4$ | 46.48 | 10.41 | 225.37 |
| Mean | | 46.2 | 10.3 | 224.8 |
| $T_3$ | $F_1$ | 45.12 | 10.09 | 220.39 |
| | $F_2$ | 44.22 | 9.80 | 216.20 |
| | $F_3$ | 44.54 | 9.89 | 217.73 |
| | $F_4$ | 44.79 | 9.97 | 219.14 |
| Mean | | 44.7 | 9.9 | 218.4 |
| $T_4$ | $F_1$ | 43.86 | 9.72 | 214.74 |
| | $F_2$ | 42.90 | 9.39 | 210.05 |
| | $F_3$ | 43.19 | 9.50 | 211.35 |
| | $F_4$ | 43.55 | 9.59 | 213.12 |
| Mean | | 43.4 | 9.56 | 212.3 |

**T1:Control (without organic fertilizer), T2: Plant residue and cow waste (compost from a combination of both), T3: Plant residue compost, T4:Cow waste compost, F1: Control , F2: Arginine, F3: Glycine, and F4: Tryptophan**

## CONCLUSION

In conclusion, the present study has shown that the application of organic fertilizers and foliar application of amino acids can significantly improve wheat growth and productivity in Egypt. The compost from a combination of plant residue and cow waste was found to be the most effective treatment, followed by plant residue compost and cow waste compost. Amino acids, particularly arginine, glycine, and tryptophan, were also found to be effective in promoting growth performance and productivity. Therefore, the use of organic fertilizers and amino acids is recommended for wheat cultivation in Egypt to enhance productivity and support the economy and society.

It is important to note that further research is needed to optimize the application rates of organic fertilizers and amino acids and to determine their long-term effects on soil health and fertility. Moreover, the environmental impacts of using organic fertilizers and their potential contribution to reducing greenhouse gas emissions and mitigating climate change should also be considered. Finally, farmers should be encouraged to adopt sustainable agricultural practices that include the use of organic fertilizers and other eco-friendly techniques to promote long-term agricultural sustainability and resilience.

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# تأثير مصادر مختلفة من الأسمدة العضوية مع الرش ببعض الأحماض الأمينية على إنتاجية القمح وبعض خصائص التربة

**مروة أحمد محمد محمود كاني**

معهد بحوث الأراضي والمياه والبيئة، مركز البحوث الزراعية، الجيزة، مصر

## الملخص

مصر تعتمد بشدة على القمح كمحصول زراعي رئيسي، ويشكل القمح أكبر حصة من إنتاج البلاد الزراعي. وعلى إثر ذلك، فمن الضروري تعزيز إنتاجية القمح في مصر لدعم الاقتصاد والمجتمع. ولذلك، تهدف الدراسة الحالية إلى تقييم تأثير إضافة اسمده عضوية مختلفة، مثل مكمورة بقايا النباتات ومكمورة مخلفات الأبقار وكذلك مكمورة المزيج بين هذان المصدران، بجرعة 10 طن/فدان، والرش الورقي للأحماض الأمينية (الأرجينين والجلسين والتربتوفان) بمعدل 100 مجم/لتر على نمو القمح وإنتاجيته، بالإضافة إلى بعض خصائص التربة. تمت مقارنة المعاملات بمجموعة الكنترول (بدون اضافه سماد عضوي للتربه) ومجموعة الكنترول للرش الورقي. وتبين أن مكمورة المزيج بين بقايا النباتات ومخلفات الأبقار هو المعاملة الأكثر فعالية لتعزيز أداء النمو والإنتاجية. وكان ثاني أكثر معاملة فعالة استخدام مكمورة سماد بقايا النباتات بمفرده، تليها سماد مخلفات الأبقار بمفرده. وبالمقابل، أدت معاملة الكنترول إلى أدنى أداء للنمو والإنتاجية. اما بالنسبة للأحماض الأمينية، تبين أن الأرجينين والجلسين والتربتوفان جميعها تعزز بشكل كبير أداء النمو والإنتاجية بالمقارنة مع المعاملة الكنترول. وكان الأرجينين الأكثر فعالية، يليه الجلسين ومن ثم التربتوفان لذلك، يُوصَى باستخدام سماد مكمورة بقايا النباتات ومخلفات الأبقار معا والأحماض الأمينية (خاصة الأرجينين) في زراعة القمح في مصر لتعزيز الإنتاجية ودعم الاقتصاد والمجتمع.

***الكلمات المفتاحية*** : المكمورة، ارجنين، جليسين، تريبتوفان.