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THE EFFECT OF ADDING DIFFERENT LEVELS AND SOURCES OF NITROGEN FERTILIZERS ON NITROGEN CONCENTRATION, UPTAKE, AND TOTAL YIELD OF TOMATO PLANTS (*SOLANUM ESCULENTUM* L.) UNDER GREENHOUSE CONDITIONS

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Abstract:
A field experiment was conducted at the agricultural Winter season 2021-2022 in a green house using tomato crop to study the effect of adding different levels of various types of nitrogen fertilizers and two levels of organic fertilizer on some growth and yield characteristics of tomatoes. The results showed the superiority of sulfur-coated Urea fertilizer at the third level (100 kg N. ha^{-1}) in terms of nitrogen concentration in tomato plant leaves, with values of 41.36 and 44.12 for the organic fertilizer levels of 20 and 40 tons. ha^{-1}, respectively, at the second date (December) of the measurement period compared to other dates. Also, sulfur-coated Urea fertilizer significantly outperformed other types of fertilizers in terms of nitrogen uptake, and the third level of this fertilizer achieved the highest rates with values of 148.85 kg N. ha^{-1} for the addition level of 20 tons. ha^{-1} of organic matter, while the addition level of 40 tons. ha^{-1} of organic matter did not have a significant effect on this trait. The results also indicate a significant superiority of sulfur-coated Urea fertilizer at the high level in the total yield of tomato plants, with values of 50.58 and 60.00 tons.ha^{-1} for the addition levels of 20 and 40 tons. ha^{-1} restpectively.

Keywords: Nitrogenous fertilizers, N concentration in leaves, absorbable amount, yield, tomato , green house

RESEARCH: A Part extracted from the Master's thesis of the first other.

INTRODUCTION

Many agricultural practices, especially fertilization, are considered a fundamental pillar relied upon by developed countries agriculturally and many farmers to provide agricultural crops, especially vegetables, with the necessary nutrients due to their significant importance in increasing yield per unit area. Nitrogen, in particular, plays an active role in contributing to and activating many processes within the plant and its impact on increasing yield and improving crop quality. Nitrogen has an effective and important role in increasing yield due to its influence on improving growth, which positively reflects on increasing yield and its components, as well as enhancing the photosynthetic efficiency of the tomato crop (Al-Ansari, 2020). Nitrogen is involved in the components of chlorophyll, protein, and nucleic acids to assist in plant growth, especially the vegetative part of the plant, as it is involved in building the protoplasm of plant cells (Disher and Abdul Karim, 2018).

Many of the nutrients available in the soil or added through mineral fertilizers are subjected to significant loss due to processes such as leaching, volatilization, fixation, and deposition. This occurs either as a result of soil physicochemical conditions or climatic conditions, especially in the central and southern areas in Iraq. which are typically hot and dry in the summer. The soil's reaction rate (pH) tends to be alkaline, reducing the availability of many nutrients by restricting their movement, thus preventing plants from obtaining their required elements. This leads to the deterioration of the aforementioned soil properties, as well as the lack of readiness of nutrients in terms of timing and quantity, meeting the plant's consumption requirements. Consequently, this results in weak germination and growth, decreased productivity, and a decline in quality (Qu et al., 2020).

Modern and traditional nitrogen fertilizers have contributed to the development and improvement of agricultural crop yield. However, excessive use of traditional fertilizers, such as Urea, leads to a significant loss and deterioration of these fertilizers. Trenkel (2010) showed that the loss of traditional nitrogen fertilizers added to the soil ranges from 40-70%. Some studies have also indicated that high nitrogen additions to the soil result in a decrease in the efficiency of nitrogen fertilizers, which does not exceed 60%. Additionally, these fertilizers have an impact on groundwater and water bodies (Yousaf et al, 2016).

Due to the high demand for the use of nitrogen fertilizers as a result of the significant expansion in field crop and vegetable cultivation, and to contribute to the development of nitrogen fertilizer utilization efficiency, researchers and specialized companies have been driven to search for nitrogenous fertilizer sources that can reduce nitrogen loss and increase plant nitrogen use efficiency. Al-Ansari (2020) demonstrated in his study the reduction of nitrogen waste and enhancement of its efficiency by using coated fertilizers, slow-release fertilizers, or blending other major nutrients with nitrogen in these fertilizers, resulting in good growth and yield for tomato plants. These products also slow down the nitrogen cycle processes in the soil. Several studies have also focused on studying the impact of fertilizer coating on fertilizer efficiency, especially nitrogen fertilizers (Du and Zhou, 2002; Sun et al., 2005).

These fertilizers are characterized by the slow, regular, and continuous release of nutrients, reducing leaching or volatilization. This, in turn, lowers yield costs as they are slow-release or controlled-release fertilizers. They also contain other major nutrients such as phosphorus in varying proportions and in forms that delay the release or provide the nutrient in a readily available form in the soil solution for a longer period of time. This allows plants more time to absorb and benefit from them by reducing solubility in water. According to Fujinuma *et al*. (2018), slow-release fertilizers increase nitrogen absorption by plants and reduce loss. Shaviv (2018) classified slow-release fertilizers into slightly soluble organic compounds such as Urea-formaldehyde and fertilizers coated with polymers, sulfur, or fertilizers that are in the form of an emulsion or slightly soluble inorganic compounds such as Urea-phosphate or humic-Urea fertilizer. These contribute to increasing nitrogen availability in the soil, plant growth, and improving productivity and quality. The use of such nitrogen fertilizers has contributed to a 20% reduction in fertilizers.

The tomato crop (*Solanum esculentium* L.) is considered one of the important and necessary vegetable crops in the world, as well as being one of the main crops known to be cultivated in many regions of Iraq, especially in the southern region (Basra) due to the great daily demand and consumption of it, as well as its high nutritional importance as its fruits contain It contains vitamins B and C, carbohydrates, lycoptin, and carotene, as well as many minerals (Ejaz *et al*., 2011). Under the conditions of greenhouses, being hybrid varieties and unlimited growth due to the length of their growing season, this requires the necessity of providing nutrients throughout the period of their growth (Anderson, 2002).

Because of the deteriorating physicochemical characteristics of the soil of southern Iraq and as a result of the excessive uses of traditional mineral nitrogen fertilizers and the accompanying losses and waste in these fertilizers due to washing or volatilization and fixation and the lack of maximum benefit from the plants of these fertilizers and the limited growth and yield, this experiment aimed to:

1- Knowing the best types of inorganic and slow-release nitrogen fertilizers and comparing them with organic fertilizers and Urea fertilizer.

2- Knowing the best level of nitrogen fertilizers in the concentration of nitrogen in the tissues of the tomato plant and the amount of N-uptake.

3- Knowing the effect of different types and levels of nitrogen fertilizers on the total yield of tomato plants.

MATERIALS AND METHODS

A field experiment was carried out at the Agricultural Research Station of the College of Agriculture - University of Basra at Karmat Ali site in a green house located within the coordinates of longitude N 10 34 ° 30 and latitude E 04 45 ° 47 during the agricultural season 2021-2022 to study the response of the tomato crop to types and levels of Nitrogen fertilizers and organic residues under greenhouse conditions of silty loam soil.

The soil samples were taken randomly from different locations of the study site after removing the vegetation cover (surface layer) and at a depth of (0-30 cm), mixed well for the purpose of homogenization, then air-dried, ground and passed through a sieve with a diameter of openings (2 mm) and some chemical analyzes were carried out. and physical before planting. Table (1) shows some of the physical and chemical properties of the study soil. Where pH and EC were estimated in an extract (soil: water, 1:1) and CaCO3 and the volume distribution of soil particles, bulk density, true density, total porosity, O.M and O.C according to the method presented in Black et al. (1965) and CEC according to the method of (Papanicolaou, 1976). It was estimated in an extract (1:1) Ca^{+2}, Mg+2, Na^{+}, K^{+}, SO_4^{2-}, CO_3, HCO^{-}_3 as well as total nitrogen, ready nitrogen, ready phosphorus and ready potassium according to the method presented in (Page et al., 1982) either Cl^{-} according to What was stated in (Richards, 1954). Nitrogen was estimated in the digesting solution of plant leaf samples from each experimental unit using a steam distillation apparatus, according to the Bremner (1970) method. As for the amount of uptake, it was calculated from the following equation:

The amount of uptake = the concentration of the element in the plant at the end of the season * the dry weight of the plant

The final total yield of tomato fruits was calculated for each experimental unit and for the length of the yield period.

The green house was prepared with dimensions (9 x 30 m), then the soil of the green house was plowed twice in a perpendicular manner with a depth of 50 cm, then the soil was smoothed and leveled, then divided into lines of 2 m in length and 0.4 m in width, with a distance of 0.35 m between one line and another, leaving a distance of 0.5 m from each side of the green house. The land was fertilized with decomposed cow waste for all agricultural lines in equal quantities, which were brought from the fields of the College of Agriculture.

The experimental factors were distributed to the experimental units in a randomized complete block design, which included the factor of the type of nitrogen fertilizers (Urea, Urea coated with sulfur, Urea phosphate, and Urea humic) and the factor of the type of organic fertilizer (cattle residual) 20 and 40 tons.ha^{-1} (whose characteristics are shown in the table 2). And the level of addition factor for slow release fertilizers (0, 25, 50, 100) kg ha^{-1} and the traditional fertilizer Urea (100, 200, 400) kg ha^{-1}.

Tomato seedlings at the age of 35 days (5) real leaves of a hybrid variety Red Flora (unlimited growth) were planted in hollows on lines, at a depth of about 4-5 cm, with a distance of 40 cm between one seedling and another, using the zigzag method. The number of plants in the experimental unit was 6 plants on 11/1. / 2022. Irrigation was done through a green tube connected to a water pump (2 inch) and then to pipes carrying drippers. The above-mentioned nitrogen fertilizers, according to the treatments, were added in the experimental units by the panding method, by making a hole at a distance of (5 cm) from the plant and at a depth of

Table 1: Some chemical and physical properties of the soil Study

Adjective		Value Depth (25-0)	Value depth (25-50)	Unit
(pH)		7.67	7.72	
(EC)		5.50	1 6.4	ds m $^{-1}$
(CEC)		13.97	14.12	Cmd $^{-1}$
Available nitrogen		4.22	4.26	mg kg^{-1}
Available phosphorus		11.04	11.0 2	
Available potassium		115.17	114.8 5	
Total nitrogen		0.35	0.41	Kg^{-1}
(O.C)		2.30	2.32	
(OM)		3.9 5	3.8 1	
Cations dissolved ions	Ca^{++}	9.4 3	9.5 6.9	m.mol $^{-1}$
	Mg^{++}	7.75	7.77	
	Na^{+}	36.5	36.1	
	K^{+}	1.69	1.66	
Inions dissolved ions	HCO_3^-	5.4 8	5.40	
	$CO_3^=$	0.00	0.00	
	Cl^-	34.45	34.41	
	$SO^=_4$	13.30	13.23	
Real density		2.65	2.64	M gm $^{-1}$
Bulk density		1.26	1.25	
Total perosity		36	35	%
Sand		114	111	kg.g^{-1}
Silt		434	436	
Clay		452	453	
Texture		Clay silty	Clay silty	

(5 cm) from the soil surface, and after a month of transferring the seedlings to the permanent field. Crop service operations were carried out in terms of chemical control such as fungal and insect diseases, as well as removing bushes in experimental units, then covering the plants in the green house with transparent yellow polyethylene (green) on 1/12/2021 to protect the plants from freezing when temperatures drop, and removing this cover on 3/2022 1/ Covering with green net.

Table 2: Some chemical properties of cattle waste

Unit	Value	Adjective
	7.20	**pH 1:5**
ds m^{-1}	7.50	**(EC) 1:5**
gm kg^{-1}	11. 422	**Organic matter**
gm kg^{-1}	18.51	**Total nitrogen**
gm kg^{-1}	7.77	**Total carbon**
________________	13.25	**C/N Ratio**

The weeding process was also done manually and for five times during the growing season. Harvest operations were carried out every week when signs of ripeness appeared in the tomato fruits after 3 months of cultivation had passed, and after the appearance of clear signs of effort from the plant, it was harvested for the last time 4/15/2022.

The results were analyzed according to Gen-stste analysis No. (18.2) statistically, and the averages were compared using the least significant difference LSD at the level of probability 0.05 (Al-Rawi and Khalaf allah 1980).

RESULTS AND DISCUSSION

- Nitrogen concentration in the leaves

- The adding a level of 20 tons.ha^{-1} organic fertilizer

The results in Table (3) show that there is a significant effect of the factor of nitrogen fertilizer addition levels in nitrogen concentration in the leaves (g.kg^{-1}) of tomato plants when adding the level of 20 tons. ha-^{1} organic fertilizer for all types of nitrogen fertilizers, where we notice the superiority of the third level from the addition of nitrogen fertilizer was significant at all the rest levels, where it recorded a rate of 36.52 g.kg^{-1}, while levels zero, the first and the second were recorded at a rate of 24.45, 28.90 and 32.43 g.kg^{-1} respectively, with an increase of 48.98% and 26.30% And 12.53% for the third level over the rest of the levels, respectively. Increasing the level of nitrogen fertilizer application led to encouraging the roots to absorb the largest amount of nitrogen, which led to an increase in the biomass of the plant and an increase in the concentration of nitrogen in the leaves, and this is consistent with the findings of Wang *et al.*, (2020), (Al-khafaji, 2013) stated that nitrogen fertilization had a significant effect on the nitrogen content of the leaves when adding three levels of Urea fertilizer (400, 600, 1200) kg N.ha^{-1}, and the higher levels gave the highest rate of nitrogen concentration. Leaves throughout the growing season.

As for the date of sampling, Table (3) indicates that there is a significant effect of the date on the nitrogen concentration in tomato leaves. As the concentration increased in the first perioed (November) to reach its highest level in the second month of sampling date (December) to record a value of 33.24 g.kg^{-1} with a significant difference from all measurement dates, which began to decline after this date. To record values of 29.95 and 28.01 g.kg^{-1} for the months of (January and February), respectively. The reason for the high concentration of nitrogen in the tissues of tomato plants in the second stage of the measurement date may be due to the growth and growth of the plant and the growth of its roots, which led to the absorption of larger quantities of nitrogen fertilizer, as well as the fact that the date of adding nitrogen fertilizer is not far from the date of adding fertilizer. As for the reason for the decrease in the nitrogen concentration in the plant tissues in the subsequent (last) months, it may be due to the movement of the nitrogen element from the leaves to the fruits. These results are similar to those of Anand Pandey Rajawat (2019).

As the results indicate in Table (3), there is a significant effect of the factor of adding the type of nitrogen fertilizers on the nitrogen in the leaves (gm.kg^{-1}) of tomato plants when adding the level of 20 ton. ha^{-1} organic fertilizer, as the sulfur-coated Urea fertilizer achieved Urea- Sulphate had a significant effect on all treatments with an average value of 33.46 g.kg^{-1}, while average values of 27.72, 30.06 and 30.05 g.kg^{-1} were recorded for the nitrogen fertilizers Urea, Urea phosphate and Ureahumic, respectively.

Table (3) Effect of adding types of nitrogen fertilizers at the level of adding 20 tons.h^{-1} organic fertilizer in nitrogen concentration in leaves (g.kg^{-1}) for tomato plant during the growth period.

Appointment	Type of nitrogen fertilizer	Levels (kg N E - 1)				Appointment X Type of fertilizer
		zero	First	Second	Third	
November	Urea	24.33	26.94	27.93	31.98	27.79
	Urea-Sulphate	24.33	32.93	36.25	40.44	33.48
	Urea-phosphate	24.33	26.64	30.90	35.02	29.22
	Humic-Urea	24.33	31.11	32.75	35.64	30.95
December	Urea	26.64	27.37	32.67	36.20	30.72
	Urea-Sulphate	26.64	35.30	40.24	45.46	36.91
	Urea-phosphate	26.64	30.34	35.20	39.90	33.02
	Humic-Urea	26.64	30.96	34.93	40.27	33.2
January	Urea	23.64	24.49	28.00	31.33	26.86
	Urea-Sulphate	23.64	32.05	35.70	39.86	32.81
	Urea-phosphate	23.64	28.07	32.47	36.70	30.22
	Humic-Urea	23.64	28.99	33.04	37.95	30.90
February	Urea	23.21	24.33	25.78	28.70	25.50
	Urea-Sulphate	23.21	27.98	31.74	39.67	30.65
	Urea-phosphate	23.21	27.38	28.73	31.84	27.79
	Humic-Urea	23.21	27.52	32.59	33.39	29.17
LSD 0.05		3.10				1.68
Effect levels		24.45	28.90	32.43	36.52	Appointment effect
LSD 0.05		0.61				
Appointment X Level	November	24.33	28.39	31.96	35.77	30.11
	December	26.64	30.12	35.76	40.46	33.24
	January	23.63	27.44	32.30	36.46	29.95
	February	23.21	26.08	29.71	33.40	28.01
LSD 0.05		1.36				0.71
						Fertilizer type effect
Fertilizer Type X Level	Urea	24.45	25.78	28.60	32.05	27.72
	Urea-Sulphate	24.45	32.06	35.98	41.36	33.46

	Urea-phosphate	**24.45**	**28.11**	**31.82**	**35.86**	**30.06**
	Humic-Urea	**24.45**	**29.64**	**33.32**	**36.81**	**31.05**
LSD 0.05		**1.43**				**0.79**

The efficiency of the quality and manufacture of Urea fertilizer coated with sulfur, in addition to being slow to decompose, leads to the liberation of nitrogen continuously and for a long period into the soil solution, which reflected positively on plant growth and increased absorption and concentration of nitrogen in the leaves, in addition to the volatilization and leaching of the nitrogen component less than it is in Urea fertilizer ordinary. (Al-azawi & Salih, 2018) stated that the addition of humic acid gives significant differences in all vegetative growth characteristics, including the nitrogen content of the leaves compared to the no-addition treatment.

As for the effect of the Bilaterny interaction between the type of nitrogen fertilizer and the time of sampling, table (3) indicates a significant increase in the concentration of nitrogen in the leaves of tomato plants with the advancement of the date of sampling and for all types of nitrogen fertilizers used in the experiment, and that the highest concentration of nitrogen in the leaves and a significant difference at all stages For the types of fertilizers used, it was on the second date of (December) compared to the rest of the measurement dates. The Urea-Sulphate fertilizer recorded a value of 36.91 $g.kg^{-1}$, and for the same date the rest of the fertilizers (Urea, Urea phosphate and Urea humic) recorded higher values than the rest of the dates with values of 30.72, 33.02 and 33.20 $g.kg^{-1}$, respectively. While the treatment of Urea fertilizer for the month of February (the last date of measurement) recorded the least significant difference with a value of 25.50 $g.kg^{-1}$ The reason for this may be due to the slow decomposition of the added encapsulated nitrogen fertilizers compared to the nitrogen fertilizer (Urea), which is known to quickly decompose and lose nitrogen from it by volatilization or washing, and that the slow release encapsulated fertilizers reduce the loss of nutrients from the soil and increase the efficiency of nutrient use and contribute to the development of growth and increase yield of vegetable plants, including tomato. (Xiao *et al.*, 2017)

As for the effect of the interaction between the date of sampling for the concentration of nitrogen in the leaves and the level of nitrogen fertilizer addition, it is clear from Table (3) that there is a significant effect of this interaction on the concentration of nitrogen in the leaves, and that the highest value was recorded when the date of the second calculation (December) coincided. In all three levels of addition and comparison treatment, however, the third level of application at the time of the second measurement (December) achieved the highest value of nitrogen concentration in the leaves of tomato plants for all samples with a value of 40.46 $g.kg^{-1}$. The reason for this is due to the coincidence between the close period of adding nitrogen fertilizers (about a month ago), and also as a result of increasing the addition of nitrogen fertilizers to their highest levels. While the comparison treatment for the month of February recorded the lowest value of 23.21 $g.kg^{-1}$.

With regard to the interaction between the type of nitrogen fertilizer and the level of application, Table (3) shows that the significant increase in the concentration of nitrogen in the leaves of tomato plants varies according to the type of nitrogen fertilizer added with an increase in the level of application. The type of nitrogen fertilizer, Urea-Sulphate, achieved a significant increase in the concentration of nitrogen in the leaves and reached the highest value at the third level at a rate of 41.36 $g.kg^{-1}$ with a significant superiority compared with level of second , first and zero were recored rate values 35.98 , 32.06 and 24.45 $g.kg^{-1}$ for the same type of nitrogen fertilizer, respectively. Then came the type of nitrogen fertilizer Urea Humic ranked second for all levels in the concentration of nitrogen in the leaves. The variation in the concentration of nitrogen in the leaves of tomato plants between the types of nitrogen fertilizers added with the different level of application may be due to the type of nitrogen fertilizer, which has provided the plant with the nutrients it needs for growth and stimulated it compared to the rest of the treatments, and these results are close to the results of Farinati and Morariu -Istodor (2017).

The data in Table (3) show that the highest value of nitrogen concentration in the leaves was affected at the high level of all types of added nitrogen fertilizers, with the observation of growth, indicating that the triple interaction between the type of nitrogen fertilizer, the level of application, and the date of measurement had a significant impact on the concentration of nitrogen in the leaves of tomato plants. Up until the second stage of the measurement date (December), when the slight decrease for the following measurement months started, the nitrogen concentration in the leaves gradually increased as the measurement stages progressed and coincided with the development of the plant growth stages. The results are clear in Table (3) that the highest concentration of nitrogen in the leaves has been recorded for Urea-Sulphate fertilizer at the highest level of addition of 100 kg N ha^{-1} in the second stage of the calculation (December) with a value of 45.46 g. kg^{-1}, while the comparison treatment for the month of February recorded the lowest value of 23.21 $g.kg^{-1}$. The reason for this may be due to the efficiency of the nitrogen fertilizer manufactured in a way that leads to the liberation of nitrogen slowly and for the longest possible period during the growing season and at a high level (100 kg N ha^{-1}), which led to the survival of significant amounts of ready nitrogen in the soil solution and the plant was able to absorb it through roots and its rapid upward movement (vegetative parts), which is consistent with Wang *et al.*, (2020) and Geisseler *et al.*, (2020) where they stated that increasing the level of nitrogen added to the soil led to an increase in biomass and an increase in the concentration of nitrogen in plant leaves, and the increase may be due to the fact that nitrogen contributed to the development of the roots of tomato and sweet pepper plants and encouraged the roots to absorb the largest amount of nitrogen, which led to an increase concentrated in the leaves.

- The adding a level of 40 tons. ha^{-1} organic fertilizer

The results in Table (4) show that there is a significant effect of the factor of levels of nitrogen fertilizer addition in nitrogen in the leaves (gm.kg^{-1}) of tomato plants when adding a level of 40 tons.ha^{-1} organic fertilizer and for all types of nitrogen fertilizers, where we note the superiority of the third level From the addition of nitrogen fertilizer to all the rest of the levels, where it recorded a rate of 38.95 g.kg^{-1}, while levels zero, the first and the second recorded a rate of 27.71, 32.68 and 35.03 g.kg^{-1}, respectively, with rates of increase for the third level of 40.79% and 19.26 % and 11.43% for the compared with the first and second levels, respectively. When nitrogen fertilizer is added to the tomato plant, an increase in the concentration of the nitrogen element in the leaves of the plant occurs for several reasons, including that the nitrogen fertilizer contains a high percentage of nitrogen, which is an essential element for plant growth, as well as nitrogen that enhances the process of vegetative reyield in the plant and stimulates the growth of leaves and stems. When the plant gets a large amount of nitrogen, it produces more leaves and thus increases the concentration of nitrogen in the young leaves. This is consistent with the findings of Li *et al.*, (2023).

Table (4) Effect of adding types of nitrogen fertilizers at the level of adding 40 tons.h^{-1} organic fertilizer in nitrogen concentration in leaves (g.kg^{-1}) for tomato plant during the growth period.

Appointment	Type of nitrogen fertilizer	Levels (kg N E - 1)				Appointment X Type of fertilizer
		zero	First	Second	Third	
November	Urea	28.06	28.67	30.59	33.24	30.14
	Urea-Sulphate	28.06	33.26	35.96	45.51	35.69
	Urea-phosphate	28.06	30.97	33.34	36.70	32.26
	Humic-Urea	28.06	32.78	35.64	41.86	34.58
December	Urea	29.32	30.66	33.65	37.33	32.74
	Urea-Sulphate	29.32	41.63	42.37	50.45	40.94
	Urea-phosphate	29.32	38.70	38.95	43.12	37.52
	Humic-Urea	29.32	40.39	42.02	45.29	39.25
January	Urea	27.10	26.98	30.57	33.12	29.44
	Urea-Sulphate	27.10	34.77	36.79	43.10	35.44
	Urea-phosphate	27.10	32.43	36.24	35.40	32.79
	Humic-Urea	27.10	34.42	36.04	40.07	34.40
February	Urea	26.36	26.65	30.22	32.79	29.00
	Urea-Sulphate	26.36	30.93	34.08	37.44	32.20
	Urea-phosphate	26.36	28.96	31.07	32.67	29.76
	Humic-Urea	26.36	30.77	33.02	35.18	31.33
LSD 0.05		2.27				1.43
Effect of levels		27.71	32.68	35.03	38.95	Appointment effect
LSD 0.05		0.43				
Appointment X Level	November	28.06	30.62	33.88	39.32	32.97
	December	29.32	36.14	39.25	44.05	37.19
	January	27.10	31.14	34.91	37.92	32.76
	February	26.36	28.73	32.10	34.56	30.43
LSD 0.05		0.962				0.50
						Fertilizer type effect
Fertilizer type X Level	Urea	27.71	28.08	31.26	34.17	30.30
	Urea-Sulphate	27.71	35.15	37.30	44.12	36.07
	Urea-phosphate	27.71	32.76	34.90	36.68	33.01
	Humic-Urea	27.71	34.59	36.68	40.60	34.89
LSD 0.05		1.013				0.56

Table (4) also shows when the plant sampling was taken during the plant growth stages, there was a significant effect on the concentration of nitrogen in the leaves of the tomato plant, as it increased significantly in December, which recorded a value of 37.19 g.kg^{-1}, an increase of 2.23% over February. Which recorded the lowest value of 30.43 g.kg^{-1}, followed by the date of plant sampling for the concentration of nitrogen in the leaves in November and January, at a rate of 32.92 and 32.76 g.kg^{-1}, respectively. It has a limit of (32.97 g.kg^{-1}) in the first month of measurement (November) to the period close to adding different types of nitrogen fertilizers, noting that the nitrogen has not completely dissolved and liberated from the fertilizers, while nitrogen has been liberated from all fertilizers after about two months. From the addition, which reflected positively on the increase in the absorption and the concentration of nitrogen in the leaves of the plant at the time of the second measurement (January), which achieved a high value of

(37.19 g.kg^{-1}), after which the concentration decreased with the passage of the time of addition as well as the transition to the fruits. This may agree with the findings of Manalil S, and Bhalerao S. A (2015).

As the results indicate in Table (4), there is a significant effect of the factor of adding the type of nitrogen fertilizer on the nitrogen in the leaves (gm.kg-1) of tomato plants when adding the level of 40 ton. ha^{-1} organic fertilizer, as the sulfur-coated Urea fertilizer achieved Urea- Sulphate had a significant superiority over all treatments with an average value of 36.07 g.kg-1, while it recorded values of 30.30, 33.01 and 34.89 g.kg-1 for the nitrogenous fertilizers Urea, Urea phosphate and Urea-humic, respectively. The method of manufacturing Urea fertilizer coated with sulfur makes it slow to decompose, and this leads to the liberation of nitrogen continuously and for a long period into the soil solution, which reflected positively on plant growth and increased nitrogen in the leaves, unlike Urea fertilizer, which decomposes and dissolves with water quickly before maximum use by the plant. (Al-azawi & Salih, 2018) stated that the addition of humic acid gives significant differences in all vegetative growth characteristics compared to the no-addition treatment.

As for the effect of the Bilaterny interaction between the type of nitrogen fertilizer and the date of sampling, the table (4) indicates a significant increase in the concentration of nitrogen in the leaves of tomato plants with age and for all types of nitrogen fertilizers used in the experiment, and that the highest concentration of nitrogen in the leaves was achieved with a significant difference at all stages For the types of fertilizers used on the second date of (December), noting the significant superiority of Urea-Sulphate fertilizer with an average of 40.94 g.kg^{-1}. For the same date, the rest of the fertilizers (Urea, Urea phosphate and Urea humic) recorded the highest values from the rest of the dates. 32.74, 37.52 and 39.25 g.kg^{-1}, respectively, while the treatment of Urea fertilizer for February recorded the lowest value of 29.00 g.kg^{-1}. The reason for this may be due to the slow decomposition of the added encapsulated nitrogen fertilizers compared to the nitrogen fertilizer (Urea), which is known to quickly decompose and lose nitrogen from it by volatilization or leaching, and that the slow release encapsulated fertilizers reduce the loss of nutrients from the soil and increase the efficiency of nutrient use and contribute to the development of growth and increase yield of vegetable plants, including tomato (Xiao *et al.*, 2017).

As for the effect of the interaction between the sampling date of the nitrogen concentration in the leaves and the level of nitrogen fertilizer addition, it is clear from Table (4) that there is a significant effect of this interaction in knowing the nitrogen concentration in the leaves, and that the highest value was recorded when the second measurement date coincided (the month of January The first) in all three levels of addition and the comparison treatment, however, the third level of addition at the date of the second calculation (December) achieved the highest value of nitrogen concentration in the leaves of tomato plants for all samples with a value of 44.05 g.kg^{-1}, and this is due to compatibility Synchronization between the date of application of nitrogen fertilizer close to the date of measurement (approximately two months), as well as the result of increasing the addition of nitrogen fertilizers to their highest levels. While the comparison treatment for the month of February recorded the lowest value of 26.36 g.kg^{-1}.

With regard to the interaction between the type of nitrogen fertilizer and the level of application, Table (4) shows that the significant increase in the concentration of nitrogen in the leaves of tomato plants varies according to the type of nitrogen fertilizer added with an increase in the level of application. The type of nitrogen fertilizer, Urea-Sulphate, achieved a significant increase in the concentration of nitrogen in the leaves and reached the highest value at the third level at a rate of 44.12 g.kg^{-1} with a significant superiority compared with level of second , first and zero were recored rate values 37.30, 35.15 and 27.71 g.kg^{-1} for the same type of nitrogen fertilizer, respectively. Then came the type of nitrogen fertilizer Urea Humic ranked second for all levels in the concentration of nitrogen in the leaves. The variation in the concentration of nitrogen in the leaves of tomato plants between the types of nitrogen fertilizers added according to the level of addition may be due to the type of nitrogen fertilizer, which has worked to provide the plant with the nutrients it needs for growth and stimulate it compared to the rest of the treatments, and these results are close to the results of Makoi JH, and Wery JT (1996).

The triple interaction between the type of nitrogen fertilizer, the level of application, and the date of measurement had a significant effect on the concentration of nitrogen in the leaves of tomato plants, as the data in Table (4) indicate that the highest value of nitrogen concentration in the leaves was observed at the high level of all types of added nitrogen fertilizers, while noting growth Gradual and increased nitrogen concentration in the leaves with the passing of measurement stages coinciding with the development of the first stages of plant growth, to decrease after that in the subsequent stages. The results are clear in Table (4) that the highest concentration of nitrogen in the leaves has been recorded for Urea-Sulphate fertilizer at the highest level of addition of 100 g N ha^{-1} in the second stage of the calculation (December) with a value of 50.45 g. kg^{-1}, while the comparison treatment for the month of February was lower with a value of 26.36 gm.kg^{-1}. The reason for this may be due to the efficiency of the nitrogen fertilizer manufactured in a way that leads to the liberation of nitrogen slowly and for the longest possible period during the growing season and at a high level (100 kg N ha^{-1}), which led to the survival of significant amounts of ready nitrogen in the soil solution and the plant was able to absorb it until And if a percentage of the nitrogen was lost from the soil solution by leaching or volatilization, and this is consistent with the findings of Ziaei A. *et al.*, (2012) that by adding Urea fertilizer, plants can absorb the nitrogen extracted from it through their roots, and thus, the use of nitrogen fertilizers can lead to To improve the nitrogen available to the plant.

- N – uptake (kg ha^{-1})

- The adding a level of 20 ton. ha^{-1} organic fertilizer

The results in Figure (1) show that there is a significant effect of increasing the level of nitrogen fertilizer addition at the level of nitrogen fertilizer addition when adding 20 tons. ha^{-1} organic matter in the amount of nitrogen of uptake by tomato plants compared to the control treatment, and that the highest amount of absorption was achieved when The third level of addition, with a value of 137.67 kg ha^{-1}, with a significant difference from the first level and without a significant difference from the second level, which in turn did not differ significantly from the first level of addition, which recorded the lowest values in nitrogen in the leaves at a rate of 128.75 kg ha^{-1}, and that the lowest value of the quantity The uptake was recorded in the comparison treatment as 115.66 kg ha^{-1}. The significant increase in uptake for most levels of nitrogen fertilizers compared to the control treatment may be due to the response of tomato plants used in the experiment to these levels of fertilizers and their contribution to increasing the nitrogen content in the tissues of plants (Tables 3 and 4), which encouraged a good absorption of nitrogen by tomato plants. These results are similar to the findings of Wang *et al.*, (2020).

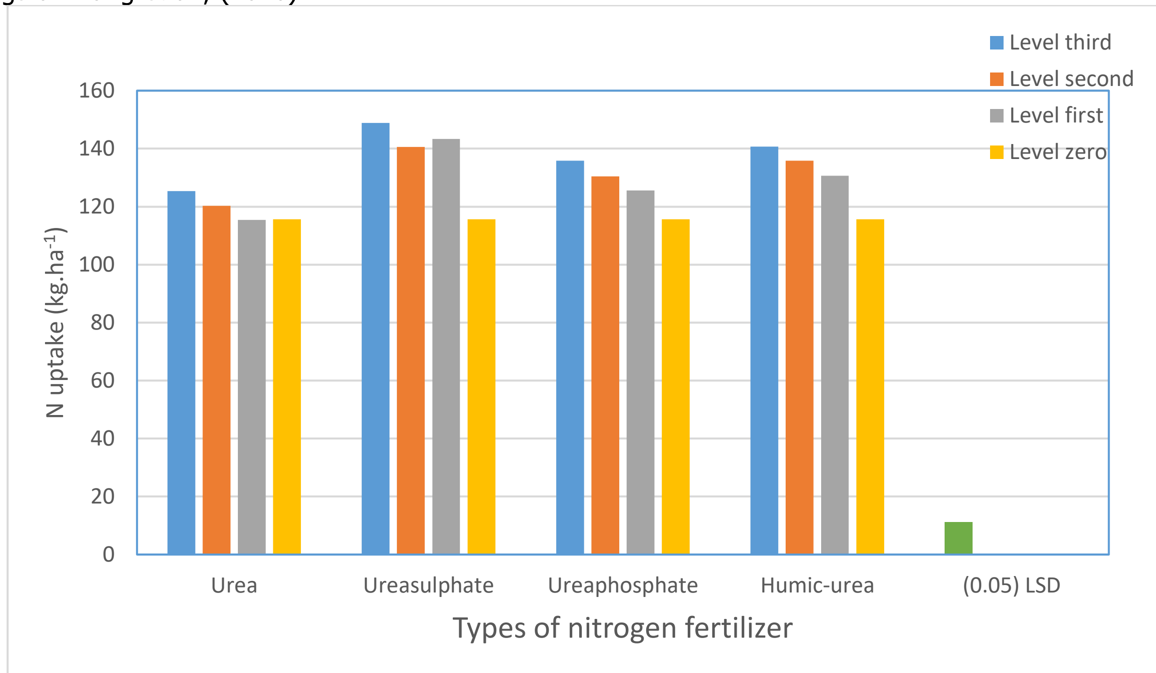

Figure (1) The effect of adding different types of nitrogen fertilizers at the level of adding 20 ton ha-1 organic fertilizer on the N- uptake by tomato plants during the growth perioed.

The results in Figure (1) also indicate that there is a significant effect of the type of nitrogen fertilizer added on the amount of nitrogen of uptake by tomato plants, as the nitrogen fertilizer (Urea Sulphate) achieved the highest amount of nitrogen uptake with a value of 139.67 kg ha^{-1}, with a significant difference from Urea fertilizer. And Urea - phosphate, which achieved an N- uptake of 120.34 and 130.62 kg ha^{-1}, with an increase of 16.03 and 6.90%, respectively, while it did not differ significantly from Urea-Humic fertilizer, which achieved an uptake amount of 135.64 kg ha^{-1}. The superiority of the of uptake quantity of Urea Sulphate fertilizer compared to other nitrogenous fertilizers may be due to the efficiency of the quality and manufacture of this fertilizer in providing a high content of ammonium and ready-made nitrates and the plants' absorption of these nitrogenous forms and their representation inside the cells and its positive reflection on the of uptake amount. These results are consistent with what Qureshi *et al.*, (2018) found on the uptake of tomato plants.

Although there was no significant effect of the binary interaction between the type and level of nitrogen fertilizer application on the amount of nitrogen uptake of tomato plants. However, the results in Figure (1) show that the rate of increase in the of uptake quantity varies according to the type and level of addition of those fertilizers, as it is clear that the high level of addition (the third) of Urea Sulphate fertilizer has achieved the highest values of the of uptake quantity 148.85 kg ha^{-1}. While the lowest values were recorded in the control treatment of 115.66 kg ha^{-1} for all types of added nitrogen fertilizers.

- The adding a level of 40 ton. ha^{-1} organic fertilizer

The results in Figure (2) show that there is a significant effect of increasing the level of nitrogen fertilizer addition at the level of adding 40 tons. ha^{-1} of this organic matter in the amount of nitrogen of uptake by tomato plants compared to the comparison treatment, and that the highest amount of N-uptake was achieved at the third level of addition With a value of 147.13 kg ha^{-1} and a significant difference from the first and second levels, which in turn was significantly superior to the first level, which were recorded in the place of the relevant amount of nitrogen of 137.57 and 143.58 kg ha^{-1}, respectively, and the lowest value of the quantity of nitrogen. It was recorded in the comparison treatment by 125.75 kg ha^{-1} and the rates of increase in the third, second and first levels amounted to 17.01, 14.17 and 9.39% compared to the control treatment respectively. Tomato used in the experiment to these added levels and its contribution to increasing the uptake of nitrogen from the soil solution and movement to the vegetative part and thus and the effect of increasing the content of nitrogen. Nitrogen in plant tissues (Tables 3 and 4). These results are similar to those reached by Al-Ansari (2020).

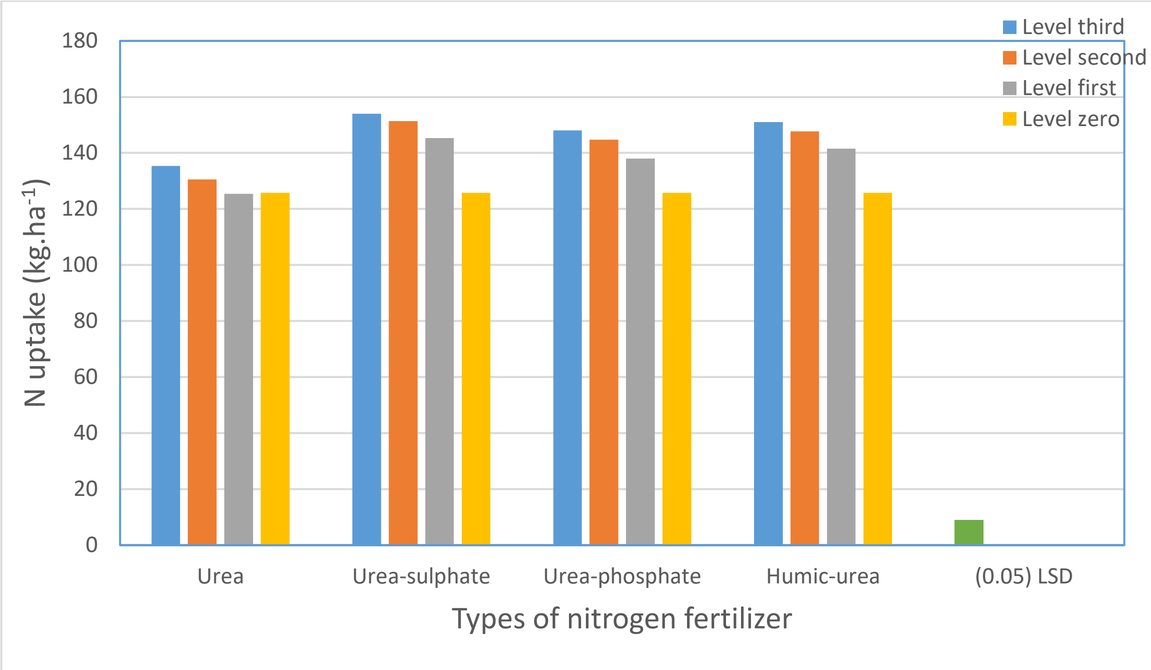

Figure (2) The effect of adding different types of nitrogen fertilizers at the level of adding 40 ton ha^{-1} organic fertilizer on the N- uptake by tomato plants during the growth period.

The results in Figure (2) also indicate that there is a significant effect of the factor of the type of nitrogen fertilizer added on the amount of nitrogen of uptake by tomato plants, as the nitrogen fertilizer (Urea Sulphate) achieved the highest amount of nitrogen of uptake with a value of 150.17 kg ha^{-1}, with a higher difference than Urea fertilizer. And Urea - Phosphite and we achieved an of uptake amount of 130.43 and 143.56 kg ha^{-1}, which is attributed to an increase of 15:13 and 4.60%, respectively, while it did not differ significantly from Urea-humic fertilizer, which achieved an uptake amount of 147.02 kg ha^{-1}. The superiority of the N-uptake quantity of Urea Sulphate fertilizer compared to other nitrogen fertilizers may be due to the efficiency of the quality and manufacture of this fertilizer in providing a high content of ammonium and ready-made nitrates (in the soil solution) through the slow liberation of nitrogen and the ease with which plants absorb these nitrogenous forms and their representation inside the cells easily and their reflection in an effective manner. Positive on the amount uptake These results are consistent with what Ansari (2013) found on the amount uptake of tomato plants.

There was no bilateral interaction between the type and level of nitrogen fertilizer application in the amount of nitrogen of uptake in tomato plants, but the data in figure (above) indicate that all levels of application of all types of nitrogen fertilizers are superior to the comparison treatment in the amount of nitrogen of uptake.

- **Total yield (tons.ha^{-1}):**
- **Level of addition of 20 tons. ha^{-1} organic matter:**

The results in Figure (3) show that there is a significant effect of increasing the level of addition of different nitrogen fertilizers at the level of addition of 20 ton. ha^{-1} organic mana on the total yield of tomato plants compared to the comparison treatment, and that the highest total yield was achieved at the level of the third addition with a value of 43.88 of ha^{-1} with a significant difference from the first and second levels and the comparison treatment, which achieved a total yield of 35.28, 41.60 and 26.76 ton. ha^{-1}, respectively, with an increase rate of 24.27, 5.48 and 63.97%, respectively. The significant superiority in the total yield of tomato plants at all levels of nitrogen fertilizer addition compared to the comparison treatment may be due to the large response of the tomato plants used in the experiment (the hybrid Red Flora cultivar) to these added levels and the maximum benefit from them by absorbing them (Figures 1 and 2) and their effect by increasing the content of Nitrogen in plant tissues (Tables 3 and 4), which in turn contributed to increasing the flowering rates of tomato plants, and thus the efficient and integrated contraction of these flowers, which resulted in many tomato fruits, which was reflected in the formation of high total yield. These results are similar to the findings of Ansari (2013).

The results in Figure (3) also indicate that there is a significant effect of the filtered nitrogen fertilizer type factor on the total yield of tomato plants, that the nitrogen fertilizer (Urea Sulphate) achieved the highest total yield with a value of 39.85 ton. ha^{-1}, with a significant difference from other sources of nitrogen fertilizers: Urea, Urea-Phosphite and Urea-humic, which achieved total yield rates with values of 34.52, 36.75 and 38.84 ton. ha^{-1} with an increase of 15.44, 8.43 and 2.60%, respectively. The superiority of fertilizer and increase of Urea Sulphate by giving the highest total yield compared to other nitrogen fertilizers may be due to the efficiency of the quality and manufacture of this fertilizer in providing a high content of ammonium and ready-made nitrates in soil solutions by slowly and continuously liberating nitrogen and increasing the absorption of these nitrogen fertilizers by plants and their representation inside the cells And its positive reflection on the of uptake quantity (Fig. 1 & 2) and its increased concentration in the tissues of tomato plants (tables 3 & 4), and thus its representation inside the plant and its positive reflection on many flowers and fruits, which gave a high yield. These results are consistent with the findings of Fujinuma et al., (2018) on the total yield of tomato plants.

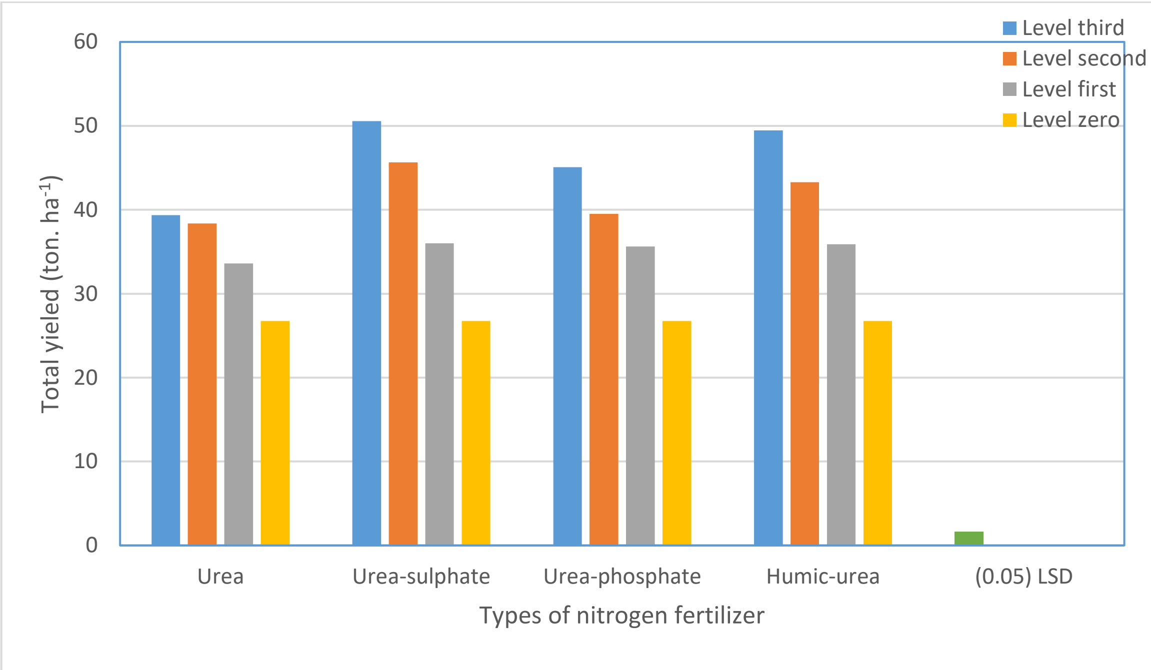

Figure (3) The effect of adding different types of nitrogen fertilizers at the level of adding 20 ton ha^{-1} organic fertilizer on the total yield by tomato plants during the growth perioed.

It is noted from the results in Figure (3) that there are significant differences due to the bilateral interaction between the type and level of addition of nitrogen fertilizers in the total yield, as it is clear that the rate of increase in total yield varies according to the type and level of addition of those fertilizers, as it becomes clear that the high level of addition (the third) of Urea Sulphate fertilizer achieved the highest total yield with a value of 50.58 ton.ha^{-1} compared to the lowest values recorded in the comparison treatment of 26.76 ton. ha^{-1} for all types of added nitrogen fertilizers, with an increase of 89.01%.

- **Level of addition of 40 ton. ha^{-1} organic matter:**

The results in Figure (4) show that there is a significant effect of increasing the level of addition of different nitrogen fertilizers at the level of addition of 40 tons. ha^{-1} organic matter on the total yield of tomato plants compared to the comparison treatment, and that the maximum total yield was achieved at the level of the third addition with a value of 54.17 ton. ha^{-1} with a significant difference from the first and second levels and the control treatment, which recorded values of total yield rates of 47.62, 51.14 and 32.64 ton. ha^{-1}, respectively. And that the lowest value of the amount total yield was recorded in the control treatment at 32.64 ton. ha^{-1} with an increase rate of 45.89, 56.67 and 65.96% compared to the control treatment, respectively. The significant increase in the total yield of most levels of nitrogen fertilizer addition compared to the comparison treatment may be due to the response of the tomato plants used in the experiment to these added levels and their contribution to increasing the soil content of ammonium and the periods ripe for tomato plants on nitrogen and the formation of flowers, and thus these flowers produced many fruits, which gave High output. These results are similar to the findings of Yousaf *et al.*, (2016).

The results in Figure (4) also indicate that there is a significant effect of the type of nitrogen fertilizer added on the total yield of tomato plants, that the nitrogen fertilizer (Urea Sulphate) achieved the highest total yield with a value of 52.86 kg ha^{-1}, with a significant difference from Urea, Urea-Phosphite and Urea- Humic, which achieved total yield rates of 42.36, 43.48 and 46.87 ton. ha^{-1}, with an increase of 24.78, 21.57 and 12.78%, respectively. The significant superiority of Urea Sulphate fertilizer in achieving the maximum total yield of tomato plants at the level of addition of 40 ton. ha^{-1} compared to the rest of the other nitrogen fertilizers may be due to the efficiency of the quality and manufacture of this fertilizer in providing a high content of ammonium and ready-made nitrates for a longer period by slowly and continuously liberating nitrogen, which Encourage the absorption of these nitrogenous forms and their representation inside the cells and reflect positively on the amount of uptake (Figures 1 & 2) and thus give a high total yield. These results are consistent with what was found by Qeisseler et al., (2020) on the total yield of tomato plants.

The data in Figure (4) indicate a significant interaction between the level and type of nitrogen fertilizer added, where it is clear that all levels of addition of all types of nitrogen fertilizers are superior to the comparison treatment in total yield, noting that the highest total yield was recorded at the third level treatment (100 kg N ha^{-1}) of Urea Sulphate fertilizer and a value of 60.00 ton. ha^{-1}, while the lowest yield on was indicated in the control treatment (zero addition) for all types of nitrogen fertilizers used in the experiment, which recorded a total yield of 32.64 ton. ha^{-1} Significantly lower than the highest value of the total yield above, at a rate of 45.60%.

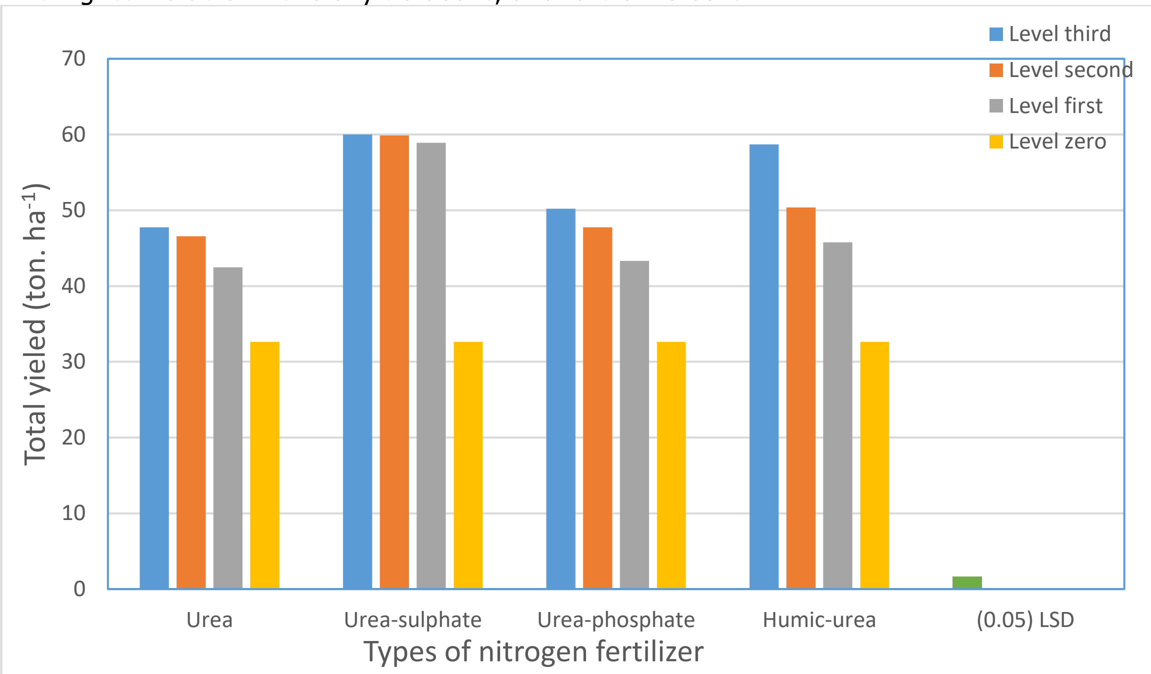

Figure (4): The effect of adding different types of nitrogen fertilizers at the level of adding 40 ton ha^{-1} organic fertilizer on the total yield by tomato plants during the growth perioed.

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