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RESEARCH PAPER

Effect of fertilizer management systems on growth and balance of nutrients in wheat cultivation

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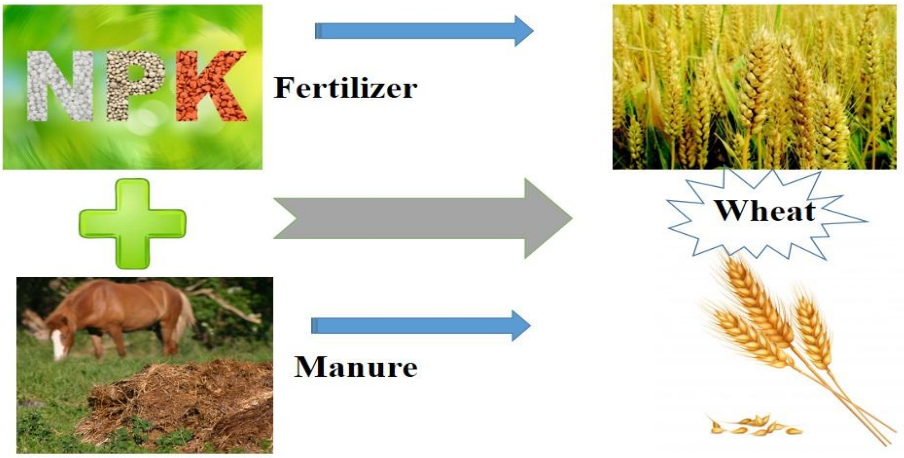
Highlights

- Different nurturing Fertilizer Management systems are effect on wheat agromorphological traits.
- Chemical fertilizers increase plant height, grain weight per spike and spike weight per plant in wheat.
- Chemical fertilizers had the wheat highest amount of nitrogen compared to biofertilizers.
- Manure increase iron, zinc, magnesium, calcium, potassium and phosphorus in the soil in wheat field.

Graphical Abstract



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Abstract

In order to investigate the effect of different fertilizer systems on the accumulation and balance of macro and microelements in the soil and some morphological characteristics of wheat, in order to reduce the use of chemical fertilizers and to determine the best level of treatments, this experiment was carried out in a randomized complete block design with three replications. Treatments include control (T1), manure (T2), vermicompost (T3), chemical fertilizers NPK (T4), vermicompost + nitroxin (T5), manure + nitroxin (T6), manure + chemical NPK (T7), were examined. The results showed that different nurturing systems were significant for all studied traits ($P< 0.01$). The use of manure combined with chemical fertilizers had a positive and significant effect on the economic yield of the grain at the rate of 3440 kg/ha so that it caused an increase of 87.71% compared to the control. The highest and lowest biomass yields with 9580 and 3890 kg were related to the treatment of chemical fertilizers and no fertilizer (control), respectively. In this study, chemical fertilizers increased plant height, grain weight per spike and spike weight per plant. The results of the process of changes in soil elements showed that chemical fertilizers had the highest amount of nitrogen (equal to 0.52%) compared to other treatments. Compared to the control, manure increased iron, zinc, magnesium, calcium, potassium and phosphorus in the soil by 15.03, 303, 9.16, 8.15, 2.26, and 10 ppm, respectively. The results of this study showed that the use of manure and integrated fertilizers have better results than other fertilizer treatments in increasing soil nutrients, which can be a good alternative to chemical fertilizers, in the direction of moving towards the principles of sustainable agriculture, while moving towards sustainable agriculture and they will reduce environmental pollution.

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1. Introduction

Today, chemical fertilizers are used as the most economical tool to achieve maximum production per unit area and compensate for the shortage of resources, which leads to increased production costs along with the destruction of soil, water and biological resources. Wheat is one of the most strategic crops among cereals, which is of great importance in the diet of human societies. Wheat plays an important role in providing essential minerals, carbohydrates and protein, and if wheat production increases, many food deficiencies will be addressed (Akbarabadi et al., 2015). Most crops, including cultivated cereals, are deficient in micronutrients. Deficiency of these elements in the soil not only reduces the yield of the plant, but also reduces the absorption of these elements by humans and livestock by reducing the concentration of these elements in the plant and this leads to various diseases and endangers public health (Zirgoli and Kahrizi, 2015; Dixit, 2020) .

Therefore, the availability of nutrients in the soil determines the nutrient status of the plant. Deficiency or lack of sufficient micronutrients in the soil not only reduces crop productivity but also reduces the nutritional quality of agricultural products, thus leading to malnutrition in the human population and causing many hidden but hidden human health problems (Zuo and Zhang, 2011). When nutrients are present in the soil crops will grow well and produce significant amounts of plant biomass. Providing nutrients in the soil determines the status of nutrients in the plant and the most important mission of agriculture in the production of healthy and nutritious food in human societies in order to achieve food security (Mohammadi et al., 2015). The effects of chemical fertilizers have caused contamination in the soil, which is one of the threatening factors of production resources and is one of the most important agricultural concerns today. But bio-organic fertilizers will not cause soil pollution compared to mineral fertilizers (Savci, 2012; Awan et al., 2020; Sarker et al., 2020).

Proper plant nutrition based on the use of organic fertilizers is one of the basic principles of achieving sustainable agriculture and plays an important role in improving the quality and quantity of agricultural products and the availability of nutrients. Chemical fertilizers, environmental protection and enrichment of agricultural products are effective in food security and health of human communities (Jat et al., 2015). Soil remediation using organic fertilizers can be considered a useful way to improve the sustainability of agricultural systems. The use of organic fertilizers, soil organic matter and nutrients increase the growth and activity of microorganisms and by maintaining the structure of the soil provides a good substrate for growth, and helps keep the plant healthy. Increasing biological activity improves nutrients from chemicals, organics, sources and decomposition of toxic substances and nutrient exchange capacity (Chew et al., 2019).

Reducing the use of chemical fertilizers and replacing them with organic and integrated fertilizers has increased the yield, which is desirable and useful for achieving sustainable agriculture. The use of chemical fertilizers changes the concentration of soil salts and on the other hand due to their acidic and alkaline properties cause changes in soil acidity which leads to the deposition or dissolution of trace elements by affecting their balance in the soil (Lansdown, 1995). Today, vermicompost is considered as a simple biotechnological process of compost and as an easy technology and a nature-friendly process, so that this process is used to obtain organic fertilizers from waste (Thakur et al., 2021). With the increasing application of different levels of vermicompost in the soil, the concentration of zinc and copper in the soil increases (Thakur et al., 2021). Nitrogen chemical fertilizer has a significant effect on wheat yield and quality (Liu et al., 2021). Organic fertilizers can reduce phosphorus uptake and increase plant access to phosphorus (Adnan et al., 2020).

The reason for the increase in phosphorus in the soil is due to the activities of soil micronutrients. Consumption of organic fertilizers increases soil potassium and the potassium content of legumes is higher than cereals (Adnan et al., 2020). Regarding the use of compound fertilizers, researchers have reported that the concentration of elements in the soil increases that the use of animal, compost and chemical fertilizers simultaneously and in combination increases the amount of mineral elements in the soil. The presence of organic matter in the soil increases the production of plant dry matter (Li et al., 2021). In plant cereals such as sorghum, wheat and barley, the use of combined nitrogen-fixing and phosphorus-solubilizing fertilizers is more effective in balancing more nutrients than their application (Bargaz et al., 2018). Manure combined with chemical fertilizers leads to soil fertility and increased crop production. The results of researchers' studies on plant height are such that chemical fertilizers increase plant height. Plant height is usually the most obvious change due to growth in plants. One of the reasons for the increase in plant height is the production of new leaves in the canopy so that the more efficient young leaves are usually located in the upper parts of the plant, which receive more radiation; the leaves are in the best position in terms of photosynthesis (Schulz and Glaser, 2012). The use of chemical fertilizers increases growth, accumulation of dry matter and larger leaves, the vegetation of the soil surface, reduces direct evaporation from the soil surface (Saffariha et al., 2021).

Inadequate soils aggravate malnutrition in human societies and cause the spread of various diseases, inadequate quality of arable soils and non-return of nutrients extracted from the soil, especially micronutrients. There is a constant relationship between healthy and healthy soil. Creating a healthy plant and a healthy plant is also beneficial to human health. The presence of nutrients in the soil determines the status of nutrients in the plant, the most important goal of agriculture is to produce healthy and nutritious food for human societies. Today, due to the high cost and destructive effects of chemical fertilizers on the environment and quality, the quantity of crops is created, so in this study, among the different fertilizer systems, the appropriate fertilizer system to reduce the use of chemical inputs, the use of alternative fertilizers such as fertilizers Organic and integrated, which is a source of nutrition and reduces soil pH and plays an important role in soil remediation, crop production, environmental protection and food security (Chen and Yada, 2011). This study was conducted to investigate the concentration of macro and microelements in the soil, some morphological characteristics of wheat under the influence of different fertilizer treatments in hot and dry areas of Zabol.

2. Materials and Methods

In order to investigate some morphological features of wheat, the balance and accumulation of macro and micronutrients in the soil, in a study, the effects of different fertilizer treatments in a randomized complete block design with three replications in the research farm of Zabol University, located 35 km Zabul was executed. In terms of geographical location, the study area is located at 61 degrees and 41 minutes east longitude and latitude 30 degrees and 54 minutes north and at an altitude of 480 meters above sea level .

In terms of climate, it has cold and dry winters and hot and dry summers, which are considered hot and deserts. The annual rainfall is 63 mm and the average annual evaporation is 4500-5000 mm, which is more than 87 times the annual rainfall of the region. The long-term average temperature of the region is 22 °C and the minimum absolute temperature is -7 °C. In 1992, the Morder study area had more local and sunny dust with winds of 22 km per hour and relative humidity of 56% and maximum and minimum temperatures of 24 and 9 °C, respectively. These cases have the same trend on most days of the month and often without rain or little rainfall.

The cultivation operations performed include plowing, discs for crushing the clumps, weed control, leveling, creating furrows and creeks. They were divided by creating an atmosphere and a ridge, and the place of cultivation was prepared by the labor force. The seed used was Sistan cultivar and native to the region. The cultivar has a spring growth type, plant height of 90-95 cm, which is tolerant of yellow and brown rust. The average percentage of protein is 11.5% and amber seed pigment weighs 48000 seeds and the number of flowering days is 125 days and is resistant to seed shattering. It has good germination power. Seed consumption was considered to be 150 kg/ha. The distance between each experimental unit was considered 0.5 m and each experimental unit that was prepared had 10 planting rows and the distance between the rows was considered 25 cm, phosphorus and potassium were used. Table 1 shows the physical and chemical properties of the soil and Table 2 shows the chemical decomposition of manure and vermicompost.

Table 1. Physical and chemical characteristics of soil.

Texture	EC (dS/m)	pH	N (%)	P (mg/kg)	K (mg/kg)	Ca (mg/kg)	Mg (mg/kg)	Fe (mg/kg)	Zn (mg/kg)
Sandy clay	3.18	7.41	0.04	9	146	1.13	7.26	5.30	1.25

Table 2. Chemical characteristics of organic fertilizers used in experiment.

Fertilizers	N (%)	P	K	Ca (mg/kg)	Mg (mg/kg)	Fe (mg/kg)	Zn (mg/kg)	Na (mg/kg)
Manure	2.26	0.64	2.04	1.42	0.44	1856.13	20.85	0.15
Vermicompost	1.6	1.10	1.5	-	-	-	-	-

Consumption of Manure and vermicompost fertilizers at the rate of 40 tons per hectare, chemical fertilizers at the rate of 200, 140, and 100 kg/ha, nitroxin fertilizer at the rate of 5 liters per hectare and combined fertilizers as 1.2 pure fertilizers were considered in phosphorus farming operations. Potassium was added in full and nitrogen in the form of urea in three stages. In the first stage, half of the nitrogen was added to the experimental plots before sowing the seeds. Then, the first irrigation was done immediately after planting and the next steps of the irrigation cycle were considered according to the needs of the plant and the customs of the region. Treatments include control (T1), cattle manure (T2), vermicompost fertilizer (T3), chemical fertilizers (T4), vermicompost fertilizer with nitroxin fertilizer (T5), manure with nitroxin fertilizer (T6) and manure with Chemical fertilizers (T7). The basis of soil sampling in order to measure the physical and chemical properties of the soil before planting was that eight soil points were sampled at a depth of 30 cm of soil using a soil sampling device and a composite sample was transferred to the laboratory for study. In the next steps, soil sampling was performed to examine macro and microelements in the soil. Plant sampling to measure morphological traits was plotted using a 1.1 m^2 plot in the valley of the studied experimental plots and then plants were randomly removed from the soil surface, which eliminates the effect of margins. Study traits include: plant height, spike and leaf, spike weight per plant, grain weight per spike, grain yield, biomass or biological yield and concentration of macro and micro soil elements including nitrogen, phosphorus, potassium, calcium, magnesium, iron and Zinc were studied. To study and measure soil nitrogen, from the Kjeldahl device.

Also, a spectrophotometer was used to measure the concentration of phosphorus in the soil and a flame photometer and an automatic absorption apparatus were used to measure potassium and microelements in the soil, respectively. A vacuum pump device was used to prepare soil saturated extract to measure microelements. Finally, to calculate and analyze the statistical data, the data obtained from the experiments were first transferred to Excel software and then, after ensuring the normality of the data, the results were analyzed using SAS statistical software version 19. Mean data comparisons were performed using Duncan's Multi-Range Test (LSR), the data obtained from the study and experimental study were compared at a probability level of 5%. The correlation coefficients between the studied traits were calculated using SAS statistical software. Finally, charts, figures and tables were drawn using Excel and Word software.

3. Results and Discussion

3.1. Plant height (stem, spike, leaf)

The results of the analysis of variance of data in Table 3 showed that the effect of different fertilizers on the length of the stem, spike and leaf had a significant effect on the level of 1% probability. Thus, the studied treatments caused a relative increase in plant height compared to the control. The maximum and minimum length of the stem, spike and leaf with values of 70.6, 7.6 and 18.7 cm and 0.62, 6.1 and 12.2 cm, respectively, were allocated to the treatment of chemical fertilizers and control (no fertilizer application). The use of chemical fertilizers increased the length of stem and spike by 13.8 and 25.2% compared to the control (Table 4). The effect of chemical fertilizers on plant growth is due to the increased availability of nutrients, especially nitrogen and phosphorus. Nitrogen increases the growth of aerial organs, phosphorus increases the energy transfer for the growth of plant vegetative organs, in general, it improves photosynthesis and thus plants growth. The increase of these traits by chemical fertilizers can be considered by increasing the length of intermediates due to providing water and nutrients required by the plant. Chemical fertilizers increase plant height (Jamir et al., 2017). The reason for increasing plant height is probably affected by the number of spikes per unit area and the control treatment by reducing the number of spikes per unit area, for light and nutrient availability, compared to other fertilizer treatments has a high level of competition between plants. This increases the plant height in the plant (Geravandi et al., 2011). The use of chemicals and manures separately had the highest and lowest plant height. Nitrogen increase leads to an increase in plant height and has a significant effect on plant aerial height. Consumption of organic fertilizers along with chemical fertilizers increased the length of the spike compared to the control. Increasing the height of the plant is fertile and has more flowers, which increases the number of seeds per spike (Sepahvand et al., 2021).

Table 3. Analysis of variance (mean of squares) of measured characters of wheat affected by chemical, organic, biological and integrated fertilizer treatments.

(S.O.V)	(df)	Stem Length (Cm)	Leaf Length (Cm)	Spike Length (Cm)	Grain weight Per plant (gr)	Grain weight Per plant (gr)	Grain Yield (Kg/ha)	Biological Yield (Kg/ha)
Replication	2	0.25 ns	0.032 ns	0.0068 ns	0.00038 ns	0.00031 ns	183.196 ns	9871.43 ns
Treatment	6	32.90**	15.006**	1.031**	0.83**	0.036**	912861.251**	11293942.86**
Error	12	0.80	0.096	0.018	0.0042	0.00068	643.516	33371.43
Cv	-	1.35	2.20	2.01	2.72	2.74	1.007	2.44

ns and **: Are significant at 1% probability levels, and non-significant, respectively.

Table 4. Mean comparison of measured characters of wheat affected by chemical, organic, biological and integrated fertilizer treatments.

Treatment	Stem length (Cm)	Leaf length (Cm)	Spike length (Cm)	Grain weight Per plant (gr)	Grain weight Per spike (gr)
T1	62.07 d	12.20 f	6.14 e	1.80 d	0.76 e
T2	67.49 b	13.41 d	6.54 d	2.40 b	1.01 b
T3	62.64 d	12.46 ef	6.28 e	1.87 cd	0.87 d
T4	70.66 a	18.71 a	7.69 a	3.03 a	1.09 a
T5	64.24 c	12.80 e	6.32 ed	1.97 c	0.92 c
T6	68.25 b	14.06 c	6.97 c	2.31 b	0.97 b
T7	68.77 b	14.63 b	7.30 b	3.08 a	1.02 b

Means in each column, following the same letter (S) are not significantly different (P< 0.05). T1: Control, T2: manure, T3: Vermicompost fertilizer, T4: Chemical fertilizer, T5: Vermicompost + Nitroxin fertilizer, T6: manure and Nitroxin fertilizer, T7: manure and chemical fertilizer.

3.2. Important functional components are the number of grains per spike and the number of grains per unit area

According to the results obtained from the analysis of variance in Table 3, different fertilizer ratios on the number of grains per spike and the number of spikes per unit area showed a significant effect at the level of 1% probability that the studied treatments caused a relative increase in important yield components compared to the control (Table 4). The maximum and the minimum number of grains per spike and number of grains per unit area with values of 26.66, 501, 18.26, and 441 respectively, were allocated to the treatment of chemical fertilizers with manure and control (Table 4). In connection with the use of combined chemical fertilizers with livestock, it can be stated that this is due to the increase in soil fertility and plant uptake and plant nutritional needs are met. Organic fertilizers that can be used in combination with chemical fertilizers can have a compensatory and complementary effect.

The combined composition of organic and chemical fertilizers causes the chemical fertilizers to provide absorbable nutrients to the plant in the early stages of plant growth, and in the later stages of growth, organic fertilizers provide macro and micronutrients to the plant. Organic fertilizers play an essential role in providing nutrients and improving plant vital reactions. Other researchers reported in their studies that combining manure with chemical fertilizers increases the number of spikes per square meter and increasing the level of organic fertilizers increases the number of seeds per spike (Wang et al., 2020). The reason for increasing the number of fertile spikes is to increase the absorption of water and nutrients due to further development of roots and the nitrogen biostabilization process. With increasing nitrogen consumption, the number of spikes per unit area and the number of seeds per spike increases (Fang et al., 2010).

3.3. Seed weight per spike and spike weight per plant

Different fertilizer systems showed a positive and significant effect on grain weight per spike and spike weight per plant at the probability level so that different fertilizer treatments increased these two traits compared to the control (Table 3). Maximum and minimum spike weight per plant and grain weight per spike with values of 1.09 and 3.08, 3.03, 0.76 and 1.80 g, respectively, treated with chemical fertilizers separately, chemical fertilizers with manure combined and control treatment without fertilizer was allocated. So that chemical fertilizers caused an increase of 71.42 and 43.47% of grain weight per spike and spike weight per plant compared to the control of no fertilizer application (Table 4).

Regarding the improvement of these traits by chemical fertilizers, it can be said that this is due to the important role that nitrogen plays in the structure of proteins. Therefore, it is effective in increasing grain weight. The researchers stated that the availability of nutrients, especially nitrogen in corn, causes good pollination and increases fertility and turns florets into seeds, which in corn increases the number of seeds in a row (Troyer, 2006).

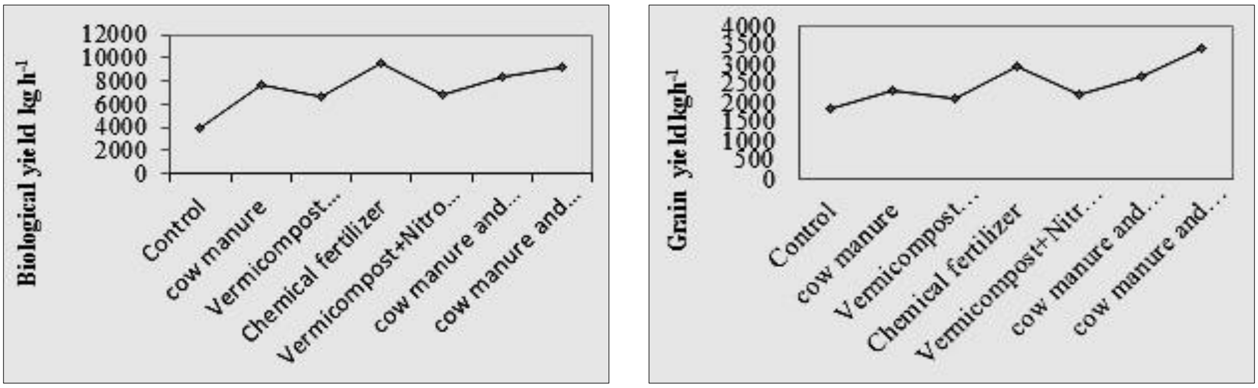
3.4. Grain performance

Different fertilizer systems showed a positive and significant effect on grain yield at the level of 1% probability so that different fertilizer treatments caused a relative increase in grain yield compared to the control of no fertilizer application (Table 3). The highest and lowest grain yields of 3440 and 1835 kg/ha were allocated to the treatment of chemical fertilizers with manure and control, respectively, and then the highest grain yield was allocated to the treatment of chemical fertilizers and manure with nitroxin and manure separately Were found and were in the statistical classes b, c, d, respectively (Fig. 1). The reason for the increase in yield in integrated systems can be attributed to the increase in important yield components, the maximum number of grains per spike and the number of spikes per unit area, and probably another reason for this. The positive process of manure in integrated systems can be considered as increasing the yield in the balance between nutrients and availability of moisture suitable for the plant, which was consistent with the results of other researchers.

The most direct effect on grain yield belongs to the use of combined chemicals and manures increased grain yield. The use of nutrients in chemicals and manures, especially nitrogen, in the stages of vegetative, reproductive and especially in seed filling by increasing the sap, increasing photosynthesis and increasing leaf area play an important role in increasing yield and important yield components (Farooq et al., 2017). Consumption of organic and chemical fertilizers increases production, crop quality, soil fertility and water use efficiency without it affects the amount of water consumed Aphids increase grain yield (Aulakh and Malhi, 2005). Fertilizers containing nitrogen have an effective role in improving the quality and increasing grain yield. Nitrogen is one of the main elements in increasing sustainable yield in cereals (Ladha et al., 2005).

3.5. Biological yield (biomass)

Different fertilizer systems showed a significant effect on biomass yield at a probability level of 1% so that the studied treatments caused a relative increase in biological yield compared to the control (Table 3). The highest and lowest biomass yield with 9580 and 3890 kg/ha were allocated to chemical fertilizer treatments and chemical fertilizers with manure and control fertilizers, respectively. Chemical fertilizers, by providing nutrients, especially nitrogen, increase plant growth and biomass compared to the control, and organic fertilizers provide the nutrients needed by the plant and gradually release them, increasing plant growth and biomass yield, in addition to providing The nutrients required by the plant, while maintaining the usable moisture in the plant, also increase it, thus increasing vegetative growth and biomass production. Other researchers have shown that the use of chemical fertilizers improves biomass yield (Bistgani et al., 2018; Saha et al., 2019). The manure combined with chemical fertilizers increases biomass yield. Biological yield in integrated systems increases separately due to the increase of vegetative (leaf and height) and reproductive components of the plant (number of seeds and 1000-seed weight) in comparison with organic and chemical fertilizer treatments. Increased grain yield in integrated treatments and treatment of organic fertilizers used separately compared to the control treatment due to higher total and absorbable concentration of nutrients in organic fertilizers compared to soil (Iqbal et al., 2020).



(A) (B)

Figure 1. A) Comparison of grain yield, B) biological yield, in fertilizer treatment, Control, manure, Vermicompost fertilizer, Chemical fertilizer, Vermicompost + Nitroxin fertilizer, manure and+ Nitroxin fertilizer, manure + Chemical fertilizer.

3.6. Investigation of different fertilizer treatments on soil nutrient concentrations

3.6.1. The rate of nitrogen accumulation in the soil

According to the results of the analysis of variance (Table 5), it can be said that the nitrogen concentration is affected by different fertilizer treatments and has a significant difference at the level of 1% probability. So that different fertilizer systems caused a relative increase in nitrogen compared to the control. The highest and lowest nitrogen concentrations with values of 0.52 and 0.35% were allocated to the treatment of chemical fertilizers and control of the non-fertilizer application, respectively. Consumption of chemical fertilizers caused a 48.78% increase in nitrogen compared to the control and then chemical fertilizers with manure with a concentration of 0.50% had the highest concentration of nitrogen (Table 6). The reason for the increase in chemical fertilizers compared to other fertilizer treatments can be stated like this because chemical fertilizers have significant amounts of absorbable nitrogen and are more affected by sublimation and leaching, which makes the plant out of reach and less absorbed. And the reason for the increase in nitrogen under the treatment of chemical fertilizers compared to manure can be expressed as chemical fertilizers are mineral and in a suitable environment under the process of nitration and soil is transferred to a lower depth, while this process is slower in manure treatments.

Other researchers, according to their studies, with the use of organic fertilizers on the concentration of total nitrogen in the soil was not significant, but the concentration of available phosphorus and potassium in the soil compared to the control showed a significant difference (Thomas et al., 2019). Organic fertilizers, in addition to increasing soil organic matter, also increased soil nutrients, especially nitrogen (Ladha et al., 2011). Vermicompost increases the concentration of soil nitrogen compared to the control (Tognetti et al., 2005).

3.6.2. The rate of phosphorus accumulation in the soil

Fertilizer treatments had a significant difference at the level of 1% probability on the amount of phosphorus accumulation in the soil (Table 5). The maximum and minimum concentrations of phosphorus in soil were 15.03 and 8.49 ppm, respectively, which were allocated to the treatment of manure and control fertilizers, respectively. The use of manure increased 77.51% phosphorus concentration compared to the control (Table 6). The reason for the high phosphorus in the soil under the influence of manure is that organic phosphorus is more in the manure and is gradually released using the activity of microorganisms in the mineral soil, while the phosphorus in chemical fertilizers is introduced into the soil. Participates in adsorption reactions and causes deposition. In general, with increasing the amount of chemical fertilizers compared to manure, soil absorbed phosphorus decreases. Therefore, the amount of soil phosphorus accumulation in organic and integrated methods is preferable to the chemical. Other researchers have reported that manure increases soil organic matter and increases the cation exchange capacity of the soil, covering the surface of clay particles and preventing phosphorus stabilization in the soil (Ramos et al., 2018). Most organic fertilizers, including vermicompost, release nutrients, especially phosphorus, which increases the uptake of phosphorus into the soil (Khosravi et al., 2018). Researchers have stated that the use of vermicompost increases the concentration of phosphorus in the soil (Lim et al., 2015).

3.6.3. The amount of potassium accumulation in the soil

Potassium under the influence of different fertilizer treatments had a statistically significant difference at the level of 1% probability (Table 5). According to the results of Table 6, the comparison of the mean of the data indicates that the highest and lowest levels of potassium in the soil at 303 and 146 ppm were allocated to manure and control treatments, respectively. The high amount of potassium that can be absorbed by the fertilizer-treated soil, manure is probably due to the gradual release of elements in the organic fertilizers used by the plant, and due to the low nitrogen content of the soil, the decomposition of residues slowly, and less absorption of elements by Plant, this may cause the accumulation of potassium in the soil and increase its amount. Fodder fertilizers increase the concentration of potassium in the soil (Zeng et al., 2001). Also, studies on soil under wheat cultivation in Isfahan using fertilizer treatments in Different levels have shown that absorbable potassium with increasing the amount of fertilizer in manure and compost treatments compared to the control without any fertilizer has a significant increase and the highest potassium concentration is related to the treatment of 100 tons of manure, so at different levels of manure, more manure from other fertilizers, it increased the concentration of this element in the soil. The presence of organic matter in the soil increases potassium, thus improving various functions in the plant. Cellular and role in stomata movements play an important role. The use of organic fertilizers that contain a lot of organic matter while increasing the biological and microbial activities of the soil increases the solubility and mobility of elements in the soil and facilitates their access to the plant (Masciandaro et al., 2013).

3.6.4. The rate of calcium accumulation in the soil

The concentration of calcium in the soil under the influence of different fertilizers showed a significant effect at the level of 1% probability (Table 5), the highest and lowest concentrations of calcium in the soil with values of 9.16 and 1.10 ppm were allocated to manure and control treatments (Table 6). Therefore, the reason for this can be stated that in the composition of some chemical fertilizers, calcium acts as a double element and there is also an antagonistic relationship between calcium, magnesium and potassium. The use of organic fertilizers increased the concentration of soil calcium and the percentage of soil organic matter. Increasing the amount of calcium increased the absorption of phosphorus and the amount of alkalinity in the soil. This has adverse effects. Therefore, the appropriate ratio of calcium and magnesium content improves soil structure and reduces weed populations, reduces leaching of other elements and increases the balance of most nutrients (Atkinson et al., 2010).

3.6.5. The rate of Magnesium accumulation in soil

The effect of different fertilizer treatments on soil magnesium concentration showed a significant difference at the level of 1% probability (Table 5). The highest and lowest magnesium concentrations in the soil with values of 8.15 and 7.25, which are in the statistical class a and b, respectively, were allocated to the treatment of manure and control fertilizers. Manure caused an increase of 12.42% compared to the control (Table 6). Therefore, chemical fertilizers have physiological acidic properties that cause the excretion of magnesium from the place of plant growth and development, and with the entry of organic fertilizers into the soil, the balance between magnesium and potassium is established. By adding chemical fertilizers to the soil, an antagonistic (negative interaction) relationship is established between the elements calcium and magnesium with potassium, so that by adding potassium, the symptoms of calcium and magnesium deficiency will appear. When the concentration of magnesium is lower, the deficiencies will intensify so that its deficiency in the plant slows down the growth. The absorption of some nutrients depends on their ratio in the soil solution. Increasing the potassium element reduces the absorption of calcium and magnesium. Other researchers have stated that the use of organic vermicompost fertilizers increases the concentration of magnesium and the percentage of soil organic matter compared to the control, a large amount of manganese in the soil will reduce the absorption of magnesium (Atkinson et al., 2010).

3.6.6. The amount of zinc accumulation in the soil

Zinc concentration in soil was affected by different fertilizers and showed a significant effect at the level of 1% probability (Table 5). The highest and lowest concentrations of zinc in the soil with values of 2.26 and 1.21 ppm, respectively, were allocated to the treatment of manure and control fertilizers, which increased 86.95% concentration of zinc compared to the control (Table 6). In this regard, the reason for this can be stated as follows, and manure may be acidified by soil nitration activities, which increases the ionic strength and soil organic matter. Other researchers have stated that manure increases soil organic colloids and these colloids absorb some salt and the plant can grow better (Hens and Merckx, 2001). Urea fertilizer increases the concentration of zinc in the soil compared to other nitrogen fertilizer treatments (Khan et al., 2009). Consumption of organic fertilizers increases the concentration of zinc and iron in the soil, which increases the yield of plants. These researchers believe that the formation of zinc and iron chelates increases their solubility (White and Broadley, 2009). Zinc is more miscible with organic matter and is available in a more diverse form. Organic matter in the soil is considered as one of the sources of zinc that slowly releases the element zinc in the soil and makes it available to the plant (Almås et al., 2000). Application of nitrogen fertilizer under maize (*Zea mays* L.) had no significant effect on the amount of zinc and copper in the soil (Losak et al., 2011).

3.6.7. The amount of iron accumulation in the soil

The concentration of iron in the soil under the influence of different fertilizers had a significant effect at a probability level of 1% (Table 5). The highest and lowest iron concentrations with values of 10 and 5.27 parts per million were allocated to the treatment of manure and control fertilizers without the use of fertilizer, respectively. Manure caused an increase of 90.09% in the concentration of iron in the soil compared to the control and then the highest amount of manure with nitroxin and vermicompost, compost separately and vermicompost with nitroxin and manure with chemical fertilizers in class respectively. , c, c, e, d was assigned (Table 6). Regarding the increase of iron concentration in soil treated with manure, it may be due to the organic matter present in organic fertilizers, which increases the nutrient content of the soil. The reason for the increase in this trait under the application of vermicompost fertilizers can be expressed as the increase in microbial activity and mineralization of nutrients in the soil, which increases the micro-nutrients that can be absorbed in the soil. Soil organic matter can convert soil iron into a usable form for the plant. The presence of these substances in the soil makes iron available. Other researchers have reported that the use of nitrogen fertilizers increases the concentration of iron in the soil under corn. Under maize cultivation, the addition of nitrogen fertilizers to the soil iron increases (Losak et al., 2011).

Table 5. Analysis of variance (mean of squares) of measured characters of wheat Soil affected by chemical, organic, biological and integrated fertilizer treatments.

(S.O.V)	df	N (%)	P (mg/kg)	K (mg/kg)	Ca (mg/kg)	Mg (mg/kg)	Fe (mg/kg)	Zn (mg/kg)
Replication	2	0.00012 ns	0.588 ns	0.027 ns	0.0051 ns	0.024 ns	0.00029 ns	0.0095 ns
Treatment	6	0.010 **	18.25 **	12438.62 **	29.72 **	0.343 **	10.99 **	0.39 **
Error	12	0.00049	0.169	32.23	0.017	0.049	0.059	0.019
Cv	-	4.94	3.28	0.46	3.13	2.90	3.23	8.47

ns and **: Are significant at 1% probability levels, and non-significant, respectively.

Table 6. Mean comparison of measured characters of Soil affected by chemical, organic, biological and integrated fertilizer treatments.

(Treatment)	(N) (%)	P (mg/kg)	K (mg/kg)	Ca (mg/kg)	Mg (mg/kg)	Fe (mg/kg)	Zn (mg/kg)
T1	0.35 e	8.49 e	146 f	1.10 f	7.25 b	5.27 e	1.21 e
T2	0.48 abc	15.031 a	303 a	9.16 a	8.15 a	10 a	2.26 a
T3	0.44 c	14.33 a	190 d	5.05 c	7.60 b	8.36 c	1.41 de
T4	0.52 a	10.25 d	163 f	1.80 e	7.30 b	5.32 e	1.31 de
T5	0.40 d	13.44 b	170 e	3.03 d	7.59 b	8.27 c	1.56 cd
T6	0.46 bc	14.50 a	256 c	7.73 b	8.02 a	9.30 b	1.84 b
T7	0.50 ab	11.61 c	288 b	1.97 e	7.50 b	6.30 d	1.79 bc

Means in each column, following the same letter(S) are not significantly different at the 5% level of probability. T1: Control, T2: Cow manure, T3: Vermicompost fertilizer, T4: Chemical fertilizer, T5: Vermicompost + Nitroxin fertilizer, T6: cow manure and Nitroxin fertilizer, T7: cow manure and chemical fertilizer.

3.7. Correlation coefficients between soil nutrients

Based on the results of Table 7, the correlation coefficients between macro and microelements in the soil can be recognized that the concentration of nitrogen with potassium in the soil has a positive and significant correlation at a probability level of 5% and calcium with magnesium a positive and significant correlation in probability level one. Has had a percentage. In this study, due to the positive and significant correlation between nitrogen concentration with potassium and calcium concentration with magnesium, it shows that with increasing nitrogen, the amount of potassium increased and the increase in calcium increased the amount of magnesium in the soil Table 7. It should be noted that excess magnesium will increase the absorption of zinc. In many plants, zinc deficiency will increase iron absorption.

3.8. Correlation coefficients between stem, spike and leaf length

Based on the results of calculating the correlation coefficients of traits, stem length showed a positive and very significant correlation with spike length at the level of 1% probability and with leaf length at the level of 5% probability at a positive and significant correlation. Spike length showed a positive and significant correlation with leaf length at the level of 1% probability and significant at the level of 1% probability. The positive and very significant correlation between stem length and spike and also between spike length and leaf length indicates that with increasing stem length, spike length and leaf length increased and increasing spike length increased leaf length (Table 8).

Table 7. Correlation coefficients between elements soil Nitrogen, Phosphorous, Potassium, Calcium, magnesium, Sodium, Zinc, Iron.

	Nitrogen (N)	Phosphorous (P)	Potassium (K)	Calcium (Ca)	Magnesium (Mg)	Iron (Fe)	Zinc (Zn)
Nitrogen (N)	1						
Phosphorous (P)	0.06 ns	1					
Potassium (K)	0.78 *	0.20 ns	1				
Calcium (Ca)	0.60 ns	-0.17 ns	0.56 ns	1			
Magnesium (Mg)	0.55 ns	-0.21 ns	0.53 ns	0.96 ns	1		
Iron (Fe)	0.16 ns	0.48 ns	0.38 ns	-0.20 ns	-0.12 ns	1	
Zinc (Zn)	-0.41 ns	-0.04 ns	-0.55 ns	-0.04 ns	-0.19 ns	-0.27 ns	1

3.9. Correlation coefficients between stem, spike and leaf length

Based on the results of calculating the correlation coefficients of traits, stem length showed a positive and very significant correlation with spike length at the level of 1% probability and with leaf length at the level of 5% probability at a positive and significant correlation. Spike length showed a positive and significant correlation with leaf length at the level of 1% probability and significant at the level of 1% probability. The positive and very significant correlation between stem length and spike and also between spike length and leaf length indicates that with increasing stem length, spike length and leaf length increased and increasing spike length increased leaf length (Table 8).

Table 8. Correlation coefficients between stem length, spike length and leaf length.

	Stem Length (Cm)	Spike Length (Cm)	Leaf Length (Cm)
Stem Length	1		
Spike Length	0.92 **	1	
Leaf Length	0.83 *	0.92 *	1

*and **: Are significant at 5 and 1% probability levels.

4. Conclusion

It should be noted that the impact of chemical fertilizers on agricultural production is not hidden from anyone, but today all over the world, especially in developed countries, are looking for alternative systems in agriculture, which can produce sufficient and quality products, minimal environmental degradation and resources. At the same time, they should have long-term stability. Fertilizer is suitable that has the desired amount of nutrients in the soil and can provide nutrients to the plant well and does not cause environmental pollution by fertilizer that does not endanger the health of human communities, in addition to increasing production, product quality Promote agriculture and maintain a balance between nutrients. Results obtained in this study, considering the morphological characteristics of wheat, yield and yield components and the concentration of soil nutrients, it can be said that the effect of different fertilizer systems on all morphological traits of wheat and the concentration of elements in the soil at 1% compared to other treatments. Cody had a statistically significant difference. In such a way that chemical fertilizers increase plant height in terms of the stem, spike and leaf length and chemical and manures together also increase yield and yield components (number of seeds per spike and number of seeds per unit area) and spike weight per plant and seed weight per Became a spike. The highest and lowest biomass yield were allocated to the treatment of chemical fertilizers and chemical fertilizers with manure, respectively. Regarding the concentration of soil nutrients, it can be said that chemical fertilizers are superior to other fertilizer treatments in increasing soil nitrogen and manure in increasing the concentration of phosphorus, potassium, calcium, magnesium and zinc in the soil. By using chemical and manure fertilizers in combination compared to the separate application of each of them, the yield is significantly increased, so that organic and chemical fertilizers complement each other and compensate for each other's shortcomings, so organic fertilizers affect the effect of chemical fertilizers are increasing. Organic and integrated fertilizers increased soil elements compared to the control. On the other hand, in this case, the use of chemical fertilizers separately from combined fertilizers in the short term due to the gradual release of elements cannot fully meet the plant nutritional needs, so using chemical fertilizers. Organic and biological, in combination, while balancing the nutrients, provide optimal conditions to improve the physical, chemical and fertility properties of the soil, which are considered an important component of sustainable management and development, are used. Therefore, integrated fertilizers can be a suitable alternative to chemical fertilizers, which, while advancing the goals of achieving sustainable agriculture and establishing a balance between soil nutrients, will reduce environmental pollution and ultimately provide food security.

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