The Role of Poultry Manure and Humic Acid in the Water Consumption, Nitrogen Availability, and the Summer Squash Plant (Cucurbita pepo L.) Yield

Khaleel Farhan
University of Anbar

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 6, 2021, Pages. 8671 - 8678
Received 25 April 2021; Accepted 08 May 2021.

The Role of Poultry Manure and Humic Acid in the Water Consumption, Nitrogen Availability, and the Summer Squash Plant (*Cucurbita pepo* L.) Yield

Khaleel J. Farhan, Mustafa Subhi Abbul AlGabbar, Bassam A.A.H. Alkhateb

Department of Soil Science and Water Resources, College of Agriculture, University of Anbar, Iraq.
Email: khaleel.farhan@uoanbar.edu.iq

Abstract

A field experiment was carried out during the spring season 2019-2020 in sandy loam soils, to study the role of poultry manure and Humic acid in the water consumption of Summer squash crop or nitrogen availability under the drip irrigation system. Poultry manure was added to the soil at four levels 0, 5, 10, and 15 ton.ha^{-1}.Summer squash seeds were planted in the field on beds with a distance between one bed and another 0.50 m and the distance between one plant and another 0.40 m. Then, humic acid was sprayed at a concentration of 0 and 4 g.L^{-1}twice, the first after the emergence of the true leaves of the plant, and the second was added before the flowering stage. The study treatments were distributed using the split-plot system according to the Randomized Complete Block Design (RCBD) with three replicates. Soil water retention capacity increased by 13.9%, water consumption was 370 mm, and rationalize irrigation water by 28.2% when poultry manure was added at the level of 15 tons. ha^{-1}. The available nitrogen concentration increased with increasing the level of addition and the highest average was 98.10 mg.kg^{-1}. Humic acid spraying increased the available nitrogen concentration, which reached 91.56 mg.kg^{-1}. The highest yield was 19,232 tons. ha^{-1}and the highest water use efficiency was 6.310 kg.m^{-3} at the level of addition of 15 ton.ha^{-1}, while spraying with Humic acid led to an increase of 5.64%.

Keywords: poultry manure, Humic acid, water consumption, squash (*Cucurbita pepo* L.).

Introduction

Poultry manure is an important source in increasing the availability of nutrients in the soil and a source of nitrogen and other nutrients. The use of poultry manure in poorsoils with their content of organic matter is of particular importance in plant nutrition.(AL-Abbasi and Kamal 2011) indicated that fertilizing *Cucurbita pepo* L. crop with poultry manure at levels 0, 10, and 20 tons.ha^{-1} led to a significant increase in dry weight, number of fruits, leaf area, and total yield at the level of 20 tons.ha^{-1}, reaching 0.227 kg.plant^{-1} and 5.99 fruit.plant^{-1} and 1.947 m^{2} and 12.89 ton.ha^{-1}, respectively, by increasing the levels of added poultry manure compared to the comparison treatment. The addition of organic fertilizer to the soil at a level of 20 tons. ha^{-1} or by spraying on the plant resulted in a significant increase in the fruit weight, dry matter weight, leaf area, number of fruits per plant, and plant content of nitrogen, phosphorus, and potassium for the squash plant (Al-Magrebi, 2015).Moreover,(Al Khateebet al., 2018) pointed out that adding organic fertilizers at the level of 20 tons. ha^{-1} to squash plants led to a significant increase in plant height, dry weight, early yield, and total yield, which reached 91.59 cm, 227.66 g, 9.26 kg. plant^{-1} and 25.96 ton.ha^{-1} respectively. However, Humic acid is one of the basic components of organic matter, which is great affects plant growth by stimulating plant cell division and elongation, increasing the effectiveness of the plant's enzymatic system, and stimulating vitamins inside cells. It contains many organic compounds that help increase the biological activity of plants and develop the root system. Foliar fertilization with Humic acid improves the ability of plants to retain water and photosynthesis. Furthermore, adding Humic spraying on the plant increases the length of roots and leaf area.(Kandil et al., 2016) showed that spraying wheat plants with Humic acid was significantly superior in all growth and germination indicators compared to plants sprayed with distilled water for two consecutive seasons. (Taha and Pshtwan,2019) found that the addition of Humic acid at a level of 4 $g.L^{-1}$spraying on squash plant led to a significant increase in the number of fruits, fruit length, fruit diameter, fruit weight, plant yield, and total yield were 13.81, 14.14 cm, 3.65 cm, 123.41 g, and 1.707 $g.plant^{-1}$ and 39.61 $ton.ha^{-1}$, respectively. Summer squash (*Cucurbita pepo* L.) is one of the important vegetable crops belonging to the *Cucurbita ceae* family, and it is one of the most famous vegetable crops in Iraq, especially during the spring season. The cultivated area in Iraq is about (148,000) hectares, and in 2012 the average production was (15,472)$tons.ha^{-1}$(Annual Statistic Book, 2012), where the productivity of squash is relatively low in Iraq compared to global production. Therefore, modern agricultural methods must be followed to increase the growth and production of squash plants. Estimating the water consumption of vegetable crops is essential in developing successful agricultural plans and reducing water waste, as choosing an efficient irrigation method and adding water needs is a guarantee of increasing agricultural production and improving its quality. The water requirements of the squash crop vary with the availability of added irrigation water, soil moisture, rain, relative humidity, and wind during the growing season.(Atiet al., 2017) found that adding 30 $ton.ha^{-1}$of organic fertilizer (Humic acid) gave the highest yield of squash of 25.678 $ton.ha^{-1}$and water use efficiency of 6.50 $kg.m^{-3}$. Therefore, this study aims to determine the role of poultry manure and Humic acid in the values of water consumption of squash yield and nitrogen availability under the drip irrigation system.

Materials and methods of work

A field experiment was carried out during the spring season 2019-2020 in soils with a sandy loam texture, where the soil was morphologically described and classified to a level of Torrifluvents Typic according to the modern American classification. Samples represented of field soil were taken from a depth of 0 - 0.30 m with a Soil Auger, the samples were air-dried, grounded, and passed through a sieve with an opening diameter of 0.002 m. A representative sample was taken from it, and some physical and chemical analyzes were made. Then, the field was plowed to a depth of 0 - 0.30 m, and it was divided into three blocks and the study treatments were distributed according to the split-plot system twice. Each block was divided into 4 main units in which the poultry manure treatments described in Table 1 were mixed with soil and at four levels (W_1 and W_2, W_3, and W_4) with quantities (0, 5, 10, and 15) ton. ha^{-1}. Similarly, each main plot was divided into two subplots in which the spraying treatment with Humic acid was distributed in two levels (H_2, H_1) at concentrations 0 and 4 $g.l^{-1}$.Cucurbitapepo L. squash seeds were planted on March 28, 2019, on two rows in each bed, the distance between one row and another 0.50 m and between one hole and another 0.40 m, and 3 seeds were placed in each hole, where after a week of germination. Plants were thinned to one per hole. Triple superphosphate fertilizer (21% P) at a rate of $80kgP_2O_5.ha^{-1}$ was added in one batch before planting and potassium sulfate fertilizer (41.5% K) at a rate of 60 kg $K.ha^{-1}$. The nitrogen fertilizer was added in the form of urea (46% N) at a rate of 60 $kgN.ha^{-1}$in two batches for both fertilizers at the branching and flowering stages. Humic acid was prepared at a concentration of 0 and 4 $g.l^{-1}$and the treatments were sprayed twice, the first after the emergence of the true leaves of the plant and the second added before the flowering

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 6, 2021, Pages. 8671 - 8678
Received 25 April 2021; Accepted 08 May 2021.

stage. The drip irrigation system was used, with a discharge of 4 liters/hour byT.tap. Thus, the evaluation process was conducted and the operating pressure of 60 k Pa gave the best uniformity coefficient of 96% and the variance of 7%.The irrigation of germination was given to make the soil moisture reached the limits of field capacity in preparation; the amount depleted from the ready water in the root zone of the plant was compensated after depletion of 35% of the available water. The water of the Euphrates River was used for irrigation, while the irrigation was done at a rate of depletion of 35% of the available water. Irrigation time was determined using a Diviner - 2000 moisture sensor manufactured by Sentek Environmental Technologies Pty Ltd - Adelaide South Australia to track the change in volumetric soil moisture content.

Table (1) Some chemical characteristics of poultry manure added to soil

Characteristic	Value	Unit
Electrical conductivity	4.75	dsm^{-1}
Degree of reaction	6.91	-
Total nitrogen	4.9	%
Phosphorous	6.2	%
Potassium	14.75	%
Organic matter	58	%

The volumetric moisture content of the soil was calculated by correlating the volumetric moisture values with the values of the frequency of the device through the mathematical relationship that was for the study soil: $S.F. = 1.2270\ \theta + 0.632$

S.F: Scaled Frequency
Ө: volume tricmoisture, based on the depth of water, according to the equation as follows:

$$d = (\theta_{f.c} - \theta_{w.p})dwD$$

d= Depth of water to be added (cm).

$\theta_{f.c}$ = Volumetric moisture at field capacity $cm^3\ cm^{-3}$

$\theta_{w.p}$ = Volumetric moisture at the permanent wilting point $cm^3\ cm^{-3}$.

dw = 0.35 moisture depletion ratio
D= Root depth (cm), measured according to the stages of plant growth
According to the Gross Irrigation Requirement as in the equation: $GIR = \frac{d}{EI}$

Since: - GIR = Gross Irrigation Requirement (cm)
d = calculated water depth
I = irrigation efficiency
The depths and volumes of added water were recorded, and the water consumption was calculated.

Measures and procedures:
The yield of one plant was calculated by dividing the yield of ten plants by their number and the yield of the experimental unit was calculated as follows:

$$\text{the yield of the experimental unit} = \text{yield of one plant} \times \text{number of plants in the experimental unit}$$

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 6, 2021, Pages. 8671 - 8678
Received 25 April 2021; Accepted 08 May 2021.

Total yield was calculated as follows: $total\ yield = \frac{\text{the yield of the experimental unit} \times \text{rea of hectares}}{\text{area of the experimental unit}}$

The water use efficiency was calculated as follows:

$$\text{water use efficiency} = \frac{\text{Amount of water added } (m^3 ha^{-1})}{total\ yield\ kg.ha^{-1}}$$

W.U.E = water use efficiency ($kg.m^{-3}$).
Yield = crop yield ($kg.ha^{-1}$).
Water Applied = Volumes of water added ($m^3.ha^{-1}$).

Results and discussion:

Water consumption

Table 2 shows the effect of adding poultry manure on the values of the volumetric moisture content at the field capacity and the permanent wilting point. It was noticed that the volumetric moisture content increases with an increase in the level of addition, where the highest volumetric moisture value reached 0.3602 $cm^3\ cm^{-3}$ and 0.1160 $cm^3\ cm^{-3}$ at water stress 33 kPa and 1500 kPa respectively. The increase in the moisture content at the field capacity and the permanent wilting point led to an increase in the capacity of soil water retention, as the increasing percentage was 4.7%, 7.5%, and 13.9% when adding 5, 10, and 15 $ton.ha^{-1}$ poultry manure compared to treatment of without addition.

Table (2) The effect of adding poultry manure on the values of available water

Poultry manure $ton.ha^{-1}$	Volumetric moisture $cm^3\ cm^{-3}$		Available water $cm^3\ cm^{-3}$	Increasing Percentage
	33 k Pa	1500 k Pa		
0	0.3110	0.0966	0.2144	
5	0.3306	0.1060	0.2244	% 4.7
10	0.3412	0.1108	0.2304	% 7.5
15	0.3602	0.1160	0.2442	% 13.9

The addition of poultry manure led to the improving the physical properties of the soil, such as soil structure, bulk density, and porosity, which led to an increase in the capacity of soil water retention. Moreover, Table 3 shows that the number of irrigations, water consumption, and volumes of water added to the treatments of adding poultry manure, as it is noticed that the highest water consumption reached 490 mm, this value presented a good agreement with (Yasemin et al., 2013) findings. The addition of poultry manure reduced the water consumption values, which showed differences between them and the treatment without addition. The reason for this is that the number of irrigation has decreased with the increase in the level of addition of poultry manure, as it reached 21 irrigations for the comparison treatment, while it decreased to 18, 16, and 13 for the addition treatments 5, 10 and 15 $ton.\ ha^{-1}$ respectively. Furthermore, the addition of poultry manure increased the soil's water retention capacity as shown in (Table 2). The available quantities of water can be used for the cultivation and irrigation of additional areas. It is evident from Table 4 that the values of water consumption decreased with the increase in the level of addition of poultry manure, as the lowest value of water consumption was recorded at 370 mm when adding 15 $tons.\ ha^{-1}$ poultry manure. Based on these results, it was found that the addition of poultry manure levels reduced water consumption in different proportions, which was increased with the increase in the addition level, in addition to rationalizing irrigation water size by 9.7%,

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 6, 2021, Pages. 8671 - 8678
Received 25 April 2021; Accepted 08 May 2021.

20.4%, and 28.2% at the level of addition of 5, 10 and 15 ton. ha^{-1}, respectively. This is due to the role of poultry manure in improving the physical properties of the soil, including the water holding capacity due to its colloidal properties and its large specific surface area, which increases its water holding capacity, and this is consistent with (Wolf and Snyder,2003). The differences in the water consumption values in other studies may be attributed to the change in environmental conditions in the study areas, as well as to the technique used to determine the timing of irrigation according to the approved moisture depletion rate.

Table (3) Depths and volumes of water added during the growing season of squash

Poultry manure $ton.ha^{-1}$	Irrigation number	Depth of rainwater Mm	Depth of irrigation water	Water consumption mm	Volumes of water added ($m^3.ha^{-1}$)	Water availability percentage%
0	21	25	490	515	5150	
5	18	25	440	465	4650	% 9.7
10	16	25	385	410	4100	% 20.4
15	13	25	345	370	3700	% 28.2

Available nitrogen

The results of statistical analysis in Table 4 indicated that the addition of poultry manure to the soil led to a significant increase in the concentration of available nitrogen in the soil of the squash plant with an increase in the level of addition. Accordingly, the level of 15 $ton.ha^{-1}$gave the highest concentration of available nitrogen in the soil, which reached 98.10 $mg.kg^{-1}$ compared to levels of 10, 5, and 0 $ton.ha^{-1}$, which amounted to 94.55, 91.21, and 77.00 $mg.kg^{-1}$, respectively, with an increase of 3.75, 7.55 and 27.40%.The addition of poultry manure increased the nitrogen availability in the soil, the reason for this was due to the role of poultry manure added to the soil, which caused an increase in the soil content of organic fertilizers, which increases the activity of living organisms in the soil. In addition to the fact that organic fertilizers are a source of energy that the living organisms use in their vital activities, which increases the mineralization of organic fertilizers in the soil and increases nitrogen release. The addition of Humic acid as a spray to the plant at a concentration of 4 $g.l^{-1}$ had a significant effect on the concentration of available nitrogen in the soil, which amounted to 91.56 $mg.kg^{-1}$, compared to a treatment of 0 $g.l^{-1}$, which amounted to 88.87 $mg.kg^{-1}$, with an increase of 3.03%.The results of the same Table also indicate that the interactions of poultry manure with the levels of spraying had a significant effect on the concentration of available nitrogen in the soil by increasing the level of addition, as the level of 15 tons. ha^{-1}exceeded with spraying at a level of 4 $g.l^{-1}$ by giving the highest rate of the available nitrogen concentration in the soil of 99.72 $mg.kg^{-1}$.However, the comparison treatment gave the lowest rate of 74.75 $mg.kg^{-1}$, with an increase of 33.40%.Possibly the reason for this increase is due to the integration between poultry manure and Humic acid, which is one of the organic fertilizer components, so the activity of living organisms increases in the root zone and this increases the mineralization of organic fertilizers to produce the necessary energy for living organisms in the soil. Besides, increase the nitrogen availability of the fertilizer added to the soil, in addition to reducing nitrogen loss as a result of adsorption of ammonium ion on the outer surfaces of the Humic colloids of the organic matter, which increases its availability.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 6, 2021, Pages. 8671 - 8678
Received 25 April 2021; Accepted 08 May 2021.

Table (4) Effect of poultry manure and spraying with Humic acid on the available nitrogen in soil mg.kg^{-1}

Level of poultry manure (ton.ha^{-1})	Level of spraying with Humic acid km/l		Average
	0	4	
0	74.750	79.253	77.002
5	90.283	92.150	91.217
10	93.993	95.107	94.550
15	96.477	99.723	98.100
Average	88.875	91.558	
LSD	W 0.5228	H 0.3697	W× H 0.7393

Total yield

Table 5 shows that the addition of poultry manure to the soil significantly increased the total yield of squash plants, as the level of 15 ton. ha^{-1}gave the highest total yield of the plant at 19,232 ton.ha^{-1}compared to levels 10, 5, and 0 ton.ha^{-1}, which amounted to 17.62, 16.87 and 15. 192 ton.ha^{-1}, respectively, with an increase of 9.14, 13.99, and 26.60%. The reason for the increase in the total yield of squash plant is due to the addition of poultry manure containing Humic acid-rich with the organic and mineral complex, which is a key factor in plant growth and increasing the quantity and quality of the yield (Gad El-Hak, et al., 2012). The addition of Humic acid as a spray to the plant at a concentration of 4 g. l^{-1} had a significant effect on the total yield of the plant, as it reached 17.72 ton.ha^{-1}compared to a treatment of 0 g.l^{-1} that amounted to 16.75 ton.ha^{-1}, with an increase of 5.79%.The results of the same Table also indicated that the interaction of poultry manure with the levels of spraying had a significant effect on the total yield of the plant by increasing the level of addition, as the level 15 ton.ha^{-1}exceeded with spraying at a level of 4 g.l^{-1} by giving the highest rate of total plant yield of 20.14 ton.ha^{-1}. While the comparison treatment gave the lowest rate of 14.52 ton.ha^{-1}, with an increase of 38.70%.The addition of organic acids as spray-on plants had a great effect on the plant yield, it can explain this increase that the foliar spray contributed to an increase in the gas exchange processes in the leaf. This effect leads to an increase in the photosynthesis process, which is reflected in a gradual increase in vegetative growth, which contributes to the acceleration of fruit growth and increased production. Besides that the spraying of organic acid contributed to improving and encouraging the roots to absorb nutrients and regulate the water balance of the plant and thus better fruit growth and yield (Haytova, 2015).

Table (6) Effect of poultry manure and Humic acid spraying on total yield ton.ha^{-1}

Level of poultry manure (ton.ha^{-1})	Level of spraying with Humic acid km/l		Average
	0	4	
0	14.517	15.867	15.192
5	16.803	16.947	16.875
10	17.333	17.910	17.622
15	18.327	20.137	19.232
Average	16.745	17.715	
LSD	W 0.3189	H 0.2255	W× H 0.4511

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 6, 2021, Pages. 8671 - 8678
Received 25 April 2021; Accepted 08 May 2021.

Water use efficiency

Table 7 shows that the addition of poultry manure to the soil led to a significant increase in the water use efficiency of squash plants, as the level of 15 ton.ha^{-1}gave the highest water use efficiency for the plants, reached 6.31 kg.m^{-3}, compared to levels 10, 5 and 0 ton.ha^{-1}, which amounted to 5.78, 5.53 and 4.98 kg.m^{-3}, respectively, with an increase of 9.17, 14.10 and 26.70%. This is due to the role of the physical properties of the soil, providing adequate moisture for a longer period and giving better appropriate conditions in terms of soil bulk density and water retention capacity for a longer period between the irrigations and its distribution in the soil profile (Hossain et al., 2017).The addition of Humic acid as a spray to the plant at a concentration of 4 g.l^{-1} had a significant effect on the plant's water use efficiency rate, reached 5.80 kg.m^{-3} compared to 0 g.l^{-1} treatment, which reached 5.49 kg.m^{-3}, with an increase of 5.64%. The results of the same Table also indicate that the interaction of poultry manure with the levels of spraying had a significant effect on the rate of water use efficiency for the plant by increasing the level of addition, as the level 15 ton.ha^{-1} exceeded with spraying at a level of 4 g.l^{-1}by giving the highest rate of water use efficiency for the plant reached 6.60 kg.m^{-3}. Whereas the comparison treatment gave the lowest rate of 4.76 kg.m^{-3}, with an increase of 38.65%. This is due to the difference in the content of Humic acid from the nutrients, especially nitrogen, phosphorus, and potassium, and the important role they play in plant growth and development and an increase in production.

Table (6) The effect of poultry manure and Humic acid spraying on water use efficiency

Level of poultry manure (ton.ha^{-1})	Level of spraying with Humic acid km/l		Average
	0	4	
0	4.759	5.202	4.980
5	5.509	5.556	5.532
10	5.683	5.872	5.777
15	6.008	6.602	6.305
Average	5.490	5.808	
LSD	W 0.1046	H 0.0739	W× H 0.1479

Conclusion

The addition of poultry manure increased the values of soil available water, reduced the water consumption of squash, which lead torationalizing irrigation water that could be used in the cultivation of other areas. Poultry manureplayed an important role in increasing nitrogen availability, total yield, and water use efficiency. Finally, the addition of Humic acid as a spray on the plant led to a significant increase in nitrogen availability, total yield, and water use efficiency.

References

1- Al Khateeb B., Husham, and M. H. munajed and K.J. farhan, 2018. The effect of organic fertilizers and drip discharge on soil physical properties, growth and production of Cucurbitapepo L. *Journal of Kirkuk University for Agricultural Sciences* 9(3): 70-81.

2- Al-Abbasi, G. B. and J. K. Kamal. 2011. The effect of fertilization with nitrogen and organic matter in the growth and yield of the pumpkin (*Cucurbita pepo* L). *Qadisiyah Journal of Agricultural Sciences* (1):24-33.

3- Al-Magrebi, N.M.H. 2015. Effect of Organic Fertilizer Application to the Soil or Spraying Plant in Qualitative Characteristics and Mineral Content of Squash. *Alexandria Journal of Scientific Exchange* 36(2): 245 - 257.

4- Annual Statistic Book 2012. Vegetable and field crop production. Directorate of Agriculture Statistical-Planning Unit- Ministry Council-Iraqi Republic. (In Arabic).

5- Ati, A. S. K. M. Naser B. B. Albandawy 2017. Water Use Efficiency, Fruit Yield and Quality of Squash *Cucurbita pepo* L. with Different Irrigation Quantities and Humic Acid Fertilization in a Semi-arid Agricultural Area. *Anbar Journal of Agricultural Sciences*. 15(special issue): 362-370.

6- Gad El-Hak, S.H.; A.M. Ahmed, and Y.M.M.Moustafa, 2012. Effect of foliar application with twoantioxidants and humic acid on growth, yield, and Yield Components of Peas (*Pisumsa tivum* L.). *Journal of Horticultural Science and Ornamental Plants*, 4 (3): 318-328.

7- Haytova, D., 2015. Physiological response of zucchini squash (*Cucurbita pepo* L. Var. Giromontia) to foliar fertilization. *Scientia Agriculture*. 9(1):30-33.

8- Kandil A. A.;Sharief A. E.M1.;Seadh S.E.1 and Altai D. S. K2. 2016. Role of humic acid and amino acids in limiting the loss of nitrogen fertilizer and increasing productivity of some wheat cultivars grown under the newly reclaimed sandy soil. *International Journal of Advanced Research in Biological Sciences*. 3(4):123-136.

9- Pshtwan J.M.AL-Zebari and Taha Z. Sarha. 2019. Effect of licorice root extract and humic acid on yield characters of summer squash (*Cucurbita pepo* L.) Journal of University of Duhok., Vol. 22, No.2 (Agri. and Vet. Sciences), Pp 49-60.

10- Wolf, B., and Snyder, G. 2003. Sustainable soils: the place of organic matter in sustaining soils and their productivity. CRC Press.

11- Yasemin K., U. Sahin, F. Kiziloglu and S. Memis, 2013. Fruit Yield and Quality,and Irrigation Water Use Efficiency of Summer Squash Drip-Irrigated with Different Irrigation Quantities in a Semi-arid Agricultural Area. *Journal of Integrative Agriculture*, (13): 1-15.

12- Hossain, M. Z., Von Fragstein, P., Von Niemsdorff, P., and Heß, J. 2017. Effect of different organic wastes on soil properties and plant growth and yield: a review. *Scientia agricultur aebohemica*, 48(4): 224-237.

13- Serge-Olivier, . K. K., Mathieu , B. ., Dje Bi, Y. B. T. ., Kamagate, S. ., & Angoué, P. . (2021). Influence Of Crude Protein Diet on Growth Performance and Some Blood Biochemical Parameters of Growing Male Japanese Quail In Côte d'Ivoire. Journal of Scientific Research in Medical and Biological Sciences, 2(1), 10-18. https://doi.org/10.47631/jsrmbs.v2i1.217