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Effect of Agaricus mushroom spent residues on maize production under a drip irrigation system

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Abstract

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The compost (Agaricus mushroom spent residues) is used to avoid environmental pollution problems caused by chemical fertilizers while increasing soil fertility and raising the yellow corn crop production capacity. Compost, being a macronutrient, is considered one of the important components in combating nutritional deficiencies related to growth and yield traits. The present study aimed to evaluate a two-drainage subsurface drip irrigation system (SDIS- 8 and 10 l. h^{-1}) in integration with five fertilizer levels (Com0- comparison, Com1-10, Com2-12, Com3-14, and Com4-16 $tons.ha^{-1}$), carried out in 2022–23 at the Al-Musayyib Agriculture Directorate, Hilla City, Iraq. The study was conducted using a randomized complete block design (RCBD) with a split-plot arrangement, involving two factors and three replications. The results showed that dripper discharge for SDIS at 10 l/hr was significantly better than other dripper discharges for SDIS at 8 l/hr in all studied traits. The 10 l/hr^{-1} dripper discharge performed better in terms of parameters, water distribution uniformity, water use efficiency, plant height, chlorophyll ratio, cob seed number, 500-seed weight, and grain yield, i.e., 93.94% and $1.47kg.m^{-3}$, 147.27cm, 46.36%, 555.22 g, 625.52 $seed.cob^{-1}$, 282.67g and 7.30 t ha^{-1}, respectively. The com4 with the highest dose (16 t ha^{-1}) was found to be significantly superior to the four other lower doses (com0, com1-10, com2-12, com3-14 t ha^{-1}) in all studied parameters. (SDIS 10 and 8 $l.hr^{-1}$) In integration with nitrogen, Com4 (16 t ha-1) showed the best performance among all other interactions.

Keywords: corn (*Zea mays L.*); compost; subsurface drip irrigation system; water distribution uniformity; water use efficiency; growth and yield characteristics

Introduction

The corn crop is one of the most important grain crops because it contributes to food availability for humans as well as animal feed for poultry. Iraq is one of the critical countries that possess key success factors for its agriculture, having achieved a significant increase in production due to horizontal expansion. From this standpoint, we must provide all modern means and technologies that essentially contribute to increasing crop productivity by enhancing unit area productivity and thus achieving what is called vertical expansion in agriculture (Alsharifi et al., 2021b; Shathar et al., 2024). The scientific techniques that can be adopted include nutrient management and determining the optimal levels for adding them, as they are related to plant growth stages and development, and ultimately, to determining the quantitative and qualitative yield. Optimal management requires a thorough understanding of how the plant performs its functions in the field during various growth stages (Shtewy et al., 2020). The overall goal of establishing field crops is to achieve rapid and uniform germination, followed by rapid and regular plant emergence, in addition to self-feeding, which is important and affects growth and plant productivity development, resulting in a decrease in its growth characteristics. All plant properties are affected by the type of variety to be grown and the cultivation methods and irrigation followed (Alaamer et al., 2023a).

The study by Mohammed et al. (2022) showed that plant height has a direct effect on yield because it is not one of its components; it gains great importance because it has a strong relationship with height on one hand and its efficiency in intercepting light on the other. Chlorophyll content in the leaf is of great importance because it is directly linked to the photosynthesis process. The formation of chlorophyll depends on three main factors: genetics, light, and the availability of essential nutrients, particularly magnesium, sulfur, and nitrogen (Merza et al., 2023). According to the method of Amer et al. (2025). The yield of any crop is affected by many factors, including the type and size of seeds, climate conditions, fertilizers, and the soil's physical properties. Crop yield may also be affected by factors such as the use of low-yielding varieties. (Alsharifi et al., 2021a), grain yield is the main goal that both plant breeders and producers strive to achieve. It is considered a function of both plant yield and the number of plants per unit area. It is the most important field measure because it reflects the final yield resulting from the vital activities carried out by the plant during the growth stage, until full maturity and harvest. Preparing organic fertilizers and adding them to the soil is one of the factors that contribute to increased growth characteristics and improved final crop productivity. The use of artificially prepared organic fertilizers had a positive effect on improving soil physical properties during plant growth stages, which in turn reflected positively on growth characteristics and yield (Suhag, 2016; Ghali et al., 2020). Irrigation methods have been applied that are highly efficient in using irrigation water, including Drip irrigation has become more efficient in water use of 60% compared to other traditional irrigation methods, which causes the waste of water large amounts in addition to the soil properties weakness, causing plant's life cycle a weakening resulting when large amounts of irrigation water accumulate due to the soil unevenness, thus the yellowing of the plant and a decrease in its productivity.

Most farmers adopt drip irrigation methods, both surface and subsurface, considering drip irrigation valuable because it adds water directly to the root zone (Douh and Boujeben, 2011). It provides uniform water distribution throughout the irrigated field, leading to increased water use efficiency and plant resistance to water stress (Nayyef, 2021). It reduces the loss of evaporation and transpiration processes at the soil depths and prevents the growth of weeds that compete with the plant for nutrients during the growth period (Huthily et al., 2020; Alaamer et al., 2024). Regarding the effect of added fertilizer levels on the character of the number of grains in the ear, the plant absorbs most of the fertilizers from the soil from the beginning of the branching stage until the flowering stage, as the time of adding fertilizer coincides with the emergence and development of the locations and nodes of grains in the ear. As a result, it increases the pollination and fertilization of grains, which consequently leads to an increase in the number of grains in an ear (Sabri and Abed, 2019; Al-Kadhim et al., 2019). The primary objective of this outline is to investigate the impact of various dripper discharges on corn properties in subsurface drip irrigation systems and spent mushroom compost ratios.

Material and Methods

Experiment location

The research was conducted in Babil Governorate, specifically in the Al-Musayyib project district, located in the northern section, approximately 45 km from the city of Hilla. Iraq (latitude 32-7996591 North, longitudes 45-4016508 East).(Fig. 1). During the Summer season 2022-2023, in a silty clay sand soil, the specifications of which are shown in Table 1.

The MF-285S tractor was used in conjunction with the moldboard plow to move and stir the soil to a depth of 23 cm, as determined by the hydraulic lifting device and the depth-determining wheel. After stirring, the field soil was leveled using disc harrows to break up large earth masses that hindered seed growth and reduced their germination rate, according to the method used by Shathar and Alsharifi (2023). The experimental land was fertilized with triple superphosphate fertilizer (P2O5 – 46%) before planting, in an amount of 100 kg ha^{-1}. The corn seeds were planted for the Cadiz cultivar with a planting distance between lines of 75 cm and a planting depth of 10 to 12 cm. A machine (type SSD-4) was used for cultivating and fertilizing the corn. They were arranged with a planting distance of 25 cm between one hole and another and 75 cm between one line and another (Fig. 2), with three seeds and 5 g of fertilizer per hole. A subsurface drip irrigation system (SDIS) was used. The thinning process was carried out 15 days after germination.

The study included two factors:

The first factor: drippers discharge at rates of 8 and 10 L/h. The drip irrigation method was employed, utilizing motors and drip paths powered by alternative solar energy. Solar-powered irrigation systems demonstrate the potential to reduce greenhouse gas emissions per unit of energy used for pumping water by more than 95 percent compared to diesel-powered alternatives or fossil fuel-powered electricity grids.

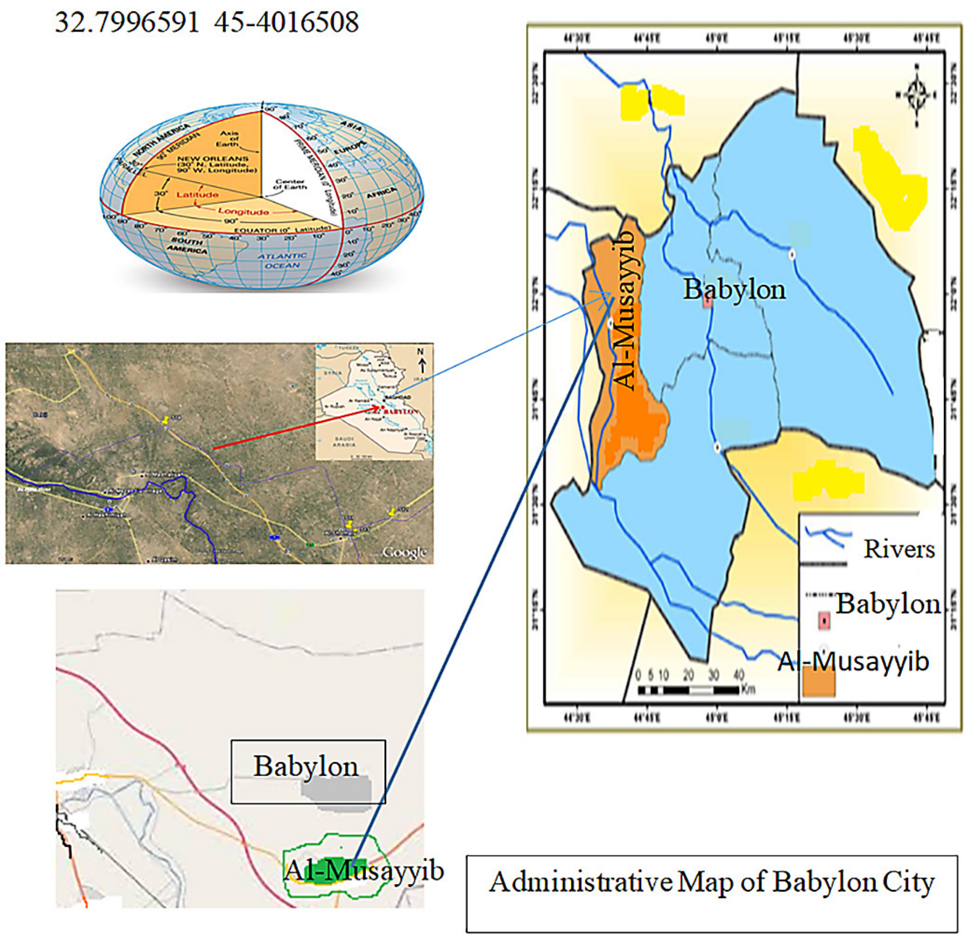


Fig. 1.Experiment location
Source: Authors' own elaboration

Table 1. The physical and chemical properties of the soil

Depth	Texture %			Silt Clay loam
	Clay	Silt	Sand	
	44	22	34	
0–24 (cm)	Soil physical properties			
	Soil bulk density (mg m^{-3})	Total soil porosity (%)	Soil penetration resistance (Kpa)	
	1.36	48.67	1633.48	
	1.39	47.54	1687.11	
	1.42	46.41	1478.12	
VA	1.40	47.16	1612.61	
0–24 (cm)	Soil chemical properties			
	E.C (ds.cm^3)	pH		
	2.48	5.69		
	Soluble cation meq\I			
	Na	K	Ca+Mg	
	9.42	11.45	48.82	
	O.C (%)	CEC (Meq\100g)	CaCo3 (%)	O.M (%)
	0.45	32.91	4	0.54

Source: Authors' own elaboration

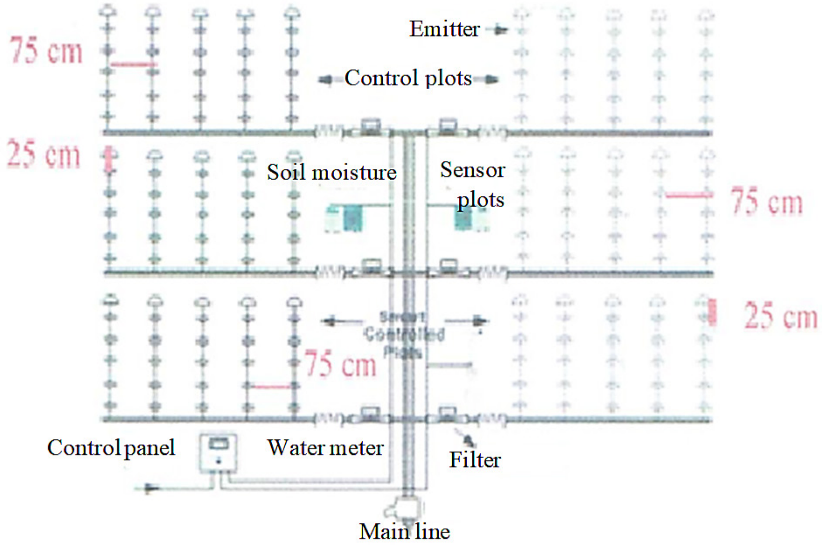


Fig. 2. Precision agriculture using machine type Sssd-4 corn planting
Source: Authors' own elaboration

The system consists of four main parts:

First, the moisture content measurement unit is a field electronic sensor placed in the soil to measure its water content at 20 cm intervals of soil depth. Data on the moisture levels of the soil layers is collected using a transmitter equipped with a SIM card that operates on solar energy. The data is then transmitted via satellites.

Second – "The Future": It receives data from all field moisture measurement units, which are then transmitted to a computer program that analyzes and translates them according to the quantities of water and irrigation periods required.

Third – The operational program: It is the central part of the system that receives data from all devices, and through graphs, the water needs of the yellow corn crop are estimated.

Fourth – Meteorological station: It is also connected to a computer, providing us with data on temperature, humidity, wind direction, wind speed, and rainfall amount. (Fig. 3).

The second factor: fertilizer levels

Comparative treatments included 100% soil without addition (COM 0) and four levels of fertilizer: Spent Mushroom Residues, compost 10 t ha^{-1} (COM 1), compost 12 t ha^{-1} (COM 2), compost 14 t ha^{-1} (COM 3), and compost 16 t ha^{-1}. ha^{-1} (COM 4) (Fig. 4).

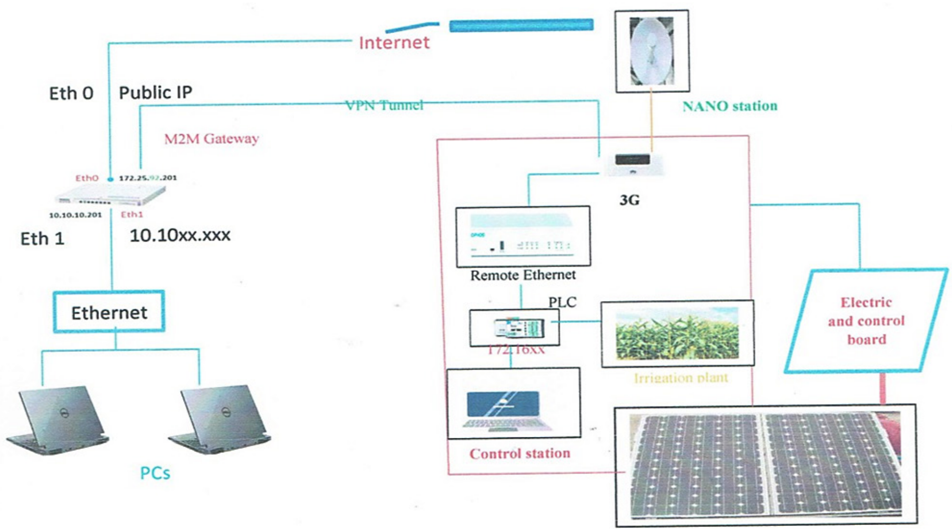


Fig. 3. Electronic control using a subsurface irrigation system
Source: Authors' own elaboration

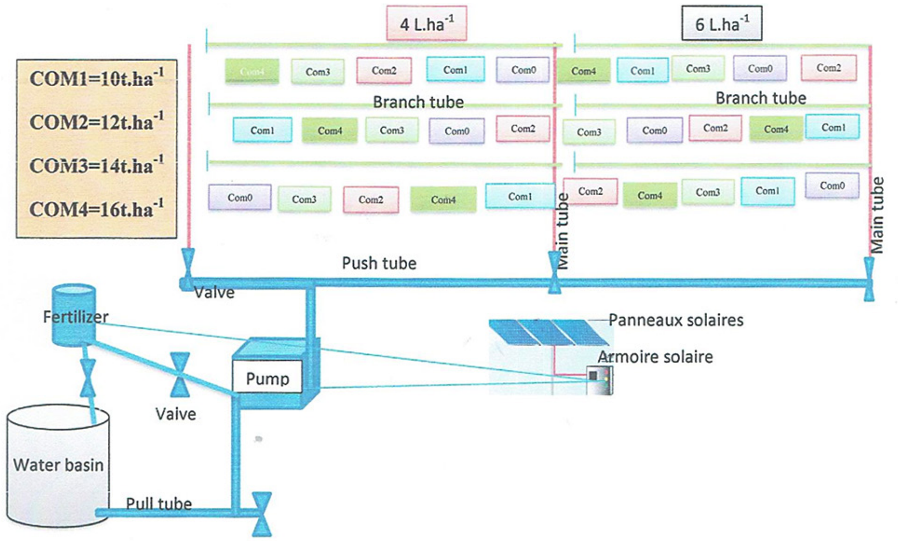


Fig.4. Experiment parameters distribution

Source: Authors' own elaboration

Soil physical characteristics

Soil physical properties are of great importance in their agricultural and engineering uses. They are important in the farming operations, hoeing, irrigation, and discharge, soil physical properties, their suitability for plant growth, and improving the possibility of extending them to make them more suitable for different soil uses. It is one of the important and necessary things for researchers in agriculture to know. Random samples were taken from nine locations in the experimental field at a depth of 0, 15 and 23 cm to measure soil moisture, bulk density and the total porosity of soil, (Hu et al., 2012; Alaamer and Alsharifi, 2020), during the growing season after one month (1Mon), two months (2Mon), and the stage of full maturity (growth season end) .

$$W = \frac{W_w}{W_s} \times 100 \quad (1)$$

where: W is soil humidity ratio (%), W_w is mass wet soil(kg), and W_s is mass of dry soil. **(**kg**)**

$$P_b = \frac{M_S}{V_T} \quad (2)$$

where: P_b is Dry bulk density (mg. m^{-3}), M_S – the weight of the dried soil sample (mg), M_T – total volume of the soil sample (m^3).

$$T_{SP} = \left(1 - \frac{P_b}{P_S}\right) \times 100 \quad (3)$$

where: T_{SP} is total of soil porosity (%), P_b – dry of bulk density (mg.m^{-3}), P_S – partial density (2.65 mg.m^{-3}).

Study characteristics

Water distribution uniformity

It is calculated according to the previously approved method by (Kima et al., 2014)

$$W_{du} = \left[1 - \frac{\varepsilon[x]}{M \times N}\right] \times 100 \quad (4)$$

where: W_{du} is Water distribution uniformity [x]; The numerical deviation of the water depth, M; Average dripper discharge (mm), N ; Number of drippers.

Water use efficiency

$$W_{ue} = \frac{G_y}{W_a} \quad (2)$$

where: W_{ue} is Water use efficiency, (kg.m^3), G_y – Grains yield (kg.ha^{-1}), W_a – Water added amount (m^3.ha^{-1}).

Growth characteristics of the corn plant

Plant height

It was measured for ten randomly selected plants for each experimental unit using an Envar tape. After stage 100% flowering, the measurement was made from the soil surface to the plant top (Alaamer et al., 2022).

Chlorophyll percentage

It was calculated using a chlorophyll meter, SPAD Model-502. By taking an average of three readings for each leaf for ten randomly selected plants in each experimental unit (Berahmand et al., 2012; Peng et al., 2013).

Plant dry weight

Ten randomly selected plants were measured for each experimental unit, dried in the oven at 60 °C for 72 hours, then weighed using a sensitive electric balance. (Al-Ghobari and El-Marazky, 2012; Alsharifi et al., 2025).

Yield characteristics

The number in the cob

Corn cobs were shelled using corn threshing machines (type Local MTL). Seed promise using a Satak device (Aljibouri et al., 2022).

500 seeds weigh

Seed promise (500 seeds) using a Satak device, then weighed using a sensitive electric balance (Hamzah et al., 2020; Alaamer et al., 2022).

Grains yield

Estimating grain yield by harvesting one square meter of the experimental unit, then weighing it and converting the weight to $t.ha^{-1}$ (Soomro et al., 2011; Alaamer et al., 2023b).

The data were analyzed statistically using Genstat software, according to the experimental design used, which was R.C.B.D. The least significant difference test (LSD, p = 0.05) was used to compare transactions.

Results and Discussion

Water distribution uniformity

This characteristic is the primary indicator of soil moisture content, as shown in Table 2. There are significant differences between the dripper discharge, the compost treatments (spent mushroom residues), and the interaction between them in terms of water distribution uniformity, as the dripper discharge exceeded 10 l/hr, resulting in the highest average of 93.94%. In contrast, the dripper discharge achieved 8 L/h, the lowest average of 92.62%. This discrepancy arose from the difference in geometric design and pumping power required to achieve the necessary discharge for the dripper type, which is consistent with the findings of Alaamer et al. (2023a). In terms of uniformity of water distribution, treatment Com4 excelled, achieving the best average of 97.41%, compared to treatment Com1, which recorded the lowest average of 92.20%. The comparison treatment Com0 achieved the lowest average of 87.11%. Increasing the values of the water distribution uniformity characteristic indicates that this characteristic responded to the compost treatments studied and achieved the highest results with the added fertilizer levels. The reason for the increase is attributed to the treatment Com4. Compost is one of the most important factors determining corn growth, which leads to good productivity, and its availability ensures vegetative growth. Therefore, it is considered the most important key concept for improving the characteristics of the crop, resulting in the highest productivity. This finding is consistent with that of Merza et al. (2023). The best result was obtained at 97.89%. The Com4 treatment interacted with the dripper's discharge at 10 L hr^{-1}, while the lowest water distribution uniformity of 86.14% was recorded

Table 2. Effect of dripper discharge and compost treatments on water distribution uniformity

Dripper discharge	Compost					Mean of D
	Com0	Com1	Com2	Com3	Com4	92.62
8	86.14	91.24	92.15	94.66	96.92	93.94
10	88.08	93.15	94.82	95.78	97.89	
Mean of Com	87.11	92.20	93.49	95.22	97.41	
LSD = 0.05	D		0.582			
	Com		0.435			
	D*Com		1.216			

Source: Authors' own elaboration

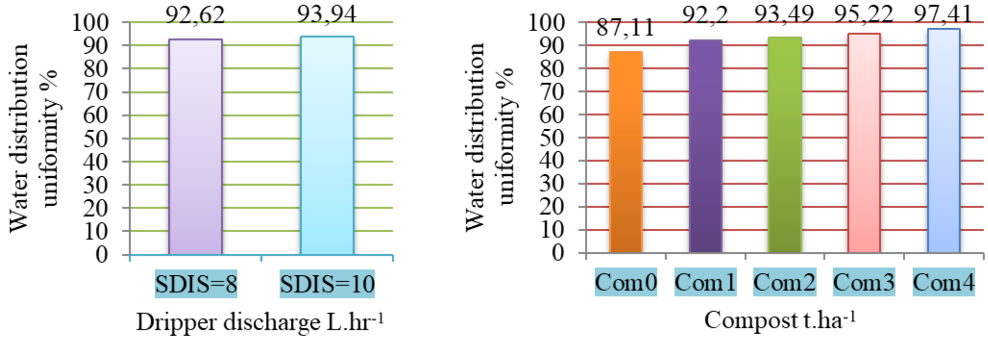


Fig. 5. Effect of dripper discharge and compost treatments on water distribution uniformity

Source: Authors' own elaboration

when the comparison treatment, Com0, interacted with the dripper's discharge at 8 L hr^{-1}. The water distribution uniformity under different conditions is shown in figure 5 for each compost treatment and drip discharge.

Water use efficiency

Table 3 shows there are significant differences between drip discharge, compost treatments(spent mushroom residues), and the interaction between them in the water irrigation use efficiency. Treatment Com4 excelled by achieving the best average of 1.51 kg/m³ compared to Treatment Com1, which recorded the lowest average of 1.42kg/m³.m^{-3}, while the comparison treatment Com0 achieved the lowest average of 1.37kg/m^{-3}, by which it increased its amount by 6.33% and 3.64%, respectively. Subsurface drip irrigation is beneficial, as it distributes water uniformly throughout the root area. As a result of adding compost, the evaporation process is reduced, and the crop's resistance to water stress is increased. This indicates a decrease in evaporation and leaching into the soil depths, which was reflected positively in increased water use efficiency with increased compost treatments. This agrees with Douh and Boujeben (2011). However, the dripper discharge of 10 L h^{-1} was significantly better than the dripper discharge of 8 L h^{-1}, with results of 1.47 and 1.42 kg m^{-3}, representing a 3.5% increase in amount. Providing the root system with sufficient moisture and good distribution may lead to water being available to the entire root system first, thereby dissolving nutrients and increasing their readiness for absorption by the plant (Alaamer et al., 2024). The best result was obtained at 1.53kg.m^{-3}. The Com4 treatment interacted with the dripper's discharge at 10 L hr^{-1}, while the lowest water distribution uniformity of 1.35kg m^{-3} was recorded when the comparison treatment, Com0, interacted with the dripper's discharge at 8 L hr^{-1}. The water use efficiency under different conditions is shown in figure 6 for each compost treatment and drip discharge.

Plant height

The importance of plant height in increasing the fertility rate of grains and the relationship between this trait and the grain yield characteristic. Table 4 shows a significant difference in this trait, as the average plant height was 154.80cm for the compost treatment Com4, 142.21 cm for Com1, and 134.41 cm for the comparison treatment Com0. The reason for this is due to the increase in the plant growth resulting from its height due to the plant's tissue cells improvement when fertilizer is available in the root area and its distribution there is regular, which led to the plant height with compost treatment Com4, using spent mushrooms remains (Al-Kadhim et al., 2019). As the dripper discharge exceeded 10 l/hr^{-1}, giving the highest average of 147.27 cm, while the dripper discharge achieved 8 l/hr^{-1}, the lowest average of 143.66cm for plant height. Increasing the discharge of the drip below the soil surface makes the moisture content suf-

Table 3. Effect of dripper discharge and compost treatments on water use efficiency

Dripper discharge	Compost					Mean of D
	Com0	Com1	Com2	Com3	Com4	
8	1.35	1.40	1.43	1.46	1.48	1.42
10	1.38	1.44	1.48	1.50	1.53	1.47
Mean of Com	1.37	1.42	1.46	1.48	1.51	
LSD = 0.05	D		0.033			
	Com		0.065			
	D*Com		0.132			

Source: Authors' own elaboration

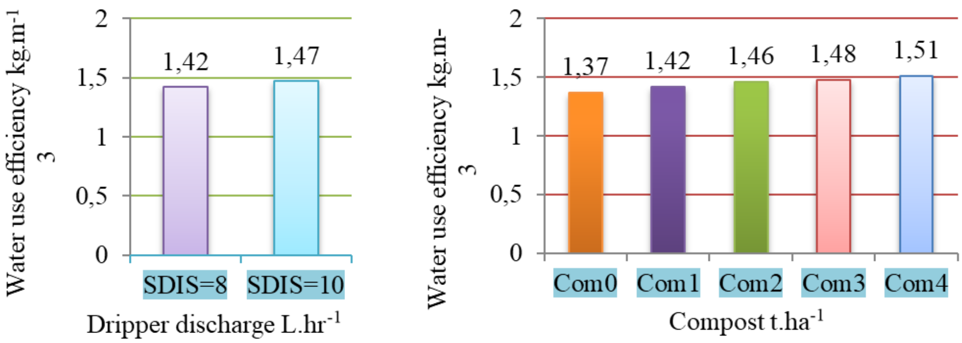


Fig. 6. Effect of dripper discharge and compost treatments on water use efficiency
Source: Authors' own elaboration

ficient to provide growth elements for the plant, thereby improving its resistance to water stress. This, in turn, enhances plant characteristics, such as plant height, which is positively linked to total grain yield. This finding is consistent with Suhag (2016). The best result was obtained at 157.44cm. The Com4 treatment interacted with the dripper's discharge atL hr^{-1}, while the lowest water distribution uniformity of 132.61 cm was recorded when the comparison treatment, Com0, interacted with the dripper's discharge at 8 L hr^{-1}. r^{-1}. The plant height under different conditions is shown in figure 7 for each compost treatment and drip discharge.

Chlorophyll percentage

The results shown in Table 5 indicate that compost treatments achieved a highly significant effect on the chlorophyll ratio character. The Com 4 fertilization treatment gave the highest average of 50.55%, and the Com1 compost treatment gave a low average of 43.98%, while the comparison treatment achieved the lowest average of 34.84%. The reason for this is attributed to the beneficial microorganisms' presence that work to stabilize nutrients and increase their absorption by the plant. This is reflected in the increase in chloroplasts, which led to an increase in the chlorophyll pigment in the leaves, which in turn delayed the leaves' senescence and reduced their destruction. This agrees with (Peng et al.,2013; Alsharifi et al., 2025). The dripper discharge of 10 $l.hr^{-1}$ was significantly better than the dripper discharge of 8$l.hr^{-1}$ and the results were 46.36% and 42.34% respectively. When the dripper drain is increased, the soil moisture content increases, and it provides water in the root area for a longer period, as the leaf length increases and makes the new leaves green in color. This indicates an increase in the chlorophyll pigment with increased soil moisture and plant watering. This agrees with (Huthliy et al., 2020). The best result was obtained at 51.71%. The Com4 treatment interacted with the dripper's discharge at 10 $l.hr^{-1}$, while the lowest water distribution uniformity of 33.12%cm was recorded when the comparison treatment Com0 interacted with the dripper's discharge at 8 $l.hr^{-1}$. The chlorophyll percentage under different conditions is shown in figure 8 for each compost treatment and drip discharge.

Plant dry weight

Table 6 shows there are significant differences between drip discharge, compost treatments(spent mushroom residues), and the interaction between them in the plant dry weight. The Com4 gave the best average of 637.51 g, compared to treatment Com1, which recorded the lowest average of 492.74 g, while the comparison treatment Com0 achieved the lowest average of 362.58 g. Subsurface drip irrigation is beneficial, as it works to add water in the root area with a homogeneous distribution throughout the field. As a result of adding compost, it reduces the evaporation process and increases the crop's resistance to water stress. This indicates

Table 4. Effect of dripper discharge and compost treatments on plant height

Dripper discharge	Compost					Mean of D
	Com0	Com1	Com2	Com3	Com4	
8	132.61	140.75	145.91	146.87	152.16	143.66
10	136.22	143.67	148.33	150.69	157.44	147.27
Mean of Com	134.41	142.21	147.12	148.78	154.80	
LSD = 0.05	D		0.454			
	Com		0.589			
	D*Com		1.134			

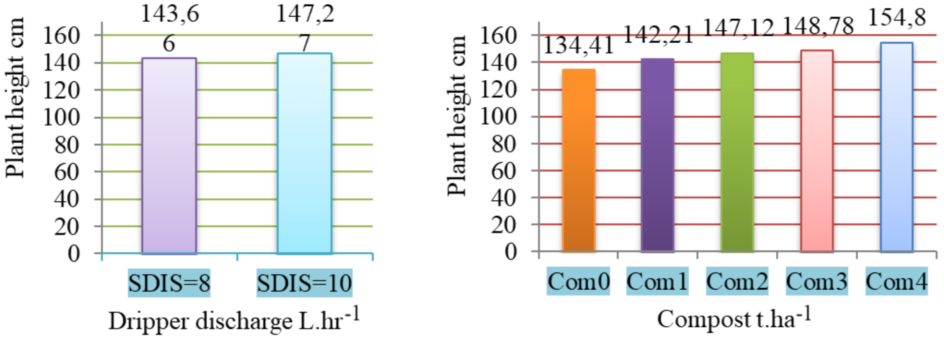


Fig. 7. Effect of dripper discharge and compost treatments on plant height
Source: Authors' own elaboration

Table 5. Effect of dripper discharge and compost treatments on chlorophyll percentage

Dripper discharge	Compost					Mean of D
	Com0	Com1	Com2	Com3	Com4	
8	33.12	41.80	43.11	44.29	49.38	42.34
10	36.55	46.17	48.26	49.13	51.71	46.36
Mean of Com	34.84	43.98	45.68	46.71	50.55	
LSD = 0.05	D		0.024			
	Com		0.183			
	D*Com		1.560			

Source: Authors' own elaboration

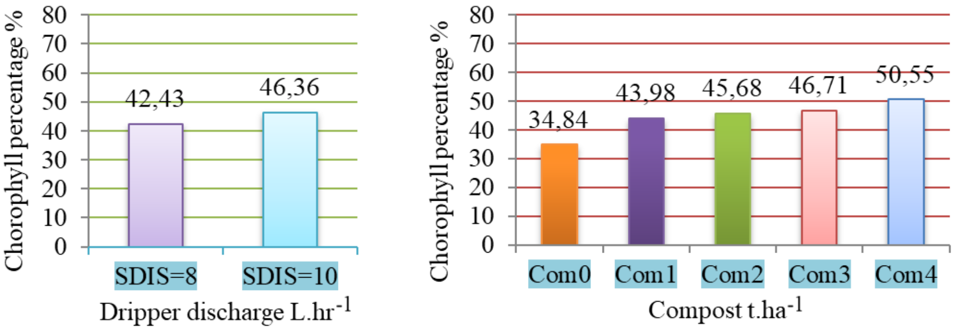


Fig. 8. Effect of dripper discharge and compost treatments on chlorophyll percentage

Source: Authors' own elaboration

a decrease in evaporation and leaching into the soil depths, which was reflected positively in increasing the plant dry weight with increased compost. This agrees with (Al-Ghobari and El-Marazky, 2012). The 10 l/hr^{-1} dripper discharge was significantly better than the 8 l/hr^{-1} dripper discharge, and the results were 555.22 g and 485.47 g. The reason for this is that the drip irrigation process under the soil surface has the ability to provide the appropriate soil moisture content to increase the plant growth characteristics represented by the plant height and the increase in the leaves number as it is the energy source for the plant, this is reflected in the increase in the plant dry weight (Alaamer et al., 2023a). The best result was obtained at 678.14g. The Com4 treatment interacted with the dripper's discharge at 10 l.hr^{-1}, while the lowest water distribution uniformity of 328.91g was recorded when the comparison treatment Com0 interacted with the dripper's discharge at 8 l.hr^{-1}. The plant dry weight under different conditions is shown in figure 9 for each of the compost treatments and drip discharges.

Cob seed number

This characteristic shows the main indicator of grain yield from the Table. 7. There are significant differences between the dripper discharge, the compost treatments (spent mushroom residues), and the interaction between them in the cob seeds. The 10 l.hr^{-1}, giving the highest average of 625.52 seeds.cob^{-1}, while the dripper discharge achieve of 8 l.hr^{-1}, lowest average of 586.23 seed.cob^{-1}. The reason for the increase in the above characteristic is the increase in the plant's ability to absorb the water available in the root area and the dissolved nutrients it carries that participate in the division and increase the turgor pressure of the cells with increased drip drainage (Alsharifi et al., 2021a). As for compost treatments in terms of uniformity of water distribution, treatment Com4 excelled by giving the best average of 691.26 seeds.cob^{-1} compared to treatment Com1, which recorded the lowest average of 593.95 seeds.cob^{-1}, while the comparison treatment Com0 achieved the lowest average of 8472.42 seed.cob^{-1}. Increasing the cob seed number characteristic gives an indication that this characteristic responded to the compost treatments studied and achieved the highest results with the added compost levels. The reason for the increase is attributed to the treatment Com4. Compost is one of the most important factors determining corn growth, which leads to good productivity, and its availability ensures vegetative growth. Therefore, it is considered the most important key concept in improving the characteristics of the crop by giving the highest cob seed number (Shtewy et al, 2020). The best result was obtained at 697.43 seed.cob^{-1}. The Com4 treatment interacted with the dripper's discharge at 10 l.hr^{-1}, while the lowest water distribution uniformity of 448.62 seed.cob^{-1} was recorded when the comparison treatment Com0 interacted with the dripper's discharge at 8 l.hr^{-1}. The cob seed number under different conditions is shown in figure 10 for each compost treatment and drip discharge.

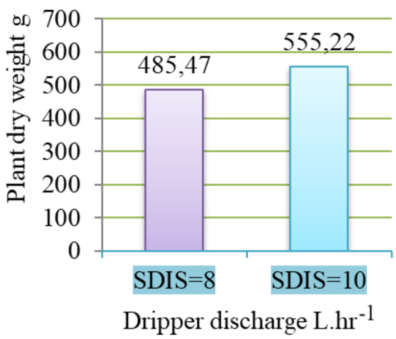
500 seeds weigh

Table 8 shows that there are significant differences between drip discharge, compost treatments (spent mushroom residues), and the interaction between them in the 500 seed weight. The Com4 gave the best average of 329.90 g, compared to treatment Com1, which recorded the lowest average of 225.17 g, while the comparison treatment Com0 achieved the lowest average of 194.28 g. Subsurface drip irrigation is beneficial, as it works to add water in the root area with a homogeneous distribution throughout the field. As a result of adding compost, it reduces the evaporation process and increases the crop's resistance to water stress. This indicates

Table 6. Effect of dripper discharge and compost treatments on plant dry weight

Dripper discharge	Compost					Mean of D
	Com0	Com1	Com2	Com3	Com4	
8	328.91	476.19	503.66	521.70	596.88	485.47
10	396.25	509.28	591.17	601.24	678.14	555.22
Mean of Com	362.58	492.74	547.42	561.47	637.51	
LSD = 0.05	D		14.261			
	Com		17.138			
	D*Com		26.271			

Source: Authors' own elaboration



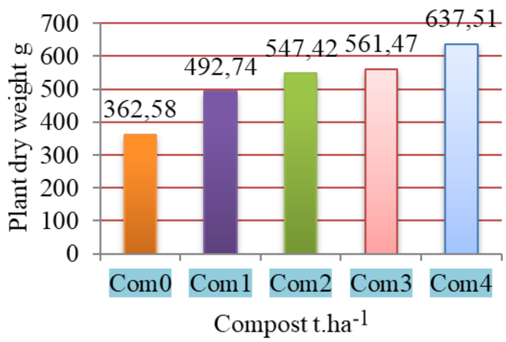
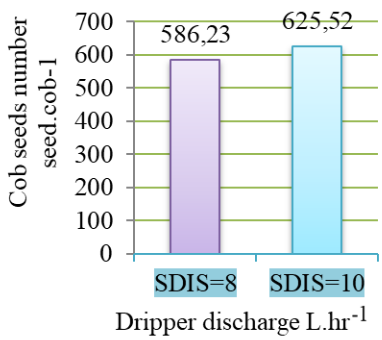


Fig. 9. Effect of dripper discharge and compost treatments on plant dry weight
Source: Authors' own elaboration

Table 7. Effect of dripper discharge and compost treatments on the number of cob seeds

Dripper discharge	Compost					Mean of D
	Com0	Com1	Com2	Com3	Com4	
8	448.62	581.75	599.91	615.78	685.10	586.23
10	496.23	606.15	645.57	682.22	697.43	625.52
Mean of Com	472.42	593.95	622.74	649.0	691.26	
LSD = 0.05	D		19.310			
	Com		22.546			
	D*Com		31.723			

Source: Authors' own elaboration



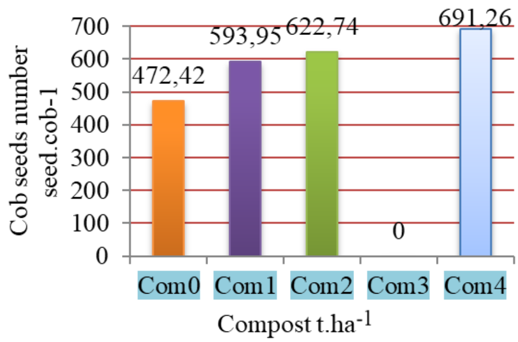


Fig. 10. Effect of dripper discharge and compost treatments on cob seeds number
Source: Authors' own elaboration

a decrease in evaporation and leaching into the soil depths, which was reflected positively in increasing the 500 seed weight with increased compost. This agrees with (Ghali et al., 2020). The 10 l/hr^{-1} dripper discharge was significantly better than the 8 l/hr^{-1} dripper discharge, and the results were 282.67 g and 248.52 g. The reason for this is that the drip irrigation process under the soil surface has the ability to provide the appropriate soil moisture content with increased water distribution uniformity, which increases the plant yield characteristics represented by the cob seed number and the increase in the number, as reflected in the increase in 500 seed weight (Al-jibouri et al., 2022). The best result was obtained at 358.37 g.

Table 8. Effect of dripper discharge and compost treatments on 500 seeds' weight

Dripper discharge	Compost					Mean of D
	Com0	Com1	Com2	Com3	Com4	
8	185.12	201.76	265.01	289.28	301.42	248.52
10	203.44	248.57	293.33	309.66	358.37	282.67
Mean of Com	194.28	225.17	279.17	299.47	329.90	
LSD = 0.05	D		8.254			
	Com		9.552			
	D*Com		16.349			

Source: Authors' own elaboration

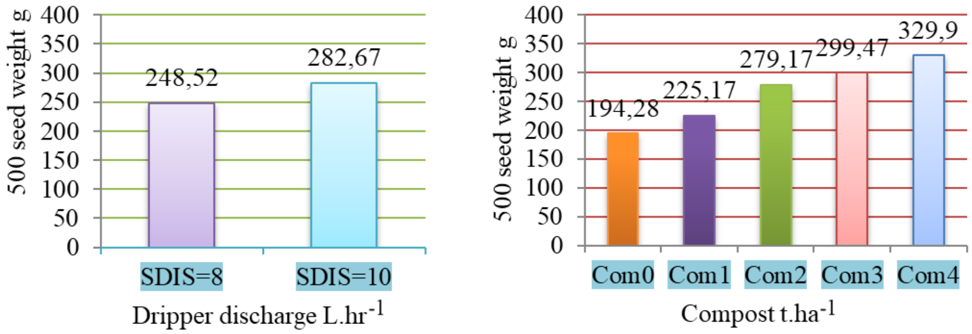


Fig. 11. Effect of dripper discharge and compost treatments on 500 seeds weight
Source: Authors' own elaboration

Table 9. Effect of dripper discharge and compost treatments on grain yield

Dripper discharge	Compost					Mean of D
	Com0	Com1	Com2	Com3	Com4	
8	5.08	6.49	6.93	7.18	7.95	6.73
10	5.45	6.82	7.01	7.96	9.24	7.30
Mean of Com	5.27	6.65	6.97	7.57	8.60	
LSD=0.05	D		0.421			
	Com		0.618			
	D*Com		0.837			

Source: Authors' own elaboration

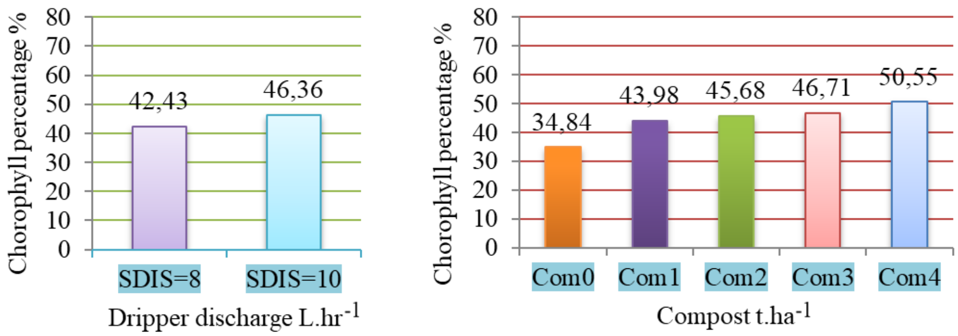


Fig. 12. Effect of dripper discharge and compost treatments on grain yield
Source: Authors' own elaboration

The Com4 treatment interacted with the dripper's discharge at 10 l.hr^{-1}, while the lowest water distribution uniformity of 185.12 g was recorded when the comparison treatment Com0 interacted with the dripper's discharge at 8 l.hr^{-1}. The 500 seed weight under different conditions is shown in figure 11 for each compost treatment and drip discharge.

Grains yield

The results of Table 9 show that the compost treatments differed significantly in grain yield properties. The compost treatment com4, with the highest average of 8.60t.ha^{-1}, was significantly superior to the compost treatments (com0, com1, com2, com3,com4), and their averages were 5.27, 6.65, 6.97, 7.57 and 8.60 t.ha^{-1}, respectively. Increasing the fertilizer amount works to improve the physical and chemical properties of the soil, which achieves the best growth characteristics for the plant, represented by the seeds number in the cob, because there is a positive relationship between the cob length and grain yield, because each cob carries a number of seeds, and thus increasing the number of cob, this contributes to increasing the grain yield, and this is consistent with (Soomro et al.,2011; Alaamer et al., 2023b). The 10 L.hr^{-1}dripper discharge was significantly better than the 8 L.hr^{-1}dripper discharge, and the results were 7.30 t.ha^{-1} and 6.73 t.ha^{-1}. The best result was obtained at 9.24t.ha. The Com4 treatment interacted with the dripper's discharge at 10 l.hr^{-1}, while the lowest water distribution uniformity of 5.08t.ha^{-1} t.ha^{-1} was recorded when the comparison treatment Com0 interacted with the dripper's discharge at 8 l.hr^{-1}. The grain yield under different conditions is shown in Figure 12 for each of the compost treatments and drip discharges.

Conclusion

The results showed that dripper discharge for SDIS-10 l.hr^{-1} was significantly better than that of other dripper discharges for SDIS-8 l.hr^{-1} in all studied traits. The 10L/hr^{-1} dripper discharge performed better in terms of parameters. The results showed that dripper discharge for SDIS-10 l/hr^{-1} was significantly better than that of other drippers for SDIS-8 l/hr^{-1} in all studied traits. The com4 with the highest dose (16 t. ha^{-1}) was found significantly superior to four other lower doses (com0, com1-10,com2-12,com3-14 t.ha^{-1}) in all studied parameters. (SDIS 10 and 8 l.hr^{-1}) In integration with nitrogen, Com4 (16 t.ha^{-1}) showed the best performance among all other interactions. four other lower doses (com0, com1-10,com2-12,com3-14 t.ha^{-1}) in all studied parameter. (SDIS 10 and 8 l.hr^{-1}) In integration with nitrogen, Com4 (16 t.ha^{-1}) showed the best performance among all other interactions.

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References

Amer, K. Z, Azawi, A, Jabur, H. A., Al-Shammary, A. A. G. & Alsharifi, S. (2025). The impact and analysis of mechanical factors of the mechanized unit on the production of "Vigna radiata L." crop.*Natural and Engineering Sciences*, *10*(1), 418 – 424.

Al-Ghobari, H. M. & El-Marazky, M. A. (2012). Surface and subsurface irrigation systems wetting patterns as affected by irrigation scheduling techniques in an arid region. *Afr. J. Agric. Res., 7*, 5962 – 5976.

Al-Kadhim, Q. S., Al-Jubouri, S. M. I. & Al-Jubouri, J. M. A. (2019). Effect of Biofertilization on Improving Yield Components and Yield of Maize Zea mays L. *Kirkuk Univ. J. Agric. Sci., 10*(3), 81 – 91.

Alaamer, S. A. & Alsharifi, S. K. Alwan (2020) Affecting mechanical on some growth characteristics for maize, SYN5018 variety. *Plant Archives, 20*(2), 1150 – 1155.

Alaamer, S. A., Alsharifi, S. K. & Khalil, A. H. (2023a). Sustainable use of sub-surface drip irrigation system for corn growth and productivity. *AIP Conference Proceedings 2776*, 040015. https://doi.org/10.1063/5.0135994.

Alaamer, A., Alsharifi, S. K. & Shtewy, N. (2022). Wheat parameters under influence of the depths and cultivation machinery, *IOP Conf. Series: Earth and Environmental Science 1060*, 012131. doi:10.1088/1755-1315/1060/1/012131.2022.

Alaamer, S. A., Malik, M. M., Tahani, J. M., Alsharifi, S. K., Saad, A. N. & Mrwan, Z. R. (2024). Effect of spent mushroom compost in organic agriculture to produce Okra under drip irrigation system. 2nd International *Conference on Engineering and Science to Achieve the Sustainable Development Goals. AIP Conf. Proc. 3092*. 060021-1–060021-17. https://doi.org/10.1063/5.0200523.

Aljibouri, M. A., Alsharifi, S. K. & Alaamer, A. (2022). A test of the threshing machine (LMS type) at different feed rates and speeds on some corn properties. *In IOP Conf. Series: Earth and Environmental Science, 1060*, 012133. Third International Scientific Conference of Agriculture, Environment and Sustainable Development (ISAESC 2022) 28/05/2022 – 30/05/2022 Al-Qadisiyyah, Iraq.

Alsharifi, S. K., Ghali, A. & Hamzah, I. J. (2021b). A study some growth characteristics for maize , Bohooth 106 variety under affecting mechanical for machine (moldboard plow type). *IOP Conference Series:Earth and Environmental Science*. doi:10.1088/1755-1315/735/1/012007.

Alsharifi, S. K., Shtewy, N. & Alaamer, A. (2021a). Affecting mechanical on some growth properties for corn ,MAHA cultivar. Third International Scientific Conference of Agriculture, Environment and Sustainable Development. Al-Qadisiyyah, Iraq. *IOP Conf. Series: Earth and Environmental Science, 735*(1), 012009.

Al-Sharifi, S. K., Alaamer, A. & Saldani, S. M. K. (2025). Wheat crop productivity requirements using modern irrigation technology. *CIGR Journal, 27*(3), 136 – 149.

Berahmand, A. A, Panahi, A. G., Sahabi, H., Feizi, H., Moghaddam, P. R., Shahtahmassebi, N., Fotovat, A., Karimpour, H. & Gallehgir, O. (2012). Effects of silver nanoparticles and magnetic field on growth of fodder maize (Zea mays L.). *Biol. Trace Element Res., 149*, 419 – 424.

Douh, B. & Boujelben, A. (2011). Effect of surface and subsurface drip irrigation on agronomic parameters of maize (Zea mays L.) under tunisian climatic condition. *J. Nat. Prod. Plant Resour., 1*(3), 8 – 14.

Ghali, A., Alsharifi, S. K. Alwan & Ibrahim J. H. (2020). A study the effect of Sowing machine (type Adwhit) on potato specification, Bintje cultivar. *Plant Archives, 20*(2), 981 – 989.

Hamzah, I. J. & Alsharifi, S. K. Alwan (2020). Innovative harvesting methods about the harvest losses for two machines. *Bulg. J. Agric. Sci., 26*(4), 913 – 918.

Hu, W., Shao, M. A. & Si, B. (2012). Seasonal changes in surface bulk density and saturated hydraulic conductivity of natural landscapes. *Eur. J. Soil. Sci*., 63, 820 – 830. https://doi:10.1111/j.1365-2389.2012.01479.x

Huthily, K. H., Al-Dogagy, K. A. & Kalaf, M. A. (2020). Effect of Nitrogen Fertilization and Foliar Application of Zinc in Growth and Yield of Maize (Zea mays L.). *Int. J.Agricult. Stat. Sci., 16*(Supplement 1), 1375 – 1380.

Kima, A. S., Chung, W. G. & Wang, Y.-M. (2014). Improving irrigated lowland rice water use efficiency under saturated soil culture for adoption in tropical climate conditions. *Water 6*(9), 2830 – 2846. doi:10.3390/w6092830.

Merza, N. A. R., Atab, H. A., Al-Fatlawi, Z. H. & Alsharifi, S. K. A. (2023). Effect of irrigation systems on rice productivity. *SABRAO. J. Breed. Genet*., *55*(2), 587 – 597. http://doi.org/10.54910/sabrao2023.55.2.30.

Mohammed, Y., Atab, H. A. & Alsharifi, S. K. A. (2022). Response of corn at different levels of nitrogen fertilizer and cultivation distances. *IOP Conf. Ser.: Earth Environ. Sci., 1060*(1), 012134. doi:10.1088/1755-1315/1060/1/012134.

Nayyef, H. R. (2021). Study of Some Hydraulic Parameters of A solar-Powered Drip Irrigation System. *IOP Conference Series: Earth and Environmental Science*, *910*(1), 012015.

Peng, S. H., Wan-Azha, W. M., Wong, W. Z., Go, W. Z., Chai, E. W., Chin, K. L. & H'ng, P. S. (2013). Effect of using Agro-fertilizers and N- fixing azotobacter enhanced biofertilizers on the growth and yield of corn. *J. Applied Sci., 13*(3), 508 – 512.

Sabri, N. A. & Abed, M. A. (2019). Effect of intercropping systems of (maize and mangbean) on growth, yield and its components of mung bean crop. *Anbar Journal of Agricultural Sciences, 17*(1), 62 – 75.

Shathar, A. A. & Alsharifi, S. K. A. (2023). Levelling machines and its effect on the growth characteristics and productivity for two corn cultivars. *Bulg. J. Agric. Sci., 29*(3), 552 – 563.

Shather.A, Shtewy.N.&.Alsharifi.S.K. (2024).Wheat response to the nitrogen fertilizers in productivity. *SABRAO Journal of Breeding and Genetics, 56*(6), 2532 – 2543. http://doi.org/10.54910/sabrao2024.56.6.35.

Shtewy, N., Ibrahim, J. H. & Alsharifi, S. K. (2020). Effect of mechanical properties on some growth characteristics for wheat crop. *Plant Arch*., *20*(1), 3141 – 3148.

Soomro, Z. H., Baloch, P. A. & Gandhai, A. W. (2011).Comparative Effects of Foliar and Soil applied Boron on Growth and Fodder yield of maize. *Pak. J. Agri. Agril. Engg .Vet. Sci., 27*(1),18 – 26.

Suhag, M. (2016). Potential of Bio-fertilizers to replace Chemical Fertilizers. *Int. Adv. Res. J. Sci. Eng. Technol., 3*(5), 163 – 167.

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