

Wheat crop productivity requirements using modern irrigation technology

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Abstract: The main goal was to use modern irrigation technology that meets the crop's needs throughout the growth period with the highest productivity. The presented research was transpired 2023 winter season in the Al-Shomali area, Babil City, Iraq. Smart irrigation was used as a subsurface drip irrigation system (SDIS), with two dripper drainage flow rate of 6 and 8 L hr⁻¹ and two drip irrigation distances of 20, and 25 cm. Two wheat (*Triticum aestivum L.*) varieties, i.e., Tamoz-2 (T-2), and Bhooth -22 (B-22) were planted. The dripper distance 25 cm was significantly superior to the other level of 20 cm. While the dripper drainage at range of 8 L hr⁻¹ was significantly superior to the other range of 6 L hr⁻¹. The T-2 variety was significantly better than B-22 variety. For T-2 variety, the plant height (Ph), spike length (SL), spikes number (SN), chlorophyll percentage (CP), grains number (GNS), 1000 grains weight (1000GW), and grain yield (GY), were 90.57 cm, 15.85 cm, 324.88 spike m², 67.36%, 81.67 grain spike⁻¹, 49.31 g and 6.24 t ha⁻¹ respectively.

Keywords: Wheat, smart subsurface irrigation system, local wheat varieties, drip drainage, drip distances

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1 Introduction

Wheat (*Triticum aestivum L.*) crop is at the strategic crops forefront in the world due to its nutritional importance, which represents a food source for most of the world's population, this crop covers the largest agricultural area on earth and is the first crop in Iraq in area terms, production and farm income, the modern technological methods adoption in agriculture for any crop achieves major leaps, especially in production and quality. The Iraqi

Agriculture Ministry has paid great and distinctive attention to using modern irrigation methods that aim to provide water in large quantities and the exploiting possibility this amount of available water in the other crops cultivation, in addition to supplying the plant according to its water needs. This leads to an improvement in the production rate and growth characteristics compared to traditional methods for irrigation methods, thus increasing production at the farm level and achieving food security (Alaamer et al., 2023a). The most important challenge facing farmers is the crop productivity low, despite the scientific and technological development in increasing the unit area productivity, it has not reached the desired levels that achieve an increase in farm income. Therefore, the program adopted modern irrigation methods for

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sustainable development in wheat cultivation, disseminating modern technological knowledge and transforming it into special practices by farmers to bring about major changes in the hectare productivity with the water abundance (Alsharifi et al., 2022).

Study of Alaamer et al. (2023b), shows that modern irrigation techniques use in agriculture has had a positive impact on eliminating water scarcity during the plant's growing season until full maturity, and thus lowering the groundwater level, reducing salts, and increasing grains yield. Agriculture is in a deteriorating situation, water shortages, high levels of salinity and desertification have a negative impact on agricultural production processes, the agricultural sector has been affected by all the basic requirements related to increasing production, in order to ensure the plant growth continuity at the level that gives the best productivity, focus on using the scientific foundations of the available water strategy during the growth stages to support production at the highest levels (Lesk et al., 2016; Şahin, 2023). There is an inverse relationship between climatic conditions and the plants water requirement, the rise in surface temperatures of cultivated soil has a clear and tangible negative effect on crop growth and productivity (Li et al., 2015; Yang et al., 2023). Moreover, the increase in population increases the demand for food, dealing with low crop productivity resulting from water shortages in the final stages is a matter of great interest to fill the food deficit and provide food security (Hodgkinson et al., 2017; Amer et al., 2025).

Based on scientific information about the water requirements for each crop growth stage and determining its water requirements for each growth period, farmers choose varieties that are suitable and adaptable to environmental conditions and the amount of water available, wheat crop productivity is affected by low water levels at the plant's end life cycle, especially in the stage grains are full, which leads to atrophy and damage to the plant and consequently a decrease in growth and productivity

characteristics (Zhang et al., 2017; Sun et al., 2024). To achieve environmental security and sustainable development for wheat production at the highest levels of total grain yield, this requires good management of irrigation water in a way that ensures the water availability continuity during the growing season until harvest (Dar et al., 2017; Xiao et al., 2023). The plant height characteristic is very important in photosynthesis and increasing the yield (Solomon and Akena, 2017; Alaamer et al., 2024c), because the yield is closely related to the photosynthesis period length during which the plants remain in the photosynthesis process and thus increase the yield amount. Providing irrigation water in a way that meets the plant's needs during the entire growing season enables the plant to withstand all climatic changes that occur during the growing season.

Improving the growth characteristics of the plant is a clear indication of the suitability of environmental conditions for the growth stages, resulting in more efficient vegetative growth in intercepting sunlight during the growing season, which increases the nutrients deposited in plant parts all, and this is reflected in the increase in the plant height (Abdulhamed et al., 2021). Most of the studies conducted by researchers in this field Shtewy et al. (2020), Alsharifi et al. (2021) shown that providing soil moisture facilitates the roots spread by exploiting the largest area of soil, which results in the nutrients rapid absorption from the soil, which leads to rapid growth represented by the plant height, the spike length, and the chlorophyll ratio, and thus an increase in the yield components such as the spikes number, the 1000 grains weight, and the grains number in the spike. The grain yield is the its components sum, and therefore any increase in one of its components, such as an increase in the spike numbers in the spike, the grain numbers, the 1000 grains weight, etc., will have a direct impact on the crop total productivity, noting that these components are affected by genetic and environmental factors (Shirinzadeh et al., 2017). Most

field crops still do not achieve self-sufficiency due to the increasing population growth with a significant decrease in agricultural areas and a decrease in water supplies, increasing grain and water productivity is the main advantage that specialists in the agricultural field rely on. Therefore, modern irrigation techniques and soil leveling are important indicators for the crop components (Hamzah and Alsharifi, 2020).

Optimal growth and production for plants is requires the water availability throughout the growth period without any significant defect occurring, such as a lack of the allocated water amount, because this causes damage to all vegetative growth characteristics and negatively affects on all crop components (Hussein and Alva, 2014; Alaamer and Alsharifi, 2021). The variety selection to be planted is done through several factors, the most important of which are its ability to withstand difficult environmental conditions such as high temperatures and water lack during the growing season, despite all the factors mentioned, the selected variety gives the highest growth and productivity characteristics (Abdelmageed et al., 2019; Alaamer et al., 2024a). The irrigation water absorption increased by the plant

depends primarily on the good management for irrigation water allocated to each crop according to the water need during the entire season (Liu et al., 2015; Surendran et al., 2021). This leads to improving the use water efficiency and its availability from the cultivation beginning to the harvesting end, with the least amount of wasted water. Therefore, the optimal use for irrigation water based on the plant's need ensures good results in raising the irrigation water efficiency used and the highest grain productivity (Shahani et al., 2016; Alaamer et al., 2022). Modern irrigation techniques are among the methods and means developed in agricultural irrigation, their optimally exploitation it this is reflected positively on increasing the agricultural areas to the largest possible area and increasing agricultural productivity and production.

2 Material and methods

2.1 Experiment location

This study was carried out at Al-Shomali city, the Babil Governorate, Iraq, (latitude 32-3280975 North, longitudes 44.9183294 East) (Figure 1).

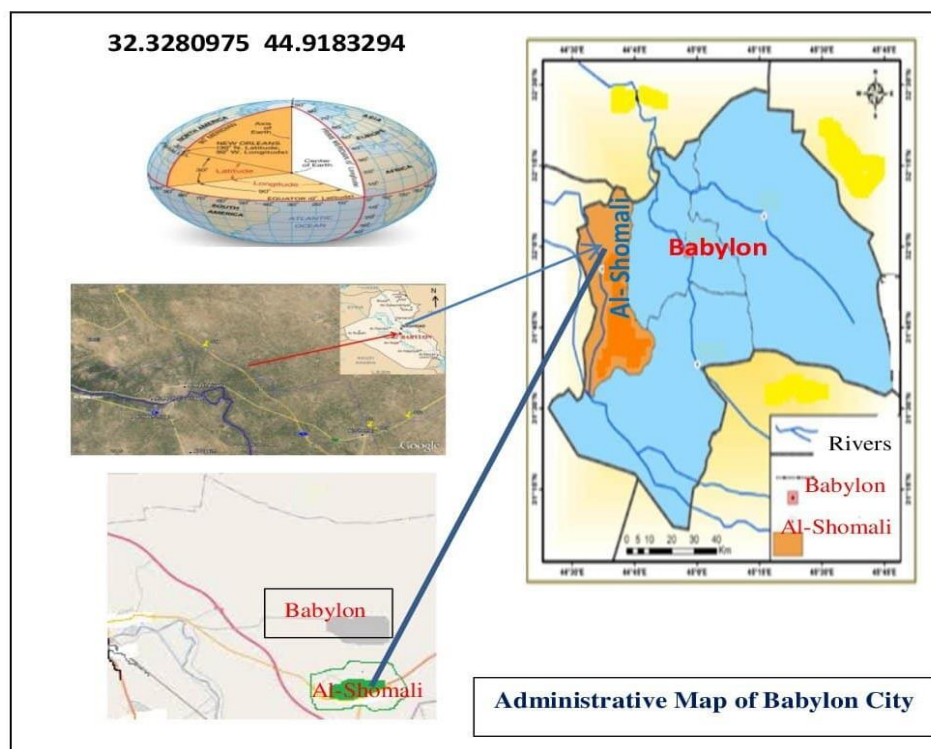


Figure 1 Experiment location

2.2 Seedbed preparation

The soil was prepared before planting by removing the plant previous remains. Random soil samples were taken with 0-20 cm depth and analyzed to determine the physical and chemical properties and soil texture as shown in Table 1. The soil plowing was conducted using undercut tillage implement which work to stir the soil by penetrating it to a 20 cm depth in a vibrating manner without turning it over. Then, the soil was smoothed using a disc harrow the soil was leveled using a leveling machine Scraper type. The experimental field was divided into panels, leaving a distance of 100 cm between the main panels. The experimental land was fertilized with triple superphosphate fertilizer 46% (P₂O₂) before planting at a rate of 100 kg ha⁻¹, added in one batch before planting (Kobata et al., 2018; Amer et al., 2020).

Potassium fertilizer was added in the form of potassium sulphates 42% at a rate of 80 kg ha⁻¹ in two batches, the first before planting after completing the soil leveling process and the second in the flowering stage. As for nitrogen fertilizer 46%, it was added in four batches, the first after 20 days from planting, the second batch at the three complete leaves on the stem, the third when the nodes appear and the fourth at the lining stage (Alaamer and Alsharifi, 2020).

The wheat grains were planted using the Poznaniak 550 planting equipment at a rate of 80 kg ha⁻¹ with planting distances of 10 cm between each line and other for both study varieties (Amer et al., 2021), after completing the planting process, the pumps were installed and the main and sub-pipes wiring the drippers for the subsurface drip irrigation system were extended to a 20 cm depth and 10 cm towards the soil surface top, to achieve a moisture circle of 30 cm and 2 cm from the surface dry soil from top. And with a distance of 50 cm between each sub-pipes line to achieve a soil Moisture content level of 95% the soil moisture content was measured as wet base, during the growing season. The irrigation process is carried out automatically according to the plant's need through sensors that give a signal to operate the irrigation system and when the saturation stage is reached, the sensors give a signal to stop the irrigation system and this process is repeated throughout the growing season until harvest. The dripper discharge was 8 L hr⁻¹ with the operating pressure was 300 kPa. The drippers were distributed at a distance of 25 cm between each dripper and other, the irrigation process continued to achieve a germination rate of 96% and a germination speed of 83%, for both cultivars Figure 2 (Merza et al., 2023; Alaamer et al., 2024b).

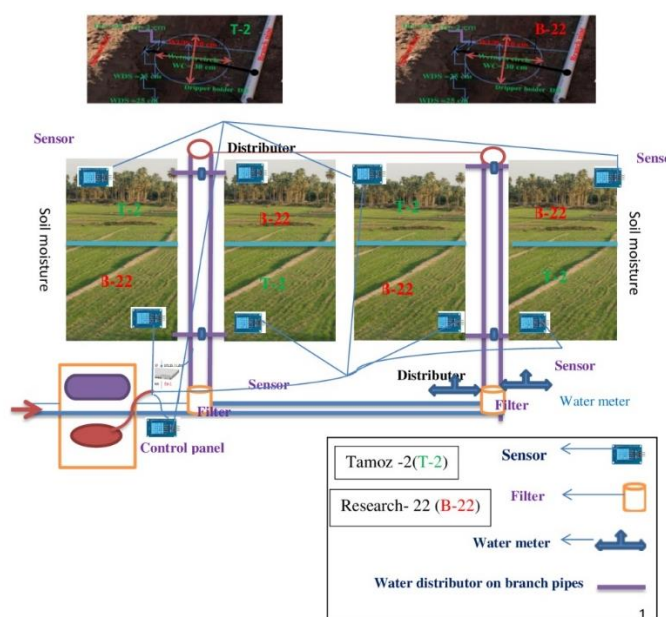


Figure 2 Smart irrigation system

Table 1 Experimental site soil physical and chemical characteristics

| Depth | Soil particles distribution, % | | | |
|-----------|--------------------------------|----------------|------------------------------------|------------------|
| | Clay | Silt | Sand | Silt Clay loam |
| | 55 | 25 | 20 | |
| | Soil physical properties | | | |
| 0-20 (cm) | Pb (Mg m ⁻³) | TSP (%) | SPR (Kpa) | field capacity % |
| | 1.28 | 51.69 | 1505.22 | 34.12 |
| | 1.30 | 50.94 | 1611.42 | 31.55 |
| | 136 | 48.67 | 1733.15 | |
| VA | 1.31 | 50.56 | 1616.59 | |
| | Soil chemical properties | | | |
| 0-20 | E.C (ds cm ⁻³) | HP | True Density (Mg m ⁻³) | |
| | 2.42 | 7.11 | 2.54 | |
| | Soluble cation meq/l | | | |
| | Na | K | Ca+Mg | |
| | 8.33 | 12.45 | 56.34 | |
| | O.C (%) | CEC Meq\100 g) | CaCO ₃ (%) | O.M (%) |
| | 0.55 | 32.81 | 4 | 0.64 |

2.3 Studied factors

2.3.1 Wheat varieties

The two varieties are Tamoz-2 and Bhooth-22.

2.3.2 Drippers drain

Drippers exhaustion for subsurface smart irrigation system were 6 L hr⁻¹ and 8 L hr⁻¹.

2.3.3 Drippers between distance

The distance between one dripper and another was 20 and 25 cm, respectively, distributed on the branch pipes.

Check soil moisture: In smart irrigation systems, the sensor is used to measure the moisture content in the soil periodically, and the data is sent to the smart control system to make the appropriate decision for the irrigation process. That is, when the soil moisture level is low, the control system operates the

subsurface drip irrigation system to increase the moisture levels in the soil, and vice versa when it soil moisture increased, control system stops the irrigation system.

2.3.4 Receiver

It receives all data from moisture measurement units and transmits, analyzes and translates it through smart programs to determine the water amount according to the wheat plant’s need

2.3.5 Operating system:

It relies on graphs, which is why it is considered an important part of irrigation systems

Meteorological station: Through it, humidity levels, wind speed and direction, and rainfall are determined.

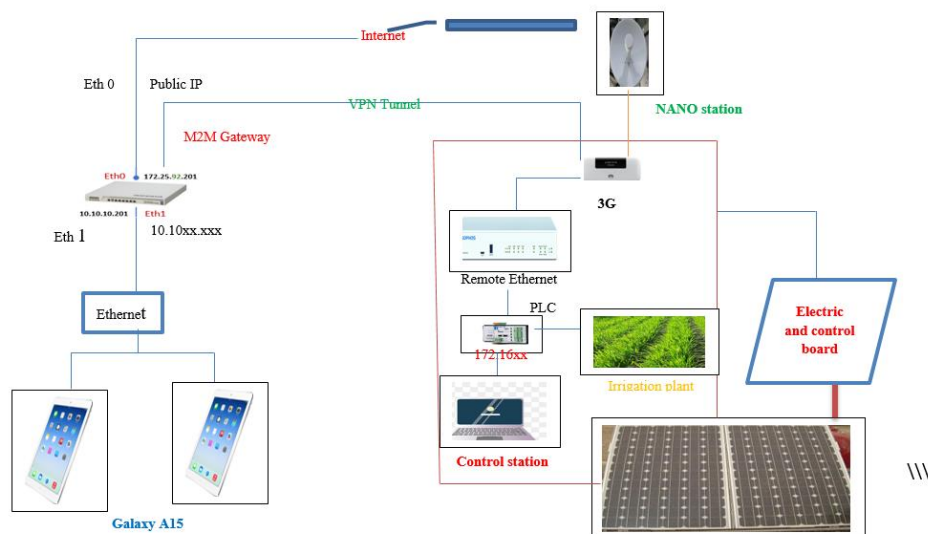


Figure 3 Subsurface smart irrigation system

2.4 Physical soil properties

The current study focused on the physical soil properties represented by soil moisture, density and porosity, which were checked and monitored throughout the plant growth period after one month, two months and when the plant was fully mature to know the impact extent of the smart subsurface irrigation system on the soil composition in terms of creating suitable growth conditions for the plant according to the drainage and distance between drippers (Nayyef, 2021).

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

Where: W is soil humidity ratio (%), W_w is mass wet soil (kg), W_s is mass dry soil (kg).

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

Where: P_b is the dry bulk density (mg m^{-3}), M_s is the weight of the dried soil sample (mg), V_T is the 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 the total of soil porosity (%), P_b is the dry of bulk density (mg m^{-3}), P_s is the partial density (2.65 mg m^{-3}).

2.5 Vegetative growth characteristics for the plant

2.5.1 Plant height

It was measured using an Invar tape starting from the soil surface to the spike end (Alaamer et al., 2022).

2.5.2 Spike length

It was measured using a metal ruler starting from the spike neck to the spike top (Ghali et al., 2020).

2.5.3 Spikes number

It was measured per m^2 (Alaamer et al., 2024b).

2.5.4 Chlorophyll percentage

It was estimated for ten randomly selected plants at the flowering stage for each experimental unit using a device Leaf Chlorophyll content meter.

2.6 Yield properties

2.6.1 Grains number in the spike

Wheat crop was harvested at full maturity with three replicates for each experimental unit. Then, it was threshed and counted by machine (type Satak) (Alwang et al., 2018; Alsharifi et al., 2017a).

2.6.2 1000 grains weight

It was measured using a Japanese-made device (Satak type) that counts and sorts grains by size (Alsharifi et al., 2017b; Alsharifi et al., 2024).

2.6.3 Grain yield

It was calculated according to the method approved by Hamzah et al. (2021) and Alaamer and Alsharifi (2023).

The data were statistically analyzed using the statistical program Genestat for the studied traits and the means were compared with the least significant difference $\text{LSD}=0.05$.

3 Results and discussion

3.1 Physical soil properties

Table 2 shows the significant effect for drip discharge on the physical soil properties, as the discharge 8 L hr^{-1} achieved the lowest average for the apparent soil density, and the results were 1.27, 1.29 and 1.32 Mg m^{-3} , corresponding to an increase in the total soil porosity values, were 52.07%, 51.32% and 50.18% respectively, while the distance between the drippers 20 cm achieved the lowest average for the apparent soil density were 1.28, 1.31 and 1.32 Mg m^{-3} , and in return an increase in the total soil porosity values 51.69%, 50.56% and 50.18%, respectively. As for the wheat variety selected for this study, the T-2 variety achieved the lowest average for the apparent soil density were 1.27, 1.30 and 1.32 Mg m^{-3} , and was accompanied by an increase in the total porosity values were 52.07%, 50.94% and 50.18%, respectively, after one month, two months, and the season end (Nayyef, 2021; Alaamer et al., 2024b).

3.2 Vegetative growth characteristics

Table 3 results showed that there is a highly significant effect of both the drip drainage factors and the distance between the drippers for two varieties of local wheat on the plant vegetative growth characteristics. The averages of this characteristic differed according to the drainage, as the drip drainage of 8 L hr^{-1} gave the highest vegetative growth averages of 91.18 cm, 16.19 cm, 328.47 spike m^2 and 65.63% respectively, compared to the drip

drainage of 6 L hr⁻¹, which gave undesirable results for this study. This is due to the suitable moisture availability for plant growth during the growth period, the spread of roots over wide distances, and the largest possible amount absorption from available nutrients with the soil moisture abundance, which was positively reflected in the growth characteristics (Li et al., 2015; Alaamer et al., 2023a). As for the distance between the drippers, the 25 cm distance achieved the highest averages, reaching 89.83 cm, 15.81 cm, 65.69%, respectively. While the 20 cm distance between the drippers was superior in the spikes number property in the square meter, as it recorded the highest average, reaching 303.98 spike m². The reason for this is the roots spread to a greater distance and obtaining the highest nutritional levels necessary for growth and the low rates of competition between the plants roots, which results from the decrease in the intertwining between the roots to

expand the planting distance in proportion to the dripper distance (Dar et al., 2017; Alsharifi et al., 2022). The results showed that the T-2 local wheat variety was significantly superior in giving the highest average plant vegetative growth of 90.57 cm, 15.85 cm 324.88 spike m² and 67.36%, respectively, compared to the B-22 local wheat variety which recorded undesirable results for this study. This was due to the genetic composition for the selected variety and its suitability to withstand the cultivation conditions by giving the highest growth rates (Abdelmageed et al., 2019), that the interaction among drippers drain 8 L hr⁻¹ and the distances between drippers 25 cm for two wheat varieties T-2 and B-22 caused the best results for this study. The level of the vegetative growth characteristics at different conditions is show in Figure 4 for both wheat varieties.

Table 2 Effect of DD and the Distance between the drippers on the physical soil properties for two wheat varieties

| WV | DD | DBD | Soil bulk density | | | Total of soil porosity | | |
|----------|-----------|-----|-------------------|------|------|------------------------|-------|-------|
| | | | 1Mon | 2Mon | GSE | 1Mon | 2Mon | GSE |
| T-2 | 6 | 20 | 1.28 | 1.31 | 1.32 | 51.69 | 50.56 | 50.18 |
| | | 25 | 1.29 | 1.32 | 1.34 | 51.32 | 50.18 | 49.43 |
| | | 20 | 1.24 | 1.29 | 1.31 | 53.21 | 51.32 | 50.56 |
| | 8 | 25 | 1.27 | 1.28 | 1.32 | 52.07 | 51.69 | 50.18 |
| | | 20 | 1.30 | 1.32 | 1.33 | 50.94 | 50.18 | 49.81 |
| | | 25 | 1.31 | 1.33 | 1.36 | 50.56 | 49.81 | 48.67 |
| B-22 | 6 | 25 | 1.29 | 1.30 | 1.32 | 51.32 | 50.94 | 50.18 |
| | | 20 | 1.29 | 1.30 | 1.32 | 51.32 | 50.94 | 50.18 |
| | | 25 | 1.30 | 1.32 | 1.34 | 50.94 | 50.18 | 49.43 |
| WV | T-2 | | 1.27 | 1.30 | 1.32 | 52.07 | 50.94 | 50.18 |
| | B-22 | | 1.30 | 1.32 | 1.34 | 50.94 | 50.18 | 49.43 |
| DD | 6 | | 1.29 | 1.33 | 1.33 | 51.32 | 49.81 | 49.81 |
| | 8 | | 1.27 | 1.29 | 1.32 | 52.07 | 51.32 | 50.18 |
| DBD | 20 | | 1.28 | 1.31 | 1.32 | 51.69 | 50.56 | 50.18 |
| | 25 | | 1.29 | 1.32 | 1.34 | 51.32 | 50.18 | 49.43 |
| LSD=0.05 | WV | | 0.03 | 0.04 | 0.06 | 0.15 | 0.17 | 0.34 |
| | DD | | 0.03 | 0.04 | 0.06 | 0.15 | 0.17 | 0.34 |
| | DBD | | 0.03 | 0.04 | 0.06 | 0.15 | 0.17 | 0.34 |
| | WV*DD*DBD | | 0.06 | 0.08 | 0.09 | 0.33 | 0.48 | 0.65 |

Note: Tamoz, T-2; Bhooth, B-22; Drippers drain, (DD); Distance between the drippers, DBD; Wheat varieties, WV; Dripper discharge, DD; One month, 1Mon; Two months, 2Mon; Growth season end, GSE.

3.3 Yield properties

Results showed that there is a highly significant effect of both the drip drainage factors and the distance between the drippers for two varieties of local wheat on the yield properties. The averages of this characteristic differed according to the drainage, as the drip drainage of 8 L hr⁻¹ gave the highest yield

properties averages of 77.97 grain spike⁻¹, 50.39 g and 6.03 t ha⁻¹ respectively, compared to the drip drainage of 6 L hr⁻¹, which gave undesirable results for this study, the high drainage rates caused an increase in the homogeneity of the soil moisture distribution in the appropriate range to increase the wetting circle size, which was positively reflected in

the crop characteristics (Shtewy et al., 2020; Alsharifi et al., 2021). From Table 4, as for the distance between the drippers, the 25 cm distance achieved the highest averages, reaching 77.95 grain spike⁻¹, 51.09 g and 6.05 t ha⁻¹ respectively. Increasing the planting distance between one plant and another allows for wider root growth and spread, absorption of the largest possible amount of nutrients, and lower competition between the roots (Lesk et al., 2016; Alaamer and Alsharifi, 2021). The results showed that the T-2 local wheat variety was significantly superior in giving the highest average yield properties of 81.67 grain spike⁻¹, 49.31 g and 6.24 t ha⁻¹,

respectively, compared to the B-22 local wheat variety which recorded undesirable results for this study. This was due to the genetic composition for the selected variety and its suitability to withstand the cultivation conditions by giving the highest growth rates with high productivity (Zhang et al., 2017; Shtewy et al., 2020), that the interaction among drippers drain 8L.hr⁻¹ and the distances between drippers 25 cm for two varieties of local wheat T-2 and B-22 caused the best results for this study. The level of the yield properties at different conditions is show in Figure 5 for both wheat varieties.

Table 3 Effect of DD and the DBD on the vegetative growth characteristics for two wheat varieties

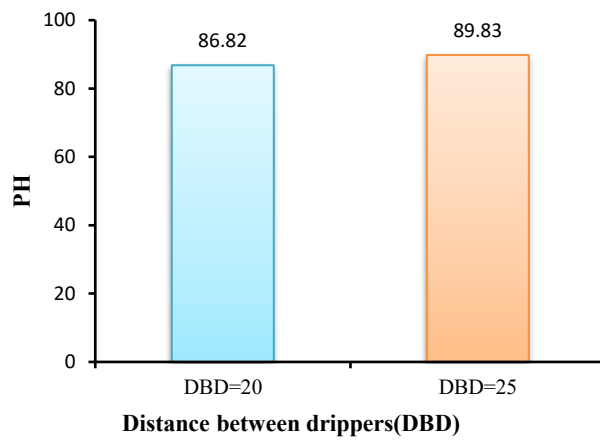
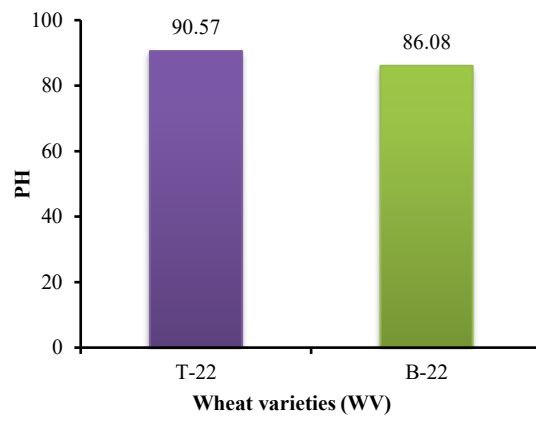
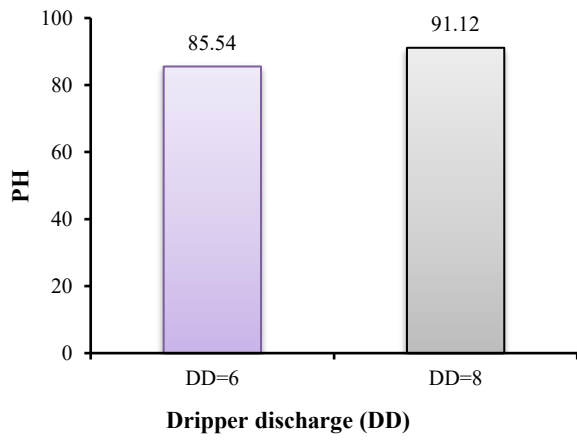
| WV | DD | DBD | Ph | SL | SN | CP | |
|----------|-----------|-------|-------|-------|--------|--------|-------|
| T-2 | 6 | 20 | 85.91 | 14.61 | 306.16 | 65.00 | |
| | | 25 | 88.15 | 15.22 | 298.83 | 68.17 | |
| | 8 | 20 | 92.17 | 16.11 | 376.11 | 66.82 | |
| | | 25 | 96.08 | 17.46 | 318.45 | 69.46 | |
| | B -22 | 6 | 20 | 83.12 | 12.93 | 215.62 | 59.22 |
| | | | 25 | 84.96 | 14.44 | 209.33 | 60.15 |
| 8 | | 20 | 86.09 | 15.08 | 318.09 | 61.24 | |
| | | 25 | 90.13 | 16.10 | 301.26 | 65.01 | |
| WV | | T-2 | | 90.57 | 15.85 | 324.88 | 67.36 |
| | | B -22 | | 86.08 | 14.63 | 261.07 | 61.41 |
| DD | 6 | | 85.54 | 14.30 | 257.48 | 63.13 | |
| | 8 | | 91.18 | 16.19 | 328.47 | 65.63 | |
| DBD | 20 | | 86.82 | 14.68 | 303.98 | 63.07 | |
| | 25 | | 89.83 | 15.81 | 281.96 | 65.69 | |
| | WV | | 4.352 | 2.124 | 18.82 | 1.244 | |
| | DD | | 4.352 | 2.124 | 18.82 | 1.244 | |
| LSD=0.05 | DBD | | 4.352 | 2.124 | 18.82 | 1.244 | |
| | WV*DD*DBD | | 5.075 | 3.009 | 24.68 | 2.619 | |

Note: plant height; Ph, spike length; SL, spikes number; SN, Chlorophyll percentage; CP

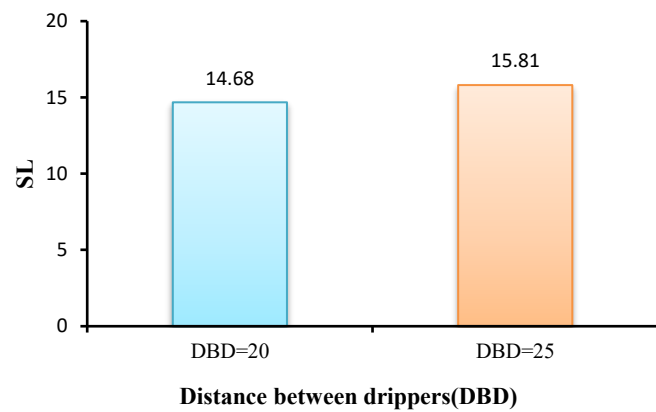
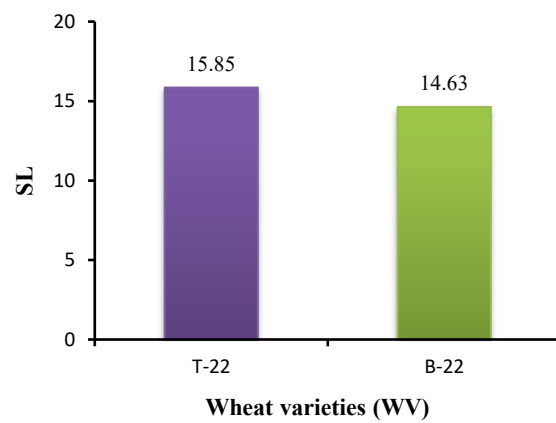
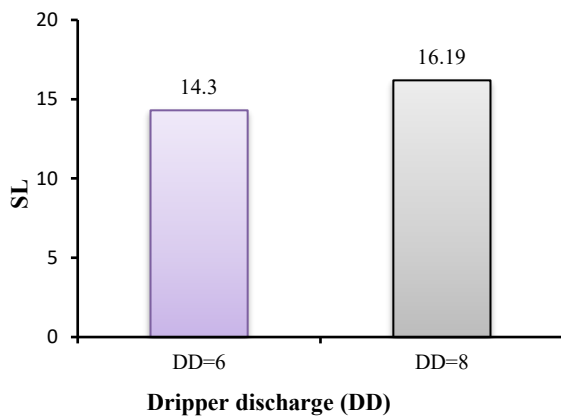
Table 4 Effect of DD and the DBD on the yield properties for two wheat varieties

| WV | DD | DBD | GNS | 1000GW | TGY | |
|----------|-----------|-------|-------|--------|-------|------|
| T-2 | 6 | 20 | 76.18 | 43.69 | 5.18 | |
| | | 25 | 83.09 | 52.01 | 6.44 | |
| | 8 | 20 | 82.16 | 45.66 | 6.28 | |
| | | 25 | 85.27 | 55.91 | 7.05 | |
| | B 113 | 6 | 20 | 68.09 | 41.47 | 4.93 |
| | | | 25 | 70.18 | 46.18 | 4.98 |
| 8 | | 20 | 71.19 | 49.71 | 5.09 | |
| | | 25 | 73.28 | 50.29 | 5.71 | |
| WV | | T-2 | | 81.67 | 49.31 | 6.24 |
| | | B -22 | | 70.69 | 46.91 | 5.17 |
| DD | 6 | | 74.38 | 45.83 | 5.38 | |
| | 8 | | 77.97 | 50.39 | 6.03 | |
| | 20 | | 74.41 | 45.13 | 5.37 | |
| | 25 | | 77.95 | 51.09 | 6.05 | |
| | WV | | 3.413 | 2.616 | 0.55 | |
| LSD=0.05 | DD | | 3.413 | 2.616 | 0.55 | |
| | DBD | | 3.413 | 2.616 | 0.55 | |
| | WV*DD*DBD | | 4.218 | 4.913 | 0.87 | |

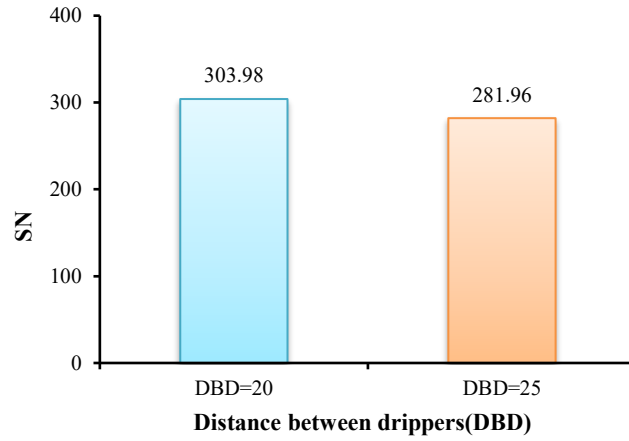
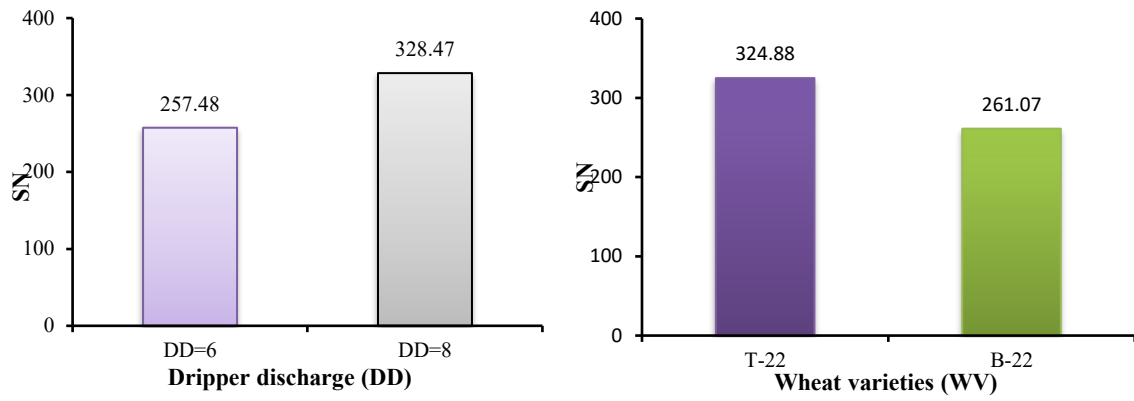
Note: Grains number in the spike, GNS; 1000grains weight, 1000GW; Grain yield, GY.



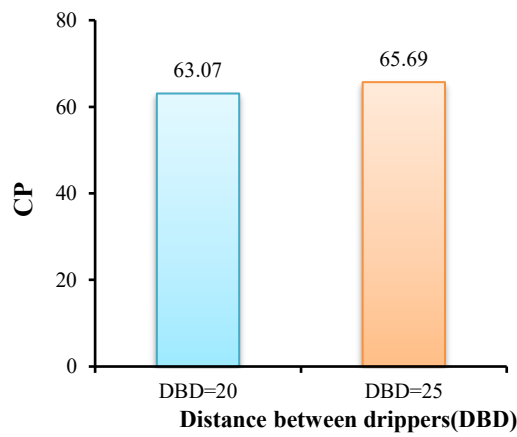
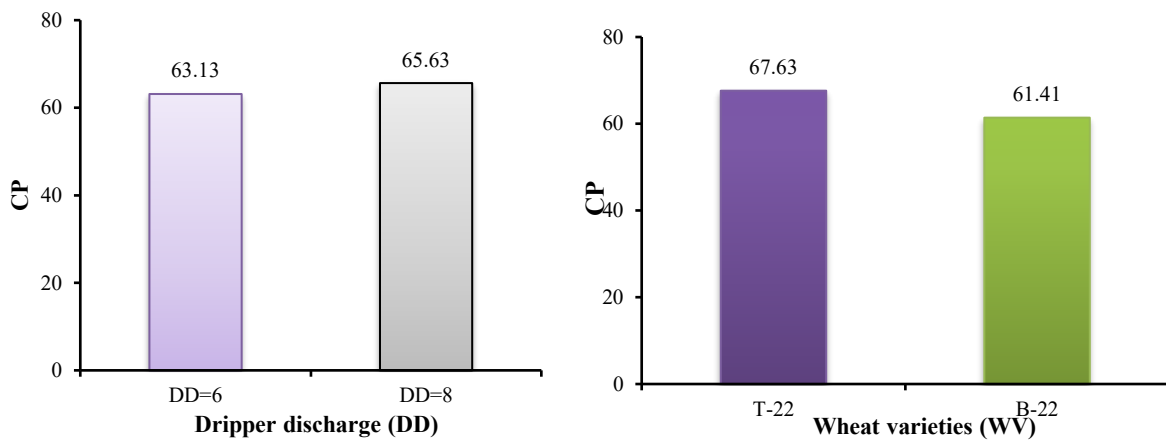
(a) Plant height (pH)



(b) Spike length (SL)

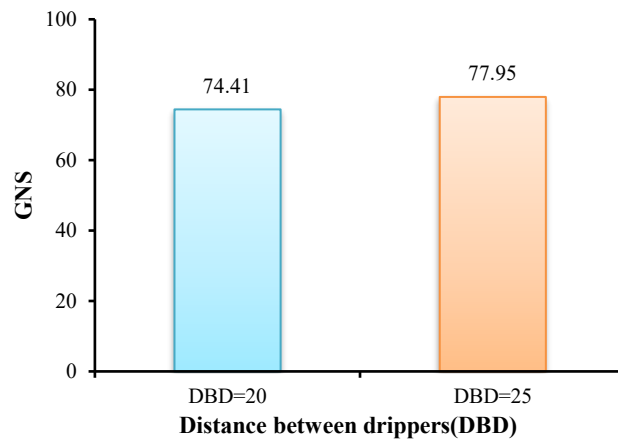
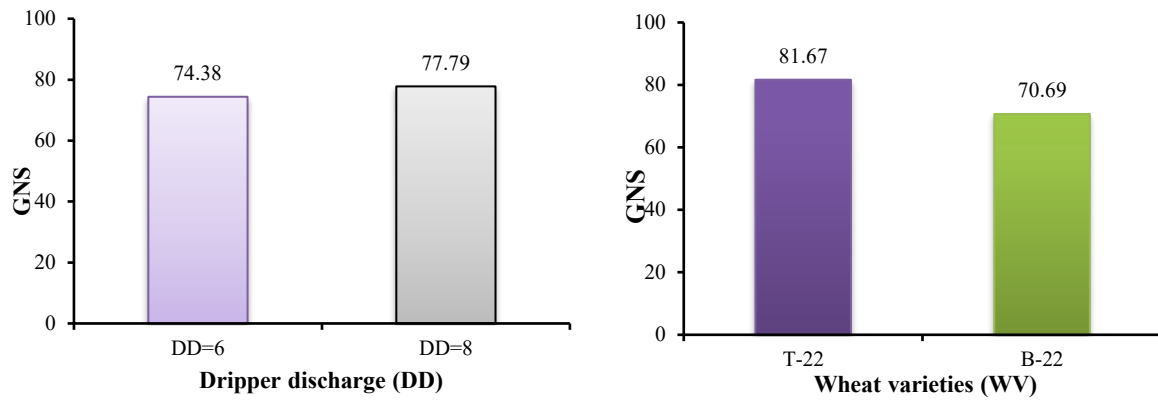


(c) Spikes number (SN)

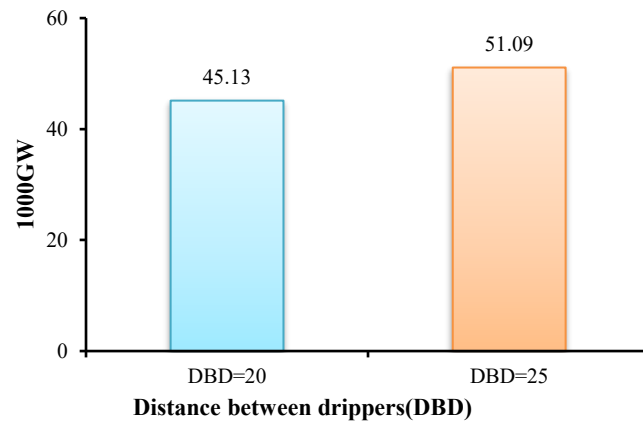
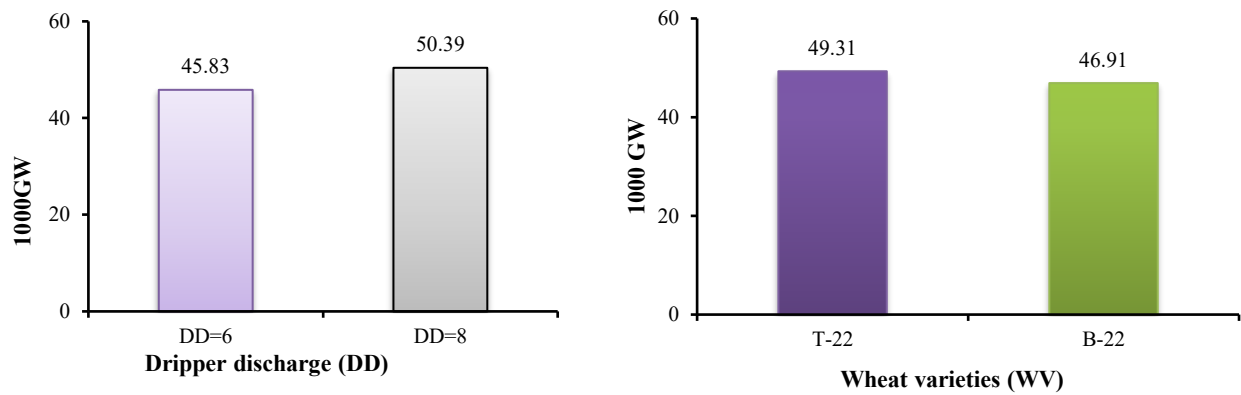


(c) Chlorophyll percentage (CP)

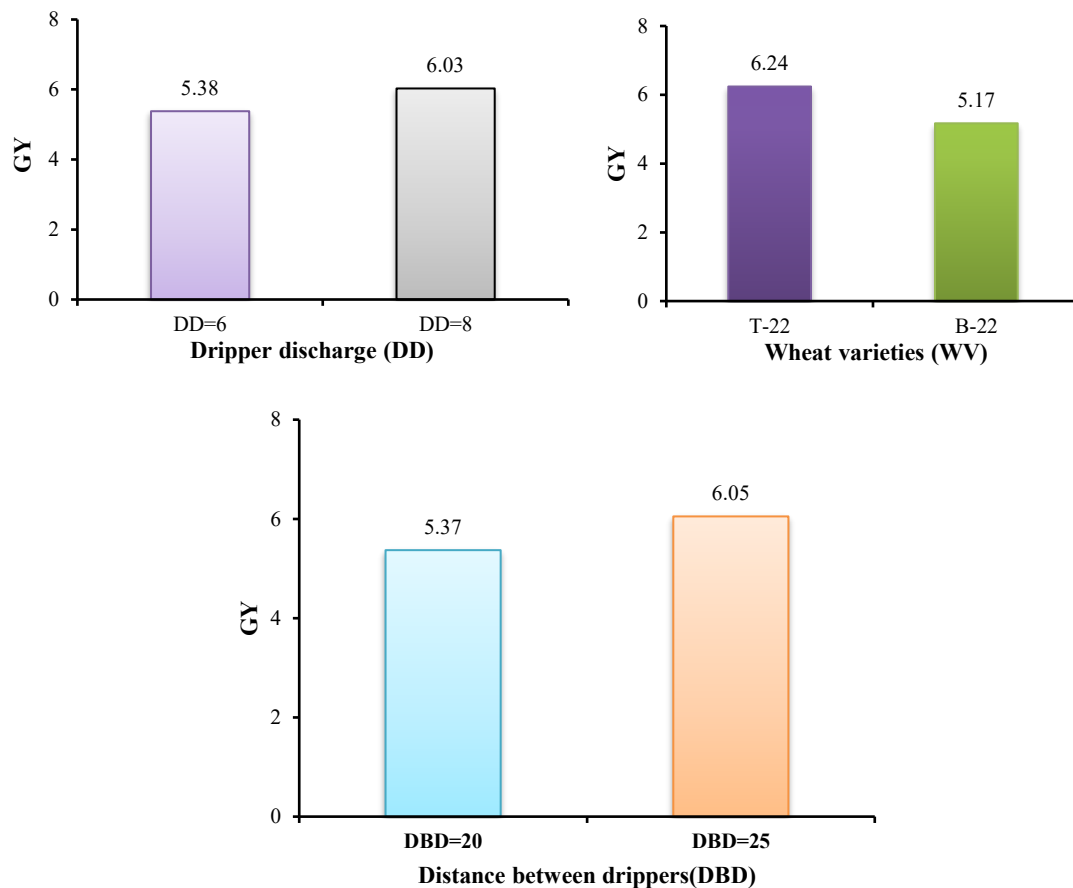
Figure 4 Vegetative growth properties at dissimilar stand for both wheat varieties



(a) Grains number in the spike (GNS)



(b) 1000 grains weight (1000GW)



(c) Grain yield (GY)

Figure 5 Yield properties at dissimilar stand for both wheat varieties

4 Conclusions

Wheat variety T-2 showed significant superiority compared to other variety B-22 in the studied parameters. The dripper drainage DD of 8 L hr⁻¹ also provided a significantly better response than DD of 6 L hr⁻¹, the distance between the drippers DBD of 25 cm it achieved the best values during the growing season for rice compared to distance DBD of 20 cm, which gave the best value for the spike number per square meter. The interaction of wheat variety T-2, smart irrigation system, DD of 8 L hr⁻¹ and DBD of 25 cm present noteworthy execution versus other interactions.

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