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Effect of Using Floppy Sprinklers on Irrigation Water Use Efficiency of Wheat under El-Salheya El-Gedida Condition

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ABSTRACT

Shortage of precipitation and restricted irrigation water resources is the major defy for agricultural dilating policies and strategies. On the other hand, there is an elevated apprehension to rise the area of wheat farming in require to convention the growing regional consumption. The great defy is to raise wheat output using same or lower quantities of irrigation water. an Experiment was carried out through two winter sequential seasons of 2020/2021 and 2021/2022, at a special ranch in El-Salhia El-Gedida area, El- Sharqia Governorate, Egypt, to investigation the effectiveness of two irrigation systems floppy sprinklers (FSS) and center pivot (CPS) at various irrigation water levels (IR=100, 90, 80, 70, and 60% studied depends on crop evapotranspiration) and three chemical fertilizer rates (MFR=100, 80 and 60% of recommended chemical fertilizer N, P, K rates) on the marketable yield (MY), crop goodness standards, seasonal actual evapotranspiration (ETa), water use efficacy (WUE) and irrigation water use efficiency (IWUE) for wheat bread (*Triticum aestivum L.*) were investigated. The experimental purpose was a split-split plot design with three replicates. The discussion reported that; 1) the crop yield and crop goodness standards of winter wheat gave the maximum values at FSS irrigation system, IR=100% and MFR=100 treatments for both seasons. 2) Seasonal ETa gave the minimum values: 159.19 and 155.72 mm for both seasons, respectively, under FSS irrigation system, IR=60% and MFR=60 treatments. 3) The highest values of wheat WUE and IWUE were 5.38 and 3.21 kg m^{-3}; 5.56 and 3.29 kg m^{-3} for both seasons, respectively, at FSS irrigation system, IR=70% and MFR=80 treatments. This study concluded that the cultivation of winter wheat at FSS irrigation system, IR=70% and MFR=80% treatment could be saved about 38% of added irrigation water, 20% of the total chemical fertilizers rates additive and increased yield of the winter wheat about 11.33 and 10.85% for both seasons, respectively, compared with that under the control treatment (CPS irrigation system, IR=100% and MFR=100%).

Keywords: floppy sprinklers, Center pivot, water use efficiency, wheat, actual evapotranspiration, irrigation water use efficiency.

1. Introduction

Water is used for water system more than some other goal, addressing more than 70% of water withdrawals universally. Water addresses for 40% of food creation overall and is vital for feed the total populace, representing 20% of all developed land (Hamidov and Helming, 2020). Wheat is the most broadly normal and developed crop on the planet, covering 216 million hectares with a typical yield of 3.5 tons hectares (at 11% dampness content) and an all-out creation of 765 million tons around the world (FAOSTAT 2019). Wheat is one of the most important strategic crops in Egypt and all countries of the world. The area of wheat has increased in the past 10 years has been expanded from (0.18 - 0.25 million/ha) and the mean yield has been increased from (6.4 to 8.8 million tons/ha) through that period. On the other hand, total consumption of wheat has increased drastically due to steady population increase by about 2.5% per year. Therefore, Egypt imports about 60% of its annual needs of wheat, this reflects the size of the problem and the state's efforts to bridge the deficit in the wheat food gap and reduce its import, which represents a burden on the Egyptian state. It has become necessary to progress

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irrigation water productivity and reduce irrigation request while maintaining crop yields (Mansour *et al.,* 2015). Under ideal irrigation conditions, primarily in semi-arid and dry locations, current irrigation techniques can significantly reduce water use. The volume of the flooded land represents the water supply in contrast to surface water irrigation, due to the high irrigation efficiency, and it is dependent to obtain high crop production along with more income with better supervision. These are some of the main benefits of floppy sprinkler (FSS), sprinkler, and drip irrigation systems (Samimi *et al.,* 2020). Evaluated of seven floppy sprinklers regarding field dispersion. They observed that the uniformities distribution of floppy sprinkler was ranged from 59 to 78% In the meantime, the uniformities coefficients of floppy sprinkler were ranged from 66 to 84% (Schwankl *et al.,* 2003). Surface irrigation, subsurface irrigation, sprinkler irrigation, micro irrigation, and hybrid irrigation are the most effective irrigation methods. The average irrigation efficiency and water application results for each of the aforementioned irrigation methods are as follows: 68% for the solid set, 74% for the floppy sprinkler system, 82% for the center pivot system, and 95% for subsurface drip irrigation (Shabbir *et al.,* 2020). The maximum values of UC and UD, 72.14 and 58.13%, respectively were measured at a pressure of 200 kPa at a height of 3 m. By increasing ETc% and values UC and UD, the characteristics of the wheat plant, including grain production and straw yield, were improved. The highest yield and yield components, as well as the highest WUE values, were reached by 100% and 20%, respectively. Adopting 80% ETc could save water, helping to address future water scarcity, so an overhead floppy sprinkler is suggested for producing wheat with a good yield (Khedr, 2020). Five years of field research were used to examine how winter wheat yields under a center pivot irrigation scheme are determined. Twenty wheat cultivars were cultivated under four different water regimes, I_{100}, I_{75}, I_{65}, and I_{50}, to satisfy the requirements for 100%, 75%, 65%, and 50% of evapotranspiration (ET). ET, biomass, and grain yield typically fell from higher to lower water regimes over the course of most seasons, although at I_{75}, water use efficiency (WUE) and harvest index (HI) were at their highest levels. Grain yield decreased from I_{100} to I_{75} by only 5% on average for all years and genotypes, showing that irrigation may still be reduced to meet 75% of the ET need while still producing comparable yield to $I_{100\%}$ and maximizing HI and WUE. This study showed that a high yield could be obtained with I_{75} of irrigation. (Thapa *et al.,* 2019). Water stress through with deficit irrigation at the spike germination and grain reloading phases reduced grain yield and growth parameters components (Zareian and Hamidi, 2014). The greatest and normal filling rates expanded first and afterward diminished with the increment of water shortage. The timespan filling expanded with the increment of treatment rate. The grain weight of winter wheat expanded and afterward diminished with the increment water or manure levels. The gentle water shortfall and fitting preparation further developed the grain filling and expanded the grain weight. The greatest grain weight level of spike weight was around 80% (Yan *et al.,* 2019). The wheat plant's capacity for photosynthesis was helped by the water system at 60% exhaustion of the accessible water, which prompted expansions in banner leaf region, number of spikes per m^2, and plant level (cm) The least yields and most significant returns were related with the 100 kg N/ha+ 40 kg P/ha+ 80 kg K/ha (F1) and 200 kg N/ha+ 80 kg P/ha+ 80 kg K/ha (F3), separately, while the degree of manures F3 didn't fundamentally contrast from F2 in any of the boundaries of development, yield, or water use effectiveness of wheat. In Al-Qadisiya, the aggregate sum of estimated time of arrival was 471 mm at 40%, 60%, and 80% of the accessible water, separately, while in Wasit, it was 485, 435 mm at 40%, 60%, and 80% of the accessible water, separately. Furthermore, the outcomes exhibit huge WUEf and WUEc values at 60% exhaustion of the accessible water (I2) recorder upsides of 1.74 and 1.38 kg m^{-3} in Al-Qadisiya and 1.56 and 1.26 kg m^{-3} in Wasit, separately (Ati *et al.,* 2016). Water use efficiency (WUE) mostly, decreased linearly with increasing seasonal irrigation levels (Wang *et al.,* 2012).

This study aimed to discuss the leverage of the floppy sprinklers irrigation system on cultivation winter wheat yield crop production, quality growth parameters, actual evapotranspiration, water use efficiency and irrigation water use efficiency compared to center pivot irrigation system at different levels of applied irrigation water and chemical fertilizer rates.

2. Materials and Methods

2.1. Experimental

Field experiments were performed in El- Salhia El-Gedida area, El- Sharqia Governorate, Egypt, at (30° 26` 03`` N: 31° 12` 24``E.; 26 m a.s.l.) during the winter seasons 2020/2021 and 2021/2022. In a split-split plot design with three replicates, the experimental area of center pivot and floppy sprinklers irrigation systems were divided into (50x20m) and (60x24m) for every main plots respectively, with space left 10 and 12 m separation area between plots for both irrigation systems respectively, to eschew horizontal leakage and variables overlapping. The acquired data were subjected to statistical analysis harmony to Snedecor and Cochran (1989), using Co-state software program. The winter wheat (*Triticum aestivum* L.) Misr 2 were irrigated by added five levels of irrigation water (IR=100, 90, 80, 70 and 60% studied depends on crop evapotranspiration) and three chemical fertilizer rates (MFR=100, 80 and 60% of recommended chemical fertilizer N, P, K rates) through using floppy sprinklers (FSS) and center pivot (CPS) irrigation systems (Fig. 1). The Plant height (PH) cm, numbers of spikes (NS) spikes/m^2, 1000 grain weight (GW) g, grain crude protein content (GCP) %, gluten content (GC) %, harvest index (HI) %, total yield (TY) Mg/ha, straw yield (SY) Mg/ha and grain yield (GY) Mg/ha were determined for winter wheat. While, the actual evapotranspiration ETa (mm), water use efficiency WUE (kg/m^3) and irrigation water use efficiency IWUE (kg/m^3) were calculated for all applied irrigation water levels and chemical fertilizer rates under different irrigation systems for all winter wheat plots.

2.2. Floppy Sprinkler irrigation system

One floppy sprinkler gives water at a pace of 730L/h the stream controller keeps up with this rate with a 5% change inside the water pressure limits at the sprinkler from 1.8 to 6 bar, realizing that the base strain expected at the sprinkler is 2 bars. The complete water precipitation rate is 5 mm/h while the dispersing between sprinklers is (12 x 12 m), as the distance between the points of support is 12m and in the contrary reach 60 m. Sprayers joined to a link of excited iron thickness of 6 mm (7 × 2) and the link is elasticity of 1200 kg. The link level of the ground 5 meters and the Props of wood or iron are covered one meter somewhere down in the ground. Filtration: Water system water should go through a eparating framework with a sifting level of 800 microns.

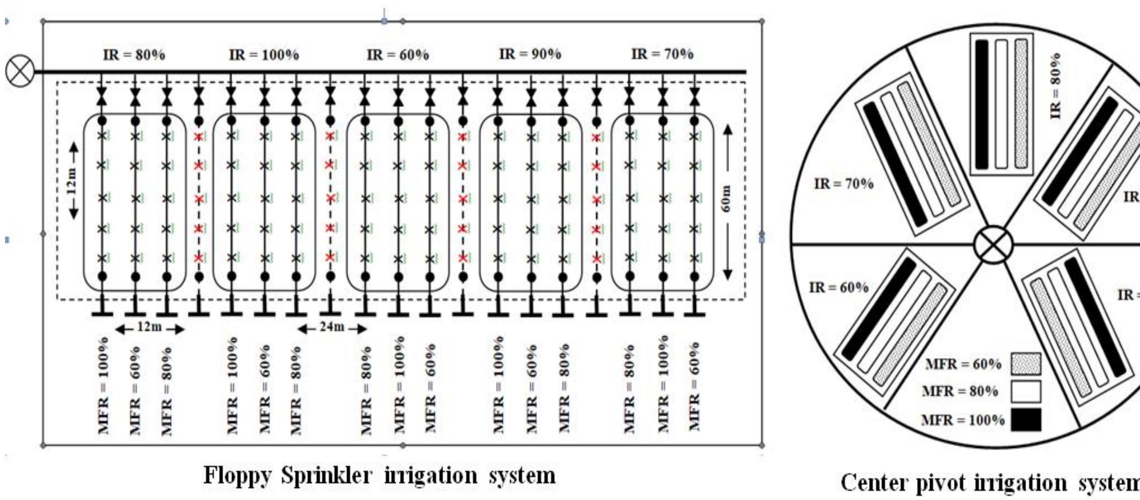

Fig. 1: Field experiment layout of El- Salhia El-Gedida area.

2.3. Soil characteristics

Soil samples were collected to determine the physical and chemical soil characteristics. The methodological procedures followed the methods described by Page *et al.,* (1982) and Klute (1986) as shown in Tables 1 & 2.

Table 1: Physical characteristics of the experimental soil.

Soil depth (cm)	Particle size distribution %			Textural class	OM %	ρ_b g/cm^3	Ks cm/h	FC %	PWP %	AW %
	Sand	Silt	Clay							
0-20	90.85	6.31	2.84	S	0.39	1.53	15.91	10.97	4.43	6.54
20-40	90.71	6.18	3.11	S	0.34	1.56	16.13	10.45	4.27	6.18
40-60	90.69	6.03	3.28	S	0.21	1.58	16.35	10.11	4.09	6.02

Table 2: Chemical characteristics of the experimental soil.

Soil depth (cm)	EC (dS/m)	pH	$CaCO_3$ %	CEC Cmole/kg	Soluble ions (%) in saturated soil paste extract							
					Na^+	K^+	Ca^{++}	Mg^{++}	Cl^-	HCO_3^-	CO_3^{--}	SO_4^{--}
0-20	2.35	7.51	4.07	3.19	10.68	1.36	6.94	4.52	9.26	2.79	-	11.45
20-40	2.48	7.39	3.81	3.43	11.27	1.49	7.23	4.81	10.08	2.93	-	11.79
40-60	2.53	7.27	3.59	3.75	11.41	1.53	7.39	4.97	10.24	3.08	-	11.98

2.4. Quality of irrigation water

Chemical analyses of the irrigation water were performed according to the methods described by Ayers and Westcot (1994) and are presented in Table 3.

Table 3: Chemical analysis of irrigation water.

pH	EC dS/m	SAR	Soluble cations (%)				Soluble anions (%)			
			Na^+	K^+	Ca^{++}	Mg^{++}	CL^-	HCO_3^-	$CO_3^=$	$SO_4^=$
7.49	1.64	1.01	2.54	1.29	12.26	0.31	6.49	1.75	-	8.16

2.5. Chemical (Mineral) fertilizer rates

All plots were fertilized as percentages of the recommended rates in the Ministry of Agriculture:

- Ammonium nitrate NH_4NO_3 as a source of nitrogen with three rates of $N_{100\%}$= 225 kg/fed, $N_{80\%}$= 180 kg/fed and $N_{60\%}$= 135 kg/fed It was added in three doses during the growing season by injection in irrigation network.
- Super phosphate (P_2O_5) as a source of phosphorus with three rates of $P_{100\%}$= 100 kg/fed, $P_{80\%}$= 80 kg/fed and $P_{60\%}$= 60 kg/fed was added to the soil before cultivation.
- Potassium sulfate (K_2O) as a source of potassium with three rates of $K_{100\%}$= 50 kg/fed, $K_{80\%}$= 40 kg/fed and $K_{60\%}$= 30 kg/fed were added while preparing the land for planting.

2.6. Reference evapotranspiration ETo

The reference evapotranspiration (ETo) shown in Table 4 was calculated by using Penman-Monteith equation FAO 56 method Allen *et al.,* (1998).

Table 4: Calculated reference evapotranspiration (mm/day) through winter wheat plant growth period.

Month	Nov	Dec	Jan	Feb	Mar	Apr	May
ETo mm/day	3.15	2.43	2.65	3.35	4.49	6.17	6.83

2.7. Crop evapotranspiration ETc

The crop evapotranspiration ETc shown in Table 5 was calculated by using the equation:

- **$ETc = Kc_{FAO} . ETo$ (mm/period)** Allen *et al.* (1998)

Where:
Kc_{FAO} : Crop coefficient from FAO No.(56).
ETo : Reference crop evapotranspiration, mm / period.

Table 5: Calculated crop evapotranspiration (ETc), mm through winter wheat plant growth period.

Stages	Initial	Develop.	Mid	Late	Seasonal
Planting date	17/11 to 6/12	7/12to 25/1	26/1 to 26/3	27/3 to 25/4	17/11 to 25/4
Period length (day)	20	50	60	30	160
Kc_{FAO} (-)	0.30	0.73	1.15	0.30	--------
ETo (mm)	58.68	127	226.44	176.70	588.82
$ETc_{100\%}$ (mm)	17.60	92.71	260.41	53.01	423.73
Eff. Rainfall (mm)	0	0	0	0	0

2.8. Applied irrigation water IR

The amounts of applied irrigation water (IR) for winter wheat crop at different irrigation systems shown in Table 6 were calculated by using the equation:

- **$IR_{100, 90, 80, 70, 60\%} = (ETc - pe)Kr / Ea) + LR$ (mm/period)** Keller and Karmeli (1974)

Where:

Kr: correction factor for limited wetting at wheat percent round coverage by canopy 80%, Kr = 0.90. Smith (1992).

Ea: Irrigation efficiency for center pivot= 73% and floppy sprinkler =82%, Allen *et al.,* (1998).

Pe: Effective rainfall, 0 mm/season.

LR: Leaching requirements, under salinity levels of irrigation water (0.15 x ETc), mm.

Table 6: Calculated applied irrigation water (IR), mm through winter wheat plant growth period.

IS	IR (%)	Applied Irrigation water (mm)				
		Growth Stages				
		Initial	Development	Mid	Late	Seasonal
Floppy sprinklers	100	22.04	116.1	326.1	66.38	530.57
	90	19.84	104.48	293.45	59.74	477.51
	80	17.63	92.87	260.85	53.10	424.46
	70	15.43	81.26	228.24	46.47	371.40
	60	13.22	69.65	195.64	39.83	318.34
Center Pivot	100	24.45	128.8	361.7	73.64	588.62
	90	22.005	115.91	325.57	66.276	529.76
	80	19.56	103.03	289.39	58.912	470.90
	70	17.115	90.153	253.22	51.548	412.03
	60	14.67	77.274	217.04	44.184	353.17

2.9. Actual evapotranspiration Eta

- **$ETa = (M_2\,\% - M_1\,\%)/100 .\ d_b .\ D$ (mm),** Doorenbos and Pruitt (1984).

Where:

M_2 : Moisture content after irrigation %.

M_1 : Moisture content before irrigation %

d_b : Specific density of soil .

D : Mean depth, mm.

- **Water use efficiency WUE = MY / Eta (kg/m^3),** Howell (2001).

Where:

MY: marketable yield of wheat, (kg/h).

- **Irrigation water use efficiency IWUE = MY / IR (kg/m^3),** Michael (1978).

Where:

IR : Seasonal applied irrigation water, m^3, Table 6.

3. Results and Discussion

3.1. Effect of IR and MFR under FSS and CPS treatments on studied quality parameters and yield production of winter wheat

Data in Figures (2, 3, 4, 5, 6 and 7) showed that the studied quality parameters and yield production for wheat increased with increasing applied irrigation water "IR" and chemical fertilizer rates "MFR" for both irrigation systems floppy sprinklers "FSS" and center pivot "CPS". Also, data illustrated significant superiority of FSS compared to CPS for all treatments. The results recorded the same trend for both seasons 2020/2021 and 2021/2022. The maximum values of winter wheat Plant height "PH" cm, numbers of spikes "NS" spikes/m^2, 1000 grain weight "GW" g, grain crude protein content "GCP" %, gluten content "GC" %, harvest index "HI" %, total yield "TY" Mg/ha, straw yield "SY" Mg/ha and grain yield "GY" Mg/ha were 119.79 cm, 409.27 spikes/m^2, 58.63 g, 16.09 %, 32.19 %, 45.37 %, 15.12 Mg/ha, 9.89 Mg/ha and 5.23 Mg/ha ; 123.93 cm, 416.41 spikes/m^2, 60.25 g, 16.13 %, 33.76 %, 47.52 %, 15.29 Mg/ha, 9.98 Mg/ha and 5.31 Mg/ha for both seasons respectively, under FSS irrigation system, IR=100% and MFR =100% treatment. While, the minimum values were 32.51 cm, 117.38 spikes/m2, 7.84 g, 6.35 %, 7.84 %, 8.84 %, 4.35 Mg/ha, 3.14 Mg/ha and 1.21 Mg/ha; 36.09 cm, 131.90 spikes/m^2, 9.16 g, 6.56 %, 9.84 %, 9.19 %, 4.56 Mg/ha, 3.27 Mg/ha and 1.29 Mg/ha for both seasons respectively, under CPS irrigation system, IR=60% and MFR =60% treatment. These results are in agreement with that found by Samimi et al., (2020), Shabbir et al., (2020), Khedr, (2020), Thapa et al., (2019), Zareian and Hamidi, (2014) and Yan et al., (2019).

Moreover Figures (2, 4 and 6) indicated that the relationships between IR, mm and studied quality parameters and yield production of winter wheat for season 2020/2021 were highly significant positively correlated PH (r = 0.958**, 0.959** and 0.981**), NS (r = 0.938**, 0.936** and 0.979**), GW (r = 0.973**, 0.969** and 0.982**), GCP (r = 0.956**, 0.938** and 0.981**), GC (r = 0.967**, 0.967** and 0.957**), HI (r = 0.982**, 0.992** and 0.993**), TY (r = 0.943**, 0.943** and 0.949**), SY (r = 0.945**, 0.947** and 0.948**) and GY (r = 0.941**, 0.938** and 0.949**) for all chemical fertilizer rates “MFR” (100, 80 and 60%) respectively, under FSS irrigation system treatment. While, PH (r = 0.988**, 0.992** and 0.998**), NS (r = 0.996**, 0.996** and 0.999**), GW (r = 0.994**, 0.994** and 0.997**), GCP (r = 0.996**, 0.995** and 0.996**), GC (r = 0.994**, 0.990** and 0.988**), HI (r = 0.997**, 0.995** and 0.997**), TY (r = 0.992**, 0.987** and 0.995**), SY (r = 0.995**, 0.988** and 0.996**) and GY (r = 0.987**, 0.987** and 0.991**) for all MFR (100, 80 and 60%) respectively, under CPS irrigation system treatment.

Meanwhile, Figures (3, 5 and 7) showed that the relationships between IR, mm and studied quality parameters and yield production of winter wheat for season 2021/2022 achieved the same results for all MFR (100, 80 and 60%) respectively, under FSS and CPS irrigation systems treatments.

3.2. Effect of IR and MFR under FSS and CPS treatments on seasonal actual evapotranspiration of winter wheat

Data in Figures (6 and 7) find out that the seasonal actual evapotranspiration “ETa”, mm for winter wheat increased with increasing IR and MFR for all treatments. Also, data indicated that, FSS had a clear effect on all treatments compared to CPS. The results recorded the same trend for both seasons 2020/2021 and 2021/2022. The minimum values of ETa were 159.19 and 155.72 mm for both seasons respectively, under FSS irrigation system, IR=60% and MFR =60% treatment. While, the maximum values were 346.11 and 341.25 mm for both seasons respectively, under CPS irrigation system, IR=100% and MFR =100% treatment. These results are consistent with the findings of Ati et al., (2016), Thapa et al., (2019), Yan et al., (2019), Mansour et al., (2015) and Shabbir et al., (2020).

Moreover, Figure (6) presented that the relationships between IR, mm and seasonal ETa of winter wheat for season 2020/2021 were highly significant positively correlated seasonal ETa (r = 0.999**, 0.997** and 0.988**) for all MFR (100, 80 and 60%) respectively, under FSS irrigation system treatment. While, seasonal ETa (r = 0.989**, 0.999** and 0.983**) for all MFR (100, 80 and 60%) respectively, under CPS irrigation system treatment.

Meanwhile, Figure (7) showed that the relationships between IR, mm and seasonal ETa of winter wheat for season 2021/2022 achieved the same results for all MFR (100, 80 and 60%) respectively, under FSS and CPS irrigation systems treatments.

3.3. Effect of IR and MFR under FSS and CPS treatments on WUE and IWUE of winter wheat

Data in Figures (6) and (7) illustrated that the highest WUE and IWUE for winter wheat were 5.38 and 3.21 kg m^{-3} and 5.56 and 3.29 kg m^{-3} for both seasons respectively, under FSS irrigation system, IR=70% and MFR =80% treatment. While, The lowest values were 1.59 and 0.82 kg $m^{-3}$and 1.74 and 0.87 kg m^{-3} for both seasons respectively, under CPS irrigation system, IR=60% and MFR =60% treatment.

Meanwhile, the values of WUE and IWUE under FSS irrigation system, IR=70% and MFR =80% treatment for both seasons were recorded increased significantly by approximately 69 and 72 % ; 70 and 73 % respectively, compared to that under control treatment (CPS irrigation system, IR=100% and MFR =100%). These results may be attributed to the effects of FSS irrigation which led to increased MYs with decreased water consumption. These results were similar to those reported by Wang et al., (2012), Ati et al., (2016), Thapa et al., (2019), Khedr, (2020)

Moreover, Figure (6) presented that the relationships between IR, mm and WUE and IWUE of winter wheat for season 2020/2021 were highly significant positively correlated seasonal WUE (r = 0.713*, 0.818* and 0.867**) and IWUE (r = 0.793*, 0.811* and 0.810*) for all MFR (100, 80 and 60%) respectively, under FSS irrigation system treatment. While, WUE (r = 0.994**, 0.946**and 0.932**) and IWUE (r = 0.930**, 0.946** and 0.973**) for all MFR (100, 80 and 60%) respectively, under CPS irrigation system treatment.

Meanwhile, Figure (7) explained that the relationships between IR, mm and WUE and IWUE of winter wheat for season 2021/2022 achieved the same results for all MFR (100, 80 and 60%) respectively, under FSS and CPS irrigation systems treatments.

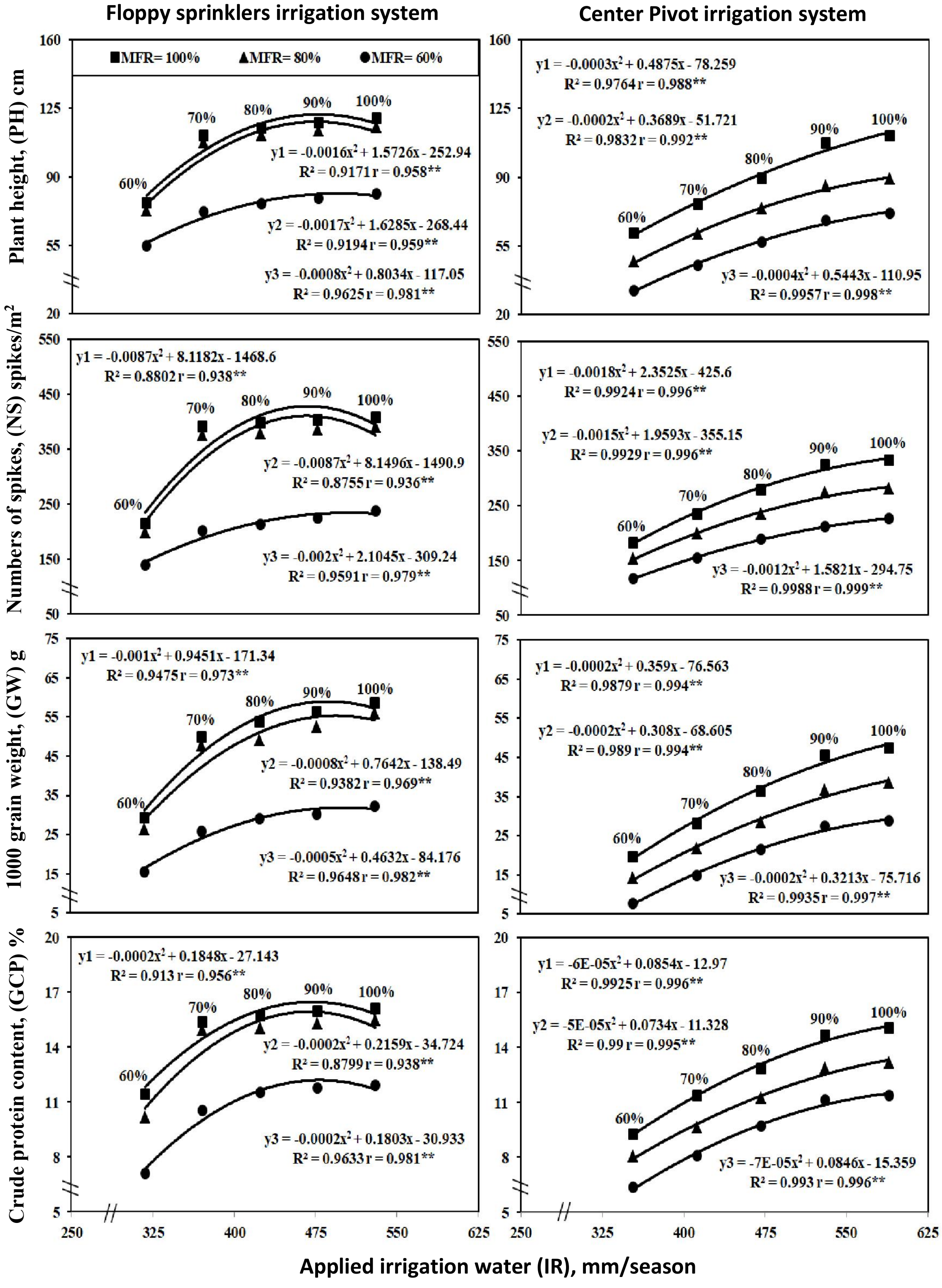

Fig. 2: Correlations between the applied irrigation water (IR), mm/season and some wheat quality parameters at various mineral fertilizer rates under floppy sprinklers and center Pivot irrigation systems for season 2020/2021.

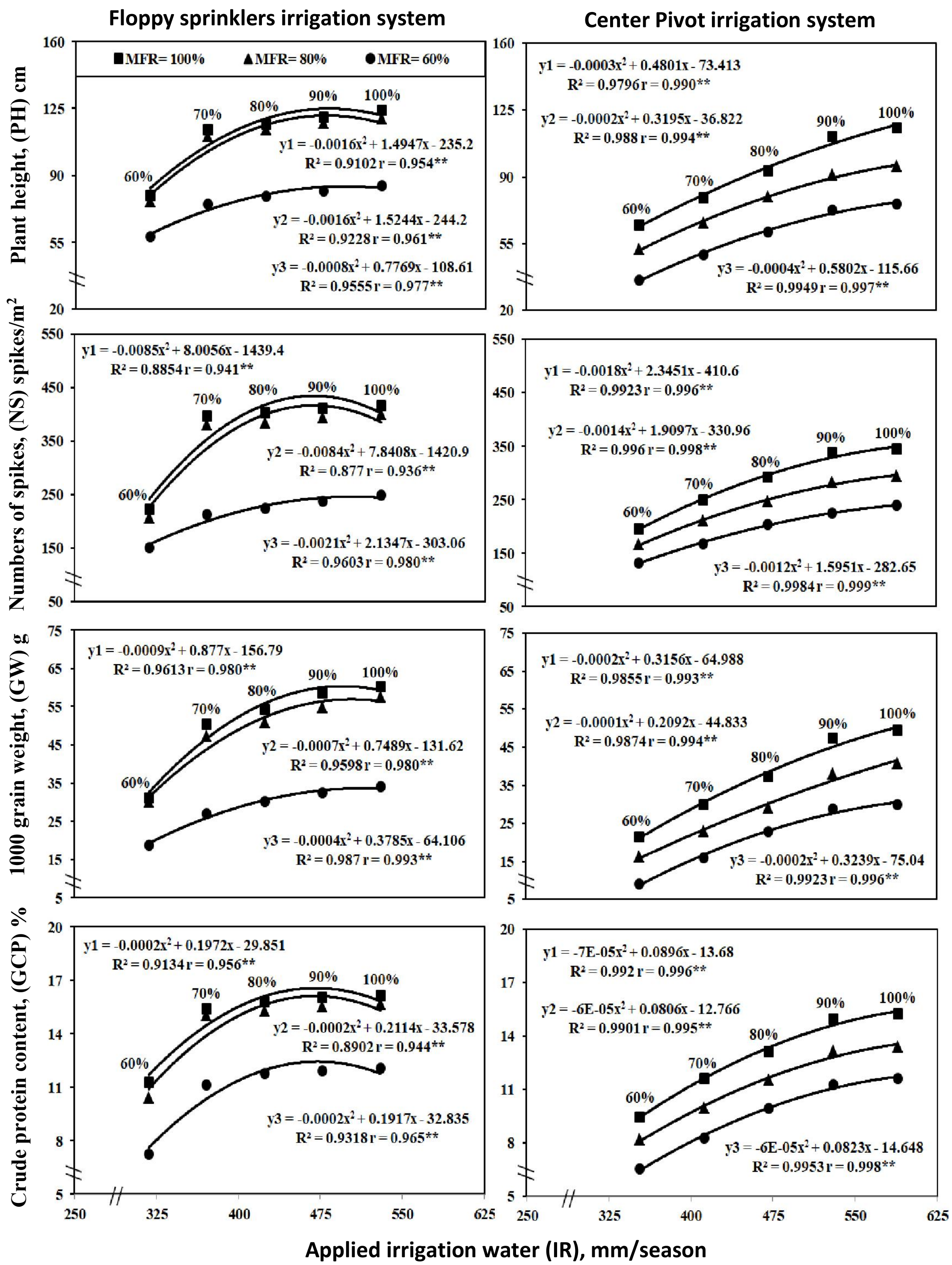

Fig. 3: Correlations between the applied irrigation water (IR), mm/season and some wheat quality parameters at various mineral fertilizer rates under floppy sprinklers and center Pivot irrigation systems for season 2021/2022.

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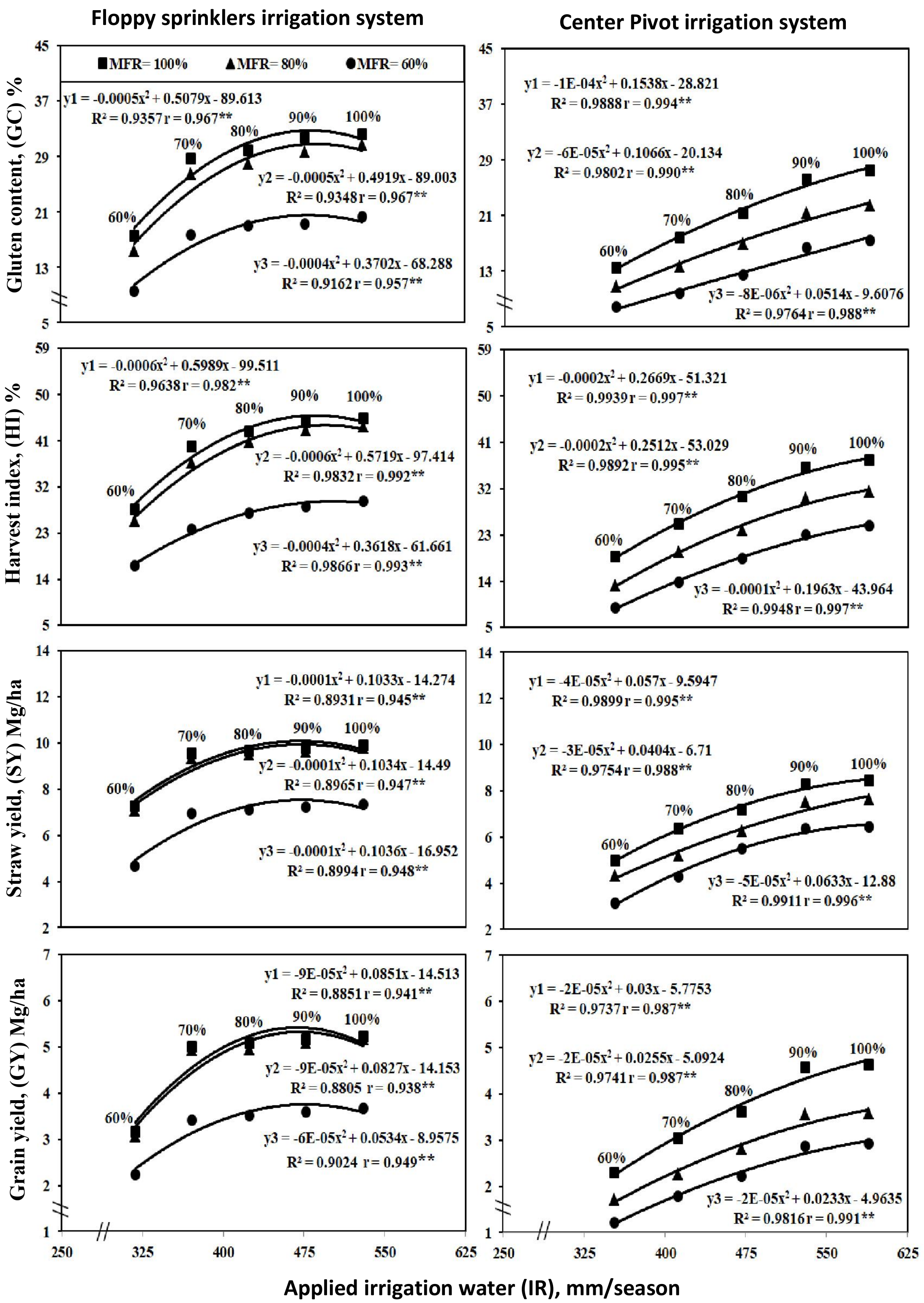

Fig. 4: Correlations between the applied irrigation water (IR), mm/season and some wheat quality parameters, straw and grain yield at various mineral fertilizer rates under floppy sprinklers and center pivot irrigation systems for season 2020/2021.

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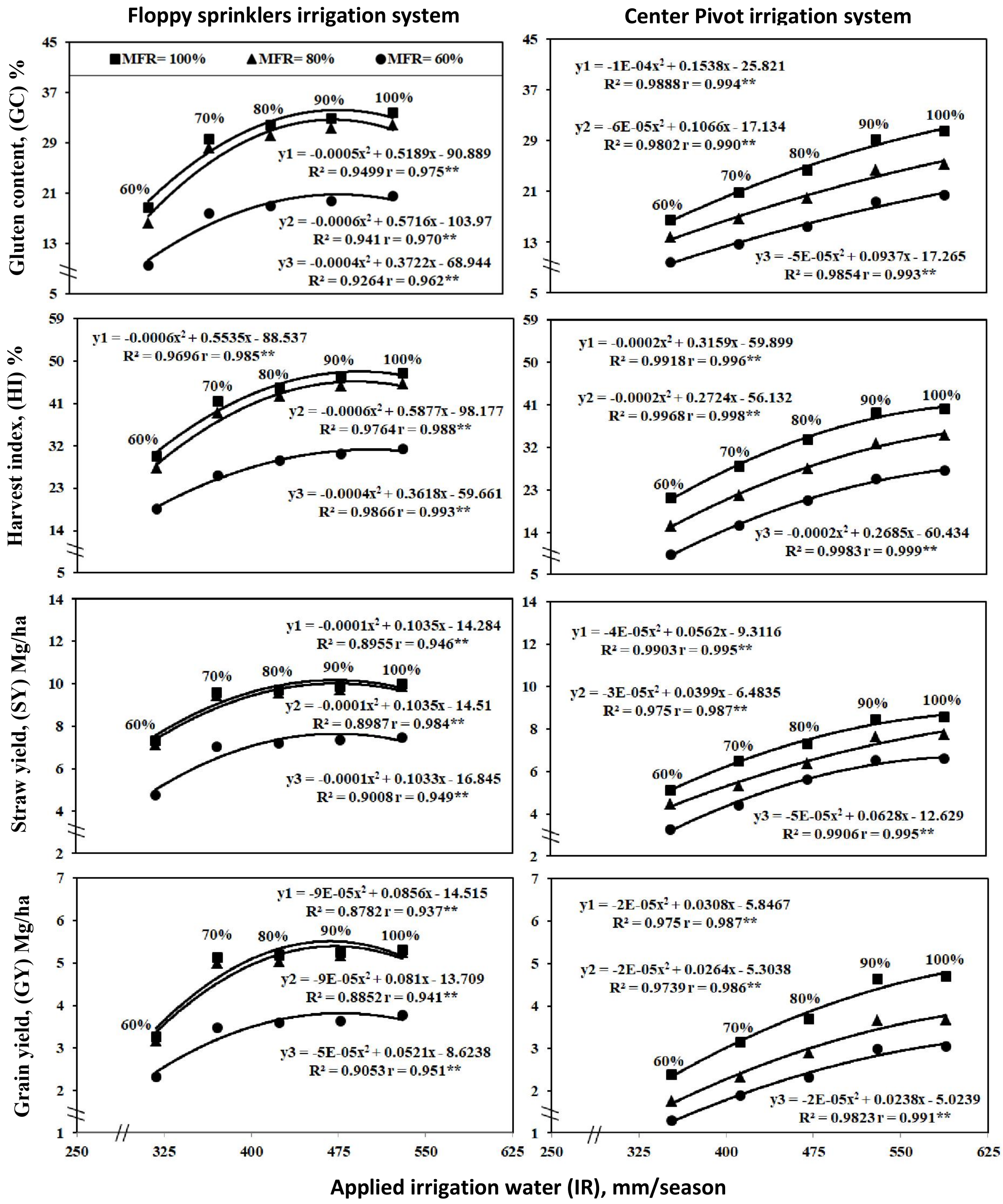

Fig. 5: Correlations between the applied irrigation water (IR), mm/season and some wheat quality parameters, straw and grain yield at various mineral fertilizer rates under floppy sprinklers and center Pivot irrigation systems for season 2021/2022.

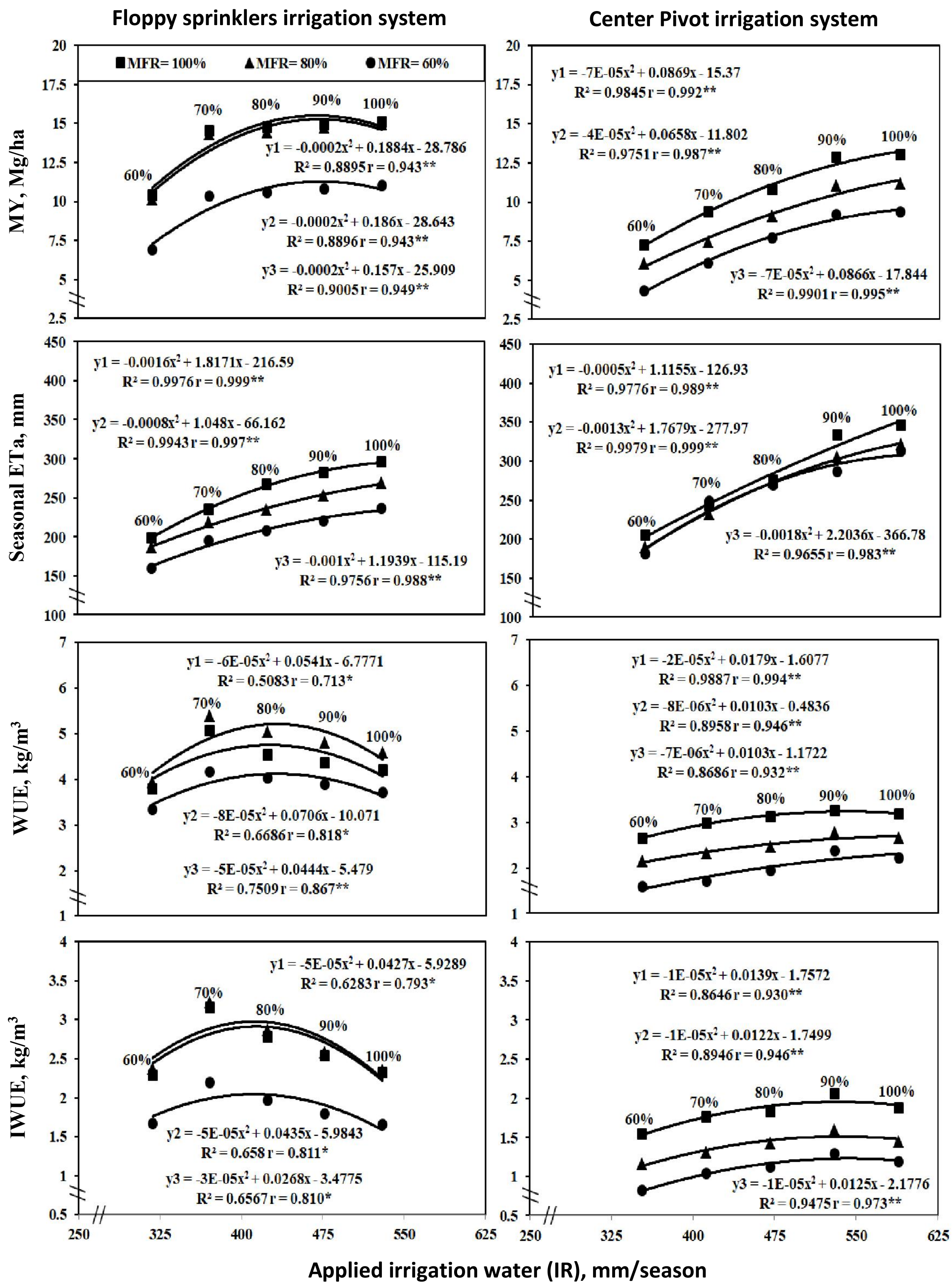

Fig. 6. Correlations between the applied irrigation water (IR), mm/season and the marketable yield (MY) Mg/ha, seasonal actual evapotranspiration (ETa) mm, water use efficiency (WUE) and irrigation water use efficiency (IWUE) kg/m^3 of wheat various mineral fertilizer rates under floppy sprinklers and center Pivot irrigation systems for season 2020/2021.

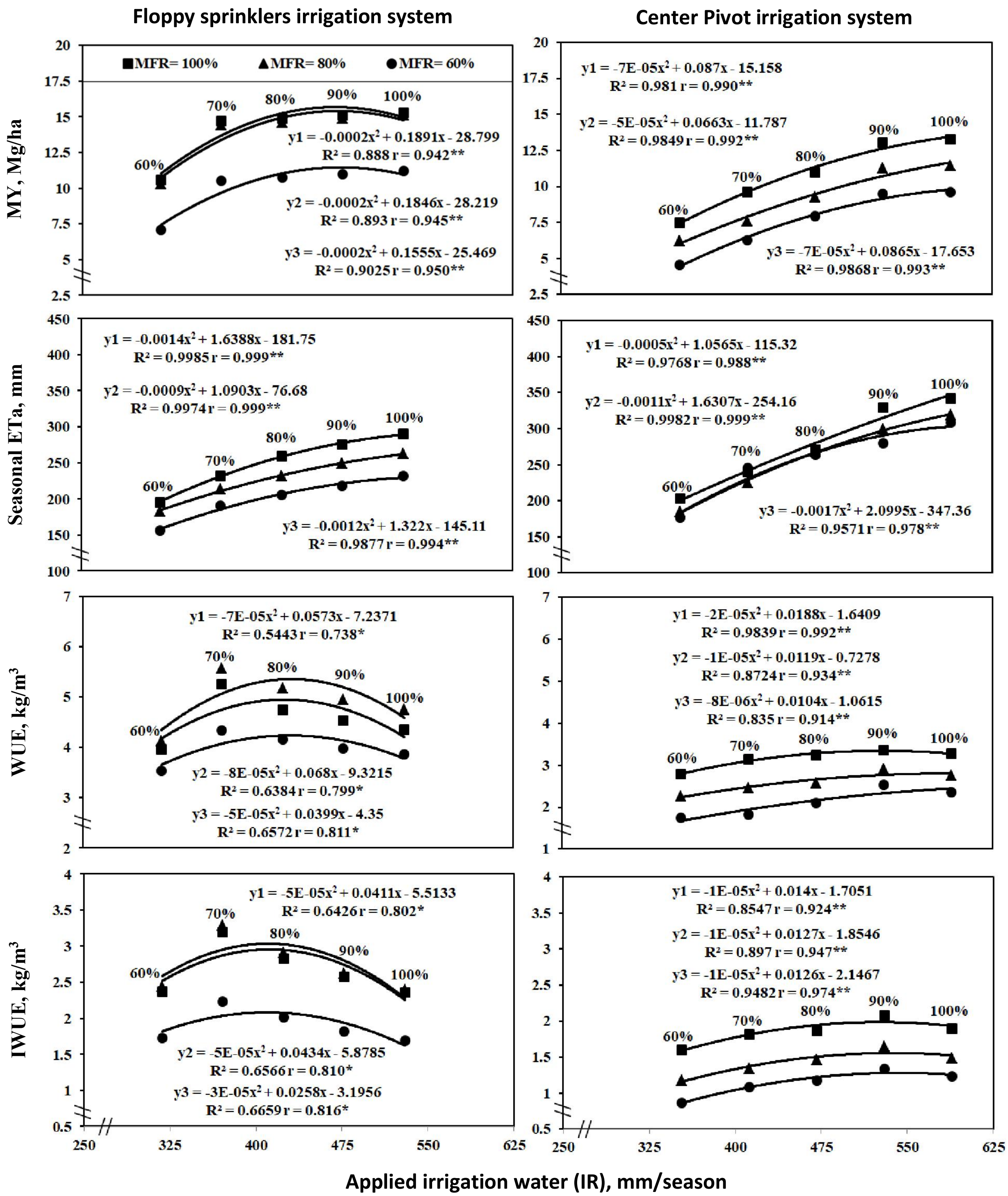

Fig. 7: Correlations between the applied irrigation water (IR), mm/season and the marketable yield (MY) Mg/ha, seasonal actual evapotranspiration (ETa) mm, water use efficiency (WUE) and irrigation water use efficiency (IWUE) kg/m^3 of wheat various mineral fertilizer rates under floppy sprinklers and center Pivot irrigation systems for season 2021/2022.

5. Conclusions

Conserving water is very important in areas experiencing severe drought, such as Egypt. This study applied irrigation water stress and evaluated the effect of different irrigation systems in FSS and CPS on winter wheat of quality parameters, biological yield production, seasonal ETa, WUE and IWUE, in El- Salhia El-Gedida sandy soil. The results indicated that the biological yield and studied quality parameters for wheat gave the highest values under FSS irrigation system, IR=100% and MFR =100% treatment. While, the seasonal ETa for wheat gave the lowest values under FSS irrigation system, IR=60% and MFR =60% treatment. Finally, the values of wheat WUE and IWUE under FSS irrigation system, IR=70% and MFR =80% treatment for both seasons were recorded increased significantly by about 69 and 72 %; 70 and 73 % for both seasons respectively, compared to that under control treatment (CPS irrigation system, IR=100% and MFR =100%).

So, it is recommended to apply (FSS irrigation system, IR=70 and MFR =80%) treatment because this treatment could be save about 38 % of added irrigation water, save about 20% chemical fertilizers and increase marketable yield of wheat about 11.33 and 10.85% for both seasons respectively, compared to that under control treatment (CPS irrigation system, IR=100% and MFR =100%). In addition, that FSS irrigation system saves a large of irrigation water and chemical fertilizers also, it save energy and does not hinder work of agricultural mechanization as well as, it irrigate the entire hectare and does not waste 23% area, compared to center pivot irrigation system which, increases productivity of hectare.

Conflicts of interest

There are no conflicts to declare.

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