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Effect of drip irrigation and fertigation on quality of wheat (*Triticum aestivum* L.)

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Abstract
Field trials were conducted in the winter months of 2017-18 and 2018-19 to examine the effect of irrigation water and fertilization levels on wheat (*Triticum aestivum* L.) yield and quality. The trial was carried out with four changes in SPD, four irrigation methods in the main plot and four fertilization stages in the second plot, for a total 16 combinations. Research has shown that scheduling 1.0 PEF drip irrigation can increase crop yields better than 0.6 PEF drip irrigation and 100% RDF drip irrigation fertilization level, resulting in more winter wheat, hay and higher protein yields. It shows that it improves wheat yield and quality. With fertilization, the RDF of rice is more than 50%.

Keywords: Protein, quality, drip irrigation, fertigation, wheat

1. Introduction

Water planning involves deciding when to water. How do I water? How much water should be used? After the end of the monsoon, the sowing season begins, such as irrigated crops or rain crops from well-moistened soil. If we are thinking of irrigating a crop, we must know that the crop needs irrigation. Irrigation can be planned using a variety of methods, including the use of climatology, soil moisture depletion, and irrigation during key stages of growth. Pan evaporation values are measured using climatological methods. Since evapotranspiration is closely related to plant evaporation, irrigation is planned according to the demand of the crop. Likewise, PEF (Pan Evaporation Fraction) irrigation scheduling technology plans irrigation based on daily evaporation data.

The water-soluble fertilizer industry has expanded in recent years, and this trend should continue. Fertilizers that dissolve easily in water and are applied to the soil or filtered from the soil are called water-soluble fertilizers. Using water-soluble fertilizers makes it easier to control the nutrient composition of your plants. The water-soluble fertilizer market is expected to grow at a CAGR of 5.3% from 2013 to 2019, reaching 9251 businesses, increasing availability and irrigation technology. The biggest problem is 2000 tons (Anonymous, 2019) [2]. The global water-soluble fertilizer market is driven by factors such as ease of application, development of new technologies, new products, and prices of water-soluble fertilizers are generally higher than soil-applied fertilizers.

2. Materials and Methods

The experiment was conducted at this facility. During the winter months of 2017-18 and 2018-19, C-7 was located at Teaching Farm, Department of Agronomy, Junagadh Agricultural University, 382001. The soil in the experimental area was clay, and the elements were moderate organic carbon, medium nitrogen content, medium phosphorus content and medium potassium content. In four split-plot design (SPD) experiments, 16 mixed treatments were distributed, including four irritations in the main plot (dog irrigation at 0.6, 0.8, 1.0 PEF, and 0.8 IW/CPE) and four seed irrigations. and fertilization rates (50%, 75%, 100% RDF in drip fertilization and 100% RDF from soil in subplots. Wheat (GW-496) was planted at the rate of 120 kg per hectare and at a row depth of 5 cm. spacing is kept at 22.5 cm.

Irrigation and fertilization were carried out for trial purposes. Cultural activities and plant protection studies are carried out when necessary.

3. Results and Discussion
3.1 Effect of drip irrigation schedules
Wheat crop, grain, straw and protein yields were higher in treatment I_3 (drip irrigation scheme at 1.0 PEF) but still at the same data as I_2; *i.e.* drip irrigated crops at 0.8 PEF during 2017-18 and 2018-19. The results and in the same column as the data I_4 (0.8 IW/CPE for surface irrigation) analyzed during 2017-18 and 2018-19, where crop and hay production are at the same level according to I_2 statistics (0.8 PEF for drip irrigation) respectively. In 2017-18, 2018-19 and combined results, it is also at I_4 (0.8 IW/CPE for flow) in 2018-19. Analysis of relevant data clearly shows that different drip irrigation methods had no significant impact on protein content in 2017-18 and 2018-19 and mixed results. Planting using drip irrigation at 1.0 PEF (I_3) harvested more protein in 2017-18 with mixed results compared to drip irrigation at 0.8 PEF (I_2) and I_4 (0.8 IW/CPE).
Abdelraouf *et al.* (2013) [1] reported that moisture stress inhibits the uptake of content by the growing grain and reduces photo assimilations. According to Chouhan *et al.* (2015) [5], drip systems work well at retaining moisture in the root zone, providing continuous access throughout the growing season and reducing water stress on crops. In accordance with Bhowmik *et al.* (2018) [4], increased irrigation to keep the root zone moist can encourage the release of more nutrients from the soil. They also reported that increased crop yield may be associated with higher water use, ensuring consistent and adequate water supply, as well as better rhizosphere conductance for nutrient uptake.

3.2 Effect of fertigation levels
When crops were fertilized with 100% RDF via drip irrigation (F_3), grain, straw and protein yields increased significantly, while in 2017-18, straw and protein yields reached F_2 (75% RDF fertilized with drip irrigation). To increase the effect of different levels of fertilization on protein content was found to be insignificant in both years with mixed results, while fertilization with 100% RDF drip irrigation (F_3) application was recorded in 2017-18, 2018-19 and the main collection period, maximum protein yields were based on the results.
According to Alam *et al.* (2003) [3], fertigation's divided administration of N at the first and second irrigation times was preferable to top dressing. According to Abdelraouf *et al.* (2013) [1], increased plant height and spikelet numbers m^{-2} led to higher nitrogen usage efficiency, which in turn increased yields. According to Jabran *et al.* (2011) [6] fertigation of nutrients like nitrogen, phosphorus, and potassium at grain growth stage assisted to create more fertile tillers and spikelets per spike and less unfertile tillers. These findings coincide with those made public by Kassem and Suker (2009) [8].

3.3 Interaction effect
The interaction between drip irrigation scheme and fertilization level (I x F) for paddy crops was found to be significant in 2017-18, 2018-19 and summary. 1.0 PEF drip irrigation and 100% RDF crop fertilization (I_3F_3) resulted in increased yield and was analyzed in comparison with I_3F_2 application in 2017-18 and 2018-19. According to the data collected, fertilizing crops with 100% RDF through drip irrigation and drip irrigation (I_3F_3) at 1.0 PEF increased straw and protein yield in 2018-19. It also includes a comparison of combined I_3F_2 treatment in 2018-19, and in the cumulative results, statistics for combination I_3F_2 are compared, excluding protein results in 2018-19.
According to Abdelraouf *et al*. (2013) [1], there was a significant interaction between fertigation treatment reduction (from 100% to 50% RDF) and irrigation demand reduction (from 100% to 50%) on grain, straw, and biological yields. These findings coincide with those made public by Karangiya *et al.* (2019) [7].

Table 1: Response of wheat to drip irrigation schedules and fertigation levels on grain and straw yields.

Treatments	Grain yield (Kg/ha)			Straw yield (Kg/ha)		
	2017-18	2018-19	Pooled	2017-18	2018-19	Pooled
Drip irrigation schedules (I)						
I_1:DI 0.6 PEF	3564	3859	3712	4357	4014	4185
I_2:DI 0.8 PEF	4083	4254	4169	4770	4594	4682
I_3:DI 1.0 PEF	4232	4507	4369	5065	4719	4892
I_4:SI at 0.8 IW/CPE ratio	4053	4133	4093	4524	4398	4461
S.Em. ±	119	126	87	142	125	94
C.D. (P=0.05)	383	406	259	454	400	281
C.V. (%)	12.0	12.1	12.1	12.1	11.3	11.8
Fertigation (F)						
F_1: 50% RDF	3659	3645	3652	4066	3947	4007
F_2: 75% RDF	4053	4309	4181	4905	4556	4731
F_3: 100% RDF	4382	4684	4533	5221	4971	5096
F_4: 100% RDF through soil application	3838	4115	3976	4524	4250	4387
S.Em. ±	80	93	61	112	101	75
C.D. (P=0.05)	231	268	174	323	291	214
C.V. (%)	8.1	8.9	8.5	9.6	9.2	9.4
I×F interaction						
S.Em. ±	160	186	123	225	202	151
C.D. (P=0.05)	461	535	347	NS	581	581

DI: Drip Irrigation, SI: Surface Irrigation and RDF: Recommended Dose of Fertilizer.

Table 2: Response of wheat to drip irrigation schedules and fertigation levels on protein content and protein yield.

Treatments	Protein content (%)			Protein yield (Kg/ha)		
	2017-18	2018-19	Pooled	2017-18	2018-19	Pooled
Drip irrigation schedules (I)						
I_1:DI 0.6 PEF	11.99	10.59	10.79	410.7	409.7	410.2
I_2:DI 0.8 PEF	11.07	10.64	10.86	451.2	453.2	452.2
I_3:DI 1.0 PEF	11.09	10.67	10.88	462.9	481.7	472.3
I_4:SI at 0.8 IW/CPE ratio	11.02	10.61	10.82	436.7	438.9	437.8
S.Em. ±	0.09	0.09	0.06	11.27	16.00	9.78
C.D. (P=0.05)	NS	NS	NS	36.1	NS	29.1
C.V. (%)	3.24	3.69	3.46	10.24	14.35	12.49
Fertigation levels (F)						
F_1: 50% RDF	10.91	10.51	10.71	385.5	383.5	384.5
F_2: 75% RDF	11.08	10.65	10.87	446.9	459.6	453.3
F_3: 100% RDF	11.17	10.73	10.95	499.4	502.8	501.1
F_4: 100% RDF through soil application	11.01	10.63	10.82	429.6	437.4	433.5
S.Em. ±	0.07	0.06	0.05	9.78	9.94	6.97
C.D. (P=0.05)	NS	NS	NS	28.1	28.5	19.7
C.V. (%)	2.58	2.21	2.41	8.89	8.92	8.90
I×F interaction						
S.Em. ±	0.143	0.117	0.092	19.56	19.88	13.95
C.D. (P=0.05)	NS	NS	NS	NS	52.87	37.88

DI: Drip Irrigation, SI: Surface Irrigation and RDF: Recommended Dose of Fertilizer.

Conclusion

According to the two-year test results, to obtain more yield of grain, straw and protein, crops should be regularly watered twice with a water depth of 50 mm, and the first irrigation should be done immediately after planting at a rate of 0.8 IW/CPE. A second joint watering three to four days after the first watering. The remaining water should be drip irrigation at a rate of 1.0 PEF per day and the crops should receive 100% RDF (120-60-60 kg NPK ha^{-1}) where 50% RDF is used as fertilizer and 50% RDF fraction. (60-30-30 kg NPK ha^{-1}) was divided into 6 equal parts with 10 days intervals and irrigated and fertilized starting from 10 DAS.

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