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Influence of Moisture Regimes and Fertility Level on Root and Qualitative Studies of Wheat (*Triticum aestivum* L.) under Late Sown condition

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ABSTRACT: The experiment was conducted at Agronomy Research Farm, Acharya Narendra Deva University of Agriculture & Technology, Narendra Nagar, (Kumarganj), Ayodhya (U.P.) during Rabi season of 2019-20 and 2020-21. The experiment were laid out in split plot design having three moisture regimes *i.e.* Irrigation at 0.8 IW/CPE ratio (I_1), Irrigation at 1.0 IW/CPE ratio (I_2) and irrigation at 1.2 IW/CPE ratio (I_3) with 6 cm depth of each irrigation were allotted as main plot and four fertility level *i.e.*100% RDF by inorganic fertilizer (F_1), 75% RDF by inorganic fertilizer + 25% RDN by FYM (F_2), 50% RDF by inorganic fertilizer + 50% RDN by FYM (F_3) and 25% RDF by inorganic fertilizer + 75% RDN by FYM (F_4) kept as sub plot. The experiment was replicated three times on silty loam in texture soil and medium in fertility status having pH (8.32 and 8.26), organic carbon (0.31 and 0.32%), EC (0.28 and 0.30) dsm^{-1}.The highest value of root studies were recorded under moisture regimes I_2 compared to other. However, in fertility level highest value observed under F_2 was compared to other treatment level at 60 DAS. The maximum value of N, P, and K content and uptake in grain and straw were recorded under moisture regimesI_2 compared to other treatment. However, maximum nutrient value under fertility level treatment F_2 was compared to other treatment during both the year experimentation.

Keywords: Root, Nutrients, protein, Moisture, Fertility and wheat.

INTRODUCTION

Wheat grown worldwide is hexaploid bread wheat, with most of the remaining 5% being tetraploid durum wheat. Small amounts of other wheat species (einkorn, emmer, spelt) are still grown in some regions including Spain, Turkey, the Balkans, and the Indian subcontinent (Shewry, 2009). The world population is increase 74 million per year, which will accumulation to approximately 2.4 billion additional people by 2050. Global demand for crop calories is expected to double between 2005 and 2050 (Tilman *et al.* 2011). In India, it's cultivated in almost all parts with majority in Indo-Gangatic plains and has an area of 31.62 million hectares with production of 109.52 million tones and productivity of 3460 Kg ha^{-1} during 2021-22 (Anonymous, 2022). The crop is sensitive to variation in environmental conditions for better emergence, development and anther is highly vulnerable to high temperature that affected the partitioning of biomass from vegetative organs (Mukherjee, 2012). The optimum time of sowing for wheat crop in India is fortnight of November but any situation delay sowing after November, decreased the yield potential of wheat by 1-1.5% per day. The delay in sowing of crop mainly because of late harvest of paddy crop, delay in field operation and climate changes etc. (Singh *et al.* 2021).In India the demand for nutrient resources particularly N,P and K is exceeding the supply and the competition for this scarce resources is becoming intense in agriculture. Nitrogen is the key input amongst all primary nutrients that's directly involved in plant photosynthetic system. This is important for all recommended agronomic practices and therefore efficient utilization of nitrogen is essential for wheat. Imbalance and improper time of use of nitrogen fertilizer warrants their judicious use to maximized fertilizer use efficiency. Recovery of added nitrogen fertilizer if only 50% or less most of arable soils owing to vitalization, leaching and dinitrification losses (Mukherjee, 2019).

MATERIAL AND METHODS

A field experiment was conducted during the winter season (Rabi) 2019-20 and 2021 at agronomy research farm of Acharya Narendra Dave University of Agriculture and Technology, Kumarganj, Ayodhya (UP). This site has sub-tropical climate of indo Gangatic alluvial plain zone having alluvial calcareous soil and located at 26°47′N latitude and 82°12′E

longitude with an altitude of 113 m above the mean sea level. The mean value of minimum and maximum temperature 5.3 and 24.2 recorded during the growing seasons. The mean value minimum and maximum 39.5 and 85.2 % of relative humidity during growing season of wheat. The total rainfall 158 mm but no rainfall during second year crop growing season, respectively. The experiment were laid out in split plot design having three moisture regimes *i.e*. Irrigation at 0.8 IW/CPE ratio (I_1), Irrigation at 1.0 IW/CPE ratio (I_2) and irrigation at 1.2 IW/CPE ratio (I_3) with 6 cm depth of each irrigation were allotted as main plot and four fertility level *i.e.*100% RDF by inorganic fertilizer (F_1), 75% RDF by inorganic fertilizer + 25% RDN by FYM (F_2), 50% RDF by inorganic fertilizer + 50% RDN by FYM (F_3) and 25% RDF by inorganic fertilizer + 75% RDN by FYM (F_4) kept as sub plot. The experiment was replicated three times on silty loam in texture soil and medium in fertility status having pH (8.32 and 8.26), organic carbon (0.31 and 0.32%), EC (0.28 and 0.30) dsm^{-1}, available nitrogen (185 and 189 kg ha^{-1}), available phosphorus (16.20 and 16.30 kg ha^{-1}) and available potassium (282 and 284 kg ha^{-1}). The what variety of 'PBW-373' was sown 4 × 5 m under experimental field using seed rate of 125 kg ha^{-1} by seed drill cum fertilizer. The recommended dose of fertilizer 120 kg ha^{-1} nitrogen, 60 kg ha^{-1} phosphorus and 40 kg ha^{-1} potassium but some amount of nitrogen given by FYM as per treatments. Root were sample at wheat growing season. Each sampling area was 40 cm in length (perpendicular to the rows, providing access to plant in two rows) and 40 cm in width (parallel to the rows). The root with soil were then transferred to a 100 mesh nylon bag and submerged in water for 1 hr. Any remaining soil was then washed from the root using a low pressure garden hose, and the clean roots were transferred to a sieve 0.25 mm^2 mesh suspended in a through partially filled with water. Nutrient content in grain and straw of wheat crop at harvest was estimation separately from the selected plant of each plot. Oven dried plant sample were ground with the help of Willy mill grinder. The uptake of nitrogen, phosphorus and potassium by the wheat crop was calculated by the following formula.

$$\text{Uptake of nutrient (kg ha}^{-1}) = \frac{\text{Nutrient content (\%)} \times \text{Yield(kg ha}^{-1})}{100}$$

The grain samples of wheat were analyzed for their nitrogen content by modified micro-Kjeldhal's method. Nitrogen content of grains was multiplied by conservation factor (6.25) to get total crude protein content (AOAC, 1960).

Protein content (%) = Nitrogen content (%) × 6.25

RESULT AND DISCUSSION

Data on root studies characters *viz*. root length (cm), Fresh weight of root (g) and Dry weight of root (g), as influenced significantly by moisture regimes and Fertility level of wheat are presented in Table 1. It clearly reveals that the rate of growth of root was maximum rate of growth was observed during 60 to 90 DAS. The progressive increase in root length continued till maturity. The moisture regimes significantly influence of the all root studies at 60 and 90 DAS was under observed treatment I_2, which was at per I_3 and highly significant I_1. The deepest root length (20.90 and 20.98 cm) and (36.34 and 36.68 cm), fresh weight of root (17.19 and 17.14 g) (42.14 and 42.20 g) and dry weight of root (2.74 and 2.82 g) and (7.06 and 7.49 g) at 60 and 90 DAS was recorded under the I_2 followed by I_3 and I_1 treatment of wheat crop both the year data. The fertility level significantly affected the all root studies at 60 and 90 DAS was found to be superior under observed F_2. However, followed by highly significant over with the under treatment of F_1, F_3 and F_4. The above same trend of root studies deepest root length was recorded (20.72 and 20.97) and (36.12 and 36.52), fresh weight of root (17.17 and 17.44 g) (42.02 and 42.82 g) and dry weight of root (2.72 and 2.81 g) (7.24 and 7.47 g) at 60 and 90 DAS stage respectively with the treatment of F_2, followed by F_1, F_3 and the lowest root length was recorded with F_4 treatment both the year of data. These finding are supporting by Pal *et al.* (2020).

Table 1: Effect of moisture regimes and fertility level on root studies of wheat crop.

Treatment	Root length (cm)				Root fresh weight (g)				Root dry weight (g)			
	60 DAS		90 DAS		60 DAS		90 DAS		60 DAS		90 DAS	
	2019-20	2020-21	2019-20	2020-21	2019-20	2020-21	2019-20	2020-21	2019-20	2020-21	2019-20	2020-21
(A) Moisture regimes												
I_1	17.80	17.91	34.44	34.96	16.18	16.25	39.08	40.05	2.41	2.53	6.48	6.94
I_2	20.90	20.98	36.34	36.68	17.19	17.41	42.14	42.20	2.74	2.82	7.06	7.49
I_3	18.68	18.87	35.31	35.73	16.49	16.83	40.93	41.45	2.48	2.64	6.61	7.02
SEm+	0.37	0.35	0.35	0.30	0.16	0.14	0.20	0.18	0.06	0.04	0.09	0.04
CD at 5%	1.44	1.40	1.01	0.86	0.64	0.56	0.81	0.69	0.23	0.15	0.35	0.16
(B) Fertility level												
F_1	19.83	19.79	35.94	36.45	16.98	17.03	41.22	41.30	2.61	2.70	6.99	7.24
F_2	20.72	20.97	36.12	36.52	17.17	17.44	42.02	42.82	2.72	2.81	7.24	7.47
F_3	18.24	18.38	35.01	35.43	16.23	16.63	40.16	40.90	2.52	2.54	6.24	7.03
F_4	17.70	17.88	34.38	34.76	16.11	16.21	39.47	39.91	2.32	2.59	6.38	6.86
SEm+	0.32	0.36	0.29	0.30	0.16	0.14	0.27	0.21	0.05	0.05	0.10	0.08
CD at 5%	0.96	1.06	0.62	0.64	0.48	0.43	0.81	0.61	0.17	0.14	0.31	0.24

The nitrogen content (%) in grain along with straw and protein (%) in grain did not influenced significantly but nitrogen uptake significantly affected by different moisture regimes and fertility level of wheat are presented in Table 2. However, the maximum nitrogen content 1.52 and 1.53 (%) and uptake 71.64 and 73.19 in grain 30.96 and 31.57 kg ha^{-1} in straw and protein 9.52 and 9.58% in grain was recorded under the treatment I_2 followed by I_3 and I_1 of wheat crop. In fertility level maximum nitrogen content 1.55 and 1.55 (%) and uptake 72.94 and 74.59 in grain, 31.51 and 32.21 in straw as well as protein 9.67 and 9.71% in grain was noted with F_2 followed by F_1, F_3 and F_4 during both the years of experimentation. These also reported by Seth *et al.* (2019; Rizk and Sheriff (2014) respectively.

The phosphorus content (%) in grain along and straw did not influenced significantly but phosphorus uptake significantly affected by different moisture regimes and fertility level of wheat are presented in Table 3. However, the maximum phosphorus content (%) 0.37 in grain, 0.11 in straw and uptake (kg ha^{-1}) 17.19 and 17.57 in grain and 6.98 and 7.12 straw was recorded under the treatment I_2 followed by I_3 and I_1 of wheat crop. In fertility level maximum phosphorus content (%) 0.37 in grain, 0.12 in straw and uptake (kg ha^{-1}) 17.51 and 17.93 in grain,7.11 and 7.26 in straw was noted with F_2 followed by F_1, F_3 and F_4 during both the years of experimentation. The also similar finding Kumar *et al.* (2018); Pandey *et al.* (2017), respectively. The potassium content (%) in grain along and straw did not influenced significantly but phosphorus uptake significantly affected by different moisture regimes and fertility level of wheat are presented in Table 4. However, the maximum potassium content (%) 0.33 in grain, 1.36 and 1.37 in straw and uptake (kg ha^{-1}) 15.47 and 15.81 in grain and 84.43 and 86.09 straw was recorded under the treatment I_2 followed by I_3 and I_1 of wheat crop.

Table 2: Effect of moisture regimes and fertility level on nitrogen studies of wheat crop.

Treatment	Nitrogen content (%)				Nitrogen uptake kg ha^{-1}				Protein (%)	
	Grain		Straw		Grain		Straw		Grain	
	2019-20	2020-21	2019-20	2020-21	2019-20	2020-21	2019-20	2020-21	2019-20	2020-21
(A) Moisture regimes										
I_1	1.49	1.50	1.49	1.50	64.38	66.01	27.99	28.59	9.33	9.39
I_2	1.52	1.53	1.52	1.53	71.64	73.19	30.96	31.57	9.52	9.58
I_3	1.51	1.52	1.51	1.52	68.15	69.83	29.50	30.17	9.45	9.38
SEm±	0.02	0.03	0.02	0.03	1.22	1.31	0.55	0.51	0.18	0.20
CD at 5%	NS	NS	NS	NS	4.82	5.17	2.17	1.99	NS	NS
(B) Fertility level										
F_1	1.53	1.53	1.53	1.53	71.23	72.87	30.83	31.48	9.54	959
F_2	1.55	1.55	1.55	1.55	72.94	74.69	31.51	32.21	9.67	9.71
F_3	1.50	1.50	1.50	1.50	66.14	67.73	28.68	29.25	9.35	9.48
F_4	1.47	1.48	1.47	1.48	61.93	63.42	26.91	27.50	9.17	9.41
SEm±	0.02	0.03	0.02	0.03	1.93	1.77	0.55	0.76	0.18	0.22
CD at 5%	NS	NS	NS	NS	5.75	5.26	1.65	2.26	NS	NS

Table 3: Effect of moisture regimes and fertility level on phosphorus studies of wheat crop.

Treatment	Phosphorus content (%)				Phosphorus uptake kg ha^{-1}			
	Grain		Straw		Grain		Straw	
	2019-20	2020-21	2019-20	2020-21	2019-20	2020-21	2019-20	2020-21
(A) Moisture regimes								
I_1	0.36	0.36	0.11	0.11	15.45	15.84	6.31	6.46
I_2	0.37	0.37	0.11	0.11	17.19	17.57	6.98	7.12
I_3	0.36	0.36	0.11	0.11	16.36	16.76	6.65	6.80
SEm±	0.01	0.01	0.00	0.00	0.31	0.29	0.12	0.12
CD at 5%	NS	NS	NS	NS	1.21	1.17	0.47	0.48
(B) Fertility level								
F_1	0.37	0.37	0.11	0.11	17.10	17.49	6.95	7.10
F_2	0.37	0.37	0.12	0.12	17.51	17.93	7.11	7.26
F_3	0.36	0.36	0.11	0.11	15.87	16.25	6.47	6.61
F_4	0.36	0.35	0.11	0.11	14.86	15.22	6.07	6.20
SEm±	0.01	0.01	0.00	0.00	0.31	0.40	0.14	0.13
CD at 5%	NS	NS	NS	NS	0.91	1.20	0.42	0.39

In fertility level maximum potassium content (%) 0.33 and 0.34 in grain, 1.39 and 1.40 in straw and uptake (kg ha^{-1}) 15.75 and 16.13 in grain, 85.95 and 87.84 in straw was noted with F_2 followed by F_1, F_3 and F_4 during both the years of experimentation. These are reported that Hingonia *et al.* (2018); Yadav *et al.* (2018); Paswan *et al.* (2014) respectively.

Table 4: Effect of moisture regimes and fertility level on potassium studies of wheat crop.

Treatment	Potassium content (%)				Potassium uptake kg ha^{-1}			
	Grain		Straw		Grain		Straw	
	2019-20	2020-21	2019-20	2020-21	2019-20	2020-21	2019-20	2020-21
(A) Moisture regimes								
I_1	0.32	0.32	1.33	1.35	13.91	14.26	76.33	78.10
I_2	0.33	0.33	1.36	1.37	15.47	15.81	84.43	86.09
I_3	0.33	0.33	1.34	1.38	14.72	15.08	80.46	82.28
SEm±	0.01	0.01	0.03	0.03	0.42	0.32	1.51	1.39
CD at 5%	NS	NS	NS	NS	1.66	1.29	5.93	5.48
(B) Fertility level								
F_1	0.33	0.33	1.37	1.38	15.39	15.74	84.09	85.85
F_2	0.33	0.34	1.39	1.40	15.75	16.13	85.95	87.84
F_3	0.32	0.33	1.35	1.35	14.29	14.63	78.21	79.93
F_4	0.32	0.32	1.32	1.33	13.38	13.70	73.39	75.00
SEm±	0.01	0.01	0.03	0.03	0.37	0.36	1.51	1.34
CD at 5%	NS	NS	NS	NS	1.11	1.08	4.50	3.99

CONCLUSION

Most suitable treatment moisture regimes at 1.0 IW/CPE ratio andAmong the fertility level, application of 75% RDF by inorganic fertilizer + 25% RDN by FYM for root studies as well as nitrogen, phosphorus, potassium and protein of wheat under late sown condition with 6 cm irrigation water.

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Conflict of Interest. None.

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