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Effect of wheat varieties, moisture regimes and nutrient supply system on growth and yield under late sown condition in eastern U.P

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Abstract
A field experiment was conducted at the Agronomy Research Farm of Narendra Deva University of Agriculture & Technology, Kumarganj Faizabad (U.P.) during *rabi* season of two consecutive years of 2012-13 and 2013-14 with eighteen treatment combinations consisted of three wheat varieties, i.e.V_1(NW-2036), V_2(PBW-373) and V_3(HUW-234) and two moisture regimes, i.e. M_1(irrigation at 0.8 IW/CPE ratio) and M_2(1.0 IW/CPE ratio) in main plots and three nutrient supply system, i.e. F_1(100% RDF through chemical fertilizers 150:60:40 NPK kg ha^{-1}), F_2(50% RDN+ 50% N through FYM and F_3(50% RDN+50% N through neem cake) in sub plots. The growth characters like plant height (cm), number of shoots per meter row length, LAI, crop dry matter as well as yield attributes e.g. number of grains m^{-2}, length of spike (cm), number of grains- $spike^{-1}$ and weight of grain $spike^{-1}$ were found significantly higher with variety PBW-373, moisture regime 1.0 IW/CPE and RDF at 150:60:40/NPK kg h^{-1} over rest of the treatments during both the years. The grain and straw yields were also followed the same trend as of growth and yield attributes during both the years.

Keywords: wheat, verities, IW/CPE, FYM, RDN, neem cake

1. Introduction
Wheat is one of the most important cereal crops of India with diverse uses. Intensive cultivation has resulted in depletion of soil nutrients to a great extent thus nutrients requirement of crops has increased considerably during the last few years. The yield and water use efficiency of cultivars/hybrids differed significantly. Those varieties /hybrids which have high water use efficiency should be grown under the areas where limited water is available to increase the water productivity. The proper use of available irrigation water and application of suitable dose of fertilizer nutrients in respect to available soil moisture may play an important role in minimizing the present large gap between yield achieved and yield achievable. The importance of irrigation management has further increase with the introduction of the dwarf wheat cultivars throughout the country, for achieving the maximum yield of different wheat varieties. In the U.P. generally 4-5 irrigation are recommended which may be increased upto 5-6 irrigation depending upon the climatic conditions as well as underground water table.
Combined application of both nitrogen and phosphorus has greatly enhanced their- efficacy, potassium fertilization further improves the utilization of nitrogen and phosphorus. It is observed now a days that soils are going sick. Improvement in the soil quality may be essential to sustain soil health and crop productivity. Some efforts have been done in this direction by involving organic manure with chemical fertilizers, FYM, vermi-compost, bio-compost and some other organic sources. Hence the study of the effect of various fertilizers and manures in balanced proportion on yield of wheat will be of immense significance to understand the fertilizer requirement, because they reach their full yield potential with adequate supply of various fertilizers. Therefore, the application of adequate irrigation and fertilizers in balance proportion is necessary for the sustainable yield.

2. Materials and Methods
The investigation was carried out during the winter (rabi) season of 2012-13 and 2013-14 at Kumarganj Faizabad. The soil was silt loam, having pH (8.21 & 8.20), organic carbon (0.35 and 0.38%), EC (0.34 and0.32 dS m^{-1}), available N (109.40 and 115.40 kg/ha). P (15.82 and 17.60 kg/ha), S (9.84 and 10.80 kg/ha), and K (245. 20 and 251.47 kg/ha). The experiment was laid out in split-plot design with 3 replications. Keeping combinations of three wheat varieties, i.e.V_1 (NW-2036), V_2 (PBW-373) and V_3 (HUW-234) and two moisture regimes,

i.e. M_1(irrigation at 0.8 IW/CPE ratio) and M_2(1.0 IW/CPE ratio) in main plots and three nutrient supply system, i.e. F_1(100% RDF through chemical fertilizers 150:60:40 NPK kg ha^{-1}), F_2(50% RDN+ 50% N through FYM and F_3(50% RDN+50% N through neem cake) in sub plots was sown on 20 December 2012 during the first year and 21 December 2013 during the second year using a seed rate of 125 kg/ha at a row spacing of 20.0 cm. 100% RDF (150:60:40 NPK) were applied as urea, DAP, MOP in first treatment. (50% RDF) Along with FYM were in the form applied in second treatment. (50% RDF) along with Neem cake were applied in third treatment. In all the treatment half dose of nitrogen and full dose of phosphorus, potash, FYM and Neem cake was applied at the time of sowing of the wheat crop and remaining dose of nitrogen were applied in the form of top dressed after first irrigation. The mode of top dressing of urea was similar in both the years.

3. Results and Discussion

3.1 Effect of wheat varieties on growth and its attributes

The significantly taller plants were recorded with wheat variety PBW-373 which was at par with NW-2036 and both varieties produced significantly taller plant than those of HUW-234. This may be attributed to different behavior of varieties *vis-à-vis* genetic character of variety. Plant growth and yield are governed by the combined effects of inherited genetic potential and environment in which plants are grown. The significant difference was not found is the initial plant population among the varieties. While significant differences in plant height, number of shoot m^{-1}, LAI and dry matter accumulation was recorded with variety PBW-373 at all the growth stage of crops while differences at 30 DAS was recorded non-significant.

3.2 Effect of wheat varieties on yield and its attributes

Similarly yield attributing characters showed the significant differences among the varieties. The variation in growth, development and yield might also be probably due to varietal their characteristics. Variation in plant growth, development and yield among varieties may be due to their genetic characters. Among the cultivars of wheat included in experiment, PBW-373 has been found more promising as comparison to (NW-2036 & HUW-234).

3.3 Effect of moisture regime on growth and its attributes

Irrigation scheduling irrigation showed significant effect on growth character *viz.*, plant height, number of shoots m^{-1}, leaf area index as well as crop dry matter m^{-2} at 60, 90 DAS and at harvest stage. At harvest significant reduction in plant height due to decrease in moisture availability was also reported by Yadav and Verma (1991) [16] and Saren *et al.* (2004) [13]. The plant height, number of shoot m^{-1} and leaf area index does not influence significantly by various moisture regimes at initial growth stage (30 DAS) because variable irrigation was received after this stage similar results were also reported by Sharma *et al.* (1990) [14] and Ahmed (1993) [1]. Number of shoot m^{-1} was not influenced at 30 DAS due to various moisture regimes. This might be due to non-application of differential irrigation upto this stage. The effect of moisture level (1.0 IW/CPE ratio) on number of shoots m^{-1} at 60 DAS, 90 DAS and at harvest was found significant over moisture level (0.8 IW/CPE ratio). Similar results were also reported by Rehman *et al.* (2000) [12] and Saren *et al.* (2004) [13]. The lowest leaf area index was recorded under 0.8 IW/CPE ratios. The results are in agreement to those of Rehman *et al.* (2000) [12]. The dry matter accumulation recorded maximum with 1.0 IW/CPE ratio which was significantly higher over 0.8 IW/CPE ratio due to availability of sufficient moisture content same trend was also found Zhong *et al.*, (2015) [17].

3.4 Effect of moisture regime on yield and its attributes

Yield attributes which determine yield, is the resultant of the vegetative development of the plant. All the attributes of yield *viz.*, number of spike m^{-2}, length of spike, number of grains $spike^{-1}$, and weight of grains $spike^{-1}$ were influenced significantly due to change in moisture regime. Maximum values of number of spike m^{-2}, length of spike, number of grains $spike^{-1}$, and weight of grain $spike^{-1}$ were recorded under 1.0 IW/CPE ratio over 0.8 IW/CPE ratio, due to favorable vegetative growth and development because it received adequate moisture during entire period of growth. Minimum yield attributes with recorded where 0.8 IW/CPE ratio, because plant were unable to extract more water and nutrients under poor moisture condition which resulted in poor growth and yield attributes. The results are in close proximity to those of Khosla *et al.* (1989) [6] and Khatri *et al.* (2001) [5]. Yield is the result of coordinated inter play of growth characters and yield attributes. Grain and straw yield was significantly influenced by the various moisture regimes. Highest grain yield was recorded under moisture regime of 1.0 IW/CPE ratio. The similar results have been also reported by Kumar *et al.* (2015) [7]. Harvest index is a function of grain and straw yield. Harvest index was not significantly influenced by different moisture level. This might be due to the fact that adequate moisture under the higher moisture regime increased the grain and straw yield at the same extent (Pal *et al.* (1996) [10] and Aslam *et al.* (2014) [2].

3.5 Effect of nutrient supply sources on growth and its attributes

In case of plant height and leaf area index, the maximum and minimum of these characters were credited to 100 % RDN through chemical fertilizers, as compared to 50% RDN along with 50% N through FYM or neem cake. It might be due to the easy availability of nitrogen and potassium resulted increase in carbohydrates synthesis in the green part of the plant which metabolized into amino acids and finally in to protein which helped plant to grow faster. Similar results have also been reported by Patel *et al.* (1995) [11]. The higher number of shoots, associated with chemical fertilizers might be due to enhanced expansion various metabolic processes in the presence of readily available nutrients which resulted into profuse tillering. The findings are in support to those of Guar *et al.*, (1990) [4]. The dry matter accumulation (gm^{-2}) increased with the age of crop. The dry matter accumulation increased significantly in 100 % RDF through inorganic fertilizer over 50 % RDN along with 50% N through FYM or Neem Cake. This might due to higher collective contribution of various growth characters like plant height, number of shoots, leaf area index which resulted increase in dry matter production. The results are in the line with those of obtained by Nehra *et al.* (2001) [9].

3.6 Effect of nutrient supply sources on yield and its attributes

The yield attributes *viz.*, number of spike m^{-2}, length of spike, number of grains $spike^{-1}$, and weight of grain $spike^{-1}$ was maximum under 100 % RDF through inorganic fertilizer as compare to 50% N substitution by organic source. Application at different nutrient sources increased the dry

matter accumulation accordingly in assimilating organs that in turn brought about incase in yield attributes. The result are in confirmation with the findings of Deshmukh *et al.* (1995) [3]. Recommended nitrogen dose through fertilizer significantly affected the grain and straw yield. The highest grain yield was recorded with treatment 100 % RDF through inorganic fertilizer followed by 50% RDN along with 50% N through fertilizers through FYM or Neem Cake, respectively. The lowest grain yield was recorded under treatment 50% N through FYM. Secondly the chemical fertilizer not only enhanced the production of photosynthates but also its translocation from source to sink which ultimately resulted increase in number of spike m^{-2}, length of spike, and grains $spike^{-1}$ which have positive relationship with grain yield. This may also be due to nitrogen released with slower rate from organic sources while the chemical fertilizers released the nitrogen at faster rate. The results are conformity with those of Mishra and Kushwaha (2016) [8],

3.7 Interaction effect of moisture regime and nutrient supply sources

Interaction of nutrient supply system with moisture regime on grain and straw yield was significant increase in grain and straw yields with 100% RDN was noted to a greater extent under 1.0 IW/CPE while very little or no effect was noted when 50% N the through fertilizers and 50% N through FYM or neem cake were used. Similar results have been also reported by Verma *et al.* (2017) [15].

Table 1: Effect of varieties, moisture regimes and nutrient supply system on growth parameter, yield attributes and yield of wheat

Treatment	Plant height (cm)	Dry matter accumulation (gm^{-1})	Number of effective shoots (m^{-1})	Spike length (cm)	No. of spikes m^{-2}	Number of grains $spike^{-1}$	1000-grain weight (g)	Grain yield (q/ha)	Straw yield (q/ha)	Harvest index
Varieties										
V_1(NW- 2036)	80.21	646.32	74.53	8.32	227.87	36.76	36.38	34.62	47.18	42.28
V_2(PBW-373)	81.84	778.13	76.00	8.51	297.18	42.26	37.60	39.16	53.22	42.41
V_3(HUW- 234)	73.71	606.60	68.63	8.10	209.34	34.50	35.17	32.82	43.93	42.77
SEm±	1.60	12.83	1.44	0.20	5.11	1.07	0.70	0.83	0.98	-
CD at 5%	4.87	40.27	4.51	NS	16.05	3.34	NS	2.59	3.08	-
Moisture regimes (IW/CPE Ratio)										
M_1(0.8)	76.15	652.30	70.84	7.89	235.24	36.54	36.03	34.12	46.39	42.41
M_2(1.0)	81.02	701.73	75.27	8.73	254.36	39.14	36.73	36.94	49.83	42.56
SEm±	1.31	10.47	1.17	0.16	4.17	0.87	0.57	0.68	0.80	-
CD at 5%	3.98	32.88	3.67	0.50	13.10	2.73	NS	2.12	2.51	-
Fertilizers levels (kg ha^{-1})										
F_1(100%RDN)	83.69	718.67	75.97	8.75	260.63	39.70	37.15	37.87	50.47	42.92
F_2(50%RDN+50%N FYM)	74.10	651.16	70.30	7.97	233.96	36.34	35.85	33.93	46.62	42.13
F_3(50%RDN+50%N Neem Cake)	77.97	661.22	72.89	8.21	239.81	37.47	36.15	34.79	47.23	42.41
SEm±	1.42	12.12	1.29	0.17	4.02	0.95	0.63	0.68	0.93	-
CD at 5%	4.10	35.00	3.72	0.49	11.60	2.73	NS	1.95	2.69	-

Table 2: Interaction effect of Nutrient supply sources and Moisture regime on grain and straw yield

Nutrient sources	Grain yield		Straw yield	
	M_1	M_2	M_1	M_2
F_1	35.17	41.94	47.55	55.99
F_2	35.43	35.51	48.63	48.44
F_3	33.79	35.43	46.88	48.97
SEm±	0.95		1.317	
CD at 5%	2.75		3.804	

4. Conclusions

Based on the results of two years, it can be concluded that for obtaining maximum yield and net return wheat variety PBW-373 irrigation with 1.0 IW/CPE fertilized with 150 kg N ha^{-1} through fertilizers.

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