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Standardization of Fertility Levels of New Wheat Cultivar JAUW-672 Under Different Sowing Dates and Restricted Irrigation Regimes

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Abstract

An experiment was conducted to evaluate the performance of wheat cultivar JAUW-672 conducted at Research Farm of Agronomy during *Rabi* season of 2019-20 and 2020-21 at Sher-e-Kashmir University of Sciences and Technology, Jammu consisted of twelve treatment combinations with two sowing dates, three fertility levels and two irrigation regimes replicated thrice under factorial randomized block design. The experimental results revealed that earlier sowing dates recorded highest pooled effective tillers/m^2 (298.56), number of grains/ear (39.19), test weight (37.47) grain yield (41.98q/ha) and B: C ratio (2.17). Whereas, among fertility levels application of 125% RDF on soil test basis recorded significantly highest pooled effective tillers/m^2 (305.81), number of grains/ear (40.14), test weight (38.30), grain yield (46.05) and B: C ratio (2.38) besides sustaining soil fertility. Whereas due to timely rainfall the irrigation treatments remained statistically at par. Thus to increase productivity and profitability of wheat, the crop should be sown earlier with increased dosage of fertilisers but on soil test basis.

Keywords: Cultivar; Fertility levels; Irrigation regimes; Sowing dates; Terminal stress; Wheat

Introduction

Wheat is one of the most important staple food of the world besides important crop for Indian food security. Indian wheat is grown in an area of 31.45mha with production and productivity of 109.86 and 34.21q/ha, respectively (Anonymous,2021). From the past decade, there has been seen a reduction in the productivity of wheat crop, due to detrimental effects of climate change on environment mainly terminal heat stress (Roy and Podder,2022). Further the researchers has projected that terminal heat stress will reduced the wheat yield in future to the tune 11% (Dubey,etal 2020). Thus to mitigate these abiotic stresses the adoption of viable management strategies remains only viable options. The sowing time plays a crucial role in the productivity of wheat crop. Wheat being a temperate crop susceptible to high temperature. Thus delayed sowings, exposed wheat growth stages to higher temperature (above 24,24°C) and encountered with heat stresses drastically reducing its yield (Upadhyaya and Bhandari, 2022). Further the low yield in wheat is also due to insufficient irrigation and poor nutrition. There is positive correlation between wheat yield and irrigation regimes as water is important for every developmental stage of wheat, the missing of irrigation during critical stages hampered the yield production. Also the application of NPK fertilizers in balanced level play a pivotal role in improvement of growth indices thus increase yield in wheat crop (Singh et al, 2018). Keeping above points in to consideration the present investigation was undertaken to evaluate the performance of new cultivar JAUW-672 under different sowing dates, fertility levels and irrigation regimes.

Materials and Methods

The field experiment was conducted at Research Farm of Agronomy during *Rabi* season of 2019-20 and 2020-21 at Sher-e-Kashmir University of Sciences and Technology, Jammu located at 32°39' N latitude and 74°53' E longitude at an elevation of 332 meter above mean sea level. The climate of the site is subtropical with hot and dry early summers followed by hot and humid summers and cold winters. The average annual rainfall is nearly 1174 mm, which is mainly received in the months of June to September. The initial soil sample analysis revealed that soil was texturaly sandy clay loam, low in organic carbon (0.42 per cent) and available nitrogen (244 kg/ha) but medium in available phosphorus (15.25 kg/ha) and potassium (128.50 kg/ha). The experiment consisted of twelve treatment combinations with two sowing dates *viz*. 2nd week of November (D_1) and 4th week of November (D_2), three fertility levels *viz*. 75% RDF (F_1), 100% RDF (F_2) and 125% RDF (F_3) and two irrigation regimes *viz*. Presowing (I_1) and CRI+Flowering (I_2) with three replications and laid out in factorial randomized block design. The sowing was done as per technical programme by using 100 kg seed rate spaced at 20 cm. The fertiliser dose was given on soil test basis (Table 1). Half dose of nitrogen, full dose of phosphorous and potassium (through urea, diammonium phosphate and muriate of potash) was applied at the time of sowing and remaining half dose of nitrogen was top dressed in two equal splits each at crown root initiation and just before ear initiation stage. Whereas due to continuous rainfall that coincides with the technical programme stages of irrigation application *viz*. presowing and crown root initiation + flowering, no artificial irrigation was applied to trial during both the years. Under chemical weed control pendimethalin @ 1kg a.i./ha as preemergence and 2,4-D @ 0.5 kg a.i./ha in 500 litres water was applied at 30 DAS to all the treatments. For initial composite soil samples (0-15 cm) were collected before land preparation of experimental field. Similarly, treatment wise surface soil samples was also collected after harvesting of each plot, air dried, grounded and passed through 2 mm sieve analyzed for soil reaction, organic carbon content and available N, P and K as per standard methods described by Jackson, (1973). Harvesting was done plotwise at physiological maturity when crop appeared yellowish and grain became hard. It took 155 to 165 days for variety to mature. Data on various yield and yield attributes were recorded by using standard procedures. The cost of cultivation, net returns and benefit: cost ratio were calculated by taking into account the prevailing cost of inputs and farm gate price of grain and straw. All the data was recorded in kg/plot which were finally converted into q/ha. The data recorded for yield was subjected to statistical analysis according to procedure outlined by Cochran and Cox, 1963. All the comparisons were worked out at 5 per cent level of significance.

Results and Discussions

Effect of dates of sowing

Yield attributes

15th November produced numerically highest yield attributes *viz*. effective tillers/m^2 (309.16 during 2019-20 and 300.33 during 2020-21), number of grains/ear (38.86 during 2019-20 and 39.81 during 2020-21) and test weight (37.50 during 2019-20 and 37.44 during 2020-21) (Table 2) during both the years. Similar trend was observed in pooled data with highest effective tillers/m^2 (298.56), number of grains/ear (39.19) and test weight (37.47). This might be due to earlier sowing encountered favourable conditions whereas crop sown under delayed environments faced drop in temperature during their vegetative stages whereas encountered sharp rise in temperature during reproductive and maturity phases thus forced maturity. The results are in conformity with earlier findings of Singh et al., 2022.

Yield and economics

The experimental results revealed (Table 3) that earlier sowing date *viz*. 15th November (recorded numerically highest grain yield (42.83 q/ha during 2019-20 and 41.53 during 2020-21), straw yield (53.00q/ha during 2019-20 and 51.41 during 2020-21) and B:C ratio (2.31 2019-20 and 2.05 during 2020-21) than late sowing (25th November). Similar trend was observed in pooled data of two years where earlier sowing numerically out yielded (41.98 q/ha) over late sowing (40.75 q/ha) with B.C ratio of 2.17. This might be due to the early grown crops have favourable weather conditions thus had longer duration recorded better yield attributes and yield. Tomar et al, 2020 also revealed that earlier sown wheat crop along with higher nutrient dose recorded significantly higher grain yield of 42.2 q/ ha and net returns of Rs. 53850/ha.

Soil fertility

The organic carbon (%), available N,P and K were not influenced by sowing dates after harvest of 2nd wheat crop (Table 4). The results are in conformity with Tomar et al., 2020.

S.No.	Nutrients	Initial values	Recommended dose of fertilizers (kg/ha)	N, P_2O_5 and K_2O applied on soil test basis	Type of Fertiliser applied	Fertiliser dose applied (kg/ha) for RDF	Fertiliser dose applied 75% RDF (kg/ha)	Fertiliser dose applied 125% RDF (kg/ha)
1.	N	244	60	75	Urea	138.0	103.0	172.0
2.	P_2O_5	15.25	30	30	DAP	65.0	49.0	82.0
3.	K_2O	128.50	20	20	MOP	33.0	25.0	42.0

Table 1: Recommendations of N, P_2O_5 and K_2O and corresponding doses of Urea, DAP and MOP on soil test basis.

Effect of fertility levels
Yield attributes

Significantly highest effective tillers/m² (320.62 during 2019-20 and 313 during 2020-21), number of grains/ear (42.37 during 2019-20 and 41.4 during 2020-21) and test weight (38.25 during 2019-20 and 38.35 during 2020-21) (Table 2) were produced by 125% RDF of fertility levels during both the years. Same trend was reproduced in pooled data with 305.81, 40.14 and 38.30 of effective tillers/m², number of grains/ear and test weight, respectively. This might be due to the higher level of nitrogen nutrition established efficient source sink relation further yield attributes are mainly controlled by fertilizer doses (Tomar et al., 2020).

Treatments	Effective tillers/m² 2019-20	Effective tillers/m² 2020-21	Pooled Effective tillers/m²	No of grains/ear 2019-20	No of grains/ear 2020-21	Pooled No of grains/ear	Test Weight (g) 2019-20	Test Weight (g) 2020-21	Pooled Test Weight (g)
D1	309.16	300.33	298.56	38.86	39.81	39.19	37.50	37.44	37.47
D2	305.42	295.27	294.17	38.59	39.68	39.00	37.17	37.15	37.17
C.D.	NS	NS	NS	NS	NS	NS	NS	NS	NS
S.em	2.95	3.25	3.05	0.38	0.37	0.25	0.23	0.39	0.26
F1	294.75	281.08	285.4	35.54	37.89	38.22	36.62	36.38	36.5
F2	306.51	299.32	297.88	38.27	39.92	38.95	37.12	37.18	37.16
F3	320.62	313	305.81	42.37	41.4	40.14	38.25	38.35	38.3
C.D.	10.6	11.71	10.96	1.38	1.35	0.91	0.82	1.44	0.93
S.em	3.61	3.99	3.73	0.47	0.46	0.31	0.28	0.47	32
I1	304.8	293.83	292.76	36.64	39.84	39.11	37.42	34.43	37.42
I2	310.51	301.78	299.96	38.81	39.63	39.09	37.25	37.18	37.21
C.D.	NS	NS	NS	NS	NS	NS	NS	NS	NS
S.em	2.95	32.5	3.05	0.38	0.37	0.25	0.23	0.39	0.26

Table 2: Effective tillers, No. of grains/ear and test weight (g) of cv. JAUW-672 under different sowing dates, fertility levels and irrigation regimes during 2019-20, 2020-21 and pooled data.

Yield and economics

Whereas amongst the fertility levels F_3 where 125% of RDF was applied proved significantly superior in terms of grain (46.83 q/ha during 2019-20 and 45.28 during 2020-21), straw yield (56.30 q/ha during 2019-20 and 55.07 during 2020-21) and B:C raio (2.51 during 2019-20 and 2.24 during 2020-21) followed by 100% RDF (Table 3). Similarly, in pooled data amongst the fertility levels 125% of RDF proved significantly superior in terms of grain (46.05 q/ha), straw yield (56.29 q/ha) and B:C raio (2.38). This might be due to application of higher dose of nitrogen during ear initiation helped in proper sink formation thus enhance production due to proper grain filling. Singh et al., 2018 also obtained the maximum grain yield (19.65q /ha) and straw yield (29.64 q/ ha) under treatments where 25% more than RDF of NPK fertilizers were applied whereas, minimum grain yield (14.83 q/ha) and straw yield (25.55 q/ha) were obtained where 25% less than RDF of NPK fertilizer was used.

Treatments	*Grain yield (q/ha) 2019-20*	*Grain yield (q/ha) 2020-21*	*Pooled Grain yield (q/ha)*	*Straw Yield (q/ha) 2019-20*	*Straw Yield (q/ha) 2020-21*	*Pooled straw yield (q/ha)*	*B:C ratio 2019-20*	*B:C ratio 2020-21*	*Pooled B:C ratio*
D1	42.83	41.53	41.98	53.00	51.41	52.60	2.31	2.05	2.17
D2	41.61	39.90	40.75	50.40	49.68	50.71	2.20	1.94	2.07
SE(m)±	0.75	0.88	0.81	0.88	0.71	0.72	-	-	-
C.D.	NS	N.S	NS	NS	NS	NS	-	-	-
F1	37.17	36.24	36.70	47.20	46.06	47.13	1.96	1.74	1.85
F2	42.66	40.62	41.64	51.60	50.50	51.56	2.28	1.99	2.14
F3	46.83	45.28	46.05	56.30	55.07	56.29	2.51	2.24	2.38
SE(m)±	0.90	1.08	0.99	1.10	0.88	0.89	-	-	-
C.D.	2.69	3.16	2.92	3.16	2.57	2.60	-	-	-
I1	41.78	40.16	40.97	51.16	49.81	51.04	2.22	1.95	2.09
I2	42.67	41.27	41.97	52.27	51.28	52.87	2.29	2.04	2.17
SE(m)±	0.75	0.88	0.81	0.88	0.71	0.72	-	-	-
C.D.	N.S	N.S	NS	N.S	NS	NS	-	-	-

Table 3: Grain, Straw yield, B:C ratio of cv. JAUW-672 under different sowing dates, fertility levels and irrigation regimes during 2019-20 and 2020-21 and pooled data.

Soil fertility

Soil data after harvest of second wheat crop also revealed significant changes in soil fertility status with respect to available N,P and K with the application of higher recommended doses of fertilizers. The plots where 125 % of RDF was applied had available N,P and K (kg/ha) of 244.66, 16.02 and 136.42, respectively. Hence, application of 125% RDF significantly build up available N,P,K to the tune of 13, 23 and 9 percent, respectively, over 75% RDF (Table 4). This might be due to effect of added fertilizers amount that determined the availability of nutrients to the crop as well as its content in the post harvest soil (Tomar et al., 2020).

Effect of irrigation regimes

Whereas due to continuous rainfall that coincides with the technical programme stages of irrigation application *viz*. presowing and crown root initiation + flowering, no artificial irrigation was applied to trial during both the years thus irrigation regimes were statistically at par with each other. As this variety performed well under restricted irrigations. If rains failed than irrigation may be given at crown root initiation and flowering.

Treatments	*Organic Carbon (%)*	*Available N (kg/ha)*	*Available P(kg/ha)*	*Available K (kg/ha)*
D1	0.347	231.94	14.61	133.06
D2	0.352	229.72	14.65	129.28
C.D.	N.S	N.S	N.S	N.S
S.em	0.13	1.50	0.30	1.73
F1	0.334	216.50	13.02	125.51
F2	0.358	231.33	14.85	131.50
F3	0.357	244.66	16.02	136.42
C.D.	N.S	5.42	1.05	6.23
S.em	0.16	1.83	0.36	2.12
I1	0.351	228.44	14.62	130.00
I2	0.349	223.33	14.64	132.33
C.D.	N.S	N.S	N.S	N.S
S.em	0.13	1.49	0.36	1.73
Initial value	0.42	244	15.25	128.50

Table 4: Changes in soil fertility under different sowing dates, fertility levels and irrigation regimes for cv. JAUW-672 after harvest of 2nd wheat crop.

Conclusion

Hence to enhance productivity and profitability of wheat cv.JAUW-672 grown under restricted irrigations, can be sown earlier with higher doses of fertility levels up to 125% of recommended dose of fertilizers applied on soil test basis.

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