



Effect of sowing environments and N-levels on wheat varieties under irrigated region of Jammu

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ABSTRACT

A field experiments were conducted during *rabi* 2015–16 and 2016–17 at SKUAST-Jammu, J&K UT to find out the effect of sowing environments and nitrogen levels on performance of varieties of wheat. Three varieties HD 2967, RSP 561 and WH 1105 with three sowing environments 25th October (early), 14th November and 4th December and three levels of nitrogen, viz. 100, 125 and 150 kg/ha replicated thrice in split split plot design. Among the varieties, WH 1105 recorded significantly higher yield than HD 2967 and RSP 561. Early sowing (25th October) of wheat produced statistically higher grain, straw and biological yield values than normal (14th November) and late sowing (4th December) environments along with higher yield attributes. The higher nitrogen dose 25 kg (125 kg/ha), than recommended dose (100 kg/ha) exhibited higher yield attributing parameters and yield of wheat crop. Early sowing and WH 1105 also recorded higher net returns and B:C ratio.

Keywords: Grain yield, Nitrogen, Sowing environments, Varieties

Wheat is globally cultivated on 224.72 mha with production and productivity of 734.62 mt and 3.27 t/ha, respectively (Anonymous 2016). It is the second staple food crop of India, cultivated in about 30.60 mha area with production of 98.38 mt and productivity of 32.16 q/ha (Anonymous, 2017). It is grown both under irrigated as well as rainfed conditions on 0.32 mha area with production and productivity of 0.50 mt and 1550 kg/ha, respectively in J&K UT (Anonymous 2016a). A perfect sowing environment exploits the full genetic potential of a particular variety by providing optimum growth conditions such as temperature, light, humidity and rainfall. Advance or delay in sowing date, increasing N application and choice of suitable variety with the best thermal requirement represent the main agronomic manipulations which help to maintain existing crop production levels (Ventralla *et al.* 2012, Gupta *et al.* 2020). The unfavourable environments created by high temperature mostly during reproductive stages especially grain filling stage could be minimized by adjusting the sowing time to an optimum time for different varieties, which are suitable for early, normal and late sown environmental conditions for assured higher yield (Gupta *et al.* 2020a). Current estimates indicated that wheat crop grown

on around 13.5 mha in India is affected by heat stress (Sareen *et al.* 2012). It is also reported by the various researchers that the cool period for wheat crop in India is shrinking, while the threat of terminal heat stress is expanding.

Nitrogen is a key element for plant nutrition and other management practices which ultimately increases the yield of wheat crop (Cui *et al.* 2010). High yielding new varieties can never be fully exploited with the existing fertilizer practice and thus fails to provide adequate yield. Since the information about the response of wheat varieties to sowing environments and N-levels under low altitude irrigated sub tropical region of Jammu under lower Shivalik zone of Himalayas is lacking. To overcome these circumstances, an experiment was planned by selecting a set of recommended wheat varieties under different sowing environments with enhanced N-levels.

MATERIALS AND METHODS

A field experiments was conducted during *rabi* 2015–16 and 2016–17 at Research Farm of Agromet Research Centre, SKUAST-Jammu (Latitude 32°39' N, longitude 74°58' E and altitude 332 m amsl), J&K UT. Three wheat varieties HD 2967, RSP 561 and WH 1105 were sown under three sowing environments 25th October (early), 14th November (normal) and 4th December (late) with three nitrogen levels (100, 125 and 150 kg/ha) and replicated thrice. The experiment was conducted in split split plot design. The soil of the experimental site was sandy clay loam in texture with 62.5% sand, 11.7% silt and 25.8% clay having moderate

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moisture retention capacity with 7.8 pH, low organic carbon content of 0.38%, low available nitrogen (236.2 kg/ha) and medium in available phosphorus (13.1 kg/ha) and potassium (120.1 kg/ha). Half of the nitrogen along with full dose of phosphorus and potassium was applied at the time of sowing as basal dose. The remaining half of nitrogen was top dressed in two equal splits, i.e. at CRI stage and before booting of wheat crop. The recommended dose of P and K was 50:25 kg/ha for wheat crop (as per package and practices of SKUAST-J) and the sources for nitrogen, phosphorus and potassium were urea, diammonium phosphate and muriate of potash, respectively. However, nitrogen was applied as per the treatment combinations. Irrigation was applied as per need of the crop. The meteorological data, viz. maximum and minimum temperature for the *rabi* 2015-16 and 2016-17 were recorded at Agrometeorological Observatory of SKUAST-Jammu situated at about 50 m from the experimental site (Fig 1). Cost of cultivation was calculated by taking into account the prevailing market price of inputs like fertilizers, seed, herbicides, irrigations, tillage operations, transportation charges, management charges, miscellaneous, etc. Returns were calculated by taking minimum support price of wheat grain and market price of wheat straw. The treatment-wise data recorded for different crop parameters were subjected to statistical analysis according to split split design as per the procedure outlined by Cochran and Cox (1963).

RESULTS AND DISCUSSION

Effect of varieties: Among the varieties, WH 1105 produced significantly higher grain yield (45.73 and 46.17 q/ha), straw yield (62.71 and 67.48 q/ha), biomass yield

(108.44 and 113.65 q/ha), tillers/m² (414.8 and 424.6), number of grains/earhead (35.5 and 37.3) as compared to HD 2967 and RSP 561 varieties during *rabi* 2015-16 and 2016-17, respectively. The harvest index and single grain weight of the varieties were at par. However, HD 2967 and RSP 561 were statistically similar to each other with respect to yield attributes and yield under both the years of experimentation (Table 1). The variation in growth, grain, straw and biological yields of these varieties might have happened due to the significant variation recorded in various growth and yield attributing characters; which are by and large governed by their respective genetic make-ups and yielding ability responsible for expression of their growth and yield attributes for grain and straw yields under a given set of environment. The higher grain, straw and biological yields could also be attributed to greater genetic potential with efficient utilization of radiation and maximum production of photosynthates in terms of high yield attributing characters. Similar results were also reported by Jatti (2013), Tripathi *et al.* (2013), Kumar *et al.* (2015) and Kaur *et al.* (2016). Variety WH 1105 performed significantly superior to HD 2967 at various locations as reported in the progress report of All India Coordinated Wheat and Barley Improvement Project (Tiwari *et al.* 2015-16).

Effect of sowing environments: Grain yield of wheat crop was affected to a great extent due to different sowing environments. Early sowing (25th October) of wheat significantly increased the various yield values like grain, straw and biological yield and harvest index, yield attributes like tillers/m², grains/earhead and single grain weight than normal (14th November) and late sowing (4th December). The reason behind the significant higher yield values in early

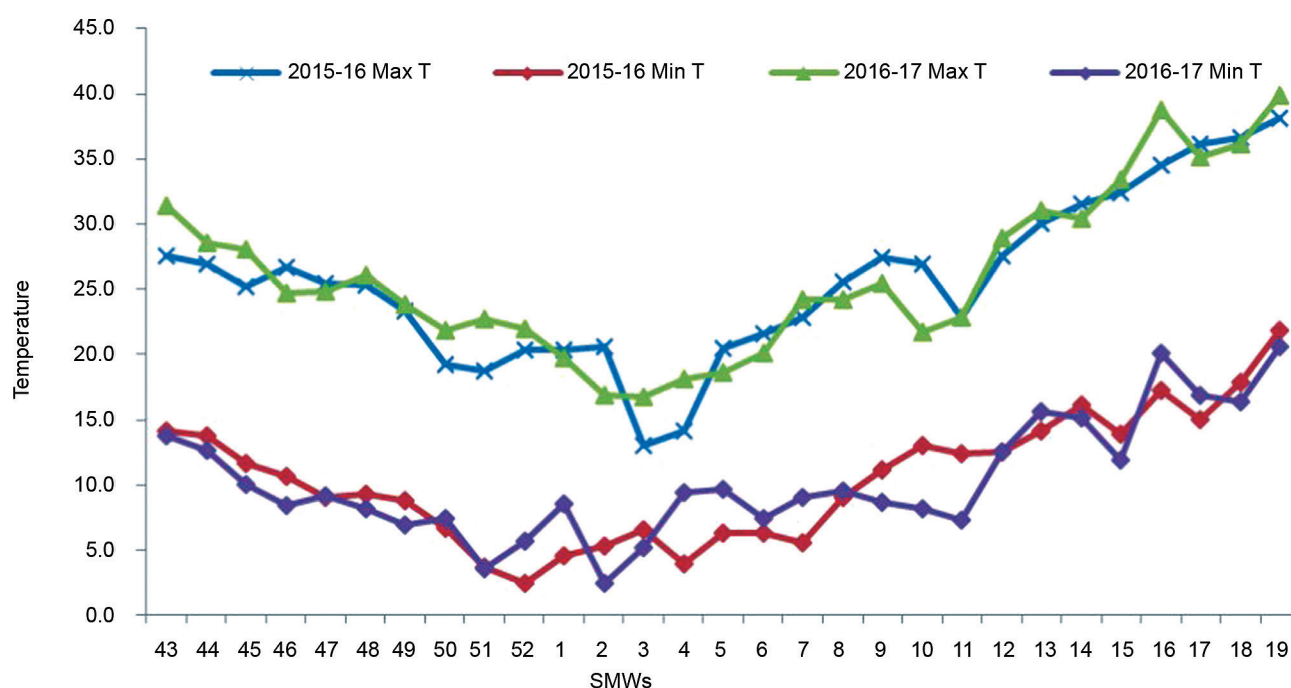


Fig 1 Maximum and minimum temperature (°C) during wheat growing season (*rabi* 2015-16 and 2016-17).

Table 1 Effect of varieties, sowing environments and nitrogen levels on yield attributes and yield of wheat

Treatment	Yield (q/ha)						HI		Tillers/ m ²		Grains/ ear		Single grain weight (g)	
	Grain			Straw			Biological							
	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
<i>Varieties (V)</i>														
V ₁ : HD 2967	41.60	43.95	58.58	63.78	100.17	107.73	41.5	40.8	359.3	376.6	31.2	33.0	0.042	0.042
V ₂ : RSP 561	39.75	42.55	59.23	64.88	98.98	107.43	40.2	39.6	333.6	364.4	30.4	32.2	0.040	0.040
V ₃ : WH 1105	45.73	46.17	62.71	67.48	108.44	113.65	42.1	40.5	414.8	424.6	35.5	37.3	0.042	0.040
Sem (±)	0.85	0.47	0.84	0.72	1.27	0.86	0.54	0.3	8.98	9.72	0.86	0.75	0.001	0.0007
CD (5%)	3.32	1.84	3.29	2.81	5.01	3.38	NS	NS	35.2	38.2	3.4	2.9	NS	NS
<i>Sowing environments (D)</i>														
D ₁ : 25 th October	47.07	48.57	66.14	72.72	113.21	121.30	41.5	40.0	446.2	451.3	36.4	38.1	0.042	0.042
D ₂ : 14 th November	43.13	46.49	59.59	66.96	102.72	113.46	42.0	41.0	373.4	391.3	33.1	35.0	0.042	0.041
D ₃ : 4 th December	36.87	37.59	54.79	56.45	91.66	94.05	40.3	40.0	288.1	323.0	27.7	29.6	0.040	0.038
Sem (±)	0.66	0.59	0.84	0.82	1.12	1.29	0.44	0.25	7.78	3.33	0.83	0.81	0.0004	0.0004
CD (5%)	2.02	1.82	2.58	2.54	3.45	3.97	1.36	0.78	24.0	28.8	2.6	2.5	0.001	0.001
<i>Nitrogen levels (N)</i>														
N ₁ : 100 kg/ha	39.55	41.79	56.52	62.63	96.07	104.41	41.1	40.0	337.7	356.4	30.6	32.5	0.041	0.040
N ₂ : 125 kg/ha	43.13	44.71	61.03	66.05	104.16	110.76	41.3	40.4	375.9	393.2	33.0	34.8	0.041	0.041
N ₃ : 150 kg/ha	44.40	46.16	62.97	67.47	107.37	113.63	41.3	40.6	394.1	416.1	33.6	35.3	0.041	0.041
Sem (±)	0.47	0.49	0.70	0.55	0.86	0.90	0.35	0.24	8.94	9.69	0.87	0.80	0.0004	0.0005
CD (5%)	1.35	1.41	2.01	1.56	2.48	2.59	NS	NS	25.6	27.8	2.5	2.3	NS	NS
Interaction V×D	3.51	3.15							41.5	49.8				

sowing might be availability of optimum environmental conditions for growth and development of crop which could have enhanced accumulation of photosynthates from source to sink. Similar findings were also reported by Ram *et al.* (2012). Lower grain and biological yields of wheat crop in sowing environments later than 25th October was mainly due to higher temperature during reproductive periods of the crop. Also, in early sowing environment, days taken for reproductive stage were more in comparison to later sowings which ultimately enhanced the yield values. Similar findings were also reported by Gupta *et al.* (2017) under irrigated conditions of Jammu. The findings are also in confirmation with the observation of Kamboj *et al.* (2008).

Effect of N levels: Wheat crop when applied 50% more nitrogen (150 kg/ha) than recommended; performed outstanding with respect to grain (44.40 q/ha), straw (62.97 q/ha) and biological (107.37 q/ha) yield values in *rabi* 2015-16 but the values were at par with that of 125 kg N/ha. The values of various yield attributes like tillers/m², number of grains/earhead and harvest index were also significantly higher in 150 kg N/ha but were at par with 125 kg N/ha. Single grain weight and harvest index was not affected significantly due to levels of nitrogen during *rabi* 2015-16 and 2016-17. Recommended dose of nitrogen (100 kg/ha) also performed well but the values were significantly inferior to other two doses of nitrogen during both the years of experimentation. Almost soils under Jammu conditions are deficient in nitrogen and the requirement of nutrients by the high yielding varieties of wheat is quite high. This may be prime reason for significant increase in yield of wheat varieties when the nitrogen dose was enhanced by 25% (125 kg/ha) over the recommended dose (100 kg/ha). Wheat crop fertilized with 120 kg N/ha had significantly more plant height, LAI and yield attributing parameters, which in turn helped the plants to maximize canopy photosynthesis with higher photosynthetic efficiency resulting in greater crop growth rate and ultimately the significantly higher grain, straw and biological yield (Malve *et al.* 2017). Hameed *et al.* (2003) also observed a significant increase in grain yield of wheat at 120 kg N/ha and a further increase in N levels did not enhance the grain yield significantly.

Interaction of sowing environments and varieties:

Significantly higher number of effective tillers/m² were observed in WH 1105 when sown on 25th October, but remained statistically at par with HD 2967 during *rabi* 2015-16 and 2016-17. RSP 561 recorded significantly lower tillers/m² in all the three sowing environments. Effective tillers/m² was statistically similar in varieties HD 2967 and RSP 561 in timely and late sowing environments (Fig 2). It is ascribed to the fact that WH 1105 and HD 2967 responded better under early sowing conditions. However, RSP 561 responded similar during early and normal sowing environments. The differential performance of wheat varieties might be due to their genetic behaviour, for the reason that these performed in a different manner in various sowing environments. Interaction effects of sowing environments and wheat varieties with respect to yield attributes were also recorded by Khavse *et al.* (2015) and Fayed *et al.* (2015).

Variety WH 1105 performed significantly better than RSP 561 and HD 2967 and also adjudged to be the best variety for sowing on 25th October (early) and 14th November (normal) followed by HD 2967 and RSP 561. All the three varieties showed statistically similar grain yields under late sown conditions. Under normal sowing conditions, RSP 561 and HD 2967 were statistically similar with respect to grain yield, however, variety RSP 561 performed similarly during early and normal sowing environments (Fig 3). Hameed *et al.* (2003) concluded from his study that wheat variety Fakhre-Sarhad performed better if it is sown on last week of October. Fayed *et al.* (2015) concluded from his experiments that Gemmeiza-9 variety of wheat is best suited under mediate sowing date (15th November) to maximize bread grain yield of wheat under N-Sinai environmental conditions.

Economics: WH 1105 variety of wheat accrued maximum net returns and B:C ratio followed by HD 2967 and RSP 561. Amongst the various sowing environments, highest net returns and B:C ratio was obtained with early sown wheat crop. However, wheat sown on 4th December (late) recorded the lowest values of net returns and B:C ratio. Application of 150 kg N/ha gave highest net returns followed by 125 and 100 kg N/ha. However, highest B:C ratio recorded in 125 kg N/ha which was followed by the

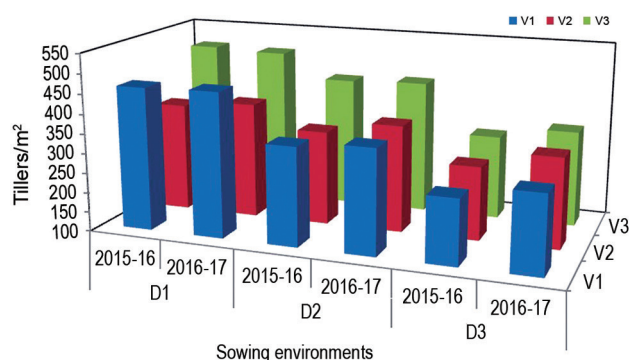


Fig 2 Interaction effect of varieties and sowing environments on number of tillers/m² of wheat.

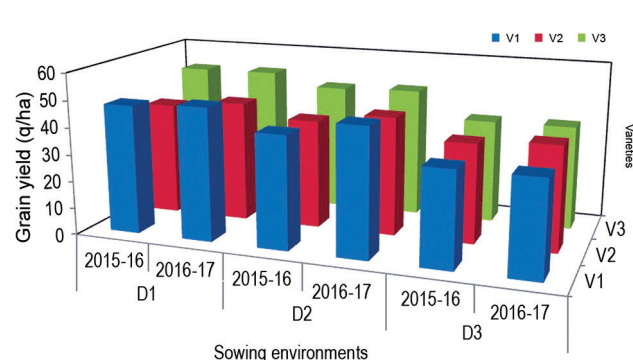


Fig 3 Interaction effect of varieties and sowing environments on grain yield (q/ha) of wheat.

Table 2 Economics of different wheat varieties as affected by various sowing environments and nitrogen levels

Treatment	2015-16				2016-17			
	Cost of cultivation (₹/ha)	Gross returns (₹/ha)	Net returns (₹/ha)	B:C ratio	Cost of cultivation (₹/ha)	Gross returns (₹/ha)	Net returns (₹/ha)	B:C ratio
<i>Varieties</i>								
V ₁ : HD 2967	24380	86866	62486	2.56	24256	96925	72670	2.99
V ₂ : RSP 561	24380	84315	59935	2.46	24256	95091	70835	2.92
V ₃ : WH 1105	24380	94819	70440	2.88	24256	102014	77758	3.20
<i>Sowing environments</i>								
D ₁ : 25 th October	24877	98242	73365	2.95	24877	108023	83146	3.34
D ₂ : 14 th November	24318	89614	65297	2.68	23945	102338	78393	3.27
D ₃ : 4 th December	23945	78143	54198	2.26	23945	83669	59724	2.50
<i>Nitrogen levels</i>								
N ₁ : 100 kg/ha	23815	82919	59104	2.48	23691	92953	69262	2.92
N ₂ : 125 kg/ha	24137	90188	66051	2.73	24013	99080	75067	3.12
N ₃ : 150 kg/ha	25188	92893	67706	2.68	25063	101998	76934	3.07

values observed in 150 and 100 kg N/ha (Table 2).

On the basis of two years study, it could be concluded that sowing of wheat variety WH 1105 on 25th October (early) in irrigated plains of low altitude region of Jammu of J&K UT produced significantly higher grain yield over timely and late sowings (14th November and 4th December), respectively. Generally timely and late sown crops suffered due to higher temperature during the grain filling period of wheat crop. However, crop sown on 25th October completes its grain filling period, i.e. reproductive period well before the raising of temperature. Thus there will be lesser chance of shrivelling of grains due to heat stress. 25 kg more nitrogen than the recommended dose could also be explored for enhancing the productivity of wheat.

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