AJH
eISSN- 0976-724X

THE ASIAN JOURNAL OF HORTICULTURE
Volume **12** | Issue 1 | June, 2017 | 63-74
Visit us -*www.researchjournal.co.in*

RESEARCH PAPER

DOI : 10.15740/HAS/TAJH/12.1/63-74

***Article history* :**
Received : 18.02.2017
Revised : 26.04.2017
Accepted : 10.05.2017

Triticum aestivum L. varietal accession evaluation under low fertility and two irrigations

■ **RAJENDRA MANDA, DEVENDRA SINGH[1] AND BHANWAR LAL JAT[2]**

Members of the Research Forum

Associated Authors:
[1]Department of Agriculture, Bhagwant University, AJMER (RAJASTHAN) INDIA

[2]Department of Agricultural Biotechnology Bhagwant University, AJMER (RAJASTHAN) INDIA

ABSTRACT : The experiment consisted of 9 treatments *viz.*, T_0 (DBW -17), T_1 (Raj 3077), T_2 (HD 2967), T_3 (Lok-1), T_4 (Raj 1482), T_5 (Raj 4120), T_6 (K-65) T_7 (HD 2967), T_8 (PBW-343) laid out in Randomized Block Design with three replications. The study showed that Lok-1variety gave highest grain yield (2.76t ha^{-1}), harvest index (31.15%), highest net income (Rs. 110,000.7 ha^{-1}) and benefit: cost (3.74) then the rest of the varieties. The plant height was found to be the highest under the treatment T_3 (Lok-1) at 30, 60 and 90DAS the differences were statistically significant. Treatment T_1 (Raj 3077) recorded significantly higher number of effective tillers per meter square than all the other treatments, while the lowest number of effective tillers per meter square was recorded for the treatment T_3 (Lok-1). The spike length was recorded to be highest under the treatment T_3 (Lok-1) which was significantly higher than all these other treatments, while the lowest spike length was recorded under the treatment T_5 (Raj 4120). Number of grains spike^{-1} was recorded to be highest under the treatment T_6 (K-65), while the lowest grains spike^{-1} was recorded under the treatment T_0 (DBW-17). Treatment T_2 (HD2967) recorded significantly higher test weight than all the other treatments, while the lowest test weight was recorded under the treatment T_8 (PBW-343). The highest grain yield was recorded under the treatment T_3 (Lok-1), while the lowest grain yield was recorded in treatment T_0 (DBW–343) and the differences were statistically non-significant.

Author for correspondence :
RAJENDRA MANDA
Department of Agriculture, Bhagwant University, AJMER (RAJASTHAN) INDIA
Email : chenaram9571@gmai.com

KEY WORDS : CGR, MOP, RGR, SSR, Harvest index, NS

HOW TO CITE THIS ARTICLE : Manda, Rajendra, Singh, Devendra and Jat, Bhanwar Lal (2017). *Triticum aestivum* L. varietal accession evaluation under low fertility and two irrigations. *Asian J. Hort.*, **12**(1) : 63-74, **DOI : 10.15740/HAS/TAJH/12.1/63-74.**

Cereals, also called as grain crops, are generally defined as grasses grown for their edible seeds. These have been under cultivation since pre-historic times. The ancient Roman Goddess for agriculture was called 'Ceres' and the common food grains at that time were also recognized with her name. The word 'Ceres' has been changed to cereals and the well known cereal crops are wheat, rice, maize, barley, sorghum and oats. Wheat is adapted to a wide range of soil and climatic conditions and is the most important cereal crop of the world because firstly, wheat is cultivated over an area of 240 million hectares which is bigger than for any other crop, secondly, wheat provides more calories and protein in the world diet than any other food crop and thirdly, the world trade in wheat exceeds other grains together. Wheat is the second most important food grain of India next only to rice and is a staple diet of people. It contributes 35 per cent to the total food grain production of the country. In India, wheat is cultivated over an area of 29.34 million hectares with a production and productivity of 96.04. Million tonnes and 29.07q ha^{-1}, respectively. India alone produces 13 per cent of world's wheat. Green revolution has enabled India to make about four fold increase in food production during last 50 years, whereas before green revolution annual wheat imported touched 10 million tones and India was a beggar bowl. Wheat is a staple food for nearly 38 per cent of world's population. This crop contributes 33 to 37 per cent of the national food grain production and will continue to play a crucial role in the food security of the country. It has been found from the archaeological records that wheat was cultivated in Mohanjo-Daro and Harappa nearly 5000 year back. Nutritional value of wheat is as good as other food grains comprising 71.2g Carbohydrate, 11-12g proteins, 1.5g fat, 1.2g crude fibre, 306mg phosphorous and 41mg calcium per 100g of grains. During the year 2016-17, wheat was grown over an area of 31.3m ha with a production of 96.8mt and an average productivity of 3173kg/ha. Uttar Pradesh is the maximum wheat producing state in India and Punjab has the best productivity. Wheat is grown in almost all the states in northern and central India. Wheat production in India has gone upto 95 million tonnes (2015-16). It contributes about 30 per cent of total food grain production in India and occupies an important position in total food grain production of the country. Sowing time is the most important factor determining the yield of wheat. The nutrient content in grain and straw has been reported to increase with delay in sowing of wheat whereas, uptake of these nutrients decreases as the sowing of wheat gets delayed. There are many factors responsible for low yield of wheat but poor crop nutrition and use of varieties with low yield potential are the most important. High yielding wheat varieties demand adequate nutrient supply to produce maximum grain yield. Varieties, however, respond differently to nutrient with respect to their genetic makeup and physiological life processes. Fertilizers play a pivotal role in increasing yield and improving the quality of crops. Phosphorus application along with nitrogen has a significant effect in increase the number of tillers, plant height and number of grains per spike, 1000-grain weight and grain yield. The nitrogen (N) management in wheat should aim at providing nutrient in sufficient quantity to meet the crop demand, avoiding excess availability, leaching losses and ultimately increasing its efficiency. Therefore, the continuous availability of nitrogen to wheat during various phases of its growth and development is important factors which influence the grain quality and yield of wheat. The top dressing of nitrogen at later stage of the crop proves most effective in increasing grain protein concentration, yield and fertilizer use efficiency. The nitrogen content in grain and stover and its apparent recovery increases with application at mid-tillering stage as compared to all application at sowing. Further, split application of N to wheat exhibits marked advantage for grain and total N uptake and results in its yield enhancing effect. The nitrogen use efficiency is greater in early sown crop as compared to late sown crop. The delay in sowing may not permit proper vegetative growth of the crop due to high temperature during its reproductive stage, leading to forced maturity and low productivity. As water for irrigation is a scarce resource, its use optimization is fundamental to water resource use. It permits better utilization of all other production factors and thus leads to increased yields per unit area and time. Efficient water management requires a thorough study of plant water relationship, climate, agronomic practices and economic assessment. In cultivation of high yielding wheat varieties, irrigation assumes greater importance because during growing season of crop (October to March) weather remains relatively dry. The normal growth and development of wheat primarily depends upon available irrigation water, because irrigation is an expensive input. Farmer, agronomist, economist and engineers need to know the response of yield to irrigation. Grain yield of different wheat cultivars have been found to be significantly reduced by water stress at all critical growth stages and greatest reduction was at anthesis stage. Since the time of green revolution numerous varieties have been developed with different response pattern to applied nutrients and irrigation frequency. It has been observed that recommended nutrient had been initially 100-120:60-80:40-60kg of NPK/ha, respectively, which was later enhanced to 120-150:60-80:40-60kg NPK/ha, respectively but the varieties failed in sustaining their yield. Therefore, the present recommendation has gone upto 150:80:60kg of NPK/ha, respectively. Thus, the ever increasing doses of nutrients are possing a serious economic consequence to farmers and they are reluctant to adopt such high doses. The response of these varieties accession with reference to standard checks under normal fertility and irrigation level is required to be tested under low fertility level of 70:40:40kg of NPK/hectare, respectively and two irrigation. Therefore, a field experiment on *Triticum aestivum* L. varietal/accession evaluation under low fertility and two irrigations was conducted during the *Rabi* season. The objectives of the field experiment were (i) To study the relative growth parameters of different wheat varieties. (ii) To evaluate the yield and yield components of wheat varieties. (iii) To find out the economics of treatments.

RESEARCH METHODS

The edaphic and climatic conditions, under which the experiment has been conducted, the materials used and techniques adopted during the course of investigation are described in this chapter under the following heads:

Physico-chemical properties of soil:

The soil samples were collected randomly from 0-15cm depth from experimental field just before layout of experimental. A representative homogenous composite sample was drawn by mixing this entire soil sample together, which was analyzed to determine the physical-chemical properties of the soil.

Experimental details:

The experiment was laid out in a Randomized Block Design with nine treatments and three replications. The description of treatments is given in Table A.

Table A: Details of treatments

Treatment	Varieties /accession
T_0	DBW -17
T_1	Raj 3077
T_2	HD 2967
T_3	Lok-1
T_4	Raj 1482
T_5	Raj 4120
T_6	K-65
T_7	HD 2967
T_8	PBW-343

Fertilizer application:

Recommended dose of fertilizer was applied through chemical fertilizers at the time of sowing. The nutrients were applied in the form of urea, diammonium phosphate and muriate of potash. Nitrogen was applied in two split doses with 50 per cent as basal application, 50 per cent at 21 days after sowing.

Thinning:

Thinning was done at 27 days after sowing. This operation was done for maintaining a proper plant to plant distance and standard plant population.

Weeding:

Hand weeding was done at 35 days after sowing, to maintain a proper weed free environment during the initial crop growth stages.

Irrigation:

Since there was in sufficient rainfall during the crop growing season, irrigation was provided two times and the source of irrigation was tube-well.

Harvesting:

The crop was harvested with the help of sickle, when more than 90 per cent of grains in the spike were fully ripened and free from greenish tint. The harvesting of each plot was done separately and dried well in the sun and the harvested produce from each net plot was carefully bundled, tagged and transported to the threshing floor.

Pre-harvest observations: Plant height (cm):

The height of the tagged plants was measured from the ground level upto the growing tips. The observations of the tagged plants were recorded at different growing stages *viz.*, 30, 60, 90DAS and the average values were recorded.

Number of tillers per running row meter:

Total number of tillers was counted in running row meter at 45, 60, 75 and 90DAS. The tillers were counted randomly from three rows in one plot and the average of three was recorded.

Plant dry weight (g plant^{-1}):

Dry weight of plants was recorded at 30, 60 and 90DAS.For taking this observation five plants were uprooted randomly from each plot. The uprooted plants were sun-dried and kept in oven for drying at 110^{0}F temperature. After 2-3 days, when the plants were dried completely, the dry weight was recorded.

Crop growth rate (g m^{-2} day^{-1}):

It represents dry weight gained by a unit area of crop in a unit time expressed as g m^{-2} day^{-1} (Fisher, 1921). The values of plant dry weight at 0 to 30, 30 to 60 and 60 to 90DAS intervals were calculated using the following formulae.

$$\text{CGR} = \frac{W_2 - W_1}{t_2 - t_1}$$

where, W_1= Initial dry weight of plant, W_2 = Final dry weight of plant (g), t_1 = Initial time period, t_2 = Final time period.

Relative growth rate (g g^{-1} day^{-1}):

It was described by Fisher (1921) which indicates the increase in dry weight per unit dry matter over any specific time interval and it was calculated by the following equation:

$$RGR = \frac{\log_e W_2 - \log_e W_1}{t_2 - t_1}$$

where, W_1= Initial dry weight of plant (g), W_2= Final dry weight of plant (g), t_1= Initial time period, t_2= Final time period.

It is also called efficiency index (y) and can be expressed in g g^{-1} day^{-1}. This parameter was calculated for the time intervals, *i.e.*, 0 to 30, 30 to 60 and 60 to 90DAS intervals using the data obtained from dry weight of plants.

Post-harvest observations:Number of effective tillers per running row meter:

Total number of effective tillers was counted in one meter square at harvesting stage. The crop of one square meter area from the centre of each plot was harvested and count the effective tillers to later the observation was recorded.

Length of spike (cm):

Spike length was counted separately which were obtained randomly from five tagged plants and their averages were recorded.

Number of grains $spike^{-1}$ (No.):

For determining the average number of grains $spike^{-1}$ under different treatments, five spikes were selected at random from each plot and the number of grains in each spike was counted and their mean was recorded.

Grain yield (t ha^{-1}):

The crop of one square meter area from the centre of each plot was harvested and collected separately on the threshing floor. Threshing was done manually and the grains obtained were weighed plot-wise. The amount obtained in kilograms from the net area was converted into t ha^{-1}.

Straw yield (t ha^{-1}):

Straw was collected plot-wise after separating the grains and weighed.

Test weight (g):

The sample of 1000 seeds were collected randomly from each plot and weighed on a Torsion balance and recorded simultaneously.

Harvest index (%):

Harvest index was obtained by dividing the economic yield (grain) by the biological yield (grain + straw). It was calculated for each of the plots and was represented in percentage. The following formula was used (Donald, 1962).

$$\text{Harvest index (HI)} = \frac{\text{Economic yield (t ha}^{-1})}{\text{Biological yield (t ha}^{-1})} x100$$

Economic analysis :

Cost of cultivation, gross return, net return and benefit: cost was calculated to evaluate the economics of each treatment, based on the existing market prices of inputs and output.

Cost of cultivation (Rs. ha^{-1}):

The cost of cultivation for each treatment was worked out separately, taking into consideration all the cultural practices followed in the cultivation.

Gross return (Rs. ha^{-1}):

The gross return from each treatment was calculated. Gross return (Rs. ha^{-1}) =Income from grain + Income from straw.

Net return (Rs. ha^{-1}):

The net return from each treatment was calculated separately, by using the following formula. Net return = Gross return (Rs. ha^{-1}) – Cost of cultivation (Rs.ha^{-1}).

Statistical analysis:

Data collected on different aspect of crop, *viz.*, growth, yield attributes and yield were tabulated for statistical analysis (Fisher, 1950). Significance of difference between treatment means was tested through 'F' test and the critical difference (CD) was worked out wherever 'F' value was found to be significant for treatment effect. The analysis of variance for all the data have been given in appendix.

RESEARCH FINDINGS AND DISCUSSION

The present investigation on *Triticum aestivum* L.

varietal/accession evaluation under low fertility and two irrigations was conducted during *Rabi* season of 2016-2017. The observations taken during the course of investigation and the results obtained have been discussed in this chapter and the inferences have been supported with logical reasoning and appropriate evidences. The observations on growth and yield of wheat crop as influenced by variety have been recorded, tabulated, statistically analyzed and explained here in this chapter along with probable reasons. The observations have been classified under two main headings, *viz.*, pre-harvest (pertaining to growth parameters) and post harvest (relating to yield and yield parameters) as given below:

Pre-harvest observations:

Emergence pattern (%) at 9 DAS:

The values recorded in Table 1 revealed average emergence pattern (%). The table indicates that the emergence pattern (%) was non- significant due to treatments. The maximum emergence pattern (%). (95.00) was recorded in the treatment T_1 (Raj 3077), followed by treatments T_2, T_3, T_7 and T_8, whereas, the minimum emergence pattern (94.00) was recorded in the treatments T_0 and T_5 (K-65). The probable reasons for such finding might be due to varietal character.

Table 1: Emergence pattern (%) at 9 DAS

Treatments symbol	Treatments	Emergence pattern (%)
T_0	DBW -17	94.00
T_1	Raj 3077	95.00
T_2	HD 2967	94.67
T_3	Lok-1	94.67
T_4	Raj 1482	94.33
T_5	Raj 4120	94.00
T_6	K-65	94.33
T_7	HD 2967	94.67
T_8	PBW-343	94.67
	F-test	NS
	S.E.±	0.62
	C.D (P=0.05)	-

NS= Non-significant

Number of plants/ running row meter:

The values recorded in Table 2 reveal average number of plants/ running row meter. The table indicates that the number of plants/ running row meter differed none significantly due to treatments. The maximum number of plants/ running row meter (28.53) was recorded in the treatment T_1 (Raj 3077), followed by treatments T_8 (PBW-343) and T_4 , whereas, the minimum number of plants/ running row meter (23.87) was recorded in the treatment T_3 (Lok-1). The probable reasons for such finding might be due to varietal character.

Table 2 : Number of plants/ running row meter (30 DAS)

Treatments symbol	Treatments	No. of plants per running row meter
T_0	DBW -17	24.40
T_1	Raj 3077	28.53
T_2	HD 2967	25.07
T_3	Lok-1	23.87
T_4	Raj 1482	26.53
T_5	Raj 4120	26.30
T_6	K-65	26.40
T_7	HD 2967	26.63
T_8	PBW-343	26.53
	F-test	NS
	S.E.±	2.27
	C.D. (P=0.05)	-

NS= Non-significant

Plant height (cm):

The observations of plant height recorded are being presented in the Table 3. A perusal of the Table 3 reveals that the plant height differed significantly in both of the observations recorded at 30 and 60DAS. The highest plant height (20.05 cm and 48.47cm) at 30DAS and 60DAS was recorded in treatment T_3 (Lok-1).The plant height of treatment T_4 (Raj 1482) were statistically at par with T_4. But at 90DAS the differences were not statistically significant. At 90DAS highest plant height was recorded in treatment T_3 (92.26cm), while lowest (75.14cm) was recorded in the case of T_8 (PBW-343). The probable reasons for the findings could have been because of varietal characteristics, all varieties recorded increased plant height by application of irrigation at all critical growth stage which might be due to the variation of genetic character among different varieties as well as with healthier plant growth with sufficient availability of nutrients having no moisture stress.

Dry weight of plants (g) :

A perusal of the Table 4 depicting the observations on dry weight of plants reveals a non-significant difference between the treatments in both of the observations recorded at 30 and 60DAS. At 30DAS, treatment T_4 (Raj 1482) and T_8 (PBW-343) recorded the highest value (5.00g) for dry weight. At 60DAS, treatment T_1(Raj 3077) recorded the highest values (17.00g) for dry weight, while lowest dry weight of plant (11.00g) was recorded in the treatment T_8. At 90DAS the differences were statistically significant. At 90DAS, treatment T_0 (DBW -17) recorded the highest values (92.67g) for dry weight, while lowest dry weight of plant (53.67g) was recorded in the treatment T_1 (Raj 3077). The dry weight recorded under treatment T_3, T_6, T_7 and T_2 were statistically at par to that of T_3 (Lok-1). The probable reasons for the findings could have been because of varietal characteristics, all varieties recorded increased dry weight of plant by application of irrigation at all critical growth stage which might be due to the variation of genetic character among different varieties as well as with healthier plant growth with sufficient availability of nutrients having no moisture stress.

Crop growth rate (g day^{-1} m^{-2}):

A perusal of the Table 5 depicting the observation of crop growth rate of plants reveals a non-significant difference between the treatments in both of the observations recorded at 0-30 DAS and 30- 60 DAS. At 0-30 DAS, treatment T_4 (Raj 1482) and T_8 (PBW-343) recorded the highest values (0.16.663 g day^{-1} m^{-2}) for CGR, while lowest CGR of plant (11.110 g day^{-1} m^{-2})

Table 3 : Plant height (cm) of wheat recorded at different intervals

Treatments	Varieties	Plant height (cm)		
		30 DAS	60 DAS	90 DAS
T_0	DBW -17	16.43	26.63	77.81
T_1	Raj 3077	15.89	27.69	81.92
T_2	HD 2967	17.62	32.09	88.08
T_3	Lok-1	20.05	48.47	92.26
T_4	Raj 1482	18.96	45.84	83.49
T_5	Raj 4120	15.10	30.33	79.56
T_6	K-65	17.19	30.79	83.79
T_7	HD 2967	17.18	34.43	86.63
T_8	PBW-343	15.00	27.75	75.14
	F-test	S	S	NS
	S.E. ±	1.10	5.12	4.96
	C.D. (P=0.05)	2.35	10.87	

NS= Non-significant S= Significant

Table 4 : Plant dry weight (g plant^{-1}) of wheat recorded at different intervals

Treatments	Varieties	Dry weight (g plant^{-1})		
		30 DAS	60 DAS	90 DAS
T_0	DBW -17	4.00	16.67	92.67
T_1	Raj 3077	3.33	17.00	53.67
T_2	HD 2967	4.33	15.67	78.67
T_3	Lok-1	4.00	16.33	91.33
T_4	Raj 1482	5.00	16.67	73.00
T_5	Raj 4120	4.00	14.67	79.67
T_6	K-65	4.33	16.33	80.67
T_7	HD 2967	4.67	13.67	73.67
T_8	PBW-343	5.00	11.00	71.00
	F-test	NS	NS	S
	S.E.±	0.77	2.82	7.08
	C.D. (P=0.05)	-	-	15.01

NS= Non-significant S= Significant

was recorded in the treatment T_1 (Raj 3077). At 30-60 DAS, treatment T_1 (Raj 3077) recorded the highest values (45.533 g day^{-1} m^{-2}) for CGR, while lowest CGR of plant (20.00 g day^{-1} m^{-2}) was recorded in the treatment T_8. At 60- 90 DAS the differences were statistically significant. At 60-90 DAS, treatment T_0 (DBW-17) recorded the highest values (266.663 g day^{-1} m^{-2}) for CGR, while lowest CGR of plant (122.220 g day^{-1} m^{-2}) was recorded in the treatment T_1. The CGR recorded under treatment T_3 (Lok-1) were statistically at par to that of T_0 (DBW-17). The probable reasons for the findings could have been because of varietal characteristics, all varieties recorded increased crop growth rate by application of irrigation at all critical growth stage which might be due to the variation of genetic character among different varieties as well as with healthier plant growth with sufficient availability of nutrients having no moisture stress.

Relative growth rate (g g^{-1} day^{-1}):

A perusal of the Table 6 depicting the observation of relative growth rate of plants reveals a non-significant difference between the treatments in all observations recorded at 30-60 and 60-90DAS. At 0-30DAS, treatment T_4 (Raj 1482) and T_8 (PBW-343) recorded the highest values (0.053 g g^{-1} day^{-1}) for RGR, while lowest RGR of plant (0.039 g g^{-1}day^{-1}) was recorded in the treatment T_1 (Raj 3077). At 30-60DAS, treatment

Table 5 : Crop growth rate (g day^{-1} m^{-2}) of wheat recorded at different intervals

Treatments symbol	Varieties	Crop growth rate (g day^{-1} m^{-2})		
		0-30 DAS	30-60 DAS	60-90 DAS
T_0	DBW -17	13.330	42.220	266.663
T_1	Raj 3077	11.110	45.553	122.220
T_2	HD 2967	14.440	37.773	176.663
T_3	Lok-1	13.330	42.220	249.997
T_4	Raj 1482	16.663	40.107	187.773
T_5	Raj 4120	13.330	35.553	183.327
T_6	K-65	14.440	39.997	214.440
T_7	HD 2967	15.343	29.997	199.997
T_8	PBW-343	16.663	20.000	199.997
	F-test	NS	NS	S
	S.E.±	0.77	2.82	19.738
	C.D. (P=0.05)	-	-	41.485

NS= Non-significant S= Significant

Table 6 : Relative growth rate (g g^{-1} day^{-1}) of wheat recorded at different intervals

Treatments	Varieties	Relative growth rate (g g^{-1} day^{-1})		
		0-30 DAS	30-60 DAS	60-90 DAS
T_0	DBW -17	0.045	0.047	0.057
T_1	Raj 3077	0.039	0.053	0.038
T_2	HD 2967	0.047	0.043	0.053
T_3	Lok-1	0.045	0.047	0.057
T_4	Raj 1482	0.053	0.039	0.050
T_5	Raj 4120	0.045	0.038	0.056
T_6	K-65	0.048	0.047	0.053
T_7	HD 2967	0.051	0.034	0.055
T_8	PBW-343	0.053	0.030	0.062
	F-test	NS	NS	NS
	S.E.±	0.006	0.008	0.007
	C.D. (P=0.05)	-	-	0.057

NS= Non-significant

T_2 recorded the highest values (0.053 g g^{-1} day^{-1}) for RGR, while lowest RGR of plant (0.030 g g^{-1} day^{-1}) was recorded in the treatment T_8 (PBW-343). At 60-90 DAS, treatment T_8 (PBW-343) recorded the highest values (0.062g g^{-1} day^{-1}) for RGR, while lowest RGR of plant (0.038g g^{-1} day^{-1}) was recorded in the treatment T_1 (Raj 3077). The probable reasons for such finding might be due to varietal character.

Number of tillers per plants:

The observations recorded on number of tillers per plant have been presented in Table 7. The analysis of data revealed that there was a non-significant difference in number of tillers per plant at 60 and 90DAS. The highest number of tillers per plant (5.13) 60DAS was recorded in the treatment T_6 (K-65) and the highest number of tillers per plant (3.53) 90DAS was recorded in the treatment T_5 (Raj 4120) and T_6 (K-65). While lowest (3.13, 2.20) at 60, 90DAS were recorded under treatments T_0 (DBW-17).The probable reasons for such finding might be due to varietal character. More or less similar results were found by Ajit *et al.* (2001); Chaturvedi (2006); Dewal and Pareek (2004); Kumar *et al.* (2010); Maurya *et al.* (2014); Saren and Jana (2001) and Singh and Agarwal (2001).

Table 7 : Number of tillers $plant^{-1}$ of wheat recorded at different intervals

Treatments	Varieties	No. of tillers $plant^{-1}$	
		60 DAS	90 DAS
T_0	DBW -17	3.13	2.20
T_1	Raj 3077	3.33	2.27
T_2	HD 2967	4.00	2.93
T_3	Lok-1	4.60	3.20
T_4	Raj 1482	3.67	2.73
T_5	Raj 4120	4.87	3.53
T_6	K-65	5.13	3.53
T_7	HD 2967	4.87	3.33
T_8	PBW-343	3.53	2.80
	F-test	NS	NS
	S.E.±	2.82	0.81
	C.D. (P=0.05)	-	-

NS= Non-significant

Post-harvest observations:

Number of effective tillers per meter square:

The observations recorded on number of effective tillers per meter square have been presented in Table 8. A critical observation of the table indicates that treatment T_1 (Raj 3077) recorded the maximum number of effective tillers/meter square (257.33). The number of effective tillers under treatment T_8 (PBW-343) was found to be at par with that of treatment T_1. The probable reasons for higher tiller count in treatment T_1 could have been because of performance of varietal characteristics. Raj 3077 being a dwarf variety may produce more tillers than the other varieties tried.

Table 8 : Number of effective tillers per meter square of different varieties of wheat

Treatment symbol	Treatments	No. of effective tillers per meter square
T_0	DBW -17	237.33
T_1	Raj 3077	257.33
T_2	HD 2967	219.00
T_3	Lok-1	207.66
T_4	Raj 1482	213.00
T_5	Raj 4120	212.33
T_6	K-65	214.00
T_7	HD 2967	209.00
T_8	PBW-343	252.66
	F-test	S
	S.E.±	7.12
	C.D. (P=0.05)	15.09

S= Significant

Length of spike (cm):

The analysis of data showed in Table 9 that there was significant difference on length of spike in various treatments. The maximum length of spike (11.04cm) was

Table 9 : Length of spike (cm) of different varieties of wheat

Treatments symbol	Treatments	Length of spike (cm)
T_0	DBW -17	8.58
T_1	Raj 3077	8.55
T_2	HD 2967	8.07
T_3	Lok-1	11.04
T_4	Raj 1482	8.60
T_5	Raj 4120	7.73
T_6	K-65	8.53
T_7	HD 2967	9.11
T_8	PBW-343	7.89
	F-test	S
	S.E.±	0.36
	C.D. (P=0.05)	0.76

S= Significant

recorded in the treatment T_3 (Lok-1) whereas, the minimum length of spike (7.73cm) was recorded in the treatment T_5 (Raj 4120). The probable reasons for such findings might be due to varietal character. Timely sowing wheat crop took more days to complete its life-cycle with sufficient availability of moisture at seeding to physiological maturity.

Number of grains spike^{-1}:

The analysis of data showed (Table 10) that there was significant difference in number of grains spike^{-1} due to various treatments. The maximum number of grains spike^{-1} (48.07) was recorded in the treatment T_6 (K-65). Treatments T_1 (Raj 3077) and T_5 (Raj 4120) were statistically at par to that of T_6.

Table 10 : Number of grains spike^{-1} of different varieties of wheat

Treatments symbol	Treatments	No. of grains spike^{-1}
T_0	DBW -17	39.20
T_1	Raj 3077	47.93
T_2	HD 2967	41.23
T_3	Lok-1	44.07
T_4	Raj 1482	40.00
T_5	Raj 4120	47.27
T_6	K-65	48.07
T_7	HD 2967	39.73
T_8	PBW-343	40.60
	F-test	NS
	S.E.±	4.79
	C.D. (P=0.05)	-

NS= Non-significant

Test weight (g):

The observations recorded on test weight as influenced by various treatments have been presented in Table 11. The table clearly shows that there was significant difference in test weight in various treatments. The maximum test weight (41.23 g) was recorded in the treatment T_2 (HD 2967). Whereas, the minimum test weight (33.73g) was recorded in the treatment T_8 (PBW-343) .The test weight recorded under treatment T_0 (DBW -17) was statistically at par to that of T_2 (HD 2967). The probable reasons for such finding might be due to recommended NPK fertilizer dose and five irrigations provided to wheat which might have helped in more translocation of photosynthates towards grain due to the availability of sufficient amount of water in root zone.

Table 11 : Test weight (g) of different varieties of wheat

Treatments symbol	Treatments	Test weight (g)
T_0	DBW -17	41.20
T_1	Raj 3077	36.50
T_2	HD 2967	41.23
T_3	Lok-1	36.90
T_4	Raj 1482	35.10
T_5	Raj 4120	35.13
T_6	K-65	34.77
T_7	HD 2967	36.90
T_8	PBW-343	33.73
	F-test	S
	S.E.±	1.64
	C.D. (P=0.05)	3.48

S= Significant

Grain yield (t ha^{-1}) :

The values recorded in Table 12 and their depiction reveal average grain yield (t ha^{-1}). The table indicates that the grain yield differed none significantly due to treatments. The maximum grain yield (2.76 t ha^{-1}) was recorded in the treatment T_3 (Lok-1), followed by treatments T_7 (HD 2967) and T_6 (K-65), whereas, the minimum grain yield (1.72 t ha^{-1}) was recorded in the treatment T_0 (DBW-17). The observation clearly depict that our varieties *i.e.*, from treatment T_2 ,T_4, T_6 and T_7 performed at par to that of the recommended varieties for the region.

Table 12 : Grain yield (t ha^{-1}) of different varieties of wheat

Treatments symbol	Treatments	Grain yield (t ha^{-1})
T_0	DBW -17	1.72
T_1	Raj 3077	2.56
T_2	HD 2967	1.74
T_3	Lok-1	2.76
T_4	Raj 1482	2.56
T_5	Raj 4120	2.46
T_6	K-65	2.63
T_7	HD 2967	2.64
T_8	PBW-343	2.02
	F-test	NS
	S.E,.±	0.51.
	C.D. (P=0.05)	1.09

NS= Non-significant

Straw yield (t ha^{-1}):

The observations on straw yield of wheat as influenced by different treatments are presented in Table

13. The statistical analysis of the data indicates that the straw yield was non-significant under different treatments. A critical review of the table reveals that the straw yield was higher (6.40 t ha^{-1}) under treatment T_3 (Lok-1) while, the minimum straw yield (2.80 t ha^{-1}) was recorded under treatment T_0 (DBW-17) and T_8 (PBW-343). The probable reasons for such finding might be due to the different varieties performance at par with influence to the straw and grain yield.

Table 13a : Straw yields (t ha^{-1}) of different varieties of wheat

Treatments symbol	Treatments	Straw yield (t ha^{-1})
T_0	DBW -17	2.80
T_1	Raj 3077	3.35
T_2	HD 2967	3.42
T_3	Lok-1	6.40
T_4	Raj 1482	3.51
T_5	Raj 4120	3.86
T_6	K-65	4.45
T_7	HD 2967	4.02
T_8	PBW-343	2.80
	F-test	NS
	S.E.±	1.09
	C.D. (P=0.05)	-

NS= Non-significant

Harvest index (%):

The values recorded in Table 14 represent the harvest index (%) of wheat varieties. The table indicates that the harvest index was non-significant under the different treatments. The maximum harvest index (43.31%) was recorded under the treatment T_1 (Raj 3077) followed by treatments T_4 and T_8, whereas, the minimum harvest index was recorded in the treatment T_3. The probable reasons for such finding might be due

Table 13b : Cost of cultivation of different varieties of wheat (fixed cost for all treatments)

Particulars	Unit	Qty.	Rate/unit (Rs.)	Cost (Rs./ha)
Land-preparation				
Ploughing	Hour	4	500.00	2000.00
Disc harrowing and leveling	Hour	6	500.00	3000.00
Layout preparation	Labour	10	200.00	2000.00
Manure and fertilizer				
Urea	Kg	95.83	6.00	574.98
DAP	Kg	86.66	12.00	1039.92
MOP	Kg	50.0	8.00	400.00
$ZnSO_4$	Kg	20	30.00	600.00
Fertilizer application				
Labour for urea top dressing	Labour	2	200.00	400.00
Seed and sowing				
Seed rate	Kg	120	30.00	3600.00
Intercultural- operations				
Thinning and gap. Filling and weeding	Labour	10	200.00	2000.00
Irrigation				
Tube well charge (2 irrigation)	Hour	8 (4 hour each)	400	800.00
Labour for irrigation	Labour	2 Labour	200.00	400.00
Harvesting	Labour	10	200.00	2000.00
Threshing	Labour	8	200.00	1600.00
Rental value of Land	Months	5	600.00	3000.00
Supervision charges	Months	5	800.00	4000.00
Miscellaneous	---	---	---	2000.00
Cost of cultivation				= 29,414.90/-
Interest @ 6% for 6 month				10,529
Total cost of cultivation				40,004.26/-

to non-significant difference between the grain and straw yield.

Economics of treatments:

The cost of cultivation, gross profit, net profit and benefit cost ratio are presented under this heading with the help of Table 14a and b. Similar were related to the present investigation on was also carried out by Ajit *et al.* (2001); Bhunia and Singh (2000); Dhaka *et al.* (2007); Kaur (2008); Mishra and Tripathi (2010); Sarma *et al.* (2006 and 2007); Sarwar *et al.* (2010) and Shivani *et al.* (2001).

Table 14a : Harvest index (%) of different varieties of wheat

Treatments symbol	Treatments	Harvest index (%)
T_0	DBW -17	39.24
T_1	Raj 3077	43.31
T_2	HD 2967	33.17
T_3	Lok-1	31.15
T_4	Raj 1482	41.95
T_5	Raj 4120	38.29
T_6	K-65	35.99
T_7	HD 2967	39.84
T_8	PBW-343	40.86
	F-test	NS
	S.E.±	4.41
	C.D. (P=0.05)	-

NS= Non-significant

Conclusion :

The experiment was conducted to study the wheat varietal evaluation under low fertility and two irrigations. The experimental findings are summarized below : (i) Emergence pattern (%) was recorded to be highest under the treatment T_1 (Raj 3077) at 9 DAS and the differences were statistically non significant. (ii) No. of tillers plant^{-1} was recorded to be highest under the treatment T_6 (K-65) at 30, 60DAS and the differences were statistically non-significant. (iii) The plant height was found to be the highest under the treatment T_3 (Lok-1) at 30, 60 and 90DAS the differences were statistically significant. (iv) The plant dry weight was recorded to be highest under the treatment T_4 (Raj 1482), T_3 (Lok-1) at 30, 60DAS, respectively and the differences were statistically non-significant. But at 90 DAS it was found to be highest under the treatment T_0 (DBW – 17) and the differences were statistically significant. (v) Number of plants per running row meter was recorded to be highest under the treatment T_1 (Raj 3077) at 30DAS all though the differences were statistically non-significant. (vi) Treatment T_1 (Raj 3077) was recorded significantly higher number of effective tillers per meter square than all the other treatments, while the lowest number of effective tillers per meter square was recorded for the treatment T_3 (Lok-1). (vii) The spike length was recorded to be highest under the treatment T_3 (Lok-1) which was significantly higher than all these other treatments, while the lowest spike length was recorded under the treatment T_5 (Raj 4120). (viii) Number of grains spike^{-1} was recorded to be highest under the treatment T_6 (K-65), while the lowest grains spike^{-1} was recorded under the treatment T_0 (DBW –17). (ix) Treatment T_2 (HD2967) recorded significantly higher test weight than all the other treatments, while the lowest test weight was recorded under the treatment T_8 (PBW-343). (x) The highest grain yield was recorded under the treatment T_3 (Lok-1), while the lowest grain yield was recorded in treatment T_0 (DBW–343) and the differences were statistically non-

Table 14b : Economics of different varieties of wheat

Treatments	Varieties	Grain yield (t ha^{-1})	Straw (yield t ha^{-1})	Sale rate Rs.		Gross return (Rs.ha^{-1})	Cost of cultivation (Rs. ha^{-1})	Net return (Rs. ha^{-1})	B:C
				Grain (Rs. ha^{-1})	Straw (Rs. ha^{-1})				
T_0	DBW -17	17.27	28.07	82,442.00	52,000.00	134,442.00	40,004.26/-	94,437.74	3.36
T_1	Raj 3077	25.67	33.50	78,506.00	52,900.00	131,406.00	40,004.26/-	91,401.74	3.28
T_2	HD 2967	17.40	34.27	95,405.00	54,600.00	150,005.00	40,004.26/-	110,000.74	3.31
T_3	Lok-1	27.67	64.00	79,121.00	53,650.00	132,771.00	40,004.26/-	92,766.74	3.74
T_4	Raj 1482	25.67	35.17	77,276.00	52,050.00	129,326.00	40,004.26/-	89,321.74	3.23
T_5	Raj 4120	24.67	38.67	81,827.00	57,343.00	139,377.00	40,004.26/-	99,372.74	3.48
T_6	K-65	26.33	44.50	80,474.00	57,100.00	137,574.00	40,004.26/-	97,569.74	3.43
T_7	HD 2967	26.40	40.27	77,998.00	53,700.00	131,698.00	40,004.26/-	91,693.74	3.29
T_8	PBW-343	20.27	28.07	83,426.00	57,050.00	140,476.00	40,004.26/-	100,471.74	3.51

Note: Selling price of wheat grain = Rs.15,750 t^{-1}, Selling price of straw Rs. 5000 t^{-1}. It is clear from above table that treatment T_3 (LOK-1) gave the maximum net profit (Rs. 110,000.7) with benefit cost ratio of 3.74.

significant. (xi) Straw yield was recorded to be the highest under the treatment T_3 (Lok-1) while the lowest straw yield was recorded under the treatment T_0 (DBW-17) and T_8 (PBW-343). (xii) Treatment T_3 *i.e.*, variety Lok-1 proved to be the most profitable variety, showing a benefit cost ratio of 3.74, due to higher grain and straw yield. It may be concluded that among the varieties tried under low fertility and two irrigations accession variety Raj 3077, was found to be the best for obtaining highest grain yield and benefit cost ratio in wheat. Since the findings are based on the research done in one season, it may be repeated for confirmation.

REFERENCES

Abdul, Aziz Khakwani, Dennett, M.D., Munir, M. and Abid, M. (2012). Growth and yield response of wheat varieties to water stress. *Pak. J. Bot.,* **44** (3) : 879-886.

Ajit, S., Nehra, Hooda, I.S. and Singh, K.P. (2001). Effect of integrated nutrient management on growth and yield of wheat (*Triticum aestivum*). *Indian J. Agron*., **46**(1): 112-117.

Bhunia, S.R. and Singh, V. (2000). Scheduling of irrigation to wheat (*Triticum aestivum*) under shallow water table conditions. *Indian J. Agric. Sci*., **70**(7): 494-495.

Chaturvedi, I. (2006). Effects of different nitrogen levels on growth, yield and nutrient uptake of wheat (*Triticum aestivum* L.) *Int. J. Agric. Sci.,* **2**(2) : 372—374.

Dewal, G.S. and Pareek, R.G. (2004). Effect of phosphorus, sulphur and zinc on growth, yield and nutrient uptake of wheat (*Triticum aestivum*). *Indian J. Agron*., **49** (3) : 160-162.

Dhaka, A.K., Bangarwa, A.S., Pannu, R.K., Garg and Ramprakash (2007). Effect of irrigation levels on consumptive water use soil moisture extraction pattern and water use efficiency of different wheat genotypes. *Indian J. Agric. Res.,* **41**(3): 220-223.

Donald, C.M. (1962). In search of yield. *J. Aust. Inst.Agric. Sci.,* **28**: 171-178.

Fisher, R.A. (1921). On the 'probable error' of a coefficient deduced from a small sample. *Metron,* **1** : 2-32.

Fisher, R.A. (1950). *Statistical methods for research workers,* Oliver and Boyd. Edinburg, London, UNITED KINGDOM

Kaur, Pannu R.K. (2008). Effect of sowing time and nitrogen schedules on phenology, yield and thermal – use efficiency of wheat (*Triticum aestivum*). *Indian J. Agric. Sci*.,**78** (4): 366-369.

Kaur, Pannu R.K. and Buttar, G.S. (2010). Impact of nitrogen application on the performance of wheat (*Triticum aestivum*) and nitrogen use efficiency under different dates of sowing. *Indian J. Agron.,* **55**(1): 40-45.

Kumar, M., Sheoran, P. and Yadav, A. (2010). Productivity potential of wheat (*Triticum aestivum*) in relation to different planting methods and nitrogen management strategies. *Indian J. Agric. Sci.,* **80**(5): 427 -429.

Maurya, Prakash, Kumar, Vinay, Maurya, K. K., Kumawat, Narendra, Kumar, Rakesh and Yadav, M.P. (2014). Effect of potassium application on growth and yield of wheat varieties. *Bioscan,* **9**(4): 1371-1373.

Mishra, A.K. and Tripathi, P. (2010). Effect of irrigation frequencies on yield and water use efficiency of wheat varieties. *Pantnagar J. Res.,* **8**(1): 1-4. 10 ref. AN: 20113047509.

Saren, B.K. and Jana, P.K. (2001). Effect of depth of irrigation and level and time of nitrogen application on growth, yield and nutrient uptake by wheat (*Triticum aestivum*). *Indian J. Agron.,* **46** (2) : 227-232.

Sarma, A., Singh, H., Pannu, R.K., Nanwal, R.K. and Singh, K.P. (2006). Effect of integrated nutrient management on yield and nutrient uptake in wheat [*Triticum aestivum* (L.) Emend. Fiori & Paol.] under adequate and limited irrigation. *Haryana J. Agron*., **22**(1): 1-4.

Sarma, A., Singh, H., Pannu, R.K., Nanwal, R.K. and Singh, K.P. (2007). Effect of integrated nutrient management on grain yield, consumptive water use and water-use efficiency of wheat [*Triticum aestivum* (L.) Emend Fiorie Paol] under adequate and limited water supply. *Haryana J. Agron.,* **23**(1 & 2): 1-5.

Sarwar, N., Maqsood, M., Mubeen, K., Shehzad, M., Bhullar, M.S., Qamar, R. and Akbar, N. (2010). Effect of different levels of irrigation on yield and yield components of wheat cultivars. *Pak. J. Agri. Sci.,* **47**(3): 371-374.

Sharma, P.K., Yadav, G.L., Sharma, B.L. and Kumar, S. (2000). Response of wheat (*Triticum aestivum*) to nitrogen and zinc fertilization. *Indian J. Agron*., **45**(1): 124-127.

Shivani, Verma, U.N., Pal, S.K., Thakur, R. and Kumar, S. (2001). Production potential and water-use efficiency of wheat cultivars under different dates of seeding and irrigation levels. *Indian J. Agron*., **46** (4) : 659-664.

Singh, R. and Agarwal, S.K. (2001). Growth and yield of wheat (*Triticum aestivum*) as influenced by levels of farmyard manure and nitrogen. *Indian J. Agric. Sci*., **46** (3) : 462-467.