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# Effect of heat tolerant varieties on physiological characterstics, yield and its attributes of wheat (*Triticum aestivum* L.) crop under timely and late shown condition

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**Abstract**
This experiment was carried out to determine the response of different heat tolerence varieties of wheat (*Triticum aestivum* L.) on physiological characterstics, yield and its attributes under timely and late sown condition. The experiment was conducted at Nawabganj Research Farm of Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (U.P.) during *Rabi* season in year 2017-18, in randomized block design with two replications and twelve treatments. The result shows that the observation was taken at two different stages of growth which shows that the canopy temperature of late sown crops was higher than the timely sown crops. Under timely sown condition PBW762 shows minimum canopy temperature under both the stages and under late sown condition shows minimum canopy temperature in first stage but in second stage DBW223 shows minimum canopy temperature. Under timely sown PBW762 and WH1218 shows maximum chlorophyll content in first stage but in second stage PBW762, and DBW150 shows maximum chlorophyll content. Under late sown condition DBW222 shows maximum chlorophyll content in both stages. Under timely sown condition some varieties like DBW14, RW5 and RAJ3765 shows maxi. C.F.L. Under late sown condition some varieties like DBW223 and DBW14 shows maxi. C.F.L. DBW222 given maxi. Grain weight/plot and biomass production in both the conditions. DBW223 given maxi. Harvest index in timely sown and PBW762 given maxi. Under late sown condition. DBW233 given highest test weight and grain weight/spike under timely sown WH1218 given highest test weight and grain weight/spike under late sown condition.WH730 given highest number of grain/spike in both the conditions. Among all the twelve varieties DBW222 can be given best superior result under both timely and late sown conditions in a field.

**Keywords:** *Triticum aestivum* L., physiological, canopy temperature

## Introduction
Wheat is the second most important staple food next to maize, consumed by nearly 35% of the world population and providing 20% of the total food calories. Wheat occupies about 32% of the total acreage under cereals in the world. The main wheat growing countries include China, India, USA, Russia, France, Canada, Germany, Turkey, Australia and Ukraine. In India, wheat is mainly grown in the states of Uttar Pradesh, Madhya Pradesh, Punjab, Rajasthan, Haryana, Bihar, Maharashtra, Karnataka and Gujarat. India accounts an area, production and a productivity of 30.37 million ha, 90.78 million metric tonnes and 2989 kg/ha. respectively. Globally, probable demand for wheat by the year 2020 is forecast at around 950 million tonnes per year. This target will be achieved only, if global wheat production is increased by 2.5% per annum.

The wheat belongs to the genus *Triticum* of the family *Poaceae* and its believed to be originated from South West Asia (Lupton, 1987). Three species of wheat *viz*. *T. aestivum* L. (Bread wheat), *T. durum* Desf. (Macaroni wheat) and *T. dicoccum* Schulb. (Emmer wheat) are presently grown as commercial crop in India, covering 86, 12 and 2 per cent of the total area, respectively. The bread wheat, a hexaploid with chromosome number 2n=6x=42 is cultivated in all the wheat growing areas of the country, the macaroni or durum wheat (tetraploid, 2n=28) is mostly grown in the northern (Punjab) and southern states, while, the emmer wheat (tetraploid, 2n=28) is confined to the southern states (mainly Karnataka) and some parts of Gujarat.

Wheat is a unique gift of nature to the mankind as it can be moulded into innumerable products like chapatis, breads, cakes, biscuits, pasta and many hot and ready-to-eat breakfast foods. Wheat is consumed by nearly 35% of the world population and contributes 20% food calories. Wheat grain contains starch (60-68%), protein (6-21%), fat (1.5-2.0%), cellulose (2.0-2.5%), minerals (1.8%) and vitamins.

The uniqueness of wheat in contrast to other cereals is that wheat contains gluten protein which enables leavened dough to rise by forming minute gas cells and this property enables bakers to produce light breads.

Availability of sufficient genetic variability is very important in a crop improvement programme. For successful breeding programme, amount of variability present in the experimental material is desirable characteristic.

All varieties do not maintain the same relationship under different temperatures with regards to physiological charcterstics, yield and its attributes. (Test weight, Harvest index, Grain weight/spike, No. of grain/spike etc). This indicates that some varieties would do better than others in yield and other physiological characters when exposed to comparatively high temperatures. The proper screening of genotypes for temperature tolerance and their use in research programme will enable us to develop thermo-insensitive varieties which will boost up the wheat production especially in temperature prone areas of the country.

It is essential for a plant physiologist to measure the variability with the help of parameters like phenotypic coefficient of variation, genotypic coefficient of variation, heritability and genetic advance. The wheat crop requires favourable winter for about 100-110 days for producing its potential yield. Therefore, the heat tolerant wheat variety is still one of the priorities of agricultural research, because above the optimum temperature (22-24$^0$C) wheat yield is drastically affected. Wheat crops can be injured at seedling emergence, reproductive stage, stem elongation, heading and maturity stage by high temperature. Even 1$^0$C increment in temperature reduce 8 to 10 % grain yield. Wheat is especially sensitive to temperature exceeds 32$^0$ C for any significant period. This occurs at the grain filling stage in wheat resulting in the development of shrivelled grain which reduces yield and decreases quality. Many studies have shown that genetic variability for heat tolerance exists in germplasm lines and varieties.

During the sixties several workers like Dancan (1967) [3], Dewit (1967) and Loomis *et al.* (1967) developed the mathematical models to stimulate the photosynthetic system and yield behavior of crops for obtaining the maximum production potentialities in different Eco-edaphic environments. De-wit realized that there exist potentialities for producing enough food to support the increasing population of world day by day.

Asana (1968) [1] and Donald (1968), have not only emphasized the signification of sink capacity and the morphological components of yield but also the important contribution of the area above the flag leaf node towards the development and growth of sink.

Harvest index is alternative and additional criteria for selection of high yielding lines. Parthasarthy and Rajan (1972) [9] also tried to emphasize that, in their attempt to uses in green revolution, plant breeders have evolved the high yielding varieties more by genetic manipulation of grain and straw ratio than productivity per se, although harvest index has been considered an important determinant of grain yield in recent years.

An experiment was conducted by Patel *et al*., (1999) [10] during 1994-95 and 1995-96 to study the effect of different sowing dates on yield attributes and yield of wheat. The study showed that sowing of wheat in first week of December gave maximum grains per spike (36.4) as compared to sowing of wheat before or after first week of December. The number of grains per ear decreased but non-significant difference in spike length was observed due to dates of sowing the 25th Nov. sown crop produced the heaviest test weight (46.4 gm) however it was at par with test weight of 5th December sown crop.

Ghosh *et al.,* (2000) [4] reported that the 16th November sown crop produced more number of grains per spike and thousand grain weight as compared to 26th November and 6th December sown wheat.

Nainwal and Singh (2000) observed that varieties having attributes like higher spike number per unit area, grain number per spike and with duration of minimum one month from anthesis to maturity are likely to perform better under late sown condition and delay in sowing resulted in reduction in number of grains per spike and a month delay in sowing after 27 November there was significant reduction in thousand grain weight.

Shivani *et al*., (2001) [12] reported that the number of grains per spike greatly reduced due to delay in sowing the 21st November sown wheat gave highest thousand grain weight (43.7) as compared to 7th December, 21$^{st}$ December and 7$^{th}$ January sown crop and timely sown wheat gave larger spike than moderate late, late and very late sown crop.

Nagrajan and Rane (2002) [6] revealed that the higher number of grains per spike under timely sown conditions as compared to late sown.

An experiment was reported that the number of grains per spike reduced with delay in sowing time and 22 December sown crop produced shorter spikes than 22 November sown crops. Sowing dates Normal (20$^{th}$ November) and on the performance of 25 wheat genotypes it was found that the number of grains per spike as well as the biological yield were reduced under late sown (21$^{st}$ October) condition as compare to normal sown condition on (22nd November) and 31day delay in sowing resulted in the 21.1 per cent reduction of grain yield (Tyagi *et al*., 2003) [13].

Behera and Pradhan (2007) reported that the maximum spike per metre square and harvest index were recorded in GW 173, while maximum grain per spike in HI 1418 and thousand grain weight in lok 1 and it also was found that maximum dry matter accumulation and grain yield per meter square were recorded in HI 977, but it took maximum duration for maturity while, GW 173 and HI 1418 with early sowing under very late planting heat stress environment.

An experiment was conducted by Pandey *et al.,* (2010) [8] and found that the crop sown on 23 November recorded significantly higher value of yield indices, i.e. effective tillers per metre square, leaf area index, ear length, grain per ear and test weight than late (21 December) and very late (4 January) sown crop but was found at par with 7 December sown crop.

## Materials and Methods

The experiment was conducted on wheat during *Rabi* season of 2017-18 under natural condition at Nawabganj research farm of Chandra Shekhar Azad University of Agriculture and Technology, Kanpur. The soil of the experimental field was alluvial in origin. Soil sample (0-15cm) depths were initially drawn from randomly selected parts of the field before sowing. The quantity of soil sample was reduced to about one kilogram through quartering technique. The soil sample was then subjected to mechanical and chemical analysis in order to determine the textural class and fertility status the soils were sampled to a depth of 0-30 cm of the soil, air-dried and sieved (2 mm) for soil analyses. Some physical and chemical properties of soils are given in Table 1.

**Table 1:** Some properties of the <2mm fraction of the top 30 cm of soil used for the site.

| S. No. | Particulars | Values |
|---|---|---|
| 1. | Sand (%) | 43.05 |
| 2. | Silt (%) | 33.73 |
| 3. | Clay (%) | 23.00 |
| 4. | Textural Class | Loam |
| 5. | pH (1:2.5) | 7.70 |
| 6. | EC (1:2.5) (ds/m at $25^0$C) | 0.60 |
| 7. | Organic Carbon (%) | 0.45 |
| 8. | Available Nitrogen (kg/ha) | 185.00 |
| 9. | Available Phosphorus (kg/ha) | 12.80 |
| 10. | Available Potassium (kg/ha) | 175.00 |
| 11. | Particle Density (Mg/$m^3$) | 2.54 |
| 12. | Bulk Density (Mg/$m^3$) | 1.32 |
| 13. | Pore Space (%) | 46.50 |

Twelve promising varieties of wheat, DBW150, PBW762, WH1218, DBW222, K1601, DBW223, DBW14, RW5, RAJ3765, DBW233, WH730, DBW71 were obtained from section of Rabi cereals. The experiment was layout in randomised block design. The treatment comprised of above twelve wheat varieties. Sowing of each wheat variety was done in line and each were replicated twice. In twelve treatment with having plot size 3 x 6 meter square. Doses of fertilizers are normally applied @ 120 Kg N, 60 Kg $P_2O_5$, 40 Kg $K_2O$/ha through Urea, D.A.P and Murate of Potash. Seed were sown in furrow placing the seed at 5 cm. depth as practicable, on 15th of Nov. 2017 (Timely sowing) and 20th of December 2017 (Late sowing).

Physiological observations were taken after germination to the end of vegetative state, Yield and its attributes observations were taken at the time of harvesting.

**Canopy temperature:** It was recorded at two different growth stages of both timely and late sown conditions. It is presented in degree Celsius.

**C.F.L (chlorophyll fluorescence):** It was also recorded two stages of growth. It is presented in the unit of Fv/Fm.

**Chlorophyll content:** Chlorophyll content was recoded at two different growth stages and presented in percentage.

**Grain weight/plot:** Grain weight was taken after harvesting the crops. Grains from each plot was cleaned properly packed in a cloth bag and was weighed. It was recorded in kg**.**

**Biomass/plot (kg):** It was recorded after harvesting of crop. The plants of each plot were tied separately and weighed using a weighing scale. It was recorded in kg.

**Harvest index:** Harvest index is the ratio of economic yield and biological yield. It is calculated by the formula suggested by Singh and Stoskopf 1971.

**Harvest index = grain weight/ biomass x 100 It is presented in percentage**. **Test weight (1000 grains weight):-** It was recorded after threshing, winnowing of the crops and drying of the grains. 500 grains were counted from random sample of each plot and was weighed. It was recorded in gm.

**Number of grain/spike:** The plant of half row length from each corner of each plots were harvested and threshed and was divided by number of spikes. It is presented in numbers.

**Grain weight/spike:** The grain numbers recorded in above observation was weighed. It is presented in gm. Statistical analyses of the data were carried out according to Randomized block design. All the parameters were subjected to analysis of variance (ANOVA), using RBD procedure.

**Results**

The effect of timely and late sown wheat genotypes on physiological characterstics, yield and its attributes of crop these are specified that

**Canopy temperature:** The data presented in Table 2 shows the observation of canopy temperature under timely sown condition and table 3 comprises the canopy temperature under late sown condition. The observation was taken at two different stages of growth which shows that the canopy temperature of late sown crops was higher than the timely sown crops. Under timely sown condition PBW762 shows minimum canopy temperature under both the stages and under late sown condition shows minimum canopy temperature in first stage but in second stage DBW223 shows minimum canopy temperature.

**Chlorophyll content:** The observation of chlorophyll content was taken after 15 and 20 days of flowering. The data is presented in Table 2 for timely sown condition and table 3 shows the data of chlorophyll content under late sown condition. The data shows that the chlorophyll content is less under late sown condition as compared to timely sown condition. Under timely sown condition some varieties like PBW762 and WH1218 shows maximum chlorophyll content in first stage but in second stage PBW762, and DBW150 shows maximum chlorophyll content. Under late sown condition DBW222 shows maximum chlorophyll content in both first and second stages.

**Number of leaves C.F.L. (Fv/Fm):** Chlorophyll fluorescent is the measurement of photosynthetic ability of the two photosystems of chlorophyll**.** The data presented in Table 2 and table 3 shows the C.F.L. value under timely and late sown condition respectively. The observation was taken at two stages of crop growth. Under timely sown condition some varieties like DBW14, RW5 and RAJ3765 shows maximum chlorophyll fluorescent in first stage whereas in second stage DBW223, DBW14 and DBW71 shows maximum chlorophyll fluorescent. Under late sown condition some varieties like DBW223 and DBW14 shows maximum chlorophyll fluorescent whereas in second stage varieties like DBW223 and RAJ3765 shows the maximum value of chlorophyll fluorescent.

**Table 2:** Observations of canopy temperature, chlorophyll content and C.F.L. under timely sown condition.

| Genotypes | Canopy Temperature ($^0$C) | | Chlorophyll Content (%) | | C.F.L. (Fv/Fm) | |
|---|---|---|---|---|---|---|
| | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| DBW 150 | 16.7 | 18.6 | 46 | 51 | 0.675 | 0.707 |
| PBW 762 | 14.4 | 17.6 | 52 | 51 | 0.651 | 0.710 |
| WH 1218 | 16.8 | 22.9 | 53 | 49 | 0.698 | 0.750 |

| | | | | | | |
|---|---|---|---|---|---|---|
| DBW 222 | 16.6 | 21.5 | 50 | 50 | 0.728 | 0.741 |
| K 1601 | 15.5 | 23.8 | 43 | 46 | 0.729 | 0.750 |
| DBW 223 | 16.1 | 22.4 | 50 | 41 | 0.639 | 0.710 |
| DBW 14 | 15.5 | 19.8 | 43 | 49 | 0.718 | 0.710 |
| RW 5 | 17.2 | 19.6 | 50 | 48 | 0.713 | 0.720 |
| RAJ 3765 | 15.5 | 20.0 | 45 | 49 | 0.712 | 0.715 |
| DBW 233 | 15.5 | 18.3 | 50 | 42 | 0.632 | 0.705 |
| WH 730 | 15.3 | 20.2 | 45 | 49 | 0.688 | 0.737 |
| DBW 71 | 15.5 | 21.0 | 50 | 49 | 0.622 | 0.725 |
| S.E. (Diff.) = | 0.69 | 1.20 | 1.91 | 1.50 | 0.04 | 0.02 |
| C.D. (0.05) = | 1.43 | 2.40 | 3.96 | 3.01 | NS | NS |

**Table 3:** Observations of canopy temperature, chlorophyll content and C.F.L. under late sown condition.

| Genotypes | Canopy temperature ($^0$c) | | Chlorophyll content (%) | | C.F.L. (Fv/Fm) | |
|---|---|---|---|---|---|---|
| | 1st | 2nd | 1st | 2nd | 1st | 2nd |
| DBW 150 | 21.7 | 18.0 | 46 | 51.4 | 0.733 | 0.740 |
| PBW 762 | 22.0 | 16.4 | 46 | 48.0 | 0.736 | 0.684 |
| WH 1218 | 22.0 | 17.8 | 41 | 48.4 | 0.750 | 0.741 |
| DBW 222 | 18.8 | 16.2 | 51 | 55.2 | 0.750 | 0.716 |
| K 1601 | 20.0 | 16.5 | 45 | 51.8 | 0.745 | 0.728 |
| DBW 223 | 21.7 | 17.5 | 46 | 51.7 | 0.756 | 0.750 |
| DBW 14 | 21.1 | 20.1 | 44 | 48.9 | 0.754 | 0.735 |
| RW 5 | 22.5 | 17.2 | 43 | 44.9 | 0.744 | 0.744 |
| RAJ 3765 | 20.6 | 18.6 | 37 | 48.0 | 0.750 | 0.745 |
| DBW 233 | 21.7 | 19.3 | 45 | 51.4 | 0.743 | 0.736 |
| WH 730 | 21.1 | 19.6 | 45 | 38.3 | 0.726 | 0.743 |
| DBW 71 | 21.3 | 20.3 | 46 | 49.2 | 0.750 | 0.731 |
| S.E. (Diff.) = | 1.03 | 1.50 | 2.22 | 3.30 | 0.02 | 0.01 |
| C.D. (0.05) = | 2.15 | 3.10 | 4.60 | 6.50 | 0.05 | 0.02 |

**Grain weight /plot:** Grain weight was taken after four months of sowing. The data presented in Table 4 and table 5 shows the grain weight per plot under timely and late sown condition respectively. The grain weight taken under timely sown condition is higher as compared to the late sown condition. Under timely sown condition some varieties like DBW222, DBW71 and RAJ3765 shows maximum grain weight. Under late sown condition some varieties like DBW222, K1601, WH1218 and PBW762 shows maximum grain weight.

**Biomass/plot**: The data presented in Table 4 shows the biomass of the crop under timely sown condition which is higher than the biomass observed under late sown condition as presented in table 5. Under timely sown condition varieties like DBW222 and DBW71 shows maximum biomass. Under late sown condition DBW222 and K1601 varieties shows maximum biomass.

**Harvest index:** The data presented in Table 4 and table 5 shows the harvest index under timely and late sown condition respectively. The data was calculated using the grain weight and biomass of the crop. Under timely sown condition DBW223, RAJ3765, DBW222 and WH730 shows maximum harvest index. The varieties such as PBW762, WH1218 and K1601 shows increase in harvest index under late sown condition from timely sown condition.

**Table 4:** Observations of grain weight, biomass and harvest index under timely sown condition.

| Genotypes | Grain Weight/Plot (Kg) | Biomass/Plot (Kg) | Harvest Index (%) |
|---|---|---|---|
| DBW 150 | 2.00 | 8.00 | 25.00 |
| PBW 762 | 1.67 | 7.00 | 23.85 |
| WH 1218 | 2.00 | 9.34 | 21.41 |
| DBW 222 | 2.50 | 10.34 | 24.17 |
| K 1601 | 1.84 | 9.34 | 19.70 |
| DBW 223 | 1.65 | 6.34 | 26.02 |
| DBW 14 | 1.97 | 8.00 | 24.62 |
| RW 5 | 2.08 | 8.34 | 24.94 |
| RAJ 3765 | 2.28 | 9.34 | 24.41 |
| DBW 233 | 2.25 | 9.00 | 25.00 |
| WH 730 | 2.25 | 9.00 | 25.00 |
| DBW 71 | 2.41 | 10.34 | 23.30 |
| S.E. (Diff.) = | 0.22 | 0.72 | 3.23 |
| C.D. (0.05) = | 0.46 | 1.49 | NS |

**Table 5:** Observations of grain weight, biomass and harvest index under late sown condition.

| Genotypes | Grain Weight/Plot (Kg) | Biomass/Plot (Kg) | Harvest Index (%) |
|---|---|---|---|
| DBW 150 | 1.13 | 5.00 | 22.60 |
| PBW 762 | 1.67 | 6.67 | 25.03 |
| WH 1218 | 1.70 | 6.85 | 24.81 |
| DBW 222 | 1.85 | 8.00 | 23.12 |

| | | | |
|---|---|---|---|
| K 1601 | 1.76 | 7.50 | 23.46 |
| DBW 223 | 1.11 | 6.34 | 17.50 |
| DBW 14 | 1.20 | 5.34 | 22.47 |
| RW 5 | 1.34 | 5.50 | 24.36 |
| RAJ 3765 | 1.30 | 5.67 | 22.92 |
| DBW 233 | 1.24 | 5.12 | 24.21 |
| WH 730 | 1.31 | 6.00 | 21.80 |
| DBW 71 | 1.25 | 6.00 | 20.83 |
| S.E. (Diff.) = | 0.21 | 0.49 | 3.40 |
| C.D. (0.05) = | 0.43 | 1.01 | NS |

**1000 grain weight:** The data presented in Table 6 and table 7 shows the weight of 1000 grains under timely and late sown condition respectively. Under timely sown condition some varieties like DBW233, WH1218 and K1601 shows maximum weight whereas WH1218 and DBW14 shows minimum weight of 1000 grains. Under late sown condition varieties like RW5 and RAJ3765 shows no change in 1000 grain weight while some varieties like DBW150, DBW223 and DBW14 shows increase in 1000 grain weight from that under timely sown.

**Grain number/spike:** The data presented in table 6 and table 7 shows the number of grain per spike under timely and late sown condition respectively. The grain number per spike is higher under timely sown condition as compared to late sown condition. Under timely sown condition some varieties like WH730, DBW233 and K1601 shows maximum number of grains per spike. Under late sown condition some varieties like PBW762 and RAJ3765 shows increase in number of grains per spike from that under timely sown whereas varieties like PBW762, DBW233 and WH730 shows maximum number of grains per spike.

**Grain weight/spike:** The data presented in table 6 and table 7 shows the weight of grains per spike under timely and late sown condition respectively. The grain weight per spike is higher under timely sown condition to that under late sown condition. But some varieties like DBW14 and RAJ3765 show an increase in grain weight per spike under late sown condition. Under late sown condition some varieties like WH1218, DBW14, RAJ3765 and DBW71 shows maximum grain weight per spike.

**Table 6:** Observations of 1000 grain weight, grain number/spike and grain weight/spike under timely sown condition.

| Genotypes | 1000 grain weight (g) | Grain number/Spike | Grain weight/spike (G) |
|---|---|---|---|
| DBW 150 | 37.67 | 64 | 3.0 |
| PBW 762 | 45.00 | 61 | 3.2 |
| WH 1218 | 50.73 | 65 | 3.7 |
| DBW 222 | 43.33 | 76 | 3.4 |
| K 1601 | 47.33 | 62 | 3.3 |
| DBW 223 | 43.10 | 64 | 3.0 |
| DBW 14 | 35.20 | 61 | 2.5 |
| RW 5 | 42.10 | 63 | 2.6 |
| RAJ 3765 | 42.20 | 54 | 2.2 |
| DBW 233 | 54.16 | 75 | 3.9 |
| WH 730 | 46.20 | 77 | 4.0 |
| DBW 71 | 41.30 | 65 | 3.1 |
| S.E. (Diff.) = | 4.04 | 3.50 | 0.91 |
| C.D. (0.05) = | 8.38 | 7.60 | 2.01 |

**Table 7:** Observations of 1000 grain weight, grain number/spike. And grain weight/spike under late sown condition.

| Genotypes | 1000 grain weight (g) | Grain number/spike | Grain weight/spike (G) |
|---|---|---|---|
| DBW 150 | 42.40 | 63 | 2.80 |
| PBW 762 | 42.67 | 67 | 3.10 |
| WH 1218 | 46.40 | 57 | 3.20 |
| DBW 222 | 43.24 | 61 | 2.80 |
| K 1601 | 43.46 | 53 | 2.20 |
| DBW 223 | 44.64 | 49 | 2.60 |
| DBW 14 | 42.54 | 46 | 3.20 |
| RW 5 | 42.20 | 59 | 2.80 |
| RAJ 3765 | 42.94 | 55 | 3.20 |
| DBW 233 | 42.80 | 65 | 3.10 |
| WH 730 | 45.86 | 66 | 2.60 |
| DBW 71 | 38.60 | 55 | 3.20 |
| S.E. (Diff.) = | 1.90 | 4.50 | 1.50 |
| C.D. (0.05) = | NS | 10.01 | 3.50 |

## Discussion

The investigation was carried out to screen out the varieties suitable for better Physiological characterstics, yield and yield attributes under timely sown and late sown condition. It has been observed that photosynthetic system like chlorophyll content, In this experiment the chlorophyll content of WH1218 (53%) is maximum in first stage while it reduced to 49% in second stage but DBW222 (50%) shows same chlorophyll content in both the stages under timely sown condition.

Under late sown condition WH1218 reduced to 41% and 48% in first and second stages respectively whereas DBW222 shows an increase in chlorophyll content from that of timely sown i.e. 51% and 55% in first and second stage respectively, similarly, K1601 shows an increase in chlorophyll content i.e. 43% and 46% to 45% and 51% in the two stages.

The chlorophyll fluorescence of DBW222 is 0.713 and 0.739 in two stages under timely sown condition whereas under late sown condition it is 0.740 and 0.716 similarly WH1218 shows 0.622 and 0.725 timely sown condition and increases to 0.750 and 0.741 under late sown condition which shows that photosynthesis in DBW222 and WH1218 higher in case of late sown condition. As far as canopy temperature is concerned, canopy temperature of all the varieties increased under late sown condition from that of timely sown condition. But DBW222 and K1601 shows minimum canopy temperature under late sown condition.

According to M. Pilar Cendreromateo *et al.*, (2016) [11], most studies assessing chlorophyll fluorescence have examined leaf response to environmental stress conditions using active techniques. Alternatively, techniques are also available to measure chlorophyll fluorescence at both leaf and canopy scales. However, the measurement principles of both the techniques are different and only a few data sets concerning the relationship between them are reported in the literature. In this study the potential for interchanging chlorophyll fluorescence was measured using active techniques with passive measurements. The ultimate objective was to determine the limits with in which active and passive techniques are comparable. The result presented in this study showed that active and passive measurements were highly correlated over the growing season. However, canopy and leaf's average active measurements can be used to better understand the daily and seasonal behaviour of passive chlorophyll fluorescence measurements. In turn, this can be used to better estimate plant photosynthetic capacity and therefore to provide improved information for crop management.

According to E. H. Murchie, T. Lawson (2017), chlorophyll fluorescence in wheat is fast measurement of photosynthetic performance, which is now used in crop improvement purpose. Here we can help the researchers make choices in terms of protocols of using the equipment and expertise available, especially for field measurements.

which resulted in higher grain weight i.e. 1.85 kg/plot in DBW222 which is highest among all the late sown variety followed by K1601 (1.76kg/plot) and WH1218 (1.70 kg/plot). Under timely sown condition 2.50 kg/plot in DBW222 followed by DBW71 (2.41 kg/plot) and RAJ3765 (2.41). The biomass of DBW222 (8.00 kg/plot) and K1601 (7.50 kg/plot) was highest in late sown condition. Under timely sown condition DBW222 (10.34 kg/plot) given highest biomass production. Harvest index of DBW223 is highest in timely sown condition, PBW762 given maximum harvest index under late sown condition. concern these three varieties (K1601, WH1218 and DBW222) gave higher result than other varieties. This shows that high chlorophyll and high photosynthetic rate gives maximum biomass (source) which converts into economic yield (sink). Coming to the well recognized component of grain yield frequently referred to sink components namely number of grain per spike, grain weight per spike, 1000 grain weight, which were higher in K1601, WH1218, DBW222, PBW762 and RAJ3765 in both the sowing condition.

Based on above results it may be concluded that among the tested genotypes under timely sown condition, genotypes DBW222 gave highest grain yield which was followed by genotypes RAJ3765 and DBW233 and WH730. On the other hand under late sown condition same genotype DBW223 again yielded highest which was followed by genotypes K1601 and WH1218. On the whole genotype DBW 222 can be sown under both timely and late sown (high temperature) conditions in a farmer field.

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