Evaluation of New Wheat Genotypes at Different Dates of Sowing under Irrigated Conditions of Central Brahmaputra Valley Zone of Assam

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Abstract

Wheat is the most important grain crop worldwide based on acreage and is ranked second when it comes to the total production volume. Wheat is the second most important staple crop in India after rice. Because of its wider adaptability it is grown from temperate irrigated to dry and high rainfall areas and from warm humid to dry cold environment. Optimum date of sowing is an important parameter, which affects the growth and yield attributes of wheat among other cultivation practices. To find out optimum date of sowing for Six wheat variety HS 562, HD 2967, HD 3086, HI1544, MACS 6222 and WR 544 was done at four different dates viz. 5th November, 25th November, 15th December and 5th January with row spacing of 20 cm as per treatments at experimental farm of Regional Agricultural Research Station (RARS), Assam Agricultural University (AAU), Nagaon, Assam, India. From the experiment, it was found that number of days to attain physiological maturity, Av. plant height (cm), Stand Count/sq.m, Number of ear heads /sq. m, Number of grain/ear head, 1000 grains weight (g), grain yield as well as biomass yield was significantly influenced. The crop sown under late sown condition took a smaller number of days to attain maturity in comparison to the crop sown timely. Maximum reduction in grain yield and biomass yield was found for the crop sown after 25th November onwards. The decreasing of yield attributes of the all six entries of wheat probably because of high temperature at the reproductive stage during the crop growing season.

Keywords
Wheat entries, Sowing date, phenophases, Grain yield, Biomass yield, Assam

Introduction

Wheat is the most important grain worldwide based on grain acreage and is ranked second when it comes to the total production volume. The global amount of wheat produced came to about 765.41 million metric tons in crop year 2019-2020. Wheat is the second most important staple crop in India after rice. Because of its wider adaptability it is grown from temperate irrigated to dry and high rainfall areas and from warm humid to dry cold environment. Because of its complex genome nature, it has wider adaptability.
Being a C3 type crop, it thrives well in cool environment. In India it is grown in 30.63 million hectares area with total production of 99.7 million tones during the season 2017-18 (Agriculture at a Glance 2018). Wheat is the second staple diet of the people of Assam next to rice. It contributes 14.4% to the value added in agriculture and 3.1% to GDP (Anon., 2010).

Seasonal fluctuations in temperature have potential impacts on the phasic development and grain yield of crops. Wheat, being a winter cereal, requires particular environmental conditions for better emergence, growth and flowering (Dabre et al., 1993) and is more vulnerable if exposed to high temperatures during reproductive stages (Kalra et al., 2008). Too early sowing produces weak plants with poor root system, which leads to irregular germination, frequent death of the embryo and decomposition of endosperm due to activities of bacteria or fungi (Paul, 1992). The local climate and associated micro meteorological variations are key factors in optimizing the date of sowings in a particular location because the relations between maximum temperature and sowing date gives best predictions of the growth intervals in various wheat growing areas (French et al., 1979). Earlier reports also emphasized the need of studying response of crops to weather variations for evaluating the impact of seasonal temperature change and estimating yield dependence of temperature rise of crops (Kalra et al., 2008). In case of delayed sowing the wheat crop is exposed to low temperature at the time of establishment and exposed to high temperature at the reproductive phase that finally leads to forced maturity. Optimum date of sowing is important parameters which affect the growth and yield attributes of wheat among other cultivation practices. Temperature is an important weather parameter that influences the growth and phenophases of wheat. Plants have definite temperature requirement before attaining a certain phenological stages. Therefore, the optimization of sowing time is an important parameter to attain maximum yield and efficient conversion of biological yield into economic yield. The optimization of exact date of sowing can be done through a comprehensive study on days taken to attain different phenophases, growing degree day’s requirement and yield response of wheat crop during rabi season. Therefore, an experiment was planned to have knowledge the exact date sowing of wheat in Assam condition.

**Materials and Methods**

The present investigation was carried out at experimental farm of Regional Agricultural Research Station (RARS), AAU, Nagaon, Assam, India. Geographically this centre is situated at 26°21′26.49″N latitude and 92°37′51.24″E longitude of Central Brahmaputra Valley Zone of Assam. The elevation of this place from mean sea level is 50.2 meter. The climate of RARS comprises of sub humid to sub tropical with hot dry summers and cool winters. Generally, the monsoon sets in around first week of June and lasts upto September end. The mean annual rainfall is 180 cm. The Maximum temperature generally rises up to °C and minimum temperature can be low as °C. The experiment was conducted during rabi season of 2018-19 and 2019-20. The soil of the experimental site was sandy loam soil with pH 5.4, organic carbon recorded 0.92 %, available nitrogen medium (305.4 kg/ha), available P$_2$O$_5$ (19.5 kg/ha) records available K$_2$O (126.9 kg/ha). The experiment was laid in factorial randomized plot design (RBD) with three replications. Size of each plot was 4 m × 3 m = 12 m$^2$. Sowing of Six wheat variety HS 562, HD 2967, HD 3086, HI1544, MACS 6222 and WR 544 was done at four different dates viz. 5$^{th}$ November, 25$^{th}$ November, 15$^{th}$ December and 5$^{th}$ January with row spacing of 268x709
20 cm as per treatments. Four irrigations were applied at four critical phenological stages of wheat. The crop was fertilized at the rate of 120 kg N, 60 kg P_2O_5 and 40 kg K_2O. Out of which, 1/3rd N and full dose of P_2O_5 and K_2O were applied as basal dose at the time sowing by broadcasting method.

The remaining 2/3rd dose of N were applied in two splits at CRI and late tillering stages. The yield and yield attributing characteristic were noted by regular field inspection method. Meteorological data, viz., maximum and minimum temperature, relative humidity, monthly rainfall, hours, days of Rainfall etc, were recorded from Agro-meteorological observatory of the research station.

**Results and Discussion**

During the experimentation period in the year 2018-19 the rainfall recorded 4.2 mm to 181.8 mm and highest rainy days received in the month of April. However, in the year 2019-20 the rainfall recorded ranges from 1mm to 67.9 and rainy days highest received in the month of April which was lowest as compared to the previous year. The Maximum temperature received ranges 24.4°C to 29°C and minimum temperature ranges 8.3°C to 18°C in the year 2018-19. Similarly, maximum temperature received ranges 22.7°C to 30.5°C and minimum temperature ranges 8.7°C to 16.6°C in the year 2019-20 (Table 1). Average plant height among the entries was observed highest in 05th November sowing as compared to the three sowing times. From the Table 2 it has been observed that as the sowing that shifted toward the month of January the average plant height has been observed lower as compared to the 5th November sowing for all the entries. This might be due to the impact of lower value of night and day temperature during the sowing time of the wheat crop. Similarly, highest plant height (94.93 cm) recorded in the entry HS 562 as compared to the other entries in all four dates of sowing. Plant population of the all entries were recorded highest in 5th November sowing as compared to the other three date of sowing (Table 1), this might be due to the cold injury during germination of the wheat seedling from the 3rd week of November to first week January.

Number of ear head has been recorded highest in first sowing date in the all entries as compared to the rest three date of sowing respectively (Table 1), this might be due to the decreases effective tiller number/hill of the all entries of wheat. Therefore, from the experiment it can be stated that beyond 5th November date of sowing leads to lower down the effective tiller numbers of the wheat entries. Similar finding has been reported by Haq& Khan, (2002) and Tahir *et al.*, (2009) that late planting affects germination, growth, grain development and produces poor tillering due to winter injury in low temperature.

Highest number of grain/ear head (45.97) recorded in the entry HS 562 as compared to the other entries in all four dates sowing. Likewise, highest number of grain/ear head of the all entries were recorded in 5th November sowing as compared to the other three date of sowing (Table 3).

The grain yield and biomass yield were recorded highest in the entry HS 562 as compared to the other entries in 5th November dates of sowing and gradual decreasing trend has been observed in all entries as compared to other date of sowing (Table 3). This might be due to delayed sowing the wheat crop was exposed to low night and day temperature at the time of establishment and exposed to high day and night temperature at the reproductive phase that finally leads to forced maturity. Singh and Uttam (1999) reported estimated yield loss @ 39 kg ha⁻¹ day⁻¹ in each delay in sowing from the optimum sowing time.
Table 1. Agro meteorological data of the station during the crop season in 2018-19 to 2019-20

| Year     | Rain Fall (mm) | Rainy Days | Max Tem (°C) | Min Tem (°C) |
|----------|----------------|------------|--------------|--------------|
|          | 2018-19 | 2019-20 | 2018-19 | 2019-20 | 2018-19 | 2019-20 | 2018-19 | 2019-20 |
| November | 12.2     | 4        | 4        | 2        | 27.6    | 28.8    | 15.3    | 16.6    |
| December | 28.2     | 1        | 2        | 1        | 25      | 23.9    | 11.2    | 9.7     |
| January  | 4.2      | 18       | 2        | 5        | 24.4    | 22.7    | 8.3     | 8.7     |
| February | 17.2     | 39.3     | 4        | 4        | 25.3    | 24.6    | 11.8    | 9.9     |
| March    | 46       | 4.7      | 8        | 3        | 27.9    | 29      | 14.9    | 14.6    |
| April    | 181.8    | 67.9     | 14       | 11       | 29      | 30.5    | 18      | 16      |

Table 2. Plant height (cm), final stand count/sq m and number of ear head/sq m of wheat entries in different date of sowings (pooled of year 2018-19 and 2019-20)

| Treatment | Av. plant height(cm) | Stand Count/sq.m. | No of ear heads /sq m |
|-----------|----------------------|-------------------|-----------------------|
|           | 05th Nov | 25th Nov | 15th Dec | 05th Jan | 05th Nov | 25th Nov | 15th Dec | 05th Jan | 05th Nov | 25th Nov | 15th Dec | 05th Jan | 05th Nov | 25th Nov | 15th Dec | 05th Jan |
| HS 562    | 94.93    | 92.00    | 91.67    | 80.20    | 187.33   | 162.67   | 152.00   | 143.67   | 257      | 210      | 184      | 181      |
| HD 2967   | 97.53    | 93.40    | 91.67    | 81.13    | 207.33   | 196.00   | 195.33   | 190.67   | 258      | 250      | 246      | 216      |
| HD 3086   | 92.47    | 91.60    | 91.33    | 82.00    | 202.33   | 177.67   | 173.33   | 189.33   | 268      | 249      | 240      | 234      |
| HI1544    | 89.87    | 89.20    | 88.67    | 73.87    | 206.67   | 183.33   | 174.00   | 176.33   | 259      | 247      | 248      | 238      |
| MACS 6222 | 92.13    | 91.33    | 90.73    | 77.87    | 196.33   | 149.67   | 146.00   | 143.67   | 276      | 240      | 235      | 223      |
| WR 544    | 90.97    | 89.93    | 89.60    | 84.07    | 207.33   | 181.33   | 178.67   | 166.00   | 253      | 245      | 239      | 230      |

Sowing date
| CV | 1.86 | 9.48 |
| CD (0.05) | 1.05 | 4.80 |

Variety
| CV | 2.31 | 4.63 |
| CD (0.05) | 1.31 | 9.24 |

Sowing date X Variety
| CV | 4.69 | 18.70 |
| CD (0.05) | 2.71 | 6.48 |
Table 3 Yield and yield attributing characteristic of wheat entries in different date of sowings (pooled of year 2018-19 and 2019-20)

| Treatment      | No of grain/earhead | Biomass yield (q/ha) | Yield (q/ha) |
|----------------|---------------------|----------------------|--------------|
|                | 05th Nov | 25th Nov | 15th Dec | 05th Jan | 05th Nov | 25th Nov | 15th Dec | 05th Jan | 05th Nov | 25th Nov | 15th Dec | 05th Jan |
| HS 562         | 45.97    | 41.43    | 46.54    | 33.44    | 121.44   | 91.66    | 88.43    | 55.81    | 48.37    | 36.26    | 34.95    | 20.06    |
| HD 2967        | 38.14    | 34.80    | 34.12    | 24.23    | 108.85   | 91.15    | 84.64    | 51.13    | 43.25    | 36.05    | 33.41    | 18.10    |
| HD 3086        | 41.01    | 39.61    | 38.68    | 40.72    | 118.99   | 105.70   | 100.24   | 83.98    | 47.37    | 41.97    | 39.75    | 33.14    |
| HI1544         | 35.25    | 34.49    | 33.12    | 31.89    | 97.91    | 92.45    | 89.06    | 75.88    | 38.80    | 36.58    | 35.20    | 29.85    |
| MACS 6222      | 34.00    | 36.20    | 34.37    | 32.68    | 101.26   | 93.73    | 85.98    | 68.75    | 40.16    | 37.10    | 33.95    | 26.95    |
| WR 544         | 30.17    | 27.94    | 27.45    | 29.54    | 90.29    | 81.27    | 80.22    | 73.83    | 35.70    | 32.04    | 31.61    | 29.01    |

Sowing date

| CV     | 2.62 | 7.12 | 8.37 |
| CD (0.05) | 0.82 | 4.24 | 2.39 |

Variety

| CV     | 2.78 | 8.14 | 6.79 |
| CD (0.05) | 0.89 | 5.19 | 1.95 |

Sowing date X Variety

| CV     | 1.85 | 17.62 | 17.38 |
| CD (0.05) | 0.58 | 10.38 | 10.25 |
Table 4 1000 Grains weight (g) and physiological maturity of wheat entries in different date of sowings (pooled of year 2018-19 and 2019-20)

| Treatment | 1000 Grains Weight (g) | Physiological Maturity (Days after seeding) |
|-----------|------------------------|---------------------------------------------|
|           | Sowing date            |                                             |
|           | 05th Nov | 25th Nov | 15th Dec | 05th Jan | 05th Nov | 25th Nov | 15th Dec | 05th Jan |
| HS 562    |          |          |          |          |          |          |          |          |
| HD 2967   | 43.72    | 41.30    | 39.65    | 35.02    | 136.00   | 135.67   | 120.67   | 107.33   |
| HD 3086   | 42.81    | 42.37    | 42.67    | 35.00    | 115.33   | 121.33   | 109.67   | 96.67    |
| HI1544    | 42.22    | 42.63    | 42.70    | 39.28    | 116.00   | 120.67   | 103.67   | 96.33    |
| MACS 6222 | 42.48    | 42.66    | 42.27    | 37.08    | 121.33   | 124.00   | 111.00   | 97.00    |
| WR 544    | 46.43    | 46.47    | 47.77    | 42.62    | 109.00   | 107.33   | 102.00   | 93.67    |

| Sowing date | CV | 2.72 | 1.79 |
| CD (0.05)   | 0.92 | 1.01 |

| Variety | CV | 2.88 | 1.98 |
| CD (0.05) | 0.99 | 1.23 |

| Sowing date X Variety | CV | 3.98 |
| CD (0.05) | 2.47 |
Normal sowing prolongs the duration of tillering (Ishag, 1994) and produced a greater number of tillers, number of spikes, grains/spike and grain weight that ultimately boosts up grain and straw yields (Qasim et al., 2008). Rajput and Verma, (1994) also observed that normal sowing time gave higher grain yield than late sowing. The numbers of days taken to attain different phenophases, decreases with delay in sowing that resulted into reduced life span of late sown crop. Similar findings have been also reported by Gupta et al., (2017). Similarly, in test weight, there has been observed significant differences among the entries and in different date of sowing, respectively (Table 4). The highest physiological maturity (days after seeding) days has been recorded in the all the entries during first date of sowing as compared to the other date of sowing in all entries. From the above findings it can be concluded that date of sowing has significant influence on growth and yield attributes of wheat crop. In case of wheat, date of sowing is most important factors that governs the phenological development of crop and also efficient conversion of biomass into economic yield. It has been observed that the wheat crop sown at normal date usually have longer crop duration thus they get an opportunity to accumulate more biomass as compared to late sowing and thus it finally resulted in higher grain yield and biological yield.

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