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# Effect of temperature stress on proximate composition of seed in wheat

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**Abstract**
Global warming is causing changes in temperature rapidly for over two decades. The increased temperature during reproductive phase of plant growth has emerged as a serious problem all over the world. The grain-filling rate of wheat, like other cereals, depends on two main sources of carbon current assimilates from photosynthesis and water soluble carbohydrates (WSCs) transported to the grain from leaves, stem and ear reserves. The present study entitled “Effect of temperature stress on proximate composition of seed in wheat” was carried out during kharif, 2016 at Central Phytotron Unit, Mahatma Phule Krishi Vidyapeeth, Rahuri. Screening of genotypes was carried out for temperature stress tolerance by three treatments, 20 °C/15 °C, 30 °C /20 °C and 35 °C /20 °C and one temperature stress tolerant genotype with one temperature stress succeptible genotype along with two check varieties were grown in field with delayed sowing dates for assessing the performance of these selected genotypes for proximate composition of wheat seed for carbohydrates, proteins, starch and moisture which was conducted during *Rabi,* 2017 at PGI Farm.

**Keywords:** temperature stress, proximate composition, seed in wheat

## Introduction

**Wheat** (*Triticum aestivum* L.) is the world′s most outstanding crop that excels all other cereals both in area and production, known as king of cereals. It is also one of the most nutritious cereals and its contribution to human diet puts it in the top rank of plants that feed the world. Wheat accords a premier place among cereals because a vast acreage of land is devoted to its cultivation. It is the staple food crop of the world and second important crop of India after rice. It belongs to family gramineae. Stress due to high-temperature has emerged as a major constraint for the successful wheat production worldwide (Hays *et al*. 2007; Kumar *et al*. 2012a, b). Nearly 40 % of total irrigated area, where wheat is grown, is severely affected by heat stress (Reynolds *et al*. 2001). Yield loss of 29% is expected by 2080 due to global warming, in wheat. High temperature (>30 °C) at the time of grain filling is one of the major constraints in increasing productivity of wheat in tropical countries like India (Zhao 2007) [6]. It has been reported that single grain mass falls by 3% - 5% for every 1°C rise in temperature above 18 °C (McDonald 1983). The supply of assimilates to the developing grain originates both from direct transport of current assimilation to kernels, and from the remobilization of temporarily stored assimilates in vegetative plant parts (Gebbing *et al.,* 1999) [4]. Globally, there is no doubt that the number of people who rely on wheat for a substantial part of their diet amounts to several billions. Therefore, the nutritional importance of wheat proteins should not be underestimated, particularly in less developed countries where bread, noodles and other products (e.g. bulgar, couscous) may provide a substantial proportion of the diet. Wheat provides nearly 55% of carbohydrate and 20% of the food calories. It contains carbohydrate 78.10%, protein 14.70%, fat 2.10%, minerals 2.10% and considerable proportions of vitamins.

## Results and Discussion

### Screening trial

#### Carbohydrates (%)

An interaction effect between temperature stress treatments and genotypes studied for seed carbohydrates content was found statistically significant. Under treatment 20/15 °C, genotypes NIAW-1994 (Phule Samadhan) (74.65%), NIAW-3033 (73.97%) and NIAW-3056 (72.86%) were having highest amount of seed carbohydrates content followed by genotypes NIAW-3166 (72.52%). Least carbohydrats content were found in genotype NIAW-3161 (69.59%).
Under treatment 30/20 °C, genotypes NIAW-1994 (Phule Samadhan) (71.95%) and NIAW-3033 (71.64%) recorded significantly higher amount of seed carbohydrates content.

Hussain *et al.,* (2015) reported that sowing dates severely influenced carbohydrate contents in subsequent grains of wheat crop.

**Starch (%)**

Under treatment 20/15 °C, starch content ranged between 21.54% to 25.86%. Highest amount of starch content recorded by the genotypes NIAW-1994 (Phule Samadhan) (25.86%), NIAW-3033 (25.36%) and NIAW-3074 (24.81%), NIAW-3096 (25.06%), NIAW-3056 (24.57%). Least amount of starch content was recorded by genotype NIAW-3161 (21.54%).

Under treatment 30/20 °C, genotypes NIAW-1994 (Phule Samadhan) (23.42%) and NIAW-3033 (22.23%) recorded significant amount of seed starch content.

**Protein (%)**

An Interaction effect between temperature stress treatments and genotypes studied for seed protein content was found statistically significant. Under treatment 20/15 °C, starch content ranged between 10.98% to 12.91%. Genotypes NIAW-3033 (12.91%), NIAW-1994 (Phule Samadhan) (12.45%) and NIAW-3074 (12.41%) recorded high protein content in seed. Genotype NIAW-3166 (10.98%) recorded least amount of seed protein content. Under treatment 30/20 °C, genotypes NIAW-1994 (Phule Samadhan) (12.14%) and NIAW-3033 (11.56%) recorded significant amount of seed protein content. Hussain *et al.,* (2015) reported that sowing dates severely influenced protein contents in subsequent grains of wheat crop.

**Moisture (%)**

Data recorded for seed moisture content are tabulated in table 4.29. An Interaction effect between temperature stress treatments and genotypes studied for seed moisture content was found statistically significant. Under treatment 20/15 °C, moisture content ranged between 10.68% to 13.45%. Genotypes NIAW-3212 (13.45%), NIAW-3074 (12.45%) and NIAW-3183 (12.05%) recorded high seed moisture content. Genotype NIAW-3166 (10.68%) recorded least amount of seed moisture content. Under treatment 30/20 °C, genotypes NIAW-3033 (11.21%) and NIAW-1994 (Phule Samadhan) (11.10%) and recorded significant amount of seed moisture content.

**Table 1:** Proximate composition of seed (%) (Screening trial)

| | Carbohydrates | | | Starch | | | Protein | | | Moisture | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Genotypes** | **20/15** | **30/20** | **Mean** | **20/15** | **30/20** | **Mean** | **20/15** | **30/20** | **Mean** | **20/15** | **30/20** | **Mean** |
| NIAW-3033 | 73.97 | 71.64 | 72.80 | 25.36 | 22.23 | 23.79 | 12.91 | 11.56 | 12.23 | 11.98 | 11.21 | 11.59 |
| NIAW-3074 | 71.56 | - | 71.56 | 24.81 | - | 24.81 | 12.41 | - | 12.41 | 12.45 | - | 12.45 |
| NIAW-3096 | 71.85 | - | 71.85 | 25.06 | - | 25.06 | 11.39 | - | 11.39 | 11.3 | - | 11.3 |
| NIAW-3108 | 70.78 | - | 70.78 | 24.35 | - | 24.35 | 11.48 | - | 11.48 | 11.56 | - | 11.56 |
| NIAW-3212 | 70.39 | - | 70.39 | 23.86 | - | 23.86 | 11.74 | - | 11.74 | 13.45 | - | 13.45 |
| NIAW-3161 | 69.59 | - | 69.59 | 21.54 | - | 21.54 | 11.23 | - | 11.23 | 11.75 | - | 11.75 |
| NIAW-3166 | 72.52 | - | 72.52 | 22.96 | - | 22.96 | 10.98 | - | 10.98 | 10.68 | - | 10.68 |
| NIAW-3173 | 71.86 | - | 71.86 | 21.85 | - | 21.85 | 11.69 | - | 11.69 | 11.36 | - | 11.36 |
| NIAW-3183 | 71.49 | - | 71.49 | 24.12 | - | 24.12 | 10.89 | - | 10.89 | 12.05 | - | 12.05 |
| NIAW-3056 | 72.86 | - | 72.86 | 24.57 | - | 24.57 | 11.56 | - | 11.56 | 11.78 | - | 11.78 |
| NIAW-34 (C) | 71.49 | - | 71.49 | 23.86 | - | 23.86 | 11.85 | - | 11.85 | 10.98 | - | 10.98 |
| MACS-6222 | 72.39 | - | 72.39 | 22.39 | - | 22.39 | 10.96 | - | 10.96 | 11.56 | - | 11.56 |
| NIAW-1994 | 74.65 | 71.95 | 73.3 | 25.86 | 23.42 | 24.64 | 12.45 | 12.14 | 12.29 | 11.52 | 11.1 | 11.31 |
| G. Mean | 71.95 | 71.80 | 71.88 | 23.89 | 22.83 | 23.36 | 11.66 | 11.85 | 11.76 | 11.72 | 11.16 | 11.44 |
| | **T** | **V** | **T×V** | **T** | **V** | **T×V** | **T** | **V** | **T×V** | **T** | **V** | **T×V** |
| SE | 0.086 | 0.179 | 0.31 | 0.078 | 0.163 | 0.282 | 0.057 | 0.118 | 0.204 | 0.041 | 0.086 | 0.148 |
| CD 5% | 0.242 | 0.504 | 0.872 | 0.22 | 0.458 | 0.793 | 0.159 | 0.331 | 0.574 | 0.116 | 0.241 | 0.418 |
| CD 1% | 0.321 | 0.707 | 1.157 | 0.292 | 0.643 | 1.052 | 0.211 | 0.465 | 0.761 | 0.154 | 0.339 | 0.555 |

**Field trial**

**Carbohydrates (%)**

Carbohydrates content were significantly variable among all the four genotypes for all three sowing dates. Interaction between sowing dates and genotypes found to be statistically non-significant for this character. Mean values of seed carbohydrates content were found decreased as sowing date delayed. Maximum amount of carbohydrates content were found in genotype NIAW-3033 (78.34%), NIAW-1994 (Phule Samadhan) (77.02%), MACS-6222 (75.33%) and NIAW-3161 (76.84%) in three sowing dates.

**Starch (%)**

Seed starch content exhibited significant variation among all the genotypes under investigation in varying sowing dates and data for starch content. It was observed that the starch content decreased as the sowing dates delayed. Interaction between sowing dates and genotypes found to be non-significant for starch content. Among the genotypes NIAW-1994 (Phule Samadhan) (25.61%) exhibited higher amount of starch as compared to NIAW-3033 (25.04%), MACS-6222 (25.12%) and NIAW-3161 (25.34%) in three sowing dates.

**Protein (%)**

Protein content was significantly variable among all the four genotypes for all three sowing dates. Interaction between sowing dates and genotypes found to be statistically non significant for this parameter. Mean values of seed protein content were found decreased as sowing date delayed. Maximum amount of protein content were found in genotype NIAW-1994 (Phule Samadhan) (12.81%) which was comparable with genotypes NIAW-3033 (12.42%), NIAW-3161 (12.57%) and MACS-6222 (12.39%) in three sowing dates.

**Moisture (%)**

Significant variations among all the genotypes under investigation in varying sowing dates were found for seed moisture content on the basis of data presented in table 4.64. It was observed that seed moisture content decreased as the sowing dates delayed. Interaction between sowing dates and genotypes found to be non-significant for the character studied. Among the genotypes NIAW-3033 (12.57%) exhibited maximum seed moisture content as compared to NIAW-1994 (Phule Samadhan) (12.41%), MACS-6222 (12.39%) and NIAW-3161 (12.42%) in three sowing dates.

Genotype NIAW-3033 exhibited significantly more protein content in second sowing date than NIAW-1994 (Phule Samadhan). NIAW-1994 (Phule Samadhan) was significantly superior for protein content for first and third sowing date. Similarly genotype NIAW-3161 had significantly maximum protein content for first and second sowing date but in third sowing protein decreased in NIAW-3161 than MACS-6222.

Genotype NIAW-3033 was found significantly best for total seed carbohydrate content than Phule Samadhan for all the three sowing dates. Genotype NIAW-3161 found significantly maximum seed carbohydrate content than MACS-6222 in all the three sowing dates.

NIAW-1994 (Phule Samadhan) found to have maximum starch content as compared to NIAW-3033 and genotype NIAW-3161 found to have more starch content than MACS-6222.

**Table 2:** Proximate composition of seed (%) (Field trial with delayed sowing dates)

| | Carbohydrates | | | | Starch | | | | Protein | | | | Moisture | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Genotypes** | **SD-1** | **SD-2** | **SD-3** | **Mean** | **SD-1** | **SD-2** | **SD-3** | **Mean** | **SD-1** | **SD-2** | **SD-3** | **Mean** | **SD-1** | **SD-2** | **SD-3** | **Mean** |
| NIAW-3033 | 79.31 | 78.22 | 78.22 | 78.34 | 27.86 | 24.31 | 22.94 | 25.04 | 12.96 | 12.36 | 11.96 | 12.42 | 12.96 | 12.36 | 11.96 | 12.42 |
| NIAW-1994 | 78.62 | 76.69 | 76.69 | 77.02 | 28.47 | 24.84 | 23.52 | 25.61 | 13..40 | 12.50 | 12.81 | 11.56 | 11.38 | 11.03 | 11.81 | 11.41 |
| NIAW-3161 | 77.36 | 75.95 | 75.95 | 76.84 | 27.16 | 24.43 | 24.44 | 25.34 | 13.23 | 12.32 | 12.17 | 12.57 | 13.23 | 12.32 | 12.17 | 12.57 |
| MACS-6222 | 77.58 | 73.17 | 73.51 | 75.33 | 27.73 | 23.70 | 23.92 | 25.12 | 12.35 | 12.10 | 11.67 | 12.39 | 13.40 | 12.10 | 11.67 | 12.39 |
| Mean | 78.55 | 76.01 | 76.09 | 76.88 | 27.80 | 24.32 | 23.70 | 25.28 | 12.74 | 12.07 | 11.90 | 12.24 | 12.74 | 11.95 | 11.90 | 12.20 |
| | D | G | D×G | | D | G | D×G | | D | G | D×G | | D | G | D×G | |
| SE | 0.434 | 0.683 | 1.183 | | 0.305 | 0.486 | 0.842 | | 0.160 | 0.249 | 0.432 | | 0.104 | 0.224 | 0.388 | |
| CD at 5% | 1.703 | 2.029 | NS | | 1.198 | 1.426 | NS | | 0.629 | 0.741 | NS | | 0.410 | 0.666 | NS | |

## Conclusions

Various seed contents of wheat seed like seed carbohydrates, protein, starch and moisture content were found to be decreased under temperature stress condition.

Rising temperature from anthesis and grain filling stage leads to lower down the seed quality as there is suppression of synthesis processes in wheat.

For proximate composition of seed *viz.,* carbohydrates, starch, protein and moisture, genotype NIAW-3033 and NIAW-1994 (Phule Samadhan) performed best among all the genotypes under investigation in screening trial.

Seed carbohydrates content was found higher in NIAW-3033 followed by NIAW-1994 (Phule Samadhan) and protein content was higher in NIAW-1994 (Phule Samadhan) followed by NIAW-3033. Moisture content was also higher in NIAW-3033 than rest of the genotypes.

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