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Screening of wheat genotypes for stress tolerance under field condition

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Abstract
An experiment was conducted to study "Screening of wheat genotypes of stress tolerance under field condition." was carried out at P.G.I. Farm, Department of Agricultural, Botany, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (MS) India during the year 2015-2017.
The experiment was carried out by using 14 wheat genotypes were selected after analysing the data for moisture stress tolerance and the second experiment on "Screening of wheat genotypes for stress tolerance under field condition." In moisture stress conditions, irrigation was given at the time of sowing and at crown root initiation stages and in non-stress conditions irrigation was given at critical growth stages. Soil moisture conditions were considered as main plot treatments, Irrigation and 14 genotypes FRBD design with three replications.
Plant height, number of tillers plant-1, at 50% flowering. The daily observations were recorded for phenological studies. The physiological parameters were recorded at 50% flowering. Grain yield data were used to calculate drought (moisture). Yield and yield attributes were recorded and calculated after harvesting. The results generated through the investigation are summarized as below: Under moisture stress conditions soil moisture content decreased continuously in all Moisture Regimes from sowing up to harvest. Under moisture and stress conditions available moisture and stress day factored AL declined continuously from sowing to onwards. Under non stress conditions it depends upon irrigation scheduling. The morphological or plant growth traits like plant height, number of tillers area decreased with increase in moisture stress. The maximum reduction in morphological traits caused due to moisture stress. The genotypes NI-5439 recorded maximum plant height under moisture stress conditions, whereas minimum values were reported in genotypes NIAW-3217.
The genotype NIAW-3183 recorded maximum number of tiller under moisture stress conditions. Phenological study indicated that NIAW-3183 took minimum days to flower initiation, 50% flowering under moisture stress conditions. The significantly highest photosynthetic rate at 50% flowering was recorded in the genotype NIAW-3170 stress condition. The genotype NIAW-3170 showed maximum number of grains per spike, and grain yield/ha under moisture stress condition. The genotypes HD-2189, NIAW-3161 and NIAW-3166 were moisture stress susceptible genotypes. The genotypes NIAW-3170, NIAW-1415, NIAW-1994, NI-5439 and NIAW-3183 were moisture stress tolerant.

Keywords: Phonological, moisture regimes, irrigation scheduling

Introduction
Wheat (*Triticum aestivum* L.) is the staple food crop of the world and second important crop of India after rice. Its productivity and yield are significantly influenced by selection of suitable varieties, soil and environmental conditions. In present situation most of the wheat growing areas comes under drought (moisture) stress. Many of the researchers reported that the stress is individual effect and they caused significant effect alone plant growth and development. But most of the plants have different adaptive mechanisms for coping up with stress. Out of which one or more than one mechanism exist for adaptation stress condition. To improve our present knowledge about stress tolerance, we need to screen wheat genotypes by using different screening techniques. The study of impact of different screening techniques and measured parameters will assist in identifying some selection criteria that might prove useful in developing moisture stress tolerant genotypes. Considering all these aspects, present investigation entitled "Screening of wheat genotypes for stress tolerance under field condition." was carried at Post Graduate Institute Farm, Department of Agricultural, Botany, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (MS) India during the year 2016-2017.

Objectives

1. Assessment of genetic variability under induced moisture stress by using different irrigation in wheat growth stages.
2. To study the effect of moisture stress on mopho-physiological characters of wheat genotypes.

Methods

Screening of genotypes for stress tolerance under field condition

1. Genotypes 14
2. Design : FRBD
3. Replication : Three (3)
4. Spacing : 22.5 cm (Between two rows)
5. Season : 2016
6. Fetilizer dose : 120 N: 60 P_2O_5: 40 K_2O kg ha-1 : (1st dose) 60 N: 60 P_2O_5: 40 K_2O kg ha-1 30 Days after sowing : (2nd dose) 60 N: 00 P_2O_5: 00 K_2O kg ha-1

7. Number of factors: A- i) Genotypes: B- i) Moisture regimeset al ii) Non stress

a) 2 Irrigations - i) Germination ii) Crown root initiation phase.

b) 3 Irrigations - i) Germination ii) Crown root initiation phase iii) Tillering phase.

c) 4 Irrigations - i) Germination ii) Crown root initiation phase iii) Tillering phase

iii) Flowering and dough stage.

d) 5 Irrigations - i) Germination ii) Crown root initiation phase iii) Tillering phase

iv) Flowering and dough stage v) Grain filling phase.

Experimental Results

Plant height (at maturity) (cm): The plant height was significantly influenced by different water regimes. At control condition (T_0) 5-irrigation maximum mean plant height (83.69 cm) was recorded and it decreases under limited water regimes i.e.3-irrigation (77.46 cm) and 2-irrigation (66.09 cm). Among the genotypes NIAW-3033 (94.39 cm) recorded maximum plant height at control condition while, minimum plant height was recorded by NIAW-3056 (73.78 cm). At 4-irrigation moisture regime NIAW-3033 (95.79 cm) recorded maximum plant height and and while, minimum plant height was recorded by NIAW-3056 (69.29 cm). At 3-irrigation moisture regime, the genotype HD-2189 (87.21 cm) recorded maximum plant height and while, minimum plant height was recorded by NIAW-3056 (63.59 cm). At 2- irrigation moisture regime, the genotype NI-5439 (76.60 cm) recorded maximum lplant height and while, minimum plant height was recorded by NIAW-3217 (54.46 cm).

The water stress affects most of the functions of plant growth, this effect depends on the level of water stress, the length of time to which the plant is subjected to water stress and the genotype of plant species. However the genotypes also showed significant variation due to their genetic potential and the environment response under normal and late sown conditions. Singh *et al*. (2011) [8]. Boutra *et al*. (2010) [5] also found that different levels of water stress have affected the growth of wheat cultivars differently, which indicates that the wheat cultivars differed in their ability to tolerate different level set of water stress. Similar findings were also reported by Grigorova *et al*. (2011) [6] in wheat.

Number of effective tiller per plant (at maturity): At control condition (T_0) 5-irrigation, the genotype NIAW-1415 recorded significantly the highest (8.05) followed by NIAW-3170 (8.01). The genotypes NI-5439 (3.38) and NIAW-316 (4.26) recorded significantly minimum number of effective tiller. In moisture stress condition at 2-irrigation, the genotype NIAW-3183 recorded significantly highest number of effective tiller (5.32) followed by NIAW-3170 (5.11). The genotype NIAW-3056 recorded significantly lowest number of effective tillers (2.00) followed by NIAW-3212 (2.31). Similar finding was also reported by Singh *et al*. (2001) [9]. They grew eight wheat cultivars under normal and moisture stress conditions in field and reported that higher moisture stress caused reduction in number of tillers.

Days to 50% flowering: In present study early flowering genotype NIAW-3170 yielded more grain under moisture stress conditions, because it enables the plant to escape the stress conditions during the critical stage of yield formation. However, under well watered conditions, earliness can negatively effect on grain yield, because the shorter crop cycle reduces intercepted radiation and biomass accumulation. This can reduce the growth rate of the reproductive organs and hence grain number and grain yield (Blum, 2005 and Passioura and Angus, 2010) [7]. These findings support the result of NIAW-3170 genotype under normal sown irrigated condition. Considering the other studied genotype, NIAW-3183 required maximum days for flowering under stress and non-stress conditions.

Water use efficiency at grain filling stage: The genotypes also showed differences among them for WUE. The genotypes at control condition (T_0) 5-irrigation the genotype NIAW-3166 recorded significantly highest (7.11) water use efficiency at grain filling stage and at 2-irrigation, the genotype NIAW-3170 recorded significantly highest water use efficiency at grain filling stage (11.43). These finding are in confirmatory with Zhang *et al*. (2010) [11]. Under drought stress they recorded maximum WUE in Superb and AC Crystal variety of wheat. In present study increase of WUE in NIAW-3170 might be due to higher photosynthetic rate at 50% flowering. Similar result was given by Bogale *et al*. (2011) [4] in wheat.

Number grains per spike: Genotypes also reported significant differences among them due to moisture stress. In present study all the genotypes showed reduction in number of grains spike-1 under moisture stress control conditions. Considering the data genotype NI-5439 and NIAW-3170 recorded significantly maximum number of grains spike-1 40.25 and 40.21, respectively. Under heights moisture stress condition (2-irrigation) the genotype NIAW- 3170 and NI-5439 maintained maximum grains spike-1 29.83 and 29.59, respectively. The above findings are also supported by Sokoto and Singh (2013) [10], they reported that water stress at flowering and grain filling are the most critical growth stages in yield determination in wheat, because plants cannot recover, while delay in sowing resulted in reduction in yield and yield components.

Grain yield (q/ha)

The significant genotypic differences were found for grain yield. higher moisture stress conditions (2-irrigation) value indicated that the genotype NIAW-3170 recorded maximum grain yield plant-1 (1.90 g), plot-1 (2.00 kg) and ha-1 (25.65 q) and it was followed by NIAW-1994 (1.70 g, 1.91 kg and NIAW-3217 (27.72 q respectively), however under moisture stress control conditions NIAW-3170 also maintained maximum grain yield (2.50 g, 2.46 kg and 43.77 q, respectively) followed by NIAW-3173,NI-5439 (2.40 g) NIAW-1994 2.41 kg and NIAW-3220 (41.02 q, respectively) genotype. Genotypic differences in grain yield might be due to genetic potential of different varieties to express in terms of yield attributing traits in differential environmental conditions. Significant differences in grain yield among the wheat genotypes were also reported by Amrawat *et al*. (2013) [1] and Bharud *et al*. (2016) [2] in wheat. In present study effect of moisture stress recorded maximum grain yield reduction than individual effect. Similar results were also reported by Sokoto and Singh (2013) [10], also reported the same conclusions.

Table 1: Thise table show that at maturity Plant height, Number of effective tiller per m^2 and Days to 50% flowering

Sr. no.	Genotypes	Plant height at maturity (cm)				Number of effective tiller per m^2 (at maturity)				Days to 50% flowering.			
		T_0-5 Irrigation (Control)	T_1-4 Irrigation	T_2- 3 Irrigation	T_3- 2 Irrigation	T_0-5 Irrigation (Control)	T_1-4 Irrigation	T_2- 3 Irrigation	T_3- 2 Irrigation	T_0-5 Irrigation (Control)	T_1-4 Irrigation	T_2- 3 Irrigation	T_3- 2 Irrigation
1	NIAW-3056	73.78	69.29	63.59	56.36	7.12	5.64	3.00	2.00	74.33	72.44	63.56	58.56
2	NIAW-3170	92.74	88.02	71.89	65.94	8.01	6.95	5.89	5.11	78.56	73.67	66.89	63.00
3	NIAW-3212	77.36	74.98	74.34	59.69	4.96	4.02	3.00	2.31	78.44	74.56	69.00	64.22
4	NIAW-3217	81.96	80.72	76.53	54.46	7.02	3.65	3.01	2.67	81.33	76.78	71.22	64.33
5	NIAW-3220	92.52	88.66	77.90	63.57	5.98	4.90	4.33	3.22	75.11	73.00	64.00	59.22
6	NIAW-3033	94.39	95.79	85.66	73.58	4.96	4.93	5.30	3.59	72.92	67.00	60.44	57.22
7	NIAW-3161	78.46	79.32	79.39	69.02	4.98	5.64	4.29	4.09	71.11	65.89	59.00	54.07
8	NIAW-3173	78.46	77.92	77.91	64.23	5.31	4.01	3.59	4.01	81.22	78.22	69.56	64.78
9	NIAW-3166	76.79	77.52	73.62	69.12	4.26	4.35	3.99	3.08	84.33	79.11	72.56	68.11
10	NIAW-3183	77.56	77.22	79.60	67.94	5.32	5.01	4.28	5.32	83.00	81.11	71.44	67.33
11	NI-5439	86.81	86.35	78.89	76.60	3.38	3.99	4.37	4.29	76.56	71.33	65.00	57.78
12	HD-2189	90.90	89.91	87.21	73.32	7.36	5.32	5.21	4.00	76.78	72.00	63.89	60.11
13	NIAW-1415	80.06	77.37	74.66	62.95	8.05	6.54	6.36	5.04	77.56	74.33	66.89	62.33
14	NIAW-1994	89.90	88.56	83.30	68.52	6.61	6.33	7.04	5.87	76.67	69.68	65.00	60.00
Mean		83.69	82.26	77.46	66.09	5.95	5.02	4.55	3.90	77.71	73.51	66.32	61.51
Source		Treatments (T)		Genotypes (G)	T X G	Treatments (T)		Genotypes (G)	T X G	Treatments (T)		Genotypes (G)	T X G
S.E.±		0.54		1.00	2.01	0.012		0.005	0.045	0.34		0.63	1.27
CD at 5%		1.50		2.81	5.63	0.044		0.019	0.165	0.95		1.78	NS

Table 2: Thise table show that at grain filling stage water use efficiency, number grains per spike and grain yield

Sr. no.	Genotypes	Water use efficiency at grain filling stage				Number grains per spike.				Grain yield (q/ha).			
		T_0-5 Irrigation (Control)	T_1-4 Irrigation	T_2- 3 Irrigation	T_3- 2 Irrigation	T_0-5 Irrigation (Control)	T_1-4 Irrigation	T_2- 3 Irrigation	T_3- 2 Irrigation	T_0-5 Irrigation (Control)	T_1-4 Irrigation	T_2- 3 Irrigation	T_3- 2 Irrigation
1	NIAW-3056	5.48	5.12	8.72	8.36	35.39	34.09	32.24	27.32	36.99	33.99	27.91	21.29
2	NIAW-3170	7.00	6.71	11.72	11.43	40.21	36.69	33.97	29.83	43.77	40.28	33.40	25.65
3	NIAW-3212	6.36	6.24	9.28	10.17	36.57	33.83	30.83	26.48	36.68	34.87	27.61	21.37
4	NIAW-3217	5.78	5.95	6.09	7.57	34.23	30.57	28.09	18.31	40.18	37.36	29.19	23.33
5	NIAW-3220	5.52	5.79	3.83	7.68	30.14	28.33	25.27	21.08	41.02	38.19	29.93	23.09
6	NIAW-3033	4.67	5.03	9.61	9.41	31.11	29.47	26.45	23.11	38.26	34.10	25.37	19.33
7	NIAW-3161	4.67	4.68	11.76	10.41	29.24	27.40	20.92	17.14	32.44	29.69	24.78	15.40
8	NIAW-3173	5.20	6.23	6.37	6.27	30.47	26.07	24.15	19.10	35.75	32.48	25.07	19.45
9	NIAW-3166	7.11	6.51	6.94	7.75	32.20	29.09	25.07	20.43	35.51	30.96	25.11	16.83
10	NIAW-3183	5.52	5.46	6.59	6.36	34.51	30.24	28.32	22.04	37.63	34.15	26.28	19.29
11	NI-5439	6.62	6.61	6.97	8.48	40.25	37.02	33.03	29.59	40.30	38.24	28.80	21.52
12	HD-2189	6.51	6.35	6.72	6.21	31.99	28.35	21.92	17.28	37.35	28.27	16.03	8.30
13	NIAW-1415	6.54	7.10	6.21	7.58	40.02	31.94	30.05	24.95	38.07	35.67	28.61	21.81
14	NIAW-1994	6.96	6.79	6.93	7.97	37.60	34.49	30.09	24.92	40.06	38.23	30.36	23.10
Mean		6.00	6.04	7.69	8.26	34.57	31.26	27.89	22.97	38.14	34.75	27.03	19.98
Source		Treatments (T)		Genotypes (G)	T X G	Treatments (T)		Genotypes (G)	T X G	Treatments (T)		Genotypes (G)	T X G
S.E.±		0.06		0.11	0.21	0.18		0.34	0.68	0.23		0.43	0.87
CD at 5%		0.16		0.30	0.60	0.51		0.95	1.91	0.65		1.21	2.43

Conclusions

The following conclusions were drawn from the present investigation.

- The genotype NI-5439 recorded maximum plant height under moisture stress conditions, whereas minimum values were reported in genotypes NIAW-3217.
- The significantly highest photosynthetic rate at 50% flowering was recorded in the genotype NIAW-3170 stress conditions.
- The genotype NIAW-3170 showed maximum number of grains per spike and grain yield/ha under moisture stress conditions.
- The genotypes HD-2189, NIAW-3161 and NIAW-3166 were moisture stress susceptible genotypes.
- The genotypes NIAW-3170, NIAW-1415, NIAW-1994, NI-5439 and NIAW-3183Were moisture stress tolerant.

These traits might be reliable selection criteria for moisture stress tolerance in wheat. One or more than one could be used as selection criteria for developing stress tolerant varieties in wheat. Based on the above findings, it is concluded that, the NIAW-3170 genotype could be exploited as a one of the parental materials in breeding program for transferring moisture stress tolerant desired characters in new varieties.

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