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Studies on impact of water stress on seed yield of wheat genotypes

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Abstract
The present experiment was carried out during *rabi* season of 2022-23 at experimental farm of B.T.C. College of Agriculture and Research Station Bilaspur, Indira Gandhi Krishi Vishwavidyalaya Raipur, Chhattisgarh, to Study the impact of water stress on seed yield of wheat genotypes. The experiment material considered, twenty-one (released, pre-released and pipeline) wheat genotypes with two checks MP 3288 & DBW 110 and two identified checks CG1036 & HI 1655. The objective of the study was to evaluate the water expense efficiency (WEE) of different wheat genotypes in four different water regimes respectively I_1 (only come-up irrigation), I_2 (come-up irrigation + one irrigation at CRI), I_3 (come-up irrigation + two irrigations each at CRI and at boot leaf stage) and I_4 (fully irrigated with irrigation at CRI, tillering, jointing, booting, flowering, milking and dough stage) with two replications in randomized block design (RBD). Result revealed that genotype CG 2202, CG 2203 and CG 2212 recorded highly water efficient in water regime I_1, CG 2203 in water regime I_2 & I_3 and DBW 110 in water regime I_4.CG 2203, CG 2209 and CG 1036 are highly water efficient genotypes on the basis of mean performance over all the water regimes.

Keywords: Water expense efficiency (WEE), crown root initiation (CRI)

Introduction

Wheat is a second most important food grain after rice. It is a highly adoptable to different agro-climatic conditions with varying level of irrigations to produce accordingly for optimum productivity. Wheat scientists have identified six critical stages of irrigations and the stress of critical stages resulting the loss in the yield. Many wheat genotypes or varieties have developed in the recent past which give more production with less number of irrigations and having ability to produce more biomass and economic yield under the drought conditions. On the global context, India is the second largest producer of wheat with approximately 12 percent world's wheat production and it is also the second largest consumer of wheat after China, and has a huge and growing demand (Anonymous, 2022-23) [2]. Wheat has occupied an area of 220.75 m ha, with a total production of 770.88 Mt and productivity 3.52 t per ha. in world (Anonymous, 2023) [3]. In India, wheat has covered an area of 31.13 m ha with a total production of 109.59 million Mt and productivity 3.52 t per ha**.** Water requirement of wheat has 60 mm which is given with interval in five to six critical stages of wheat irrigations *viz,* CRI, tillering, late-jointing, flowering, milking dough stage. Stress on critical growth stages of wheat with the aim to bring out stress tolerance ability of wheat such that it gives optimum to maximum productivity under stress condition. It is a method to improve water expense efficiency of wheat crop by creating various water regimes by timely scheduling of irrigation. Irrigation restriction is done in one, two or all stages of growth, that are, crown root initiation (CRI), tillering, booting, flowering and grain filling stages in wheat crop. Water regime created by this method varies with number of irrigations given. The water stress has been created by non-supply the irrigation water at any of critical growth stages of wheat. The phenotypic performance of a genotype changing under different water regime conditions. Some genotypes perform well in one water regime but fail in other. Modern agriculture requires determining the stable genotypes with high performance. Effect of stress estimated by morphological, bio-chemical, statistical and bio-technological methods.

There are many methodology or statistical methods has been developed for identification of potential genotypes, first parameter is Water expense efficiency (WEE) of a genotype which can be calculated based on the yield performance based on supplied water.

Materials and Methods

The present experiment was carried out during *rabi* season of 2022-23 at experimental farm of B.T.C. College of Agriculture and Research Station Bilaspur, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh. The experiment material considered,

Twenty-one (released, pre-released and pipeline) wheat genotypes with two checks MP 3288 & DBW 110 and two identified checks CG1036 & HI 1655. The experiment was laid out in randomized block design (RBD) with two replications. Each genotype was grown in four water regimes respectively water regime: I_1 (only come-up irrigation), water regime: I_2 (come-up irrigation + one irrigation at CRI), water regime: I_3 (come-up irrigation + two irrigations each at CRI and at boot leaf stage) and water regime: I_4 (fully irrigated with irrigation at CRI, tillering, jointing, booting, flowering, milking and dough stage),water regimes were created by giving four different level of irrigation in different growth stages of wheat at one location. Irrigation was applied as per treatment and in each irrigation 60 mm water was applied replication and water regimes for observing all quantitative characters Water expense efficiency was calculated for the grain yield of each genotype in all four water regimes. WEE was analyzed using the Parihar *et al.* (1976) [5] formula.

Results and Discussion

Water expense efficiency (WEE)

Water expense efficiency (WEE) of twenty-one wheat genotypes were evaluated based on grain yield. Present investigation revealed WEE (grain yield produced in kg/ha for per mm of applied irrigation at critical growth stages of wheat) was high for I_1 (37.0 kg/ha per mm), I_2 (23.65 kg/ha per mm), I_3 (18.71 kg/ha per mm) and I_4 (18.29 kg/ha per mm) with average of 24.41 kg/ha per mm. The results indicated that WEE is reduced by applying a greater number of irrigations to wheat crop. CG 2212 is most efficient wheat variety to produce 43 kg/ha of seed for per mm irrigation water given as come-up irrigation, followed by CG 2203 (42.8 kg/ha per mm) and CG 2202 (42.2 kg/ha per mm). CG 2204 produced lowest grain yield (30.8 kg/ha per mm) with come-up irrigation (60 mm water applied). CG 2203 is most efficient (28.67 kg/ha per mm) variety followed by CG 1036 (27.19 kg/ha per mm) and CG 1040 (25.72 kg/ha per mm), when 120 mm irrigation water is applied at come-up and 25 DAS. Abhineet *et al.* (2019) [1] also recorded higher values with two irrigations. CG 2206 and CG 2213 are poor productive genotypes with WEE of 20.93 and 20.98 kg/ha per mm, respectively. Scenario remains same when 180 mm irrigation applied at three growth stages. Wheat genotype CG 2203 is most efficient and produce 22.73 kg/ha per mm followed by CG 2209 (21.39 kg/ha per mm) and check CG 1036 (20.86 kg/ha per mm). Ali *et al.* (2021) also identified some wheat genotypes which given high yield under water shortage condition. DBW 359 (15.88 kg/ha per mm) and CG 2204 (16.48 kg/ha per mm) are in-efficient variety for WEE. Under fully irrigated conditions (240 mm of irrigation applied) check DBW 110 recorded highest (21.60 kg/ha per mm) WEE followed by CG 2209 (21.07 kg/ha per mm), CG 2201 (21.05 kg/ha per mm) and CG 2203 (20.36 kg/ha per mm). WEE is lowest for CG 2214 (16.47 kg/ha per mm) and CG 2205 (16.50 kg/ha per mm). Average WEE is highest for CG 2203 (28.64 kg/ha per mm) followed by CG 2209 (26.59 kg/ha per mm) and check 1036 (26.1 kg/ha per mm). Average lowest WEE was recorded for CG 2204 (21.68 kg/ha per mm) followed by DBW 359 (21.76 kg/ha per mm). The WEE analysis is represented in table 1.

Table 1: Water expense efficiency of wheat genotypes in different amount of irrigation

Genotype	Amount of irrigation applied at critical growth stages of wheat (WEE)				
	60 mm (I_1)	120 mm (I_2)	180 mm (I_3)	240 mm (I_4)	Mean
CG 2201	32.4	23.74	19.25	21.05	24.11
CG 2202	42.2	23.33	17.52	18.23	25.32
CG 2203	42.8	28.67	22.73	20.36	28.64
CG 2204	30.8	22.32	16.48	17.11	21.68
CG 2205	34.8	22.56	17.68	16.47	22.88
CG 2206	39.3	20.93	18.03	19.93	24.55
CG 2207	36.4	22.55	18.06	17.59	23.65
CG 2208	37.9	23.18	17.14	16.58	23.7
CG 2209	39.5	24.38	21.39	21.07	26.59
CG 2210	38.7	21.78	18.23	18.35	24.27
CG 2211	35.8	24.34	19.64	17.90	24.42
CG 2212	43.0	23.50	18.18	16.96	25.41
CG 2213	34.6	20.98	17.75	17.25	22.65
CG 2214	41.3	25.14	19.61	16.50	25.64
CG 2215	32.6	23.84	18.58	16.93	22.99
DBW 359	31.9	21.69	15.88	17.58	21.76
CG 1040	39.2	25.72	20.69	18.60	26.05
MP 3288 (C)	35.5	23.52	18.76	19.37	24.29
DBW110 (c)	35.2	24.62	18.73	21.60	25.04
HI 1655 (c)	33.4	22.73	17.70	17.95	22.95
CG 1036 (c)	39.7	27.19	20.86	16.66	26.1
Mean	37	23.65	18.71	18.29	24.41

Conclusion

The study above study revealed that WEE is decreasing with increased level of irrigation. Based on above studies we conclude that high yielding genotypes are maximum efficient genotypes for water expense.CG 2203, CG 2209 and CG 1036 recorded highly water use efficient genotypes.

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