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Effect of Irrigation Frequencies Applied at Different Growth Stages on the Newly Evolved Genotypes

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Abstract:The field experiment was conducted to determine the effect of irrigation frequencies applied at different growth stages on the newly evolved wheat genotypes at Agronomy Experimental Field, Agriculture Research Institute, Tando Jam during winter, 1998-99. Three irrigation frequencies (5,4 and 3) with four wheat genotypes (Mehran-89, Abadgar-93, 7001 and 7002) were included in the study. Plant height, tillers, earheads, seeds per spike, seed weight, seed index, grain yield varied significantly by the irrigation frequencies and genotypes, and their interaction. Application of 5 irrigation resulted in higher grain yield. Among the four varieties tested newly developed genotypes 7001 and 7002 yielded more than existing (Mehran-89 and Abadgar-93) genotypes.

Key Words: Wheat, Irrigation frequencies, Growth, Yield

Introduction

Wheat *Triticum aestivum L.*, is an important staple food crop in the world including Pakistan. Wheat is the leading food grain crop covering an area of about 8230 thousand hectare with an annual production of 18155 thousand tons. In Sindh province wheat is grown on an area of 1124 thousand hectares with a total production of 2692 thousand tons. Punjab is the leading wheat growing province in Pakistan, both in terms of area and production (Anonymous, 1999). Wheat was already an important crop when history was first recorded and so accurate information on the exact time and places of its origin is not available, but, the distribution of the wild wheat and grasses, believed to be the progenitors of the cultivated wheats, supported the belief that wheat originated in Southern Asia some species were cultivated in the Greece, Persia, Turkey, and Egypt in prehistoric times while the cultivation of other species may be of more recent origin. In Pakistan the evidence of Moen-Jo-Daro excavations, indicate that wheat was cultivated there more than 5,000 years ago. Gross yield of wheat obtained in the country annually is much below as compared to local demand, resulting a huge quantity is imported from abroad. To overcome the local demand of wheat, it is necessary to regulate proper package of improved technology. Among the different agronomic practices proper supply of irrigation water at critical stages play a pivotal role in boosting up the yield per unit area. However, indiscriminate use of irrigation water results improper growth of crop. All varieties have not responded same amount of water because of their genetical behavior, some varieties are drought resistant, while others are drought susceptible. Byerlee and Siddique (1994) revealed quantitative impacts of the Green Revolution on food production in Pakistan and the effects of different technologies on wheat yields over the past two decades and reported that the yield increase is expected through spread of modern wheat varieties and proper irrigation application. Looking the above facts the research was conducted for proper application of irrigation at various crop growth stages for sustainable wheat yield.

Materials and Methods

The field experiment was conducted to determine the effect of irrigation frequencies applied at different growth stages on the newly evolved wheat genotypes at Tando Jam during wheat season of 1998-99. Area was given three dry ploughing each followed by clod crushing and leveling to eradicate the weeds and uniform distribution of irrigation water. Homogenous seeds of four wheat varieties were drilled in 15 cm apart row using a seed rate of 55 kg/ac. The experiment was laid out in four replicated split plot design keeping irrigation frequencies as main - plots and varieties as sub - plots.

Treatments

A. Main plots Irrigation Frequencies = 3
I1 = 5 irrigation (25 days of sowing, booting, ear head emergence, grain formation, and milky stage).
I2 = 4 irrigation (25 days of sowing, booting, earhead emergence, and grain formation).
I3 = 3 irrigation (25 days of sowing, booting, and earhead emergence).
B. Sub-plots Varieties = 4
V1 = Mehran-89
V2 = Abadgar-93
V3 = 7001
V4 = 7002

Fertilizer was applied at the rate of 150-90 kg^{-ha} N and P_2O_5 in the form of urea and single super phosphate. The full dose of phosphorus with 1/3 of urea was applied at the time of seed bed preparation, while rest of the N was split and top dressed at the time of various growth stages. All the required cultural operations were adopted uniformly throughout the growing period in all the plots as per recommendation.

Results and Discussion

Five or four irrigation frequencies applied at various growth stages throughout the life span of wheat genotypes resulted in taller plants, more tillers , ear heads, seeds per spike, seed weight per spike, seed

index, and satisfactory grain yield. However, three irrigation frequencies exhibited water stress effects and affected crop parameters recording reduced yield of wheat.

Table 1: Mean plant height (cm), number of tiller per plant, number of earheads spikes per plant, number of seeds per plant, seed weight per spike, seed index, and 0grain yield of four wheat genotypes as affected by irrigation frequencies and their interactions

Varieties	Irrigation Frequencies I1 (5 Irrig.)	I2 (4 Irrig.)	I3 (3 Irrig.)	Means for Varieties
Plant height (cm)				
Mehran- 89	98.35	95.35	85.35	93.02a
Abadgar-93	88.50	84.10	80.00	84.20a
7001	85.40	80.35	75.45	77.28a
7002	82.15	79.50	70.20	77.28a
Means for irrigations	88.60a	84.83a	77.75c	-

	Irrig. (I)	Var. (V)	Int.action (IxV)
S.E	1.908	1.659	3.318
Cd-I	4.675	3.40	-
CdII	7.080	4.594	-

Number of tiller per plant				
Mehran- 89	98.35	95.35	85.35	93.02a
Abadgar-93	88.50	84.10	80.00	84.20a
7001	85.40	80.35	75.45	77.28a
7002	82.15	79.50	70.20	77.28a
Means for irrigations	88.60a	84.83a	77.75c	-

	Irrig. (I)	Var. (V)	Int.action (IxV)
S.E	1.908	1.659	3.318
Cd-I	4.675	3.40	-
CdII	7.080	4.594	-

Number of Earheads/plant				
Mehran- 89	7.50	7.50	6.90	7.30b
Abadgar-93	7.00	7.00	6.50	6.83b
7001	13.95	13.00	12.70	13.22a
7002	14.00	13.98	11.98	13.32a
Means for irrigations	10.61a	10.37b	9.52b	-

	Irrig. (I)	Var. (V)	Int.action (IxV)
S.E	0.098	0.049	0.098
Cd-I	0.240	0.10	-
CdII	0.364	0.135	-

Varieties	Irrigation Frequencies I1 (5 Irrig.)	I2 (4 Irrig.)	I3 (3 Irrig.)	Means for Varieties
Number of seeds per spike				
Mehran- 89	45.12	42.35	32.15	39.87c
Abadgar-93	43.56	40.00	30.00	37.85c
7001	52.14	48.35	35.15	45.31b
7002	58.95	54.15	39.20	50.77a
Means for irrigations	50.01a	46.21b	34.13c	-

	Irrig. (I)	Var. (V)	Int.action (IxV)
S.E	1.143	0.985	1.970
Cd-I	2.800	2.020	4.039
CdII	4.240	2.729	5.457

Mean seed weight per spike (g)				
Mehran- 89	3.90	3.20	2.20	3.10b
Abadgar-93	3.75	3.00	2.00	2.92b
7001	4.60	3.98	2.89	3.82a
7002	4.80	4.00	3.10	3.97a
Means for irrigations	4.26a	3.55b	2.55c	-

Irrig. (I)	**Var. (V)**	**Int.action (IxV)**
S.E	0.245	0.088	0.124
Cd-I	0.60	0.18	-
CdII	0.909	0.243	-

Seed index (1000 seed weight, g)				
Mehran- 89	52.95	49.12	35.45	45.84c
Abadgar-93	50.14	45.20	30.14	41.83d
7001	65.30	57.15	39.37	53.94a
7002	68.15	69.00	41.20	56.46a
Means for irrigations	59.14a	52.87a	36.54c	-

	Irrig. (I)	Var. (V)	Int.action (IxV)
S.E	1.335	1.220	2.440
Cd-I	3.270	2.50	5.002
CdII	4.953	3.379	6.759

Grain yield (kg/ha)				
Mehran- 89	2.472	1.887	1.272	1.877b
Abadgar-93	2.370	2.280	1.200	1.950b
7001	2.586	2.340	1.386	2.104a
7002	2.722	2.370	1.506	2.199a
Means for irrigations	2.540a	2.220b	1.340c	-

	Irrig. (I)	Var. (V)	Int.action (IxV)
S.E	0.122	0.036	0.072
Cd-I	0.300	0.073	0.148
CdII	0.453	0.099	0.199

Values followed by same letter are not significantly different at 5% probability level.

Among the four wheat genotypes, two newly lines i.e 7002 and 7001 displayed equally maximum values of crop parameters, while both the existing cultivars (Mehran-89 and Abadgar-93) recorded minimum values of crop parameters and yield.

The interaction of wheat genotypes and five irrigation frequencies applied at various critical stages to variety 7002 recorded maximum value of all agronomic characters and final yield followed by 7001 wheat genotype. The poor interaction was observed with Abadgar-93 wheat variety.

Evaluation of plant growth, development and yield require better understanding of water relations. Plant water deficiency reduces yield by affecting tillers, stem senescence, reduced harvested heads and by grain numbers (Musick and Dusek, 1980). Height of plant reduces when irrigation is scare during tillering and elongation stage which reduces tiller number and grain weight (Hefni, 1984). Water use and grain yield generally decreases as number of irrigations decreased (Masood, *et al.*, 1990). Thus, applying four irrigations (Aslam, 1989 and Pal *et al.*, 1996) or five irrigation (El-Faham, *et al.*, 1993) are considered to be better for high yield potentials. Early irrigation applied simulates root growth, nutrient uptake throughout the growing season and increases crop yield, because nutrient uptake was positively correlated with total water supply with timely irrigation application which could maintain both yield and water use efficiency optimizing profitability (Cheng *et al.*, 1996). Stability of genotype characters is important to

improve variety and evaluation for various environments (Sharif *et al.*, 1998), because cultivars significantly differ in yielding potentials and among the growth environments irrigation is equally associated with an increase in yield and yield components (Sawati *et al.*, 1985). From above results it was concluded that genotype response differently under varying irrigation frequencies and best interaction for yield and growth appeared when 7002 or 7001 newly wheat` genotypes were irrigated with four or five irrigation frequencies.

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