VOLUME-6 | ISSUE-1 | JANUARY-2017 • ISSN No 2277 - 8179 | IF : 3.508 | IC Value : 78.46

Original Research Paper

RESPONSE OF DIFFERENT GENOTYPES TO RESTRICTED IRRIGATIONS FOR INCREASING YIELD OF WHEAT

Agronomy

KEYWORDS: Genotypes, irrigation scheduling, productivity and economics)

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ABSTRACT

An experiment entitled "Response of wheat genotypes to restricted irrigation" was carried out with three irrigation levels and five genotypes in rabi 2010-11 at the farm of wheat Research Unit, Dr. PDKV., Akola (MS). Application of two irrigations at CRI and flowering with depth 0-60 cm recorded significantly higher yield over no irrigation and one irrigation at and among the five genotypes, MP 3299 proved significantly superior in producing highest number of spikelet earhead-1, number of grains plant-1, test weight, and grain yield. The maximum B:C ratio (1.65) was obtained with the genotype MP 3299. The interactive effect showed that among the new genotypes of wheat MP 3299 was found better for obtaining maximum grain yield and higher B:C ratio with two irrigations at CRI and flowering.

INTRODUCTIONWheat is the staple food of nearly 35 per cent of the world population. In India, wheat occupies 29.25 million hectares area, with annual production of 85.93 million tonnes and productivity 29.38 qha^{-1}. In Maharashtra, wheat grown on 13.06 lakh hectares with grain production of 23.00 lakh tonnes and productivity 19.19 q ha^{-1}. In Vidarbha, wheat occupies 3.64 lakh hectares area with annual production of 6.01 lakh productivity of 18.19 q^{-1}. (Anonymous, 2011). Wheat compares well with other important cereals in nutritive value it contains more protein than other cereals. It contributes about 60 per cent of daily protein requirement and more calories to world human diet than any other food crops (Mattern et al, 1970). Wheat as the cheap source of amino acids, whole wheat preparations supply significant amount of Fe, P, Mg, Mn, Cu and Zn and also vitamin B. wheat has relatively high content of niacin and thiamine. It contains the characteristics substance gluten which helps in providing structural framework for the spongy cellular structure of bread and chapatti and other baked products of bakery. It possesses abundantly available substrate for mushroom cultivation.

Water is a key input among all the inputs however, water for irrigation is a scarce resource therefore efficient utilization of irrigation water is essential. Optimum use of water for irrigation permits better utilization of all other production factors and leads to increased yield per unit area and time. Efficient water management requires a thorough study of plant water relationship, climate, agronomic practices and economic assessment. In cultivation of high yielding wheat varieties, irrigation assumes greater importance because during growing season of weather remains relatively dry. The judicial application of water calls for immediate attention and this is possible only by following some scientific basis for water application to the crop. One such scientific approach particularly in water scarcity area is critical crop growth stage approach for scheduling of irrigation. Vidarbha region is having limited water supply for rabi crops. Wheat is a suitable crop after soybean. Some genotypes are identified from this research station which can yield optimum with limited irrigation. The response of these genotypes was tested with irrigation and here an experiment was conducted with an objective to find out suitable genotypes for constraints of irrigations.

MATERIALS AND METHODOLOGY

An experiment entitled "Response of different genotypes to restricted genotypes" was conducted in *rabi* 2010 at the farm of wheat Research Unit, Sr. PDKV., Akola (MS). The topography of the field was fairly uniform and the soil of the experimental field was clay in in texture. It was slightly alkaline having pH 7.58, moderate in organic carbon (7.2 gkg^{-1}), low in available nitrogen (221 kgha^{-1}) and available phosphorus (23.10 kgha^{-1}) and fairly rich in available potassium (413kgha^{-1}). During *rabi* (44th MW of 2010 and 12th MW of 2011) 165.6 mm rainfall was received in 5 rainy days. The average maximum temperature varies from 39^{0}C to 21.5 ^{0}C and minimum temperature varied from 22.2^{0}C to 7^{0}C. The average bright sunshine hours and average wind speed were below normal. (5.75 and 2.01 kmhr^{-1}, respectively). The average relative humidity of morning and evening was higher than the normal values (69.04 and 28.81, respectively).

The field experiment was laid out in Factorial Randomized Block Designed in three replications and 15 treatment combinations consisting of three irrigations viz., I_0- No irrigation, I_1 - One irrigation at CRI and I_2 – Two irrigations at CRI and Flowering and five genotypes viz., G1- MP-3299, NI-5439, AKDW-2997-16, MACS-1967 and NIAW-1415. Biometric observations at harvest were recorded as plant height (cm), leaf area plant^{-1}, number of effective tillers plant^{-1}, length of earhead cm, test weight, grain yield, straw yield, straw yield ,biomass, spikelet earhead^{-1} and B:C ratio of the treatments were studied.

RESULT AND DISCUSSION

Growth and Yield of Wheat

Effect of Irrigations:

All the irrigation treatments significantly influenced the growth parameters (Table 1) as well as the yield parameters and the yield of wheat crop, B:C ratio also increased with the increase in number of irrigations (Table 2). The treatment receiving two irrigations at CRI and Flowering stage recorded significantly highest plant height, Leaf area plant^{-1}, dry matter production per plant^{-1}, and Number of grains plant^{-1}, number of spikelet earhead^{-1}, Test weight, and accordingly it has recorded significantly highest grain yield (2005 kgha^{-1}), straw yield over other treatments. This might be due to better availability of moisture for better cell division, and better leaf growth, However, Number of tillers m^{-2} were found statistically similar in all the irrigation treatments.

Wheat crop irrigated with two irrigations at CRI and at flowering required more days for completion of phenophases like CRI, tillereing, late jointing, panicle initiation, 50% flowering, milking stage, dough stage, 50% maturity and harvesting, respectively in comparison with crop irrigated with one irrigation at CRI and no irrigation, whereas one irrigation at CRI was significantly superior over no irrigation. The highest cumulative growing degree days required for different growth stages by the treatment receiving two irrigations. The lowest cumulative growing degree days required for different growth stages by the treatment receiving no irrigation during all the stages of crop growth. The highest B:C ratio was also observed with the treatment receiving two irrigations (1.84). These results are similar to Bramha (2005), Shirpurkar et al. (2007) and Naeem et al. (2010).

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Effect of genotypes:
Significant differences were recorded among the genotypes in growth parameters viz., plant height and dry matter production (Table 1) and yield attributing characters expect number of earhead and the yield of wheat crop (Table 2). The variation in leaf area plant^{-1}, Number of earhead m^{-2}, Number of tillers m^{-2}, was found non-significant among all the genotypes. Among the genotypes, variety MACS1967 recorded significantly highest plant height over the other genotypes. In respect of dry matter production, variety MP 3299 recorded significantly superior over other varieties however; it was statistically at par with NI 5439. Genotype MP 3299 also proved significantly superior over the other genotypes in producing highest spikelet earhead^{-1}, Number of grains plant^{-}1, test weight, and grain yield (1649 kgha^{-1}.)

Data given in Table 3 revealed that at CRI, genotype AKDW 2997-16 and NIAW-1415 found to be required similar number of days for completion of different phenophases and at late jointing genotype MP-3299 and genotype NI5439 required similar number of days for completion of different phenophases. At panicle initiation genotype MACS-1965 and NIAW-5439 required similar number of days for completion of different phenophases. And at 50 per cent flowering and 50 per cent maturity, genotype MP-3299 and NI-5439 required similar number of days for completion of different phenophases. However, genotype MACS-1957 found significantly superior in obtaining lowest number of days required for completion of different phenophases over the other genotypes. The cumulative growing degree days required for different growth stages due genotypes was found to be significant. Significantly highest cumulative growing degree days required to the genotype MP-3299. However, it was statistically on par with NI-5439 in cumulative growing degree days requirement at all stages of crop growth. The lowest cumulative growing degree days required to genotype MACS-1967 at all stages of crop growth.

The maximum gross monetary returns, net monetary returns and B:C ratio (1.65) were obtained was obtained with the variety MP 3299 (Table 2). This might be due to better suitability of the genotype at rainfed conditions and its high genetic potential. Accordingly, the benefit ratio was also highest with the genotype MP 3299 followed by NI 5439.

Table 1: Effect of irrigations and genotypes on growth parameters of wheat.

Treatments	Plant height (cm)	Dry matter production	Leaf area plant^{-1} (cm^{2})	Number of tillers m^{-2}
Irrigations				
I_0- No irrigation	90.89	14.58	46.02	273
I_1- One irrigation at CRI	93.94	15.05	52.89	288
I_2- Two irrigations at CRI and Flowering	96.42	15.89	77.83	301
SE (m)±	1.17	0.22	5.29	9
CD at 5%	3.39	0.65	15.33	NS
Genotypes				
G_1- MP 3299	96.64	16.43	64.34	310
G_2- NI 5439	100.81	16.10	59.63	292
G_3- AKDW 2997-16	86.90	14.77	57.65	284
G_4- MACS 1967	106.21	14.23	56.36	271
G_5- NIAW 1415	78.28	14.33	56.58	278
SE (m)±	1.51	0.29	6.83	12.44
CD at 5%	4.37	0.84	NS	NS

Table 2: Effect of irrigations and genotypes on yield parameters, yield and economics of wheat

Treatments	Number of earhead m^{-2}	Number of spikelet earhead^{-1}	Number of grains plant^{-1}	Test weight (g)	Grain yield kgha^{-1}	straw yield kgha^{-1}	Harvest Index	B:C ratio
Irrigations								
I_0- No irrigation	266	14	115	36.08	1014	6659	12.90	1.26
I_1-One irrigation at CRI	280	14	125	37.45	1526	8036	16.42	1.59
I_2-Two irrigations at CRI and Flowering	289	15	147	37.84	2005	10698	15.83	1.89
SE (m)±	9	0.12	0.82	0.09	29	220	0.37	-
CD at 5%	NS	0.37	2.00	0.28	84	638	1.07	-
Genotypes								
G_1- MP 3299	298	17	148	43.93	1649	7678	16.91	1.65
G_2- NI 5439	286	16	137	39.42	1560	8339	15.21	1.62
G_3- AKDW 2997-16	278	14	133	34.93	1488	7194	16.28	1.55
G_4- MACS 1967	261	13	112	32.70	1393	10174	12.63	1.56
G_5- NIAW 1415	271	13	118	34.64	1483	8934	14.22	1.59
SE (m)±	12	0.16	1.00	0.12	37	284	0.47	-
CD at 5%	NS	0.47	3.00	0.36	109	824	1.38	-

Table 3. Days required for completion of different phenophases affected by different treatments

Treatment	Days required for completion of different phenophases								
	Phenophases								
	CRI	Tillering	Late jointing	Panicle initiation	50 % flowering	Milking	Dough stage	50 % maturity	Harvesting
Irrigaations									
I_0- No irrigation	19.20	30.40	37.87	46.80	55.40	74.20	82.27	91.73	111.93

I_1-One irrigation at CRI	20.40	31.40	38.87	48.00	59.13	76.20	83.93	93.40	112.20
I_2-Two irrigations at CRI and Flowering	21.33	30.60	40.07	51.07	63.27	78.60	85.53	95.60	114.40
SE (m)±	0.27	0.28	0.30	0.32	0.35	0.25	0.34	0.29	0.67
CD at 5%	0.78	0.81	0.87	0.95	1.03	0.75	1.00	0.86	1.94
Genotypes									
G_1- MP 3299	21.56	33.56	40.89	50.44	62.78	79.56	88.00	96.44	115.44
G_2- NI 5439	20.89	33.00	40.67	49.67	62.11	78.56	85.67	96.11	115.33
G_3- AKDW 2997-16	20.33	31.56	39.11	48.11	59.11	75.78	83.67	93.89	112.33
G_4- MACS 1967	18.44	28.44	36.67	47.00	55.11	72.56	80.22	90.44	109.00
G_5- NIAW 1415	20.33	30.78	37.33	47.78	57.22	75.22	82.00	91.00	112.11
SE (m)±	0.34	0.36	0.38	0.42	0.46	0.33	0.44	0.38	0.86
CD at 5%	1.00	1.05	1.12	1.22	1.33	0.97	1.29	1.11	2.51

Table 4. Effect of irrigation and genotypes on cumulative growing degree days (^{0}c day^{-1})

Treatment	Cumulative growing degree days (GDD)								
	Phenophases								
	CRI	Tillering	Late jointing	Panicle initiation	50 % flowering	Milking	Dough stage	50 % maturity	Harvesting
Irrigaations									
I_0- No irrigation	392.77	588.45	687.87	811.95	927.66	1185.39	1327.05	1388.05	1891.05
I_1-One irrigation at CRI	416.34	603.55	700.00	830.29	969.44	1219.60	1356.34	1417.95	1896.04
I_2-Two irrigations at CRI and Flowering	434.68	620.08	714.97	875.10	1022.85	1261.98	1384.70	1455.18	1944.32
SE (m)±	5.29	4.09	3.71	4.93	4.43	4.58	6.18	5.02	14.62
CD at 5%	15.34	11.86	10.75	14.30	12.83	13.29	17.90	14.55	42.36
Genotypes									
G_1- MP 3299	439.03	634.36	725.12	865.99	1014.85	1279.04	1428.55	1468.57	1967.60
G_2- NI 5439	425.25	626.82	722.34	854.74	1006.60	1261.24	1386.74	1466.89	1964.90
G_3- AKDW 2997-16	415.02	608.42	703.09	831.83	972.19	1211.78	1351.47	1426.43	1899.91
G_4- MACS 1967	377.97	556.43	672.99	816.48	924.21	1157.58	1291.12	1365.09	1826.06
G_5- NIAW 1415	415.01	594.10	681.18	826.53	948.73	1201.96	1322.27	1374.98	1893.87
SE (m)±	6.83	5.29	4.79	6.37	5.72	5.92	7.98	6.48	18.88
CD at 5%	19.80	15.32	13.88	19.46	16.57	17.16	23.11	18.79	54.69

CONCLUSION:

Among the irrigation treatments, treatment receiving two irrigations at CRI and tillering recorded significantly higher wheat yield and highest GMR, NMR and accordingly the highest B:C ratio. And among the genotypes, MP3299 proved significantly better for producing higher yield and and highest GMR, NMR and accordingly the highest B:C ratio.

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