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Performance of wheat varieties at different levels of irrigation

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Abstract
An experiment on Performance of wheat varieties to different levels of irrigation was conducted at School of Agriculture, ITM University, Gwalior, M.P. during the winter season of 2015-16. The experiment comprised of three irrigation levels as main treatments and five varieties as sub treatments in split plot design with three replications. The yield improved with irrigation in all the varieties. The increase in frequency of irrigation increased the grain yield. Under no irrigation, variety, Lok-1 gave significantly higher grain yield as compared to other varieties. Under two irrigations, variety GW-366 produced significantly higher grain yield over other varieties - RVW-4106, MP-4010 and Lok-1 and statistically at par with variety MP1203. In treatment where four Irrigations were applied at critical stages (i.e. 20, 40, 60 & 80 DAS) highest grain yield was noted in variety GW-366 which was closely followed by MP-1203 and both these varieties were significantly superior over rest of three varieties at this level of irrigation.

Keywords: Grain yield, irrigation, wheat varieties, winter season

Introduction
Wheat (*Triticum aestivum* L.) is the most important winter season food crop of India occuping an area of 30.5 million hectare with total production of 101 million tones and a productivity of 3.31 tones ha^{-1} (India Stat, 2018-19). In Madhya Pradesh, it is cultivated in 5.26 million hectare with an annual production of 14.54 million tones and productivity of 2770 kg/ha (Madhya Pradesh, Agriculture, Economic Survey- 2014).
Different factors are responsible for higher productivity, these include use of high yielding cultivars, fertilizers and irrigation. One of the major essential parameter for growth and development of plants is irrigation. Water stress is a major constraint for agricultural production in arid and semi arid regions of the world where wheat serves as a principal food crop for human consumption. Water stress reduces wheat grain yield (Kobata *et al.*, 1992) [4]. Reduction in grain yield also depends on the genotypes cultivated and physiological stage of the plant at which the plant experiences moisture stress (Moustafa *et al.* 1996) [6].
Generally, water requirement of semi -dwarf varieties of wheat is about 45 cm in the form of 4-6 irrigations with a depth of 4-7 cm. Various genotypes of wheat have varying water requirements in different ecosystems of northern part of Madhya Pradesh. There is limited irrigation water to meet the requirement of wheat crop under the changed scenario of the rainfall and its distribution.
Genotypes play a vital role in crop production. The choice of right genotype of wheat helps to augment crop productivity by about 20-25 per cent. Any genotype of wheat before recommended for general cultivation for particular region has to be judged for its potential, tolerance against disease in general and its responsiveness to added water and fertilizer.
Keeping the above points in view, an experiment on performance of wheat varieties to different levels of irrigation was conducted to identify suitable variety and irrigation schedule.

Material and Methods
An investigation on Performance of wheat varieties to different levels of irrigation was conducted at ITM University, Gwalior (M. P.) during the *Rabi* season of 2015-16. Three replications consisting three irrigation levels - no irrigation (Control) , two irrigations -at CRI and late tillering stages (80-85 DAS) and four irrigations at critical stages (20, 40, 60 and 80

DAS) were tested in main plots and five varieties MP-1203, RVW-4106, GW-366, MP-4010 and Lok-1 in subplots in split plot design. The experiment site falls under humid sub-tropical climate and located in between 23^0 10' N latitude and 79^0 54' E longitudes at an elevation of 411.98 meters above mean sea level. The soil type of experimental field was sandy loam in nature with pH of 7.4 and EC 0.29 dsm-1, having 242 kg available nitrogen, 20.5 kg available phosphorus and 456 kg available potassium.

During the crop growth period, the maximum temperature varied between 18.9 ºC in January third week to 40.1 ºC in April first week and minimum temperature ranged from 3.9 ºC in third week of December to 23 ºC in second week of April.

The experimental field was given a pre-sowing irrigation and two ploughings were done by tractor and this was followed by planking each time and after this the field was laid out into plots with appropriate bunds between treatments. The sowing of wheat varieties was done @ 100 kg/ha by funnel attached with desi plough, keeping row-to-row distance of 20 cm on 28 November 2015 and harvested on April 20, 2016. The seeds were covered by planking. The hand weeding was done two months after sowing. After the hand weeding, the field remained free and clean from weeds.

The fertilizers were applied at 60 kg N, 60 kg P_2O_5 and 40 kg K_2O/ha. The nitrogen was applied through urea and P_2O_5 and K_2O through urea, DAP and MOP. The full dose of nitrogen, P_2O_5 and K_2O were drilled at 8 cm deep in the field (at the time of sowing), as a basal dose. Irrigations were given at 5±1 cm as per the treatments besides pre sowing irrigation.

All the agronomic management practices were done uniformly in all the treatments. The observations on plant height, numbers of tiller per meter row length and the yield contributing characters viz., ear head m^{-1} row length, spike length (cm), number of spike lets $spike^{-1}$, number of grains $spike^{-1}$ and 1000 grains weight (g) and the biological, grain and straw yields were recorded as per standard procedures.

The Harvest Index, the ratio of economic yield to the biological yield was calculated and expressed in per centage as given below

$$\text{Harvest Index (\%)} = \frac{\text{Economic yield (grain yield)}}{\text{Biological yield (grain + straw)}} \text{ X } 100$$

The data obtained on various observations were subjected to statistical analysis by using the techniques of the analysis of variance (ANOVA) and the treatment was tested by F test and Critical difference (CD) at 5% level of significance (Panse and Sukhatme, 1989) [7] for each character to compare the differences among treatment means.

Results and Discussion

Irrigation scheduling

Scheduling of irrigations significantly affected the various growth parameters of wheat. There was a progressive and significant increase in plant height with increasing number of irrigations from 2 to 4 (Table 1). Plant growth depends on cell division and cell expansion for which adequate water supply is essential (Singh and Singh, 1977) [8]. Hence, plants were taller due to increase in irrigation level (Hooda and Agarwal, 1987) [2]. Crop receiving four irrigations at critical stages produced more tillers/m row length than the crop which received only two irrigations at CRI stage and late tillering and no irrigation.

Increase in frequency of irrigations increased the number of ear heads/m row length progressively and significantly over no irrigation (Table 2). Significantly more number of grains per ear head and test weight was recorded with crop irrigated four times at critical stages (20, 40, 60 and 80 DAS) over crop irrigated two times at CRI and late tillering stage and no irrigation.

Significant increase in yield attributing characters due to increase in irrigation levels may be due to higher availability of moisture which might have helped in better nutrient absorption by the crop, which in turn resulted in assimilation of photosynthates and better development of yield attributes.

Grain yield as well as straw yield increased with increasing irrigation level (Table 3). Crop which received 4 irrigations (at 20, 40, 60 & 80 DAS) produced 11.67 percent higher grain yield over two irrigations at CRI and late tillering stages (Table 3). Likewise, the crop raised with two irrigation had significant edge over no-post sowing irrigation, which may be due to beneficial effect of soil-moisture regime on growth and yield components (Table 1 and 2). All the growth and yield components increased significantly with the increase in irrigation levels from no irrigation to 2 and 4. The increase in these yield components alternately resulted in higher grain yield in crop receiving 4 irrigations over 2 irrigations (Table 3). Similar observations were reported by Behera *et al.* (2002) [1], Kibe and Singh (2003) [3] and Yadav *et al.* (2005) [9].

The harvest index (Table 3.) increased with increase in levels of irrigation.

Variety

The growth parameters like plant height, number of tillers/m row length were significantly influenced by varieties (Table 1). At harvest, variety MP-1203 resulted in significantly tallest plant, while Variety GW-366 produced significantly highest number of tiller per plant followed by MP-1203and the tiller number in these two varieties was higher over rest of the genotypes. The differences in growth characters due to genotypes may be attributed to their inherent characteristics.

The yield attributing traits like ear heads/m row length, length of ear head, number of grains/ear head and test weight were significantly affected by varieties (Table 2). Genotype GW-366 produced significantly higher number of ear heads/row length, longest ear head, heavier ear head and higher number of grains/ear head, 1000 grain weight over other genotypes.

Variety GW-366 resulted in significantly higher grain yield over that of MP 4010, RVW 4106 and Lok-1, and was comparable with the yield obtained by the MP 1203 (Table 3). The grain yield recorded with varieties MP4010, RVW 4106 and Lok-1 was comparable.

The higher yield obtained by variety GW 366 was due to its superiority in yield attributes over all other varieties which ultimately resulted in higher grain yield in this variety over other varieties under test.

All the varieties showed more or less similar harvest index. However, maximum and minimum harvest index were noted with variety RVW-4106 and MP 4010 respectively.

Interaction of irrigations x varieties

Under no irrigation, variety Lok-1 gave significantly higher grain yield as compared to other varieties (Table 4). Under two irrigations, variety, GW-366 produced significantly higher grain yield which was statistically at par with the yield produced by variety MP1203. Under this irrigation level, varieties, RVW-4106, MP-4010 and Lok-1 the grain yield were comparable with each other.

Four irrigations scheduled at critical stages (20, 40, 60 & 80 DAS) with variety GW-366 recorded highest grain yield which was closely followed by MP-1203 and both the varieties were significantly superior over rest of three varieties at all three irrigation levels. The GW-366 had higher yield attributes as compared to other varieties. The irrigation further improved these attributes which ultimately resulted in higher grain yield along with four irrigations scheduled at critical stages.

From these results, it can be concluded that growing of wheat varieties G366 and MP 1203 and application of four irrigation at critical stages results in higher grain yield in Gwalior region of Madhya Pradesh.

Table 1: Plant population m^{-1} row length as influenced by different irrigation schedules and varieties at initial and harvest stage

Treatments	Plant population m^{-1} row length		
	Initial stage	Harvest stage	Plant height at harvest, cm
Irrigation schedule			
No irrigation (Control)	18.08	16.95	77.60
Two irrigations - at CRI and late tillering stages (80-85 DAS)	18.45	17.09	84.29
Irrigation at critical stages (20, 40, 60 and 80 DAS)	18.42	17.17	94.47
S. Em±	0.18	0.11	1.24
CD (p=0.05)	NS	NS	4.86
Varieties			
MP-1203	18.46	17.20	88.50
RVW-4106	18.29	17.01	86.06
GW-366	18.24	17.00	87.40
MP-4010	18.46	17.10	84.70
Lok-1	18.15	17.03	80.60
S. Em±	0.17	0.20	1.49
CD (p=0.05)	NS	NS	4.35
Interaction (I rrigation X Varities)	NS	NS	

Table 2: Yield attributing characters of wheat as influenced by different irrigation schedules and varieties

Treatments	Yield attributing characters				
	Length of ear head (cm)	Number of grains / ear head	Weight of ear head (g)	1000 grain weight (g)	Number of ear head m^{-1} row length
Irrigation schedule					
No irrigation (Control)	7.15	38.59	8.14	34.88	45.61
Two irrigations - at CRI and late tillering stages (80-85 DAS)	8.34	46.38	9.53	40.02	54.65
Irrigation at critical stages (20, 40, 60 and 80 DAS)	9.25	52.63	10.39	41.72	59.69
S. Em±	0.18	0.61	0.09	0.20	1.00
CD (p=0.05)	0.71	2.41	0.36	0.80	3.93
Varieties (V)					
MP-1203	8.21	46.93	9.52	39.27	54.20
RVW-4106	8.06	46.00	9.19	38.13	53.41
GW-366	8.79	47.77	9.89	40.33	59.29
MP-4010	8.35	45.42	9.26	38.64	53.50
Lok-1	7.81	43.21	8.90	37.99	46.19
S. Em±	0.09	0.90	0.14	0.41	1.38
CD (p=0.05)	0.27	2.61	0.41	1.20	4.03
Interaction (I rrigation X Varities)	NS	NS	NS	NS	NS

Table 3: Grain and straw yield and harvest index of wheat as influenced by different irrigation schedules and varieties

Treatments	Yield (kg ha^{-1})		Harvest index (%)
	Grain	Straw	
Irrigation schedule			
No irrigation (Control)	2906	5034	36.64
Two irrigations - at CRI and late tillering stages (80-85 DAS)	3789	5653	40.17
Irrigation at critical stages (20, 40, 60 and 80 DAS)	4231	5757	42.35
S. Em±	19	35	0.19
CD (p=0.05)	73	38	0.74
Varieties			
MP-1203	3716	5526	39.95
RVW-4106	3551	5196	40.47
GW-366	3824	5707	39.88
MP-4010	3539	5503	38.83
Lok-1	3580	5474	39.47
S. Em±	44	96	0.49
CD (p=0.05)	128	281	NS
Interaction (I rrigation X Varities)	S*	NS	NS

Table 4: Interaction effect of Irrigation schedules and varieties on grain yield of wheat (kg ha^{-1})

Varieties	Irrigation levels			
	No irrigation	Two irrigations	Four irrigations	Mean
MP-1203	2843	3890	4423	3716
RVW-4106	2910	3636	4108	3551
GW-366	2923	4007	4542	3824
MP-4010	2707	3753	4157	3539
Lok-1	3147	3670	3924	3580
Mean	2906	3789	4231	
S. E.m±	70			
CD (p=0.05)	209			

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