Biological Forum – An International Journal 14(4): 1221-1227(2022)

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Effect of different Irrigation Schedules and varieties on Growth and Yield of Wheat under High Altitude and Tribal Area Zone conditions of Andhra Pradesh

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(Received 06 September 2022, Accepted 29 October, 2022)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: The field experiment was conducted during the *rabi* season of 2021-2022 at the Regional Agricultural Research Station, Chintapalle, Visakhaptnam, ANGRAU, Andhra Pradesh to study the effect of different irrigation schedules and varieties on growth and yield of wheat under high altitude and tribal area zone conditions of Andhra Pradesh. The experiment was laid out in split-plot design with the three irrigation schedules *i.e.*, irrigation at CRI, maximum tillering, jointing, flowering and milking stages (M_1), irrigation at CRI, flowering and milking stages (M_2) and irrigation at CRI and milking stages (M_3) as main plots and four varieties *i.e.*, DBW-252(V_1), HI-1544 (V_2), HI-8759 (V_3) and HI-8713 (V_4) as subplots. Plant height, number of tillers m^{-2}, dry matter production (kg ha^{-1}) and CGR (g m^{-2} day^{-1}) values were found superior with five irrigations scheduled at CRI, maximum tillering, jointing, flowering and milking stages and among the varieties HI-8759 recorded the maximum values which were on a par with HI-8713. Higher grain and straw yields were recorded under five irrigations schedule. Despite of lower grain yield observed with two irrigations but straw yield was remained statistically on a par with three irrigations. The harvest index (%) was significantly highest with five irrigations and lowest with two irrigations. However, among the varieties HI-8759 recorded significantly higher grain and straw yield. Straw yield was remained at par with HI-8713. Harvest index of HI-8759 was significantly superior over all the varieties. Lowest grain and straw yields were recorded with HI-1544. The challenges of the study is to find out the best variety among the tested for a suitable irrigation schedule and for the first time durum wheat varieties were tested in High Altitude and Tribal Area zone conditions of Andhra Pradesh.

Keywords: Irrigation schedules, CRI, maximum tillering, jointing, flowering, milking, varieties and harvest index.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the most preponderant food crop in the world. It occupies an area of 220.4 m ha in the world with a production of 765.77 m t (FAO, 2019-20). Whereas in India, it is cultivated to an extent of 31.35 m ha with a production of 107.86 mt and productivity of 3.42 t ha^{-1} (USDA/FAS, 2020-21) and it occupies 2nd position in terms of area & production next to rice among the cereals in our country. Among the states in our country, Uttar Pradesh rank first in area (9.5 m ha) and production (32.59 mt) but the productivity is much lower (3432 kg ha^{-1}) than Punjab (5008 kg ha^{-1}) and Haryana (4687 kg ha^{-1}) In Andhra Pradesh, there is no prominent area under wheat cultivation (Directorate of Economics and Statistics, 2019-20). Being the "King of cereals", it contains 70% of carbohydrates and it supplements a healthy nutritional profile with an average of 12.2% protein, 1.7% fat, 2.7% minerals, 1.8% lipids, 1.8% ash, 2.0% fiber and also provides 314 Kcal per 100g of food (Gupta *et al.*, 2002).

Irrigation scheduling is a key crop management activity that affects crops' ability to use water effectively and efficiently. It regulates the decision-making process for when to irrigate, how to irrigate and how much to irrigate the crop. The sensible application of water necessitates prompt attention, which can only be achieved by adhering to some scientific guidelines for water application to the crop. The crucial growth stages strategy for irrigation scheduling is one such scientific approach, which is particularly useful in water-scarcity areas. It improves the performance and sustainability of any irrigation system by conserving water and optimizing agricultural productivity by minimizing yield loss due to water shortages. Because of geographical differences in climate and agronomic practices the influence of limited irrigation on crop yield and water use efficiency varies depending on the growth stage and moisture-sensitive stage. The crown root initiation (CRI) stage of wheat is the most sensitive growth stage producing the highest seed yield with one irrigation (BARI, 1990). In case of adequate water supply, three irrigations are given each at three defined growth stages *viz*., CRI, maximum tillering stage and grain filling stage significantly increased seed yield (BARI, 1990).

To achieve maximum yield, it is critical to select the right cultivar at the right place. Being a thermo-sensitive crop, the choice of suitable cultivar for different agro-climatic regions gets prime importance. As a result of concerted and persistent effort several high-yielding strains of wheat have been developed. Newer high-yielding varieties being relatively, thermosensitive, perform better even under variable climatic conditions.

The wheat crop requires cool weather during the vegetative phase and warm weather during the reproductive phase. Farmers of High Altitude and Tribal (HAT) Area zone of Andhra Pradesh usually cultivate rice as a major cereal crop during *kharif* and the majority of land left fallow during *rabi*, though the climatic conditions of the HAT zone of A.P. are ideal for wheat cultivation. Studies on wheat cultivation are being conducted at Regional Agricultural Research Station, Chintapalle for introducing wheat as a non-traditional crop.

MATERIAL AND METHODS

The field experiment was conducted during *rabi*season of 2021-22 at the at Regional Agricultural Research Station, Chintapalle. It is situated between 17^o 52' N latitude and 82^o 20' E longitude with an altitude of 839.0 meters above the mean sea level in the High Altitude and Tribal Area zone of Andhra Pradesh, India. The weekly maximum temperature during experimentation ranged from 25.0°C to 33.9°C and the minimum temperature ranged from 7.8°C to 19.1°C. The maximum temperature recorded was 33.9°C during the 11th standard week in the month of March 2022 whereas the minimum temperature recorded was 7.8 $^{\circ}$C during the 51st standard week in December 2021. Total rainfall of 90.0 mm was received in 7 rainy days during the crop growth period. The maximum rainfall (70.0 mm) was obtained during the 47th standard week. The weekly mean relative humidity ranged between75.6 to 91.3% during the experimentation. Maximum relative humidity was observed during the month of November 2022 on the 46thstandard week. The experiment was laid out in split-plot design with three irrigation schedules *i.e.,* irrigation at CRI, maximum tillering, jointing, flowering and milking stages (M_1), irrigation at CRI, flowering and milking stages (M_2) and irrigation at CRI and milking stages (M_3) are consisted as main plots and four varieties *i.e.,* DBW-252(V_1), HI-1544 (V_2), HI-8759 (V_3) and HI-8713 (V_4) as subplots. Wheat crop was sown on thoroughly prepared experimental plot. The crop was supplied with recommended fertilizer dose of 120 kg N, 60 kg P_2O_5 and 40 kg K_2O ha^{-1}. 60 kg of N and entire dose of P_2O_5 and K_2O were applied as basal, remaining 60 kg of N was applied in two equal splits at 25 DAS and 45 DAS. Application of irrigation was done to the respective treatments as specified. Field operations such as weeding and plant protection measures were taken as per recommendations of ANGRAU. Data were collected on plant height, number of tillers, drymatter production, crop growth rate, grain yield, straw yield and harvest index. The Plant height was measured from randomly selected plant in each plot with the help of meter scale from the base of the plant to top of the plant at 30, 60, 90, DAS and at harvest stage leaving border rows. The mean height of the plants for each plot was determined from the measured values by using statistical analysis. Number of tillers at progressive growth stages *viz.,* 30, 60, 90 DAS and at harvest was counted by using a quadrate square meter at two places in each plot and the average number of tillers m^{-2} was worked out for each plot. Randomly selected plant samples from 25 cm row length were uprooted from two different places in border rows of sub-plots. After sun drying the samples, these were kept in an oven at 60 ± 5 ^{o} C till the weight reaches to constant value to get the total drymatter production, the observation was finally calculated as dry weight of plants per square meter and were taken at all progressive growth stages *viz*., 30, 60, 90 DAS and at harvest. CGR was computed at 0-30, 31-60, 61-90 DAS and 91 DAS- At harvest stages of the crop. Grain and straw yields were recorded and grain was adjusted at 13% moisture content.

RESULTS AND DISCUSSION

A. Growth attributes

Plant height. Data in the Table 1 revealed that the different treatments of irrigation scheduling as well as varieties could not influence the plant height at 30 DAS, because of uniform application of irrigation to all the plots upto crown root initiation stage (25 DAS). Further analysis of data shows that the plant height at 60, 90 DAS and at harvest was influenced significantly with increasing the scheduling of irrigation. However, the taller plants (63.3, 90.7 and 92.7 cm) at 60, 90 DAS and at harvest, respectively were recorded under five irrigations scheduled at CRI, maximum tillering, jointing, flowering and milking stages that might be due to enhanced uptake of moisture by the wheat under this treatment. Also, it was found that plant height with three irrigations (CRI, flowering and milking) and two irrigations (CRI and milking) were at par with each other on 60 DAS. Significantly lowest plant height at 90 DAS (78.3 cm) and at harvest (79.7 cm) was observed with two irrigations scheduled at CRI and milking stages. Increase in plant height is a function of cell expansion and depends upon cell water potential. Significant increase in plant height was brought by five irrigations scheduled at CRI, maximum tillering, jointing, flowering and milking stages was due to optimum moisture supplied during the vegetative and reproductive phases which maintained good establishment of roots and various metabolic processes and resulted into profuse and vertical growth of the plants. Similar results have been reported by Kibe and Singh (2003); Brahma *et al.* (2007); Kabir *et al.* (2009); Singh *et al.* (2018); Kumar *et al.* (2019).

Among the four varieties, HI-8759 had significantly taller plants (62.6, 88.2 and 89.8 cm) than rest of the varieties at 60, 90 DAS and at harvest respectively, while it was at par with HI-8713 at 60, 90 DAS and at harvest. Wheat variety DBW-252 produced significantly dwarf plants (54.2, 81.3 and 83.2 cm) than other varieties at 60, 90 DAS and at harvest, respectively and it was remained at par with HI-1544 and at 60, 90 DAS and at harvest. This may be attributed to different genetic characters and climatic needs of the different varieties. These results are in accordance with Jat and Singhi (2004); Kumar *et al.* (2016); Pathania *et al.* (2018).

Interaction effect (M × V) between irrigation schedules and varieties on plant height was found to be non-significant during all the crop growth stages *i.e.,* at 30, 60, 90 DAS and at harvest of the wheat crop.

Number of tillers m^{-2}. The number of tillers m^{-2} were significantly influenced by the irrigation schedules (Table 2).

Table 1: Plant height (cm) at different growth stages of wheat as influenced by different irrigation schedules and varieties.

Treatments	Plant height (cm)			
	30 DAS	**60 DAS**	**90 DAS**	**At harvest**
Irrigation schedules (M)				
M_1: CRI, Maximum tillering, Jointing, Flowering and Milking	23.0	63.3	90.7	92.7
M_2: CRI, Flowering and Milking	23.1	55.1	85.3	86.1
M_3: CRI and Milking	23.3	54.6	78.3	79.7
SEm±	0.85	1.44	1.33	1.52
CD (P=0.05)	NS	5.6	5.2	6.0
CV (%)	12.7	8.6	5.4	6.1
Varieties (V)				
V_1: DBW - 252	23.5	54.2	81.3	83.2
V_2: HI - 1544	23.0	54.4	82.5	83.4
V_3: HI - 8759	22.9	62.6	88.2	89.8
V_4: HI - 8713	23.2	59.3	87.1	88.1
SEm±	0.89	1.62	1.40	1.47
CD (P=0.05)	NS	4.8	4.3	4.4
CV (%)	11.5	8.4	5.2	5.1
Interaction				
(M×V)	NS	NS	NS	NS
(V×M)	NS	NS	NS	NS

Table 2: Number of tillers m^{-2} at different growth stages of wheat as influenced by different irrigation schedules and varieties.

Treatments	Number of tillers m^{-2}			
	30 DAS	**60 DAS**	**90 DAS**	**At harvest**
Irrigation schedules (M)				
M_1: CRI, Maximum tillering, Jointing, Flowering and Milking	91.3	221.0	244.3	239.5
M_2: CRI, Flowering and Milking	90.4	202.9	225.5	220.8
M_3: CRI and Milking	94.4	200.6	200.1	196.0
SEm±	2.28	3.33	3.85	3.75
CD (P=0.05)	NS	13.1	15.1	14.7
CV (%)	8.6	5.5	6.0	5.9
Varieties (V)				
V_1: DBW - 252	91.1	196.3	210.0	206.4
V_2: HI - 1544	91.8	198.5	211.9	208.5
V_3: HI - 8759	93.2	222.8	240.7	236.8
V_4: HI - 8713	91.9	215.1	230.6	223.4
SEm±	2.26	3.69	3.85	3.96
CD (P=0.05)	NS	11.0	11.4	11.8
CV (%)	7.4	5.3	5.2	5.4
Interaction				
(M×V)	NS	NS	NS	NS
(V×M)	NS	NS	NS	NS

The number of tillers m^{-2} were increased upto 90 DAS and there after a slight decline was observed. The highest number of tillers m^{-2} (221.0, 244.3 and 239.5 at 60, 90 DAS and at harvest respectively) were found with five irrigations scheduled at CRI, maximum tillering, jointing, flowering and milking stages and was significantly superior over three irrigations scheduled at CRI, flowering and milking stages and two irrigations scheduled at CRI and milking stages at 60, 90 DAS and at harvest. This might be due to increase in number of irrigations owing to adequate moisture level at all growth stages, increases the photosynthetic activities thereby increasing the number of tillers. The result is in close proximity to those of Saren *et al.* (2004); Atikullah *et al.* (2014); Kumar *et al.* (2016). Also, it was found that the number of tillers m^{-2} at 60 DAS, three irrigations scheduled at CRI, flowering and milking stages and two irrigations scheduled at CRI and milking stages were on par to each other because of no variable irrigation upto this age for both the treatments.

In case of wheat variety HI-8759, produced the highest number of tillers m^{-2} which were found at par with HI-8713 and significantly superior over DBW-252 and HI-1544 at 60, 90 DAS and at harvest. Variation in number of tillers among the varieties might be because of the genetic constitutions of the variety. The findings are in support to those of Alam *et al.* (2013); Dhiman (2016); Ram *et al*. (2017).

Interaction effect (M × V) between irrigation schedules and varieties on number of tillers m^{-2} was found to be non-significant during all the crop growth stages *i.e.*, at 30, 60, 90 DAS and at harvest of the wheat crop.

Drymatter production. The data presented in Table 3 showed that there was a significant increase in drymatter production to number of irrigations at all the growth stages of the wheat crop. The drymatter production was recorded highest with five irrigations scheduled at CRI, maximum tillering, jointing, flowering and milking stages which was found significantly superior over three irrigations scheduled at CRI, flowering and milking stages and two irrigations scheduled at CRI and milking stages at 60, 90, DAS and at harvest. Drymatter production is resultant of the accumulation of photosynthates in different plant parts, which is based on the availability of moisture. It is a function of increased plant height and tiller production. Highest drymatter accumulation at five irrigation schedules might be due to maintenance of adequate and constant moisture level in the soil at all the growth stages, sufficient moisture supply can leads to better utilization of nutrients in the whole root zone and increased plant height and number of tillers which in turn resulted in the highest drymatter production. Also, it was found that the drymatter production (kg ha^{-1}) at 60 DAS, three irrigations scheduled at CRI, flowering and milking stage and two irrigations scheduled at CRI and milking were on par to each other. This might be due to non-application of variable irrigation up to this stage. The increase in drymatter due to increase in irrigation number was also reported by Wajid *et al.* (2002); Shivani *et al*. (2003); Chauhan *et al.* (2017); Singh *et al.* (2018).

Among the varieties tested, HI-8759 recorded significantly the highest drymatter production at all the growth stages except at 30 DAS as compared to other varieties. The improvement in the growth parameters *viz.*, plant height and number of tillers might have led to higher interception and absorption of radiant energy, resulting into greater photosynthesis and finally dry matter accumulation. Further scanning of the data in Table 3 reveals that HI-8759 being at par with HI-8713 but produced significantly higher drymatter production over DBW-252 and HI-1544 at 60, 90 DAS and at harvest. The result is in close conformity with those of Alam *et al.* (2013); Verma *et al.* (2016).

Interaction effect between irrigation schedules and varieties on drymatter production (kg ha^{-1}) was found to be non-significant during all the crop growth stages *i.e.*, at 30, 60, 90 DAS and at harvest.

Crop Growth Rate (g m^{-2} day^{-1}). The experimental data presented in Table 4 showed that there was a significant increase in CGR values to number of irrigations at all the growth stages of the wheat crop. The CGR was recorded highest with five irrigations scheduled at CRI, maximum tillering, jointing, flowering and milking stages which was found significantly superior over three irrigations scheduled at CRI, flowering and milking stages and two irrigations scheduled at CRI and milking stages at 60, 90 DAS and at harvest. Crop growth rate is resultant of the accumulation of drymatter at different stages of crop growth and assimilation of photosynthates in different plant parts, which is based on the availability of moisture. It is a function of increased drymatter production. Highest crop growth rate at five irrigation schedules might be due to maintenance of adequate and constant moisture level in the soil at all the growth stages, sufficient moisture supply can leads to better utilization of nutrients in the whole root zone and increased plant height and number of tillers as well as drymatter which in turn resulted in the highest CGR values. Also, it was found that the maximum crop growth rate at 61-90 DAS and 91 DAS- at harvest was on par for three irrigations scheduled at CRI, flowering and milking stage and two irrigations scheduled at CRI and milking. These results are in accordance with Kumar *et al.* (2019); Goswami *et al.* (2020).

Among the varieties tested, HI-8759 recorded significantly the highest crop growth rate at all the growth stages except at 30 DAS as compared to other varieties. The improvement in the growth parameters *viz.*, plant height and number of tillers might have led to higher interception and absorption of radiant energy, resulting into greater photosynthesis and drymatter accumulation and finally crop growth rate. Further scanning of the data in Table 4 reveals that HI-8759 being at par with HI-8713 but produced significantly higher CGR values than DBW-252 and HI-1544 at 60, 90 DAS and at harvest. The result is in close conformity with the Goswami *et al.* (2020).

Table 3: Drymatter production (kg ha^{-1}) at different growth stages of wheat as influenced by different irrigation schedules and varieties.

Treatments	Drymatter production (kg ha^{-1})			
	30 DAS	60 DAS	90 DAS	At harvest
Irrigation schedules (M)				
M$_1$: CRI, Maximum tillering, Jointing, Flowering and Milking	530.8	3343.3	6372.4	9994.4
M$_2$: CRI, Flowering and Milking	538.8	2696.4	5387.2	8512.0
M$_3$: CRI and Milking	539.8	2559.8	4793.4	7597.7
SEm±	21.17	79.96	134.66	162.80
CD (P=0.05)	NS	314.4	529.4	640.0
CV (%)	13.7	9.7	8.5	6.5
Varieties (V)				
V$_1$: DBW - 252	545.2	2722.4	5117.3	8027.9
V$_2$: HI - 1544	525.6	2704.8	5073.8	7988.9
V$_3$: HI - 8759	553.3	3100.4	6102.7	9617.1
V$_4$: HI - 8713	521.6	2938.3	5776.9	9171.6
SEm±	18.31	66.90	124.15	155.95
CD (P=0.05)	NS	198.7	368.7	463.1
CV (%)	10.2	7.0	6.8	5.4
Interaction				
(M×V)	NS	NS	NS	NS
(V×M)	NS	NS	NS	NS

Table 4: Crop Growth Rate (CGR) at different growth stages of wheat as influenced by different irrigation schedules and varieties.

Treatments	CGR (g m^{-2} day^{-1})			
	0-30	31-60	61-90	91-At harvest
Irrigation schedules (M)				
M$_1$: CRI, Maximum tillering, Jointing, Flowering and Milking	1.77	9.38	10.10	12.07
M$_2$: CRI, Flowering and Milking	1.80	7.19	8.97	10.42
M$_3$: CRI and Milking	1.80	6.73	7.45	9.35
SEm±	0.07	0.27	0.46	0.23
CD (P=0.05)	NS	1.07	1.82	0.92
CV (%)	13.7	12.1	18.1	7.7
Varieties (V)				
V$_1$: DBW - 252	1.82	7.26	7.98	9.72
V$_2$: HI - 1544	1.75	7.26	7.90	9.70
V$_3$: HI - 8759	1.84	8.49	10.01	11.71
V$_4$: HI - 8713	1.74	8.06	9.46	11.32
SEm±	0.07	0.24	0.45	0.58
CD (P=0.05)	NS	0.73	1.35	1.72
CV (%)	13.7	9.4	15.4	16.4
Interaction				
(M×V)	NS	NS	NS	NS
(V×M)	NS	NS	NS	NS

B. Yield

Grain yield (kg ha^{-1}). Five irrigation schedules at CRI, maximum tillering, jointing, flowering and milking stages recorded the maximum grain yield of (4255.9 kg ha^{-1}) which was significantly superior over three irrigation schedules at CRI, flowering and milking stages (3361.3 kg ha^{-1}) and two irrigation schedules at CRI and milking stages (2826.9 kg ha^{-1}). When compared to the five irrigations, three and two irrigation schedules recorded 21.02 and 33.57 per cent reduction in yield, respectively. This might be attributed to cumulative effect of vegetative growth and yield attributes *viz.*, number of productive tillers m^{-2}, number of filled grains spike^{-1} and test weight. The results are in line with Kabir *et al.* (2009); Sarwar *et al.* (2010); Mubeen *et al.* (2013).

The grain yield is the sum total of all different yield contributing factors which are controlled by genetically and environmentally, since, wheat yield production is a complex process and it governed by complimentary interaction between source (photosynthesis and availability of assimilates) and sink component (storage organs). In this study, it was found that the yield was significantly influenced by different varieties.

Among the varieties HI-8759 resulted in highest grain yield (4050 kg ha^{-1}) attributed to their higher biomass accumulation due to higher number of tillers and its appropriate partitioning as evident from corresponding higher harvest index and better yield attributes *i.e.*, effective tillers m^{-2}, grains spike^{-1}, spike length and 1000 grain weight and it was significantly superior over the rest of the varieties and it gave 7.82 %, 24.06 % and 24.26 % higher grain yield over varieties HI-8713 (3733.1 kg ha^{-1}), DBW-252 (3075.2 kg ha^{-1}) and HI-1544 (3067.2 kg ha^{-1}) respectively. These conclusions were similar to that of Moghaddam *et al.* (2012); Tomar *et al.* (2014); Ram and Gupta (2016); Haq *et al.* (2017); Alam *et al.* (2022).

Interaction between irrigation schedules and varieties on grain yield of wheat was found non-significant.

Straw yield (kg ha^{-1}). Data pertaining to straw yield are furnished in Table 5. The data revealed that straw yield of wheat was significantly influenced by various schedules of irrigation. Maximum straw yield (5315.9 kg ha^{-1}) was recorded under five irrigations scheduled at CRI, maximum tillering, jointing, flowering and milking stages and was significantly superior over three irrigations scheduled at CRI, flowering and milking stages (4526.7 kg ha^{-1}) and two irrigations scheduled at CRI and milking stages (4036.8 kg ha^{-1}). The straw yield was found on par for two and three irrigation schedules. The straw yield decreased with decrease in number of irrigations this might be due to lack of sufficient moisture to produce its maximum vegetative growth. These results were in close conformity to those of Moghaddam *et al.* (2012); Islam *et al.* (2018).

However, in varieties maximum straw yield (4886.9 kg ha^{-1}) was found with HI-8759 and was significantly superior over the varieties HI-8713 (4839.1 kg ha^{-1}), DBW-252 (4430.3 kg ha^{-1}) and HI-1544 (4349.1 kg ha^{-1}). This might be due to efficient in utilizing biomass towards grain formation as well as straw as evident from its highest harvest index. These findings are in line with those of Nagarjuna *et al.* (2014); Verma *et al.* (2016).

Interaction between irrigation schedules and varieties on straw yield of wheat was found non-significant.

Harvest index (%). The data on harvest index (%) as influenced by irrigation schedules and varieties have been summarized in Table 5. The study of data clearly indicated that the irrigation schedules had significant effects on the harvest index. Maximum harvest index (%) was found with five irrigations scheduled at CRI, maximum tillering, jointing, flowering and milking stages (44.4 %) which was on par with three irrigations scheduled at CRI, flowering and milking stages (42.6 %) and the lowest harvest index was found with two irrigations scheduled at CRI and milking stages (40.9 %). This might be due to the marked variation in grain and straw yields due to variation in irrigation schedules was also observed by Ahmad and Kumar (2015); Atikullah *et al.* (2014).

In case of varieties highest harvest index was recorded with variety HI-8759 (45.2 %) it was on par to HI-8713 (43.4 %) and significantly superior over the varieties HI-1544 (41.1 %) and DBW-252 (40.7 %). Sapkota *et al.* (2007); Bachhao *et al.* (2018) were also found similar results.

Interaction effect between irrigation schedules and varieties on harvest index was found to be non-significant.

Table 5: Yield (kg ha^{-1}) and harvest index (%) of wheat as influenced by different irrigation schedules and varieties.

Treatments	Yield (kg ha^{-1}) and Harvest index (%)		
	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Harvest index (%)
Irrigation schedules (M)			
M_1:CRI, Maximum tillering,Jointing, Flowering and Milking	4255.9	5315.9	44.4
M_2:CRI, Flowering and Milking	3361.3	4526.7	42.6
M_3:CRI and Milking	2826.9	4036.8	40.9
SEm±	73.71	197.58	0.71
CD (P=0.05)	289.8	776.8	2.8
CV (%)	7.3	14.8	5.8
Varieties (V)			
V_1: DBW - 252	3075.2	4430.3	40.7
V_2: HI - 1544	3067.2	4349.4	41.1
V_3: HI - 8759	4050.0	4886.9	45.2
V_4: HI - 8713	3733.1	4839.1	43.4
SEm±	75.54	90.44	0.65
CD (P=0.05)	224.3	268.6	1.9
CV (%)	6.5	5.9	4.5
Interaction			
(M×V)	NS	NS	NS
(V×M)	NS	NS	NS

CONCLUSION

From the results of the present experiment conducted on *rabi* on wheat, the following broad conclusions can be drawn that the five irrigation schedules at different phenological stages significantly improved growth and yield of wheat. While, significantly lower growth and yield were observed in two irrigation schedules. Among the varieties, the variety HI-8759 registered the highest growth attributes and yield which was on a par with HI-8713 in all the growth parameters and also in straw yield.

FUTURE SCOPE

To examine various new varieties and optimising irrigation schedules would help to promote wheat in non-traditional areas/rice fallows.

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How to cite this article: P.V.S. Ramunaidu, D. Sekhar, K. Anny Mrudhula and D. Srinivas (2022). Effect of different Irrigation Schedules and varieties on Growth and Yield of Wheat under High Altitude and Tribal Area Zone conditions of Andhra Pradesh. *Biological Forum – An International Journal, 14*(4): 1221-1227.