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Effect of different irrigation levels and moisture conservation techniques on growth attributes, yield, yield attributes and economic of wheat (*Triticum aestivum*)

Maharaj Singh, UP Shahi, Shakti Om Pathak, Brijesh Kumar Pandey and Aryan Baliyan

Abstract

A field experiment entitled "Effect of different irrigation levels and moisture conservation techniques on growth attributes, yield, yield attributes and economic of wheat (*Triticum aestivum*)"was carried out at the Crop Research Centre of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, U.P. during Rabi season of 2018-19. The experiment was laid out in a split plot design considering the irrigation levels as main plot and moisture conservation techniques as sub plot with three replications. The irrigation levels consisted of I1– (5 irrigations at CRI, tillering, booting, milking and dough stage), I2– (3 irrigation at CRI, tillering and booting stage), I3– (2 irrigation at CRI and booting stage) and moisture conservation techniques consisted M1 – Control (no moisture conservation techniques), M2 - Rice residues @ 5 ton ha-1), M3 - application of Pusa hydrogel (3kg /Acre), M4- seed treatment with *Pseudomonas fluorescens* (PF6) @ 4 g kg-1 seed, M5- Seed treatment with *Pseudomonas fluorescens* (PF2) @ 4 g kg-1 seed and M6- Seed treatment with (IRRI-1) @ 4 g kg-1 seed. The soil of the experimental site was sandy loam in texture, low in available nitrogen and organic carbon, medium in available phosphorus, potassium, zinc and alkaline in reaction. Wheat variety HD- 2967 was grown as a test crop. Result reveal that plant height, dry matter accumulation increased with I1 (5 irrigation) and I2 (3 irrigation). Among the yield attributes number of grains per spike, spike length (cm), numbers of spikelet per spike and test weight increased significantly in I1 (5 irrigation).The improvement in grain yield 8.74 and 17.38% over I2 and I3 respectively was due to maximum supply of water under I1 (5 irrigation). Among the moisture conservation techniques, the higher plant height, dry matter accumulation and yield attributes characters were recorded with the application of rice residue @ 5 ton ha-1. Maximum gross return was observed in treatment combination I1M2 (5irrigation with rice residues@ 5 ton ha-1). Among treatments, maximum net return and B: C ratio was recorded under I1M2 (Five irrigation with rice residues @ 5 ton ha-1. Among the microbial inoculate PF-6 was found better in all parameters. Mulching resulted a storage of 2.0% more soil moisture in the root zone of the crop over rest of treatments, indicating better microclimate for crop growth and development.

Keywords: Rice residues, pseudomonas fluorescens, moisture conservation techniques

1. Introduction

Wheat a crop of global significance is grown in diversified environments. It is a staple food for millions of people. Around one-sixth of the total arable land in the world is cultivated with wheat. Whereas paddy is mainly cultivated in Asia, wheat has grown in all the continents of the world. It is one of the principal cereal crop grown worldwide and one of the important staples of nearly 2.5 billion of the world population. Wheat is the significant staple nourishment crop, giving practically 50% of all calories in the region of North Africa and West, and Central Asia. It supplies about 20 percent of the food calories for the world's growing population. Globally wheat is cultivated in an area of about 220 million hectares with a record production of 763.06 million tonnes of grain. In India, the wheat crop is cultivated in Rabi season is ordinarily sown during November and harvested among March and April. The cultivated area under wheat at a national level has shown an increasing trend, from 29.04 million hectares to 30.54 million hectares with a magnitude of 1.5 million hectares (5%) net gain regarding the area. Utter Pradesh has the largest share in an area with 9.75 million hectares (32%), followed by Madhya Pradesh (18.75%), Punjab (11.48%), Rajasthan (9.74%), Haryana (8.36%) and Bihar (6.82%) (Sendhil *et al.*, 2019) [6]. Carbohydrate and protein are the two main constituents of wheat.

It is rich in proteins, vitamins, and carbohydrates, and provides balanced food on average wheat contains 11-12% protein.
The amount of precipitation required for wheat development varies between 30 cm and 100 cm. The soil suitable for wheat crop is loam or light clay or heavy loam. The sensitive growth stages of wheat to water stress are from stem elongation to booting, followed by anthesis, and grain-filling. The irrigation scheduling, application of mulches, anti- transparent and hydrophilic polymer increase the duration of moisture availability in the soil. Irrigation scheduling is one of the important managerial activities and affects the effective and efficient utilization of water by the crops. It determines the process to decide when to irrigate the crops, and how much water to apply. It optimizes agricultural production by minimizing yield loss due to water shortage and improving the performance and sustainability of any irrigation system through conserving. In general five irrigation at a different stage like CRI, tillering, jointing, booting, milking and grain formation in the wheat crop are given for better yield while wheat receiving four irritations at crown root initiation, maximum tillering stage, boot stage, and milky stage maintained taller plants, more tillers per unit area, dry matter accumulation, leaf area index, net assimilation ratio, crop growth rate and relative growth rate over two and three irritations at crown root initiation and boot stage and crown root initiation, boot stage, and milk stage respectively on sandy loam soil of Ranchi (Shivani *et al.*, 2003) [8]. The impact of limited irrigation on crop yield and WUE depends on the growth stage and the most sensitive stage varies from region to region due to regional variability in environment and agronomic practices. Wheat response to water stress from stem elongation to booting, followed by anthesis and grain-filling stages (Singh *et al.*, 2017) [7]. Hydrogel a semi-synthetic super absorbent polymer has shown the potential to realize more yield per drop of water.
Mulch conserved soil water, and delayed the need for irrigation and improves the crop performance when water is limiting, and occasionally increased yield. Mulch lowered average soil temperature and delayed crop development up to anthesis (Balwinder *et al.*, 2011) [2]. Organic mulches result in enhanced soil water status and improved plant canopy regarding biomass, root growth, leaf area index and grain yield, which subsequently resulted in improve water and nitrogen uptake and their use efficiencies with reducing runoff and evaporation losses (Dushouyu *et al.*, 1995) [3]. Microbes have also shown the ability to protect the crop from moisture stress. Plant development advancing bacterial strains Pseudomonas fluorescens Pf1 and endophytic Bacillus subtilis EPB5, EPB22, EPB 31 were tried for their ability to and among the different bacteria used, P. fluorescens Pf1 expanded the power file new weight and dry load of green gram seedlings in vitro. Quantitative and subjective examinations of stress-related catalysts showed the more prominent action of catalase and peroxidase in green gram plants bacterized with P. fluorescens Pf6 against water stress when compared to untreated plants (Kumar *et al.*, 2013) [4].
The *Azospirellum brasilence sp.* 245 primed wheat under drought stress condition resulted in large increase in water content, potential, and apoplectic water function in both shoot and root compared to the non-primed plants (Ramazan *et al.*, 2016) [5].

2. Method and Material
The experiment was conducted at Crop Research Centre Chirori of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P) in rabi season of 2018-19. Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P) is situated on the Delhi-Dehradun road about 7 km from Meerut towards Dehradun.
The weather data recorded from meteorological observatory of Sardar Vallabhbhai Patel University of Agriculture & technology Meerut during crop period (*rabi* 2018-19) shows that total amount of rainfall received during crop period was 96.4 mm, whereas mean relative minimum and maximum humidity varied between 34.1 to 96.14 per cent. The experiment was laid out in a split plot design considering the irrigation levels as main plot and moisture conservation techniques as sub plot treatments with three replications.
The irrigation levels consisted of I1– (5 irrigations at CRI, tillering, booting, milking and dough stage), I2– (3 irrigation at CRI, tillering and booting stage), I3– (2 irrigation at CRI and booting stage) and moisture conservation techniques consisted M1 – Control (no moisture conservation techniques), M2 - Rice residues @ 5 ton ha-1), M3 - application of Pusa hydrogel (3kg /Acre), M4- seed treatment with *Pseudomonas fluorescens* (PF6) @ 4 g kg-1 seed, M5- Seed treatment with *Pseudomonas fluorescens* (PF2) @ 4 g kg-1 seed and M6- Seed treatment with (IRRI-1) @ 4 g kg-1 seed. The soil of the experimental site was sandy loam in texture, low in available nitrogen and organic carbon, medium in available phosphorus, potassium, zinc and alkaline in reaction. Wheat variety HD-2967 was grown as a test crop. Observations on plant growth attributes, yield and yield-attributing characters were recorded using the standard procedure.

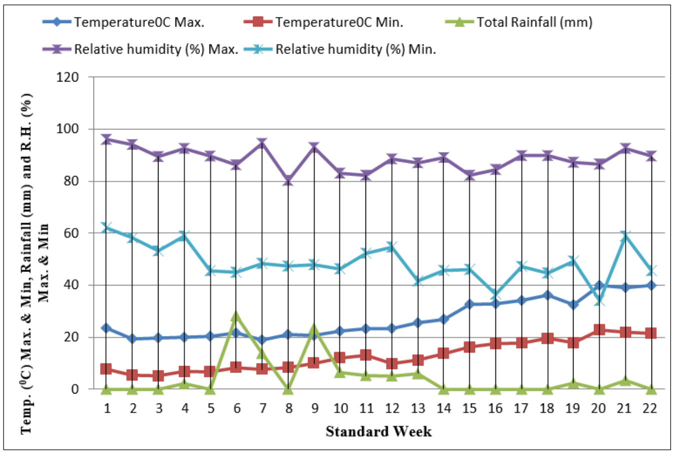

Fig 1: Weekly meteorological data: Meerut, year 2018-2019

3. Result and Discussion
3.1 Growth attributes
The plant height significantly differed due to irrigation levels and moisture conservation techniques. The maximum plant height was 25.5 (cm) recorded with I1 (5 irrigations at CRI, Tillering, Booting stage, Milking stage and Dough stage) was significantly superior over I2 (3 irrigation at CRI, Tillering and Booting stage) and I3 (2 irrigation at CRI and Booting stage). I2 and I3 also differ significantly. Moisture conservation techniques also resulted significant variation in plant height. All the moisture conservation techniques

differed significantly from each other in respect of their effect on plant height. Application of rice residues @ 5 ton ha-1 resulted in significantly plant (79.3cm) over the rest of all treatments. Control (without any moisture conservation techniques) produced significantly smaller plant (65.00 cm) among all the moisture conservation techniques treatments. Among the microbial inoculates *Pseudomonas fluorescens* (PF6) was found significant superior (73.5 cm) over other two inoculants which were at par in respect of their effect on plant height. Number of tillers m-2 also differ significantly under different irrigation levels and moisture conservation techniques. The maximum number of tillers recorded in I1 (5 irrigations) (281), were significantly superior to I2 (3 irrigation) (275) and I3 (2 irrigation) (270) and the effect of I2 (3 irrigation) was significantly better than I2 (2 irrigations). It is evident from data that moisture conservation techniques had a significant effect on the number of tillers. Treatment having rice residue @ 5 ton ha-1 produce significantly higher number of tillers (282) over the rest of treatments fallowed by application of pusa hydrogel while, control (without residue hydrogel and seed treatment) produced the significantly lower number of tillers. Application of pusa hydrogel (3kg Acre-1) (279) and seed treatment with Pseudomonas fluorescens (PF6) @ 4 g kg-1 seed (278) were statistically at par to each other at booting and harvest stages. Among the microbial inoculants IRRI-1 was found inferior to other two inoculants which have similar effect. The dry matter accumulation varied significantly under different irrigation levels and moisture conservation techniques. Application of I1 (5 irrigations) produced significantly higher dry matter accumulation over I2 (3 irrigation) and I3 (2 irrigation). The increase in dry matter accumulation due to I1 (5 irrigations) over I2 and I3 was 5.74 and 13.99 percent respectively. Among different moisture conservation techniques rice residues @ 5 t ha-1 accumulated significantly more dry matter (g/m row length) than the other treatments. Among the microbial inoculates seed treatment with *Pseudomonas fluorescens* (PF6) @ 4 g kg-1 seed produced significantly high dry matter than seed treatment with *Pseudomonas fluorescens* (PF2) @ 4 g kg-1 seed and IRRI-1strain. Different irrigation levels and moisture conservation techniques also significantly influenced leaf area index. Application of I1 (5 irrigations) resulted in a significantly higher leaf area index over I2 (3 irrigation) and I3 (2 irrigation). Moisture conservation techniques also caused significant variation in leaf area index. Application of rice residues @ 5 ton ha-1 resulted in significant higher leaf area index over the rest of treatments, while control (without residue hydrogel and seed treatment) produced the lowest and significant inferior leaf area index. Application of pusa hydrogel was found better than seed treatment. Among the microbial inoculates seed treatment *Pseudomonas fluorescens* (PF6) found significantly better over IRRI-1 over *Pseudomonas fluorescens* (PF2).

3.2 Yield Attributes
The data pertaining to spike length as affected by different levels of irrigation and moisture conservation techniques are summarized in Table 2. The maximum spike length (9.3 cm) recorded from I1 (5 irrigations) was significantly superior to (8.8cm) I2 (3 irrigation) and (8.0cm) I3 (2 irrigation). Similarly spike length 8.8 cm recorded in I2 (3 irrigation) was significantly superior over 8.0 cm I3 (2 irrigation). It is evident from data that moisture conservation techniques also caused significant variation in spike length. The maximum spike length 9.3 cm recorded with treatment rice residues @ 5 ton ha-1was significantly higher than the other treatments. The minimum spike length 7.7 cm significantly lower than the remaining treatments was recorded in control. Among the microbial inoculants IRRI-1 was found significant inferior. The number of grains/spike varied significantly from 36 to 42 under different irrigation levels. The maximum number of grains/spike recorded in I1 (5 irrigations) (42) was significantly superior to (38) I2 (3 irrigation) and (36) I3 (2 irrigation) which were at par to each other. It is clear from data that moisture conservation techniques also caused significant variation in the number of grains/spike. Treatment application of rice residue @ 5 ton ha-1 produced significantly higher grains/spike (43) over the rest of treatments. Control (without residue hydrogel and seed treatment) recorded the lowest and significantly inferior number of grains/spike (35) than the other moisture conservation techniques treatments. Treatments consisting application of pusa hydrogel (3kg /Acre) and seed treatment with *Pseudomonas fluorescens* (PF6) @ 4 g kg-1 seed were also found statistically at par similarly. The 1000 grain weight also differs significantly under different irrigation levels and moisture conservation techniques. The maximum 1000 grain weight (40g) recorded in I1 (5 irrigations), was significantly superior to I2 (38g) and I3 (37g) (2 irrigation). Similarly, I2 (38g) (3 irrigation) was significantly higher than I3 (37g) (2 irrigation). The test weight of wheat increased with increasing levels of irrigation. A perusal of data on the effect of moisture conservation techniques reveals significant variation in 1000 grain weight. Maximum 1000 grain weight recorded in the treatment consisting application of rice residues @ 5 ton ha-1 (42g) was significantly superior to other treatments. Application of pusa hydrogel (3kg /Acre) was also better than microbial inoculants treatments in respect of test weight Data also indicate that all the moisture conservation techniques accounted for significantly higher 1000 grains weight than no moisture conservation practice.

3.3 Grain yield
Data regarding the effect of different irrigation levels on grain yield are given in Table 3. Maximum grain yield (37.3 q ha-1) recorded in I1 (5 irrigations), and was significantly superior to I2 (3 irrigation) and I3 (2 irrigation). Similarly grain yield recorded in I2 (3 irrigation) was significantly superior over I3 (2 irrigation). An examination of data on the effect of moisture conservation techniques on grain yield also indicates significant variation in yield. Treatment having application of rice residue @ 5 ton ha-1 recorded maximum grains yield (38.3 q ha-1) which was significantly higher than all the other moisture conservation techniques. The application of pusa hydrogel (3kg /Acre) yielded (36.8 q ha-1) was also significantly better than the treatments of microbial inoculants and control. The minimum grain yield was recorded with control where no moisture conservation technique was fallowed.

3.4 Straw yield
Straw yield showed significant variation under the influence of different treatments (Table 3). The maximum straw yield (50.2 q ha-1) recorded from I1 (5 irrigations), was statically at par to I2 (3 irrigation) and significant higher than I3 (2 irrigation). I2 (3 irrigation) was significantly superior over I3 (2 irrigation). The data on the effect of moisture conservation techniques on straw yield indicate significant variation during

the study with exception of hydrogel, application of rice residues @ 5 ton ha-1 produced significantly higher straw yield (50.6 q ha-1) over the rest of treatments. Control produced the significantly lowest straw yield (46.4 q ha-) than the other treatments with exception of PF 6. All the moisture conservation techniques consisting seed inoculation were found similar in respect of their effect on similar yield.

3.5 Biological yield (q ha-1)
Different treatments had a significantly effect on biological yield. The maximum biological yield (87.5 q ha-1) recorded from I1 (5 irrigations) was significantly superior to I2 (3 irrigation) and I3 (2 irrigation). Similarly, I2 (3 irrigation) was also significantly superior over I3 (2 irrigation). Moisture conservation techniques caused significant variation in biological yield during the study. The maximum biological yield (88.9 q ha-1) recorded from rice residues @ 5 ton ha-1was significantly superior over other treatments. The minimum biological yield (77.6 q ha-1) was recorded with control with no moisture conservation practice followed.

3.6 Harvest index
The maximum harvest index (42.6) recorded in I1 (5 irrigations), was significantly superior to I2 (3 irrigation) and I3 (2 irrigation). Similarly, I2 (3 irrigation) was significantly superior over I3 (2 irrigation). The data on the effect of moisture conservation techniques on harvest index indicate significant variation. Harvest index with the application of rice residues @ 5 ton ha-1 was significantly higher harvest index over the rest of treatments. Control resulted in significantly lowest harvest index (40.3). Application of pusa hydrogel (3kg /Acre) (42.2) and seed treatment with *Pseudomonas fluorescens* (PF6) @ 4 g kg-1 seed (41.7) were statistically at par to each other. Similarly, seed treatment with *Pseudomonas fluorescens* (PF2) @ 4 g kg-1 seed (41.2) and seed treatment with (IRRI-1) @ 4 g kg-1 seed (40.8) were statistically at par to each.

3.7 Economic
Data related to different economic indices of wheat cultivation under the influence of different treatments have been presented in Table 4.
The maximum cost of cultivation was recorded in the treatment combination I1M3 (5irrigation with application of Pusa hydrogel (3kg /Acre). Similarly all irrigation treatments combination with M3 (pusa hydrogel (3kg /Acre) had higher cost of cultivation and was followed by I1M2 (Five irrigation and Rice residues@ 5 ton ha-1).
Maximum gross return was observed in I1M2 (Five irrigation and Rice residues@ 5 ton ha-1). It was closely followed by I1M3 (5irrigation with application of Pusa hydrogel 3 kg /Acre). Among treatments, maximum net return and B: C ratio was recorded under I1M2 (Five irrigation with rice residues @ 5 ton ha-1). The next best treatment combination was I1M4 (5irrigation with seed treatment with *Pseudomonas fluorescens* (PF6) @ 4 g kg-1 seed). In case of 3, 2 irrigation levels the maximum gross return and B: C ratio recorded under treatment combination I2M2 (3irrigation with rice residues @ 5 ton ha-1) while in low of 2 irrigation I3M2 gave the maximum gross return and B.C ratio.

Table 1: Effect of different irrigation levels and moisture conservation techniques on growth attributes of wheat

Treatments	Plant height (cm)	Numpblaenrt of tihlleirgsh mt-2(cm)	Dry matter (g/m row length)	leaf area index
A (Irrigation level)				
I1(5 irrigations at CRI, Tillering, Late jointing Milk stage and Dough stage)	75.1	281	184.92	2.22
I2 (3 irrigation at CRI, Tillering and Boot stage)	72.4	275	174.88	2.15
I3 (2 irrigation at CRI and Boot stage)	69.8	270	162.29	2.06
S.Em±	0.3	0.6	0.24	0.002
CD (0.05)	1.1	2	0.98	0.02
B (Moisture conservation practices)				
M1(Control (without residue hydrogel and seed treatment)	65.0	262	166.42	2.09
M2 (Rice residues @ 5 ton ha-1)	79.3	282	178.21	2.21
M3 (Application of Pusa hydrogel (3kg /Acre)	75.5	279	177.00	2.18
M4 (Seedtreatment with *Pseudomonas fluorescens* (PF6) @ 4 g kg-1 seed)	73.5	278	175.74	2.16
M5 (Seedtreatment with *Pseudomonas fluorescens* (PF2) @ 4 g kg-1 seed)	72.2	276	173.89	2.13
M6 (Seed treatment with (IRRI-1) @ 4 g kg-1 seed)	68.9	274	172.92	2.11
S.Em±	0.4	1	0.26	0.01
CD (0.05)	1.0	2	0.76	0.02

Table 2: Effect of different irrigation levels and moisture conservation techniques on yield attributes of wheat

Treatments	Spike length (cm)	Number of grains/spike	1000 grain weight (g)
A (Irrigation levels)			
I1(5 irrigations at CRI, Tillering, Booting stage, Milking stage and Dough stage)	9.3	42	40.0
I2(3 irrigation at CRI, Tillering and Booting stage)	8.8	38	38.0
I3(2 irrigation at CRI and Booting stage)	8.0	36	37.0
S.Em±	0.1	1	0.02
CD (0.05)	0.2	3	0.1
B (Moisture conservation techniques)			
M1 (Control(without residue hydrogel and seed treatment)	7.7	35	35.7
M2 (Rice residues @ 5 ton ha-1)	9.6	43	42.3
M3 (Application of Pusa hydrogel (3kg /Acre)	9.3	41	40.8
M4 (Seed treatment with *Pseudomonas fluorescens* (PF6) @ 4 g kg-1 seed)	8.8	39	37.8
M5 (Seed treatment with *Pseudomonas fluorescens* (PF2) @ 4 g kg-1 seed)	8.7	37	37.0
M6 (Seed treatment with (IRRI-1) @ 4 g kg-1 seed)	8.1	36	36.5
S.Em±	0.04	1	0.1
CD (0.05)	0.1	2	0.2

Table 3: Effect of different irrigation levels and moisture conservation techniques on grain yield, straw yield, biological yield and harvest index of wheat

Treatments	Grain yield (q/ha)	Straw yield (q/ha)	Biological yield (q/ha)	Harvest Index%
A (Irrigation levels)				
I (5 irrigations at CRI, Tillering, Booting stage, Milking stage and Dough stage)	37.3	50.2	87.5	42.6
I2(3 irrigation at CRI, Tillering and Booting stage)	34.3	48.3	82.6	41.5
I3(2 irrigation at CRI and Booting stage)	31.8	47.2	79.0	40.3
S.Em±	0.2	0.5	0.6	0.2
CD (0.05)	0.9	1.9	2.4	0.9
B (Moisture conservation techniques)				
M1 (Control(without residue hydrogel and seed treatment)	31.1	46.4	77.6	40.3
M2 (Rice residues @ 5 ton ha-1)	38.3	50.6	88.9	43.1
M3 (Application of Pusa hydrogel (3kg /Acre)	36.8	50.3	87.1	42.2
M4 (Seed treatmentwith *Pseudomonas fluorescens* (PF6) @ 4 g kg-1 seed)	34.8	48.7	83.5	41.7
M5 (Seed treatment with *Pseudomonas fluorescens* (PF2) @ 4 g kg-1 seed)	33.4	47.7	81.1	41.2
M6 (Seed treatment with (IRRI-1) @ 4 g kg-1 seed)	32.3	47.6	79.9	40.4
S.Em±	0.2	0.5	0.6	0.3
CD (0.05)	0.4	1.5	1.7	0.8

Table 4: Effect of different irrigation levels and moisture conservation techniques on economic of wheat

Treatments Combination	Cost of cultivation (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	B:C ratio
I1M3–Five irrigation and Application of Pusa hydrogel (3kg /Acre)	63763	96712	32949	1.52
I1M4–Five irrigation and Seed treatment with *Pseudomonas fluorescens* (PF6) @ 4 g kg- 1 seed	57895	92135	34240	1.59
I1M5–Five irrigation and Seed treatment with *Pseudomonas fluorescens* (PF2) @ 4 g kg-1 seed	57895	90476	32581	1.56
I1M6–Five irrigation and Seed treatment with (IRRI-1) @ 4 g kg-1 seed	57907	88589	30683	1.53
I2M1–Three irrigation and no moisture conservation techniques	57543	79940	22398	1.39
I2M2 –Three irrigation and Rice residues @ 5 ton ha-1	60953	92499	31546	1.52
I2M3–Three irrigation and Application of Pusa hydrogel (3kg /Acre)	63763	89662	25899	1.41
I2M4–Three irrigation and Seed treatment with *Pseudomonas fluorescens* (PF6) @ 4 g kg- 1 seed	57895	87344	29449	1.51
I2M5–Three irrigation and Seed treatment with *Pseudomonas fluorescens* (PF2) @ 4 g kg- 1 seed	57895	82751	24856	1.43
I2M6 –Three irrigation and Seed treatment with (IRRI-1) @ 4 g kg-1 seed	57907	78470	20563	1.36
I3M1–Two irrigation and no moisture conservation techniques	57543	73466	15923	1.28
I3M2-Two irrigation and Rice residues@ 5 ton ha-1	60953	88321	27368	1.45
I3M3–Two irrigation and Application of Pusa hydrogel (3kg /Acre)	63763	85931	22169	1.35
I3M4–Two irrigation and Seed treatment with *Pseudomonas fluorescens* (PF6) @ 4 g kg-1 seed	57895	79522	21627	1.37
I3M5–Two irrigation and Seed treatment with *Pseudomonas fluorescens* (PF2) @ 4 g kg-1 seed	57895	76615	18720	1.32
I3M6 –Two irrigation and Seed treatment with	57907	76501	18595	1.32

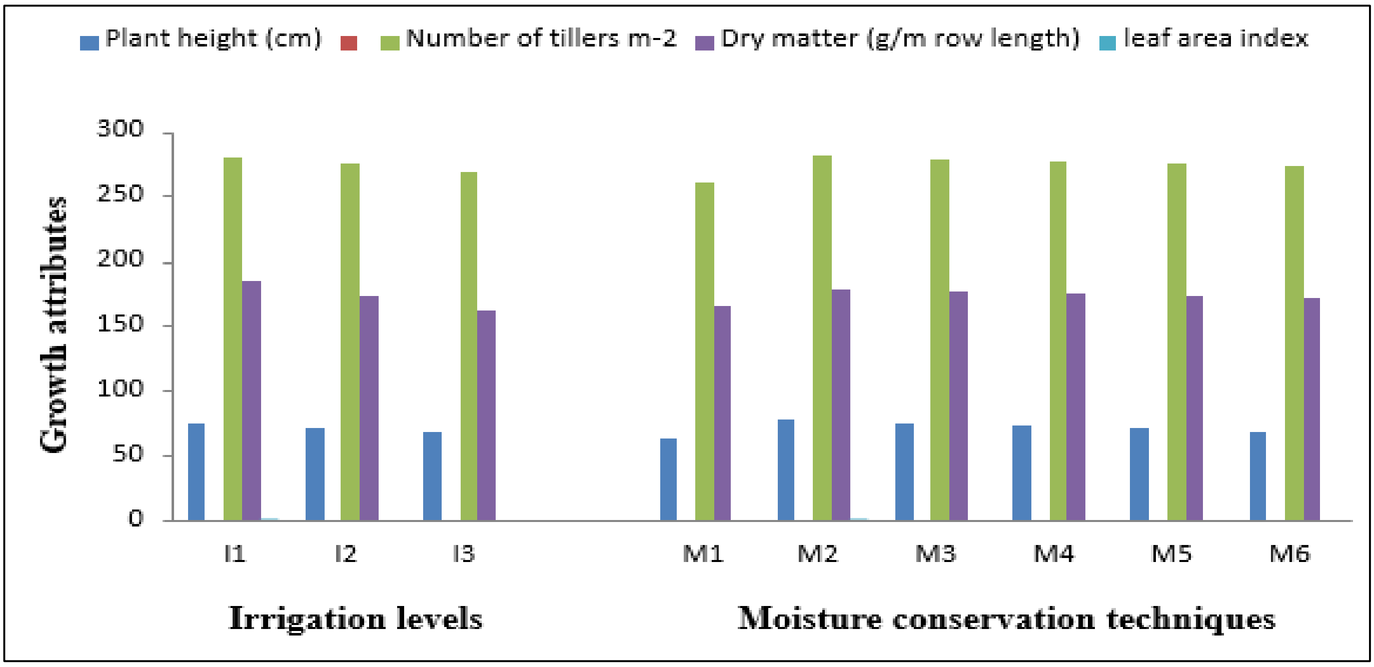

Fig 2: Effect of different irrigation levels and moisture conservation techniques on growth attributed of wheat

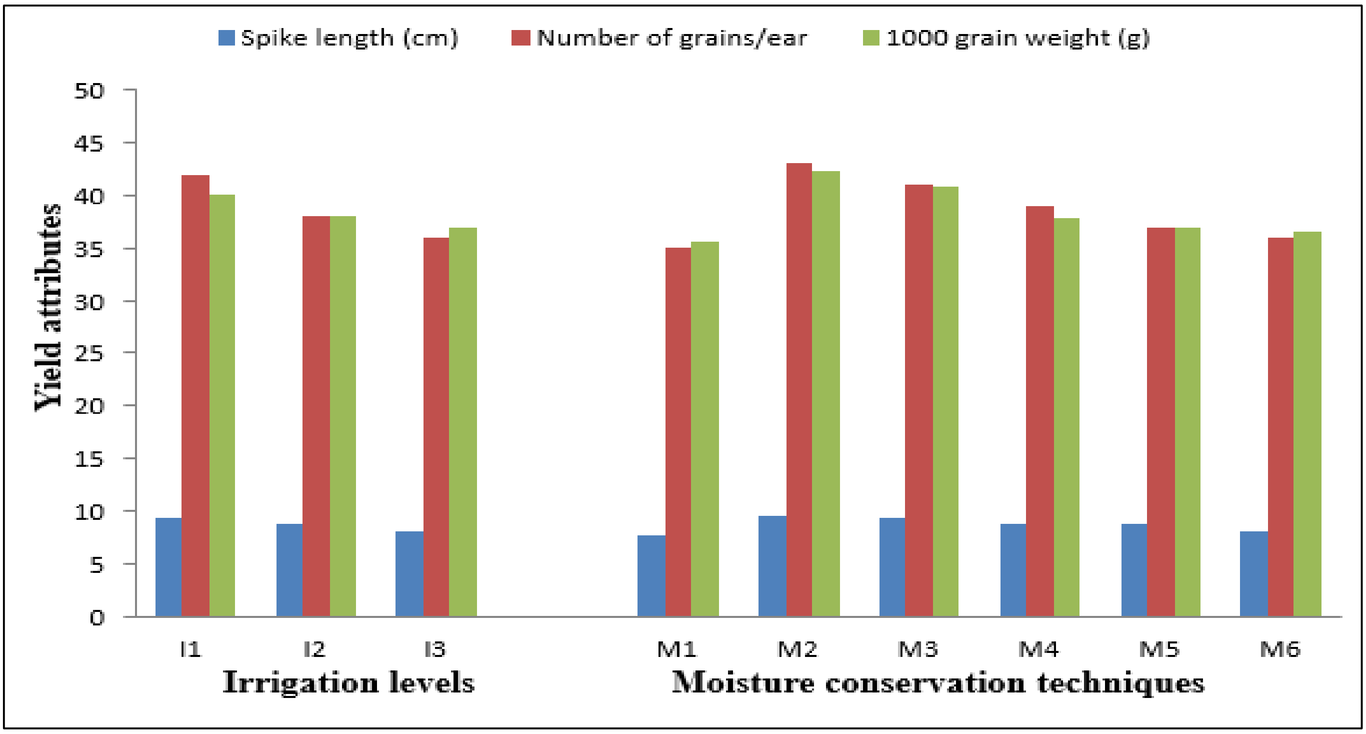

Fig 3: Effect of different irrigation levels and moisture conservation techniques on number of grains/ear, spike length and 1000 grain weight at harvest stage of wheat

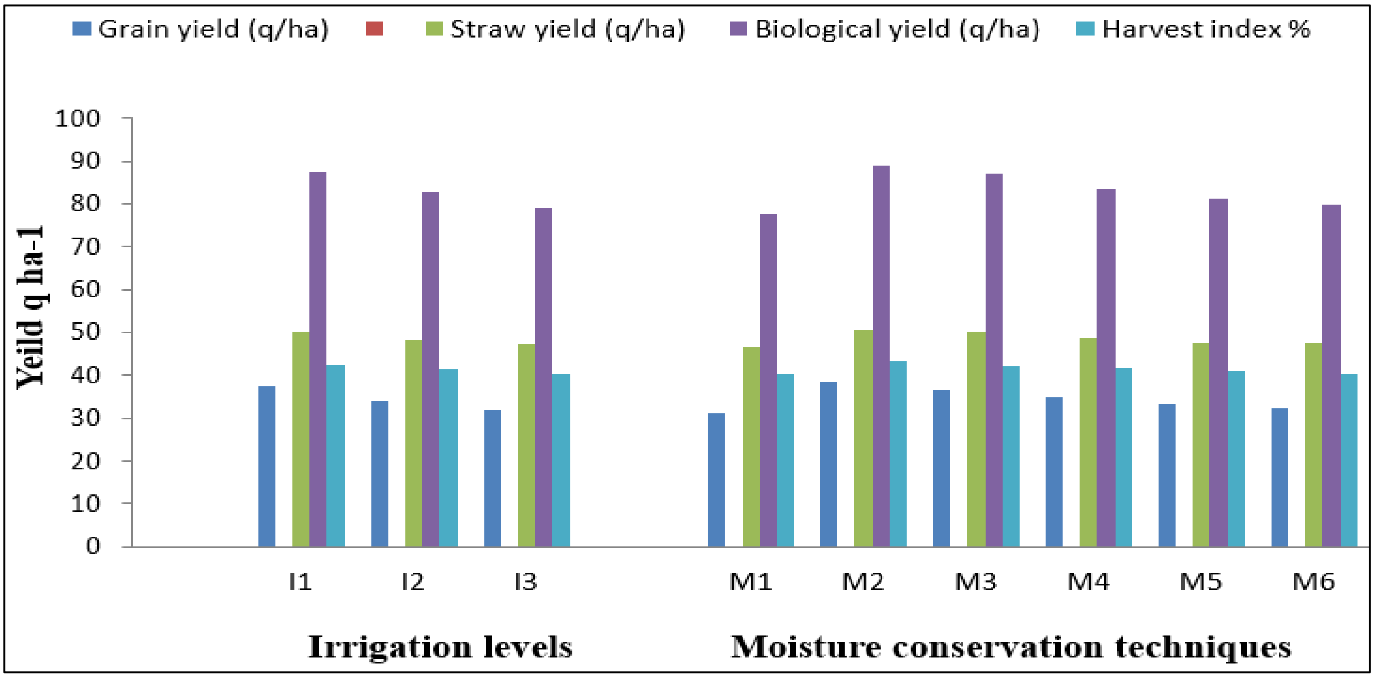

Fig 4: Effect of different irrigation levels and moisture conservation techniques on grain yield, straw yield, biological yield and harvest index at harvest stage of wheat

4. Conclusion

On the perusal of findings, it was observed that the application of rice residues @ 5 ton ha-1 alone or in combination produced the highest growth attributes and grain yield which was supported by significantly higher yield attributes. Therefore, it can be concluded that the rice residues @ 5 ton ha-1 supplemented with all irrigation levels will be beneficial to get the higher grain yield of wheat under limited irrigation condition. The combined application of 5 irrigations with rice residues @ 5 ton ha-1 proved to be the most economic and the next best treatment combination in case of limited irrigation supply three irrigation with rice residues @ 5 ton ha-1 is found better in respect of net returns from wheat as compare to other combination treatments with limited water supply. Use of microbial inoculants may also have a good option in respect to moisture conservation. However, these results are only indications and require further experimentation to arrive at some more consistent and final. Thus, we can get more production from limited irrigation area with less irrigation using with rice residues.

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