

## Research Article

# Irrigation Scheduling in Wheat using Tensiometer at Bara District of Nepal

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## Abstract

A field experiment on ‘irrigation scheduling in wheat using tensiometer’ was conducted at Regional Agricultural Research Station, Parwanipur during 2013/2014 and 2014/015. Trial was laid out in randomized complete block design with 3 levels of irrigation threshold (20, 35 and 50 kPa) and depth of soil water tension monitoring (20, 35, 50 cm). i.e. a total of 9 treatments with three replications. The main objective of the experiments to evaluate the effects of irrigation threshold and measurement depth on wheat yield, irrigation water use and water productivity. Wheat variety Gautam was used in the experiment. Fertilizer was applied at the rate of 100: 50: 50 N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O kg ha<sup>-1</sup> and other agronomical operations were followed as per recommendation. Tensiometer reading was recorded every day and irrigation was applied when tensiometer reading reached at threshold.

Data on yield and yield attributes collected and analyzed using Genstat statistical package and result showed that grain yield was highest at tensiometer in 35 cm depth with 50 kPa tension (3184 kg/ha) and lowest at 20 cm depth with 20 kPa tension (2502 kg/ha) in 2013/14 and grain yield was highest 2725 kg/ha at tensiometer in 35 cm depth with 50 kPa tension in 2014/15.

**Keywords:** Irrigation, tensiometer, grain yield, wheat

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## Introduction

Wheat is the most widely cultivated food crop in the world and eaten in various forms. In Nepal, it is the third important cereal crop after rice and maize and therefore plays an important role in national food security. The total area covered by wheat in Nepal was 754243 hectares with a total production of 1727346 mt having productivity of 2.29 t ha<sup>-1</sup> [1].

The irrigation scheduling is the process of determining when to irrigate and how much water to apply per irrigation. Proper irrigation scheduling is essential for the efficient use of water, energy and other production inputs [2]. Indiscriminate use of irrigation water has led to problems of rising water tables causing widespread land degradation [3, 4]. Scheduling irrigation of wheat based on soil water tension can help increase irrigation water productivity through avoiding water deficit stress and over-irrigation [5]. However, there are no rigorously determined guidelines on what depth to place the tensiometers, nor the optimum irrigation threshold. Therefore, a series of experiments is being implemented in a range of agro-ecological situations (climate, soil type, variety) to evaluate the effects of irrigation threshold and measurement depth on wheat yield, irrigation water use and water productivity.

## Materials and Methods

The experiments were conducted during the winter season of 2013/2014 and 2014/2015 at Regional Agricultural Research Station, Parwanipur, Bara. Experiment was laid out in randomized complete block design with 3 levels of irrigation threshold (20, 35 and 50 kPa) and depth of soil water tension monitoring (20, 35, 50 cm). i.e. a total of 9 treatments with three replications. Wheat variety Gautam was used in the experiment. Fertilizer was applied at the rate of 100: 50: 50 N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O kg ha<sup>-1</sup> and other agronomical operations were followed as per recommendation. The size of each plot was 11m x 9 m. Wheat was sown on 12 Dec 2013 and 14 Dec, 2014 with zero till drill machine. Growth parameters, yield attributing characters and yield were recorded at 12% moisture level. Wheat straw was sun dried and yield was taken. Data were analyzed using Genstat Discovery Edition 3.

## Results and Discussions

### *Days to heading*

Different irrigation scheduling shows non significant effect on days to heading as in **Table 1**. Mean range of days to heading lie from 74.5 to 78.5 days. Maximum mean was for 20 Kpa at depth of 20cm and minimum for 50Kpa at 50cm depth.

**Table 1** Mean performance of different treatment of irrigation scheduling on different morpho physiological traits of wheat during 2013/14 and 2014/15

Treatment	Depth (cm)	kPa	Days to heading			Days to maturity			Plant height(cm)		
			2013/14	2014/15	Mean	2013/14	2014/15	Mean	2013/14	2014/15	Mean
20, 20	20	20	80	77	78.5	124	122	123	99	94	96.5
20, 35	20	35	79	76	77.5	123	121	122	96	91	93.5
20, 50	20	50	77	75	76	122	120	121	98	93	95.5
35, 20	35	20	77	75	75	121	121	121	99	95	97
35, 35	35	35	79	75	77	121	121	121	97	93	95
35, 50	35	50	76	74	75	122	119	120.5	100	95	97.5
50, 20	50	20	79	75	77	122	119	120.5	98	94	96
50, 35	50	35	77	73	75	122	118	120	97	93	95
50, 50	50	50	75	74	74.5	121	118	119.5	99	93	96
F-test			ns	ns		ns	ns		ns	ns	
LSD (P=0.05)											
CV%			3.2	1.5		1.2	1.1		1.3	2.2	

Note: \*, \*\*, ns denotes significant at 5% and 1% level of significance and non-significant, respectively

### *Days to maturity*

It is clear that irrigation scheduling was non significantly affected by days to maturity as in Table 1. Mean range of days to maturity lies between 119.5 days to 123 days having maximum mean for 20 Kpa at depth of 20cm.

### *Plant height (cm)*

Similarly irrigation scheduling was non significantly affected by plant height as in table. Mean range for this trait was from 93.5 cm to 97.5 cm having maximum mean for 35 Kpa at depth of 50cm and minimum for 20 Kpa at depth of 35cm.

### *Tillerm<sup>-2</sup>*

The statistical analysis revealed significant effect of irrigation schedule on number of tiller /m<sup>2</sup>. Tiller/m<sup>2</sup> are important attribute for yield and significant relation to irrigation scheduling give better insight for good yield as reported [6]. As in table maximum number for Tiller/m<sup>2</sup> was 308 with irrigation threshold 20 Kpa at depth of 20cm soil water tensiometer monitoring.

### *Spike length (cm)*

The results pertaining to spike length of wheat was significantly affected by various irrigation schedules as given in **Table 2**. The maximum value for spike length was 13.5 cm with irrigation threshold 35Kpa at depth of 50cm tensiometer reading.

### *Thousand grains weight (gm)*

The trait 1000 grains wt. was statistically non significant to different irrigation scheduling which reveal that grain wt. is not affected by different irrigation scheduling.

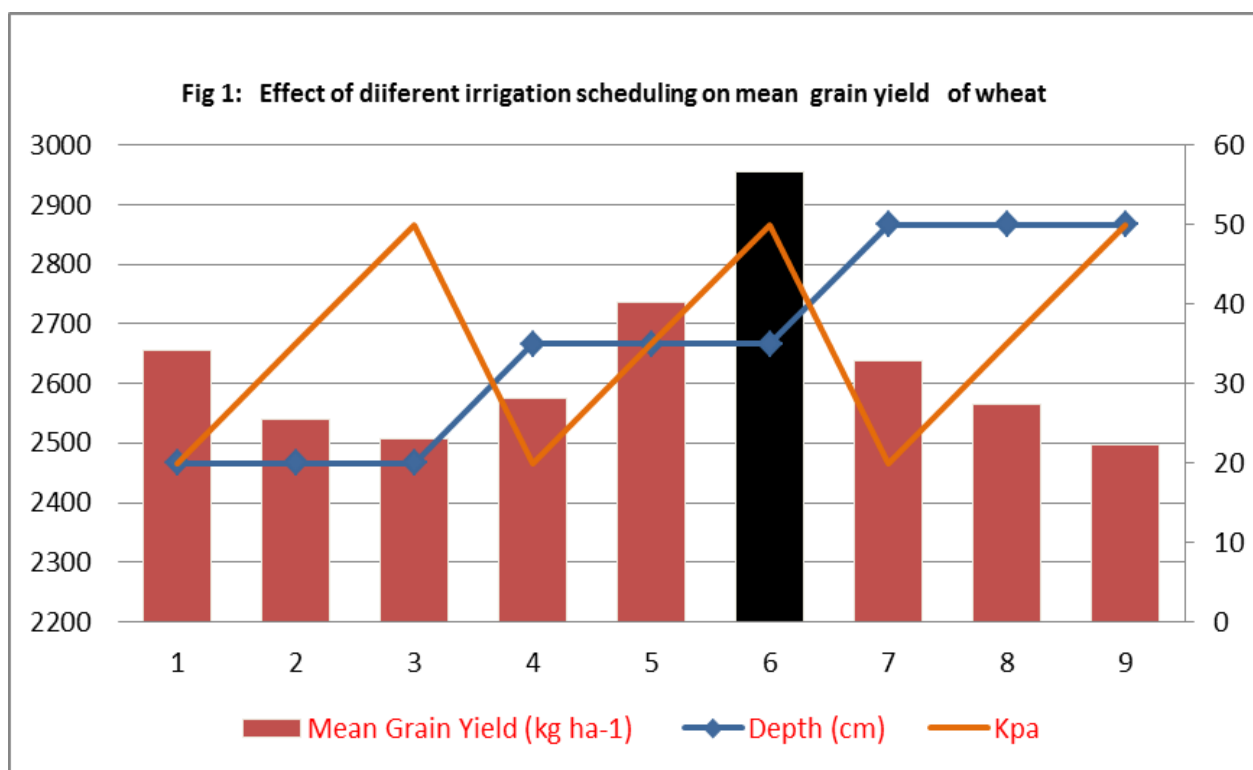
**Table 2** Effect of irrigation scheduling on yield attributes of wheat in RARS, parwanipur during 2013/14 and 2014/15

Treatment	Depth (cm)	kPa	Tiller m <sup>-2</sup>			Spike length (cm)			1000 grains wt (gm)		
			2013/14	2014/15	Mean	2013/14	2014/15	Mean	2013/14	2014/15	Mean
20, 20	20	20	344	272	308	12	12	12	39	37	38
20, 35	20	35	286	259	272.5	13	13	13	39	37	38
20, 50	20	50	285	264	274.5	12	13	12.5	38	37	37.5
35, 20	35	20	315	284	299.5	13	13	13	39	36	37.5
35, 35	35	35	293	253	273	13	13	13	40	36	38
35, 50	35	50	266	260	263	14	13	13.5	44	38	41
50, 20	50	20	284	260	272	13	13	13	39	38	38.5
50, 35	50	35	291	250	270.5	13	13	13	38	40	39
50, 50	50	50	281	218	249.5	13	13	13	42	41	41.5
F-test			*	ns		**	ns	*	ns	ns	
LSD (P=0.05)			37.10			0.8813					
CV%			7.3	12.5		3.9	3.0		3.9	4.0	

Note: \*, \*\*, ns denotes significant at 5% and 1% level of significance and non-significant, respectively

### Grain Yield (kg ha<sup>-1</sup>)

The statistical analysis revealed significant effect of irrigation schedules on grain yield. Mean grain yield of data for two year reveal that maximum yield were recorded for irrigation threshold 35kPa at depth of 50cm tensiometer reading i.e 2954.5 kg/ha and minimum yield were recorded for irrigation threshold 50Kpa at depth of 50cm tensiometer reading which was 2497.5 kg/ha. As the data trend shows that maximum yield can be gain in wheat on treatment no. 6 i.e., 35 kPa 50cm depth irrigation scheduling as reported by [7, 8] as shown in **Figure 1**.



### Straw Yield (kg/ha)

The data regarding straw yield of wheat were not influenced by various irrigation schedules are presented in **Table 3**. The trait was non significant for different irrigation scheduling as tested in farm.

**Table 3:** Effect of irrigation scheduling on yield of wheat in RARS, parwanipur during 2013/14 and 2014/15

Treatment	Depth (cm)	kPa	Grain Yield (kg ha <sup>-1</sup> )			Straw Yield (kg ha <sup>-1</sup> )		
			2013/14	2014/15	Mean	2013/14	2014/15	Mean
20, 20	20	20	2610	2703	2656.5	5644	4609	5126.5
20, 35	20	35	2502	2579	2540.5	5644	4944	5294
20, 50	20	50	2545	2468	2506.5	4621	4156	4388.5
35, 20	35	20	2526	2625	2575.5	4962	4531	4746.5
35, 35	35	35	2768	2703	2735.5	4470	4317	4393.5
35, 50	35	50	3184	2725	2954.5	4650	4318	4484
50, 20	50	20	2563	2712	2637.5	4546	4413	4479.5
50, 35	50	35	2569	2561	2565	4507	4048	4277.5
50, 50	50	50	2557	2438	2497.5	4470	4251	4360.5
F-test			*	ns		ns	ns	
LSD (P=0.05)			336.7					
CV%			7.3	5.6		9.7	9.4	

Note: \*, \*\*, ns denotes significant at 5% and 1% level of significance and non-significant, respectively

## Conclusion

The different irrigation scheduling tested in RARS, parwanipur, Nepal in two different year 13-14 and 14-15 with 3 levels of irrigation threshold (20, 35 and 50 kPa) and depth of soil water tension monitoring (20, 35, 50 cm). i.e. a total of 9 treatments shows non significant for most of the morphological traits taken viz. days to heading, days to maturity, plant height, 1000 grains wt. and straw Yield. The different irrigation scheduling was significant for Tiller/m<sup>2</sup>, Spike length and Grain Yield. As grain yield is important attribute and data finally conclude that it was highest at tensiometer in 35 cm depth with 50 Kpa tension (3184 kg/ha) and lowest at 20 cm depth with 20 Kpa tension (2502 kg/ha) in 2013/14 and grain yield was 2725 kg/ha at tensiometer in 35 cm depth with 50 Kpa tension in 2014/15.

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