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EFFECT OF DIFFERENT IRRIGATION SCHEDULING WITH THIOUREA ON GROWTH OF VARIOUS WHEAT CULTIVARS IN CENTRAL PLAIN ZONE OF U.P. AND ITS ECONOMIC FEASIBILITY

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Abstract

The present study was carried out at the Students' Instructional Farm of Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (UP) during *Rabi* season of 2017-18. The experiment was conducted under split plot design with three replications, treatments comprising of three irrigation levels (1- CRI, Booting stages, 2- CRI, Booting, Milky stages and 3- CRI, Maximum Tillering, Booting and Milking stages) in main plots, two varieties (K -1006 and DBW-107) in sub-plots and spraying of thiourea (TU) (T_1, - TU (0.2%) at BT stage, T_2 - TU (0.2%) at Dough stage, T_3 - TU (0.2%) at BT + Dough stages) in sub plots. Results of present study revealed that four irrigations at CRI, Tillering, Booting and Milky stages and spraying of thiourea showed its superiority throughout the growth period and shows remarkable increase *viz*., final plant population, Plant heights at 60, 90 DAS and at maturity, fresh weight, dry matter accumulation were recorded highest in treatment having all four Irrigations at CRI + MT + BT + MK stages along with spray of thiourea (0.2%) at BT + Dough stages. Gross return obtained was around (Rs.130350/ha.), Net return was also recorded highest in the same *i.e.* (Rs.86833/ha) and B:C ratio (1:2.99) which was actually a great response and very fruitful result for wheat cultivation in areas having low availability of water. Even with 4 irrigations we can obtain same or higher yield than usually recommended. However, variety DBW-107 performed better than K-1006 with all treatment combinations.

***Keywords*:** Thiourea, Irrigations, Treatments and Varieties.

Introduction

Wheat being a major food crop of India especially in northern region. Globally it is grown in 122 Countries and occupied an area of 215 million ha producing nearly 758 million tons of wheat during 2018-19 (FAO, 2018/19). Total world consumption of wheat is around 746 million tons per year and this is expected to continue grow over the coming years (FAO, 2018/19). Net irrigated area in India is around 54 million hectare accounting about 39 percent of the cropped area. Approximately 86 percent of wheat area is irrigated in India (GFFA, 2017). In India wheat grown is 30.72 million ha with grain production of 97.44 million tons and productivity of 3172 kg/ha, respectively (IIWBR, 2017). Among the total wheat production, 6 states mainly U.P, Bihar, M.P, Rajasthan, Punjab and Haryana constitute around 91% of the total grain production, Productivity of wheat genotypes depends largely on the prevailing weather conditions (*i.e.* optimum temperature required for good growth of wheat is around 15°C and productivity of wheat mainly depends on the maximum duration of optimum temperature observed by crop that is why productivity of wheat increases when we moves from east to west, soil moisture regime during the crop growth period also plays a vital role in increasing productivity. Water stress adversely affects various physiological processes of the plant including photosynthesis, respiration, amino acid, carbohydrate metabolism, growth, morphogenesis and senescence (Random and Sethi, 2006; Tomar *et al.,* 2018). This experiment is conducted keeping in view of these two important factors only, Use of Thiourea in regions where there is less availability of water makes crop develop resistant against water stress, helps in translocation of sugars and many useful effects been reported by different scientists. Foliar applied treatment of crop with 0.5 kg/ha thiourea at tillering stage increased the number of ears, grains/ear, weight/grain, biological yield, grain yield and harvest index (Sahu and Singh, 1995; Tomar *et al.,* 2018a) and many more benefits keeping in view all above reasons, the present experiment was conducted and different dosage of thiourea were given

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accordingly with irrigations at various stages and their effect was studied separately.

Materials and Methods

The present investigation was carried out during *Rabi* season of 2017-2018 with the main objective of finding out the effect of limited irrigations and effect of thiourea on wheat varieties. The details of material used and methods adopted during the course of study are discussed in brief. The experimental place Kanpur is situated in subtropical region of India at 80° 18' 25" east longitude and at 26° 29' 35" north latitude, the field was well levelled having assured irrigation facility by tube well, soil was Indo-Gangetic of deep alluvium origin, soil samples were randomly collected from experimental sites and the results indicated that experimental soil was poor in nitrogen, potassium and medium in phosphorus content. Soil reaction was slightly alkaline. Available soil moisture range was 12.47 percent. The treatments included 3 levels of limited irrigation and 3 levels of anti-transpirants on two varieties of dwarf wheat as given below-

Irrigation levels - 3 *viz.*

I_1 = Two irrigations at CRI & booting stages.

I_2 = Three irrigations at CRI, booting & milky stages.

I_3 = Four irrigations at CRI, maximum tillering, Booting and milky stages.

Thiourea:

T_1 = Thiourea 0.2% at booting stage.

T_2 = Thiourea 0.2% at dough stage.

T_3 = Thiourea 0.2% at booting and dough stage.

Varieties- V_1: K 1006 (CSAUA&T, Kanpur) and V_2: DBW - 107 (IIWBR, Karnal)

The experiment was laid out in split plot design keeping irrigation levels in main plots and varieties and thiourea in sub-plots. A uniform seed rate of 100 kg/ha was used for sowing all varieties. A uniform dose of 150 kg N + 60 kg P_2O_5 + 40 kg K_2O/ha was applied to all treatment plots. The sources of N, P, K used were Urea, DAP and MOP, respectively. Half of N and full of P and K were applied at sowing while remaining half of N was top dressed in standing crop after first irrigation at optimum soil moisture condition.

Irrigations were applied as per treatment at different critical stages of crop growth. Irrigations at the stages of CRI, tillering, booting, dough and milky stages were applied as per treatment. Thiourea solution @ 0.2%was prepared by mixing 2 g of thiourea in 1L of water. According to the guidelines spraying of 0.2% solution of thiourea was practiced in different plots in booting and dough stages. Crops were harvested plot wise carefully at the time of maturity manually and tied in small bundles and were shifted to threshing yard. Threshing was performed manually. The grains were collected carefully to count and record. The data of the following parameters: Plant heights at 60, 90 DAS and at maturity, fresh weight, dry matter accumulation, no. of effective tillers per meter square, ear length, no. of grains per ear, No. of spikelets per ear, grain weight per ear (g), test weight (g) were calculated later economic data pertaining cost of cultivation, Net return and benefit cost ratio were also calculated.

Result and Discussion

The present investigation on "Effect of scheduling of irrigation and thiourea on growth and yield on different cultivars of wheat in central plain zone of U.P." was studied on growth, growth attributes, economics and water use during *rabi* seasons to investigate the effect of different irrigation schedules on growth Performance of wheat varieties to be assessment in this experiment (V_1 = K 1006 released from CSAUA&T, Kanpur) and V2 = DBW-107 (released from IIWBR, Karnal were evaluated for their performance against three irrigation schedules such as: I_1 = two irrigations at CRI and Booting stage; I_2 = three irrigations at CRI, Booting & milky stages; I_3= four irrigations at CRI, tillering, Booting and milky. Results of Spray of different doses of Thiourea were also studied *i.e.* T_1 = thiourea 0.2% at booting stage; T_2 = thiourea at dough stage; T_3 = thiourea 0.2% at booting and dough stage both. The observations were recorded in plant population, plant height, fresh weight, dry matter accumulation, no. of effective tillers per meter square, ear length, all these attributes and factors of economics are briefly discussed here.

Plant population

Initial plant population of wheat crop does not show significant differences to various scheduling of irrigation were applied to the wheat crop (Table 1). Similarly, different treatments do not shown any significant differences on initial plant population and varieties as well as their interaction effect on plant population.

Plant height

Data pertaining to plant height (cm) of wheat crop at different physiological stages of crop growth as affected by different scheduling of irrigation and thiourea on varieties have been presented in the table given along and data clearly shows that the different plant height of wheat at 30, 60, 90

DAS and at harvest recorded with the application of irrigation at following stages CRI + MT + BT + MK were highest. The lowest plant height at 30, 60, 90 DAS and at harvest stage was obtained with the application of irrigation at CRI + BT 12.75, 66.04, 71.76 and 73.28, respectively (Table 2). It is evident from the data that plant height of wheat at 60, 90 DAS and at harvest significantly improved with spraying of thiourea (0.2%) at BT + Dough stages 70.53, 77.02 and 79.48cm, respectively. Spraying of thiourea (0.2%) at dough stage ranked second best treatment for increasing plant height. Minimum plant height was observed when thiourea (0.2%) was sprayed only at BT stage. Similar results have been reported by Singh *et al.*, 2018; Tomar, 2020a; Sahu and Singh, 1995.

Fresh weight per plant

Data on fresh weight per plant of wheat crop at 30, 60, 90 and at harvest as influenced by different scheduling of irrigation and thiourea on varieties has been presented in table 3. Application of irrigation water to wheat crop growth at CRI + MT + BT + MK stages recorded maximum plant fresh weight at 30, 60, 90 DAS and at harvest followed by irrigation scheduling at CRI + BT + MK, both were statistically at par but significantly superior over irrigation scheduling at CRI + BT stages. Among varieties significant effect was observed on plant fresh weight at 60, 90 and harvest stages of crop. However, fresh weight per plant recorded higher in DBW-107 than K-1006 in all stages of crop growth.

Spraying of thiourea shown on-significant effect on plant fresh weight at 30 DAS, whereas, 60, 90 and at harvest spraying of thiourea at BT + dough stages recorded significant effect on fresh weight per plant. However, spraying of thiourea at different stages showed statistically at par result at all stages of growth.

Dry matter accumulation per plant

A perusal of data on dry matter accumulation per plant of wheat crop at 30, 60, 90 and at harvest as influenced by different scheduling of irrigation and thiourea on varieties has been presented in table 4. It is apparent from the data that dry matter accumulation per plant of wheat was non-significant at 30 DAS, whereas, 60, 90 DAS and at harvest significantly improved with the spraying of thiourea. Highest dry matter accumulation per plant was observed with the spraying of thiourea (0.2%) at BT + Dough stages followed by spraying of thiourea (0.2%) at dough stage ranked in dry matter accumulation per plant. Both were statistically at par but, significantly superior when spraying was done at BT + Dough stages.

The varieties show non-significant result at 30 DAS, whereas, at 60, 90 DAS and at harvest, significant difference among varieties was observed. The dry matter accumulation of variety DBW-107 was recorded superior at all stages of growth. However, interaction effect of irrigation scheduling and spraying of thiourea on different varieties does not show any significant result. These results are in close conformity with the findings of Tomar *et al.,* 2020b; Sharma *et al.*, 2007.

Economics

Data on economics *viz*., cost of cultivation, gross returns, net return and B:C ratio as influenced by the various scheduling of irrigation and thiourea on varieties has been presented in table 5. The cost of cultivation was highest for the treatment with application of thiourea (0.2%) at BT + Dough stages (Rs. 38973). However, minimum cost of cultivation was observed in treatment with the spraying of thiourea at BT stage (Rs.38749/ha). The cost of cultivation for both varieties was recorded same whereas the spraying of thiourea (0.2%) at BT + dough stage recorded maximum gross returns (Rs.120043/ha) followed by spraying of thiourea at dough stage. Similarly in case of Net return spraying of thiourea (0.2%) at BT + dough stage recorded maximum net return (Rs.81069/ha) followed by spraying of thiourea at dough stage.

Finally, study of benefit cost ratio were recorded higher in variety DBW107 than K1006, the spray of thiourea (0.2%) at BT + dough stage recorded maximum B:C ratio (1:3.08) followed by spraying of thiourea at dough stage. Both were statistically at par but, significantly superior over spraying of thiourea at BT, which was recorded minimum B:C ratio (1:2.95). Similar results have also been reported by Vashisht *et al.,* 2015; Tomar *et al.,* 2018a; Barkha *et al.*, 2017.

Conclusion

Effect of scheduling of irrigation

The initial plant population of wheat was not effected with different levels of irrigation, whereas plant height was significantly affected- at crown root initiation, maximum tillering, booting and milky stages produced significantly highest plant height of wheat crop at all the physiological stages. The fresh weight per plant of wheat, dry matter accumulation effective shoots per square meter, cost of cultivation, gross return, net return and B:C ratio was higher when crop is irrigated four times *i.e.*, CRI + MT + BT + MK stages lower, when irrigated thrice *i.e.*, CRI + BT + MK irrigation.

Effect of spraying of thiourea

The initial plant population of wheat was not affected

much while application of two sprayings at booting and dough stages produced significantly highest plant height of wheat crop as compared to other thiourea scheduling. Fresh weight per plant and dry weight per plant of wheat at 60, 90 DAS and maturity was significantly increased with two sprayings as compared to the single spraying along with higher total number of effective shoots per square meter. The cost of cultivation, gross return, net return and B:C ratio was recorded maximum in treatment with two sprayings of thiourea at BT + dough stages.

The spraying of thiourea (0.2%) at BT + dough stages proved its superiority in increasing plant height, dry weight of plant, yield attributes, biological yield (122.85 q/ha), grain yield (46.87 q/ha), gross income (Rs.120042.5) and net income over the single spraying of thiourea BT or dough only. The variety DBW 107 showed its superiority over K 1006 in terms of growth, yield attributes, biological yield (123.85 q/ha), grain yield (47.37), gross income and net income.

Therefore, it is concluded that application of irrigation at CRI + MT + BT + MK stages with spraying of thiourea (0.2%) at BT + Dough stages on wheat variety DBW-107 registered significant improvement in growth attributes, yield attributes, yield and economics of the experiment under study.

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Table 1: Effect of irrigation and thiourea on initial plant population of wheat

Treatments	Initial plant population (m^{-2})
Scheduling of irrigation (3)	
Two Irrigations at CRI + BT stages	123.39
Three Irrigations at CRI + BT + MK stages	122.39
Four Irrigations at CRI + MT + BT + MK stages	123.11
	0.968
C.D. at 5%	**N.S.**
Thiourea level (3)	
Thiourea (0.2%) at BT stage	123.06
Thiourea (0.2%) at Dough stage	122.78
Thiourea (0.2%) at BT + Dough stages	123.06
SE (d) ±	**0.637**
C.D. at 5%	**N.S.**
Varieties (2)	
K 1006	122.93
DBW 107	123
SE (d) ±	**0.520**
C.D. at 5%	**N.S.**
Interaction I x T x V	
	1.562
C.D. at 5%	**N.S.**

Table 2: Effect of irrigation and thiourea on Plant height at different DAS of wheat

Treatments	Plant height (cm)			
	30 DAS	**60 DAS**	**90 DAS**	**At maturity**
Scheduling of irrigation (3)				
Two Irrigations at CRI + BT stages	12.75	66.04		73.28
Three Irrigations at CRI + BT + MK stages	13.04	70.56	76.77	79.08
Four Irrigations at CRI + MT + BT + MK Stages	13.22	73.11	78.66	83.11
SE (d) ±		**0.919**		**1.138**
C.D. at 5%		**2.551**	**4.019**	**3.715**
Thiourea level (3)				
Thiourea (0.2%) at BT stage	12.93	69.04		77.11
Thiourea (0.2%) at Dough stage	13.02	70.14	76.52	78.88
Thiourea (0.2%) at BT + Dough stages	13.05	70.53	77.02	79.48
SE (d) ±	**0.373**	**0.928**	**1.191**	**1.308**
C.D. at 5%	**N.S**	**1.894**	**2.431**	**2.672**
Varieties (2)				
K 1006	12.94	69.59	75.83	77.85
DBW 107	13.06		76.74	79.13
SE (d) ±	**0.304**	**0.757**	**0.972**	**1.068**
C.D. at 5%	**N.S**	**1.547**	**1.985**	**2.181**
Interaction I x T x V				
SE (d) ±	**0.914**	**2.272**	**2.916**	**3.205**
C.D. at 5%	**N.S**	**N.S**		**N.S**

Table 3: Effect of irrigation and thiourea on Fresh weight /plant of wheat

Treatments	Fresh weight per plant (g)			
	30 DAS	60 DAS	90 DAS	At maturity
Scheduling of irrigation (3)				
Two Irrigations at CRI + BT stages	10.68	42.38	59.06	42.09
Three Irrigations at CRI + BT + MK stages	10.72	47.2	66.37	45.12
Four Irrigations at CRI + MT + BT + MK Stages	10.78	48.3	70.84	46.94
	0.378	**1.374**	**1.602**	**1.021**
C.D. at 5%	**N.S**	**3.815**	**4.448**	**2.834**
Thiourea level (3)				
Thiourea (0.2%) at BT stage	10.48	44.94	64.24	44.03
Thiourea (0.2%) at Dough stage	10.79	46.08	65.46	44.49
Thiourea (0.2%) at BT + Dough stages	10.90	46.85	66.57	45.63
SE (d) ±	**0.346**	**1.532**	**1.585**	**1.027**
C.D. at 5%	**N.S**	**3.129**	**3.237**	**2.096**
Varieties (2)				
K 1006	10.66	45.17	64.28	44.26
DBW 107	10.79	46.75	66.56	45.18
SE (d) ±	**0.282**	**1.251**	**1.294**	**0.838**
C.D. at 5%	**N.S**	**2.555**	**2.642**	**1.712**
Interaction I x T x V				
SE (d) ±		**3.753**	**3.882**	**2.514**
C.D. at 5%	**N.S**	**N.S**	**N.S**	**N.S**

Table 4: Effect of irrigation and thiourea on Dry matter accumulation at different DAS of wheat

Treatments	Fresh weight per plant (g)			
	30 DAS	60 DAS	90 DAS	At maturity
Scheduling of irrigation (3)				
Two Irrigations at CRI + BT stages	1.95	9.47	20.93	20.93
Three Irrigations at CRI + BT + MK stages	2.07	9.93	21.73	21.56
Four Irrigations at CRI + MT + BT + MK Stages	2.15	12.03	22.69	22.20
	0.033	**0.234**	**0.314**	**0.329**
C.D. at 5%	**0.092**	**0.666**	**0.872**	**0.914**
Thiourea level (3)				
Thiourea (0.2%) at BT stage	2.05	10.18	20.95	20.95
Thiourea (0.2%) at Dough stage	2.05	10.42	22.09	21.80
Thiourea (0.2%) at BT + Dough stages	2.08	10.81	22.31	21.95
SE (d) ±	**0.033**	**0.206**	**0.286**	**0.326**
C.D. at 5%	**N.S**	**0.422**	**0.584**	**0.665**
Varieties (2)				
K 1006	2.04	9.69	21.38	20.83
DBW 107	2.07	11.26	22.18	22.30
SE (d) ±	**0.027**	**0.169**	**0.165**	**0.266**
C.D. at 5%	**N.S**	**0.344**	**N.S**	**0.543**
Interaction I x T x V				
SE (d) ±		**0.506**	**0.701**	**0.797**
C.D. at 5%	**N.S**	**N.S**	**N.S**	**N.S**

Table 5: Effect of treatments on economics of wheat production

Treatments	Economics			
	Cost of cultivation (Rs/ha)	Gross Return (Rs/ha)	Net returns (Rs/ha)	B:C ratio
Scheduling of irrigation (3)				
Two Irrigations at CRI + BT stages			59459	
Three Irrigations at CRI + BT + MK stages	42269	120215	77946	1:2.84
Four Irrigations at CRI + MT + BT + MK Stages	43517	130350	86833	1:3.00
			2284.85	
C.D. at 5%			**4577.70**	**0.37**
Thiourea level (3)				
Thiourea (0.2%) at BT stage	38749	114110	75361	1:3.00
Thiourea (0.2%) at Dough stage	38749	116890	78141	1:3.02
Thiourea (0.2%) at BT + Dough stages	38973	120043	81069	1:3.08
SE (d) ±			**1608.80**	**0.26**
C.D. at 5%		**2380.912**	**3286.51**	**0.52**
Varieties (2)				
K 1006	38525	112863	74338	1:2.93
DBW 107	38525	121138	82613	1:3.14
SE (d) ±		**1944.01**	**1313.58**	**0.37**
C.D. at 5%		**3971.30**	**2683.43**	**0.90**
Interaction I x T x V				
SE (d) ±		**628.52**	**508.84**	**0.07**
C.D. at 5%		**N.S**	**N.S**	**N.S**