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Effect of different level of irrigation and chitosan on wheat (*Triticum aestivum* L.) growth and yield

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Abstract
Drought stress is one of the major abiotic stresses in worldwide that affects plant physiological and yield traits. As per "SAPCC 2014" some part of UP, especially eastern UP will face rise in temperature (3 to 5° C up to 2050) and water scarcity condition. This will have decreased productivity due to drought stress thus a study conducted to evaluate the effect of chitosan on morphology and physiology characteristics of Wheat under different level irrigation for the purpose of an experiment conducted on wheat verity grown under different water stress condition with chitosan applied as a foliar application treat under taken were based on different level of irrigation (100% IR, 80% IR, 60%IR, 40%IR, 20%IR) and Chitosan (100% CHT, 75% CHT, 50% CHT) with over all 20 treatments and three replication with R.B.D result growth and yield observed statically analysed. Result on crop growth and yield under water deficit condition was observed. However, treatment five showed best result but the chitosan treated plant perform better than that of their water deficit result as for as statistical analysis treatment T_5 to T_{10} are showing either non-significant or at par result for all parameter observed and the chitosan treated treatments are giving better result.

Keywords: Chitosan, water scarcity, drought and stress

Introduction
As per world economic forum, water scarcity will affect most of the continent by 2015. Lack of fresh water recourse to find the water demand will be the largest global risk in terms of potential impact over the next decade (World Economic Forum 16 January 2015) [21]. Improving living standards, changing consumption patterns, and expansion of irrigated agriculture are the main driving forces for the rising global demand for water (Vorosmarty *et al.*, 2000) [5] leading to scarcity of water resource.

Adding to it on the basis of analysis of the Intergovernmental Panel on Climate Change is likely to affect agriculture, increase the risk of hunger and water scarcity, and lead to more rapid melting of glaciers. The availability of freshwater in many river basins in India is likely to decrease due to climate change (Gosain *et al.*, 2006) [9].

Indian climate is dominated by the southwest monsoon. About 80% of the rainfall in India occurs during the four monsoon months (June–September) with large spatial and temporal variations over the country. Such a heavy concentration of rainfall results in a scarcity of water in many parts of the country during the non-monsoon period. (IPCC, 2007) [14].

Further climate change report states increasing in temperature and low rainfall causes drought prone condition in coming years in utter Pradesh especially eastern UP will face rise in temperature (2 - 4.5) and water scarcity condition, which is directly, effects on agriculture production. While investigating the climatology of drought in India (due to deficient rainfall), in eastern Uttar Pradesh region it occurs once in every four years. The combined factors such as changing precipitation patterns, excessive utilization of groundwater and ecologically unsuitable agricultural practices, are primarily responsible for the occurrence of drought in these regions. (Parthasarathy *et al.*1987) [17] With such water scenario and high rate of increase in population is going to exert tremendous pressure on agriculture production.

As per estimation the demand of wheat is projected to be 109 met by 2020 in India. Globally, the demand for wheat by the year 2020 is forecasted to be around 950 mi. This target will be achieved only, if the global wheat production would be increase by 2.5% per annum. water deficit leads to severe reduction in overall production.

The production of any crop can be increased by some ways; (1) by increasing area under crop, which is not expected to expand (2) by increasing the productivity through efficient input management along with varietal improvement and (3) by increasing the productivity by reducing the losses caused by various pests (4) by improving water use efficiency of crop.

This can be done either by reducing loss of water through transpiration or by increasing soil water holding capacity of soil.

That will increase the rate of transpiration in turn will increase the water demands. Thus to improve WUE of crop plant by lowering down the loss of water through stomata can be one of the aspect to be considered to deal with such situation in coming future. Antitranspirants are one of such resources through which rate of transpiration can be reduced.

Antitranspirants are the chemical compound which favours reduction in rate of transpiration from plant leaves by reducing the size and number of stomata and gradually hardening them to stress. It is a substance involved in increasing drought stress resistance (Pandey *et al*., 2017) [16]. Foliar sprays markedly increase all growth parameters and Relative Water Content and may reduce transpiration (Ahmed *et al*., 2014) [1]. It is a substance involved in increasing drought stress resistance.

Chitosan is an antitranspiration compound that has proved to be effective in saving water loss from areal part of many crops. It was used to protect plants against oxidative stress (Guan *et al.,* 2009) [8] and to stimulate plant. Chemically it is β-1, 4-linked polymer of D-glucosamine, chitosan does not get broken down or digested by human gastrointestinal enzymes. It is the most abundant natural polymer after cellulose.

It breaks down slowly to harmless products (amino sugars), which are completely absorbed by the human body. Chitosan, (1, 4)-[amino-2-deoxy-β-D-glucan] has amine side group, which is responsible its polycationic character, and formation of well-known intermolecular complexes with carboxylic acid and poly (carboxylic acid).

Chitosan give best result in foliar application like higher vegetative growth and improvement in fruit quality (Farouk *et al*. 2008*)* [6]. on other cultivated plants, (Bittelli *et al.* 2001) [3] found that foliar application of chitosan decreased transpiration in pepper plants, and reduced water use by 26-43% while maintaining biomass production and yield On strawberry showed that chitosan application improved plant height, number of leaves, fresh and dry weights of the leaves and yield components.

The use of chitosan in the agriculture has shown good results in plant protection before and after harvest, as an inductor of the plant defence system (against pests and diseases) (Iriti and Varoni, 2015) [15]. The objective of this study determine to study the effect of different level of irrigation and Chitosan on Growth and Yield parameter of Wheat (*Triticum aestivum* L.)

Material and Methods

Present study was conducted in central agricultural field of SHUATS, located at 25.57^0 N latitude, 81.51^0 E longitude and 98 m altitude above the mean sea level. As per the purpose of study experiment was conducted based on surface irrigation to create water deficit condition for wheat variety HD-2967 we have taken different level of irrigation (100% IR, 80% IR, 60% IR, 40% IR,20% IR) and different doses foliar spray of antitranspirant (100%, 75%, and 50%) at jointing and booting stage. Overall twenty treatments were laid under randomized block design with three replications.

Different vegetative growth (Plant height, No. of tillers/hill, flag leaf length, flag leaf width) and reproductive and yield parameter (Spike length, No. of spikelet/spike, Days to 50% flowering, biological yield, grain yield, harvest index, and 1000 grain weight) are analysed are analysed during the course of study. All the observation and analysis are conducted by standard procedure and statistical analysis are provided.

Treatment details: T_0 (100% IR without CHT), T_1 (80% IR without CHT), T_2 (60% IR without CHT 100%), T_3 (40% IR without CHT), T_4 (20% IR without CHT), T_5 (100% IR with 100% CHT), T_6 (100% IR with 70% CHT), T_7 (100% IR with 50% CHT), T_8 (80% IR with 100% CHT), T_9 (80% IR with 75% CHT), T_{10} (80% IR with 50% CHT), T_{11} (60% IR with 100 CHT), T_{12} (60% IR with 75% CHT), T_{13} (60% IR with 50% CHT), T_{14} (40% IR with 100% CHT), T_{15} (40% IR with 75% CHT), T_{16} (40% IR with 50% CHT), T_{17} (20% IR with 100% CHT), T_{18} (20% IR with 75% CHT), T_{19} (20% IR with 50% CHT). Where, CHT is chitosan and IR is irrigation.

Results and Discussion

Wheat yield under drought stress suffer serious moisture deficit throughout its growth period from seedling to full maturity (Bilal *et al*. 2015). Under drought condition decreasing pattern was experienced in morphologically yield contributing characters like plant height (PH), grains per spike, spikes per plant, 1000grain weight (TGW) in wheat (Kilic and Yagbasanlar 2010) [11]. Drought stress lead to reduction in number of fertile tillers per plant, grains per spike and 1000-grain weight (TGW) which ultimately cause noticeably low grain productivity. The decreasing graph in grain number was linked with reduced leaf area and lower photosynthesis as outcome of drought stress (Fischer *et al.*, 1980) [7]. Antitranspirants are the chemical compound which favours reduction in rate of transpiration from plant leaves by reducing the size and number of stomata and gradually hardening them to stress. It is a substance involved in increasing drought stress resistance (Pandey *et al*., 2017) [16].

This study observation suggests that All the treatments which were treated with Chitosan were showing better result in comparison to water deficit condition (20% IR). However, when we are comparing our observation with normal irrigation we observed that treatment T_5 were showing better result while T_4 was showing lower result.

For plant height all the treatments which were treated with Chitosan were showing better result in comparison to water deficit condition (20% IR with CHT). However, when we are comparing our observation with normal irrigation we observed that treatment T_5 (90.70 cm) were showing better result While T_5 (90.70), T_6 (90.26), T_7 (90.10) was non-significant with each other. The plant height of basil was significantly affected by chitosan and irrigation treatments. The plant height significantly decreased with decreasing irrigation levels. the growth of cells is the most important process that is affected by water deficit and the decrease in the growth of cells leads to decrease in the plant height. (Shao *et al.*, 2008) [19].

For number of tillers per hill all the treatments under water deficit condition treated with Chitosan were found to be better compare to treatment which is not treated with chitosan i.e. T_4 (6.67) (20% IR with No PH No CHT), however T_5 (10.67) were showing better result while T_6(10.56) However, T_8 (10.10), T_9 (10.67) was non-significant with T_0 (10.13). More number of branches might be due to concentration of antitranspirants because it takes part in biosynthesis of auxin which helps in apical dominance which stimulate new emerging shoots in plants. Affecting the rate of cell division and enlargement. In addition, water deficit leads to increase in abscisic acid which causes an inhibition of the growth

(Abdalla, 2011) Number of branches per plant significantly decreased under water deficit (Cavatte *et al.*, 2012) [4]

For flag leaf length and flag leaf width all the treatments under water deficit condition treated with Chitosan were found to be better compare to treatment which is not treated with chitosan i.e. T_4 (10.42 FLL; 0.42 FLW) (20% IR with No CHT), however T_5 (18.64 FLL; 1.67 FLW) were showing better result while T_7 (18.04cm). T_8 (17.37cm), T_9 (17.29cm), T_{10} (17.25cm) was non-significant with T_0 (18.00cm). Drought stress lead to reduction in number of fertile tillers per plant, grains per spike. It is possible that application to drought plants at an earlier stage than flag leaf visible may prove to be even more effective the decreasing graph in grain number was linked with reduced leaf area and lower photosynthesis as outcome of drought stress (Fischer *et al.* 1980) [7].

For days to maturity, treatment under water deficit condition in which CHT is not applied i.e. T_4 (101.6 DTM) showed early maturity as compared to CHT applied treatments. However, T_5 (116.1 DTM) The plants strive to complete their life cycle as early as possible to cope with drought stress conditions. Therefore, days required to initiate heading or flowering in wheat are generally decreased due to early start of reproductive stage (Riaz 2003) [18]. Escape from drought is attained through a short need life cycle or growing season, allowing plants to reproduce before he environment becomes dry., where a short life cycle can lead to drought escape. Crop duration is the environment and determines the ability of the crop to escape from climatic stresses including drought. Drought escape occurs when phonological development is successfully matched with periods of soil moisture availability, where the growing season is shorter and terminal drought stress predominates (Araus *et al.*, 2002) [2]

For spike length per spike and number of spikelet per spike all the treatments which were treated with Chitosan were showing better result in comparison to water deficit condition (20% IR with no CHT). Whereas T_5 (SL11.37 cm; NSL 23.00),) were showing better result, However, when we are comparing our observations with normal irrigation While T_5 (11.37), T_6 (11.19), T_7 (11.15), T_8 (11.05), T_9 (11.0) (non-significant with T_0 (11.08 cm).

Drought stress lead to reduction in number of fertile tillers per plant, grains per spike and 1000-grain weight (TGW) which ultimately cause noticeably low grain productivity. Relationship between plant height (PH), leaf area and wheat grain yield has been noticed at booting and anthesis phase which cause improvement in grain yield under water deficit condition (Gupta *et al.* 2001) [10]

For yield parameters grain yield all the treatments in which chitosan is applied were showing better results in comparison to water deficit condition T_4 (GY 171.7) (20% IR with no CHT). However, when we are comparing our observation with normal irrigation T_5 (GY 351.7) were showing better result. The effects of drought are numerous, including reduce crop yield, decreased availability of fodder and feed. Wheat yields are reduced 57% from their potential because of drought spell on at least 60 million hectares in the developing world (Mozny M, *et al*. 2009) [13]**.** The results of other researchers also show that harvest index will decrease in the treatments under drought stress due to the effect of drought stress on grain yield.

Table No. 1: Effect of different level of irrigation and Chitosan on plant height, number of tillers per hill, flag leaf length (cm) and flag leaf width (cm), day of maturity of wheat.

Treatments	Plant height (cm)	No. of tillers per hill	Flag Leaf Length (cm)	Flag Leaf Width (cm)	Days to Maturity
T_0	89.63	10.13	18.00	1.43	113.93
T_1	85.60	9.67	17.08	1.31	111.20
T_2	78.87	8.73	14.59	1.11	107.03
T_3	73.40	7.94	12.62	0.88	104.23
T_4	65.90	6.67	10.42	0.46	101.17
T_5	90.70	10.67	18.64	1.67	116.10
T_6	90.27	10.57	18.50	1.55	115.17
T_7	90.10	10.17	18.04	1.45	114.77
T_8	87.67	10.10	17.37	1.41	113.87
T_9	87.50	10.07	17.29	1.39	113.27
T_{10}	86.17	9.70	17.25	1.36	112.50
T_{11}	84.03	9.20	15.43	1.26	110.13
T_{12}	81.33	9.07	14.76	1.21	108.90
T_{13}	79.23	8.93	14.67	1.16	108.20
T_{14}	75.30	8.50	14.58	1.04	106.70
T_{15}	74.90	8.13	13.68	1.02	105.70
T_{16}	74.00	8.01	12.81	0.90	105.20
T_{17}	72.07	7.60	11.21	0.69	103.33
T_{18}	71.30	7.20	10.95	0.64	102.63
T_{19}	67.17	6.93	10.81	0.50	101.67
Mean	80.26	8.90	14.93	1.12	108.78
SE. d	1.196	0.161	0.619	0.078	0.370
C.D (5%)	3.554	0.481	1.389	0.234	1.101
C.V	2.869	3.278	5.616	12.441	0.781
F Test	S	S	S	S	S

Table 2: Effect of different level of irrigation and Chitosan on spike length (cm), number of spikelet/spike, days to 50% flowering, grain yield q/ha

Treatments	Spike Length (cm)	No. of Spikelet/ spike	Grain yield (q/ha)
T_0	11.08	21.40	318.0
T_1	10.20	20.70	298.3
T_2	9.40	19.70	265.0
T_3	8.13	16.57	208.0
T_4	7.37	15.67	171.7
T_5	11.37	23.00	351.7
T_6	11.19	21.87	326.0
T_7	11.15	21.60	322.3
T_8	11.05	21.23	312.0
T_9	11.00	21.07	308.7
T_{10}	10.39	21.03	305.0
T_{11}	10.01	20.67	291.0
T_{12}	9.99	20.27	288.7
T_{13}	9.81	20.13	268.3
T_{14}	9.08	17.47	254.3
T_{15}	8.67	17.13	245.7
T_{16}	8.38	17.00	226.7
T_{17}	7.83	16.27	207.7
T_{18}	7.59	16.13	201.3
T_{19}	7.55	16.07	196.3
Mean	9.56	19.25	268.33
SE. d	0.144	0.307	0.543
C.D (5%)	0.428	0.913	7.140
C.V	2.723	2.892	1.614
F Test	S	S	S

Conclusion

This study may conclude that under water deficit condition all the treatments are showing better results in comparison to T_4 (20% IR and without Chitosan) for growth and yield parameters. Although T_5 (1000% IR with 100% Chitosan) was showing best results for all growth, reproductive and yield parameters. In comparison to T_0 (100% IR) treatment T_5 to T_{10} are showing either non-significant or at par result for all parameter observed Overall T_5 is performing best followed by T_6.

References

1. Ahmed YM, Ahmed. Impact of Spraying Some Antitranspirants on Fruiting of Williams Bananas Grown Under Aswan Region Conditions. Stem Cell. 2014; 5(4):34-39.
2. Araus JL, Slafer GA, Reynolds MP, Royo C. Plant breeding and drought in C3 cereals: what should we breed for? Ann. Bot. 2002; 89:925-940.
3. Bittelli M, Flury M, Campbell GS, Nichols EJ. Reduction of transpiration through foliar application of chitosan. Agricultural & Forest Meteorology. 2001; 107(3):167-175.
4. Cavatte PC, Martins SC, Mattos MS. Damietta Functional analysis of relative growth rate, 2012.
5. CJ Vorosmarty, Green JP, Salisbury R, Lammers B. Global water resources: Vulnerability from climate change and population growth. Science. 2000; 289:284-288.
6. Farouk S, Ghoneem KM, Ali Abeer A. Induction and expression of systematic resistance to downy mildew disease in cucumber plant by elicitors. Egyptian Journal of Phytopathology. 2008; 1(2):95-111.
7. Fischer R, Turner N, Kramer P. Influence of water stress on crop yield in semiarid regions. In: Turner NC & Kramer PJ (ends) Adaptation of plants to water and high temperature stress. Wiley, New York, 1980, 323-339.
8. Guan Y, Jin H, Xian-ju W, Chen-xia S. Seed priming with chitosan improves maize germination and seedling growth in relation to physiological changes under low temperature stress. Journal of Zhejiang University Science B. 2009; 10:427-33.
9. Gosain AK, Sandhya Rao. Impact of Climate Change on Water Sector Climate Change and India – Vulnerability Assessment and Adaptation (eds Shukla, P. R. *et al*.). Universities Press, Hyderabad. 2006; 11:159-192.
10. Gupta N, Gupta S, Kumar A. Effect of water stress on physiological attributes and their relationship with growth and yield of wheat cultivars at different stages. Journal of Agronomy and Crop Science. 2001; 186:55-62.
11. Kilic H, Yagbasanlar T. The effect of drought stress on grain yield, yield components and some quality traits of durum wheat (*Triticum turgidum*) cultivars. Notulae Botanicae Horti Agrobotanici Cluj-Napoca. 2010; 38:164-170.
12. Lamia, Barakat. Hypolipidemic and Antiatherogenic Effects of Dietary Chitosan and Wheat bran in High Fat-High Cholesterol Fed Rats. Australian Journal of Basic and Applied Sciences. 2011; 5(10):30.
13. Mozny M, Hlavinka P, Trnkaa M, Semeradova D, Dubrovsky M, Zaluda Z. Effect of drought on yield variability of key crops in Czech Republic. Agric. Forest Met. 2009; 149:431-442.
14. IPCC, Climate change The physical science basis. In: Solomon, S., Qin, D.,Manning, M., Chen, Z., Marquis, M., Averyt, K.B., Tignor, M., Miller, H. Eds.),Contribution of Working Group I to the Fourth Assessment Report of the Inter-governmental Panel on Climate Change. Cambridge University Press, Cambridge, UK, New York, USA, 2007.
15. Iriti, Varoni. Chitosan-induced antiviral activity and innate immunity in plants. Environ Sci Pollut Res. (2015; 22:2935-2944.

16. Pandey PP, Sharma R, Neelkanthe SS. Climate change: Combating drought with antitranspirants and super absorbent. Plant Archive. 2017; 17(2):1146-1156
17. Parthasarathy B, Sontakke NA, Munot AA, Kothawale D R. 'Droughts/floods in the summer monsoon season O\T~it' different meteorological subdivisions of India for the period 1871-1984', J Climatol. 1987; 7:57-70.
18. Riaz R. Genetic Analysis for yield and yield components in spring wheat under drought conditions. Ph.D. Thesis, Dissertation, Department of Agriculture, Faisalabad Agriculture University, Faisalabad, Pakistan, 2003.
19. Shao HBL, Jallel CA, Zhao CX. Water deficit stress-induced anatomical change in higher plants, C.R Biol. 2008; 331: 215-25.
20. Shewry PR, Hey SJ. Review: The contribution of wheat to human diet and health. Food and Energy Security. 2015; 4(3):178-202.
21. World Economic Forum. 16 January Water crises are a top global risk) (https://www.weforum.org/agenda/2015/01/why-world-water-crises-are-a-top-glob al-risk/). World Economic Forum. 16 January 2015. Retrieved 30 December, 2015-2017.