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Effect of different level of irrigation and chitosan on wheat (*Triticum aestivum* L.) physiological and biochemical parameters

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Abstract
Water deficit stress is one of the most important abiotic stresses that affects plant physiological and biochemical traits. Availability of water plays important role in agriculture. In future, population increase along with a higher demand for water for irrigation and industries will put more pressure on water resources. Due to High temperature drought stress increased respiration, photosynthesis and enzyme activity in the plant and Decreased of chlorophyll level due drought stress, Effect of chitosan on physiological and biochemical 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 physiological and biochemical observed statically analysed. Result on physiological and biochemical under water deficit condition was observed. However, treatment four showed best result but the chitosan treated plant perform better than others and the chitosan treated treatments are giving better result.

Keywords: chitosan, water scarcity, drought and stress, physiological, biochemical

Introduction
As per estimation, India is blessed with good rainfall well distributed over 5-6 months in the year. The average annual rainfall in the country is 1170 mm with a wide range between 100 mm in desert areas of Rajasthan to 10000 mm in Cher punji. The total available sweet water in the country is 4000 billion m^3 per annum. Out of this, over 1047 billion m^3 water is lost due to evaporation, transpiration and runoff, reducing the available water to 1953 billion m^3 and the usable water to 1123 billion m^3. However, water consumption will increase from 829 m^3 (2006) to 1093 billion m^3 in 2025 and 1047 billion m^3 in 2050. Further India has potential for increasing the volume of utilization of water is hardly 5-10%, which bound it to face severe scarcity of water near future (Govt. of India, 2009) [7].

Drought is one of the most common environmental stresses that affect growth and development of plants. It is assumed that by the year 2025, around 1.8 billion people will face water shortage and 65% of the world's population will live under water-stressed environments. Drought, the result of low precipitation or high temperature is one of the main problems underlying the success of modern agriculture around the world and it is one of the most important environmental factors that affect the growth, development and production of plants. Drought is a non-uniform phenomenon that effect plants differently depending on the development stage at the time of its occurrence (Zhao *et al*., 2012) [18].

Drought tends to be the deficiency of precipitation causing a side impact on the society, economy and environment in a period of time. Drought stress is a decrease of soil water potential so plants reduce their osmotic potential for water absorption by congestion of soluble carbohydrates and proline and in other words osmotic regulation is performed (Martin *et al.*, 1993) [15]. Leaf relative water content (RWC) is an important indicator of water status in plants; it reflects the balance between water supply to the leaf tissue and transpiration rate (Lugojan and Ciulca 2011) [11, 13]. Decrease of relative water content close stomata and also after blocking of stomata will reduce photosynthesis rate (Cornic, 2000) [4].

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) [17]. 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 growth (Farouk *et al.,* 2011). 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 (Lamiaa and Barakat 2011) [12].

Materials 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 physiological and biochemical parameters (Chlorophyll 'a', Chlorophyll 'b', total chlorophyll, carotenoid, gluten content, relative water content) and antioxidant (proline and Superoxide dismutase) 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.

Result and Discussion

For Chlorophyll the treatments which were treated with Chitosan were showing better result in comparison to water deficit condition (20% IR, NO, CHT). However, for chlorophyll 'a' when we are comparing our observation with normal irrigation we observed that treatment T_5 (1.84 mg/g fw) were showing better result while However, T_8 (1.77 mg/g fw), T_9 (1.75 mg/g fw) and T_{10} (1.74 mg/g fw) was at par in comparison to T_7 (1.1.80 mg/g fw). And T_7 was non-significant with T_0 (1.79 mg/g fw). while for chlorophyll b However, T_8 (1.59 mg/g fw), T_9 (1.53 mg/g fw) T_{10} (1.50 mg/g fw) was at par in comparison toT_0 (1.55 mg/g fw), while T_5 (1.63 mg/g fw), T_6 (1.62 mg/g fw) was non-significant with each other Water stress effects on biochemical component of plant like chlorophyll, carotenoid and total chlorophyll of plant**.** Drought stress imposed at the vegetative stage, significantly decreased chlorophyll a content, chlorophyll b content and total chlorophyll content both at the vegetative and flowering stages, whereas drought stress imposed at anthesis also influenced these contents at flowering. Decreased or unchanged chlorophyll level during drought stress has been reported in other species, depending on the duration and severity of drought (Kpyoarissis *et al.,* 1995) [10]. clearly show that decreasing the irrigation level significantly decreased the Chl a, Chl b and carotenoid of basil The decrease in chlorophyll content under drought is a commonly observed phenomenon (Nikolaeva *et al.,* 2010) [16]. the effects of chitosan, in increasing chlorophyll contents, were confirmed in cucumber, radish, and cowpea (Farouk *et al.,* 2011) [5].

For gluten content maximum gluten content was recorded in water deficit condition in which CHT was not applied as compared to normal irrigation and CHT applied treatments. (Table 4.11) Maximum gluten content was observed in T_4 (11.70) and minimum was observed in T_5 (8.77cm). Compare to normal irrigation (100 Ir) T_5 to T_{12} are showing lower gluten level than that of others and compare to water stress condition created by different irrigation level Chitosan treatment was showing low gluten level. The highest protein aqumalation occurred in response to lowest soil moisture level. The aqumalation of protein content may be hydrolysis of protein also may be occurring in response to the change the osmotic adjustment. (H. Greenway 1980) [9].

For relative water content all the treatment in which chitosan is applied showing better results in comparison to water deficit condition T_1 (33.30) (20% IR with CHT). However, when we are comparing our observations with normal irrigation we observed that treatment T_5 (54.13). However, T_6 (52.87 %), was statistically at par in comparison to T_5. While T_6 (52.87%), T_7 (52.60) was found non-significant with T_0 (52.43). (Table 4.13). Relative water content (RWC) of leaves has been reported as direct indicator of plant water contents under water deficit conditions (Lugojan and Ciulca 2011) [11, 13]. The highest Relative water content (RWC) might be calculated at crop vegetative stage (Almeselmani *et al.,* 2011) [2]. Under water stress condition decrease in water status and osmotic potential in plants is the ultimate outcome of lower relative water content

For antioxidant Proline and Superoxide dismutase (SOD) treatments under water stress are showing higher level Proline and superoxide dismutase level the highest level was found in T_4(20% IR with no CHT). However, when we are comparing our observation with normal irrigation we observed that treatment T_4 (Proline1.04; SOD 1.31) are showing better result while T_{19} (2.42 µg/g fw) and T_{18} (2.36µg/g fw), T_{17} (2.37 µg/g fw) was non-significant with each other (Table 4.12). T_5 to T_{10} are showing lower stress level of hormones than that of others and compare to water stress condition created by different irrigation level Chitosan treatment was showing low proline and Sod level. Increase substances such as proline, glycine and betaine can be one of the major molecular responses to drought stress is (Matysik *et al.,* 2002) [14]. The activities of SOD application of chitosan corroborated with the observation of Caiyan (2010) in A. annual. Which were higher than control and (Ngo 2015).

Table 1: Effect of different level of irrigation and Chitosan on chlorophyll 'a', 'b', total chlorophyll, carotenoid, gluten, RWC, proline and SOD of wheat

Treatments	Chlorophyll 'a' (mg/g fw)	Chlorophyll 'b' (mg/gfw)	Total Chlorophyll (mf/g fw)	Carotenoid (mg/g fw)	Gluten Content (%)	Relative Water Content (%)	Proline (µg/gfw)	Superoxide Dismutase (µg/gfw)
T_0	1.79	1.39	3.18	2.82	9.13	52.43	2.17	1.13
T_1	1.73	1.33	3.06	2.72	9.70	51.23	2.76	1.21
T_2	1.67	1.24	2.91	2.61	10.17	49.07	3.84	1.27
T_3	1.56	1.12	2.68	2.48	10.83	45.23	4.05	1.32
T_4	1.39	1.07	2.46	2.39	11.70	33.30	4.28	1.39
T_5	1.84	1.48	3.32	2.88	8.77	54.13	2.04	1.09
T_6	1.82	1.46	3.28	2.85	8.90	52.87	2.10	1.10
T_7	1.80	1.40	3.20	2.83	9.03	52.60	2.13	1.12
T_8	1.77	1.38	3.14	2.81	9.23	52.30	2.64	1.15
T_9	1.75	1.36	3.11	2.79	9.37	51.93	2.66	1.17
T_{10}	1.74	1.34	3.09	2.73	9.63	51.43	2.71	1.19
T_{11}	1.72	1.31	3.03	2.69	9.77	50.17	3.63	1.21
T_{12}	1.71	1.29	3.01	2.64	9.87	49.77	3.70	1.23
T_{13}	1.69	1.26	2.95	2.62	10.00	49.27	3.83	1.25
T_{14}	1.64	1.23	2.87	2.60	10.27	48.43	3.87	1.28
T_{15}	1.61	1.19	2.80	2.59	10.50	48.07	3.94	1.30
T_{16}	1.58	1.17	2.75	2.51	10.67	45.37	4.04	1.31
T_{17}	1.55	1.10	2.67	2.46	11.00	40.63	4.06	1.33
T_{18}	1.55	1.12	2.65	2.44	11.43	35.20	4.15	1.35
T_{19}	1.51	1.09	2.60	2.41	11.57	33.90	4.25	1.38
Mean	1.67	1.27	2.94	2.64	10.08	52.43	3.24	1.24
SE. d	0.054	0.031	0.068	0.043	0.158	0.725	0.288	0.025
C.D (5%)	0.161	0.093	0.204	0.086	0.470	2.156	0.586	0.075
C.V	5.383	4.648	4.148	1.981	2.824	2.750	10.671	3.445
F Test	S	S	S	S	S	S	S	S

Conclusion

Under water deficit condition all the treatments are showing better results in comparison to T_0 (100% IR and without CHT) for physiological and biochemical parameters. Although T_5 was showing best result for chl.'a' (1.84 mg/g fw), chl 'b' (1.48 mg/g fw), Total chl. (3.32 mg/g fw), carotenoid 2.88 mg/g fw), and SOD, gluten and proline content showing in high stress level in T_4. Compare to normal irrigation (100 Ir), T_5 to T_{10} are showing lower stress level of hormones than that of others and compare to water stress condition created by different irrigation level Chitosan treatment was showing low stress level.

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