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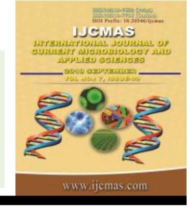

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Impact of Different Level of Level of Irrigation and Antitranspirant upon Wheat (*Triticum aestivum* L.) Growth and Yield under Soil Application of Hydrogel

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A B S T R A C T

Suitable Irrigation to the crop is an important attribute for potential yield of among various crops. Present scenario of weather fallouts at destructing besides allocating rainfall pattern leading to different water stress. In some part of U.P, especially eastern U.P will face in temperature (3 to 5ºC up to 2050) as per SAPCC, due to increase in rate of transpiration that will rise demand. To cope up with coming situation the experiment was conducted at Central Agricultural field, Sam Higginbottom University of Agriculture, Technology & Sciences, U.P on wheat variety (HD-2967). Hydrogel and Chitosan were taken under different concentration to evaluate the efficacy of hydrogel on wheat (*Triticum aestivum* L.) Physio-biochemical and yield under different levels of Irrigation and Chitosan. Absorbing the water and retaining water in the soil and by reducing the loss of water through stomata by forming a layer of waxy coating, is the aspect to be considered to deal with such arriving future. Superabsorbent polymer can absorb large quantities of water and retain in soil and Antitranspirant may reduce the loss of water via transpiration.Hydrogel (50%) and Chitosan (100%,75% and 50%) with twenty-five treatments and three replications along with control were laid out in randomized block design Result on Growth and Yield under soil application of Hydrogel was observed Treatment T_1 (100% HG and 100% CHT) showed best results, however T_2 was statistically at par with $T_{1,}$ whereas comparing with control T_0 (100% IR 70 Lit +NO SAP +NO AT.

Introduction

Water is necessary for plant growth and development as it is involved in various physiological functions and is essential for different metabolic activities (Saeedipour, 2012). It has been said that water stress is considered to be most important among various environmental factors that drastically reduce plant production (European plant science organisation, 2005).

Climate change and global warming has destructing the available natural resources and agriculture (Paul, 2000). The change in pattern of precipitation it would directly affects the water resources in the concerned region. If the frequency and quality of rainfall changes that it alters the stream flows pattern and demands especially in agriculture, soil moisture and ground water reserves (Dore, 2005). Such increasing in temperature and low rainfall UP will face rise in temperature (2-4.5) and water scarcity condition, which is directly, effects on agriculture production (SAPCC, 2014). In the areas of India affected with water stress were declining half of its potential yield comparing with irrigated areas (GoP, 2010).

Wheat (*Triticum aestivum* L.) is an essential grain food component and is a very important commodity among cereal crops (Montazeri *et al.,* 2005). Demand of the wheat is increasing gradually due to growing world population and millions of hectares of agriculture land are being lost every year in India due to stresses (Ashraf *et al.,* 2004).

Water requirement of wheat plant is estimated as 450-650mm /ha. Due to current water shortage issues, it is essential that the water use efficiency (WUE) of wheat be improved, while maintaining, or potentially increasing, grain yields (Shin *et al.,* 2012). There are various management practices through which water soil relationship can be maintained to make plant withstand water stress condition.

The use of water absorbing polymers (i.e., hydrogels) or superabsorbent polymers (SAPs) such as polyacrylates cross-linked with polyacrylamides (PAM) can effectively improve the top soil's ability to store water available for plant growth and production (Yu *et al.,* 2011), and reduce seepage of water, and fertilizer and heavy metal leaching down the soil profile (Qu and Varennes, 2009). It was designed specifically to perform in tropical and sub-tropical conditions of the country. Similar products of foreign origin introduced and tried in India. Antitranspirants are chemical compounds applied to plants to reduce transpiration and maintain high plant water status Chitosan is an antitranspirant compound that has proved to be effective in many crops (Karimi *et al.,* 2012) and can help to preserve water resources use in agriculture (Bittelli *et al.,* 2001).

Under chitosan application plant reacts to water deficit with a rapid, abscisic acid (ABA)-mediated closure of stomata bringing down rate of transpiration (Pospisilova *et al.,* 2003). The objective of this study was to understand the relationship of hydrogel for better growth and biochemical parameters of wheat under different level of irrigation and chitosan.

Materials and Methods

Present study was conducted central agricultural field of SHUATS as per the purpose of study experiment was conducted based on surface irrigation to create water deficit condition for Wheat variety (HD-2967), and experiment has undertaken with different irrigation levels & chitosan. Over all 25 treatments has been undertaken with soil application hydrogel (7kg/ha). Different biochemical parameters have been recorded & statistically analysed during the course of study (Table 1).

Results and Discussion

For plant height which were treated with Hydrogel and Chitosan are showing better result in comparison to water deficit condition. When compared with Control (100% IR 70 Lit +NO SAP +NO AT) (35.62). Maximum plant height was observed in T1 (77.96 cm) followed by T2 (73.60 cm), T3 (72.66 cm), T4 (70.44 cm), T5 (69.48 cm), T6 (66.80 cm), T7 (64.45 cm), whereas, Minimum plant height was observed in T24 (56.48 cm) Table 2.

Hydrogel have been reported to increase the activity of cell division, cell expansion and cell elongation, ultimately leading to an increased plant height (Singh *et al.*, 2015). Similar results have been reported by (Sivalapan, 2001) in soybean and (Kumaran *et al.*, 2001) in tomato. For Number of Tillers (per hill) all the treatments under water deficit condition Over the stress treatments, stress imposed at vegetative caused decline of 19.11% in tillers as compared to non-stresses condition. When compared with Control (100% IR 70 Lit +NO SAP +NO AT) (6.56). Maximum Number of Tillers was observed in T1 (11.20 per/hill) followed by T2 (7.33 per/hill), T3 (7.27 per/hill), T4 (6.93 per/hill), T5 (6.60 per/hill), T6 (6.60 per/hill), whereas, Minimum Number of Tillers was observed in T24 (4.87 per/hill) Table 2. Similar to present findings (Kimurto *et al.,* 2003) and (Baque *et al.*, 2006) have reported that water stress at tillering or at booting significantly affected the formation of tillers in wheat. For flag leaf length and flag leaf width all the treatments under water deficit condition. when compared with Control (100% IR 70 Lit +NO SAP +NO AT) (11.34) Maximum Flag Leaf Length was observed in T1 (14.40 cm) followed by T2 (13.24 cm), T3 (12.84 cm), T4 (12.54 cm), T5 (11.94 cm), T6 (11.53), T7 (11.46 cm), whereas, Minimum Flag Leaf Length was observed in T24 (7.93 cm) Table 2 compared with Control (100% IR 70 Lit +NO SAP +NO AT) (2.02).

Maximum Flag Leaf Width was observed in T1 (1.73 cm) followed by T2 (1.66 cm), T3 (1.62 cm), T4 (1.57 cm), T5 (1.49 cm), T6 (1.46 cm), T7 (1.42 cm), whereas, Minimum Flag Leaf Width was observed in T24 (1.01 cm) Table 2. The decreasing graph in grain number was linked with reduced leaf area and lower photosynthesis as outcome of drought stress (Fischer *et al.,* 1980). For spike length per spike and number of spikelet's per spike all the treatments which were treated with Hydrogel and Chitosan were showing better result in comparison to water deficit condition. When compared with Control (100% IR 70 Lit +NO SAP +NO AT) (6.68). Maximum spike length was observed in T1 (11.25 cm) followed by T2 (7.83 cm), T3 (7.53 cm), T4 (7.26 cm), T5 (6.99 cm), T6 (6.96 cm), T7 (6.89 cm), whereas, Minimum Spike Length was observed in T24 (5.41 cm) Table 3 compared with Control (100% IR 70 Lit +NO SAP +NO AT) (11.56). Number of Spikelet's was observed in T1 (16.07 per spike) followed by T2 (15.33 per spike), T3 (14.07 per spike), T4 (13.73 per spike), T5 (13.53 per spike), T6 (13.40 per spike), T7 (12.13 per spike), whereas, Minimum Number of Spikelet's was observed in T24 (8.40 per spike) (Table 3).

The decrease in stem height and ear length due to water stress has been reported earlier in wheat (Iqbal *et al.,* 1999). For yield parameters grain yield, 1000 grain weight all the treatments in which Hydrogel and chitosan is applied were showing better results in comparison to water deficit condition Maximum Grain yield was observed in T1 (32.65 q/ha^{-1}) followed by T2 (24.49 q/ha^{-1}), T3 (22.47 q/ha^{-1}), T4 (21.42 q/ha^{-1}), T5 (20.83 q/ha^{-1}), T6 (20.42 q/ha^{-1}), T7 (19.56 q/ha^{-1}) whereas, Minimum Grain Yield was observed in T24 (8.67 q/ha^{-1}) Table 3. Maximum Test Weight was observed in T1 (42.81 gm) followed by T2 (32.35 gm), T3 (31.45 gm), T4 (29.16 gm), T5 (28.56 gm), T6 (28.36), T7 (28.00 gm) whereas, Minimum Test Weight was observed in T24 (17.34 gm) Table 3. The results of many researches show that drought stress at different stages of the growth wheat under different levels Irrigations and Chitosan. Lead to a reduction in the yield of biomass, grain yield, harvest index and grain yield components wheat under different levels Irrigations and Chitosan (Gooding *et al.*, 2003; Garcia *et al.*, 2003 and Zaharieva *et al.*, 2001).

Table.1 Treatment details

Treatments	Treatment combination
T_0	100% IR 70 Lit +NO SAP +NO AT
T_1	80%IR (56 Lit) +100%AT (250ppm) +50%SAP (0.2 gm)
T_2	80%IR (56 Lit) +100%AT (250ppm) +NO SAP
T_3	80%IR (56 Lit) +75%AT (187ppm) +50%SAP (0.2 gm)
T_4	80%IR 56 Lit +75%AT (187ppm) + NO SAP
T_5	80%IR (56 Lit) +50%AT (125ppm) + 50%SAP (0.2 gm)
T_6	80%IR (56 Lit) +50%AT (125ppm) + NO SAP
T_7	80%IR (56 Lit) +NOAT +50%SAP (0.2 gm)
T_8	80%IR (56 Lit) + NOAT +NO SAP
T_9	60%IR (42 Lit) +100%AT (250ppm) +50%SAP (0.2 gm)
T_{10}	60%IR (42 Lit) +100%AT (250ppm) + NO SAP
T_{11}	60%IR (42 Lit) +75%AT (187ppm) +50%SAP (0.2 gm)
T_{12}	60%IR (42 Lit) +75%AT (187ppm) + NO SAP
T_{13}	60%IR (42 Lit) +50%AT (125ppm) +50%SAP (0.2 gm)
T_{14}	60%IR (42 Lit) +50%AT (125ppm) +NO SAP
T_{15}	60%IR (42 Lit) + NOAT+50%SAP (0.2 gm)
T_{16}	60%IR (42 Lit) + NOAT+NO SAP
T_{17}	40%IR (28 Lit) +100%AT (250ppm) +50% SAP (0.2 gm)
T_{18}	40%IR (28 Lit) + 100%AT 250ppm + NOSAP
T_{19}	40%IR (28 Lit) +75%AT (187ppm) +50%SAP (0.2 gm)
T_{20}	40%IR (28 Lit) +75%AT (187ppm) +NO SAP
T_{21}	40%IR (28 Lit) +50%AT (125ppm) +50%SAP (0.2 gm)
T_{22}	40%IR (28 Lit) +50%AT (125ppm) +NO SAP
T_{23}	40%IR (28 Lit) +NOAT +50% SAP (0.2 gm)
T_{24}	40%IR (28 Lit) +NOAT+ NOSAP

Table.2 Efficacy of Pusa hydrogel on plant height (cm), number of tillers (per hill), flag leaf length (cm) and flag leaf width (cm) of wheat under different levels of irrigation and chitosan

Treatments	Plant height (cm)	No. of tillers per hill	Flag Leaf Length (cm)	Flag Leaf Width (cm)
T_0	64.31	6.56	11.34	1.39
T_1	**77.96**	**11.20**	**14.40**	**1.73**
T_2	73.60	7.33	13.24	1.66
T_3	72.66	7.27	12.84	1.62
T_4	70.44	6.93	12.54	1.57
T_5	69.48	6.60	11.94	1.49
T_6	66.80	6.60	11.53	1.46
T_7	64.45	6.57	11.46	1.42
T_8	64.20	6.53	11.28	1.38
T_9	63.40	6.47	11.21	1.34
T_{10}	63.18	6.33	11.13	1.32
T_{11}	63.04	5.93	11.09	1.29
T_{12}	62.30	5.80	11.08	1.27
T_{13}	62.02	5.73	11.07	1.25
T_{14}	61.94	5.73	11.06	1.23
T_{15}	61.34	5.73	10.97	1.21
T_{16}	61.22	5.67	10.93	1.18
T_{17}	60.78	5.64	10.91	1.15
T_{18}	59.90	5.62	10.81	1.13
T_{19}	59.48	5.61	10.78	1.11
T_{20}	58.74	5.60	10.69	1.09
T_{21}	58.24	5.60	10.51	1.07
T_{22}	58.00	5.00	10.48	1.05
T_{23}	57.64	4.93	10.28	1.03
T_{24}	**56.48**	**4.87**	**7.93**	**1.01**
Mean	**63.66**	**6.23**	**11.26**	**1.30**
C.D.	**1.282**	**0.620**	**0.848**	**0.082**
SE(m)	**0.450**	**0.431**	**0.298**	**0.029**
F-test	**Significant**	**Significant**	**Significant**	**Significant**

Table.3 Efficacy of hydrogel on Spike length (cm), Number of spikelet (per spike), grain yield (q/ha), harvest index (%) of wheatunder different levels of irrigation and chitosan

Treatments	Spike length (cm)	Number of spikelet's/spikes	Grain yield (q/ha^{-1})	Harvest index (%)
T_0	6.68	11.56	20.19	411.76
T_1	**11.25**	**16.07**	**32.65**	**523.82**
T_2	7.83	15.33	24.49	481.19
T_3	7.53	14.07	22.47	468.3
T_4	7.26	13.73	21.42	441.21
T_5	6.99	13.53	20.83	423.18
T_6	6.96	13.40	20.42	421.13
T_7	6.89	12.13	19.56	415.29
T_8	6.57	11.40	18.83	408.15
T_9	6.55	11.20	18.74	407.85
T_{10}	6.41	11.00	18.17	406.62
T_{11}	6.34	10.80	17.67	404.23
T_{12}	6.32	10.73	17.33	400.99
T_{13}	6.27	10.73	17.24	396.69
T_{14}	6.27	10.67	17.02	395.29
T_{15}	6.26	10.63	16.83	395.24
T_{16}	6.24	10.60	16.17	393.65
T_{17}	6.08	10.53	16.12	390.26
T_{18}	5.95	10.40	15.17	389.91
T_{19}	5.89	10.27	14.93	389.67
T_{20}	5.84	9.27	14.54	388.21
T_{21}	5.72	9.13	14.39	387.74
T_{22}	5.61	9.13	14.33	385.31
T_{23}	5.59	8.93	14.24	383.88
T_{24}	**5.41**	**8.40**	**8.67**	**302.83**
Mean	**6.59**	**11.35**	**18.10**	**399.42**
C.D.	**0.251**	**0.154**	**77.172**	**2.191**
SE(m)	**0.088**	**0.546**	**27.103**	**0.770**
F-test	**Significant**	**Significant**	**Significant**	**Significant**

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 Economical yield (Gebeyehu, 2006).

Under Agro climatic condition of Allahabad This study may conclude that T_1 is performing best for all the absorbed parameters with maximum yield (32.65q/ha^{-1}) Minimum performance was showed by T_{24} yield (8.67q/ha^{-1}). Whereas in Proline, Superoxide dismutase under stress condition treatments are showing better in T_{24} than T_1. Recommendation: T_1, T_2, T_3, T_4, T_5, T_6, T_7 from all treatments are performing well, according to requirement and retention capacity of the soil any of these treatments can be adopted by the farmer.on the basis of cost benefit analysis following treatments are performing better comparison to T_0, thus on the basis of soil condition and availability of water any of these can be adopted by the farmer.

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