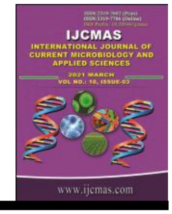
Int.J.Curr.Microbiol.App.Sci (2021) *10*(03): 166-175

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 10 Number 03 (2021)**
Journal homepage: http://www.ijcmas.com



Original Research Article https://doi.org/10.20546/ijcmas.2021.1003.023

Impact of Excess Moisture in Onion Genotypes (*Allium cepa* L.) under Climate Change Scenario

Shambhavi Dubey[1], V. B. Kuruwanshi[1*], Kiran P. Bhagat[2] and P. H. Ghodke[2]

[1]*Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India*
[2]*ICAR-Directorate of Onion and Garlic Research, Pune, Maharashtra, India*

**Corresponding author*

Keywords

Antioxidants, Onion, Phenols, Water logging, Weather parameters

Article Info

Accepted:
04 February 2021
Available Online:
10 March 2021

A B S T R A C T

Intensity and frequency of abiotic stresses in plants are increasing globally under present changing climatic scenario. The recent decades increasing frequent and severe flooding events due to erratic and unseasonal rainfall pattern negatively impacted the overall agriculture productivity globally. Onion is one of the most water logging sensitive crops as severity of depleting oxygen and light supply to the developing roots are very high, thereby affecting the gas exchange process and inducing anaerobic fermentation pathways ultimately affecting plants normal metabolic pathways in waterlogged soil. Therefore, the present investigation was conducted at ICAR- Directorate of Onion and Garlic Research, Rajgurunagar, Pune, Maharashtra, *kharif*, 2018-19, to examine the impact of water logging stress in onion. The experiment was conducted in pot condition to provide appropriate artificial water logging condition. The experimental materials comprises of 17 onion entries including red and white onion entries. The seedlings of each entry were raised from seeds in nursery for 45 days with recommended cultural practices and after that transplanted in pot experiment. Thereafter, an artificial water logging condition was imposed to one set for 120 hours and one set was kept as control. Results obtained from experiments indicated that water logging condition significantly affected most of the morpho-physiological parameters in onion genotypes and also it led to enhance defense mechanisms under water logging condition. The percent reduction in leaves and related parameters were recorded lowest in RGP 5 and Acc 1664, whereas it was highest in W 344 and W 448 among the studied onion genotypes under excess moisture condition when compared with control. Though, the percent reduction in survival counts was recorded highest in Bhima Red (99.48) and Bhima Super (99.39), whereas it was lowest in Acc 1630 (80.05) and Bhima Shweta (90.08). Moreover, the percent reduction of recovery was observed highest in Acc 1664 (90.15) and RGP 5 (89.83), whereas it was lowest in W 344 (22.83) and Bhima Dark Red (30.16) among the studied onion genotypes under excess moisture condition when compared with control. The concentrations of antioxidants, secondary metabolites such as phenols and flavonoids which are part of efficient plant defense mechanism, are also found better in RGP 5 and Acc 1664, whereas it was lower in W 344 and W 448 onion genotypes among the studied onion genotypes under excess moisture condition. The percent reduction in single bulb weight was recorded lowest in RGP 5 (1.47) followed by Acc 1664 (19.04) and Bhima Red (21.73), whereas it was highest in W 344 (76.94) followed by W 361 (73.57) and W 448 (65.61) among the studied onion genotypes under excess moisture condition when compared with control. The genotypes which are survived and recovered from the apprehensive stress, it is not necessary that it yields better. The source-sink relationship of individual genotypes defined the ultimate yield potential under various exposures to stress conditions. There is meager work on impact of water logging in onion has been done so far, our study abridge the research gap and strengthening the research material with respect to response of onion under water logging stress.

Introduction

The changing pattern of weather and climate, and its impact study are the imperative task across the globe due to climate change scenario. These changes hamper many interdependent physical and bio-chemical processes which are ongoing in ecosystems on the earth. These processes in terms of plant life, can be affected by change in climate, various abiotic stresses such as drought, water logging, salinity etc. and several biotic stresses. Change in rainfall pattern is significantly either creates drought or severe flood conditions resulting in negative performance of almost all crops in terms of yield. Abiotic stress from water logging and flooding affects large areas of the world (Martinez-Alcantara *et al.,* 2012); and onion crop is not an exception for this stress condition.

Onion (*Allium cepa* L.) is one of the economically important *Allium* crops belonging to the family- *Alliaceae,* which is highly recognized for its distinct flavor and nutritive values throughout the world. It is cultivated for food, medicines and religious purpose since ancient times. World-wide, onion cultivation is expanding tremendously owing to its great demand for domestic consumption and trade in national and international market. India ranks first in area and second in onion production, the first being China (Kumar *et al.,* 2015; Laxmi *et al.,* 2017). India has about 1.2 million hectare area under onion cultivation constituting about 10% of total acreage under vegetable with an annual production of 19.40 MT in 2015 (Singh *et al.,* 2017). Despite this the productivity of onion in India is very low i.e. 14.21 tons/ ha as compared to other countries (Tripathi *et al.,* 2017). The major reason for its low productivity is mainly the environmental constraints namely biotic and abiotic stress.

Onion is mainly a cool season crop and performs well during winter followed by early part of summer. In India, onion is mainly cultivated in three major season i.e., *Kharif*, late-*Kharif* and *Rabi* contributing about 20%, 20% and 60% respectively. In short day onion varieties, bulb initiation takes place between 10-15^{0}C night and 20-25^{0}C day temperature. Bulb development is best at 18-20^{0}C night and 25-30^{0}C day temperature. For maturity, day temperature between 35-38^{0}C are required. Sunshine hours of 12-13 hours during bulb development and maturity, humidity between 65-75% and 500-600mm well distributed rainfall ensures good crop growth. Thus, weather plays a predominant role in growth, development and productivity of onion crop.

However, the recent aberrant weather events are the major constraints limiting onion production and its storage quality. Onion crop is extremely sensitive to water logging or soil flooding stress due to its shallow root growth habit. The maximum root penetration is about 75 cm in onion crop with high root density occurring in top soil layer of 18 cm (Drinkwater and Janes, 1955). So, it is essential to maintain the optimum moisture in the upper layer of the soil for good bulb development. This root architecture makes the onion crop highly susceptible to excess moisture stress particularly during *kharif* season. The extent of damage due to flooding depends on the season, soil property, variety, crop growth stage, intensity and duration of rainfall that overall predict the bulb yield and survival potential of a particular onion variety. Since in future due to changing climatic and rainfall distribution pattern most of the onion growing belt might be subjected to heavy rainfall leading to soil flooding condition. To cope with such situation identification of improved onion genotypes with better adaptive traits and tolerance character are of particular interest for developing water logging tolerant onion variety for flood prone areas. Although progress has being made in developing adaptive strategies for water logging tolerance in other crops, however, little is known in onion crop.

Most of the previous findings mainly focused on refining agronomic management and production technologies, however, it is not up to that extend which can summaries the exact physiological and biochemical changes that occurred during frequent or prolonged water logging stress in onion crop.

Thus, in order to address the challenges ahead and achieving sustainable onion production in the flood risk environment a thorough understanding of various physiological and biochemical traits governing the various adaptive mechanism need to be focused. In this context, the study was conducted with contrasting onion genotypes to evaluate the impact of weather parameters and water logging condition on different physiological and adaptive mechanism. The findings will help in thorough understanding of the mechanism governed by the tolerant onion genotype in order to sustain under waterlogging condition.

Materials and Methods

A pot experiment was conducted with 17 onion genotypes in rainout shelter using plastic pot at ICAR- Directorate of Onion and Garlic Research, Rajgurunagar, Pune (M.H.) during *kharif* 2018-19. Seeds of the genotypes were procured from Department of Crop Improvement, ICAR-Directorate of Onion and Garlic Research, India.

The one set is used for treatment by creating artificial water logging condition with the help of tank pit and another set were kept outside in rainout shelter was taken as control. Plan of layout are mentioned below-

Crop	**Onion (*Allium cepa* L.)**
Season	*Kharif* 2018
Design	Factorial CRD
Plastic Pot Size	20 Litre (Soil/pot 20 kg)
Spacing	Plant to Plant- 8cm Row to Row-8cm
Plant/Pot	20
No. of Treatment	17
No. of Replication	3
Start of Treatment	45 DAT
End of Treatment	50 DAT

The agro-meteorological data from the experimental site during the period of experimentation was recorded by Agro-meteorology Observatory Unit, installed by Indian Meteorological Department, Pune at ICAR- Directorate of Onion and Garlic, Rajgurunagar, Pune and the represented data shown with graph in figure 1 on weekly basis.

Plant material and water logging treatment

The seedlings of each genotype were raised in nursery for six weeks with recommended cultural practices and after that transplanted in plastic pot of size 30cm width, 30cm height and 50cm length. Each pot was filled with Garden soil of sandy loam texture (32-35% clay, 20% silt and 40% sand) and vermicompost in the ratio of 2:1. The experimental site was at ICAR-Directorate of Onion and Garlic Research, Pune; Maharashtra, India was situated at 18.32^0 North latitude and 73.51^0 East longitude, 553.8m above mean sea level with annual rainfall of 574mm. All the recommended agronomical and plant protection practices were carried out in order to raise a good crop. Artificial water logging condition was created in tank. Each genotype were planted in 20 pots out of which 10 pots were kept as control where normal water supply was maintained and kept under Rainout shelter to avoid the rainfall. Twenty plants were planted in each pot by maintain a spacing of about 8cm in between two plants. After 30 days of transplanting, remaining 10 pots of each genotype was subjected to water logging stress by creating an artificial water logging condition in tank where water level was maintained 5cm above the soil surface for continuous 120 hours and after that plants were kept for recovery.

Morphological and physiological parameters

Plants were monitored daily for various phenotypic and physiological traits during stress period. The survival percentage were recorded when the whole plant get collapsed for each genotype whereas the recovery percentage was recorded 10 days post waterlogging treatment. The phenotypic traits like plant height, number of leaves per plant, leaf length, leaf area and root length was recorded from both control and stressed plants in order to evaluate the impact of water logging treatment on overall plant growth.

The survival percentage was recorded after 120 hours when plants were relieved from water logging treatment. Survival rate is calculated by counting the number of plants of each replication that have survived, divided it by the number of plants originally planted of that replication and multiply by 100 to express as a percentage of survival.

$$Survival\ \% = \frac{Number\ of\ remaining\ plats}{Number\ of\ plants\ originally} \times 100$$

The recovery percent was recorded at the time of harvesting. The bulb from each replication was counted and then compare with the initial plant planted. The percent value was calculated and recorded as recovery percentage.

$$Recovery\ \% = \frac{Final\ \ Plant - Initial\ Plant}{Final\ Plant} \times 100$$

Biochemical parameters

For biochemical analysis, 4^{th} leaf sample were collected after water logging treatment and immediately used for biochemical analysis. The antioxidant activity is determined by Ferric Reducing Antioxidant Power (FRAP) Assay method described by Sharma (2014). The ability to reduce ferric ions was measured using the method Total flavonoids content was determined method given by Olivera (2008). Phenol content from onion bulb was quantified by using method given by Ainsworth and Gillespie (2007). All the results of antioxidant activity, flavonoids and phenols were expressed in mg per gram of sample.

Yield and quality parameters

Bulb yield in grams was calculated after harvesting on the basis single weight of onion bulb obtained from each genotype. The polar bulb size was measured with the help of vernier callipers. The average of 5 bulbs was used to measure the polar bulb size and expressed in mm. The equatorial bulb size was measured with the help of vernier callipers. Same bulb which is used to measure the polar bulb size were subjected to measure the equatorial bulb size, The average value is taken as equatorial bulb size and expressed in mm.

Statistical analysis

The data obtained from the above experiment was analysed in factorial CRD as given by Panse and Sukhatme (1967). The significance of difference was tested by 'F' test. 5% level of significance was used to test the significance of result. The critical difference were calculated when difference among the treatments were found significant by 'F' test. The statistical analysis was done by using SPSS 16.0

Results and Discussion

Genetic performance of red and white onion along with DOGR varieties were recorded in this experiment and the physiological and biochemical changes took place due to excess moisture were discussed below.

Impact of excess moisture on onion leaves

Onion leaves and its related parameters are the most affected after roots due to flooding. The effect of water logging stress on number of leaves, leaf length and leaf area was significantly differed among the onion genotypes under water logging condition (Table 1). The percent reduction in number of leaves was recorded lowest in RGP 5 (1.67) followed by Acc 1664 (2.83) and Bhima Red (4.21), whereas it was highest in W 448 (26.32) followed by W 344 (25.53) and W 361 (24.77) among the studied onion genotypes under excess moisture condition when compared with control. In case of leaf length, the percent reduction was recorded lowest in RGP 5 (0.54) followed by Acc 1664 (1.19) and Bhima Super (2.56), whereas it was highest in W 344 (39.98) followed by Bhima Dark Red (33.20) and W 448 (26.76) among the studied onion genotypes under excess moisture condition when compared with control. In case of leaf area, the percent reduction was recorded lowest in RGP 5 (0.13) followed by Acc 1664 (6.33) and Bhima Shweta (10.93), whereas it was highest in W 448 (109.86) followed by W 344 (109.80) and Bhima Raj (99.80) among the studied onion genotypes under excess moisture condition when compared with control. The overall observations of studied onion genotypes for leaf and related parameters shown that genotypes RGP 5 and Acc 1664 performed consistently better while W344 and W448 observed consistently inferior as compared to other onion genotypes under water logging condition. This might be differing due the difference in expression of genetic potential of the individual genotype under water logging condition. Similar results were obtained by Aldana *et al.,* (2014) in cape gooseberry and Saha *et al.,* (2016) in sesame.

Impact of excess moisture on survival and recovery percentage

The survival and recovery percentage is vital parameters to be recorded after plant exposure to any kind of stress. The percent reduction in survival counts was recorded highest in Bhima Red (99.48) followed by Bhima Super (99.39) and RGP 5 (99.37), whereas it was lowest in Acc 1630 (80.05) followed by Bhima Shweta (90.08) and Bhima Dark Red (90.04) among the studied onion genotypes under excess moisture condition when compared with control. When we recorded recovery of genotypes, the percent reduction was recorded highest in Acc 1664 (90.15) followed by RGP 5 (89.83) and Bhima Super (80.30), whereas it was lowest in W 344 (22.83) followed by Bhima Dark Red (30.16) and W 448 (47.45) among the studied onion genotypes under excess moisture condition when compared with control (Fig. 2). The ability of plant to get survives and recovers after stress elimination is majorly contributed by genetic potential of the individual genotype. The higher percentage of recovery in our experiment emphasized on the tolerance capacity and lower percentage of recovery emphasized on the susceptibility of individual onion genotypes under excess moisture stress.

Impact of excess moisture on biochemical parameters

As the plant exposed to abiotic stresses, its defense mechanisms get activated and as a result, concentration of antioxidants, secondary metabolites such as phenols and flavonoids increase to cope up with stresses. The similar results were obtained in our study, when we imposed water logging stress to onion plants but the significant variation was observed among the onion genotypes but the concentrations in leaves and bulb were diverge (Figure 3, 4 and 5). The percent increase in antioxidants was recorded highest in RGP 5 (31.33 in leaf and 63.07 in bulb) followed by Acc 1664 (18.51 in leaf and 60.60 in bulb) and Bhima Super (15.65 in leaf and 60.58 in bulb), whereas it was lower in W 344 (1.66 in leaf and 2.21 in bulb) and Bhima Safed (4.48 in leaf and 4.02 in bulb) among the studied onion genotypes under excess moisture condition when compared with control.

Table.1 Impact of water logging stress on number of leaves, leaf length, leaf area and root-shoot ratio in onion (*Allium cepa* L.) genotypes at bulb development stage under pot condition

	Number of leaves			Leaf length (cm)			Leaf area (cm^2)		
Genotypes	**Control**	**Water logging**	**Percent Reduction**	**Control**	**Water logging**	**Percent Reduction**	**Control**	**Water logging**	**Percent Reduction**
W 344	9.90	7.37	25.53	42.57	25.55	39.98	113.85	53.58	52.94
W 448	8.86	6.53	26.32	30.97	22.68	26.76	113.92	68.63	39.76
Bhima Shubhra	8.20	7.79	5.07	36.47	34.17	6.31	61.51	52.31	14.97
Bhima Safed	10.40	8.83	15.07	41.40	34.55	16.55	56.75	29.98	47.17
Acc 1630	9.77	8.64	11.54	36.70	31.50	14.17	41.62	28.36	31.86
KH-M2	9.37	8.90	5.02	41.23	36.92	10.45	33.47	24.49	26.84
Acc 1664	9.10	8.84	2.83	33.60	33.20	1.19	41.39	38.77	6.33
Bhima Dark Red	10.16	7.68	24.41	33.93	22.67	33.20	91.64	38.75	57.71
Bhima Raj	10.17	7.89	22.44	37.03	29.78	19.59	103.85	68.04	34.48
W 361	9.93	7.47	24.77	37.53	27.55	26.60	101.46	51.35	49.39
RGP 5	9.80	9.63	1.67	32.64	32.47	0.54	49.47	49.41	0.13
W 208	8.53	7.89	7.47	39.87	34.93	12.38	37.73	27.39	27.41
W 355	9.90	8.49	14.22	41.00	34.22	16.54	51.49	33.75	34.45
DOGR HY 7	9.20	7.90	14.16	40.27	34.13	15.23	50.03	33.69	32.66
Bhima Super	7.96	7.60	4.56	40.33	39.30	2.56	32.54	28.90	11.19
Bhima Shweta	8.97	8.56	4.54	36.58	34.40	5.97	62.62	55.78	10.93
Bhima Red	9.50	9.10	4.21	33.77	31.87	5.63	40.70	34.62	14.93
Factors	**C.D. (P=0.05)**	**SE(m)**		**C.D. (P=0.05)**	**SE(m)**		**C.D. (P=0.05)**	**SE(m)**	
Factor (A)	1.203	0.425		2.009	1.005		11.817	5.909	
Factor (B)	0.413	0.146		0.689	0.345		4.053	2.027	
Factor(A X B)	N/A	0.602		2.841	1.421		16.712	8.357	

Table.2 Impact of water logging stress on number of leaves, leaf length, leaf area and root-shoot ratio in onion (*Allium cepa* L.) genotypes at bulb development stage under pot condition

	Bulb polar dm (mm)			Bulb equatorial dm (mm)			Single bulb weight (gm)		
Genotypes	**Control**	**Water logging**	**Percent Reduction**	**Control**	**Water logging**	**Percent Reduction**	**Control**	**Water logging**	**Percent Reduction**
W 344	33.09	17.58	46.89	35.38	11.25	68.19	13.62	3.14	76.94
W 448	32.89	19.50	40.70	33.49	18.20	45.66	8.63	2.97	65.61
Bhima Shubhra	42.11	35.42	15.89	19.24	14.87	22.71	4.35	2.70	37.93
Bhima Safed	33.31	21.66	34.98	34.43	19.50	43.36	6.90	2.54	63.13
Acc 1630	36.42	28.42	21.96	25.02	15.56	37.82	3.09	1.27	58.76
KH-M2	42.98	35.83	16.65	18.01	11.49	36.21	5.46	3.81	30.24
Acc 1664	36.51	34.78	4.74	22.67	22.26	1.82	4.12	3.33	19.04
Bhima Dark Red	31.34	16.85	46.24	34.53	12.08	65.02	10.96	3.48	68.25
Bhima Raj	38.23	24.97	34.67	38.02	22.92	39.71	7.65	2.65	65.39
W 361	44.15	29.92	32.23	37.23	19.63	47.28	8.46	2.24	73.57
RGP 5	34.41	32.72	4.91	16.94	16.69	1.49	4.95	4.88	1.47
W 208	43.27	35.98	16.84	21.78	14.57	33.13	3.92	2.23	43.19
W 355	33.60	23.53	29.97	34.92	22.08	36.78	6.07	2.39	60.68
DOGR HY 7	42.43	33.04	22.14	23.82	13.12	44.93	5.34	3.05	42.92
Bhima Super	32.86	30.61	6.85	19.56	18.88	3.46	4.99	3.90	21.95
Bhima Shweta	36.38	30.46	16.28	19.49	17.29	11.30	3.91	2.35	39.87
Bhima Red	25.59	22.76	11.04	17.13	15.92	7.08	5.36	4.19	21.73
Factors	**C.D. (P=0.05)**	**SE(m)**		**C.D. (P=0.05)**	**SE(m)**		**C.D. (P=0.05)**	**SE(m)**	
Factor (A)	1.943	0.972		1.991	0.995		0.803	0.401	
Factor (B)	0.666	0.333		0.683	0.341		0.275	0.138	
Factor(A X B)	2.748	1.374		2.815	1.408		1.135	0.568	

Fig.1 Agro-meteorological data (weekly) of experimental site at ICAR- DOGR, Rajgurunagar, Pune during the period of experimentation during *kharif*, 2018-19

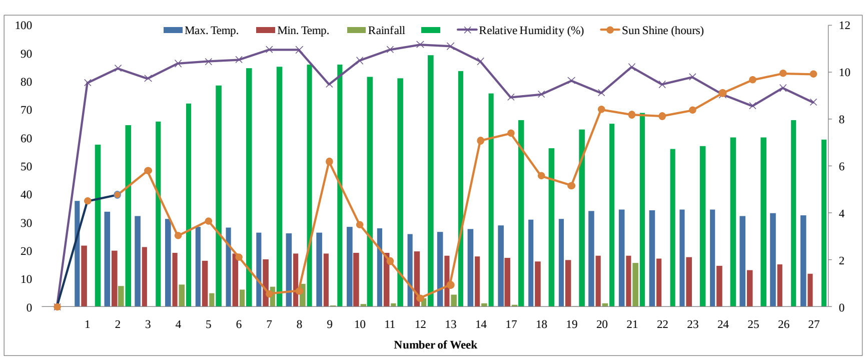


Fig.2 Impact of water logging stress on survival and recovery (%) in onion (*Allium cepa* L.) genotypes at harvest stage under pot condition

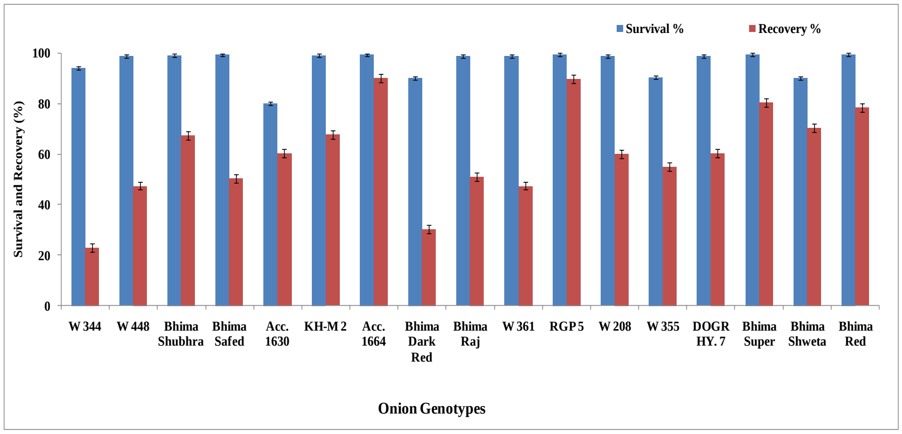


Fig.3 Impact of water logging stress on antioxidants (mg/ gm) in onion (*Allium cepa* L.) genotypes at bulb development stage under pot condition

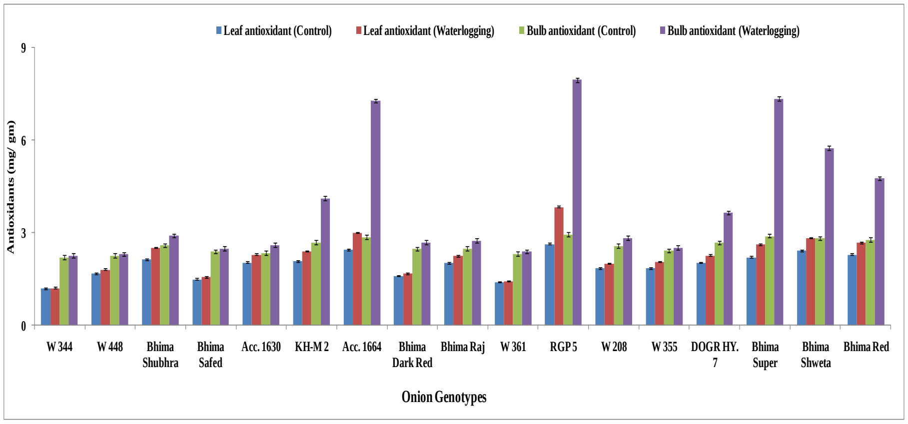


Fig.4 Impact of water logging stress on flavonoids (mg/ gm) in onion (*Allium cepa* L.) genotypes at bulb development stage under pot condition

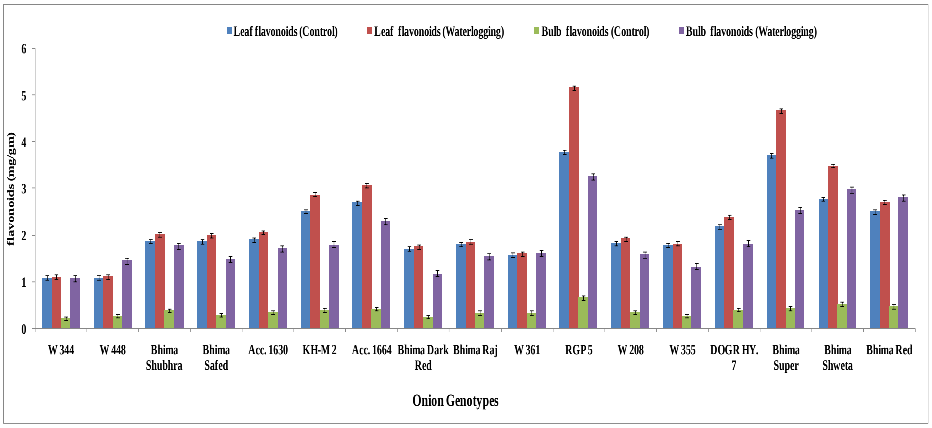
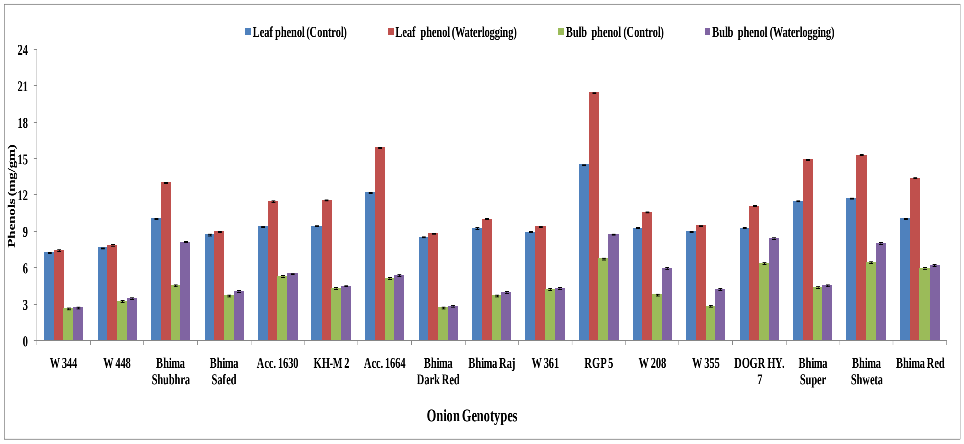


Fig.5 Impact of water logging stress on phenols (mg/ gm) in onion (*Allium cepa* L.) genotypes at bulb development stage under pot condition



In case of flavonoids, the percent increase was recorded highest in RGP 5 (26.70 in leaf and 79.85 in bulb) followed by Bhima Super (20.57 in leaf and 83.02 in bulb) and Bhima Shweta (20.54 in leaf and 82.53 in bulb), whereas it was lower in W 448 (1.81 in leaf and 81.59 in bulb) and W 344 (1.81 in leaf and 80.65 in bulb) among the studied onion genotypes under excess moisture condition when compared with control. In case of phenols, the percent increase was recorded highest in RGP 5 (17.48 in leaf and 23.26 in bulb) followed by Acc 1664 (14.08 in leaf and 4.99 in bulb) and Bhima Shubhra (22.61 in leaf and 44.57 in bulb), whereas it was lower in W 344 (2.29 in leaf and 3.06 in bulb) and W 448 (3.17 in leaf and 5.49 in bulb) among the studied onion genotypes under excess moisture condition when compared with control.

The biochemical observations of studied onion genotypes for antioxidants and secondary metabolites shown that genotypes RGP 5 and Acc 1664 performed consistently better while W344 and W448 consistently inferior as compared to other onion genotypes under water logging condition. The tendency of increasing antioxidants and secondary metabolites concentration might be differing due the difference in expression of genetic potential of the individual genotype under water logging condition.

The similar results were also reported by Ahmed *et al.,* (2002) in mungbean and Saha *et al.,* (2016) in sesame and stated that the production of defense related parameters in plants increase under flooding stress.

Impact of excess moisture on onion bulb yield and quality parameters

When plant gets exposure to stress, it may survive and recover after elimination of stress, but the yield recovery is still uncertain as yield is quantitative trait which depends on various phenotypic, genotypic and environmental factors. Though the quality parameters in case of onion bulb such as equatorial and polar diameter of onion bulbs did not show much variation, we observed significant results in single bulb weight among the studied onion genotypes.

The percent reduction in single bulb weight was recorded lowest in RGP 5 (1.47) followed by Acc 1664 (19.04) and Bhima Red (21.73), whereas it was highest in W 344 (76.94) followed by W 361 (73.57) and W 448 (65.61) among the studied onion genotypes under excess moisture condition when compared with control. The genotypes which are survived and recovered from the apprehensive stress, it is not necessary that it yields better.

The source-sink relationship of individual genotypes defined the ultimate yield potential under various exposures to stress conditions. Our results were in similarity with Ahmed *et al.,* (2002) in mungbean; Sumesh *et al.,* (2008) in wheat and Saha *et al.,* (2016) in sesame.

In conclusion the results of pot experiment revealed that among the seventeen contrasting onion genotypes, the performance of RGP 5 (Red Gene Pool 5) and Acc 1664 were observed better morpho-physiological adaptations, whereas W 344 and W 448 were among the least performed genotypes under water logging stress condition. The RGP 5 genotype also found to be superior in terms of improved biochemical traits like antioxidants, and secondary metabolites such as phenols and flavonoids recorded significantly increasing trends under water logging condition. Further, the economical traits, i.e., yield and yield attributes was also found to be significantly superior in RGP 5 followed by Acc. 1664, whereas in case of W 344, it was found the least. Hence, the present work concluded that onion genotype RGP 5 and Acc 1664 can be categorized as among the water logging tolerant genotypes, whereas onion genotype W 344 and W 448 as water logging sensitive. Therefore, the above said contrasting lines found for water logging stress can be utilized for further onion breeding research programmes.

Acknowledgement

The authors sincerely acknowledge Indira Gandhi Krishi Vishwavidyalaya (IGKV), Raipur, Chhattisgarh and ICAR-Directorate of Onion and Garlic Research, Rajgurunagar, Pune for their sincere support for research and need based facilities.

References

Martinez-Alcantara B., Jover S., Quiñones A., Forner-Giner M.A., Rodríguez-Gamir J., Legaz F., Primo-Millo E. and Iglesias D.J. 2012. Flooding affects uptake and distribution of carbon and nitrogen in citrus seedlings. *J. Plant Physiol*., 169: 1150-1157.

Panse V.G. and Sukhatme P.V. 1967. *In*: Statistical Methods for Agricultural Workers. *Indian Council of Agricultural Research*, New Delhi.

Saha R.R., Ahmed F., Mokarroma N., Rohman M.M. and Golder P.C. 2016. Physiological and biochemical changes in waterlog tolerant sesame genotypes. *SAARC J. Agri.*, 14(2): 31-45. (doi:http://dx.doi.org/10.3329/sja.v14i2.31243).

Aldana F., García P.N. and Fischer G., 2014. Effect of waterlogging stress on the growth, development and symptomatology of cape gooseberry (*Physalis peruviana* L.) plants. *Rev. Acad. Colomb. Cienc*. 38(149): 393-400.

Ahmed S., Nawata E., Hosokawa M. and Sakuratain T. 2002. Alterations of photosynthesis and some antioxidant enzymatic activities of mungbean subjected to waterlogging. *Plant Science*, 163: 117-123.

Sumesh K., Sharma-Natu P. and Ghildiyal M. 2008. Starch synthase activity and heat shock protein in relation to thermal tolerance of developing wheat grains. *Plant Biology*, 52: 749-753.

How to cite this article:

Shambhavi Dubey, V. B. Kuruwanshi, Kiran P. Bhagat and Ghodke, P. H. 2021. Impact of Excess Moisture in Onion Genotypes (*Allium cepa* L.) under Climate Change Scenario. *Int.J.Curr.Microbiol.App.Sci.* 10(03): 166-175. doi: https://doi.org/10.20546/ijcmas.2021.1003.023