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Research Article

FLUCTUATION OF *Aloe vera* GEL COMPONENT AND ADAPTATION IN DIFFERENT ENVIRONMENTAL CONDITION

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Abstract- Aloe vera is a drought resistant plant. It has glycoproteins, anthraquinones, polysaccharides and some low-molecular-weight product. It was plays very important role in adaptable to adverse condition. This experiment was conduct in RGSC Barkachha Mirzapur during winter and summer season 2014-15, for differentiation of their component and resistance in dry condition. Aloin, proline, glucose and fructose were analysis in winter and summer season. After analysis of dry weight determined that, aloe components were fluctuating in different summer and winter season. Drought stress increases the aloe secondary metabolites. Proline was a vital substance for aloe survible which resist to drought; it increases in leaves during summer season. But, aloe plants were damage near the soil attachment in presence of more moisture. In addition found that cold stress damaged cellular membrane of aloe more severely than drought stress. This indicated that aloe was better survible in drought condition than cold stress.

Keywords- Aloe, Adaptation, Dry matter, Leaf gel, Proline, Temperature, Polysaccharides and Soluble sugars.

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Introduction

Aloe vera (*Aloe barbadensis* L) is a perennial draught resistant plant [1], belong to family liliacea with succulent green leaves, originated from Africa [2]. It geographically famous in west India [3] as cultivated widely in warm and dry regions of the world. Aloe plant is stemless large, thick, fleshy leaves that have lance shape and sharp apex with spiny margin [4]. The name Aloe is derived from the Arabic "alloeh" meaning bitter shiny substance [5]. Aloe has 15-30 leaves per plant, the young leaves more or less erect and the older, lower ones more spreading. Leaves in young plant, appear at ground level, but the stem can grow up to 25 cm long in older plants [6]. The raw pulp of aloe vera contains 98.5% water, in which mucilage contains 99.5% water [6]. Remaining 0.5-1.5& solid materials contains a range of water soluble and fait soluble compounds [7]. The peripheral bundle sheath of aloe produce an bitter, yellow latex containing some amount of aloin, aloe-emodin and other related compounds [8]. Gel production and phytochemicals are highly affected by environmental factors to seasonal fluctuations [9]. The dry matter of aloe consists of polysaccharides (55%), sugars (17%), minerals (16%), proteins (7%), lipids (4%), and phenolic compounds (1%) with some seasonal fluctuations [10]. Polysaccharide is very large amount in aloe leaf than other component [11]. Carbohydrates composition of aloe vera is fluctuate with polysaccharide composition as a significant seasonal influence, between cultivars in terms of the quantities of mannose-containing polysaccharides within the parenchyma cells [12]. Aloe vera skin is rich anthraquinones and the content of aloin in leaf epidermis is significantly higher than which in the gel [13]. Aloe vera skin is also containing a variety of mineral elements and calcium, iron, zinc, manganese is higher than the content of the gel [14]. Aloe skin is regarded as a main byproducts of processing with a lot of quantity and high value of nutrition. The *Aloe vera* plant has been used for its health, beauty, medicinal value and also for skin care properties. Aloe vera is a drought tolerant plant, its water requirement depends on soil water holding capacity [15]. Aloe vera skin had good tolerance for thermo-stability [16]. The objective of my study is fluctuation of *aloe vera* gel component and adaptation in different environmental condition of summer and winter season.

Materials and Methods

This experiment was carried out in winter and summer environmental condition in RGSC Barkaccha, Mirzapur during season 2014-15 with water stress (20, 40, 60 and 80%) of the filed capacity (FC).RGSC, Barkaccha, Mirzapur is located at 25.15 ^{o}N 82.58 ^{o}E. The district of Mirzapur lies between the parallels of 23.52 and 25.32 North latitude and 83.33 East longitudes, that is a portion of Varanasi [17]. A aloe plant having 7-13 suckers. Suckers were choosing for this experiment and transplanting in field, as completely randomized block design with three replications. Each plot was having 3m width and 3m length, spacing between row to rows were 1m and plants to plant were 70cm, respectively. The aloe plant was growing in natural environment in presence of water and sun light as applicable. The growth of aloe plant was starting after 7 to 15 days. Therefore, 7-8 irrigations were given in winter and 2 irrigations were given in summer season.

Three leaf samples were selected from per plant and harvested, the leaves (harvested 3 hrs after sunrise in summer and 5 hrs in winter) were transferred to the laboratory (Department of Genetics and Plant Breeding, Institute of Agricultural Sciences BHU Varanasi) where weight was determined in fresh condition and dry. Fresh leaves were drying under the hot air ovens at a temperature of 105-110^{o}C for 24 hrs. Parenchymatous tissues were manually removed of remaining leaves sample to obtain the gel from each leaves. Proline, aloin and soluble sugar contents were analytically determines by HPLC [18].

Statistical Analysis

Data on dry matters of gel as Aloin (%), Proline (mg)g, Glucose (mg) Fructose (mg) were recorded in different season of winter and summer during 2014-15. Experimental data was subjected to one way analysis of variance (ANOVA) and significance differences between treatments by Duncan Multiple Range test (DMRT) using SPSS software package (SPSS 11.5.0 for windows, standard version 2002) procedure at $P < 0.05$.

Results and Discussion

Leaf and gel yield were affected by severe water stress in harvest seasons [9]. Low soil water potentials were decreases leaf and gel yield, so aloe yields were more loss in winter season than summer. But, aloe plants were more favorable in summer season. It having open stomata under water deficit stress condition and continues CO_2 fixation. The similar results have been reported by Delatorre-herrera et al. [19] who studied the effect of soil moisture content in aloe vera leaf.

Leaf and Fresh Gel Weight of Aloe vera Plant

Leaf and gel fresh weight were affected by water deficit stress. Comparison of means showed that leaf and gel fresh weight increased with increasing water availability. The maximum value was observed when plants were irrigated after depleting 40% of the filed capacity [Table-1]. Mean performances were testing shows that the highest fresh leaf yield was recorded in winter and summer season at RGSC, Barkaccha field. Non-significant difference was recorded among testing locations on plant height, number of harvested leaves per plant and percentage gel content. The yield and agronomic performance of aloe vera were higher and comparable results obtained as well adapted summer season of the RGSC field.

Table-1 *Fresh weight of aloe leaf and gel in summer and winter season during seaon 2015*

Water stress(%)	Harvest Season			
	Winter season		Summer Season	
	Fresh Weight of leaf (g)	Fresh weight of gel (g)	Fresh Weight of leaf (g)	Fresh weight of gel (g)
20	471.13	262.37	242.23	153.06
40	538.32	348.22	253.05	43.08
60	413.62	267.01	181.21	109.31
80	332.02	169.06	158.17	91.07
Mean	419.08	274.75	203.63	131.02

FC (%): Irrigation after depleting 20, 40, 60 and 80% of the filed capacity.

Polysaccharides Component of Aloe vera Leaf

Aloe vera parenchyma was made up of most dry matter of polysaccharides [Table-1]. Tabulated dry matters [Table-2] were analysis from the aloe leaf at four water stress (20, 40, 60 and 80). It was mainly mannose containing polysaccharides cellulose whereas the skin of the leaf contains xylose and polysaccharides [20].

Dry Matter of Aloe vera

Dry matter content was determined by homogenized samples. Dry matter and water contents were calculated after cooling at room temperature, and reweighed. Dry matter of *aloe vera* gel consists of polysaccharides, sugars, minerals, proteins, lipids and phenolic compounds in some seasonal fluctuation. Soluble sugars such as, aloin, proline and fructose were increases in winter season but decrease in summer season [Table-2] while glucose is increases in summer season and decreases in winter season.

The production of aloe vera plants depends on many factors such as the climatic, edaphic, irrigation, soil water availability for plant root development.

Table-2 *Analyzed aloe vera gel component during winter and summer season 2015*

Water Stress (FC%)	Gel Component of Aloe vera in different Season							
	Winter				Summer			
	Aloin (%)	Proline (mg)g	Glucose (mg)	Fructose (mg)	Aloin (%)	Proline (mg)g	Glucose (mg)DW^{-1}	Fructose (mg)
20	10.92	0.92	54.87	28.91	14.18	0.55	56.54	26.93
40	12.56	0.56	72.13	36.02	16.89	0.91	63.68	32.14
60	15.98	1.13	99.68	43.88	18.16	1.43	89.67	38.56
80	18.06	0.82	217.82	79.53	21.13	1.63	213.06	78.08
Mean	35.77	0.89	111.54	47.94	19.06	0.87	113.46	43.42

The soil water retention capacity and water content determines the metabolic pathway of aloe vera. Aloe vera cultivation was focused on water stress conditions under depleted water supply, which revealed a steady decrease in relative water content. There was no change in chlorophyll, protein, and ribulose bisphosphate carboxylase activity in water-deficient plants compared with the well-watered plants. The aloe vera was a drought resistant plant, affected to continuous water supplement and water-logged. Like temperature, moisture influences aloe plant by monthly increasing to relative humidity [Fig-2]. Thus, we should be supplement of water amount in control conditions during summer as well as winter.

Accumulation of polysaccharides and anthra-quinones in aloe leaf, plays a very important role in adaptation during adverse condition. In adverse condition, muco-polysacchrides significantly increase osmotic potential of leaf water storage cell and promote root absorption of water in moist environment. The above factors were more responsible for differentiation ofgel compositions in different winter and summer season [Fig-1].

The results show that aloe leaf and gel affected to different winter and summer seasonal variation. In addition, the study found that soluble sugars were most important component for survivable of aloe plants [21]. Soluble sugars were increases in warm season's comparison to winter seasons [19] due to some fluctuations. Aloe vera plants under water restriction increased the levels of glucose that improve water stress resistance and increase water use efficiency.

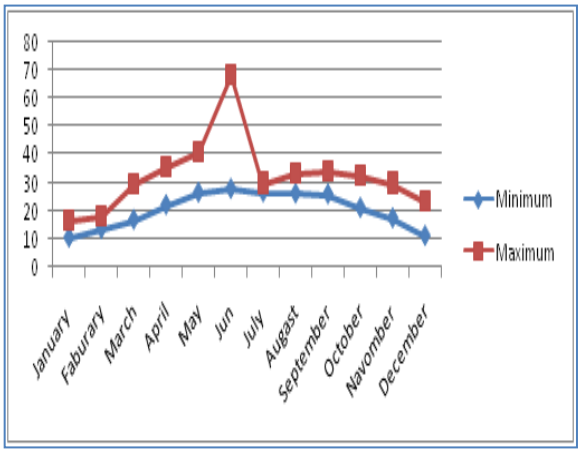

Fig-1 Monthly increasing temperature of RGSC Barkacha Mirzapur field

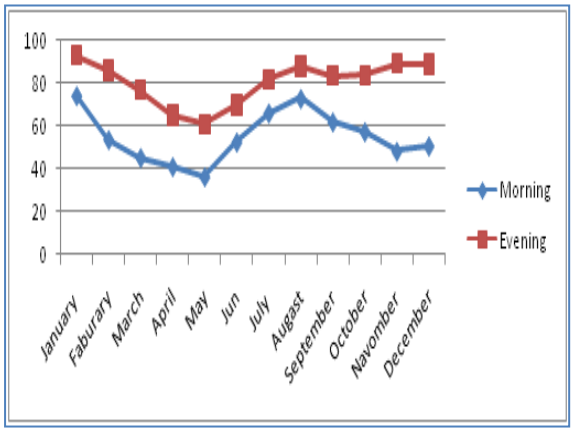

Fig-2 Monthly increasing relative humidity of RGSC Barkacha Mirzapur field

On the other hand, proline was also an important amino acid, plays a pivotal role [22] in plants under water stress conditions. Proline incensement was determined with aloin incensement in water stress condition [23]. The highest aloin content was determined to irrigation from water stresses in winter season. According to previous study, young leaves synthesis more aloin content than older leaves [24], and aloin contents increases due to synthesis of secondary metabolites [25] in winter seasons.

Conclusions

Aloe vera contains glyco-proteins, anthrax-quinones, polysaccharides and low molecular weight plant, as a source of medicine. The leaf tissue of phenolic compounds can effectively absorb the ultraviolet rays in sunlight, thereby reducing damage which caused by the strong solar radiation on plants. Aloe vera commonly affected during post harvest condition in summer as well as affected to water stress in winter season. Aloe vera was more loss in winter season than the summer season due to water stress. Aloe vera plants increased the levels of soluble sugars under water restriction and resistance to stress condition. Mucopoly-saccharides were significantly increasing the osmotic potential of leaf water storage cells and promote root absorption of water in moist environment and aloe survives. Polysaccharides and anthraquinones were plays a important role in adaptation of aloe vera to adverse conditions. I conclude that, aloe vera is a drought resistant plant which better survive at higher temperature than other fleshy plant.

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Abbreviation

RGSC=Rajeev Gandhi South Campus, FC=Field Capacity, HPLC= High Performance Liquid Chromatography, M= Meters, CM= Centimeter, Mg=Milligram, Hrs= Hours, DMRT=Duncan Multiple Range Test, ANOVA=Analysis of Variation

Conflict of Interest: None declared

References

[1] Biswas B.C. (2010) *Indian Fertilizer Marketing News,* 41(3), pp. 1-4 &20.
[2] Saeid H., Zeinolabedin T. and Amin S. (2012) *International Research Journal of Applied and Basic sciences,* 3(4), pp. 682-687.
[3] Reynolds T. and Dweck A.C. (1999) *J. Ethnopharmacol.,* 68, 3-37.
[4] Steenkamp V. and Stewart M.J. (2007) *Pharm. Biol.,* 2007, 45, 411-420.
[5] Karkala M. and Bhushan B. (2014) *Journal of Pharmacognosy and Phytochemistry,* 2 (5),pp. 85-88.
[6] Eshun K. and He Q. (2004) *Crit. Rev. F ood Sci. Nutr.,* 44,91.
[7] Boudreau M.D., Beland F.A., Environ J. and (2006) *Sci. Health,* 24,103.
[8] Davis R.H. (1997) Aloe vera: A Scientific Approach, Vantage Press, New York.
[9] Rodríguez-García R., Rodríguez D.J., Gil-Marín J.A., Angulo Sánchez J.L. and Lira-Saldivar R.H. (2007) *Ind. Cr ops Prod.,* 25,123.
[10] Ahlawat K.S. and Khatkar B.S. J. (2011) *Food Sci. T echnol.,* 48,525.
[11] Zhiliang X. (2008) Ph. D. Thesis, Researches on Polysaccharides of Skin of Aloe vera Irrigated with Sea Water, Dalian University of Technology, Dalian, China.
[12] Femenia A., Sanchez E.S. andSimal S.C. (1999) *Carbohydr. Polym,* 39, 109-117.
[13] Ju M J., Duan J.-Z., Qian D.-Z. Zhu L.-Y and Qian Y.Q. (2003) *Res. Practice Chin. Med.,* 17, 12.
[14] Zhe P., Wang S., Wang Y., Dong H., Wang Q.Y. and Cheng W., Hebei J. (2011) North University. (Nat. Sci. Ed.), 27,27.
[15] Ramachandra C.T. and Rao P.S. (2003) *Agric. Biol. Sci.,* 3,502.
[16] Chen W., Lu Z., Viljoen A. and Hamman J. (2009) *Planta Med.,* 75,587.
[17] Falling Rain Genomics (2012) Inc-Mirzapur Fallingrain.com. Retrived on june.
[18] Bates L.S., Waldren R.P. and Tear I.D. (1973) *Plant Soil.,* 207, pp. 205–207.
[19] Delatorre-herrera J., Delfino I., Salinas C., Silva H. and Cardemil L. (2010) *Agric. Water Manag.,* 97, pp. 1564–1570.
[20] Femenia A., Garcia-Pascual P., Simal S. and Rosello C.(2003) *Carbohydr. Polym.,* 51, 397-405.
[21] Hamman J.H. and Viljoen A.M. (2008) Use of Aloe verafor increasing the bioavailability of poorly absorbable drugs. SA patent application 01542.
[22] Bastide B., Sipes D., Hann J. and Ting IP. (1993) *Plant Physiol.,* 103(4), 1089–96.
[23] Zapata P.J., Navarro D., Guillén F., Castillo S., Martínez-romero D., Valero D. and Serrano M. (2013) *Ind. Crop. Prod.,* 42, PP.223–230.
[24] Ray A. and Gupta S.D. (2013) *Ind. Crop. Prod.,* 51, pp. 130–137.
[25] Lucini L., Pellizzoni M. and Molinari G.P. (2013) *Biochem. Syst. Ecol.,* 51, pp. 264–268.