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Effect Of Salinity Stress On Organic Metabolites In Mulberry *(Morus Alba L.)* Variety M5 And Mysore Local

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ABSTRACT:

The present study investigates the influence of NaCl stress on various organic metabolites in two varieties of Mulberry, Mysore Local and M5. The organic metabolites such as carbohydrates, proteins, total phenols, proline, total acid number and nitrogen contents were analyzed at different levels of (0.0, 0.25,0.5 and 1.0 Molar) NaCl stress in pot culture. Both the varieties showed moderate influence of salinity stress on organic constituents, there was slight inhibition in the proteins, sugars, Nitrogen and Total Acid number. Accumulation of proline and polyphenols act as osmoprotectants to overcome the NaCl stress. Among two cultivars variety M5 has got more salt tolerance capacity than the variety Mysore Local. The present study may help to screen salinity resistant cultivars.

Key Words: Salinity, Mulberry, Organic Metabolites, Nitrogen

INTRODUCTION:

Soil salinity is one of the major abiotic stresses throughout the world. According to present statistics 1125 million hectares of land is affected by salinity in the world, of which 76.6 million hectares are by anthropogenic activities (Oldmen.,1991; Mashali,1995; Shahid et al.,2018). Every year a large area is getting salinized and probably by 2050 around 50% of arable land would be salt affected (Pradeep Kumar and Pradeep K Sharma 2020). In India saline soil occupy 44% area covering 12 states and one union territory. According to Singh (1980) the introduction of irrigation projects has been the main cause of soil salinity in many countries. At present Agriculture sector has two threats that is population explosion and unavailability of cultivable land (Shahbaz and Ashraf 2013). In this context ICAR, Central soil salinity Research Institute and many States Agricultural Universities are engaged in the studies related to salt affected land and developing several innovative technologies in the country. Among them are screening and cultivation of salt tolerant crop varieties. Because Soil salinity reduce net cultivable area and also affects productivity and quality of the crop (Munns 2005, Jamil et al 2011). An estimate suggested the global economic losses are about 11.4 billion USD in an irrigated land and 1.2 billion USD in non-irrigated land per year (Ghassemi et al 1995) due to soil salinity. Salinity affects almost all parts of the plant and also growth and reproduction. They face osmotic and nutrient stress. The agriculture crops exhibit many complex responses and interaction of physiological, morphological and biochemical processes which ultimately leads to low quality and production ((Ghassemi et al 1995)).

In addition to this soil salinization also affects physicochemical properties of the affected area which leads to ecological imbalances (Liu et al 2019). Salinity stress leads to accumulation of various types of metabolites, these metabolites helps to overcome the stress in plants by developing tolerance (Gomez et al 2019; Pyne et. al 2019). The present study aimed to understand the influence of soil salinity on various organic metabolites under increasing concentration of salinity in two varieties of Mulberry.

Mulberry (*Morus alba. L*) is a deciduous woody tree, which has great economic importance and cultivated as commercial crop, the leaves are used to feed silkworms Bombyx mori. L to get superior quality of silk. The tender parts of the plant are used as fodder and also the ripe fruits are nutritious and edible. Mulberry is cultivated as both rainfed and irrigated crop. Mulberry cultivation is associated with rearing of silkworms known as sericulture. Sericulture is practised by small and marginal land holders; it gives economy and employment for rural women. The present study aimed to investigate effects of salinity on the physiological and biochemical characters which may help to screen new salinity resistant varieties, this may help rural women folk to utilize salt affected lands.

MATERIAL AND METHODS:

During present investigation two mulberry cultivars Mysore Local and M5 were selected. Mulberry cuttings were obtained from Regional Sericulture Research Station, Kadaganchi. Kalaburagi. Healthy cuttings with 15-18 cm length with 3-4 axillary buds were selected. The selected cuttings were immersed in 10ppm solution of NAA for 20-30 min to initiate rooting. The cuttings were planted in earthen pots (22 x 20 CMS) filled with equal quantities of (4 kg/pot) garden soil and sand. The saplings were established. The well-established three months old healthy and uniform saplings were transplanted to experimental pots, each pot with 4 saplings, after recovery of saplings due to transplantation shocks the pots were irrigated with 1 lit of tap water to cotrol,1lit of 0.25 M,0.5 M, and 1.0 M NaCl solution to other experimental pots respectively. Three replications for each treatment were maintained. The salt treatment was given by the method of Black (1956) The plants were harvested and collected after 45 days for analysis of organic metabolites. EC and pH of soil extract was measured up to 45 days. The leaves were used for analysis of organic metabolites. Total Proteins were estimated by Bradford method (1976), Proline was estimated by the method Bates et al (1973), Polyphenols were estimated by Folin and Dennis method (1915), Total soluble sugars were estimated by Anthrone method (Duboise et al.,1951), Reducing and nonreducing sugars were estimated by Somogyis method (Nelson 1944) ,Titrable acid number was estimated by Thomas and Beevers method (1969) .Total Nitrogen was analyzed in root, stem and leaf by the method of Hawk et.al (1948).

RESULT:

The effect of salinity on various organic constituents in variety M5 has been shown in. Table 1 and 2.

In variety M5 mild stimulation of total proteins at lower salinity level and decreased at higher levels of salinity. Total sugars and Total acid number decreased at 0.25 and 0.5 molar salinity level whereas increased at 1.0 M salinity level. Total phenols accumulated at lower salinity level but reduced at 0.5 and 1.0 m salinity. Proline accumulation increased with increasing salinity level. The nitrogen accumulation in root and leaves increased with increased salinity level. whereas in stem total nitrogen reduced at 0.5 M concentration.

Table-1.

EFFECT OF NaCl ON ORGANIC METABOLITES IN MULBERRY VAR.M5

NaCl(M)	Protein	Total Phenols	Proline	Total Sugars	Reducing Sugars	Non Reducing Sugars	TAN
Control	52.26 ±7.2	15.13 ±12.7	0.15 ±0.07	9.9 ±1.2	2.9 0.35	7.0 +0.2	83.33 +2.62
0.25	58.63 +13.75	22.89 +18.55	0.17 +0.03	7.65 +1.9	6.0 +0.14	1.65 +0.4	42.67 +4.0
0.5	51.4 +7.17	8.0 +6-41	0-23 +0.11	9.75 +1.9	2.6 +0.28	7.75 +1.2	23.16 +1.35
1.0	51.5 +10.41	12.2 +10.1	0.51 +0.29	13.4 +1.14	2.1 +0.56	11.3 +0.2	46.17 +1.44

Table-2.

EFFECT OF NaCl ON NITROGEN IN MULBERRY VAR.M5

NaCl(M)	Leaf	Stem	Root
Control	11.8 +4.9	25.0 +1.2	10.5 +1.0
0.25	12.0 +5.8	21.5 +2.0	19.2 +1.5
0.5	14.2 +9.1	26.2 +1.9	11.2 +1.5
1.0	16.1 +8.1	17.4 +1.7	16.0 +1.1

The effect of NaCl in variety Mysore Local is shown in Table 3 and 4.

Table-3.

EFFECT OF NaCl ON ORGANIC METABOLITES IN MULBERRY VAR. MYSORE LOCAL

NaCl(M)	Protein	Total Phenols	Proline	Total Sugars	Reducing Sugars	Non Reducing Sugars	TAN
Control	53.4 ± 7.3	11.5 ± 9.1	0.16 ± 0.06	10.5 ± 0.42	3.8 ± 0.42	6.7 ± 1.0	44.00 ± 1.6
0.25	57.96 ± 9.3	9.5 ± 7.3	0.19 ± 0.04	12.5 ± 9.4	3.2 ± 0.49	9.3 ± 0.42	36.3 ± 1.6
0.5	51.1 ± 9.6	8.5 ± 6.7	0.16 ± 0.04	10.2 ± 3.9	1.4 ± 0.28	8.8 ± 0.49	30.8 ± 1.4
1.0	43.7 ± 3.1	8.5 ± 6.8	0.31 ± 0.05	11.0 ± 7.3	4.0 ± 0.28	7.0 ± 0.35	16.5 ± 0.9

Table-4.

EFFECT OF NaCl ON NITROGEN IN MULBERRY VAR. MYSORE LOCAL

NaCl(M)	Leaf	Stem	Root
Control	16.4 +10.8	12.7 +1.9	6.4 +1.3
0.25	18.2 +9.7	11.3 +1.4	4.5 +1.1
0.5	18.3 9.7	17.5 +2.0	7.6 +0.8
1.0	16.1 +5.9	12.3 +1.2	10.2 +0.7

The proteins and Phenols decreased with the increasing salinity levels. the total sugars stimulated at lower salinity level but decreased at higher salinity level. Reducing sugars decreased at lower salinity levels but increased at 1.0 M level. The proline accumulated in0.25 and 1.0 m but reduced at 0.5 M concentration. The total nitrogen in leaf increased at0.25 and 0.5 M but reduced slightly at 1.0 M total nitrogen. In stem the nitrogen enhanced at 0.5 M whereas at 0.25 and 1.0 m nitrogen reduced. In root nitrogen accumulation was increased with increased salinity levels.

DISCUSSION:

Amelioration and utilization of the saline affected agricultural lands, various technical measures were adapting to restore the soil such as physical, chemical, mechanical and biological methods. These methods are less attractive to the formers (Vijayan 2019). So, the only method is to identify suitable salt tolerant or resistant varieties which are indigenous to specific saline lands.

Developing salt tolerance is a polygenic trait. Therefore, integration of knowledge on physiological, biochemical and genetic aspects of salt tolerance is essential to make in salt affected lands (Ashraf and Foolad,2007). Salinity affects the plants in various ways, it depends on the tolerance capacity of the plant it affects growth and development, physiological conditions, sevearity of the salt stress and other environmental factors such as temperature, radiation, relative humidity and air pollution (Shanon et.al 1994). The most common effects of salinity is reduction in growth, senescence, decreased rate of photosynthesis, respiration and loss of cellular integrity (Singh and Singh 1999).

Accumulation of proline and sodium increased with increasing salinity level in mulberry (Kumar et.al.2003; Ramanjulu et al 1993,1994,2000; Vijayan et.al 2008a) An increase in soluble sugar under low salinity and decline under higher salinity was observed in some varieties of Mulberry (Vijayan et.al 2008a). Vijayan et.al (2007,2008 a, b) reported the proteins in the mulberry leaves grown under salinity decreased significantly.

Accumulation of nontoxic and compatible solutes such as proline, sucrose, polyols, trehalose, glycine betaine, alanine betaine, proline betaine etc in the cytoplasm (Pollard and Wyn1979; Rhodes and Hansdry 1993; serraj and Sinclair;2002). Ramanjulu and Sudhakar (2000), Vijayan et.al. (2008a) have reported proline is one of the most prominent osmolyte in plants, acuumulates for osmotic adjustment under salt stress in mulberry and other species. Paul Austian and Kingsley (2012) observed soluble proteins, free amino acids, soluble sugars, sucrose, starch and phenols increased at low salinity and decreased at higher salinity in pot culture experiments in Mulberry genotypes when subjected to salinity (0-12mS cm-1). Pervaiz Ahmed et. al (2013) reported proline, glycine betaine, Lipid Peroxidase, Super oxide dismutase , catalase, peroxidase, Glutothione reductase increased with increased salinity levels in two Mulberry cultivers S146 and Sujanpuri. One of the most important biochemical response of plants to abiotic stress is over production of different types of compatible solutes such as proline, glycine betaine, sugar, soluble protein, amino acids etc.(Ahmad et.al.2007;Koyaro et.al.2012). Accumulation of osmoprotectants clearly indicates that they could be used as potential indicators and alkalinity tolerance in Mulberry and also reported in broad bean (Azooz et.al.2011) Mustard (Ahmad et.al 2012a and b) Chick pea (Rasool et.al 2013).

Mulberry has the characteristics of drought tolerance and strong adaptability to soil (Liu.Y et.al 2019). During presenting investigation variation has been observed in the cultivars in the metabolic activities. The effect of salt stress was not severe ,because there was a slight inhibition in the proteins, Sugars, nitrogen and total acid number. Whereas the increased proline and polyphenols may act as osmoprotectants to overcome the salt stress.among the two cultivers M5 has got more salt tolerance capacity than the Local cultivar.

CONCLUSION:

The present investigation may help to screen salt tolerant varieties which in turn helps to undertake mulberry cultivation in the salt affected marginal lands

REFERENCES

1. Oldeman LR, Hakkeling RTA, Sombroek W G (1991). World map of the status of human-induced soil degradation. An explanatory note. Second revised edition. International Soil Reference and Information Centre (ISRIC), Wageningen, 35 pp

2. Mashali AM (1995) Integrated soil management for sustainable use of salt-affected soils and network activities. Proceedings of the international workshop on integrated soil management for sustainable use of salt-affected soils. 6–10 November 1995. Bureau of Soils and Water Management, Manila, Philippines, pp 55–75

3. Shahid, S.A., Zaman, M. and Heng, L. (2018) Soil Salinity: Historical Perspectives and a World Overview of the Problem. Eds., Guideline for Salinity Assessment Hawk P B, Oser B L and Summerson W H (1948). Practical physiological chemistry Pb.The Blankiston Company,USA.

4. K Vijayan (2019). Approaches for enhancing salt tolerance in Mulberry (Morus L) - Plant Omics – Cite seer

5. Ashraf M Foolad M R (2007) Roles of glycine betaine and proline in improving plant abiotic stress resistance. Environmental and Experimental Botany 59: 206–216. Mitigation and Adaptation Using Nuclear and Related Techniques.Springer International Publishing, Cham.

6. Pradeep Kumar and Pradeep K Sharma (2020). Soil Salinity and Food Security in India. Review article Front. Food Syst.,06 october 2020Sec.Agroecology and Ecosystem Services Vol 4.

7. Singh (1980) . Growth of Guava Plants (Psidium gajuava L.) as affected by salinity Indian Journal of Horticulture - indianjournals.com.

8. Shahbaz and Ashraf (2013). Improving salinity tolerance in cereals .Crit. Rev. Plant Sci., 32 , pp. 237-249

9. R. Munns (2005). Genes and salt tolerance: bringing them together.New Phytol. 167,pp. 645-663

10.A. Jamil,S.Riaz,M.Ashraf and M.R.Foolad (2011). Pages 435-458 | Published online: https://doi.org/10.1080/07352689.2011.605739.

11. Ghassemi F, Jakeman AJ, Nix HA (1995) Salinisation of land and water resources: human causes, extent, management and case studies. CABI Publishing, Wallingford, 526 pp

12. Liu Y, Ji D, Turgeon R, Chen J, Lin T, Huang J, Luo J, Zhu Y, Zhang C and Lve.Z (2019). Inter. J. Mol. Sci. 20 (1)

13. F A Gomez,S K Lee,F J Hernandez Jr,L M Chiaverano.Scientific reports(2019) - nature.com

14. A R Pyne, D M Burdick, G E Moore (2019). Estuaries and Coasts - Springer

15. Black R F (1956). Effect of NaCl in water culture on the ion uptake and growth of Atriplex hastata L.Aust.J.Biol.Sci.9:67-80

16. Bradford M M(1976).A rapid and sensitive method for quantification of microgram quantification of protein utilizing the principle of protein dye binding.Anal.Biochem.72:248-254.

17. Dennis method (1915),

18. Duboise M, Gilles R A,Hamilton J K, Rebers p A and Smith F(1951). Colorimetric method for the determination of sugars.Nature.168:167

19. Nelson N (1944). A photometric adaptation of the Somogyi method for the determination of glucose. J.biol.chem.153:375-380.

20. Thomas M and Beevers H (1969). Physiological studies on acid metabolism in green plants II.evidences of CO2 fixation in Bryophyllum calycinum and study of diuranal variation in the genes. New Phytol.48:421-427.

21. Shanon M C and Noble C L (1995). Variation in salt tolerance and ion accumulation among subterranean clover cultivars.Crop.Sci.35(3): 798-804

22. S G Kumar, AM Reddy, C Sudhakar - Plant Science (2003). NaCl effects on proline metabolism in two high yielding genotypes of Mulberry (Morus alba L.) with contrasting salt tolerance- Elsevier

23. Ramanjulu, S., Veeranjaneyulu, K., Sudhakar, C.(1993): Physiological changes induced by NaCl in mulberry var. Mysore local.-Indian J. Plant Physiol. 36: 273-275.

24. Vijayan K, Chakraborti S P, Ercisli S, Ghosh P D(2008a) NaCl-induced morpho-biochemical and anatomical changes in mulberry (Morus spp.). Plant GrowthRegulation 56: 61-69

25. Vijayan K, Chakraborti SP, Doss SG, Ghosh PD, Ercisli S (2008b) Combining ability for morphological and biochemical characters in mulberry (Morus spp.) under salinity stress. stress. International Journal of Industrial Entomology 16:

26. Ramanjulu S, Veeranjulu K, Sudhakar C (1993) Sodium, potassium and nitrogen status of some mulberry (Morus alba L.) cultivars under NaCl salinity. Indian Journal Plant Physiology and Biochemistry 19: 103-106

27.Ramanjulu S, Veeranjaneyulu K, Sudhakar C (1994) Short term shifts in nitrogen metabolism in mulberry (Morus alba) under salt shock. Phytochemistry 37 : 991–995

28. Ramanjulu S, Sudhakar C (2000) Proline metabolism during dehydration in two mulberry genotypes with Review Article 57 contrasting drought tolerance. Journal of Plant Physiology 157: 81–85

29. Pollard and Wyn1979; Enzyme activities in concentrated solutions of glysine betain and other solutes. Planta -Springer

30 Serraj and Sinclair (2002). Osmolyte accumulation : can it really help increase crop yield under drought conditions. Plant cell & Environment-Willey online library.

30. P Ahmad,M M Azooz,M N V Prasad(2013)- Ecophysiology and responses of plants under salt stress-Springer

31. Ahmad A, S Yadav, M Irfan (2007). Causes of salinity and plant manifestations to salt stress: A review -Journal of environmental search.proquest.com

32. M M Azooz and A M Youssef (2011). Evaluation of salicylic acid (SA) application on growth, osmotic solutes, antioxidant enzyme activities on broad bean seedlings grown under diluted NaCl. Int. J. Plant Physiol.

33. S Rasool, A Ahemad, T O Siddiqi, P Ahmad (2013). Changes in growth, lipid peroxidation and some key antioxidants , enzymes in chick pea genotypes under salt stress. Acta physiologiae plantarum - Springer.