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VARIATIONS IN PRIMARY METABOLITES DURING DIFFERENT DEVELOPMENTAL STAGES IN *CORBICHONIA DECUMBENS* (FORSSK.) EXELL FROM THE INDIAN THAR DESERT

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ABSTRACT

In the present investigation, an attempt has been made to understand which developmental stage is most favourable for obtaining maximum concentrations of primary metabolites in *Corbichonia decumbens*. For this, primary metabolites such as leaf pigments, osmotic potential (OP), proline, sugar, crude protein and phosphorus contents were evaluated at different developmental stages during rainy season 2015-16. Results revealed that maximum amount of Chl. *a*, total chlorophylls and crude protein were recorded in vegetative stage, while proline and OP during flowering stage and remaining parameters in fruiting stage. Data on total chlorophylls, carotenoids, proline, OP, total sugars and crude protein were significant at < 0.05 level.

KEYWORDS: Leaf pigments, OP, Proline, Crude protein, Developmental stages, *Corbichonia decumbens.*

INTRODUCTION

Deserts are living biomes with a critical ecosystem. In deserts, water demand by vegetation and crops is high but availability is restricted by scanty rainfall and long dry periods throughout the year.[1] Medicinal plants represent a rich source of antimicrobial agents. *Corbichonia decumbens* (Forssk.) Exell (Family: Lophicarpaceae) commonly known as "stone plant" is a prostrate, glabrous, succulent and annual herb, which is found almost

throughout India in rocky or sandy places, in dry hot areas up to 1000 m altitude. This plant is used in kidney stone problems, gonorrhoea and also as tonic.[2]

The primary metabolites have countless benefits to humans, which are exploited as natural pesticides, flavouring, fragrances, fibers and beverages and also act as a precursor for bioactive compounds used as therapeutic drugs.[3] Chlorophyll *a* is main photosynthetic pigment and sensitive for photo oxidation damage. Carotenoids is accessory pigment, which prevent photo oxidation damage of chlorophylls and are capable of adapting different intensities of sunlight by changing their composition.[4] Proline is compatible osmolytes accumulation in plant is accompanied by a decrease in osmotic potential. Osmotic adjustment or osmoregulation enables plant to maintain growth as plant water potential decreases.[5] Carbohydrates in plants have considered as the energy reserve to be used under stress conditions and have been widely used as a physiological measure of stress tolerance.[6] Proteins are composed of large numbers of amino acids, which differ in both arrangement and in quantitative relationships. They are the major nitrogenous constituents of living organisms.[7] Phosphorus plays an important role as a structural component of the cell constituents and metabolically active compound and also vital in the energy transfer compounds needed by both plants and animals to carry on their life activities.[8] Thus, the main objective of the present investigation is to evaluate variations in primary metabolites and their concentrations during different developmental stages for obtaining maximum production of these parameters.

MATERIALS AND METHODS

The plant specimen was identified from the Botanical Survey of India, Jodhpur with accession number 35437. The plant materials were collected randomly from the natural habitat located at Bhimbhadak, Jodhpur (15 km away from JNV University Campus in north-west direction) during rainy season at three different developmental stages [vegetative (July), flowering (August-September), and fruiting (September)] during 2015 & 2016. Flowering and fruiting take place simultaneously during September. The samples were analyzed for leaf pigments, proline, OP, total sugars, crude protein and phosphorus. Leaf pigments, proline and OP were analysed from fresh leaves, while other parameters from oven-dried ones. Leaf pigments were estimated according to the method suggested by Arnon.[9] Proline, OP and total sugars were estimated according to Bates *et al*.[10] Janardhan *et al*.[11] and Plummer[12], respectively. Crude protein was estimated by Microkjeldhal method as described by Peach

and Tracey[13] while phosphorus as per Allen *et al*.[14]. The mean values of data obtained from three replicates for each parameter during both years were analyzed statistically as per the Gomez and Gomez.[15]

RESULTS AND DISCUSSION

The phytochemicals are the plants chemical constituents, their type and quality being affected by environmental factors such as climate, soil and stages of development.[7] The data on various primary metabolic products such as leaf pigments (Chl. *a*, *b*, total chlorophylls and carotenoids) proline, OP, sugar, crude protein and phosphorus are presented in Table 1. It is evident from this table that the highest values for Chl. *b* and carotenoids were observed during rainy season at fruiting stage. Gehlot *et al*.[16] reported that *Withania coagulans* showed highest chlorophyll contents during rainy season. *Phyllanthus amarus* exhibited maximum values of total chlorophylls and carotenoids during rainy season[17]. In the present studies, total chlorophylls in *C. decumbens* were highest at vegetative, and carotenoids in fruiting stage, which may be due to sprouting of new leaves.

Proline is one of the most common compatible osmolytes in water-stressed plants that does not interfere with normal biochemical reactions and make their survival possible under stress[18]. The values of proline during three stages ranged from 4.267 to 4.832 μg g^{-1} fresh weight, being maximum at flowering while the minimum in fruiting stage. The OP values ranged from -0.141 to -2.653 MPa, being highest at flowering while the lowest in fruiting stage. Saharan *et al*.[19] reported highest proline during flowering stage in *Evolvulus alsinoides*. Sagar and Kasera[20] also reported maximum value of proline along with OP during flowering stage in *Dipcadi erythraeum*. In the present investigation, the values of proline and OP were recorded to be maximum at flowering stage, which shows negative correlations. The higher values of both parameters in the flowering stage can be correlated with its tolerance towards environmental stresses.

In the present studies, maximum values of total sugars were observed during fruiting stage followed by flowering and minimum in vegetative stage. Increase in total sugars may be due to stress conditions during flowering and fruiting stages as compared to vegetative ones. Saharan *et al*.[19] reported maximum sugar content during flowering phase in *E. alsinoides*. On the contrary, Sagar and Kasera[20] observed highest total sugars in *D. erythraeum* during vegetative stage.

Crude protein was observed highest (6.0452 mg g^{-1} d. wt.) during vegetative phase followed by flowering (4.650) and minimum at fruiting phase (3.1621 mg g^{-1} d. wt.). Sagar and Kasera[20] observed maximum values of crude protein during vegetative phase in *D. erythraeum*, also confirm the present findings.

The maximum phosphorus content was recorded during fruiting stage in *C. decumbens*. However, Sagar and Kasera[20] observed highest phosphorus contents in *D. erythraeum* during vegetative stage. The ANOVA showed that temporal variations were significant ($p>0.05$) for total chlorophylls, carotenoids, proline, osmotic potential, soluble sugar, total sugars and crude protein, whereas non significant for Chl *a*, *b*, insoluble sugar and phosphorus.

Table 1: Various primary metabolic parameters in *C. decumbens* during different developmental stages.

Parameters	Stages			CD
	Vegetative	Flowering	Fruiting	
Chlorophyll *a* (mg g^{-1} f. wt.)	0.709	0.1756	0.4816	2.154^{ns}
Chlorophyll *b* (mg g^{-1} f. wt.)	0.2436	0.1486	0.4153	3.292^{ns}
Total chlorophylls (mg g^{-1} f. wt.)	1.055	0.3243	0.9913	299.924^{*}
Carotenoids (mg g^{-1} f. wt.)	0.000541	0.000227	0.000563	111.373^{*}
Proline (µg g^{-1} f. wt.)	4.647	4.832	4.267	14.752^{*}
Osmotic potential (-MPa)	0.168	0.141	2.653	497.738^{*}
Soluble sugar (mg g^{-1} d. wt.)	3.69	17.08	14.70	65.295^{*}
Insoluble sugar (mg g^{-1} d. wt.)	8.613	5.166	13.623	4.465^{ns}
Total sugars (mg g^{-1} d. wt.)	11.85	22.24	28.33	59.066^{*}
Crude protein (mg $100g^{-1}$ d. wt.)	6.0452	4.6501	3.1621	19.485^{*}
Phosphorus (mg $100g^{-1}$ d. wt.)	0.1284	0.1572	0.1590	1.459^{ns}

*ns = Non significant; and * = Significant at (<0.05) level.*

CONCLUSIONS

Thus, it concluded from the present studies that *C. decumbens* plants at vegetative as well as fruiting stages are found to be the most favourable for obtaining maximum production of leaf pigments. Vegetative and flowering stages are most suitable for maximum accumulation of crude protein and proline, respectively.

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