



# INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

## MINERAL NUTRITION IN THE LEAVES OF *AEGLE MARMELLOS L.* UNDER PATHOGENESIS

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**Abstract:** The current paper deals with mineral contents in the leaves of *Aegle marmelos L* affected by powdery mildew disease (*Oidium spp.*). The mineral analysis was carried out by Tri-acid digested sample, according to the method of Toth *et al.*, (1948). The minerals such as Manganese, Iron, Copper, Zinc and Boron were estimated by Atomic Absorption Spectrophotometer (Thermo-Scientific – AAS – Chemito AA203 model). While elements Potassium, Calcium and Sodium were measured by Flame Photometer (Systronics 128 model) and Phosphorous was estimated by Sekine (1965) method. The element Manganese, Iron, Potassium, Sodium, Calcium, Phosphorous and Boron were found enhanced in the infected leaf tissue, whereas Zinc and Copper elements were reduced in the affected leaf, shows a great metabolic activity during pathogenesis.

**Index Terms** - *Aegle marmelos*, AAS, Flame photometer, *Oidium spp*

### I. INTRODUCTION

*Aegle marmelos* (Linn) Corr, medicinal and holy plant of India, widely distributed over Indian peninsula, Thailand, Sri Lanka, Burma, Bangladesh and Indo China area, belong to Family: Rutaceae growing to height of several meters. This tree is commonly called as Bael or Bilva and in Sanskrit it is called Shivphala, worshiped by Hindus in India. The whole tree is used in ayurvedic preparation, its bark, root, leaf, flower and fruits are utilized in different treatments in Siddha and Unani traditional preparations. The tree possess variety of nutritional and with large amount of phytochemicals such as flavonoids, tannins, alkaloids, cardiac glycoside, saponin, steroids, coumarins like scopoletin, marmin, marmelosin, marmesin, imperatorin, phenylpropenoids, terpenoids, polysaccharides, flavonoids. In addition to that fruit contains highly nutritious element such as organic acids, fatty acids, amino acids, vitamins, carbohydrates, fibres. While leaves contain lupeol, gamma-sitosterol, beta-sitosterol, aegelin, rutin, flavone phenylethyl cinnamamides and an alkaloid Shahidine (Asha and Krishan, 2016). A terpenoid phellandrene and p-cymene were reported from leaf. Fruit contains psoralein and tannic acid, aegelinol, furanocoumarin, furocoumarins, marmelosin, marmeleide, white pulp contains mucilage, tannins, pectin, reducing sugars, etc. Hence the tree possesses anti-inflammatory, antipyretic and analgesic properties (Sharma and Dubey., 2016), anticonvulsant activity (Patel et al., 2012), Antihistaminic activity (Nugroho., 2011b) antihyperglycemic activity (Nigam and Nambiar., 2019) anxiolytic and antidepressant activity (Kothari, et al., 2010) and anti-cancer activity (Lampronti, et al., 2003). Therefore, such a divine medicinal tree with maximum importance in Ayurveda, Siddha, Unani, medicine get affected by a powdery mildew fungus *Oidium sp.* during winter season, therefore an attempt was made to study nutritional aspect under pathogenesis.

## II. MATERIAL AND METHODS

*Aegle marmelos*(L) Corr. Leaves affected *Oidium* sp. fungus and healthy leaves were collected from Keertivan garden – Shivaji University Campus, Kolhapur during the month of Dec 2023. The harvested samples were brought to laboratory, Department of Agrochemicals and Pest management and blot to dry with filter paper. After few hours, the samples were kept in Electric oven for a period of 1-2 consecutive days maintained a temperature of 60°C. Later samples were powdered with help of domestic grinder. The healthy and infected dried samples were digested by tri-acid method prescribed by Toth et al., (1948). The digested healthy and infected samples were filtered through Whatman paper no.1 and made upto 100ml with distilled water and used for estimation of minerals by Atomic Absorption Spectrophotometer (Thermo- Scientific Chemito AA 203model). Meanwhile elements Potassium, Calcium and Sodium were estimated by Flame photometer (Systronics -128 model). The non-metal Phosphorous was estimated by Sekine (1965) method. The results were expressed in terms of mg-1 g-1 of dried tissue.

## III. RESULTS AND DISCUSSION

The results were depicted in Table-1. The element manganese acts as activator of many enzymes such as malic dehydrogenase, oxalo succinic dehydrogenase, nitrate reductase, hydroxylamine reductase and responsible for evolution of oxygen during photosynthesis, has a high impact on fungal metabolism. The manganese content gets accumulated in the infected leaves of *Aegle marmelos* L (Table -1). A similar finding was documented by Nagaraja (2008, 2005) and Ingavale et al., (2020) under pathogenesis. This indicates that pathogen may consume in lesser amount. The element iron acts as a catalyst and a component of ferredoxin, which plays in biological nitrogen fixation and electron transport system in plants including fungi get enhanced in the infected tissue. 0.63 mg of iron get accrued to 1.85mg per gram in infected tissue. The enhanced condition of iron in the infected tissue may be due to its failure to be translocated to physiologically active site as cited by Brown (1976). A parallel result was published by Philip and Devadath (1981) in rice under infection. Again, by Nagaraja (2001) in *Woodfordia* sp.

The element copper is one of the constituents of plastocyanin and essential for the activity of enzyme cytochrome oxidase, polyphenol oxidase etc. greatly reduced in the infected leaves of *Aegle marmelos* L (Table -1). Reduction of copper may be due to absorption of copper ions; it increases in respiration rate under pathogenesis. A concurrent condition was recorded by Nagaraja (2001) under infection. The element potassium is responsible for translocation of organic solute and maintaining electroneutrality of cells in plant as well as fungi, get rised in the infected leaves of *Aegle marmelos* (Table-1), increased amount of potassium may be due to greater mobility and a tendency to accumulate at metabolically actives or may be due to antagonistic effects and disturbed ratio of mineral elements, may cause accumulation as reported by Grumberg (1958) and Lal et al., (1970). Much the same result was reported by Nagaraja (1994) in *Ricinus communis* affected by phyllody disease.

The element sodium and calcium contents were slightly intensified in the infected leaves of *Aegle marmelos* L Table-1. The ubiquitous sodium ions are desirable to maintain osmotic potential and sustain turgor pressure, again a cofactor of ATPase and many enzymes, 1.20 mg of sodium gets doubled to 2.40 mg per gram of diseased tissue, suggest that more metabolic shift under pathogenesis, similarly calcium responsible for many enzymes as well as integral part of cell wall pectin, etc gets inflated in the diseased parts of *Aegle marmelos* indicate high metabolic activities. A congenial finding was documented by Nagaraja (1998) in *Dioscorea bulbifera*.

Element zinc required for the development of mitochondria as an energy source, and found a metallo enzymes hence, greatly consumed by pathogen (*Oidium* sp.), as a result it greatly reduced in the infected leaves of *Aegle marmelos* (Table-1). An equivalent condition was reported by Nagaraja (2007) in *Mappia foetida*. The non-metallic element phosphorous content elevated increased in the infected leaves of *Aegle marmelos* (Table -1) and requires in lesser quantities for host as well as pathogen and as a part and parcel of nucleic acids, along with energy source, it get accumulated infected leaves, paradoxically. Ingavale (2020) reported similar condition in *Cestrum diurnum* under pathogenesis.

Element boron, micronutrient, regulates carbohydrate metabolism, translocation of sugars, mainly responsible for pollination and formation of fruits, hormone metabolism and its importance were first documented in both plant and fungi by Bowen and Gauch (1996). The element gets slightly accumulated in the infected tissue of *Aegle marmelos* (Table-1) indicate its immobility nature.

Therefore, mineral forms integral part as well as part and parcel in the metabolism of host and pathogen, reflects plant physiognomy.

#### IV. ACKNOWLEDGEMENT

The authors are very much thankful to Head, Department of Agro chemicals and Pest management, Shivaji University, Kolhapur for providing laboratory facilities.

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TABLE-1

MINERAL NUTRITION IN THE LEAVES OF *AEGLE MARMELOS* L UNDER PATHOGENESIS

Sr No.	Minerals*	Healthy Leaves	Infected Leaves
1	Manganese	0.00041	0.00733
2	Iron (Fe)	0.63379	1.8570
3	Copper	0.00054	0.00038
4	Potassium	5.50	9.50
5	Sodium	1.20	2.40
6	Calcium	21.20	28.00
7	Zinc	0.0923	0.0408
8	Phosphorous	1.60	4.40
9	Boron	0.00337	0.00368

\*Expressed as  $\text{mg}^{-1} \text{g}^{-1}$  of dried tissue