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Growth regulator spray induced nutrient element variation in leaves of annual moringa (*Moringa oleifera* Lam.) *Cv*. PKM-1

Divyabharathi V[1], Swaminathan V[2], Paramaguru P[3], Venkatesan K[4] and Anitha T[5]

[1]Senior Research Fellow, Department of Horticulture, Institute of Agriculture, Tamil Nadu Agricultural University, Kumulur, Tiruchirappalli, Tamil Nadu.

[2] Professor and Head Retd., Department of Horticulture, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai, Tamil Nadu.

[3] Dean (Horticulture), Horticultural College and Research Institute for Women, Tamil Nadu Agricultural University, Tiruchirappalli, Tamil Nadu.

[4] Professor (Crop physiology), Department of Floriculture and Medicinal Crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Periyakulam, Theni, Tamil Nadu.

[5] Assistant Professor (Biochemistry), Department of Post-Harvest Technology, Horticultural college and Research Institute, Tamil Nadu Agricultural University, Periyakulam, Theni, Tamil Nadu.

Abstract: Growth regulators, a group of synthetic chemicals have the capacity to create physical, physiological and nutritional changes in crops. The induced changes affect the hormonal balance, growth and development leading to improved yield and quality. The effect of diff erent growth regulators on mineral nutrients in leaf of annual moringa *Cv.* PKM-1 was studied at field level under randomized block design with three replications. The mineral nutrients (P, K, Ca, Mg, Cu, Zn) in moringa leaves were assessed from control and treated plants (GA_3 20 ppm, NAA 20 ppm, SA 0.5 %, Nitrobenzene 0.5 %, Paclobutrazol 20 ppm and Mepiquat chloride 50 ppm). Paclobutrazol (20 ppm) was found effective in enhancing the mineral content of moringa leaves followed by Mepiquat chloride (50 ppm).

Keywords: Moringa, leaves, growth regulators, mineral elements

INTRODUCTION

Moringa (*Moringa oleifera* Lam.) is a single genus plant available in the family Moringaceae. It is multipurpose vegetable grown widely in tropical and sub-tropical regions of Indian and Africa. Moringa is a preferable vegetable in markets grown exclusively for edible pods and leaves. Every part of moringa like root, bark, gum, leaf, flowers, pods, seeds and seed oil are useful in one or other way in most of the indigenous medicines all over the world. Moringa has gained the commercial attention because of its nutritive properties, richness in amino acids, flavonoids, phenolics, minerals and folate. Moringa serves as medicine, nutraceuticals, water purifier as well as source for biodiesel production and hence it is referred as a miracle tree.

Moringa leaves are in great demand world-wide. Leaves as fresh and in dry form considered as significant food source, used as a nutrient supplement for vitamins A, B, and C, riboflavin, nicotinic acid, folic acid, pyridoxine, starch, calcium, iron and alpha-tocopherol (Fuglie, 2001). Micronutrient deficiencies are the major factor contributing to various diseases (Dhakar *et al*. 2014). Malnutrition can be alleviated by making use of naturally available food substances. Considering the nutrient status of leaves and need to alleviate the malnutrition, the mineral status of this crop has been focused to enhance mineral content availability.

EXPERIMENTAL METHODS

The trial was conducted at the Department of Vegetable Science, Horticultural College and Research, Periyakulam, during 2019-20. The experiment was laid out in randomized block design with three replications. Seeds of annual moringa cv. PKM-1 were sown in an area of 0.63 acres with a spacing of 3 m x 3m. The trees were sprayed with six different growth regulators along with a control. The six growth regulators include Nitrobenzene 0.5 %, GA_3 20 ppm, NAA 20

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ppm, SA 0.5 %, Mepiquat chloride 50 ppm and Paclobutrazol 20 ppm. The leaf samples were collected two weeks after the second spray.

The collected leaves were dried and used for the quality parameter (P, K, Ca, Mg, Cu and Zn) analysis. The phosphorous content was estimated using vanadomolybdate yellow colour method propsed by Jackson *et al.* (1973) and expressed in per cent (%). The potassium content was estimated using Piper's (1944) flame photometric method and expressed in mg per 100g. The calcium content was estimated using the EDTA method proposed by Jackson *et al.* (1973) and expressed in per cent (%). The magnesium content was estimated using versanate method (Jackson *et al.*, 1973) and expressed in per cent (%). The Copper and Zinc content was estimated using atomic absorption spectrophotometer as proposed by Jackson *et al.* (1973) and expressed in µg per g and mg per 100 g respectively. The data obtained were statistically analysed as per the methods of Panse and Sukhatme (1967) using agres statistical software.

RESULTS AND DISCUSSION

The spray of different growth regulators shows significant impact on potassium, calcium, magnesium and zinc content of moringa leaves (Table 1.). No significant effect was observed in the amount of phosphorus and copper content of moringa leaves. Spraying of paclobutrazol 20 ppm increased the potassium (77.99 mg/100g), calcium (2.88 %) and magnesium (1.15 %) content of leaves. Zinc content was enhanced by the application of GA_3 20 ppm. The mineral contents were equally increased in mepiquat chloride 50 ppm spray as that of in paclobutrazol spray. Paclobutrazol is often referred as multi stress protectant due to its potential to mitigate the effects of various abiotic stress on growth and development of the crops by regulating the level of hormones, enzymatic and non-enzymatic antioxidants and osmolytes (Kamran *et al*., 2018).

Application of paclobutrazol improved the root activity through enlarging the root diameter along with cortex width, favoured the induction of more secondary xylem vessels. Increased root area influences the potassium and calcium uptake (Baysan and Lynch, 2007). Low hydraulic conductivity and daily water uptake influenced by paclobutrazol might have influenced the improved calcium and magnesium uptake (Bowling, 1976). Accumulation of minerals by mepiquat chloride spray in moringa leaves was on par with paclobutrazol spray.

Mepiquat chloride being a retardant reduces the vegetative growth and thus increased possibility of storage of elements in the available vegetation at an increased rate (Sharples and Johnson, 1985). Zinc plays a significant role in auxin biosynthesis. Synthetic auxin spray competes with the native auxin for the site of action. Competition between two molecules stimulates the plant oxidases activity. Those oxidases destroy both auxin and the native auxin (IAA) will be synthesized after a short period of time (Gowing, 1956). This might have influenced the increased uptake of Zn for the synthesis of IAA to balance the loss.

Table 1. Effect of growth regulators on mineral content in leaves of annual moringa 'PKM 1'

Treatments	Phosphorous content (%)	Potassium content (mg/100g)	Calcium content (%)	Magnesium content (%)	Zinc content (mg/100g)	Copper content (µg/g)
T_1	0.026	73.71	2.13	0.67	1.40	16.63
T_2	0.030	69.76	2.80	0.82	1.83	16.16
T_3	0.018	64.17	2.11	1.23	1.49	16.35
T_4	0.016	71.41	1.97	0.77	0.92	16.39
T_5	0.018	75.68	1.81	1.15	1.58	16.33
T_6	0.031	77.99	2.88	1.27	0.92	16.32
T_7	0.017	77.00	1.65	0.64	0.63	16.02
Mean	**0.022**	**72.82**	**2.19**	**0.94**	**1.37**	**16.31**
SEd	**0.006**	**1.769**	**0.326**	**0.219**	**0.174**	**0.360**
CD (0.05)	**0.013^{NS}**	**3.854****	**0.711***	**0.477***	**0.379****	**0.648^{NS}**

**** -Significant at 1% * -Significant at 5 % NS -Not Significant**

CONCLUSION

Growth regulators are a great boon to the crops and farmers as it supports the crop growth as well as enhance the income of the farmers. Moringa is a miracle tree, a cheap source of nutraceutical. To enhance the available mineral element content in moringa leaves growth regulators are of great use. In conclusion, spraying Paclobutrazol (20 ppm) and Mepiquat chloride (50 ppm) is beneficial to harness the maximum potential of moringa leaves.

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