International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(3): 2926-2929

Received: 02-03-2019
Accepted: 04-04-2019

Monisha S
Department of Seed Science and Technology, AC & RI, Madurai, Tamil Nadu, India

Geetharani P
Department of Vegetable Crops, HC & RI, Periyakulam, Tamil Nadu, India

Geetha R
Department of Seed Science and Technology, AC & RI, Madurai, Tamil Nadu, India

Venkatesan K
Department of Floriculture and Medicinal Plants, HC & RI, Periyakulam, Tamil Nadu, India

Correspondence
Monisha S
Department of Seed Science and Technology, AC & RI, Madurai, Tamil Nadu, India

Effect of foliar spray of growth regulator, micronutrient and chemical in different methods of propagation on growth and yield parameters of ratoon crop of annual Moringa (*Moringa olifera* Lam.) cv. PKM 1

Monisha S, Geetharani P, Geetha R and Venkatesan K

Abstract
An investigation was carried out to study the effect of foliar spray of growth regulator, micronutrient and chemical in different methods of propagation on growth, flowering and pod setting percentage of ratoon crop of annual moringa (*Moringa olifera* Lam.) cv. PKM 1 in Horticultural college & Research Institute, Periyakulam, Tamil Nadu. Treatments consist of NAA (20 and 40 ppm), boric acid (0.1 and 0.2%) and potassium schoenite (0.2 and 0.4%) foliar spray at 90 and 180 days after ratooning. Results revealed that growth parameters such as tree height, leaf area and chlorophyll content were found to be higher in NAA 20 ppm and the beneficial effect of NAA 20 ppm and boric acid 0.2% towards the fruit set of moringa.

Keywords: Moringa, foliar spray, NAA, boric acid, potassium Schoenite, cuttings, air-layering

Introduction

Moringa oleifera belongs to the monogeneric family Moringaceae which has 13 diverse species in it. Among them, *Moringa oleifera* is the most popular species with multitude use. (Reyes, 2006) [21]. India is the prime producer of moringa with an annual production of 2.2 million tonnes of tender pods turning to a productivity of 51 tonnes per ha. Among the different states, Andhra Pradesh leads in both area and production (15,665 ha) followed by Tamil Nadu (13042 ha) and Karnataka (10,280 ha). Tamil Nadu is one of the largest producer of moringa with an annual production of 6.71 lakh tonnes of tender fruits from an area of 13042 ha (Sekhar *et al*., 2018) [24].

Almost all the parts of this miracle tree have been found to be very useful. Leaves are used as fodder, tree trunk for making gums, flower nectar in honey, powdered seeds for water purification (Fuglie *et al*., 1999) [8], used as a live fence (Morton, 1991) [17]. *M. oleifera* leaf has been used as an alternative food source to combat malnutrition, especially among children and infants (Anwar *et al*., 2007 and Beaulah and Mariappan, 2016) [2, 5]. Its flower pods has great potential to be used as natural preservative and nutraceutical in food industry (Gull *et al.,* 2016) [13]. Moringa seed kernels contain a significant amount of oil that is commercially known as Ben oil, which has been used for illumination and is considered to be particularly suitable as a lubricant for fine machinery (Angadi and Jagadeesha, 2018) [1] and in cosmetic industry (Saha *et al.,* 2012) [23]. Owing to its uses, it is known by other names such as miracle plant, tree of life, horse radish tree, Spinach tree, mother's best friend, drumstick tree and ben oil tree etc.

The success of the crop and its performance in subsequent years largely depend on the method of propagation. Various methods of propagation *viz.,* asexual methods such as hard wood cutting, soft wood cutting, air layering, grafting are practiced for perennial moringa. Seed propagation of moringa is the easy, cheap and widely used method (Muhl 2009) [18]. The perennial moringa grown in the Southern states of India, was replaced by the two seed grown annual moringa cultivar PKM-1 and PKM 2 due to their wide adaptability to varied soil and climatic conditons. At present, annual moringa occupies about 70 per cent of the total area under moringa cultivation in Southern India, propagated solely by seeds. In Andhra Pradesh alone, over 90% of the total area under moringa cultivation involves seed-propagated annual types (Rajangam *et al.,* 2001).

Though moringa produce lush flowering in seasons, percentage of pod set is just around one per cent (Sadasakthi, 1995) [22]. Hence to meet the growing demand for moringa there is a need to improve the pod set per cent. Plant growth regulators are compound when added in small amount, alters the plant growth usually stimulating or modifying the natural growth system, thereby increasing the yield (Surendra, 2006) [26]. Plant growth harmones are involved in plant growth and development and yield by preventing the flower and fruit drop (Aslam *et al*., 2010) [4]. Foliar application of micronutrients is the most efficient way to utilize the nutrients by plants. (Harris and Mathuma, 2015) [14]. Potassium schoenite being a source of potassium, magnesium and suphur, supply balance nutrients and helps in better accumulation of photosynthates in the sink (Gosh *et al*., 2017) [10]. This study aimed at impoving the pod set per cent of moringa through the foliar spray of growth regulator, micronutrient and chemicals in different methods of propagation of PKM 1 cultivar of annual moringa.

Materials and Methods

The experiment was conducted in Western block of Horticultural College and Research Institute, Periyakulam during 2018-2019 using the annual moringa cultivar PKM 1. The crop established during 2017 by air layering, semi hard wood cuttings and seeds, were cut down to 75cm to get the ratoon crop. The experiment was laid in a factorial randomized block design with three replications. The treatments consist of different methods of propagation such as air layering (P_1), semi hard wood cutting (P_2) and seed propagated plants (P_3) and foliar spray of water (S_0), NAA 20 ppm (S_1), NAA 40 ppm (S_2), boric acid 0.1% (S_3), boric acid 0.2% (S_4) and potassium schoenite 0.2% (S_5) and potassium schoenite 0.4% (S_6). Spray treatments were imposed at 90 and 180th days after ratooning. The observations such as tree height, leaf area, chlorophyll content, days to first flowering, days to 50% flowering, and pod set per cent were recorded after the second spray in three randomly tagged trees. The observations recorded were statistically analyzed using AGRESS software. The result were subjected to analysis of variance and treatment differences tested for significance (P=0.05) as per Gomez and Gomez (1984) [12].

Results and Discussion

Tree heights were affected by foliar application of growth regulator, micronutrient and chemical on different methods of propagation. Tree height differed significantly due to propagating material and foliar spray. Seed propagated trees sprayed on 90th and 180th days after ratooning with NAA 20 ppm recorded the maximum tree height (378.33 cm) followed by potassium schoenite of 0.4% (362.33 cm). Minimum plant height was found in air layered tree sprayed with water (258.00 cm). The highest value of tree heights were observed in the NAA 20 ppm in all the methods of propagation. This is due to the fact that foliar application of NAA causes apical dominance by increased the plasticity of cell wall by loosening it and followed by hydrolyzing starch into sugars causing rapid cell elongation and cell division (Arvindkumar *et al*., 2014 and Vishampayam 2003) [3, 27]. Kathiravan in 2009 observed similar results that seed propagated plants shown maximum height compared to cuttings in jatropha. Increase in tree height might be due to efficient metabolism and effective source sink relationship.

Interaction effect of methods of propagation and foliar spray significantly influenced the leaf area. Among the different treatments NAA 20 ppm recorded the maximum leaf area of 316.81cm^2 in air layered trees. The present finding of leaf area was supported by the finding of Chaudary *et al.* (2006) and Vishampayan (2003) [27] who noted the increasing in leaf area with the application of NAA in chilli and moringa respectively.

Chlorophyll content was found significantly varying only with the foliar application. The interaction of foliar spray and method of propagation did not produced significant effects.

The number of days to first flowering and 50% flowering were earlier in NAA 20 ppm foliar spray in seed propagated plants (125 and 150 days) and in cuttings (130.67 and 153.67 days) and which was on par with boric acid 0.2% sprayed seed propagated plants (130.33 and 155.33 days). The effect of NAA on the number of days taken for the first flower showed earliness in flowering when compared to other treatments. Application of NAA 20 ppm increased the synthesis of auxin in the root system and their transport to the axillary buds helps in the early transformation to vegetative phase to reproductive phase. (Kannan *et al*., 2009 in paprika and Geetharani *et al*., 2008 in onion) [15, 9]. Findings of Rajput *et al.*, 1976 [20] and Gogoi *et al*., 2014 [11] revealed the effect of boron on early flowering in mango and brinjal respectively.

Pod set percentage was significantly varied with method of propagation and foliar spray. It was maximum in seed propagated trees sprayed with NAA 20 ppm (2.11%) followed by boric acid 0.2% in cuttings (2.04%). The effect of NAA 20 ppm prevents the flower abscission and improved the pod set as reported by Vijayakumar *et al.,* (2001) [19]. Boric acid by maintaining cell integrity, enhancing respiration rate, increasing the uptake of certain nutrients and metabolic activities such as IAA reflects in the increased fruit set (Suganiya *et al*., 2015) [25]. Application of NAA 20 ppm in the flowering stages responded well in seed propaged plants of ratoon annual moringa cv. PKM 1.

Table 1: Effect of foliar spray of growth regulator, micronutrient and chemical in different methods of propagation on growth and yield parameters of ratoon crop of annual moringa cv. PKM 1

Parameters	Tree height (cm)	Leaf area (cm^2)	Chlorophyll content (SPAD values)	Days to first flowering	Days to 50% flowering	Pod set per cent (%)
P_1S_0	258.00	231.72	52.43	158.00	183.00	1.12 (6.07)
P_1S_1	344.33	316.81	56.10	137.67	162.00	1.81 (7.72)
P_1S_2	303.67	285.00	57.70	152.00	177.00	1.30 (6.56)
P_1S_3	292.33	246.32	52.60	156.67	181.67	1.50 (7.04)
P_1S_4	303.00	250.54	55.40	146.00	168.67	1.70 (7.48)
P_1S_5	307.33	270.36	59.87	155.00	180.00	1.50 (7.04)
P_1S_6	330.33	280.00	60.63	153.33	178.33	1.62 (7.30)
P_2S_0	280.67	220.91	53.90	158.67	183.67	1.14 (6.12)
P_2S_1	345.67	300.09	56.67	130.67	153.67	1.93 (7.99)
P_2S_2	317.67	292.30	62.70	146.67	171.67	1.37 (6.72)

P_2S_3	300.67		248.21		56.67		155.33		180.33		1.45 (6.88)	
P_2S_4	297.33		254.36		55.23		144.33		169.33		2.04 (8.21)	
P_2S_5	308.00		276.50		61.37		138.33		163.33		1.50 (7.11)	
P_2S_6	328.67		284.32		59.20		150.00		175.00		1.60 (7.27)	
P_3S_0	310.67		198.32		48.27		151.67		175.33		1.05 (5.87)	
P_3S_1	378.33		310.91		56.50		125.00		150.00		2.11 (8.35)	
P_3S_2	350.67		292.34		56.00		133.67		158.67		1.63 (7.33)	
P_3S_3	303.67		258.13		55.87		143.00		168.00		1.72 (7.54)	
P_3S_4	328.67		265.34		52.90		130.33		155.33		1.96 (8.04)	
P_3S_5	346.67		271.53		57.87		143.33		168.33		1.73 (7.54)	
P_3S_6	362.33		268.62		60.47		133.00		158.00		1.84 (7.76)	
mean	318.98		268.62		56.59		144.89		169.59		1.60 (7.23)	
	SEd	CD	SEd	CD	SEd	CD	SE d	CD	SE d	CD	SE d	CD
P	2.40	4.85**	2.24	NS	1.21	NS	1.16	2.35**	1.11	2.24**	0.02	0.03**
S	3.66	7.41**	3.42	6.91**	1.85	1.85**	1.77	3.58**	1.69	3.42**	0.03	0.05**
PxS	6.35	12.84**	5.92	11.97**	3.21	2.93	3.07	6.21**	2.93	5.93**	0.04	0.09**

(Values in parenthesis are arc sine transformation)

References

1. Angadi AP, Jagadeesha RC. Distinctness, uniformity and stability testing in Moringa-An overview. Journal of Pharmacognosy and Phytochemistry. 2018; 3:30-34.
2. Anwar F, Latif S, Ashraf M, Gilani AH. *Moringa oleifera*: a food plant with multiple medicinal uses. Phytother. Res. 2007; 21:17-25.
3. Arvindkumar PR, Vasudevan SN, Patil MG. Effect of foliar sprays of NAA, triacontanol and boron on growth and seed quality in bitter gourd (*Momordica charantia* L.) cv. Pusa Visesh. J Hortl. Sci. 2014; 9(2):148-152.
4. Aslam Muhammad, Ahmad Ejaz, Saguu AG, Hussain Khalid, Ayaz Muhammad, Ullah Inayat *et al*. Effect of plant growth regulator (NAA) and available soil moisture depletions on yield and yield components of chickpea. Sarhad J Agric. 2010; 26(3):325-335.
5. Beaulah A, Mariappan S. Moringa tree of life for preventing malnutrition among women and children. International Journal of Nutrition and Agriculture Research. 2016; 3(2):34-43.
6. Chaudhary BR, Sharma MD, Shakya SM, Gautam DM. Effect of plant growth regulators on growth, yield and quality of chilli (*Capsicum annuum* L.) at Rampur, Chitwan. J Inst. Agric. Anim. Sci. 2006; 27:65-68
7. Fahey JW. *Moringa olifera*: A review of the medical evidence for its nutritional, therapeutic and prophylactic properties. Part 1. Tree life J, 2005, 1-15.
8. Fuglei L. The miracle tree: *Moringa oleifera*: Natural nutrition for the Tropics. Church World Service, Moringa. Church World Service, Dakar, 1999, 172.
9. Geetharani P, Manivannan MI, Ponnuswamy AS. Seed production of onion as influenced by the application of growth regulators and nutrients. Asian Journal of Horticulture. 2008; 3(2):301-303.
10. Ghosh D, Sarkar S, Brahmachari K, Garai S, Pal M, Sharma A. Potassium schoenite: an emerging source of potassium for improving growth, yield and quality of potato. Journal of Experimental Biology and Agricultural Sciences. 2017; 5(2):173-182.
11. Gogoi S, Das MR, Bora P, Mazumder N. Effect of foliar application of nutrients on fruit and seed production of brinjal (*Solanum melongena* L.). Indian Journal Assam Agricultural Sci. 2014; 2(1-2):23 -27.
12. Gomez KA, Gomez AA. Statistical procedures for agricultural research. (2 ed.), John wiley and sons, NewYork, 1984, 680.
13. Gull I, Javed A, Aslam MS, Mushtaq R, Athar MA. Use of *Moringa oleifera* flower pod extracts as natural preservative and development of SCAR markers for its DNA based identification. Bio Med Research International, 2016, 12.
14. Harris KD, Mathuma V. Effect of foliar application of boron and zinc on growth and yield of tomato (*Lycopersicon esculentum* Mill.). Asian Journal of Pharmaceutical Science & Technology. 2015; 5(2):74-78.
15. Kannan K, Jawaharlal M, Prabu M. Effect of plant growth regulators on growth and yield parameters of paprika cv.KtPl-19. Agric. Sci. Digest. 2009; 29(3):157-162
16. Kathiravan M, Ponnuswamy AS, Vanitha C. Determination of suitable cutting size for vegetative propagation and comparison of propagules to evaluate the seed quality attributes in *Jatropha curcus* Linn. Natural Product Radiance. 2009; 8(2):162-166.
17. Morton JF. The horseradish tree, *Moringa pterigosperma* (Moringaceae): A boon to arid lands. Econ. Bot. 1991; 45:318–333.
18. Muhl QE. Seed germination, tree growth and flowering responses of *Moringa olifera* Lam. (Horseradish tree) to temperature. M.Sc. Thesis. University of Pretoria. Pretoria. 2009.
19. Rajangam J, Azahakia Manavalan R, Thangaraj T, Vijayakumar A, Muthukrishan N. Status of production and utilization of Moringa in southern India. Development potential for moringa product. Dar Es Salaam, Tanzania. 2001. http://www.moringanews.org/actes/rajangam_en. Doc.
20. Rajput CB, Singh BP, Mishra HP. Effects of foliar application of boron on mango. Scientia Horticulturae. 1976; 5:311-313.
21. Reyes SN. *Moringa oleifera* and *Cratylia argentea*: potential fodder species for ruminants in Nicaragua. Doctoral thesis, 2006.
22. Sadashakti A. Studies on combining ability, heterosis and prediction model for ideotypes in anuual moringa (*Moringa pterygosperma* Gaertn.). Ph.D. thesis. Tamil Nadu Agricultural University. Coimbatore, 1995.
23. Saha P, Jena RC, Sahoo B, Sahoo K, Lenka A. Sufficing Neutraceutical Rich Multipurpose Leafy Vegetable on Earth: Moringa. Odisha Review, 2012, 72-80
24. Sekhar C, Venkatesan N, Murugananthi D and Vidhyavathi A. Status of value addition and export of moringa produce in Tamil Nadu – a case study, International Journal of Horticulture, 2018; 8(3):16-28.
25. Suganiya S, Harris KD. Effect of Boron on flower and fruit set and yield of ratoon Brinjal crop. International

Journal of Scientific Research and Innovative Technology. 2015; 2(1):135-141.

26. Surendra P, Nawalagatti CM, Chetti MB, Hiremath SM. Effect of plant growth regulators and microurients on yield and yield component of okra. Karnataka J Agric. Sci. 2006; 19(2):264-267.
27. Vaishampayan DC. Studies on effect of fertilizers, growth regulators and pruning on growth, yield and quality of drumstick (*Moringa oleifera* Lam.) Var. PKM 1. Ph.D. Thesis. Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli. India, 2003.
28. Vijayakumar RM. Studies on influence of months of sowing and growth regulation on annual moringa (*Moringa ptergosperma* Gaertn) Ph.D. Thesis, TNAU, India, 2001.