International Journal of Plant & Soil Science

Volume 35, Issue 24, Page 147-153, 2023; Article no.IJPSS.111374
ISSN: 2320-7035

Influence of Perennial Rootstocks and PKM1 Scion on Nutritional Content of Grafted Moringa (*Moringa oleifera* Lam.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJPSS/2023/v35i244306

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/111374

Original Research Article

Received: 23/10/2023
Accepted: 28/12/2023
Published: 28/12/2023

ABSTRACT

The investigation was undertaken at Horticultural College ad Research Institute, Coimbatore to identify the graft compatibility of seven perennial moringa rootstocks for PKM 1 Moringa scion under drought condition. Among the seven rootstocks, moolanur moringa is identified as the best rootstock for PKM 1 Scion with wedge method of grafting as confirmed with histological method. The leaf nutritional contents were analysed in all the seven perennial rootstocks, PKM1 moringa scion and graft combinations. Among the rootstocks, Padasolai local rootstocks had highest calcium content (559.93 mg/100g). Moolanur moringa rootstocks had highest potassium content (358.46 mg/100g) and iron content (2.54 mg/100g). Among the graft combinations highest potassium content (368.74 mg/100g) and highest iron content (2.76 mg/100g), highest C/N ratio of 24.82 and highest total nitrogen content of 1.48% were recorded in the PKM-1 moringa scion grafted on to moolanur moringa rootstock.

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Keywords: Moringa; graft; rootstock; calcium; potassium; iron; nitrogen; CN ratio.

1. INTRODUCTION

"Moringa oleifera Lam. belonging to the family Moringaceae is a handsome softwood tree, native of India, occurring wild in the sub-Himalayan regions of Northern India and now grown worldwide in the tropics and sub-tropics. In India it is grown all over the subcontinent for its tender pods and also for its leaves and flowers. The pod of moringa is a very popular vegetable in South Indian cuisine and valued for their distinctly inviting flavour. It is grow best in dry sandy soil and also tolerates poor soil of Semi- arid tropical and sub tropical areas. Optimum temperature for cultivation of moringa is 25- 35 ◦ C. India is the primary producer of tender pods with an annual production of 2.20 to 2.40 million tonnes from an area of 38,000 ha leading to the productivity of around 63 tonnes per ha. In Tamil Nadu. Moringa paid its attention in export due to its nutritional value. It is called as 'Miracle tree' since all parts is exploited commercially for nutracetical, cosmetics, food and oil induxtries" [1,2]. Vijayakumar et al. [3] mentioned "moringa as a multipurpose tree, wherein the leaves, flowers and fruits are used for culinary and medicinal purposes. Before the variety PKM 1 released by Tamil Nadu Agricultural University moringa had been grown as a perennial crops and in a limited area. Invention of annual moringa cv. PKM-1 is a milestone in the research on moringa by which the area and productivity were greatly increased in Tamil Nadu. It has occupied considerable area in adjoining states like Karnataka and Andhra Pradesh and spred to Gujarath and parts of Rajasthan and Madhya Pradesh. Since it is a seed sown crop and annual in nature, it responds markedly to seasonal changes. The vegetative phase is extended if it is sown in a wrong season. Research findings on several horticultural crops accomplished that grafting is one of the technique to improve the nutritional composition". Hayat et al. [4] reported that "the starch content were higher in leaf and root of Red Fuji apple grafted onto M-9 rootstock compared with more vigorous rootstock". Liu et al. [5] reported that "grafting musk melon on interspecific rootstock can reduce total carbohydrate accumulation during early development and increase starch accumulation in the later developmental stage of leaves". Pulgar et.al. [6] studied "the mineral nutrition in grafted water melon plant and reported that the pumpkin cultivar as rootstock showed a high capacity of N uptake". Chen et.al. [7] reported that "grafted squash seedlings recorded significant increase in photosynthetic rate, chlorophyll content and soluble protein than in self-rooted seedlings after undergoing the same period of chilling stress". Zhang [8] reported that "dry matter, protein, vitamin C and sugar content of grafted eggplant were higher than those of non-grafted eggplant". With a view on considering the nutritional importance of moringa, an investigation was undertaken to study the influence of perennial moringa rootstocks grafted with PKM 1 Annual Moringa scion at Horticultural College ad Research Institute, Coimbatore during the year 2021-2022.

2. MATERIALS AND METHODS

Experiment on screening of perennial moringa rootstocks for grafting of PKM 1 Annual moringa (*Moringaoleifera* Lam.) scion was conducted in the College Orchard, Department of Vegetable Science, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, situated at 11^0N latitude, 77^0E longitude and at an altitude of 426.26 m above mean sea level. The materials in this present study consist of seven rootstocks *viz*., MO1 (Moolanur moringa), MO2 (Karumbu moringa), MO3 (Kanyakumari local), MO4 (Kumbakonam local), MO5 (Padasolai Local), MO6 (Kallivalasu Local) and MO7 (Puthupalayam Local), whereas Annual moringa PKM 1 was utilized as a scion material. Wedge grafting method carried out in 25-30 days old seedlings. The Completely Randomized Design was followed. The recorded data was analyzed using the statistical method suggested by Panse and Sukhatme [9]. The mean difference was statistically computed by the standard error and critical difference among the treatments.

The total nitrogen content was estimated by Kjeldahl's method by Humphries (1956). The calcium and potassium content of leaf was determined by Jackson [10]. The iron content of leaf samples were determined by Atomic Absorption Spectrophotometer method [11]. The ratio of carbohydrate to nitrogen was calculated from total carbohydrate and total nitrogen contents.

3. RESULTS AND DISCUSSION

3.1 Confirmation of Graft Union with Histological studies

Among the seven rootstocks, Moolanur moringa is identified as the best rootstock for PKM 1 Scion. The wedge method of grafting is standardized and confirmation studies were carried out with Histological method. In the present study, all processes of grafting were observed sequentially. Necrotic layer which formed as a result of cutting was seen along the cut surfaces in all the grafts. But in the course of time, necrotic layer was broken into pieces and absorbed by the newly formed callus, especially in the cortex regions of the grafts and finally necrotic layer was seen as light dark strands. It was seen that the removal of necrotic layer depended on cell division where callus was profuse.

3.2 Calcium Content on Grafted and Non-grafted Moringa

The calcium content for grafted and non-grafted seedlings was found to be significantly different, ranging between 249.59 to 559.93 mg/100g. Results revealed that, Padasolai local rootstocks had highest calcium content (559.93 mg/100g) than that of PKM-1 moringa (440.25 mg/100g), Among the graft combinations PKM-1 annual moringa scion grafted on to Moolanur moringa rootstock showed highest calcium content (438.23 mg/100g) followed by Karumbu moringa rootstock (427.94 mg/100g) and Kallivalasu local moringa rootstock (406.17 mg/100g) respectively.

3.3 Potassium Content on Grafted and Non-grafted Moringa Leaves

The potassium content for grafted and non-grafted seedlings was found to be significantly different, ranging between 279.64 to 368.74 mg/100g. Results revealed that, Padasolai local rootstock had comparatively lowest potassium content i.e. 279.64 mg/100g which was on par with Kumbakonam local moringa (284.89 mg/100g). However, Moolanur moringa rootstocks had highest potassium content (358.46 mg/100g) which was on par with karumbu moringa (347.93 mg/100g). Among the graft combinations of rootstocks with PKM-1 moringa grafted on to moolanur moringa rootstock showed highest potassium content (368.74 mg/100g) which was on par with karumbu moringa rootstock (351.23 mg/100g). Rootstock padasolai moringa had lowest potassium content (288.87 mg/100g) which was on par with Kumbakonam local moringa rootstock (298.76 mg/100g).

3.4 Iron content on Grafted and Non-grafted Moringa Leaves

The iron content for grafted and non-grafted seedlings was found to be significantly different, ranging between 0.61 to 2.76 mg/100g. Results revealed that, Padasolai local rootstock had comparatively lowest iron content i.e. 0.61 mg/100g which was on par with kumbakonam1ocalmoringa (0.69 mg/100g). However, Moolanur moringa rootstocks had highest iron content (2.54 mg/100g) than that of PKM-1 moringa (1.82 mg/100g).

Among the graft combinations of rootstocks with PKM-1 moringa grafted on to Moolanur moringa rootstock showed highest iron content (2.76 mg/100g) followed by Karumbu moringa rootstock (1.95 mg/100g) and Kallivalasu local rootstock (1.79 mg/100g) respectively. Rootstock Padasolai moringa had lowest iron content (0.65 mg/100g) after grafting followed by Kumbakonam local moringa rootstock (0.74 mg/100g) and Kanyakumari moringa rootstock (0.83 mg/100g).

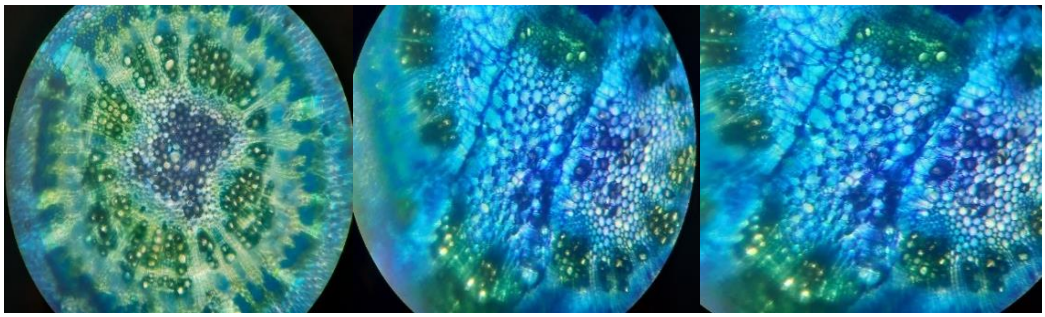

Fig. 1. Moolanur moringa Rootstock and Graft Union

Table 1. Calcium content on grafted and non-grafted moringa leaves

Treatments	Calcium content (mg/100g)	Potassium content (mg/100g)	Iron content (mg/100g)	C/N ratio	Total nitrogen content (%)
T1 -Moolanurmoringa	429.75	358.46	2.54	21.54	1.86
T2 -Karumbumoringa	419.64	347.93	1.78	19.27	1.46
T3 -Kanyakumarimoringa	337.43	327.46	0.75	21.34	1.31
T4 -Padasolai local	559.93	279.64	0.61	23.67	1.59
T5 -Kallivalasu Local	394.38	337.23	1.73	14.35	1.28
T6 -Puthupalayam Local	287.37	315.46	0.81	13.72	1.67
T7 -Kumbakonam Local	378.57	284.89	0.69	17.61	1.21
T8 -PKM-1 moringa	440.25	349.92	1.82	22.57	1.33
T9 -PKM-1 moringa grafted on to moolanurmoringa rootstock	438.23	368.74	2.76	24.82	1.48
T10 -PKM-1 moringa grafted on to karumbumoringa rootstock	427.94	351.23	1.95	18.69	1.29
T11 -PKM-1 moringa grafted on to kanyakumarimoringa rootstock	345.15	338.76	0.83	23.65	1.20
T12 -PKM-1 moringa grafted on to padasolaimoringa rootstock	364.82	288.87	0.65	22.51	1.47
T13 -PKM-1 moringa grafted on to kallivalasu local moringa rootstock	406.17	348.27	1.79	17.96	1.31
T14 -PKM-1 moringa grafted on to puthupalayam local moringa rootstock	294.59	321.89	0.86	16.52	1.25
T1 5-PKM-1 moringa grafted on to Kumbakonam moringa rootstock	389.67	298.76	0.74	19.32	1.19
CD	22.279	18.117	0.085	1.096	0.076
SE (d)	10.820	8.799	0.041	0.532	0.037

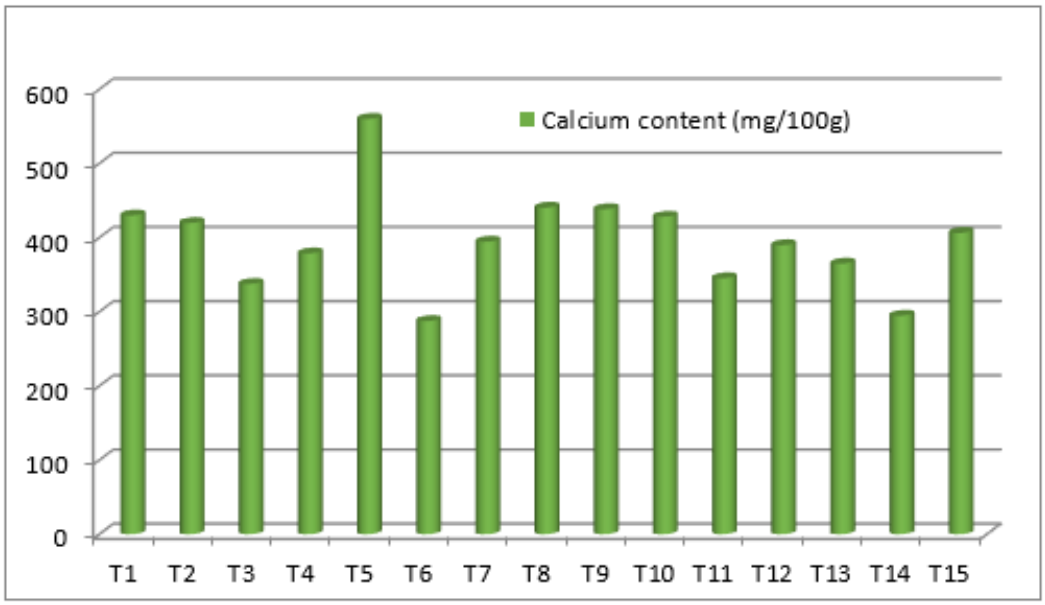

Fig. 2. Calcium content (mg/100g)

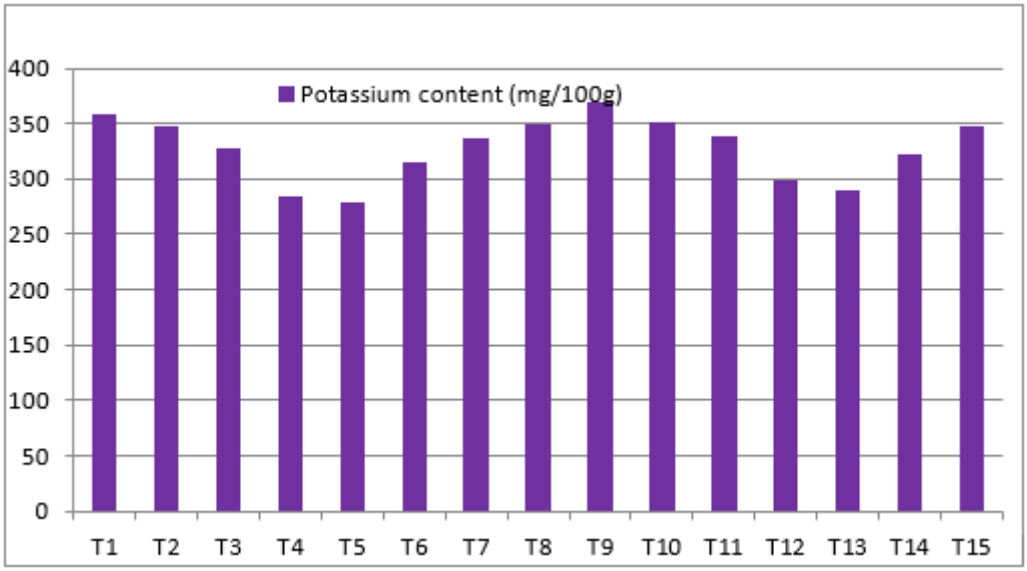

Fig. 3. Potassium content (mg/100g)

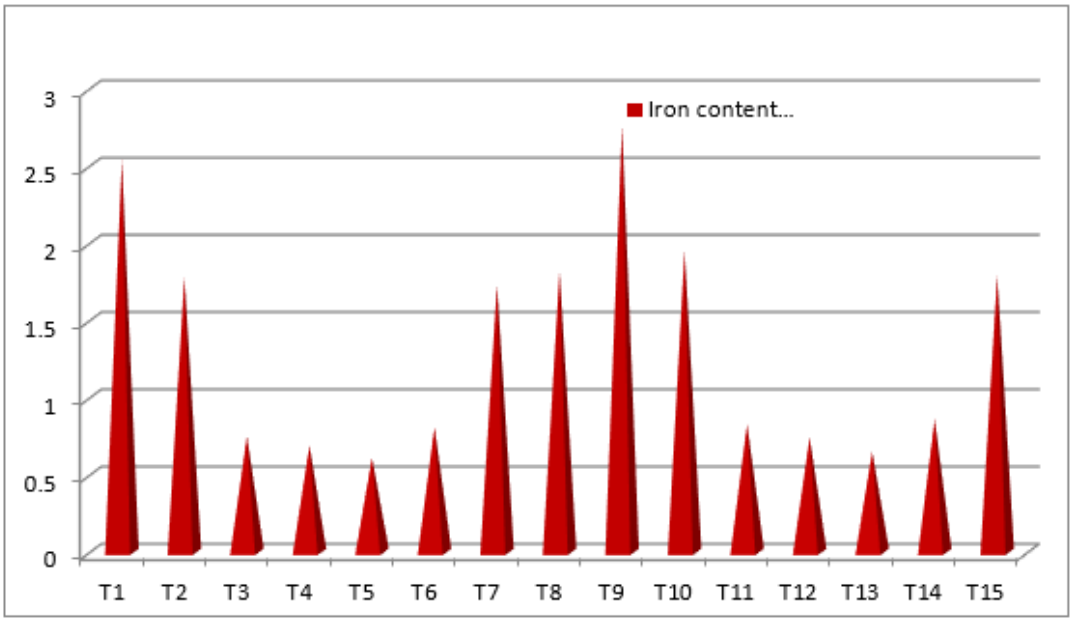

Fig. 4. Iron content (mg/100g)

3.5 C/N Ratio

Results revealed that, PKM-1 moringa (scion) had shown significantly lesser C/N ratio i.e. 22.57 than that of Padasolai local (23.67) rootstock. Among the rootstocks, Padasolai local recorded highest C/N ratio of 23.67 followed by Moolanur moringa (21.54) and Kanyakumari local moringa (21.34) respectively. Significant difference was found to be null between Moolanur moringa and Kanyakumari local moringa. It was evident that Padasolai local rootstock significantly differed with rootstocks *viz*., Moolanur moringa and Kanyakumari local moringa. However, rootstock recorded lowest C/N ratio (13.72) followed by kallivalasulocal (14.35) rootstock.

Among the graft combinations of rootstocks with PKM-1 moringa (scion), Moolanur moringa rootstock seedlings recorded highest C/N ratio of 24.82 followed by Kanyakumari local moringa rootstock (23.65) and Padasolai moringa rootstock (22.51) respectively. However, after grafting with PKM-1 moringa, Puthupalayam

local moringa rootstock were reported to have lowest C/N ratio (16.52) followed by to kallivalasu local moringa rootstock (17.96) and Karumbu moringa rootstock (18.69).

3.6 Total nitrogen content

Results revealed that, Puthupalayam local rootstock had shown comparatively lesser total nitrogen content i.e. 1.67% than that of Moolanur moringa rootstock (1.86%). Among the rootstocks, Moolanur moringa recorded highest total nitrogen content of 1.86% followed by rootstocks *viz*., Padasolai local (1.59%) and Karumbu moringa (1.46%) respectively. It was evident that Moolanur moringa rootstock significantly differed with rootstocks *viz*., Padasolai local and Karumbu moringa. However, Kumbakonam local moringa rootstock recorded lowest total nitrogen content (1.21%) followed by kallivalasu local rootstock (1.28%). This clearly depicted that significant difference was null between rootstocks viz., Kumbakonam local moringa and Kallivalasu local moringa.

Among the graft combinations of rootstocks with PKM-1 moringa (scion), Moolanur moringa rootstock seedlings recorded highest total nitrogen content of 1.48% followed by Padasolai moringa rootstock (1.47%) and perennial long moringa rootstock (1.31%) respectively. However, when grafted with PKM-1 moringa, rootstock Kumbakonam local moringa were known to have lowest total nitrogen content (1.19%) followed by Kanyakumari moringa rootstock (1.20%) and Puthupalayam local moringa rootstock (1.25%).

4. CONCLUSION

Among the rootstocks, Padasolai local rootstocks had highest calcium content (559.93 mg/100g) than that of PKM-1 moringa (440.25 mg/100g). Moolanur moringa rootstocks had highest potassium content (358.46 mg/100g) and iron content (2.54 mg/100g). Among the graft combinations of rootstocks with PKM-1 moringa grafted on to Moolanur moringa rootstock showed highest potassium content (368.74 mg/100g) and highest iron content (2.76 mg/100g), highest C/N ratio of 24.82 and highest total nitrogen content of 1.48%. From this study it can be concluded that the performance of graft combinations of Moolanur moringa on to PKM 1 Scion recorded the highest nutritional content when compared to other combinations

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
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