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Response of Biochemical Aspects on the Success of Various Propagation Methods in Annual *Moringa* cv.PKM1

G. Priyadharshini and P. Irene Vethamoni*

Department of Vegetable Crops, HC & RI,
Tamil Nadu Agricultural College, Coimbatore-3, Tamil Nadu, India
**Corresponding author*

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A B S T R A C T

An investigation was carried out to find the role of physiological and biochemical factors in the success of different propagation methods of annual *Moringa* cv.PKM 1 with respect to root initiation, growth and graft compatibility. The biochemical factors viz., orthodihydroxy phenol content, total phenol, peroxidase activity, catalase activity, total carbohydrate, total nitrogen, starch content, and C/N ratio were assessed in the different propagation materials viz., limb cuttings, air layering, grafts of annual *Moringa* cv.PKM 1 scion with Moolanur *Moringa* rootstock and Karumbu *Moringa* rootstock and seedling of annual *Moringa* cv.PKM 1. Lowest content of ortho dihydroxy phenol, total phenol, with highest peroxidase activity, catalase activity, carbohydrate, starch and nitrogen content were noticed in the grafts with perennial Moolanur *Moringa* rootstock and annual *Moringa* cv.PKM 1 scion followed by graft with perennial Karumbu *Moringa* rootstock with annual *Moringa* cv.PKM 1 scion which favoured highest success in terms of compatibility than other propagation methods.

Introduction

India is the largest producer of *Moringa* with an annual production of 1.1 to 1.3 million tonnes of tender fruits from an area of 38.000 ha (Anonymous, 2006). Among the states Andhra Pradesh leads in both area and production (15,665 ha) followed by Karnataka (10,280 ha) and Tamil Nadu (7,408 ha). In other states, it occupies an area of 4,613 ha. Tamil Nadu is the pioneering state as it has varied genotypes from diversified geographical areas, as well as introduction from Sri Lanka. *Moringa* is a fast growing, drought tolerant and compatible tree to varied ecosystems and farming systems.

The perennial *Moringa* is evergreen and can tolerate drought conditions. In general it is propagated by limb cuttings. But annual *Moringa* cv. PKM 1 is being propagated through seeds. To assess the rooting efficiency of different propagation methods viz., grafting, air layering, cuttings and seedlings physiological and biochemical aspects were studied.

Materials and Methods

The graft combinations with perennial Moolanur *Moringa* rootstocks and annual

Moringa cv. PKM 1 scion(T4), Karumbu *Moringa* rootstock with annual *Moringa* cv. PKM 1 scion(T5), limb cuttings(T1), air layering(T2) and seedlings of PKM 1 *Moringa*(T3) were utilized for the study to assess the best method of propagation. The biochemical aspects viz., Ortho-dihydroxy phenol, total phenol, peroxidase (PO), catalase, starch, total carbohydrate, total nitrogen, C/N ratio were analysed in CRD.

Results and Discussion

OD phenol

The data on OD phenol content revealed significant effects with different method of propagation (Table 1). Among different methods of propagation, graft with Moolanur *Moringa* rootstocks and annual *Moringa* cv.PKM 1 scion (T3) recorded lowest OD phenol content of 2.68 mg g-1 followed by graft with Karumbu *Moringa* rootstocks in annual *Moringa* cv.PKM 1 scion (T4) with 2.82 mg g^{-1}. Highest OD phenol content was registered in limb cuttings of annual *Moringa* (T1) with 4.45 mg g-1. Highest OD phenol content might be the reason for highest success rate of grafting in terms of graft union and rooting of grafts. The role of phenolic compounds in the regulation of growth and development of plants has been emphasized by many workers. It has long been recognised that the phenolic compounds, which play a vital role in the rooting of plants, are synthesised in leaves and translocated to the base resulting in rooting (Hess, 1962). The concept put forth by Nanda *et al.,* (1974) indicated that phenols at high concentration induced callus formation and the auxins at high concentration induced roots from callus.

Total phenol

The data on total phenol content revealed significant effects with different method of propagation (Table 1). Among different methods of propagation, graft with Moolanur *Moringa* rootstocks and annual *Moringa* cv.PKM 1 scion (T3) recorded lowest total phenol content of 27.70 mg g^{-1} followed by graft with of Karumbu *Moringa*root stocks and annual *Moringa* cv.PKM 1 scion (T4) with of 28.57 mg g-1. Highest total phenol content was recorded in limb cuttings (T1) of annual *Moringa* with 42.58 mg g^{-1}

Peroxidase

Significant differences were noticed for peroxidase activity in the planting materials of different propagation methods (Table 1). The highest peroxidase activity of 0.42 mg g^{-1} was observed in the *Moringa* grafts with Moolanur *Moringa* rootstock and annual *Moringa* cv.PKM 1 scion (T3) followed by graft with Karumbu *Moringa* rootstock with annual *Moringa* cv. PKM 1 scion with 0.37 mg g^{-1} (T4). The lowest peroxidase activity of 0.23 mg g^{-1} was recorded in limb cutting (T1). This is in line with the findings of Nieves *et al.,* (2004) who studied the structural development of graft union formation in tomato plants with positive relationship with the activities of peroxidase and reported that success of graft union is coincided with an increase of peroxidase activity.

Catalase

Significant difference was noticed for catalase activity due to different method of propagation (Table 1). In the methods of propagation, Moolanur *Moringa* rootstock grafted with annual *Moringa* cv. PKM 1 scion (T3) recorded highest catalase activity of 0.23 µg of H_2O_2 g^{-1} min^{-1} than other methods of propagation. Lowest catalase activity was recorded in limb cutting method of propagation (T1) with 0.13µg $H_2O_2g^{-1}$ min^{-1}. Nieves *et al.,* (2004) confirmed increased activity of catalase in the graft union involving cellular defence against the high level of production of H_2O_2 in the graft union during curing stage.

Table.1 Effect of methods of propagation on OD phenol content, total phenol, peroxidase activity, catalase activity in planting materials

Treatment	OD phenol content (mg g^{-1})	Total phenol content (mg g^{-1})	Peroxidase activity (mg g^{-1})	Catalase activity (µg of H_2O_2 g^{-1} min^{-1})
T_1 - Limb cuttings of annual *Moringa* cv. PKM 1	4.45	42.58	0.23	0.13
T_2 - Air layerings of annual *Moringa* cv. PKM 1	3.66	37.96	0.33	0.17
T_3 - Graft with Moolanur *Moringa* rootstock and annual *Moringa* cv. PKM 1 scion	**2.68**	**27.70**	**0.42**	**0.23**
T_4 - Graft with Karumbu *Moringa* rootstock and annual *Moringa* cv. PKM 1 scion	2.82	28.57	0.37	0.20
T_5 - Seedlings of annual *Moringa* cv. PKM 1	3.63	30.79	0.34	0.16
Mean	3.45	33.52	0.34	0.18
CD (0.05)	0.28	1.57	0.02	0.02
SEd	0.14	0.77	0.01	0.01

Table.2 Effect of methods of propagation on starch content, nitrogen content, starch content, C/N ratio in planting materials

Treatment	Total carbohydrate content (%)	Total nitrogen content (%)	Starch content (mg g^{-1})	C/N ratio
T_1 - Limb cuttings of annual *Moringa* cv. PKM 1	27.81	1.66	116.00	16.77
T_2 - Air layerings of annual *Moringa* cv. PKM 1	31.75	1.40	134.95	24.19
T_3 - Graft with Moolanur *Moringa* rootstock and annual *Moringa* cv. PKM 1 scion	**33.88**	**1.31**	**140.85**	**24.95**
T_4 - Graft with Karumbu *Moringa* rootstock and annual *Moringa* cv. PKM 1 scion	32.29	1.36	137.87	23.07
T_5 - Seedlings of annual *Moringa* cv. PKM 1	31.64	1.32	120.85	23.97
Mean	31.47	1.41	130.10	22.59
CD (0.05)	1.14	0.04	4.76	0.96
SEd	0.56	0.02	2.33	0.47

Starch

The results on starch content of planting materials showed significant differences (Table 2). Among the propagation methods, graft with Moolanur *Moringa* rootstock and annual *Moringa* cv.PKM 1 scion (T3) showed highest starch content of 140.85 mg g^{-1} followed by Karumbu *Moringa* rootstocks grafted with annual *Moringa* cv.PKM 1 scion (T4) with the starch content of 137.87 mg g^{-1}. The lowest starch content was noticed in limb cuttings (T1) of annual *Moringa* cv. PKM 1 with 116.00 mg g^{-1}.

Total carbohydrate

Significant difference in carbohydrate content was observed due to different method of propagation (Table 2). Among different methods of propagation, graft with Moolanur *Moringa* rootstocks and annual *Moringa* cv.PKM 1 scion (T3) recorded higher amount of carbohydrate (33.88 per cent) than Karumbu *Moringa* rootstocks grafted with annual *Moringa* cv.PKM 1 scion (T4) with 32.29 per cent. The lowest carbohydrate content of 27.81 per cent was recorded in the limb cutting method of propagation (T1). This finding is in conformity with the findings of Aloni *et al.*, (2008) in the grafts with cucurbita rootstock and melon scion. They reported that carbohydrate content of compatible grafts leading to higher success of the better root formation.

Total nitrogen

There was significant difference among different method of propagation for total nitrogen content (Table 2). Among different method of propagation, *Moringa* graft with Moolanur *Moringa* rootstock and annual *Moringa* cv.PKM 1 scion (T3) recorded lowest amount of nitrogen (1.31 per cent). Karumbu *Moringa* rootsocks grafted with annual *Moringa* cv.PKM 1 scion (T4) recorded 1.36 per cent of total nitrogen. The highest nitrogen content of 1.66 per cent was observed in limb cuttings (T1). This is in line with the findings of Mokashi, 1978 who observed low nitrogen in cuttings of grape showed better capacity to root. Hussein (2008) also reported negative correlation of nitrogen with the rooting percentage in *Thunbergia grandiflora*.

C/N ratio

The carbohydrate/nitrogen ratio differed significantly with the method of propagation (Table 2). Among the different methods of propagation, Moolanur *Moringa* rootstock grafted with annual *Moringa* cv.PKM 1 scion (T3) recorded higher ratio of C/N ratio with 24.95 followed by graft with Karumbu *Moringa* rootstock with annual *Moringa* cv.PKM 1 scion (T4) with C/N ratio of 23.07. The lowest ratio was recorded with limb cutting method of propagation (T1) with 16.77. Mokashi (1978) observed that an abundance of soluble carbohydrates in comparison to nitrogenous reserves was significant for rooting. The results of the present study confirm the earlier findings of Mokashi (1978) in grapes. The results indicated that, the rootstock and scion before grafting registered the highest C/N ratio and scion recorded higher ratio than rootstock. Gandev (2009) showed the supporting evidence that the highest grafting percentage was recorded with the better quality scion, which contained higher soluble sugars, starch and C/N ratio. The C/N ratio could be an important factor for rootability, since the value of C/N ratio was positively related to the rooting percentage. Although carbohydrate was found to be beneficial for root initiation, a balance between carbohydrate and nitrogen reserves appeared to be better for root development (Sen *et al.*, 1965). Highst C/N ratio might be the reason for highest success of grafting.

It can be concluded that the performance of graft of annual *Moringa* cv PKM 1 scion onto Moolanur *Moringa* rootstock was good on biochemical basis when compared to other vegetative propagation methods.

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