Journal of the Andaman Science Association Vol. 27(1):8-12 (2022)
ISSN 0970-4183, Printed in India
© Andaman Science Association, Port Blair (A & N Islands), India

The Potential of Seaweed Liquid Formulations for Rooting Promotion in Stem Cuttings of Black Pepper *(Piper nigrum L)*

T.P.Swarnam, A.Velmurugan*, V.Shajeeda Banu, G.Kavitha and N.V.Laxmi
ICAR- Central Island Agricultural Research Institute, Port Blair
** Corressponding author: velu2171@gmail.com*

Abstract

A study was conducted to assess the potential of seaweed liquid formulations prepared from brown seaweed (*Padina gymnospora)* as an alternative substance in propagation of black pepper cuttings. Seaweed liquid fertilizer (SWLF) was prepared from brown seaweed in different combinations and their effect on rooting on stem cuttings of black pepper (Panniyur 2) was studied. The effect was compared with panchakavya (PK) and control. The experiment was conducted in RBD with 5 treatments and 4 replications in a shade house. The SWLF were applied at the time of planting (dipping @ 3% for 30 minutes) and as soil drenching 15 days after planting, followed by regular applications at 15 days interval up to 2 months. The observations on rooting percent, average root length, sprout length and number of leaves in each sprout was recorded after 4 months of planting. The study indicated a significant positive effect of different SWLF on stem cuttings compared to panchakavya and control. Highest rooting percent (>95%), average root length (>12cm), sprout length (15cm) and number of leaves(5) was observed in SWLF 3 & SWLF 1 indicating their potential as an alternative rooting substance in promoting vegetative propagation of black pepper.

Key words: *black pepper, seaweed liquid fertilizer, alternative rooting substance, vegetative propagation*

Introduction

The Black Pepper (*Piper nigrum* L) is a perennial vine extensively cultivated in tropical areas of the world for its berries that are used for culinary purpose or in a wide range of industries: medicine, food processing and even perfumery. The plant is propagated through vegetative means by using stem cuttings taken from runner shoots and synthetic growth hormones like IAA/IBA are used for root promotion.

Alternative plant growth regulators are natural materials that possess the ability to stimulate the rooting of cuttings. They are suitable substitutes to the synthetic plant growth substances such as auxins, cytokinins and gibberellins which are popular rooting hormones extensively used in vegetative propagation of plants. Some of the alternative growth regulators used in recent times are plant growth promoting rhizobacteria (PGPR), seaweed extract, coconut water and moringa leaf extract (Gad and Ibrahim, 2018). Products derived from marine algae represent a relatively recent technology with a potential for agronomic applications, mainly by the promotion of plant growth and development. Different seaweed species have shown their activity as biostimulants, because of the presence of bioactive compounds like plant hormones, carbohydrates, proteins, and mineral nutrients. The seaweed extracts are not only enriched in plant hormones but also found to promote the biosynthesis of auxins, cytokinin, and gibberellins in plants (Traversari et al.2022) providing scope to use seaweed extracts or seaweed based formulations in root promotion of many horticultural crops. As black pepper is mainly propagated by stem cuttings, it is pertinent to study the effect of seaweed liquid formulations as the knowledge on use of organic biostimulants is limited. Hence an attempt was made to study the effect of seaweed based formulations in root promotion in stem cuttings of black pepper.

Materials and methods

Preparation of seaweed liquid fertilizer (SWLF)

Seaweed liquid fertilizer (SWLF) was prepared from brown seaweed *Padina gymnospora* collected from South Andaman coast by fermentation method. After collection, the debris and other adhered particles were cleaned with

seawater and brought to the Central Lab, ICAR- Central island Agricultural Research Institute, Port Blair and thoroughly washed with tap water to remove the salts and shade dried to remove the water for 2 days. Then the seaweeds were macerated into small pieces, added with other ingredients in different proportions and in different combinations to promote fermentation in a plastic container. The materials were covered with muslin cloth and stirred twice on daily basis for 60 days. Then the supernatant was filtered and used as liquid fertilizer (100%). The chemical characterization of different formulations was done following standard procedures.

Selection and preparation of stem cuttings

The cuttings of 2 to 3 nodes having 25cm length were collected from matured mother plants (Panniyur 2) during April 2021. The rooting media used in this experiment consists of soil, compost, and perlite in 50:25:25 ratios, 500g of media was filled in polybags and kept in a shade house. The experiment was conducted in randomized block design (CRBD) with 5 treatments and four replications. A total of 20 cuttings were used for each replication, so that each treatment accounts for 80 cuttings. The SLF prepared in three combinations (SWLF1, SWLF2 & SWLF3) were compared with panchakavya (PK) cow dung based organic formulation and control (Water). The organic formulations were applied at 3% concentration as dipping before planting and soil drenching. The prepared cuttings were dipped in 3% of liquid formulations (SWLF1, SWLF2, and SWLF3 & PK) for 30 minutes, while tap water is used for control. The cuttings were placed in grow bags previously filled with rooting substrate and moistened with the leftover solutions of liquid formulations of respective treatments. After planting, cuttings were kept under shade net and regular watering was done to maintain the soil moisture content. While, soil drenching was done 15 days after planting thereafter applied regularly at 15 days interval up to 2 months. For soil drenching 25ml of 3% concentration of respective formulations were used. After 4 months of planting, seedlings were removed from the grow bags and cleaned with tap water.

Data were recorded for rooting percent (%), average root length (mm), sprout length (mm) and no. of leaves for each seedling. Data obtained were statistically analyzed using ANOVA test according to Snedecor and Cochran (1973) and the means were compared using least significant difference (LSD) test at 5% confidence level. One way analysis of variance (ANOVA) was performed on the data using Web based Agricultural statistical Software Package (WASP 2.0).

Results and discussion

In this study effect of seaweed liquid formulations and panchakavya on rooting and seedling performance of black pepper was studied and the results are given below.

Rooting percent and average root length

The variance analysis indicated a significant effect of different organic formulations on all the observed variables. The rooting percent significantly varied in different formulations with highest rooting percent in SWLF 1 & SWLF 3 (>95%), followed by SWLF 2 (75.7%) and PK (73.4%) with least rooting percent in control (Fig 1). The observations on mean root length also indicated significant effect of various organic formulations on average root length as against control (Fig 2). Maximum mean root length was recorded in SWLF1 (15 cm) & SWLF 2 (14.9 cm) followed by SWLF 3(13.4 cm) & PK(14.1cm).

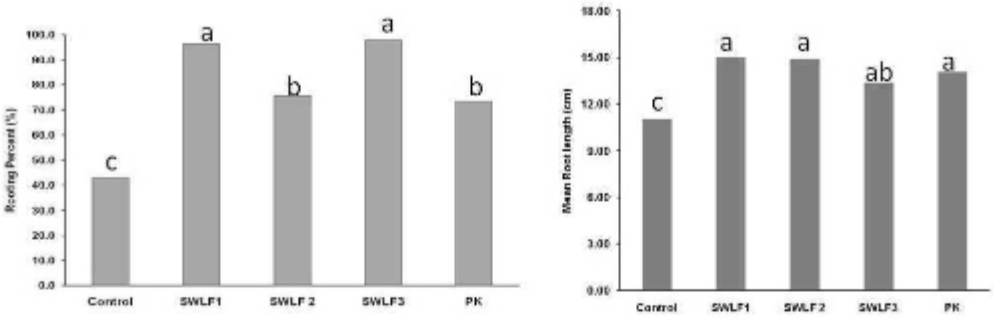

Fig1. Effect of various organic formulations on rooting percent (%) & Mean root length (cm) in black pepper

The success of regeneration through rooted cuttings depends on many factors including the species- specific ability to totipotency and regeneration. Auxins are used for enhancing root regeneration in many plants until recently as they are known for activation of vascular cambial cells, promoting adventitious roots emission and growth in stem cuttings (Hartmann et al., 2011). In recent times, other rooting stimulators like seaweed extracts are extensively tested on many crops (Pacholczak A et al. 2016). Though the stem cuttings of black pepper easily roots without any exogenous application of growth hormones as seen in control (48%), rooting percent significantly increased in different organic formulations.

The positive effects of SWLF on rooting and seedling growth could be attributed to the presence of plant hormones and major plant nutrients (Ghaderi Ardakani *et al.*2019), since the seaweed extracts are known to contain considerable amounts of indole-3-acetic acid (Sanderson et al., 1987), cytokinins, phenols, carbohydrates and mineral nutrients. The IAA content of the different formulations used in the study ranged from 1.86 to 2.27 µg/ml with 0.38-1.58% total N, 0.22-0.97% P, 0.73- 1.42% Ca and 0.96 -1.14% Mg (Table 1). The organic formulations also contained micronutrients viz., iron (Fe), zinc (Zn) and boron (B) which are used for improving rooting in stem cuttings. The Zn is important for biosynthesis of tryptophan, an auxin precursor and B is essential for cell elongation which is considered a rooting cofactor, as it acts synergistically with auxin, facilitating its transport through the cell membranes (Nunes Gomes et al. 2018). It was also reported that polyphenols act as rooting cofactors that enhances the formation of adventitious root (Osterc et al., 2004). Thus the total polyphenols and carbohydrates present in SWLF might have played a crucial role in rooting of cuttings of black pepper as reported in many vegetatively propagated plants (Ibrahim 2020).

Table 1 Nutrient and IAA content of various organic formulations used in the study

Name	Concentration (%)					Concentration (mg kg^{-1})			IAA
	N	P	K	Ca	Mg	Fe	Zn	B	(µg/ml)
SWLF 1	1.33	0.31	1.45	1.22	1.14	468.0	349.0	21.5	1.93
SWLF 2	1.52	0.32	1.65	0.93	0.99	502.0	493.0	26.3	1.98
SWLF 3	0.38	0.22	1.20	1.42	0.96	437.0	521.0	30.4	1.86
PK	1.58	0.97	0.23	0.73	0.43	301.0	456.0	12.6	2.27

Sprout length and number of leaves

The data on sprout length (cm) and number of leaves indicated that only one sprout was produced from each cutting. The sprout length and number of leaves produced were significantly higher in organic formulations than control (Fig 2). In both the traits SWLF 3 & SWLF 1 recorded significantly higher sprout length (15 cm, 12.9 cm) and mean leaf number (4.8, 5.0) respectively. Such

increase in shoot length and leaf area by application of seaweed extracts was reported in many horticultural plants (Kularathne et al.2021). As reported earlier, the enhanced growth performance of cuttings in organic formulations could be due to the presence of required plant hormones, macro and micro nutrients in sufficient quantity and form.

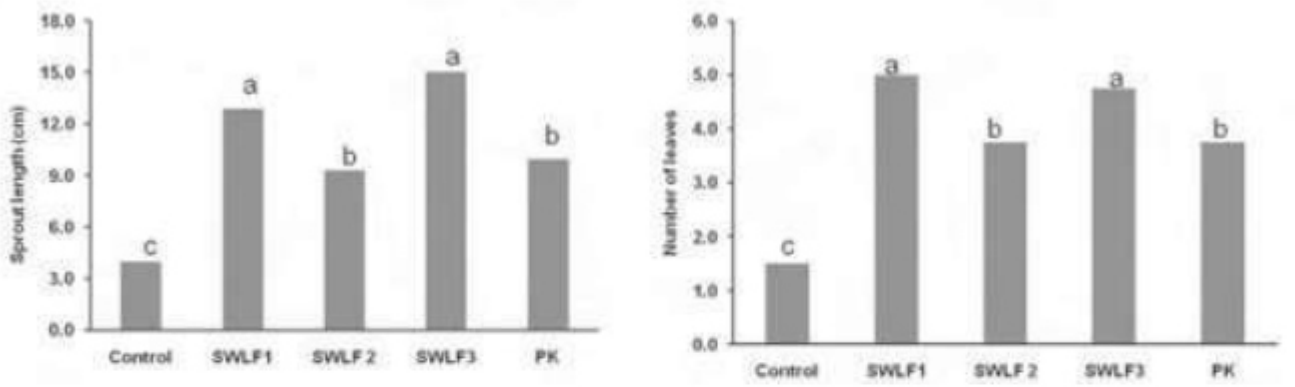

Fig 2 Effect of various organic formulations on sprout length and number of leaves

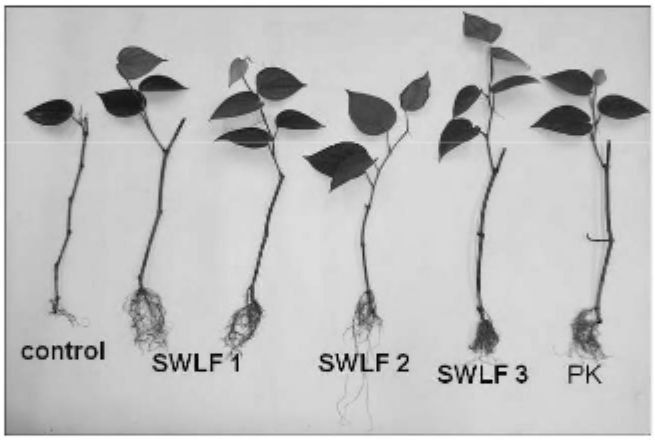

Plate 1 Effect of application of various organic formulations on rooting and seedling growth in black pepper

Conclusions

Seaweed liquid formulations prepared from brown seaweeds found to be a promising alternative in promoting rooting of stem cuttings of black pepper. Among the three SWLF preparations SWLF 1 & 3 performed best and shown to improve both rooting percentage, root length besides the sprout length and number of leaves compared to panchakavya and control. These results highlighted the suitability of seaweed based organic formulations as an alternative for synthetic hormones used for rooting promotion in black pepper. Since the use of hormonal agrochemicals is very limited and expensive, this study offers a new possible product available for organic production systems. The same can be explored for promoting rooting in other important horticultural crops.

References

Gad, M.M. & Ibrahim, M.M. (2018). Effect of IBA and some natural extracts on rooting and vegetative growth of Picual olive sucker and shoot cuttings. Current Science International, 7(2):191-203.

Ghaderi Ardakani, F., Collas, E., Damiano, D.K., Tagg, K., Graham, N.S., & Coates, J.C. (2019). Effects of green seaweed extract on Arabidopsis early development suggest roles for hormone signalling in plant responses to algal fertilisers. Scientific Reports, 9(1):1-13.

Hartmann,H.T., Kester, D.E., Davies, F. Jr. & Geneve, R.L. (2011). Plant Propagation: Principles and Practices, Prentice-Hall: Upper Saddle River, NJ, USA.

Ibrahim O.H.M. (2020). Developing air layering practices for propagation of *Dracaena arginata* Lam. utilizing phloroglucinol and seaweed extract as IBA-synergists or alternatives. Scientific J. Flowers & Ornamental Plants 7(2):185-197

Kularathne N. M.A.M., Srikrishnah, S. & Sutharsan S. (2021). Effect of seaweed extracts on ornamental plants. Curr. Agri. Res., 9(3) 149-160.

Nunes Gomes, E., Vieira, L. M., Tomasi, J.D.C., Tomazzoli, M. M., Grunennvaldt, R. L., Fagundes, C.D.M. & Machado, R. C. B. (2018). Brown seaweed extract enhances rooting and roots growth on *Passiflora actinia* Hook stem cuttings. Ornamental Horticulture 24(3):269-276.DOI: 10.14295/oh.v24i3.1221

Osterc, G., Trobec, M., Usenik, V., Solar, A. & Stampar, F. (2004). Changes in polyphenols in leafy cuttings during the root initiation phase regarding various cutting types at Castanea. Phyton (Horn,Austria), 44:109-119.

Pacholczak, A., Nowakowska, K. & Pietkiewicz, S. (2016). The Effects of synthetic auxin and a seaweed-based biostimulator on physiological aspects of rhizogenesis in Ninebark stem cuttings. Not Bot Horti Agrobo, 2016, 44(1):85-91. DOI:10.15835/nbha44110061

Sanderson, K.J., Jameson, P.E. & Zabkiewicz, J.A. (1987). Auxin in a seaweed extract: Identification and quantitation of indole-3-acetic acid by gas chromatography mass spectrometry. Journal of plant physiology, 129,(.3-4): 363-367. DOI: https://doi.org/10.1016/S0176-1617(87)80093-7

Sarmast, M.K., Kordkatooli, R., Rezaei, Z. & Ghasemnezhad, A. (2019). Effect of seasons, gender and *Agrobacterium rhizogenes* strains on adventitious root induction of male and female *Juniperus communis* L. J. Orna. Plants, 9(1):23-31.

Snedecor, G.W. & Cochran, W.G. (1967). Statistical methods. The Iowa State University Press, Ames, Iowa USA pp 593.

Traversari, S., Cacini, S. & Nesi, B. (2022). Seaweed Extracts as Substitutes of Synthetic Hormones for Rooting Promotion in Rose Cuttings. Horticulturae 8: 561.https://doi.org/10.3390/horticulturae8070561

WASP 2.0 . Web Agri Stat Package 2.0. https://ccari.icar.gov.in/wasp2.0/index.php

Received : 12th January 2022 Accepted : 20th May 2022