Research Article

Ekin
Journal of Crop Breeding and Genetics

7(1):48-51, 2021

www.ekinjournal.com

Ekin International biannual peer-reviewed journal

Development of Plant Growth Promoter Based on Globally and Abundantly Available Waste Banana Pseudo-Stem and Hair

Yadav Anil KUMAR **Yadav Karm RAJ*** **Chhangani JAYKISHOR** **Gupta Ram KISHOR**

Mahatma Gandhi Institute for Rural Industrialization, Wardha, India

* Corresponding author e-mail: krykcp@yahoo.com

Citation:
Kumar YA., Raj YK, Jaykishor C., Kishor GR., 2021. Development of Plant Growth Promoter Based on Globally and Abundantly Available Waste Banana Pseudo-Stem and Hair. Ekin J. 7(1):48-51, 2021.

Received: 24.06.2020 ***Accepted: 11.08.2020*** ***Published Online: 29.01.2021*** ***Printed: 30.01.2021***

ABSTRACT

Banana is cultivated in more than 120 countries, over an area of 4.8 million hectares, with an annual production of 99.99 million tons in the year 2011 whereas in India alone in about 1.0 million hectares generating approximately 51.18 million tons of pseudo-stem as waste annually. Similarly, millions tones of small hair (approximately 2500-3000 MT) are being generated annually in India as waste. Both the waste material is abundantly, economically and easily available at throw away price. These waste materials contain various nutrients, vitamins, nitrogen, phosphorus Potassium and trace elements etc. useful for plant growth. With a view to develop wealth from these wastes namely banana pseudo-stem and hair, the study was carried out to develop plant growth promoter utilizing these wastes. Banana pseudo-stem juice (BPSJ) was extracted from the leaf sheath and tender core with the help of a juice extraction machine by squeezing pseudo-stem twice to extract the juice maximum. Plant growth promoter was prepared in laboratory using waste hair and banana pseudo-stem juice under acidic condition which contains dissolved solid (40%), amino nitrogen (4%), total nitrogen (7%), organic carbon (8%), total amino acids mixture (13%) and trace elements. The efficacy study of this product was carried out 5 L diluted in 200 L of water per acre on banana plantation. Drenching of this product was done five times at an interval of 1 month. During efficacy trials, parameters such as chlorophyll content, total biomass, root and shoot biomass and harvested fruit yield were studied. The efficacy reveals, increase in chlorophyll content (50%), total biomass (35%), root and shoot (50%) and fruit yield (15%) as compare to control. Based on efficacy study it is concluded that plant growth promoter has shown encouraging fruit growth and can be promoted among banana cultivators to enhance the productivity of crop.

Keywords**:** Banana, hair, hydrolysate, bio-efficacy, biomass.

Introduction

Banana is an herbaceous plant of the family Musaceae. In terms of overall production, it is in the second place after citrus, accounting for about 16% of the world's total fruit production (Deharveng et al. 1999). It is cultivated in more than 120 countries, over an area of 4.8 million hectares, with an annual production of 99.99 million tons in the year 2011 whereas in India alone in about 1.0 million hectares generating approximately 51.18 million tons of pseudo-stem as waste annually (Table 1) (Indian Horticulture Database, 2011). This crop generates a large amount of residue, due to the fact that each plant produces only one bunch of bananas. After the harvest, pseudo-stem is cut and usually left on the plantation site or burned, which could ultimately cause environment issues (Cordeiro et al. 2004). Thus, the utilization of the banana waste pseudo-stems has gained more attention in recent years. The banana pseudo-stem has been used as material for paper, furniture and forage (Buragohain et al. 2010; Umaz et al. 2005). Moreover, it has been also reported that these banana waste materials are rich in micronutrients, especially Mg, Ca, K, etc. (Aziz et al. 2011). The exploitation of waste banana pseudo-stems into value added products could significantly benefit to the society and increase its economic value.

Similarly millions tones of small hair (approximately 2500-3000 MT) are being generated annually in India as waste. Human hair is a material considered useless in the societies and therefore is found in the municipal waste streams in almost all cities and towns of the world (Kumar et al. 2009). The hair is thrown away in nature where it often accumulates in large amounts in the solid waste streams and chokes the drainage systems, posing a multifaceted problem. Due to slow degradation, it stays in the dumps/waste streams for long, occupying large volumes of space. Over time, leachate from these dumps increases the nitrogen concentration in the water bodies, causing problems of eutrophication. Burning of human hair or the waste piles containing them-a practice observed in many parts of the world-produces foul odor and toxic gases such as ammonia, carbonyl sulphides, hydrogen sulphides, sulphur dioxide, phenols, nitriles, pyrroles and pyridines (Brebu et al. 2012). Open dumps of hair generate hair dust which causes discomfort to people near them and if inhaled in large amounts, can result in several respiratory problems. Oils, sweat and other organic matter sticking to the hair rot over time and become a source of foul odor and breeding ground for pathogens (Ankush 2014).

To overcome these problems an effort was made to develop a system to utilize these waste materials as a resource. This study focused on efficient utilization of banana pseudo-stem and waste human hair to develop cost-effective and eco-friendly plant growth promoter.

Materials and Methods

Fresh pseudo-stem of banana was procured from the banana plantation field, Wardha, Maharashtra (India). The chemicals and media used were procured from Merck and Qualigens.

Extraction of banana pseudo-stem juice (BPSJ)

A fresh pseudo-stem of post-harvest banana plant was taken and the leaf sheaths and tender core (floral stalk) were manually separated from the pseudo-stem. The separated leaf sheaths and tender core were washed in running tap water. Juice was extracted from the leaf sheath and tender core with the help of a sugar-cane juice extractor machine. Fresh pseudo-stem banana plant juice was hazy, it represents 70% of pseudo-stem weight. The juice becomes brown after 2 hrs when exposed to air and light.

Banana pseudo-stem juice hair hydrolysate (BPSJHH)

Banana pseudo-stem juice hair hydrolysate was prepared in laboratory using banana pseudo-stem juice and waste hair. The analysis of hydolysate shows dissolved solid (40%), amino nitrogen (4%), total nitrogen (7%), organic carbon (8%), total amino acids mixture (13%) and trace elements.

Bio-efficacy studies on banana plants

The bio-efficacy of banana pseudo-stem juice hair hydrolysate was carried out on banana plants in earthen pots at initial stage, in duplicate. For this purpose, 10 earthen pots, each pot (50x50x50 cm) was filled with soil up to 40 cm height and one rhizome of equal weight was put in the center and fully covered with soil. These pots were irrigated twice every week with 1liter tap water.

When the banana plants were 5-week-old, first drenched with BPSJHH was made. Followed by the second, third, fourth and fifth drenching at one month interval (i.e. totally 5 times) of 2.5% volume/volume diluted in tap water. Total one liter was drenched in each pot whereas control was drenched with one liter of tap water.

The plants height, stem diameter was monitored at monthly interval for 6 months and Chlorophyll content was measured every month during the experimentation. After 6 months the experiment was terminated, observation was made for dry root biomass, shoot height, chlorophyll content and total biomass.

Field trials

After getting encouraging results from the above pot experiments, field trials on 50 Banana plants in duplicates was conducted in a black cotton soil. For this purpose, 5 liter BPSJHH thoroughly mixed with 200 liter of water, first drenched was made on 5 week old banana plants, followed by the second, third, fourth and fifth drenching at one month interval (i.e. totally 5 times).

Results and Discussion

Banana pseudo-stem juice hair hydrolysate (BPSJHH)

Human Hair waste was hydrolyzed through chemical approach (5N HCL,100°C temp. 5 hrs) as it was rapid and cost-effective reproducible hydrolysate with more than 95% recovery. Hair, being a protein rich and banana pseudo-stem juice rich in micro-nutrients which is economically available raw material provided cost effective hydrolysate. Its rapid and easier processing afforded higher yield over the amino acids-based plant growth promoter available indigenously or from overseas. Due to absence of starch, it provided less caramelization and the resultant de-colourization, increased the recovery. Thus, techno economically banana pseudo-stem juice and waste hair appeared to be a superior potential raw material.

Increased biomass

Drenching of BPSJHH into the banana plants reproducibly gave 48% increase in the biomass and 50% increase in the chlorophyll content, 20% increase in the rhizome weight over the control plants (Table 2). The increase in biomass in each plant varied, per pot or plot, in terms of absolute values. However, the trend in biomass yield was always higher in different experimental pots or plots over their respective control. Therefore, it was desirable to accord an emphasis on the trend rather than percentage increase in absolute terms. These observations prompted us to carry out the BPSJHH drenching on large scale field trials.

Eco-friendly aspects of PSBJHH

The PSBJHH drenching did not affect the microbial flora qualitatively and if at all there was a change, it was a marginal increased due to highly nutritious, being a natural product and vital ingredient in different systems of living organisms. Therefore, PSBJHH is safe and eco-friendly products. From the above studies, it may he concluded that banana pseudo-stem juice and waste hair can be used for productive purpose waste to wealth. These wastes create problems of chocking the drainage pipes and thereby creating recurring environmental problems. Its hydrolysate, a plant tonic, could preserve ecology and enrich day to day nutrition by preserving soil microflora and creating greener environment/more food.

The beneficial attribute could be generation of plant growth stimulants may be due bio available of organic compounds like amino acids mixture, organic carbon and trace elements availability to the roots provided more nutrient to the plant resulting in overall development of the plant.

Another possibility is that BPSJHH can act as nutrient for other beneficial microorganism to the plants and we have also observed plant vigour increased as compare to control. It may be attributed due to available of higher potassium and phosphorous which has contributed higher bio mass of banana pseudo-stem juice as well as biological yield.

The growth promoting effects of BPSJHH was evident with field trial at large scale which provided similar results as the earthen pot. Studies in field had the advantage of testing the response of plants under their normal condition of growth for agronomic purpose. We tested the response of the plants from germination to harvest and it provided 20% higher biological yield as compare to control.

The long-term effect of BPSJHH may contribute in improving the soil health, texture, microbial flora and may reduce the use of synthetic fertilizers. Therefore, its further evaluation on other commercially valuable crops and its long term economic and environmental effect may be carried to conclude its applicability in agriculture for improving the biological yield.

From the above studies, it could be concluded that Banana pseudo-stems juice and waste hair can be used for as a plant nutrients to increase plant productivity, instead of throwing as garbage.

Table 1. Top 11 producers of bananas in the world and the production of different countries in 2012.

Rank	Country Production	Millions of Tones
1	India	29.7
2	Uganda	11.1
3	China	10.7
4	Philippines	9.2
5	Ecuador	8.0
6	Brazil	7.3
7	Indonesia	6.1
8	Colombia	5.1
9	Cameroon	4.8
10	Tanzania	3.9
11	Australia	0.2

Source: Horticulture Australia (HAL, 2012) FAO, 2011

Table 2. Average chlorophyll, height, root biomass and shoot biomass and rhizome profile of banana plants.

Parameters Monitored	% Increase Over Control
Chlorophyll	50.00
Shoot height	20.00
Root biomass	35.00
Shoot biomass	48.00
Rhizome weight	20.00

References

Anhwange BA, Ugye TJ and Nyiaatargher TD (2009). Chemical composition of *Musa sapientum* (banana) peels. EJEAFChe, 8(6):437-442.

Ankush Gupta (2014). Human hair "waste" and its utilization: Gaps and possibilities, National Institute of Science, Technology and development studies, PUSA, gate New Delhi.:1-17.

Aziz NAA, Ho LH, Azahari B, Bhat R, Cheng LH and Ibrahim MNM (2011). Chemical and functional properties of the native banana (*Musa acuminata x balbisiana* Colla cv. Awak) pseudo-stem and pseudo-stem tender core flours. Food Chemistry, 128(3):748-753.

Brebu M and Spiridon I (2011). Thermal degradation of keratin waste, Journal of Analytical and Applied Pyrolysis, vol. 91, no. 2:288-295.

Buragohain R, Kalita G and Sharma K (2010). Nutritional significance of banana as swine feed. India Vet., 87(3): 301-302.

Cordeiro N, Belgacem MN, Torres IC and Moura JCVP (2004). Chemical composition and pulping of banana pseudo-stems. Industrial Crops and Products, 19(2):147-154. DOI: 10.1016/j.indcrop.2003.09.001.

Deharveng G, Charrondiere UR, Slimani N, Southgate DA and Riboli E (1999). Comparison of nutrients in the food composition tables available in the nine European countries participating in EPIC. The European Journal of Clinical Nutrition, 53:60-79.

Kumar S, Bhattacharyya JK, Vaidya AN, Chakrabarti T, Devotta S and Akolkar AB (2009). Assessment of the status of municipal solid waste management in metro cities, state capitals, class I cities, and class II towns in India: an insight. Waste Manag. 29(2):883-95. doi: 10.1016/j.wasman.2008.04.011.

Robinson JC and Saúco VG (2010). Bananas and plantains: Second edition, pp. 1-311.

Yadav KR, Sharma RK, Yadav MPS and Kothari RM (1995). Human hair waste: An environmental problem converted into an eco-friendly plant tonic. Fresenius Environmental Bulletin, 4(8): 491-496.