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Effect Of Fruit Peel As Biostimulant And Biofertilizer On Germination And Early Growth Of *Brassica nigra* L.

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Abstract: This study aimed to investigate the potential of organic based waste material used in the form of Biostimulant and Biofertilizer. The contemporary research deals with the usage of fruit peels for efficient growth of plants and higher yield. Two different kinds of fruit peels such as banana and pomegranate were used. These fruit peels are highly rich in potassium, iron, calcium, zinc etc. Mustard seeds were used to test the utilization of fruit peel powder and extract as a natural growth enhancer. After 30 days of application of Biofertilizer plant growth was measured and the yield of mustard was counted.

Keywords: Biostimulant, Biofertilizer, Fruit peels, Mustard seeds.

Introduction: This research work titled "Effect of Fruit peel as Biofertilizer and Biostimulant on Germination and Early growth of *Brassica nigra* L.'' is a small effort to judge the potential of organic based waste material, used in the form of Biostimulant and Biofertilizer. Biostimulants as the name indicates stimulate the physiological processes of variable nature, when applied or supplied in an optimum strength. Whereas Biofertilizers are the organic based fertilizers of biological source that can be used individually or in amalgamation with other chemical fertilizers. They boost plant growth, increase productivity and yield, improve seed germination, improve soil texture and organic matter content and also enhances soil fertility.

Biostimulants are natural organic compounds applied to soil, seeds, plants, or other living things. In order to influence plant growth through enhanced tolerance to abiotic stimuli and boost seed and/or grain yield and quality. Biostimulants also lessen the requirement for fertilizers (Vasconcelos & Chaves, 2019).

Regardless of the amount of nutrients present, these compounds are effective at tiny concentrations for improving crop quality traits, abiotic stress tolerance, and/or nutrition efficiency. The compounds present in biostimulants operate similarly to the classes of recognised plant hormones, whose key members include auxins, gibberellins, and cytokinins, when administered exogenously. In the present era, abiotic stress is an

issue for plant growth and productivity. Abiotic stressors like drought, salt, and extremely high temperatures are responsible for significant crop losses worldwide. Biostimulants are increasingly being used into production systems with the intention of altering physiological processes in plants to maximise productivity in order to reduce these losses.

The term "Biofertilizer" can be defined as a substance which contains living microorganisms which colonizes the rhizosphere or the interior of the plant and promotes growth by increasing the supply or availability of primary nutrient and/or growth stimulus to the target crop, when applied to seed, plant surfaces, or soil. Biofertilizers are eco-friendly i.e causes less pollution and enhances the soil texture by increasing the amount of humus. An extensive range of fruits and vegetables waste are discarded in the environment which affect aimlessly to the environment as well as to the health of the people. The waste that are discarded inappropriately can produce odour and causes displeasure to the people living around (Raji & Onu, 2017).

Hence using this waste as a biofertilizer improves the soil texture, soil fertility and also increase the yield of crops. Scientific research has acknowledged that these wastes consist of various bioactive compounds that can be useful for growth of plant. In India, systematic study on biofertilizers was started by N. V. Joshi in 1920. Rhizobium was the first isolated from various cultivated legumes and this was followed by extensive research by Gangulee, Sarkaria and Madhok on the physiology of the nodule bacteria along with its inoculation for better crop production (Panda, 2011).

Fruit peels consist of large amount of nutrients like iron, potassium, magnesium, zinc, calcium. These are inexpensive and innocuous materials and are used for plant growth. The contemporary research deals with the usage of fruit peels for efficient growth of plants and higher yield. Two different kinds of fruit peels such as banana and pomegranate will be used in the present research. Recently, these peels are not used for some other reason and are mainly dumped as a strong waste at rapid rate. With growing environmental focus and developing significance of unfriendly agriculture wastes plant and fruits waste can be used for green conversion into biomaterials like biofuels and biofertilizers. Fruit peels are very rich in macro and micronutrients that are effective for plant growth. By utilization of fruit peels as biofertilizer we can decrease the load of debris and might get extra benefits than inorganic fertilizers. Biofertilizers contain living microbes, whereas chemical fertilizers contain chemical substances. Biofertilizers do not directly supply nutrients to the crops, while chemical fertilizers provide the soil directly with the nutrients. Biofertilizers are composed of natural materials that are extracted from animals, plants and vegetable waste materials. Chemical fertilizers are composed of non-organic and artificially cultivated elements. Biofertilizer make the soil healthier and more fertile, soil life in chemical fertilizer will not be enriched or stimulated. Biofertilizers are biodegradable, sustainable, and eco- friendly. Chemical fertilizers affect microbial ecosystem and the soils pH and also enhance chemicals in the soil.

Plant material to be used is *Brassica nigra* L. . Mustard, an annual herbaceous plant with long, branched stems measuring between 1 and 2 metres and clusters of yellow flowers, is a member of the Brassicaceae family (crucifers). Since ancient times, mustards have been eaten as vegetables, and their derivatives have been used

as sauces, culinary oils, and industrial oils (Raymer, 2002). (Nesi et al., 2008). The oil is frequently used in cooking and to give meals a hot, spicy flavour (Duke, 2002). They are one of the oilseed species that produce the most oil and have the highest protein content as a crop. Vegetables like broccoli, cabbage, Chinese cabbage, turnips, and cauliflower as well as the seed oil crop canola are among the members of this family that are economically significant (Collettet et al., 2014). (Spragg, 2016). Studies have revealed that regular use of black mustard seeds can lower the rate of colon, bladder, and lung carcinogenesis and is said to strengthen the body's biological defensive mechanisms against the formation of cancer. By bringing blood to the surface, it relieves congestion caused by headaches, neuralgia, and other head ailments (Hill, 2011).

In order to promote the use of fruit waste-based organic fertilisers, ensure the production of safe, incredibly nutritious food, and ensure the long-term sustainability of the environment, the research's objective was to study the effect of biostimulant and biofertilizer on the early growth of Brassica nigra L..

1. **Review of Literature:** A large number of researchers have worked on the use of crok, vegetable and fruit organic waste as organic fertilizers. Vermiculture is one of the most common technique for the use of these organic waste as compost. Modern research has shown the efficacy of various waste in form of organic manure that can be used as a biostimulant and biofertilizer (Prabha L.M. et al., 2013). As stated in the introduction the objective of this research is to study the effect of biostimulant and biofertilizer on the early growth of Brassica nigra L.. With this respect there are two aspects on which brief review has been carried.

1.1.Method of preparation of the specific organic manure in

a. Dry- powder form
b. Liquid form
c. Nano – liquid fertilizer

1.1.1 Dry – powder form:

Alasa et al., 2021 conducted experimental study on the use of banana and pineapple peel waste as biofertilizers, tested them on *Hibiscus sabdariffa* plant. They adopted a simple method for extraction of fruit peel. Banana and pineapple peel wastes were separately collected from homes, dumps, and markets. The peels were cleaned by thoroughly rinsing them under running water to remove debris, sand, and foreign objects. The cleaned peels were then cut into small pieces (1–5 cm) and sun dried for 33 days before being ground into powder, sieved and stored at room temperature. In addition to the three different formulations of pineapple and banana peel extracts, a fourth formulation with a pineapple and banana blend was also developed.

Method of their application: Alasa et al., 2021 conducted experimental study on the use of banana and pineapple peel waste as biofertilizers, tested them on *Hibiscus sabdariffa* plant. The method adopted was; in 400 ml of water, four grammes of each of the three formulations of banana peel, pineapple peel, and combined mixture of the two fruits peels powder extract were diluted, and then applied to the soil samples A, B, and C, respectively. Controls and two replications were maintained for each preparation, and the addition of the powder extract was done continuously for 32 days.

Overall impact of these manure on the crop plant: They observed and recorded for up to 120days.

1.1.2. Method of preparation of the specific organic manure in:

Dry- powder Form: Mercy S. et al., 2014 conducted the experiment to compare plant growth by collecting the Banana, orange, sweet lime, and pomegranate fruit peels individually. To get rid of any unwanted debris, including seeds, the collected fruit peels were thoroughly rinsed with tap water. The cleaned peels were divided into little pieces [1-5 cm] and were allowed to air dry in the sun for 20 days. The dried fruit peels were powdered individually, sieved, and kept at room temperature.

Liquid Form: Mercy S. et al., 2014 conducted the experiment to compare plant growth, various fruit peel powder formulations were utilised. Various amounts of water were added to each composition. To make the extract, 100 ml of distilled water were combined with 1g of fruit peel powder from pomegranate, orange, sweet lime, and banana. The magnetic stirrer was used to agitate this mixture for three days. This was graded as an F1, same method were carried to make the extract of different concentration, 3g of fruit peel powder were combined with 300ml of distilled water and 6g of fruit peel powder were mixed with 600ml of distilled water and were graded as F2 and F3 respectively.

Method of their application:

i. Application of Dry-powder:For uniform distribution, three fruit peel powder formulations were applied to the soil and thoroughly mixed. For each formulation, a control group and three replications were kept. Fenugreek seeds were planted in a variety of pots after 15 days. Every day, water was poured into each pot, which had been sown with 100 seeds.

ii. Application of Liquid peel Extract:

Three fruit peel extract formulations were put to the soil and thoroughly mixed to ensure even dispersion. For each formulation, a control and three replications were kept. Fenugreek seedlings were sowed on various pots after 15 days. Every pot received 100 seeds, and water was added daily.

Overall impact of these manure on the crop plant: Results were observed after 45 days of inoculation.

1.1.3. Through the preparation of liquid fertiliser made from banana peels and KCl in various concentrations, Hariyono et al., 2021. conducted an experiment. The goal of this study was to establish the efficacy of liquid organic fertiliser (LOF) made from banana peels (BP) as a potassium source for the growth of eggplant (Solanum melongena L.) and to establish the ideal ratio between the use of BP-LOF and inorganic KCl fertiliser. The findings demonstrated that the comparison of BP-LOF application produced good outcomes for eggplant development and yield.

1.1.4. Method of preparation of Nano- fertilizer from banana peel by various researchers:

Hussein et al.,2019 and Wangdi, 2019, made nano-fertilizer from banana peels. The procedure he used was shredding banana peels (William Ripe peel), blending them with tap water, adding a certain amount of potassium hydroxide, and stirring for a minute to create a slurry. After 30 minutes of boiling, the alkaline mixed slurry was cooled to room temperature. Vacuum filtering was used to separate the cool slurry into a clear brown filtrate and a thick, dark brown sludge. As a result, the clear filtrate was heated to a temperature of around 70 °C while being continuously stirred at 300 rpm. After that, urea and citric

acid (5% solution) were added dropwise until pH 5 was reached. The resulting sludge was then dried at 105 °C and pulverised into a fine powder (Nanofertilizer).

1.1.5. Method of preparation of the specific organic manure in dry- powder form: The investigation on the effects of various fruit peel powders as natural fertilisers on the growth of okra was carried out by Dayarathna et al., 2021. They created a biofertilizer using fruit peels. Fruit peels were gathered, cleaned, and cleared of foreign objects. The peels were then cut into 1 to 5 cm pieces and allowed to dry naturally in the sun for 20 to 25 days. After that, each dried fruit peel was pulverised in a grinder separately. After being individually sieved with a 2 mm sieve, they were stored at room temperature.

Method of their application: 1 g of banana, pomegranate, and orange peel powder were measured out individually, added to pots, and carefully sealed. Additionally, 0.5 g combinations of banana and pomegranate peel powders and 0.5 g mixtures of banana and orange peel powders were packaged separately and labelled for later identification. Pots were made by adding an equal volume of soil, followed by the application of inorganic and fruit peel powders in accordance with the procedures. Okra seeds were sowed two days after being scarified.

Overall impact of these manure on the crop plant: Growth and yield parameters were measured.

1.1.6. Method of preparation of the specific organic manure in dry- powder form: Halpatrao et al., 2019 conducted the experiment application of different fruit peels formulations as a natural fertilizer for plant growth. They collected apple, banana, sweet lime, and pine apple fruit peel (FP) waste individually. The undesired material, including seeds, were removed by giving them a thorough wash in tap water. The cleaned peels were divided into little pieces and let to air dry in the sun for a few days. Individual dried fruit peels were pulverised, sieved, and kept at room temperature.

Method of their application: 1g of fruit peel powder and 85g of soil were combined to create the formulations. For even distribution, the FP powder and soil were well combined. For each formulation, a control and three replications were kept. Moong (Vigna radiata) seeds were sowed in a variety of containers after being surface sterilised with 1% bavistin. Five seeds were planted in each pot. The pots received routine watering.

Overall impact of these manure on the crop plant: Results were observed after 7 days of inoculation.

Table 1. An over view of the work done by different researcher on various Fruit peels as Biostimulant and Biofertilizer.

Sr.No.	Biostimulant	Biofertilizer	Plant material	Author	End result
1		Banana and Pineapple peels	Rosella plant (*Hibiscus sabdariffa*)	J. J. Alasa et al.,	The study concluded that banana and Pineapple peels waste contain considerable quantity of

	-----				nutrients to enhance soil fertility and increase plant yield, furthermore, the study found substantial improvement in terms of growth and yield parameters including germination period, plant height, leaves area and number of leaves per branch. Waste from bananas was discovered to be more suited for rosella plants.
2	-----	Papaya, Pineapple, Citrus orange, Water melon, Banana peels	Mustard plant (*Brassica juncea*)	Soh-Fong Lim and Sylvester Usan Matu	The results of this study demonstrated that the Solid-State Fermentation (SSF) approach may be used to make biofertilizer that is both efficient and affordable and that can raise crop yields. Crop growth rate, which is really the increase in plant weight, is a good indicator of how well the biofertilizers are being used. The high acidity of the biofertilizer will have an impact on plant growth, according to the results. As a result, this study has demonstrated that agrowaste from banana, papaya, and water melons may be used to make biofertilizers utilising the SSF method.
3.	-----	Banana peel	Eggplant (*Solanum melongena L.)*	Hariyono et al.,	As demonstrated by the plant response in terms of growth and production, the use of Banana peel liquid organic fertilizer as a source of potassium was determined to have potential as a

					KCl fertiliser replacement. The tested BP-LOF produced comparable growth and yield results in eggplant in each comparison.
4.	Banana peel	-----	Tomato and fenugreek plants	H S Hussein et al.,	Two crops, tomato and fenugreek, were grown using nano-fertilizer made from banana peels. According to the research, both crop's germination rates rose when the amount of banana peel extract was increased. After 7 days of planting, the tomato crop's germination percentage jumped from 14% (control without nano) to 97%. The germination percentage of the fenugreek crop improved as well, rising from 25% (control without nano) to 93.14%.
5.		Citrate peel powder- Orange+ Sweet lime+ Pomegranate peel Alkaline peel powder- Banana peel		Jariwala J.H, Syed H.S.	Utilizing this biofertilizer will help us lower the load of solid waste brought on by fruit peel trash. That sum is relatively modest, as we are aware. Utilizing peel, however, is crucial. We can obtain the highest nutritious content by combining citrate with powdered alkaline peel. Fruit peel powder has the following uses: Soil pH regulator Improving soil morphology Has the best application in horticulture and satisfies micronutrient requirements

6.	Banana peel	Banana peel	Tomato and fenugreek plants	Garad R.T. et al.,	It is advised as a biological stimulant for seed germination and seedling growth performance since it produced excellent crop yields for both fenugreek and tomato in the first planting week.
7.		Pomegranate, orange, sweet lime, banana peel	Fenugreek, rice, mustard, rye plants	Mercy S. et al.,	Improved growth in plants was observed.
8.		Banana peel powder	Okra (*Abelmoschus esculentus* L.)	Dayarathna et al.,	The research shows that the basal and top dressings of fruit peel powder significantly affected plant height, the number of leaves per plant, leaf area, chlorophyll content, days to 50% and 100% blooming, the dry weights of leaves, stems, roots, and fruit, and the length and girth of the fruit.
9.		Sweet lime, Apple, Pine apple, and Banana peels powder	Moong (Vigna radiata)	Halpatrao et al.,	The results of this research showed that fruit peel waste had a great potential for promoting plant growth.

2. Selection of the plant material and Methodology

Plant sample waste selected for use as Biostimulants and Biofertilizers are

2.1 Sample I – Banana peel

Common names: Banana, Kela (hindi), Kēḷī (marathi), mawz (arabic), Kollaa (Bengali), Kela/ Keda(Gujarati), Kella/ Kela(Punjabi), Bāḷehaṇṇu(Kannada), Kadali Phalam (Sanskrit)

Scientific name: *Musa paradisiaca* L.

Systemetic Position (Bentham and Hooker)

Division: Spermatophyta

Class: Monocotyledonea

Series: Epigynae

Order: Zingiberales

Family: Scitaminiae

Sub-family: Musaceae

Genus: *Musa*

Species: *paradisiaca*

Fig. 1. Banana plant

Fig. 2. Banana peels

2.2 Sample II- Pomegranate

Common name: Pomegranate, Anar(hindi), Dalim(Bengali), Anardana(Urdu), Dalimbo (Kannada), Anar(Punjabi), Daan(Kashmiri), Dantbeejam (Sanskrit)

Scientific name: *Punica granatum* L.

Systematic Position (Bentham and Hooker)

Division: Phanerogamia

Class: Dicotyledonea

Order: Myrtales

Family: Punicaceae/Lytheraceae

Genus: *Punica*

Species: *granatum*

Fig. 4. Pomegranat plant

Fig. 5. Pomegranate peel

Fig. 6. Pomegranate peel (pieces), used as biofertilizer

3. Methodology

3.1 Following procedure was adopted to study the efficacy of dry and liquid form as biofertilizer and biostimulant

Use of fruit peels as biostimulant.

1. Take 7 petri plates label them as control and experimental 1 to 6 with variable concentration for trial test.
2. Make appropriate aqueous solutions of following strengths
    i. 0.5 %
    ii. 1 %
    iii. 1.5%
    iv. 2%
    v. 2.5%
    vi. 3%
3. Spread blotting paper on the petri plates and also on their cover lids.
4. Soaked 25 seeds of brassica in the respective solutions for 12- 24 hours.
5. Soaked the blotting paper with respective solutions and spread the seeds at equal distances, so as to facilitate proper germination.
6. Keep the petri plates in an incubator at room temperature.
7. Take precautions to avoid fungal infection.
8. Keep for 24 hours with intermittent observations.

3.2. Preparation of Banana and Pomegranate peel dry powder fertilizer:

1. Cut banana and pomegranate peels into small pieces
2. Peels were air dried for 5-6 days
3. Oven dried the peels at appropriate temperature for 6-7 hrs
4. Ground the peels into powder with the help of mixer or mortar and pestle
5. Used this powder as a fertilizer

Use of fruit peel powder as biofertilizer:

1. Three different fruit peel powder of different concentration i.e., 1%, 2% and 3% formulation was placed to the soil and well mixed to ensure even distribution
2. For each formulation, a control and a replicant was maintained
3. Sow 25 seeds of mustard on various pots
4. On alternate days pots were irrigated with different concentration of fertilizer
5. Results were observed after 30 days of inoculation

3.3 Preparation of Banana and Pomegranate peel liquid fertilizer:

1. 3 banana peels were soaked in 500mL of water for 3 days
2. To make the extract, 100 ml of distilled water was combined with 2.5mL of fruit peel extract.
3. Same method was carried out for pomegranate peels.
4. Different concentration of fertilizers was prepared i.e., 2.5%, 5% and 10% for both banana and pomegranate peel

Use of extract as liquid biofertilizer:

1. Soil will be treated with fruit peel extract formulations and thoroughly mixed to ensure even dispersion
2. For each formulation, a control and a replicant was maintained
3. Sow 25 seeds of mustard on various pots
4. On alternate days, pots were irrigated with different concentration of liquid fertilizer
5. Results were observed after 30 days of inoculation

4. Observation and Result

4.1. Biostimulant treatment

As per the given proposal, the effect of biostimulant on germination index was studied on mustard seeds by petriplate method. Following parameters have been recorded- Growth Index, Radicle length, and Overall appearance of plants cultivated after biostimulant treatment.

Following types of biostimulant were used for (pilot testing/) this purpose:

1. Banana peel Dry powder Fertilizer (BPF)
2. Banana peel Liquid Fertilizer (BLF)
3. Pomegranate peel Dry powder Fertilizer (PPF)
4. Pomegranate Liquid Fertilizer (PLF)

The range of dry powder fertilizer in form of aqueous solution for banana as well as for pomegranate was similar, which is given below:

1. Control
2. Experimental 1 - 0.5%
3. Experimental 2 - 1%
4. Experimental 3 - 1.5%
5. Experimental 4 - 2%
6. Experimental 5 - 2.5%
7. Experimental 6 - 3%

The results are documented in Table 1 for Banana peel Dry powder Fertilizer (BPF) and in Table 2 for Pomegranate peel Dry powder Fertilizer (PPF).

Table 2. Effect of 'Banana peel biofertilizer (BPF)' as Biostimulant on germination index of Mustard.

Sr.No	Treatment	Range of Dry powder Banana peel fertilizer (BPF) used	No. of days for germination	Germination Index (%)	Radicle length (cm)
1	Control		4	100	2.9
2	Experiment 1	0.5%	4	80	2.6
3	Experiment 2	1%	4	84	3.5
4	Experiment 3	1.5%	4	96	1.5
5	Experiment 4	2%	4	100	3.1
6	Experiment 5	2.5%	4	92	2.8
7	Experiment 6	3%	4	84	2.2

Fig.7. Control

Fig.8. 0.5%

Fig.9. 1%

Fig.10. 1.5%

Fig.11. 2%

Fig.12. 2.5%

Fig.13. 3%

1. **Germination Index –** Banana peel Dry powder Fertilizer (BPF) hardly show any effect on germination index. The higher concentration, i.e., 3% appear to be rather inhibitory.The similar inhibitory pattern was seen in 0.5% and 1% concentration as well.
2. **Radicle length –** There was a significant effect of the biostimulant on radicle length. It was maximum in 1% experimental treatment followed by control, 2%, 2.5%, 0.5%and 3%. Minimum length was recorded in 1.5%.
3. **Overall appearance –** Etiolated seedlings appeared much healthy in 2% as compared to control. It is recommended that Banana peel Dry powder Fertilizer (BPF) in a specific concentration can be effectively used as biostimulant.

It is therefore concluded that:

a. Banana peel Dry powder Fertilizer (BPF) as biostimulant hardly affects germination index.
b. Biostimulant treatment (1%) significantly affects radicle length upto 3.5 cm as against 2.9 cm of control.
c. Overall appearance showed positive impact following treatment with 2% aqueous solution of Banana peel Dry powder fertilizer (BPF).

Table 3. Effect of 'Pomegranate peel bio fertilizer (PPF)' as Biostimulant on germination index of Mustard

Sr.No	Treatment	Range of Dry powder Pomegranate peel fertilizer (PPF) used	No. of days for germination	Germination Index (%)	Radicle length (cm)
1	Control	-	4	100	2
2	Experiment 1	0.5%	4	100	3
3	Experiment 2	1%	4	92	2.8
4	Experiment 3	1.5%	4	92	1
5	Experiment 4	2%	4	76	1.6
6	Experiment 5	2.5%	4	88	1
7	Experiment 6	3%	4	40	9

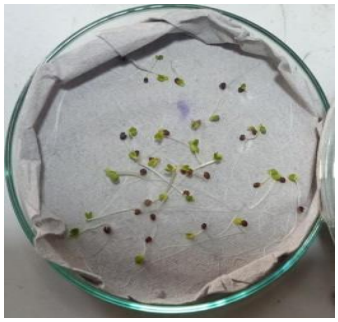

Fig.14. Control

Fig.15. 0.5%

Fig.16. 1%

Fig.17. 1.5%

Fig.18. 2%

Fig.19. 2.5%

Fig.20. 3%

1. **Germination Index –**Pomegranate peel Dry powder Fertilizer (PPF) hardly show any effect on germination index. The higher concentration, i.e., 3% appear to be rather inhibitory.
   The similar inhibitory pattern was seen in 2% and 2.5% concentration as well.
2. **Radicle length –** There was a significant effect of this biostimulant on radicle length. It was maximum in 0.5% experimental followed by control, 1%. Minimum length was recorded in 1.5%, 2%, 2.5% and 3%.
3. **Overall appearance –** Seedings showed similar appearance as that of control.
   It is therefore concluded that:

a. Pomegranate peel Dry powder Fertilizer (PPF) as biostimulant hardly affects germination index.
b. Biostimulant treatment (1%) significantly affects radicle length upto 2.8 cm as against 2 cm of control.
c. Pomegranate peel Dry powder Fertilizer (PPF) has a negative impact on germination index; as the concentration increased Growth index also decreased.

4.2. Biofertilizer treatment

Another aspect of the proposed research was to study the effect of biostimulant on germination index by pot method with soil as germinating medium.

Seeds were sown in potted soil directly and Banana peel Dry powder Fertilizer (BPF) was applied by irrigation method. The range of Banana peel Dry powder Fertilizer was 1%,2%, and 3%, whereas Banana peel Liquid Fertilizer (BLF) was used in the range of 2.5%, 5% and 10% (aqueous). Results are documented in Table 3 and 4 respectively.

Similar steps were followed by Pomegranate peel Dry powder Fertilizer (PPF) and Pomegranate peel Liquid Fertilizer (PLF). Results are documented in the Table 5 and 6 respectively.

Table 4. Banana peel Powder Fertilizer (BPF)

Sr.No	Treatment	Range of Dry powder Banana peel fertilizer (BPF) used	No. of days for germination	Germination Index
1	Control		25	21
2	Experiment 1	1%	25	24
3	Experiment 2	2%	25	25
4	Experiment 3	3%	25	14

Table 5. Banana peel Liquid Fertilizer (BPL)

Sr.No	Treatment	Range of Liquid Banana peel fertilizer (BPL) used	No. of days for germination	Germination Index
1	Control		25	21
2	Experiment 1	2.5%	25	16
3	Experiment 2	5%	25	21
4	Experiment 3	10%	25	19

Table 6. Pomegranate peel Powder Fertilizer (PPF)

Sr.No	Treatment	Range of Dry powder Pomegranate peel fertilizer (PPF) used	No. of days for germination	Germination Index
1	Control		25	23
2	Experiment 1	1%	25	16
3	Experiment 2	2%	25	23
4	Experiment 3	3%	25	25

Table 7. Pomegranate peel Liquid Fertilizer (PPL)

Sr.No	Treatment	Range of Liquid Pomegranate peel fertilizer (BPL) used	No. of days for germination	Germination Index
1	Control		25	23
2	Experiment 1	2.5%	25	22
3	Experiment 2	5%	25	18
4	Experiment 3	10%	25	12

As per the tabulated results maximum Germination Index was found in 2% Banana peel Dry Powder Fertilizer (BPF) followed by 1%. In Banana peel Liquid Fertilizer (BPL) growth index was high for control and 5% treatment. In case of Pomegranate peel Dry powder Fertilizer (PPF) maximum Growth Index was found in 3% experimental and for Pomegranate peel Liquid Fertilizer (PLF) it was seen maximum in control and 2.5% experimental.

4.3.Morphological parameters

The plantlets cultivated in the soil in pots were raised for 30 days. Following 3 weeks of growth, on 25th day morphological differences with respect to height and leaf lamina were very significant. Therefore these 2 parameters have been recorded with respect to treatment with banana and pomegranate peel fertilizer. The results are indicated in the Table 8, 9,10 and 11.

In case of Banana biofertilizer, used in peel powder form (Table 7) plant height and lamina size was maximum in 1% biofertilizer treatment. It is therefore clear that banana peel if used as biofertilizer in low concentration would enhance the growth and also biomass by enhancing the rate of photosynthesis.

Table 8. Banana peel Powder Fertilizer

Sr.No	**Treatment**	**Range of Dry powder Banana peel fertilizer (BPF) used**	**Parameters**	
			Height(cm)	**Lamina size(cm)**
1	Control	-	9.29	2.87
2	Experimental 1	1%	10.44	3.43
3	Experimental 2	2%	8.83	2.91
4	Experimental 3	3%	10.29	3.10

Fig.21. Control

Fig.22. 1% BPF

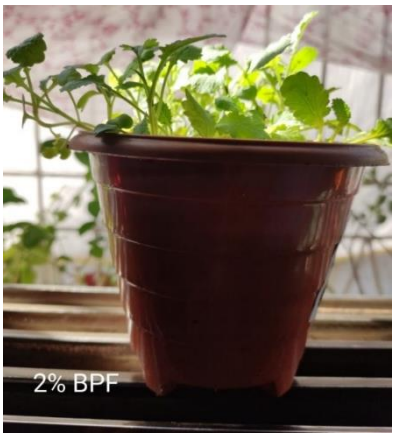

Fig.23. 2% BPF Fig.24. 3% BPF

When banana biofertilizer was used in liquid form (Table 8), height was maximum in 2.5% while lamina size was maximum in 5% application of liquid fertilizer, followed by 2.5%.

Table 9. Banana peel Liquid Fertilizer

Sr.No	Treatment	Range of Liquid Banana peel fertilizer (BPL) used	Parameters	
			Height(cm)	Lamina size(cm)
1	Control	-	9.29	2.87
2	Experimental 1	2.5%	10.88	3.76
3	Experimental 2	5%	9.88	3.82
4	Experimental 3	10%	7.73	2.54

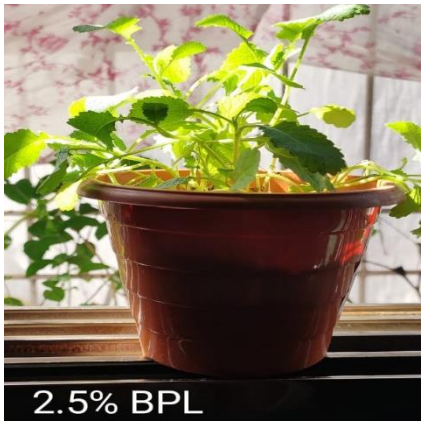

Fig.25. Control Fig.26. 2.5.% BPL

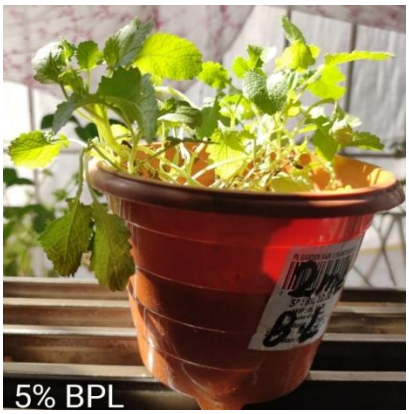

Fig. 27. 5% BPL

Fig. 28. 10% BPL

In case of Pomegranate peel powder fertilizer (Table 9) plant height and lamina size was seen to be maximum in 1% biofertilizer treatment.

Table 10. Pomegranate peel Powder Fertilizer

Sr.No	Treatment	Range of Dry powder Pomegranate peel fertilizer (PPF) used	Parameters	
			Height(cm)	Lamina size(cm)
1	Control	-	9.29	2.87
2	Experimental 1	1%	10.25	3.5
3	Experimental 2	2%	6.89	1.67
4	Experimental 3	3%	6.28	1.14

Fig.29. Control

Fig.30. 1% PPF

Fig.31. 2% PPF Fig.32. 3% PPF

When pomegranate biofertilizer was used in liquid form (Table 10) plant height and lamina size was maximum in 2.5% application of liquid fertilizer.

Table 11. Pomegranate peel Liquid Fertilizer

Sr.No	**Treatment**	**Range of Liquid Pomegranate peel fertilizer (PPL) used**	**Parameters**	
			Height(cm)	**Lamina size(cm)**
1	Control	-	9.29	2.87
2	Experimental 1	2.5%	9.51	3.43
3	Experimental 2	5%	9.21	2.91
4	Experimental 3	10%	7.5	3.10

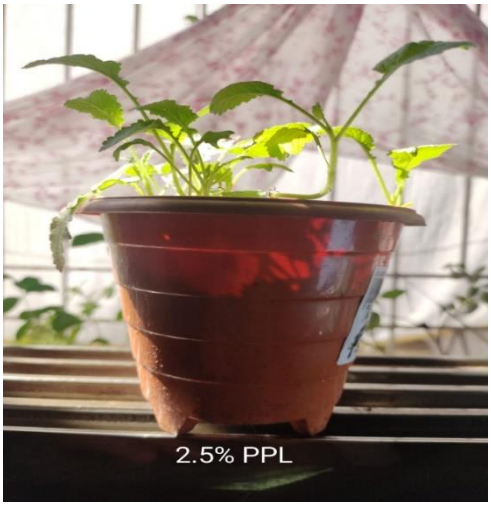

Fig.33. Control Fig.34. 2.5% PPL

Fig.35. 5% PPL

Fig.36. 10% PPL

4.1. OBSERVATION TABLES:

Table 12. Biomass

Treatments	Range of biofertilizers	Fresh weight	Dry weight
Control		2.45	0.16
BPF	1%	5.56	0.51
	2%	4.04	0.33
	3%	1.45	0.14
BPL	2.5%	1.54	0.11
	5%	2.61	0.20
	10%	3.72	0.24
PPF	1%	1.81	0.14
	2%	1.46	0.13
	3%	3.14	0.18
PPL	2.5%	3.12	0.22
	5%	2.91	0.27
	10%	2.70	0.29

Tabulated results showed that Biofertilizer treatment with BPF, BPL, PPF and PPL have a positive effect on Biomass in terms of dry weight.

Table 13. Chlorophyll content and Total carotenoids

Treatments		Chlorophyll content		Total carotenoids
		Chl a	Chl b	
Control		2.74	1.78	0.524
BPF	1%	7.42	3.82	1.243
	2%	5.13	1.24	0.957
	3%	5.89	2.82	0.847
BPL	2.5%	1.44	3.89	0.044
	5%	6.32	2.13	0.935
	10%	5.19	1.80	0.844
PPF	1%	5.61	2.22	0.602
	2%	6.54	2.23	0.985
	3%	4.62	1.64	0.599
PPL	2.5%	3.31	0.81	0.822
	5%	3.20	2.79	0.25
	10%	3.68	1.63	0.57

Total carotenoids was maximum in mustard plants treated with all the concentration of BPF, followed by 5% BPL, 2% PPF and 10% BPL.

Table 14. Vitamin C content

Treatments	Range of biofertilizers	Vitamin C (mg/100g)
Control		1000
BPF	1%	2000
	2%	2250
	3%	1750
BPL	2.5%	1500
	5%	1750
	10%	1250
PPF	1%	1750
	2%	1500
	3%	1250
PPL	2.5%	1750
	5%	1750
	10%	1250

Tabulated results showed Biofertilizer treatment with BPF, BPL, PPF and PPL have positive effect on Vitamin C content of mustard plant.

Table 15. Ash value

Treatments	Range of biofertilizers	Ash value
Control		0.02
BPF	1%	0.03
	2%	0.02
	3%	0.01
BPL	2.5%	0.01
	5%	0.01
	10%	0.0
PPF	1%	0.01
	2%	0.02
	3%	0.0
PPL	2.5%	0.0
	5%	0.01
	10%	0.0

Ash value of the treated plants showed uneven trend.

Table 16. Nitrogen content

Treatments	Range of biofertilizers	O.D (540nm)
Control		0.07
BPF	1%	0.16
	2%	0.12
	3%	0.09
BPL	2.5%	0.10
	5%	0.09
	10%	0.11
PPF	1%	0.13
	2%	0.11
	3%	0.08
PPL	2.5%	0.12
	5%	0.09
	10%	0.11

Tabulated results showed Biofertilizer treatment with BPF, BPL, PPF and PPL have positive effect on Nitrogen content of mustard plant.

Percentages of N, K, and P in vegetative growth of soil-grown tomatoes treated with banana and orange peel observed increase in vegetative growth compared to control treatment (Mona I Nossier, 2021).

5. CONCLUSION

5.1. The effect of biostimulant on Germination index studied on mustard seeds by petriplate method concluded that:

1. Banana peel Dry powder Fertilizer (BPF)

   --Hardly affect the index

   --It significantly affects radicle length at 1%

   --Shows positive impact on Overall appearance at 2% aqueous solution of biofertilizer.

2. Pomegranate peel Dry powder Fertilizer (PPF)

   --Hardly affects Germination index

   --Significantly affects radicle length at 0.5%

   --Shows negative impact on Overall appearance.

Pomegranate peel Dry powder Fertilizer (PPF) has a negative impact on Growth index; as the concentration increased Growth index also decreased.

It is recommended that Banana peel Dry powder Fertilizer (BPF) and Pomegranate peel Dry powder Fertilizer (PPF) in a specific concentration can be effectively used as biostimulant..

5.2. The effect of biofertilizer on germination index by pot method concluded that:

Banana biofertilizer and Pomegranate biofertilizer when used in powder form showed maximum height and lamina size in 1% biofertilizer treatment.

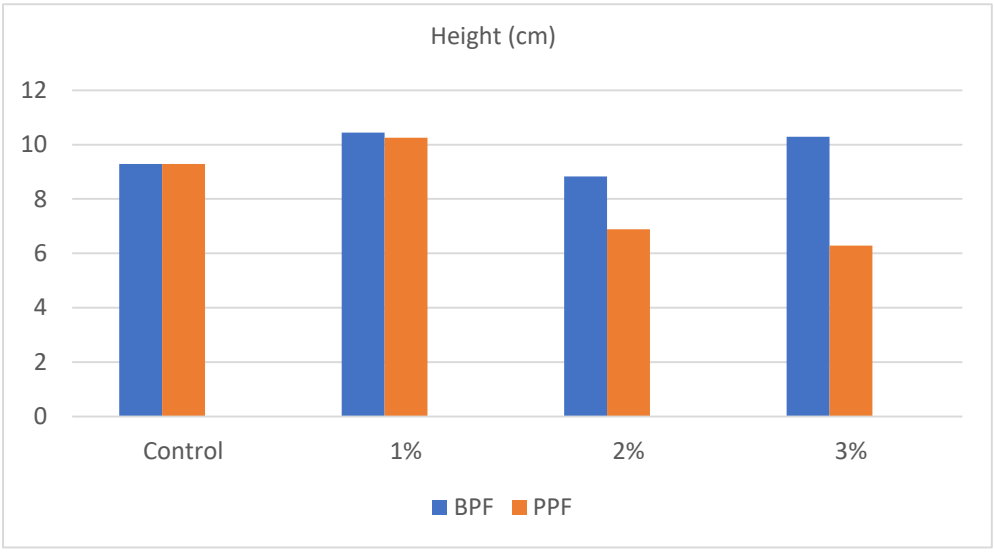

Fig.37. Effect of BPF and PPF biofertilizer on height of plant.

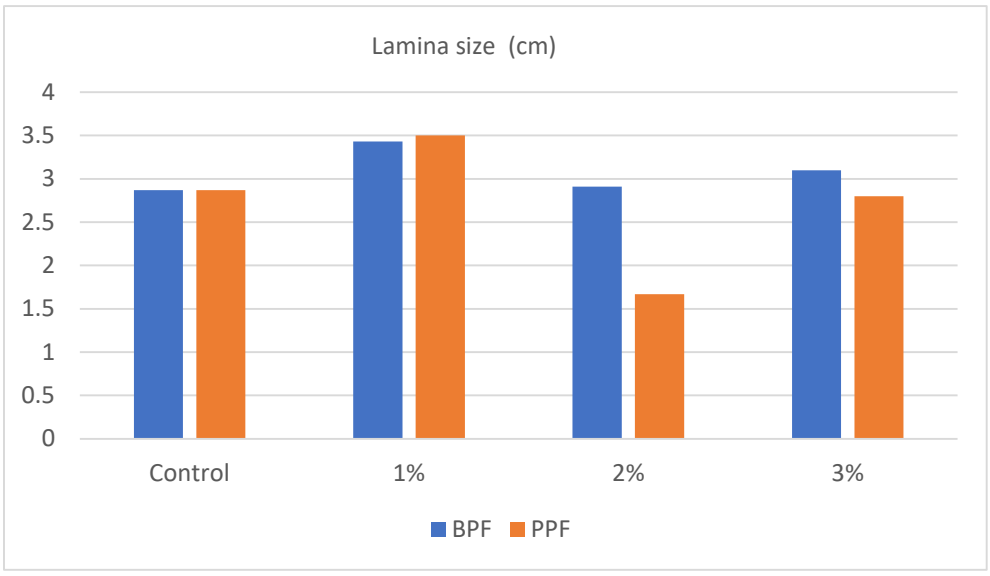

Fig.38. Effect of BPF and PPF biofertilizer on lamina size of plant.

In case of Banana biofertilizer, used in liquid form maximum height was in 2.5% while lamina size was maximum in 5% application of liquid fertilizer, followed by 2.5% and when pomegranate biofertilizer was used in liquid form plant height and lamina size was maximum in 2.5% application of liquid fertilizer.

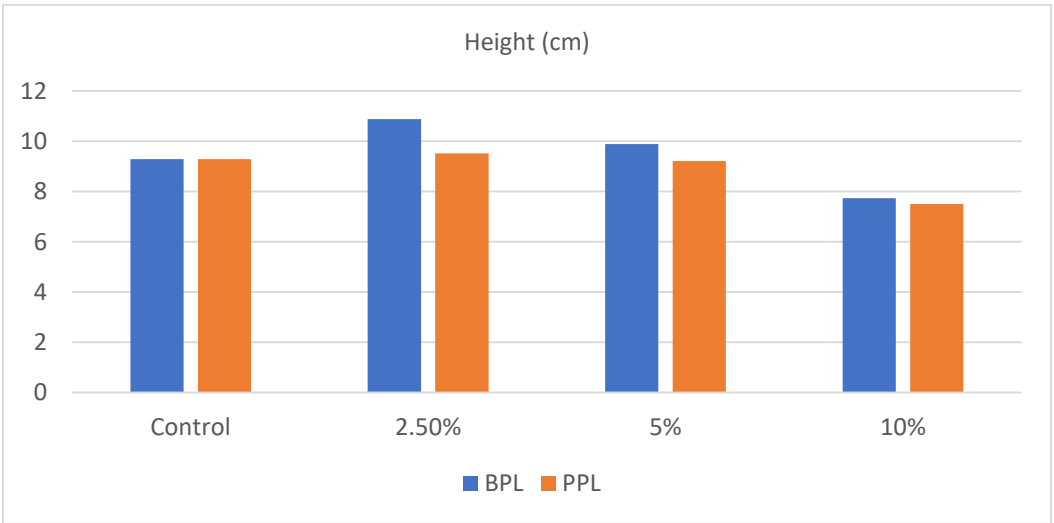

Fig.39. Effect of BPL and PPL biofertilizer on height of plant.

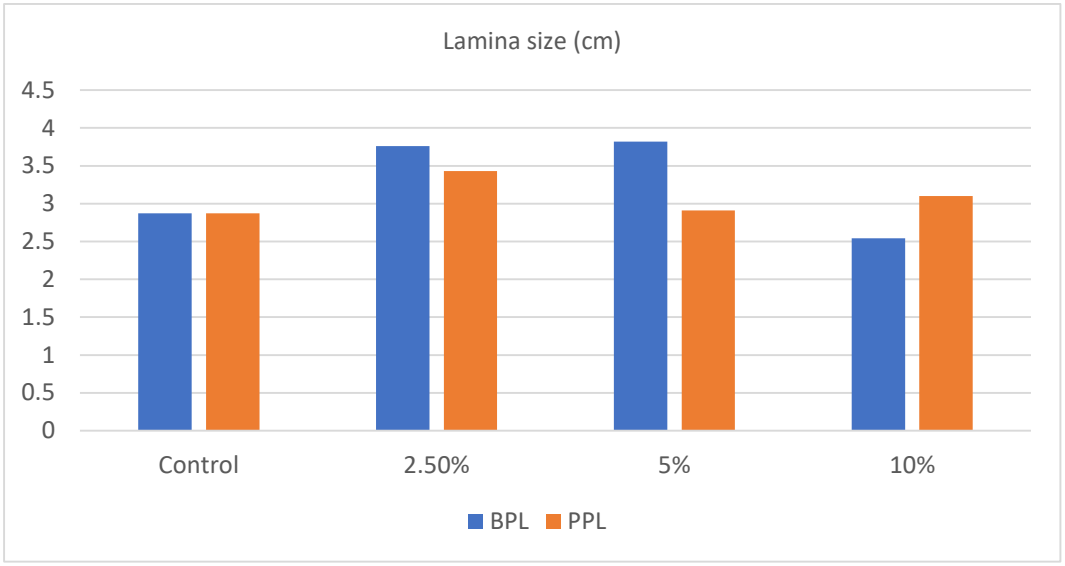

Fig.40. Effect of BPL and PPL biofertilizer on lamina size of plant.

Banana peel Liquid Fertilizer (BPL) in comparison with Pomegranate peel Liquid Fertilizer (PPL) showed greater effect on mustard seeds at 2.5%for height and at 2.5% and 5% for lamina size.

5.3.Conclusion for morphological parameters:

The result, which were tabulated (Table 12), demonstrated that the use of BPF, BPL, PPF, and PPL in biofertilizer treatments has a favourable impact on biomass in terms of dry weight.

Total carotenoids was maximum in mustard plants treated with all the concentration of BPF i.e., 1%, 2% and 3%, followed by 5% BPL, 2% PPF and 10% BPL (Table 13).

Results tabulated (Table 14) showed that the mustard plants Vitamin C content increased after biofertilizer treatment using BPF, BPL, PPF, and PPL.

Ash value of the treated plants showed uneven trend (Table 15).

Tabulated results showed Biofertilizer treatment with BPF, BPL, PPF and PPL have positive effect on Nitrogen content of mustard plant (Table 16).

6. **Discussion:** Akshata et al., 2019, conducted experiment to study the Application of Different Fruit Peels Formulations as a Natural Fertilizer for Plant Growth. They compared formulations of different fruit peels with control.

The moong bean seeds were planted in containers with a mixture of soil and peel powder at a ratio of 1 gramme fruit peel powder to 85 gm soil. The plantlets were examined for their protein and carbohydrate content. The crude extract promoted maximal plumule length, early leaf emergence, and 100% germination. When the plantlets were cultivated in soil with apple peel powder, their protein content rose, and when the plantlets were grown in soil with pineapple peel powder, their carbohydrate concentration increased. The physical and chemical characteristics of the soil that contained the various fruit peel powders were examined.

According to the findings of this study, banana peel extract had the highest pH, while pineapple, apple, and sweet lime peel extract had more or less the same impact. Pineapple peel extract had the lowest bulk density while banana peel extract had the highest. Apple extract had a high moisture content, whereas Sweetlime had a low moisture content. Control had the lowest carbon content. Apple peel extract had the highest concentration of CaCo3 while pineapple peel extract had the lowest (Akshata et al., 2019).

The length of the plant was extended to 7.2 cm by the decoction of fruit peel. Conversely, the plants raised in distilled water (the control) had a plant length of 52.3 cm. The addition of banana peel extract caused the shoot length to rise, but the addition of sweet lime peel extract caused the root length to increase (Akshata et al., 2019).

The findings of this study demonstrated that the potential for fruit peel waste to improve plant development is quite significant. One of the greatest ways to decrease accumulation and safeguard the environment would be to use household waste as a component in plant growth promoters.

J. J. Alasa et al., 2021, conducted experimental study on the use of banana and pineapple peel waste as biofertilizers, tested on hibiscus sabdariffa plant: promoting sustainable agriculture and environmental sanitation. In order to understand and analyse the growth potential of the Rosella Plant, a comparative study on the use of banana and pineapple fruit peel waste as organic fertilizer was conducted, aiming at both sustainable agriculture and environmental cleanliness. The study found significant improvements in terms of growth and yield parameters such as germination period, plant height, leaves area, and number of leaves per branch. It also found that banana and pineapple peel waste contain appreciable amounts of nutrients to enhance soil fertility and increase plant yield. Rosella plant growth was shown to be more suited to banana peel waste. The study comes to the conclusion that fruit peel powder and extract can substitute chemical fertilizers for environmentally friendly and sustainable agriculture. To ensure effective agricultural output and lessen the negative effects of synthetic fertilizer, it is advised that the general public and farmers make useful use of fruit waste as organic fertilizers and not dump it hastily.

The fruit peels of bananas, sweet lemons, oranges, and pomegranates are particularly rich in iron, potassium, zinc, and many other minerals that promote soil fertility, which in turn increases plant development and health, Mercy et al. (2014)

Hiral et al. (2016) confirmed in their research that powdered fruit peels from fruits like bananas, oranges, pomegranates, and others can be used as fertiliser for the soil, regulating pH and supplementing some nutrients like zinc, iron, and calcium. They also emphasised that using these peels in fertilisation does not require a high cost and thus it also helps in converting waste into useful materials.

In the present research work titled as “Effect of Fruit peel as Biofertilizer and Biostimulant on Germination and Early growth of *Brassica nigra* L.” Two different kinds of fruit peels such as banana and pomegranate will be used. These fruit peels consist of large amount of nutrients like iron, potassium, magnesium, zinc, calcium. Plant material used is *Brassica nigra* L. . The fruit peel was used in the form of dry powder and liquid extract. The range of dry powder fertilizer for petriplate method in form of aqueous solution for banana

as well as for pomegranate was similar i.e., Control Experimental 1 - 0.5%, Experimental 2 - 1%, Experimental 3 - 1.5%, Experimental 4 - 2%, Experimental 5 - 2.5%, Experimental 6 - 3%. The range of Banana and Pomegranate peel Dry powder Fertilizer for potted method was 1%,2%, and 3%, whereas Banana and Pomegranate peel Liquid Fertilizer (BLF) was used in the range of 2.5%, 5% and 10% (aqueous).

The effect of Banana peel Dry powder Fertilizer (BPF) as biostimulant on germination index by petriplate method, hardly affects germination index, significantly affects radicle length. Etiolated seedlings appeared much healthy in 2% as compared to control. Pomegranate peel dry powder fertilizer (PPF) showed similar effect on germination index and radicle length as that of banana peel dry powder (BBF). But for overall appearance seedings showed similar appearance as that of control.

The effect of biostimulant on germination index by pot method- Banana biofertilizer and Pomegranate biofertilizer when used in powder form showed maximum height and lamina size in 1% biofertilizer treatment while Banana peel Liquid Fertilizer (BPL) in comparison with Pomegranate peel Liquid Fertilizer (PPL) showed greater effect on mustard seeds at 2.5% for height and at 2.5% and 5% for lamina size.

Morphological Parameters: The result, which were tabulated (Table 11), demonstrated that the use of BPF, BPL, PPF, and PPL in biofertilizer treatments has a favourable impact on biomass in terms of dry weight.
Total carotenoids was maximum in mustard plants treated with all the concentration of BPF i.e., 1%, 2% and 3%, followed by 5% BPL, 2% PPF and 10% BPL (Table 12).
Results tabulated (Table 13) showed that the mustard plants Vitamin C content increased after biofertilizer treatment using BPF, BPL, PPF, and PPL.
Ash value of the treated plants showed uneven trend (Table 14).
Tabulated results showed Biofertilizer treatment with BPF, BPL, PPF and PPL have positive effect on Nitrogen content of mustard plant (Table 15).

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