DOI : 10.35124/bca.2020.20.1.2221

Biochem. Cell. Arch. Vol. 20, No. 1, pp. 2221-2227, 2020 | www.connectjournals.com/bca | *ISSN 0972-5075*

EFFECT OF PULP EXTRACT AND PEELS POWDER OF BANANA IN GROWTH AND YIELD OF CUCUMBER CV. ROLA

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(Received 12 August 2019, Revised 20 December 2019, Accepted 27 December 2019)

ABSTRACT : A greenhouse experiment was carried out in the spring season of 2018 in order to investigate the role of pulp extract and peel powder of banana fruits in growth and yield of cucumber (cv. Rola). Pulp extract was used in concentrations of 0, 10 and 20 mL 100% extract L^{-1} water while the peel powder was used as 0, 10, 20 g per experimental unit. Results of the study indicated that pulp extract and peel powder had an almost significant effect in the same direction.When they are mixed together, study factors had stronger effects due to their content of minerals, proteins, carbohydrates and amino acids. It can be recommended to use more quantity of higher concentration of the peel powder and pulp extract and apply them at different growth stages.

Key words : Banana fruit, pulp extract, peel powder, cucumber crop.

INTRODUCTION

Cucumber (*Cucumis sativus* L.) is one important crop of the Cucurbitaceae family worldwide of which Iraq. Southwest of Asia such as India and China are considered the origin of it (Wien, 1997). The importance of cucumbers comes from its high moisture (95-98%) as well as its composition such carbohydrates, proteins, minerals,and vitamins. It also has medical uses because it has enzymes for lipids, carbohydrates and protein assimilation which in turn reduce sugar level in the blood (Mohammed, 1968).

Banana (*Musa* spp.) is considered one of the perennial grasses and also considered to the most second fruit in production after citrus and it forms 16% from the fruit production in the world (Debabandya *et al*, 2010). Banana production has been increased for the period from 1992 to 2011 from 52 to 105 million tonnes. The largest amount is produced in Asia (50.82%) and in North and South America (32.97%) (FAOSTAT, 2012). More than 85% from banana is used for fresh use and for industrial purposes and the rest amount is used for export (Lescot, 2006).

Banana fruit contains several components such as proteins, lipids, carbohydrates, mineral and amino acids (Aurore *et al*, 2009 and USDA, 2012). Banana fruit has many uses besides its nutrition values such as crisps, jams, juices,and biscuits (Shyamala and Jamuna, 2011) and also contributes in several medical aspects as anaemia through hemoglobin induction in blood, blood pressure, ulcer, constipationand many other diseases (Anhwange *et al*, 2009).

Banana peels form about 40% of total weight of mature fruit (Tchobanoglous *et al*, 1993) and have many uses as animal nutrition, coal production, biofuel and water purification (Anhwange *et al*, 2009; Velmurugan, 2011). Beside it can be used bones pains and joints, coughing, bruises, wrinkles and sunburning (Edwards, 1999). Banana peels contain organic matter (91.5%) as well as it has a considerable amount of protein, carbohydrates, minerals, antioxidants and amino acids (Anhwange *et al*, 2009; Nur, 2010; Oluremi *et al*, 2012).

The very common problem that Agricultural based industries face is how to dispose of residuals. The disposing of agricultural residuals by burning or burying them in the soil or even leave it on the surface of water are more used methods and this contribute to water, soil and air pollution as well as it helps in host insects distribution, after all, they ruin the shape of the nature and cities (Rodriguez *et al*, 2010). Banana residuals whether they are peel or even pulp from the important topics and they have to be paid attention as around 40% from banana fruits are disposed of yearly (Mendoza and Aguilera, 2004). Banana fruits are disposed because either at harvest or extra of exporting or daily consumption

(Kantor *et al*, 1997; Gustavsson *et al*, 2011). The most common way to dispose of residuals is employing them in fertilizing plants for increasing growth and yield (Achsah *et al*, 2013; Mercy *et al*, 2014).

The world is aiming to use natural compounds and replace them with artificial ones, as natural compounds are environmentally friendly. Besides they have no side effects (Walaga, 2005), therefore agriculturist insisted to use plants extracts as an alternative of chemicals (Tabbache *et al*, 2008; Ghloom and Faraj, 2012). Therefore, the aim of this study was to use the alternative of chemical fertilizers through studying either of banana pulp or peel extracts in enhancing vegetative growth of cucumber cv. Rola and also enhancing the quality of its fruits as well as reducing the costs of production and disposing of residuals.

MATERIALS AND METHODS

The study was carried out during the spring season of 2018 in a greenhouse in order to use the banana pulp extract and peel powder and their effects on growth and yield of cucumber. The sterilization was done for greenhouse soil by exposing it to the sun during July and August (Katan, 1980). The seeds of Rola cultivar were chosen as they were registered according to Agriculture Ministry. This cultivar succeeded in the middle parts of Iraq. The seeds were sown in an Arboretum in 1/1/2018 and then transformed to the greenhouse in 12/1/2018. Soil samples were randomly taken at depth of 0-30 cm in order to determine chemical and physical properties (Table 1). The analysis was made in the central laboratory of the Soil Department, Agriculture College, University of Baghdad.

Table 1 : Physical and chemical properties of the experiment soil.

pH	ECds.m^{-1}	O.M%	Av. N %	Av. P %	Av. K %
8.06	2.1	2.14	12.5	186.5	163.7
Ca mmol.L^{-1}	Mg mmol.L^{-1}	Na mmol.L^{-1}	CO_3 mmol.L^{-1}	SO_4 mmol.L^{-1}	HCO_3 mmol.L^{-1}
20.4	27.8	14.7	Nil	17.9	4.6
Clay g.Kg^{-1}	Silt g.Kg^{-1}	Sand g.Kg^{-1}	Textural Class		
341.2	237.5	421.3	Clay loam		

Banana Pulp Extract preparation

The banana fruits were bought from local markets. Banana fruits were washed thoroughly with water with tap water in order to remove dust and strange things and then with distilled water. Directly peels were removed. Pulp extract was prepared by weighing 1000 g from pulp and then were cut into small pieces in Citric acid (0.5% W/V) for 10 min in order to enzymatic stabilize (Saifullah *et al*, 2009). Then the small pieces of pulp were put in one litter of warm distilled water in an electric blender for 15min. The extract was then directly filtered with two pieces of very fine cloths. Finally, the extract was obtained in a standard concentration of 100% then experimental concentrations were prepared from it.

Banana peel powder preparation

Banana peels were collected from juice shops in July, the hottest month in Iraq. Peels were washed with tap water then with distilled water. Peels were then cut into small pieces (2-4 cm) and air dried for 30 days. They were ground up into a fine powder and the powder was sieved in the produced clean fine powder was kept in very clean glass containers and stored at room temperature for further use.

Study treatments: The study included two factors, first one is the three treatment of pulp extracts (0, 10 ml and 20 ml from 100% extracts in one litter) and the second factor is also three treatments of peel powder (0, 10 g and 20 g for each experimental unit). Plants were treated with solutions directly after preparation while powder was thoroughly mixed with the soil of each experimental unit. The application of the two factors was first was after 5 days from sowing and then continued every two weeks until the end of the experiment.

Statistical analysis

The experiment was laid out as factorial according to randomized completely block design (RCBD) with three replications of each treatment. Finally, collected data were statistically analyzed according to the ANOVA table and significant differences among means were investigated using L.S.D test at 5% level of probability (Al-Mehmedi and Al-Mehmedi, 2012).

10 plants were randomly chosen in order to study the following traits:

1- **Length of the plant (cm):** it has been measured at the eighth harvest from the connection point with the soil until the apical meristems.

2- **Number of leaves (leaf plant^{-1}):** at the end of experimentnumber of leaves were calculated added to falling leaves.

3- **Number of nodes (node stem^{-1}) :** number of nodes on the stem from soil connection to the apical meristem were calculated.

4- **Stem diameter (mm) :** it was calculated by verniercaliper at a height of 2 cm from the soil surface.

5- **Leaf area (m^2 $plant^{-1}$):** leaf area was measured based on leaves dry weight according to Dvorinic (1965). Ten leaves were taken at seventh harvest and pinched with a tube with the known area in order to get 25 discs. Discs were dried at 65 °C and then the following equation was applied:

Leaf area (cm^2) = average of leaf dry weight (g)× disc area (cm^2)/ average of discs dry weight (g)

And then leaf area was multiplied with a number of leaves per plant in order to get leaf area for the plant.

6- **The dry weight of vegetative growth (g) :** dry weight of plant was measured at the end of the experiment by taking randomly 10 plants. Roots and fruit were removed and the rest parts were cut and put in the oven at 70 C and theweight was calculated.

7- **A number of fruit (fruit $plant^{-1}$):** the marketable fruit were calculated at each harvest and then the experimental unit yield was calculated by adding all together.

8- **Length of fruit (cm):** the length of 10 randomly fruits were measured by a ruler.

9- **Early yield (Kg):** the first three harvests was calculated (Esho, 1983), from 13th to 19th March 2018.

10- **Total yield (Kg) :** the accumulative total yield was calculated by adding all the 18th harvest together in each experimental unit.

RESULTS AND DISCUSSION

Fig. 1A showed that either pulp extract and peel powder had no significant effecton plant height alone while the cooperatively affected it (Table 2). Applying 20ml L^{-1} pulp extract and 20 g $plant^{-1}$ to the plants gave the highest average of plant height (1.63 m) in comparison with control.

It is also clear from Fig. 1B that pulp extract effects did not get to the significant level in a number of leaves per plant. However, peel powder significantly affected a number of leaves per plant, hence, 20 g $plant^{-1}$ treatment gave the highest number of leaves (64.62 leaf $plant^{-1}$) compared to the lowest number 48.32 leaf $plant^{-1}$ at control. Data presented in table 2 showed that there was an interaction between pulp extract and peel powder in their effect in a number of leaves per plant. The interaction took the same direction of individual factors. Plants treated with 20ml L^{-1} pulp extract and 20 g $plant^{-1}$ achieved the highest number of leaves (73.76leaf $plant^{-1}$) in comparison with control that gave 41.90 leaf $plant^{-1}$ only.

Statistical analysis of a number of nodes data showed the pulp extract did not affect this trait while peel powder significantly affected the number of nodes in the plant. Applying peel powder at 20 g $plant^{-1}$ achieved the highest number of nodes per plant (52.4 node $plant^{-1}$) compared to control that gave 38.4 node $plant^{-1}$. Pulp extract and peel powder interacted in their effect on a number of nodes per plant. Plants treated with the highest concentration of both treatments achieved 58.6 node $plant^{-1}$ in comparison with control treatment.

Although, pulp extract and peel powder affected a number of nodes along the stem, they both did not affect the stem diameter (Fig. 1D). However, the interaction between them showed a significant effect on stem diameter. The treatment 10 ml L^{-1} of pulp extract with 20 g $plant^{-1}$ of peel powder was superior in stem diameter 9.25 mm in comparison with control that gave 7.62 mm.

As for leaf area, the treatments of the study showed significant in the average of leaf area per plant. Pulp extract (20 m L^{-1}) gave the highest average of leaf area reached to 2.61 m^2 $plant^{-1}$ while the lowest leaf area was at control treatment (Fig. 1E). The highest treatment of peel powder (20 g $plant^{-1}$) gave the highest average of leaf area (2.60 m^2 $plant^{-1}$) in comparison with the control (1.90 m^2 $plant^{-1}$). Results presented in Table 2 indicated that there was an interaction between the study factors. However, plants treated with 20 ml L^{-1} pulp extract and 20 g $plant^{-1}$ peel powder showed the highest average of leaf area (2.85 m^2 $plant^{-1}$) over all other combinations while un-treated plants gave the lowest average of leaf area 1.47 m^2 $plant^{-1}$.

As many cucumber vegetative traits, pulp extract did not show a significant effect on plant dry matter, but however, banana peel powder in 10 g $plant^{-1}$ achieved the highest average of plant dry matter 80.17 g $plant^{-1}$ and decreased to its lowest average at control treatment (63.59 g $plant^{-1}$). The interaction between pulp extract and peel powder significantly affected the plant dry matter. The treatment of 10 ml L^{-1} and 10 g $plant^{-1}$ respectively showed the highest value of plant dry matter 82.90 g $plant^{-1}$ in comparison with 58.10 g $plant^{-1}$ at control treatment.

As for reproductive traits in figure 2 and table 3, results showed that both extract and powder of banana had a significant effect on a number of cucumber fruit in the plant. Banana extract in 20 ml L^{-1} achieved the highest number of fruit per plant 20.91 fruit $plant^{-1}$ in comparison with control that achieved only 18.52 fruit $plant^{-1}$ (Fig. 2A). As for banana peel powder, the amount 20g $plant^{-1}$ gave 20.85 fruit $plant^{-1}$ in comparison with 18fruit $plant^{-1}$ at the control treatment. There was a significant effect

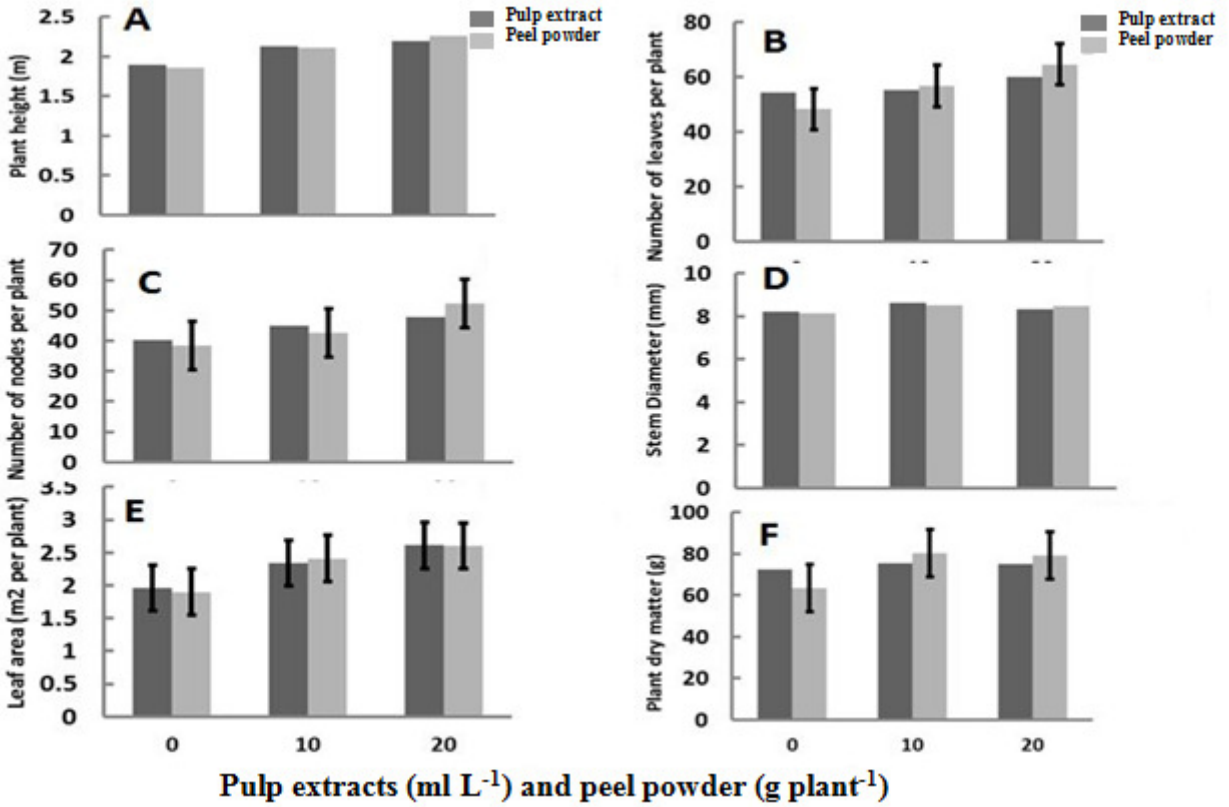

Fig. 1 : Effect of pulp extract and peel powder on vegetative traits of Cucumber cv. Rola (Error bars represent L.S.D$_{(0.05)}$ value of significant means).

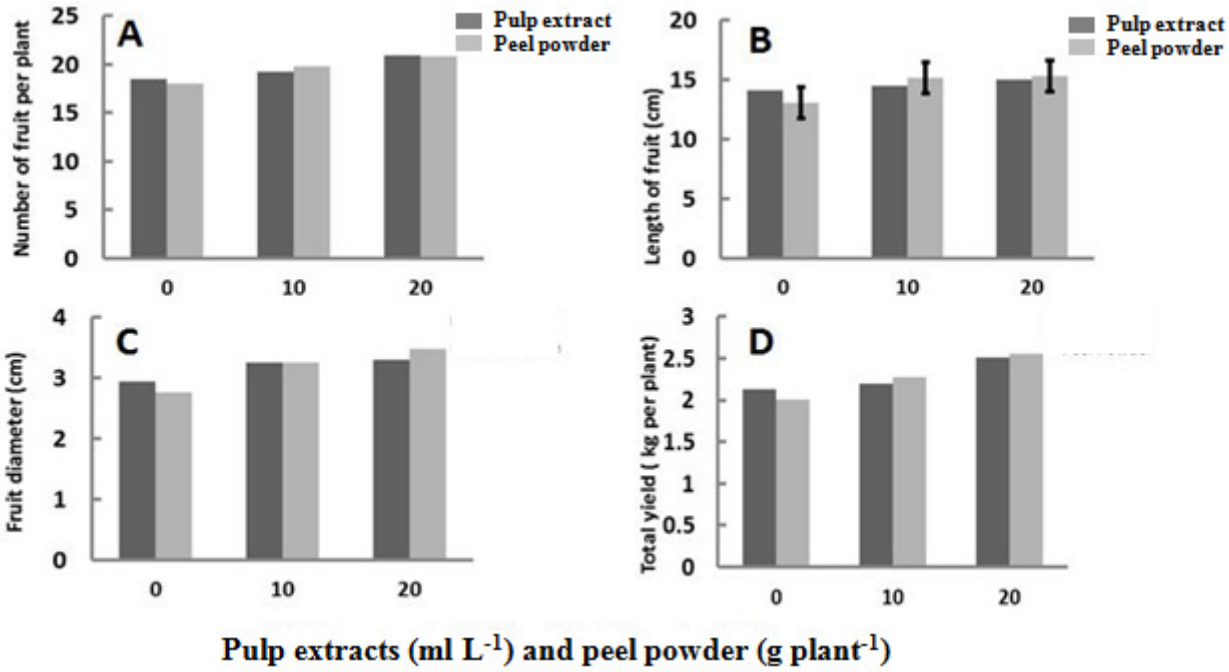

Fig. 2 : Effect of pulp extract and peel powder on yield traits of Cucumber cv. Rola (Error bars represent L.S.D$_{(0.05)}$ value of significant means).

of the interaction between study factors in cucumber fruit number in each plant. However, plants treated with 20 ml L^{-1} extract of banana pulp and 20 g plant^{-1} banana peel powder gave the highest number of cucumber fruit (23.95 fruit plant^{-1}) compared to the control that gave only 16.50 fruit plant^{-1} (Table 3).

Results presented in Fig. 2B showed that banana pulp extract did not significantly affect the length of cucumber fruit while its peel powder significantly affected this trait. The treatment of adding 20 g plant^{-1} led to increasing the

Table 2 : The interaction between pulp extraction and peel powder on vegetative traits of cucumber cv. Rola.

Pulp extract (ml L^{-1})	Peel powder (g $plant^{-1}$)	Plant height (m)	Number of leaves (leaf $plant^{-1}$)	Number of nodes (node $stem^{-1}$)	Stem diameter (mm)	Leaf area (m^2 $plant^{-1}$)	Plant dry matter (g)
0	0	1.63	41.90	32.6	7.62	1.47	58.10
	10	1.88	61.78	37.9	8.87	2.08	76.45
	20	2.20	59.41	50.7	8.13	2.33	82.65
10	0	2.01	55.19	43.5	8.36	2.01	65.06
	10	2.18	50.28	44.0	8.29	2.38	82.90
	20	2.22	60.68	47.9	9.25	2.62	78.03
20	0	1.95	47.89	39.0	8.51	2.23	67.59
	10	2.29	58.32	46.2	8.40	2.76	81.16
	20	2.36	73.76	52.4	8.05	2.85	76.43
L. S. $D._{(0.05)}$		0.65	13.01	13.76	1.42	0.61	19.75

Table 3 : The interaction between pulp extraction and peel powder on yield traits of Cucumber cv. Rola.

Pulp extract (ml)	Peel powder (g)	Number of fruits (fruit $plant^{-1}$)	Length of fruit (cm)	Fruit diameter (cm)	Total yield (Kg $plant^{-1}$)
0	**0**	16.5	11.2	2.26	1.78
	10	19.3	15.82	2.97	2.04
	20	19.76	15.32	3.59	2.57
10	**0**	18.98	13.66	3.21	1.9
	10	19.88	12.25	3.44	2.32
	20	18.83	17.54	3.12	2.39
20	**0**	18.51	14.42	2.85	2.34
	10	20.27	17.48	3.37	2.45
	20	23.95	13.17	3.72	2.74
L. S. $D._{(0.05)}$		**3.87**	**2.29**	**1.45**	**0.6**

length of fruit up to 15.34 cm in comparison with control treatment that showed 13.10 cm. The interaction between 10 ml L^{-1} extract and 20 g $plant^{-1}$ gave the highest fruit length (17.54 cm) compared to the control (11.20 cm) (Table 3).

The results presented in Fig. 2C showed that study factors did not significantly affect the fruit diameter. However, the interaction between the two factors significantly affected this trait. The treatment 20 ml L^{-1}pulp extract and 20 g $plant^{-1}$ peel powder gave the highest average of fruit diameter 3.72 cm while the diameter decreased to 2.26 cm at the control treatment (Table 3).

The results in Fig. 2D and Table 3 indicated the effect of pulp extract and peel powder of banana in cucumber yield (kg $plant^{-1}$). Banana pulpextracts significantly affected the yield of the cucumber plant, therefore the treatment of 20 ml L^{-1} gave the highest value of yield 2.51 kg $plant^{-1}$ in comparison with the control treatment that gave only 2.13 kg $plant^{-1}$. Banana peel powder treatment showed significant effects on fruit yield of cucumber. 20 g $plant^{-1}$ gave the highest average of yield per plant (2.56 kg $plant^{-1}$) while there was a reduction in the control treatment (2.01 kg $plant^{-1}$) (Fig. 2D). The interaction between the two factors also showed a significant effect on fruit yield per plant. The combination of 20 ml L^{-1} banana extract and 20 g $plant^{-1}$ banana peel gave the highest yield reached 2.74 kg $plant^{-1}$ in comparison with control treatment that gave only 1.78 kg $plant^{-1}$ (Table 3).

The application of either banana pulp extract or its peel powder enhanced the growth of cucumber plants. However the application of such materials have led to enhance soil physical properties, therefore, the water retaining has increased and the soil was more stable after addition of these organic materials (Abu Rayan, 2010).

On another hand, increasing in clay and organic matter in soil led to an increase in water content and this, in turn, made a suitable environment for micro-organisms activity. In this case, organic matter will be degraded in a better way and enhance soil stability, eventually better environment for root growth and nutrients absorption (Al-Zahawi, 2007).

Banana pulp extract and peel powder also enhanced the chemical properties of the soil which in turn led to release some organic acids such as humic and folic that have active role in plant growth and development (Oagile and Mufwanzala, 2010), as well as its role in soil pH reduction (Joann *et al*, 2000), which in turn increased the availability of nutrients for plants especially micronutrients that are related with enzymes activity which involving in cell division and extension (Al-Hamdany *et al*, 2011). However, the materials used in this study have a vital role in chlorophyll, proteins and nucleic acids synthesis (Taiz and Zeiger, 2006). The aforementioned properties can be reflected in plant growth and formation of new cells as for instance the monosaccharaides produced in photosynthesis process can take part in plant structure (Jundiah, 2003). The new plant tissues also require new nucleic acids and proteins and this, in turn,requires ATP from photosynthesis and respiration (Mohammed, 1985). Therefore, the role of organic matter is very important for ATP production required to the synthesis of plant structure.

Also, the organic matter in both study factors enhanced micro-organism activities in soil (Muslet and Al-Mehemdie, 2012). Organic matter is the store of energy for soil organisms. Carbohydrates in organic matter encourage the organism that degrades cellulose, starch and pectin, however, proteins in organic matter encourage organisms that degrade proteins (Al-Shaibani, 2005). Organic matter also affects the number and kind of micro-organisms which in turn affect the ventilation of soil. In clay soils the organic matter usually adsorbed and this would hinder its degradation, therefore, adding exogenous material probably will enhance the activity of soil organism that degrades the organic matter easily (Al-Basheer, 2003). Eventually, the aforementioned treatments (Pulp extract and Peel powder of banana) enhanced cucumber yield and this is due to the enhancement of growth and development. It can be concluded the ability of use pulp extract and peel powder of banana fruit in the nutrition of cucumber especially when they are mixed together due to their content of minerals, proteins, carbohydrates and amino acids as well as there is very environmentally friendly and also can replace the use of chemical fertilizers.

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