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EFFECT OF COMPOST WITH BANANA PEEL AND MORINGA LEAF POWDERS ON SEED YIELD AND YIELD COMPONENTS OF GREEN GRAM (*VIGNA RADIATA* L. WILCZEK)

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Abstract: The one-factor experiment was carried out in 2019–2020 at the University farm, Faculty of Agriculture, Eastern University, Sri Lanka to study the effect of compost with banana peel and *Moringa* leaf powders on seed yield and crop residue of green gram (*Vigna radiata* L. Wilczek). It was laid out in a complete randomized design with eight replicates and the following treatments: T1 – control (100 g of compost alone), T2 – 100 g of compost + 9 g of banana peel, T3 – 100 g of compost + 6 g of banana peel + 3 g of *Moringa* leaf, T4 – 100 g of compost + 4.5 g of banana peel + 4.5 g of *Moringa* leaf, T5 – 100 g of compost + 3 g of banana peel + 6 g of *Moringa* leaf and T6 – 100 g of compost + 9 g *Moringa* of leaf powder per polybag (0.07 m^2). The results showed that the application of compost with 4.5 g of banana peel and 4.5 g of *Moringa* leaf powders (T4) produced remarkable changes in the number of pods per plant, pod weight per plant, seed weight per plant, pod yield and seed yield than the other treatments. At the harvest, treatment T4 had the highest value (1,587.1 kg/ha) of seed yield, and treatment T1 gave the lowest value (906.1 kg/ha). The present study suggests that the application of 100 g (equivalent to 14.3 t/ha) of compost with 9 g (equivalent to 1.3 t/ha) of banana peel and *Moringa* leaf powders at a 1:1 (w/w) ratio would result in optimum seed yield of green gram in sandy regosol. The combined application of locally available banana peel and *Moringa* leaf powders could be used with compost for increasing the seed yield of green gram with less environmental impact.

Key words: banana peel, compost, green gram, *Moringa* leaf, seed yield.

Introduction

Green gram (*Vigna radiata* L. Wilczek) belongs to the Fabaceae family, and it is one of the most important grain legumes. The food legume is a significant crop globally, and pulses are the second most important group after cereals (Dash and

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Rautaray, 2017). Green gram grain is an excellent source of easily digestible protein and specific essential amino acids such as tryptophan and lysine in vegetarian diets (Pandiyan et al., 2012). Residues of green gram plants, especially leaves and stems, are used as organic manure in crop cultivation. The crop can fix atmospheric nitrogen in its root nodules and can be grown in various soils and climatic conditions due to its drought tolerance (Malik et al., 2006). Green gram is cultivated in the dry and intermediate zones of Sri Lanka. It can grow successfully in sandy loam soils (Seran and Krishanthy, 2009) when appropriate cultural practices are used.

In pulse crop cultivation, proper nutrient management is a significant factor for increasing the seed yield of grain legumes. A leguminous crop like green gram has a high potassium requirement (Singh et al., 2016) for its plant growth. Deore et al. (2010) stated that the balanced use of NPK fertilizer could not maintain the higher yields over the years due to micronutrient deficiencies and the decline of soil physical properties. Deficiencies of essential nutrient elements cause crop yield losses (Kumar and Babel, 2011). Moreover, excessive and continuous use of NPK chemical fertilizers decreases crop productivity and soil and environmental quality (Nasab et al., 2015). Thus, applying proper fertilizers with macro and micronutrients is necessary to increase growth and yield and decrease the negative impact on the environment (Magen, 2008). Primary and secondary nutrients and micronutrients are available in organic fertilizers to improve crop growth and development. Organic manure can replace inorganic fertilizers to increase soil nutrients and organic matter content (Gayathri and Seran, 2020). Animal waste, crop residues and other locally available plant materials are used as organic manures, increasing soil fertility to produce better crop yield (Seran, 2016; Priyadharshini and Seran, 2009; Nadeeka and Seran, 2020).

The organic material is used as a soil amendment to enhance crop growth and productivity with less environmental impact. Many people in the world consume ripe banana fruits, and their peels are solid waste, accounting for about 18–33% of the whole fruit weight (Wolfe et al., 2003). This waste increases soil fertility decreases environmental pollution (Panwar, 2015) and increases crop growth and yield (Mercy et al., 2014). Banana peels contain phosphorus and potassium, but relatively abundant potassium is available in its peel (Gayathri and Seran, 2020). Similarly, leaves of *Moringa oleifera* contain high levels of potassium, calcium, carotenoids, phenols, and vitamin E, zeatin (Asaolou et al., 2012). A sufficient amount of potassium is required for improving the crop yield due to its effect on photosynthesis, water use efficiency and plant tolerance to diseases, drought and cold (Singh, 2017). Furthermore, *Moringa* leaves consist of essential amino acids such as methionine, cysteine, tryptophan, and lysine (Makkar and Becker, 1996), and various antioxidant compounds such as ascorbic acid, flavonoids, phenolic compounds and carotenoids (Anwar et al., 2005). The addition of *Moringa* leaves to the soil enhances both micro and macro nutrients for plant uptake. Also, it can act as a scavenger of certain nutrients such as calcium, potassium, and sodium (Anyaegbu, 2014).

Banana peel and *Moringa* leaf powders are bioorganic substances locally available in Sri Lanka. Compost is a rich source of nutrients, and it has a high content of organic matter. Therefore, this experiment was aimed to study the effect of applying compost with banana peel and *Moringa* leaf powders on seed yield and yield components of green gram (*Vigna radiata* L.) and to determine the suitable quantity of banana peel and/*Moringa* leaf powder/s to obtain an optimum yield of green gram in sandy regosol.

Material and Methods

The one-factor experiment was conducted in 2019–2020 at the University farm, Faculty of Agriculture, Eastern University, Sri Lanka to study the effect of applying compost containing banana peel and *Moringa* leaf powders (BMP) on crop residue and seed yield of green gram and also to select the suitable combination of banana peel and *Moringa* leaf powders for obtaining an optimum yield of green gram. The experimental site is located between latitude 70 43’ and longitude 810 42’ in the eastern region of Sri Lanka at an elevation of 75 m above mean sea level. The temperature was 30±2℃ and the relative humidity was 60–70%. This pot experiment was carried out in a completely randomized design (CRD) with six treatments and eight replicates. They were as follows:

T1: 100 g of compost (control);

T2: 100 g of compost with 9 g of banana peel powder (ratio of 1:0 BMP);

T3: 100 g of compost with 6 g of banana peel + 3 g of *Moringa* leaf powder (ratio of 2:1 BMP);

T4: 100 g of compost with 4.5 g of banana peel + 4.5 g of *Moringa* leaf powder (ratio of 1:1 BMP);

T5: 100 g of compost with 3 g of banana peel + 6 g of *Moringa* leaf powder (ratio of 1:2 BMP);

T6: 100 g of compost with 9 g of *Moringa* leaf powder (ratio of 0:1 BMP).

Banana peels and *Moringa* leaves were collected from the market and the crop farm, respectively, in the eastern region of Sri Lanka. The collected banana peel and *Moringa* leaves were cleaned and then air dried separately for four days. Subsequently, the banana peels and *Moringa* leaves were powdered using a grinder (Magic Bullet blender, USA) and sieved separately using a 500-μm mesh sieve as described by Shiriki et al. (2015) and then kept at room temperature until used in this experiment. Subsequently, 3 g, 4.5 g, 6 g and 9 g of the banana peel powder were measured separately using an electronic analytical balance. After that, these were packed in polythene and sealed airtight. Moreover, 3 g, 4.5 g, 6 g and 9 g of

Moringa leaf powders were measured separately and sealed airtight to be applied to each polybag as fertilizer along with compost in this experiment.

A black polybag (0.07 m^2) was used in this experiment. The nutrient contents of the soil were nitrogen (10.0 µg/g), phosphorus as P_2O_5 (40.0 µg/g), and potassium as K_2O (0.25 meq/100 g), which were obtained from the previous research work done by Seran and Imthiyas (2016). The bags were filled with soil, leaving about a ¼th of the space between the soil and the top of the polybag. Holes were made at the bottom of the bags to remove excess water. All the polybags were placed 30 cm apart between rows. Organic fertilizer was applied according to the treatments in which 100 g (equivalent to 14.3 t/ha) of compost (0.56% N, 0.48% P2O5, 0.62% K2O) with 0–9 g of different rates of banana peel and *Moringa* leaf powders (BMP) were added to the soil in each polybag. In this experiment, seeds of the green gram variety *Harsha* were used. They were soaked in water for about 12 hours and then three seeds were sown at a depth of 2 cm in each bag three days after fertilizer application. No chemical fertilizers were applied in this experiment. Irrigation was done twice a day in the early morning and late evening from sowing to germination and once a day in the evening from germination to pod formation and once in two days in the evening after the pod formation by using the watering can. Weeding in the pots and on the experimental plot was done manually at two-week intervals.

Harvesting was done after eight weeks from seeding. The number of pods per plant, pod length, single pod weight, number of seeds per pod, seed weight per pod, 100-seed weight, pod weight per plant, seed weight per plant were recorded, and shelling percentage, as well as pod yield, were calculated. Further, the weights of the stem, leaves and roots were measured at the harvesting stage of the plants. The collected data were analyzed using the statistical software (SAS 9.1 version), and the treatment means were compared using the Tukey's honestly significant difference test at a 5% significance level.

Results and Discussion

Number of pods

The statistically analyzed data in Table 1 show that the application of compost containing banana peel and *Moringa* leaf powder (BMP) played a remarkable role in the number of pods per plant at harvest. There were significant differences ($P<0.01$) in the number of pods. Treatment T4 (compost containing 9 g BMP in a 1:1 ratio) remarkably differed from the other treatments except for T2 and T3. The highest average number (12.1) of pods was recorded in T4, followed by T3, whereas the lowest number of pods per plant was noted in T1 (6.8). The application of the banana peel (T2) or *Moringa* leaf powder (T6) alone resulted in lower values than the combined application of both powders. It was also noted that the number of pods was higher in the BMP treated plants than in the untreated plants (control treatment). The findings are supported by Sakpere et al. (2019), who have confirmed that a combination of *Moringa* extracts and fruit peels result in a synergistic effect that boosts the plant growth of *Solanum scabrum.* It may be due to the enriched plant nutrients in BMP for pod formation. Banana peel contains high levels of potassium and phosphorus (Gayathri and Seran, 2020). As a result, plants treated with 9 g of banana peel (T2) had a relatively higher number of pods than the control treatment (T1). The result is consistent with Mazed et al. (2015), who also noted that the number of pods was the highest in potassium treated mung bean plants compared to the control treatment. Qader (2019) also further proved that the phosphorus introduced into the soil through banana peel treatment resulted in the highest number of pods per pea plant.

Table 1. The number of pods per plant, pod length and number of seeds per pod of green gram as influenced by compost containing banana peel and Moringa leaf powders at harvest.

Treatments (compost 100 g with *BMP per polybag)	Treatment codes	Number of pods per plant	Pod length (cm)	Number of seeds per pod
0:0 BMP	T1	6.8±0.4^{b}	7.03±0.28	8.4±0.4
1:0 BMP (9 g+0 g)	T2	8.4±0.9^{ab}	6.97±0.18	7.8±0.3
2:1 BMP (6 g+3 g)	T3	9.3±1.1^{ab}	7.47±0.12	8.2±0.5
1:1 BMP (4.5 g+4.5 g)	T4	12.1±1.3^{a}	7.39±0.13	8.9±0.1
1:2 BMP (3 g+6 g)	T5	8.1±0.8^{b}	7.03±0.31	8.1±0.1

*BMP – Banana peel and *Moringa* leaf powders. Values represented are means ± standard errors of eight replicates. F test – ns: not significant; ** P<0.01. Means followed by the same letter are not significantly different from each other at a 5% significance level according to the Turkey's honestly significant difference test.

Pod length

The BMP application on the green gram plant did not substantially affect (P>0.05) the average pod length (Table 1). The greatest pod length was attained in T3 (7.47), followed by T4 (7.39 cm). Treatment T6 had a lesser pod length (6.62 cm) compared to other treatments. Colpan et al. (2013) have mentioned that the fruits are small at a low potassium level while fruits were too large at a high potassium level. The pod length of snap bean plants was increased by spraying with *Moringa* leaf extract compared to control plants sprayed with distilled water (Emongor, 2015). The application of organic manures improves soil properties (Seran, 2016; Nadeeka and Seran, 2020). Thus, the availability of nutrients in the soil after adding the compost with BMP, particularly banana peel, influenced the pod length.

Number of seeds per pod

The effect of compost with BMP application on the number of seeds per pod is presented in Table 1. The number of seeds per pod was notably similar between the treatments (P>0.05). However, the highest mean number of seeds per pod was obtained in T4 (8.9), while the lowest number of seeds per pod was recorded in T6 (7.3). Moreover, the number of seeds per pod was slightly higher in T1 (compost alone as control) than in T2, where plants were treated with compost and banana peel. Banana peel (Gayathri and Seran, 2020) and *Moringa* leaves (Asaolou et al., 2012) are rich in potassium. It showed that the high nutrient availability in the soil amended with banana peel and *Moringa* leaves, particularly potassium, may affect the seed formation. It might reduce the uptake of the other essential nutrients, particularly nitrogen, calcium, and magnesium. As a result, the addition of BMP at a 1:1 ratio showed a better response to the seed formation than the other treatments. Based on this fact, the mixture of both powders also provides the important primary and secondary macronutrients to the plants in this study in addition to the micronutrients. Moyo et al. (2011) have stated that dried *M. oleifera* leaf powder has a higher content of macro and micronutrients such as calcium (3.65%), potassium (1.5%), phosphorus (0.3%) and magnesium (0.5%). Potassium and magnesium are key contributors to the process of photosynthesis and the subsequent transport of photo assimilates (Tränknera et al., 2018).

Pod weight

The analyzed data presented in Table 2 show that there was an insignificant variation (P>0.05) in single pod weight with different ratios of BMP application. The highest mean pod weight (0.581 g) was obtained in T3, and the lowest pod weight (0.525 g) was recorded in T6. At the same time, the pod weight in T4 was 0.575 g. Fruit peels comprise sugar, protein, and nutritional components, especially potassium, which are required for crop growth and yield (Bakry et al., 2016). Fruit peel is a natural fertilizer for increasing plant yield (Mercy et al., 2014). *Moringa* leaves as a soil amendment may help to reduce the pest and disease incidence in crop production and its storage as they consist of various types of antioxidant compounds (Anwar et al., 2005).

Seed weight per pod

Seed weight per pod is an important parameter directly connected with the total seed yield. The seed weight per pod was statistically the same in all the treatments. Application of compost with BMP did not substantially influence (P>0.05) the seed weight per pod (Table 2). Among the treatments, T3 gave the highest seed weight per pod (0.415 g), and T6 showed the lowest seed weight per pod (0.372 g). This is in accordance with Sakpere et al. (2019), who stated that *Moringa oleifera* leaves applied alone did not produce a positive response in most growth parameters measured. An increase in plant growth ultimately increases crop yield (Qader, 2019). Moreover, it was also observed that seed weight per pod was slightly higher in plants treated with the compost and banana peel than with the compost and *Moringa* leaf powder. Banana peel contains essential nutrients, particularly potassium and phosphorus (Gayathri and Seran, 2020), which are responsible for physiological processes to increase seed weight.

Table 2. Single pod weight, seed weight per pod and 100-seed weight of green gram as affected by compost containing banana peel and *Moringa* leaf powders.

Treatments	Pod weight (g)	Seed weight (g) per pod	100 seeds weight (g)
T1	0.570±0.03	0.398±0.02	5.11±1.52
T2	0.567±0.02	0.405±0.02	5.24±1.50
T3	0.581±0.04	0.415±0.02	5.45±0.93
T4	0.575±0.02	0.407±0.01	5.54±3.53
T5	0.539±0.04	0.380±0.04	5.39±2.03
T6	0.525±0.05	0.372±0.04	5.12±1.61
F test	ns	ns	ns

Values represented are means ± standard errors of eight replicates. F test – ns: not significant. The means followed by the same letter are not significantly different from each other at a 5% significance level according to the Turkey's honestly significant difference test.

100-seed weight

The effect of compost with different ratios of BMP application on 100-seed weight is given in Table 2. Regarding the 100-seed weight of green gram, no significant differences were observed (P>0.05) among tested treatments at harvest. The highest 100-seed weight was obtained in T4 (5.54 g), followed by T3 (5.45 g) and T5 (5.39 g). Simultaneously, the lowest 100-seed weight was attained in T1 (5.11 g), the control treatment. The plants treated with BMP had relatively higher values of 100-seed weight values than the untreated plants with BMP (T1). This may indicate that the accumulation of seed reserves is more a result of BMP application to the soil. The findings are in conformity with Bakry et al. (2016), who corroborated that foliar application of banana peel extract considerably increased the 1000-seed weight of quinoa plants compared to the untreated plants. Zare et al. (2014) also stated that 1000-seed weight was significantly increased using the potassium effect. Both banana peel and *Moringa* leaf are rich in potassium and other essential nutrients related to dry matter accumulation.

Pod weight per plant

The data relating to pod weight per plant are a significant part of ultimate crop yield. The pod weight per plant was significantly ($P<0.05$) varied among the treatments (Table 3). The remarkably higher value (6.76 g) of pod weight per plant was achieved ($P>0.05$) in T4 (1:1 BMP treatment) than in T1 (control treatment) and T6 (*Moringa* leaf powder alone). Compared with the other treatments, the lowest values (3.87 g and 3.97 g) were recorded in T1 and T6, respectively. Furthermore, both treatments gave notably ($P>0.05$) similar results in pod weight per plant. In addition, the result showed that the lower values of pod weight were achieved in the banana peel and *Moringa* leaf applied separately than in the combined use of BMP. Hence, the plant nutrients from both organic materials contribute to the increase in pod weight per plant. Organic fertilizer increases the availability of N, P, K and other essential nutrients that play an important role in plant growth and development (Palm et al., 2001).

Table 3. The weights of pods, seeds, and crop residue per plant of green gram as affected by compost containing banana peel and *Moringa* leaf powders.

Treatments	Pod weight (g) per plant	Seed weight (g) per plant	*Crop residue weight (g) per plant
T1	3.87 ± 0.33^{b}	2.75 ± 0.24^{b}	5.55 ± 0.30
T2	4.75 ± 0.50^{ab}	3.34 ± 0.36^{ab}	6.62 ± 1.01
T3	5.44 ± 0.78^{ab}	3.88 ± 0.55^{ab}	6.90 ± 1.11
T4	6.76 ± 0.58^{a}	4.81 ± 0.43^{a}	7.94 ± 1.31
T5	4.45 ± 0.60^{ab}	3.16 ± 0.47^{ab}	7.07 ± 0.92
T6	3.97 ± 0.61^{b}	2.84 ± 0.47^{b}	5.78 ± 0.25
F test	*	*	ns

Values represented are means ± standard errors of eight replicates. F test - ns: not significant*$P<0.05$. Means followed by the same letter are not significantly different from each other at a 5% significance level according to the Turkey's honestly significant difference test.

Seed weight per plant

The impact of different ratios of BMP application on seed weight per plant of green gram is presented in Table 3. The seed weight per plant was substantially influenced by applying banana peel and *Moringa* leaf powder on the green gram. Significant differences ($P<0.05$) were observed among the treatments. The highest seed weight per plant was obtained in T4 (4.81 g), followed by T3 (3.88 g) and T2 (3.34 g), whereas the lowest seed weight per plant was noted in T1 (2.75 g). The highest seed weight in T4 may result from the necessary plant nutrients released from the organic fertilizer applied. T4 considerably varied ($P<0.05$) from T1 and T6 in terms of seed weight per plant. Lee et al. (2010) have stated that banana peel extract is high in natural phenolic compounds, vitamins, flavonoids, and K elements required for plant growth and yield.

Dry weight of plant parts

No remarkable differences (P>0.05) were noted in air - dried weight of stem, leaves and roots of green gram among the treatments (Figure 1). However, the amount of an increase in each plant part varied due to the application of compost containing banana peel and *Moringa* leaf powders. These results may be due to plant nutrients and growth-promoting substances in both powders that enhanced shoot growth. This is supported by Anhwange (2008), who has found that fruit peel consists of substantial amounts of Na, K, Ca, Fe and Mg. Asaolou et al. (2012) have also stated that *Moringa* leaf is rich in K, Ca, carotenoids, phenols, naturally occurring cytokinin, ascorbates, vitamin E and zeatin for plant growth. As a result, the dry weight of stems and leaves were higher in plants treated with compost containing banana peel and *Moringa* leaf powders than in the control treatment.

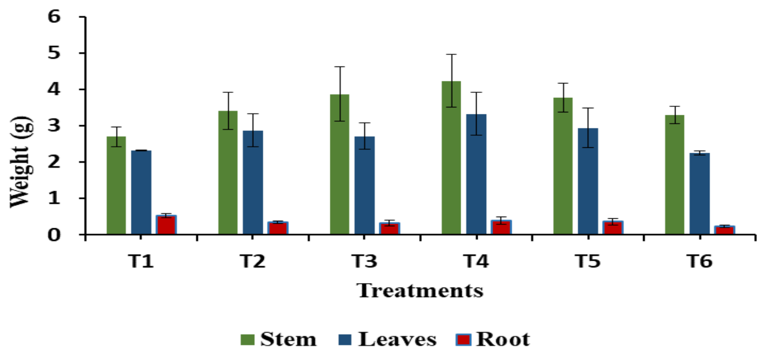

Figure 1. Air - dried weights of leaves, stem, and root of green gram plant as influenced by compost containing banana peel and Moringa leaf powders.

Treatment T4 showed the highest dry weight (4.23 g) of stem per plant, followed by T3 (3.87 g), whereas T1 had the lowest dry weight (2.69 g) of the stem. This is in agreement with Bakry et al. (2016), who reported that the application of banana peel extract increased the dry shoot weight of quinoa plants compared to the untreated plants. It was further noted that the dry weight of leaves was higher in T4 (3.32 g), and the lowest dry weight (2.25 g) was noted in T6. This could be in agreement with the statement of Makinde and Ayoola (2010), who reported that the dry matter in leaves was low due to the slow release of nutrients by organic fertilizers. Yeh et al. (2000) have also found that phosphorus-deficient plants grow slowly and have fewer leaves. Kadir et al. (2016) have stated that banana peels are rich in phosphorus. Accordingly, the nutrients that plants need may be supplied at different times and in different amounts through the combined application of banana peel and *Moringa* leaf powders for better leaf growth. Moreover, it was observed that the dry weight of roots was high in T1 (0.53 g), and the lowest value was noted in T6 (0.23 g). Consequently, essential nutrients may be available for root growth to the plants by the application of compost alone. On the other hand, Bakry et al. (2016) have reported that the percentage increase in banana peel extract is the response to dry weight of roots compared to untreated control. Phosphorus promotes rooting and fruit set, and potassium is essential for stem and root growth (Wazir et al., 2018).

Crop residues

The effect of organic fertilizer application on crop residue weight as the total air - dried weight of leaves, stems and roots is presented in Table 3. T4 had the highest weight (7.94 g) of crop residue per plant, while T1 showed the lowest weight (5.55 g) of crop residue per plant. No significant difference ($P>0.05$) was noted among the treatments, but positive effects on crop residue were observed among treatments. This may be attributed to the macro and micronutrients present in both *Moringa* leaf and banana peel powders according to available information (Moyo et al., 2011; Gayathri and Seran, 2020). Cakmak (2008) has stated that zinc increases biomass production in plants. *Moringa* leaf extract gave a non-significant increase in both shoot and root dry mass (Emongor, 2015).

Pod yield

There was a noteworthy difference ($P<0.05$) in pod yield by the application of compost with BMP on the green gram (Table 4). The highest pod yield was obtained in T4 (2231 kg/ha), followed by T3 (1793.8 kg/ha), T2 (1565.9 kg/ha), while the lowest value was obtained in T1 (1276.2 kg/ha). According to the results, plants treated with compost and a 1:1 ratio of banana peel and *Moringa* leaf powders (T4) showed significantly ($P<0.05$) higher pod yield as compared to plants treated with compost alone (T1) or compost containing *Moringa* leaf plants (T6). Even though T1 was equal to T6 in terms of pod yield, T6 gave a higher value than T1. It is in conformity with Thomas and Howarth (2000), who reported that *Moringa* leaf extract enhanced the number of leaves, which increases the photosynthesis and photo assimilates, resulting in high yield. Further, an insignificant difference ($P>0.05$) in pod yield of green gram was noted among the 1:0, 2:1, 1:1 and 1:2 ratios when banana peel and *Moringa* leaf powders were applied. Bakry et al. (2016) stated that the foliar application of banana peel extract significantly increased the yield of quinoa plants. Gayathri and Seran (2020) have found that banana peel has significant effects on various biological aspects in plants.

Table 4. The effect of compost with banana peel and *Moringa* leaf powders on pod and seed yield of green gram.

Treatments	Pod yield (kg/ha)	Seed yield (kg/ha)
T1	1276.2±10.8^{b}	906.1±7.8^{b}
T2	1565.9±16.3^{ab}	1101.6±11.8^{ab}
T3	1793.8±25.7^{ab}	1279.8±18.1^{ab}
T4	2231.0±19.3^{a}	1587.1±14.3^{a}
T5	1468.5±20.0^{ab}	1041.6±15.7^{ab}
T6	1308.4±20.3^{b}	936.4±15.6^{b}
F test	*	*

Values represented are means ± standard errors of eight replicates. F test - *: P<0.05. Means followed by the same letter are not significantly different from each other at a 5% significance level according to the Turkey's honestly significant difference test.

Shelling %

Shelling % is an imperative economic feature and indicates the percentage of the kernel weight on the pod (unshelled) weight. A slight change was observed in the shelling % of green gram by compost with BMP (Figure 2). T3 (compost with 2:1 BMP) gave the highest shelling % (71.51%), and T5 showed the lowest shelling % (69.67%). Among the treatments, an insignificant difference (P>0.05) was noticed in shelling %. It was further observed that T1 and T4 had the same values in the shelling percentage of green gram. More or less equal percentage of shelling may be due to the organic fertilizers used in this study; as a by-product, shells cannot be used efficiently and economically (Zhao et al., 2012).

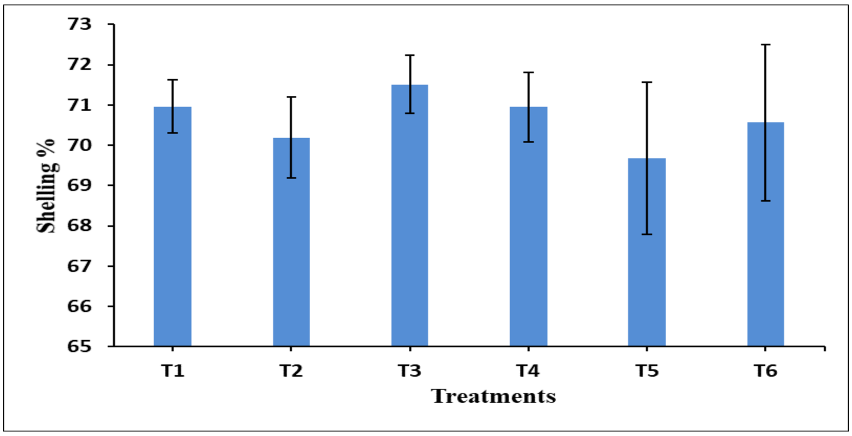

Figure 2. Shelling % of green gram plant as influenced by compost containing banana peel and *Moringa* leaf powders.

Seed yield

A significant difference ($P<0.05$) was observed in the seed yield of green gram among the treatments (Table 4). The result showed the lowest value of seed yield in T1 (906.1 kg/ha), where plants were treated with the compost alone (control treatment). However, the plants treated with compost and BMP had an effect on seed yield, and the highest value was obtained in T4 (1587.1 kg/ha) followed by T3 (1279.8 kg/ha). It was further noted that T4 remarkably ($P<0.05$) produced a higher seed yield than T1 and T6. The seed yield of T1 (compost alone) was statistically ($P>0.5$) equal to that of T6 (compost with *Moringa* leaf powder only). Sakpere et al. (2019) confirmed that *Moringa oleifera* leaves applied alone did not show a positive effect on crop yield. In the present study, plants treated with banana peel powder alone (T2) or in combination with *Moringa* leaf powder (T3, T4 and T5) gave higher yields than T1 (control) and T2 (*Moringa* leaf powder alone).

Conclusion

In the present study, the application of compost with different ratios of banana peel and *Moringa* leaf powders (BMP) had positive effects on the yield components and seed yield of green gram in sandy regosol. The results showed significant differences ($P<0.05$) in the number of pods per plant, pod weight per plant, seed weight per plant, pod yield and seed yield at harvest. It was further noted that there were no significant differences ($P>0.05$) in pod length, number of seeds per pod, single pod weight, seed weight per pod, 100-seed weight, shelling percentage, stem dry weight, leaf dry weight, root dry weight and crop residue weight per plant. However, the compost containing 4.5 g of banana peel and 4.5 g of *Moringa* leaf powders (T4) as organic fertilizer substantially increased the number of pods per plant, pod weight per plant, seed weight per plant, pod yield and seed yield compared to the control treatment at harvest. The highest value of seed yield of green gram was obtained in T4 (1,587.1 kg/ha), and the lowest value was obtained in T1 (906.1 kg/ha). According to the results, T4, which included the application of 100 g of compost with 4.5 g of banana peel and 4.5 g of *Moringa* leaf powders (1:1 ratio of BMP), was the best application in sandy regosol. Banana peel and *Moringa* leaf are locally available materials that could be used as organic fertilizer in crop production.

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UTICAJ KOMPOSTA SA KOROM BANANE I LISTOM MORINGE U PRAHU NA PRINOS SEMENA I KOMPONENTE PRINOSA MUNGO PASULJA (*VIGNA RADIATA* L. WILCZEK)

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R e z i m e

Jednofaktorski eksperiment je sproveden u 2019–2020. godini na univerzitetskom dobru Poljoprivrednog fakulteta Istočnog univerziteta u Šri Lanci kako bi se ispitao uticaj komposta sa korom banane (*Musa paradisiaca* L.) i listom biljke moringa (*Moringa oleifera* L.) u prahu na prinos semena i ostatke useva mungo pasulja (*Vigna radiata* L. Wilczek). Eksperiment je postavljen u potpuno slučajnom dizajnu sa osam ponavljanja i u okviru sledećih tretmana: T1 – kontrola (100 g kompost), T2 – 100 g komposta + 9 g kore banane, T3 – 100 g komposta + 6 g kore banane + 3 g lista moringe, T4 – 100 komposta + 4,5 g kore banane + 4,5 g lista moringe, T5 – 100 g komposta + 3 g kore banane + 6 g lista moringe i T6 – 100 g komposta + 9 g lista biljke moringe u prahu po polietilenskoj vreći (0,07 m^2). Rezultati su pokazali da primena komposta sa 4,5 g kore banane i 4,5 g lista moringe u prahu (T4) dovode do značajnih promena u broju mahuna po biljci, masi mahuna po biljci, masi semena po biljci, prinosu mahuna i prinosu semena nego ostali tretmani. Najveći prinos semena zabeležen je na tretmanu T4 (1.587,1 kg/ha), dok je na tretmanu T1 prinos semena bio najmanji (906,1 kg/ha). Ovom studijom se sugeriše da bi primena 100 g (ekvivalentno 14,3 t/ha) komposta sa 9 g (ekvivalentno 1,3 t/ha) kore banane i lista moringe u prahu u odnosu 1:1 (m/m) mogla dovesti do optimalnog prinosa semena mungo pasulja u peskovitom regosolu. Kombinovana upotreba kore banane i lista moringe u prahu, koji su lokalno dostupni, može se koristiti sa kompostom za povećanje prinosa semena mungo pasulja uz manji uticaj na životnu sredinu.

Ključne reči: kora banane, kompost, mungo pasulj, list moringe, prinos semena.

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