



Nutrient Management Strategies for Optimizing Growth and Yield in SAU Perilla-1 (*Perilla frutescens*)

Md. Humayun Kabir¹, A. K. M. Ruhul Amin², H. M. M. Tariq Hossain³, Ronzon Chandra Das^{4*}, Muhammad Tanvir Rahman⁵, Md. Lutfar Rahman⁶ and Supti Mallick⁷

¹Scientific Officer, Farm Management Unit, Bangladesh Jute Research Institute, Bangladesh, Email: kabirsumonpstu@gmail.com

²Professor, Department of Agronomy, Sher-e-Bangla Agricultural University, Bangladesh, Email: ruhulsau@yahoo.com

³Professor, Department of Agronomy, Sher-e-Bangla Agricultural University, Bangladesh, Email: hmmtariq@sau.edu.bd

⁴Scientific Officer, Department of Soil Science, Agronomy Division, Bangladesh Jute Research Institute, Bangladesh, Email: ronzonbjri2020@gmail.com

⁵Senior Scientific Officer, Department of Soil Science, Agronomy Division, Bangladesh Jute Research Institute, Bangladesh, Email: tanvir2511@gmail.com

⁶Principal Scientific Officer, Farm Management Unit, Bangladesh Jute Research Institute, Bangladesh, Email: lutfarbjri1996@gmail.com

⁷Assistant Professor, Department of Agricultural Chemistry, Bangladesh Agricultural University, Bangladesh, Email: supti.ac@bau.edu.bd

*Correspondence: ronzonbjri2020@gmail.com, Tel: +8801671787470

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Abstract: A field research was executed at Sher-e-Bangla Agricultural University in Dhaka, between July and November 2022 to evaluate the effects the various organic manures and inorganic fertilizer levels on the growth, yield and yield contributing characters of SAU Perilla-1 (*Perilla frutescens*). The research was designed as a split-plot with three repetitions and involved two trials : One is —organic manure types (five levels): i) OM₀ (control), ii) OM₁ (cowdung), iii) OM₂ (vermicompost), iv) OM₃ (decomposed rice straw), and v) OM₄ (poultry litter); another is —fertilizer levels (four levels): i) F₀ (zero material applied, control), ii) F₁ (75% of the recommended dose of fertilizers, RDF), iii) F₂ (100% RDF), and iv) F₃ (125% RDF). Results indicated that poultry litter (OM₄) and vermicompost (OM₂) significantly enhanced grain yield, with values of 1385.7 and 1249.2 kg ha⁻¹, respectively. These treatments also resulted in higher seed quality, as evidenced by the increased the count of branches/plant, seed count/branch, and the weight of one thousand seeds. In F₃ (125% RDF) resulted in the Peak seed production (1323.4 kg ha⁻¹), was preceded by closely to F₂ (100% RDF), which yielded 1304.1 kg ha⁻¹. Both F₃ and F₂ treatments exhibited superior plant growth and seed quality, reflected in a high number of branches, seeds/branch, and 1000-seed mass. The combined application of poultry litter (OM₄) and 125% RDF (F₂) produced the highest values for all key parameters (branches every plant, grain/branch, one thousand-seed weight and grain production). The combination of OM₄ with F₂, as well as OM₃ with F₃ and OM₃ with F₂, also presented uniform outcomes. Based on these findings, the application of poultry litter or vermicompost, coupled with the recommended dose of fertilizers, is recommended for optimizing Production output and it's-determining factors in SAU Perilla-1 cultivation in Bangladesh.

Keywords: Organic; Inorganic; Fertilizer; Growth; Seed; Quality; Yield.

INTRODUCTION

The plant *Perilla frutescens* also pointed to as perilla, is a yearly member of the Lamiaceae sage family. It is native to East Asia and is extensively grown in China, India, Japan, Hong Kong, South Korea, and North Korea (Omer *et al.*, 1998). It is the second-biggest upland crop of South Korea. It has been successfully cultivated in China for over

two thousand years and has a long history of use in treatment and cuisine (Lee and Kim, 2007). Perilla is often ingested in Korean cuisine in two methods: as oil and as leafy greens. Hence, the perilla cultivar has been specifically bred to facilitate the extraction of oil or the collection of fresh leaves. The primary components of perilla seed are lipids and protein, comprising 44.4% and 17.4% of the seed grain, respectively. Additionally,

carbohydrates constitute around 29.9% of the seed's composition and 8.3% of the ash content. (Oh. *et al.*, 2018). The primary reason for its health advantages is mostly linked to its high concentration of bioactive flavonoids and phenolic elements (Lee *et al.*, 2013; Guan *et al.*, 2014). Tocopherols and unsaturated fats are abundant in perilla seeds (Rouphael *et al.*, 2015). In Chinese traditional medicine, perilla leaves have been utilized as a laxative, tranquilizer, antibiotic, diaphoretic, antipyretic, antiseptic, and anti-inflammatory properties (Omer *et al.*, 1998). Furthermore, it has been shown that perilla seed oil is a high source of both saturated and unsaturated fatty acids, particularly omega-3 linolenic acid, as well as oleic and linoleic acids (palmitic and stearic, for example) (Guan *et al.*, 2014). Having potential yields of 1.3–1.5 t/ha, Perilla is an annual crop that requires short-day conditions and is cultivated during the Kharif-2 season, also known as the summer. The effective growth of the crop during the Kharif-2 season (from mid-July to mid-November) would've been used as a supplementary crop to help reduce the deficit in the national production of high-quality edible oil seeds. This would have saved money that would have otherwise been spent importing edible oils into Bangladesh. Additionally, it would have provided a consistent supply of wood for burning (Mojumdar *et al.*, 2020). Perilla cultivation in Bangladesh covers an annual area of 35 hectares as of 2021, with an average seed output of 650 kg per acre (Karmaker, 2022), which is much lower compared to neighboring nations in the region. This is mostly due to inadequate oil seed crop output to satisfy our country's needs. Nutrient source, crucial for oilseed crops, play a vital role throughout the entire cultivation process, from seed sowing to maturation and harvesting. Perilla, being a high nutrient-demanding plant, absorbs significantly more nutrients from the soil compared to many other cultivated species, thereby emphasizing the critical need for Growth enhancement (Ha *et al.*, 2012; Selmar and Kleinwächter, 2013). It is crucial to assess different plant-nutrition mechanisms during farm planning to determine their influence on crop quality, specifically on the plant's vegetative growth and development periods and their equilibrium (Kiani *et al.*, 2016). The combined application of the tested fertilizers had a greater favorable impact on the yield and quality of Perilla compared to the separate application of each fertilizer (Ghane *et al.*, 2019). The growing population has led to a apex requisition for food, which shows resulted in the desire to use chemical and organic fertilizers more effectively to maximize agricultural production (Raei *et al.*, 2013 and Rautaray *et al.*, 2003). Compost enhances the stability and yield of crops by positively influencing the chemical, biological, and physical properties of the soil (Adugna, 2016). Organic fertilizers serve as an excellent reservoir of various nutrients and have the capacity to enhance soil properties (Moller, 2009). Manure from cow dung is rich in nitrogen and used commercially as a fertilizer, feed additive, or a source of energy. The utilize of cow dung as manure involves the collection and application of its nutrients, including N,P,K, and Ca, to enhance agricultural land

fertility and promote plant growth (Smith and Wheeler, 1979). In addition, they enhance the activity of microorganisms in the soil, as well as the capacity for negatively and positively charged ion transfer process, the presence of biological material, and percentage of C in the soil. Organic fertilizers enhance the quality and productivity used in agriculture in a manner comparable to chemical particles (Arancon *et al.*, 2004; Bulluck and Ristaino, 2002; Bulluck *et al.*, 2002). Vermicompost contain distinct microbes, whereas algal extracts and enzymes exhibit superior efficacy in promoting plant development and growth (Atiyeh *et al.*, 2000). Vermicompost consists of regulatory compounds for plant growth and other substances that influence plant development, such as humates, which microorganisms create (Atiyeh *et al.*, 2002; Tomati *et al.*, 1988). Nitrogen impacts grain class by augmenting protein levels and reducing oil content (Gudade *et al.*, 2009). Sulfur is crucial in synthesizing cysteine, methionine, chlorophyll, and vitamins such as B, biotin, and thiamine. Additionally, sulfur influences the biological breakdown of carbohydrates, mainly via its impact on proteolytic enzymes (Najar *et al.*, 2011). Nitrogen-rich fertilizers significantly increase the production price as much as any other nutrient (Aslam *et al.*, 2011). Multiple studies have demonstrated that the composition and number of phenolic elements and metabolites in medicinal plants, such as Perilla, are significantly affected by various factors, including growth period, the surroundings, light quantity or effectiveness, growing methods, phenological stage, nutrient level, and the time of harvest (Sarker and Oba, 2018; Kim *et al.*, 2017; Lu *et al.*, 2017; Kiazolu *et al.*, 2016; Saeb and Gholamrezaee, 2012; Yoshimatsu, 2012 and Chauhan *et al.*, 2013). 4 Implementing a comprehensive approach that combines chemical fertilizers, the long-lasting impact of organic fertilizer, and the cultivation of high-yielding varieties such as SAU Perilla-1 may be crucial for achieving sustainable crop production and enhancing the yield. Considering all the information presented above, the present inquiry was conducted to study the yield and seed quality response of SAU perilla-1 (*Perilla frutescens*) under different nutrient management practices. The current study was formulated and conducted with the following aims:

1. To identify the effect of different organic soil amendment on the yield and seed quality of SAU Perilla-1,
2. To examine the performance of multiple stages of chemical fertilizer on the yield and seed quality of SAU Perilla-1.

MATERIALS AND METHODS

Description of experimental location

The research station of SAU in Dhaka, Bangladesh, was the site of the experiment. Situated 8.6 meters above sea level, it is also situated at longitude 90°22' E and latitude 23°4' N under AEZ-28.

Soil condition

The site of the research was distinguished by clay loam soil, and it precisely belonged to the "Madhupur Tract" within the area in which the study was conducted. The soil of the area was identified as belonging to the "Nodda" cultivated series. It was described as having a Deep Red Brown Terrace characteristic. In addition to having a pH value of 6.7, the soil had a texture that was silty clay.

Climate condition : The experimental field was located in a sub-tropical environment with significant rainfall during the Kharif season (April to September) and little rainfall during the Rabi season (October to March). Relatively low temperatures and abundant sunlight characterize the Rabi season.

Planting materials

The study was carried out using SAU Perilla-1 (Golden Perilla BD) as the plant sample.

Research protocols:

SL. No.	Factor A Organic manure (Levels-5 assigned in the main plots)	Factor B Fertilizer Levels (4 levels assigned in the sub-plots)
1	OM ₀ = Control	F ₀ = No fertilizer (Control)
2	OM ₁ = Cowdung	F ₁ = 75% RDF
3	OM ₂ = Vermicompost	F ₂ = 100% RDF
4	OM ₃ = Rice straw decomposition	F ₃ = 125% RDF

The rate of Cowdung, Vermicompost, Decomposed rice straw and Poultry manure were 5, 3, 5, and 5 t ha⁻¹ sequentially. Chemical materials were given as per the recommended dose for this crop variety. The recommended dose of fertilizers is Urea, TSP, MoP, gypsum, zinc sulfate, and boric acid at the rate of 150, 150, 50, 110, 10, and 10 kg ha⁻¹ in corresponding order.

The experimental design

The experiment used a split-plot design with three replications. In this case, the main plot is organic manure, whereas the subplot is made of inorganic fertilizer. The overall size of the unit area was 2 meters by 1.5 meters. The overall test variable was 20, which consisted of five gradations of natural resources application and four multiple stages of fertilizer application. Additionally, there were a total of 60 plots.

Details of the field operations

Seed bed preparation

At the SAU field laboratory, a piece of ground was chosen, and it was then levelled and spaded thoroughly with a spade in order to get a proper tilth.

Variety Material

The seeds for the SAU perilla-1

Germination test

Before spreading the seeds in the field, a germination test was conducted. The lab test was conducted using Petri dishes. Water was used to moisten filter papers, which were arranged on Petri plates. The seeds were randomly placed in a petri dish to initiate germination. The data on emerging were gathered and transformed into a percentage format using the following formula:

$$\text{Germination (\%)} \times 100$$

Seedling raising

On July 20, 2022, these seeds were placed in the bed. Several forms of care were done to cultivate the healthy seedling.

Land preparation

On the 12th of August in the year 2022, the area was first opened up using a tractor-drawn disc plough. After that, the area was levelled by laddering, and then it was cross-ploughed with a country plough until it was completely level. It was on August 19, 2022, that the final land preparation was completed, and the study area design was completed in accordance with the experimental design that was going to be followed. In order to ensure that no pocket was left unploughed, weeds and stubbles were removed from each individual plot, and lastly, the plots were levelled in the correct manner using wooden plunks. As part of this experiment, a total of sixty plots with dimensions of 2.0 × 1.5 m² were used.

Fertilization: CO(NH₂)₂, Ca(H₂PO₄)₂, KCl, CaSO₄·2H₂O, ZnSO₄, and H₃BO₃ were applied to the plots at rates of 150, 150, 50, 110, 10, and 10 kg ha⁻¹, respectively. Half of the urea was applied during final land preparation, with the remaining urea split into two equal doses, applied 15 and 30 days after sowing. Organic manures were also applied during final soil preparation.

Transplanting: Seedlings, 30 days old, were transplanted at a spacing of 40 cm × 30 cm on August 20, 2022.

Intercultural Operations: Irrigation was provided as needed, with rain covering most of the growth period. Two hand weeding's were performed—one 18 days after planting and another 18 days after the first weeding. Pest control was carried out by applying Ripcord (10 mL/L of water) to control caterpillar infestations, applied twice at 35 and 55 days after transplanting.

Harvesting and sampling

The crop was said to have reached its maturity when 80 to 90 percent of the inflorescence became straw-colored. Then the crop was harvested on November 15, 2022. The number of plants per plot was harvested, and yield attribution data was recorded. Individual sample container was harvested, wrapped, attached, and transported to the harvest ground

separately. The grains were cleaned and dried in the sun until their moisture content reached 12%. The adequately dried grain was weighed and turned into a t ha⁻¹ basis.

Data recording

From every plot, five plants were selected from the inside lines and indicated. All growth data was then gathered from these indicated plants. Five plants were randomly selected from each plot during the maturity stage, excluding the boundary rows and a center space of 1 m². Data on the yield and seed qualities were gathered from those five plants.

Agronomic traits

- Plant height (cm) at 20, 40, and 60 days after transplanting (DAT)
- Branches plant⁻¹ (no.) at 20, 40, 60 days after transplanting (DAT) and harvest
- Leaf area plant⁻¹ (cm²) at 20, 40, and 60 days after transplanting (DAT)
- Dry weight plant⁻¹ (g) at 20, 40, and 60 days after transplanting (DAT)

Yield contributing parameters

- Branches plant⁻¹ (no.)
- Thousand weight of the grain (g)
- Grain yield (kg ha⁻¹)

Data interpretation

The gathered data were processed and quantitative evaluation was conducted by multivariate analysis method with the Statistix 10 software. The data analysis software was used to modify the mean differences (LSD) test was employed at a significance level of 5%.

RESULTS AND DISCUSSION

The study was executed to ascertain of output production and germination potential of perilla under different nutrient management practices. Information was gathered regarding various growth and yield parameters of SAU perilla-1.

Plant and growth parameter

Plant height

Influence of organic manure

Applying organic fertilizers significantly affected the height of perilla plants at 20, 40, and 60 DAT. (Fig. 1). The data in the figure demonstrated that, regardless of organic fertilizer treatment, the plant height exhibited a gradual upward trend as the growth stages progressed. However, at 20, 40, and 60 DAT, the treatment OM₄ (Poultry litter) resulted in the most elevated plant growth (19.85, 48.63, and 70.30 cm, respectively), which is statistically similar to OM₂ (Vermicompost) and the treatment OM₀ (control) resulted in the minimized plant (16.07, 37.33 and 54.35 cm respectively). Janmohammad *et al.* (2016) and Yagoub *et al.* (2015); observed a similar outcome when using chicken manure fertilizer, which increased the height of soybean plants.

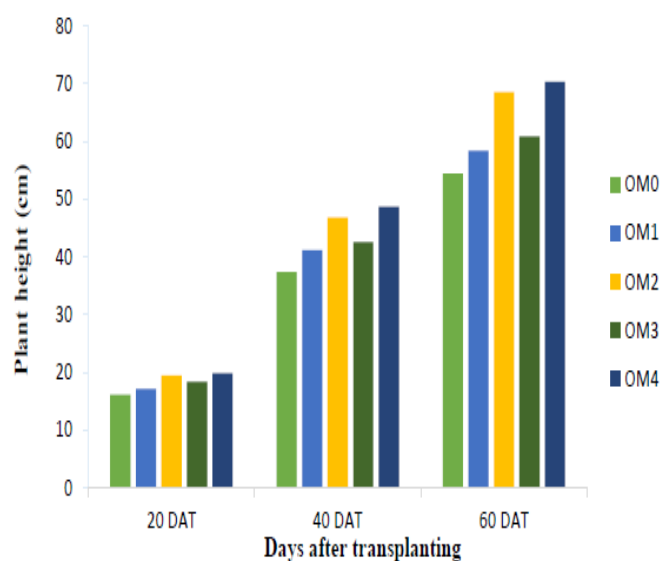


Fig. 1. Influence of natural amendment on vertical growth of SAU perilla-1 on different days after transplanting (LSD (0.05) = 0.44, 0.83, and 1.10, respectively)

Influence of inorganic fertilizer

The growth stages of perilla plants were significantly affected by various treatments of inorganic fertilizer doses, resulting in variations in plant height (Fig. 2). However, gradually increasing plant height with different inorganic fertilizers has an effect. The highest-observed F₃ treatment (RDF) showed superiority in producing the tallest plant at 20, 40, and 60 DAT (19.74, 47.28 and 67.34 cm, respectively). The second- highest plant was found in the F₂ treatment (RDF), and the F₀ (control) treatment showed the shortest plant at 20, 40, and 60 DAT (16.19, 39.34, and 56.81, respectively). Similar results have been identified by Hussain *et al.* (2010); which lends support to the current findings.

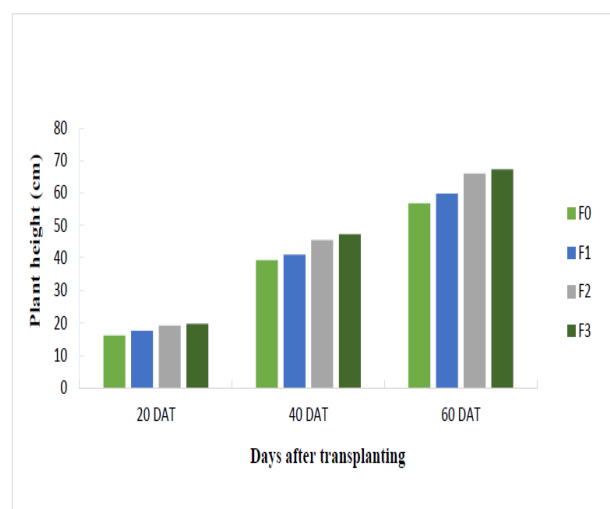


Fig. 2. Influence of inorganic fertilizer on plant height of SAU perilla-1 on different days after transplanting (LSD_(0.05) = 0.28, 0.66, and 1.03, respectively)

Branches per plant (no.)

The quantity of twig for each plant of perilla varied significantly at post-transplant several manure application. The highest branching occurred at 60 DAT, with a slight decrease observed at harvest (Fig. 3). At 20 DAT, the OM₄ treatment elicited the greatest quantity of branches each crop (8.40), which was statistically similar to the OM₂ treatment (8.11). The OM₀ treatment resulted in the fewest branches per plant (6.87), which was not significantly different from OM₁ (7.23) and OM₃ (7.42). By 40 DAT, OM₀ had the highest branch count per plant (11.28), followed by OM₂ (10.77), both of which were statistically similar. OM₀ showed the lowest branch count per plant at this stage (8.25). At 60 DAT, the supreme amount of twig every crop was logged in OM₄ (14.67), which was statistically comparable to OM₂ (14.37). The lowest branch count was observed in OM₀ (11.18). At harvest, the OM₄ treatment again produced the highest number of branches (13.83), statistically similar to OM₂ (13.54), while OM₀ had the fewest branches per plant (10.99). Corresponding findings were noted by Janmohammad *et al.* (2016) and Yagoub *et al.* (2015), who observed an increase in branch number in soybean plants treated with poultry-based fertilizers.

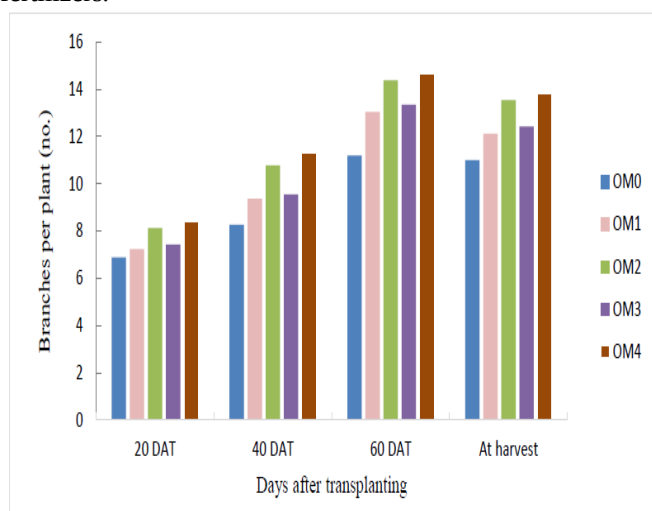


Fig. 3. Influence of organic manure Branches plant⁻¹ (no.) on different days after transplanting (LSD_(0.05) = 0.25, 0.25, 0.36 and 0.26 respectively)

Influence of inorganic fertilizer

The significant impact of the number of branches plant⁻¹ on various days following transplanting of perilla plants, as repercussion by the use of inorganic products, is illustrated in (Fig. 4). The graph displayed a consistent upward trend at 60 DAT, corresponding to the progression of vegetative part. The largest improvement was observed at this duration, followed by a minor drop during the harvest stage, which can be attributed to the decay of older branches compared to younger ones. The treatment F₃

resulted in the maximum count of branches for each individual crop at 20, 40, and 60 DAT, with values of 8.11, 10.67, and 14.21, respectively. The peak quantity of branches at the reaping stage occurred 13.48. The treatment F₀ resulted in the Minimum branch number per crop at 20, 40, 60, and harvest, corresponding values of 7.12, 8.81, 12.11, and 11.28 respectively.

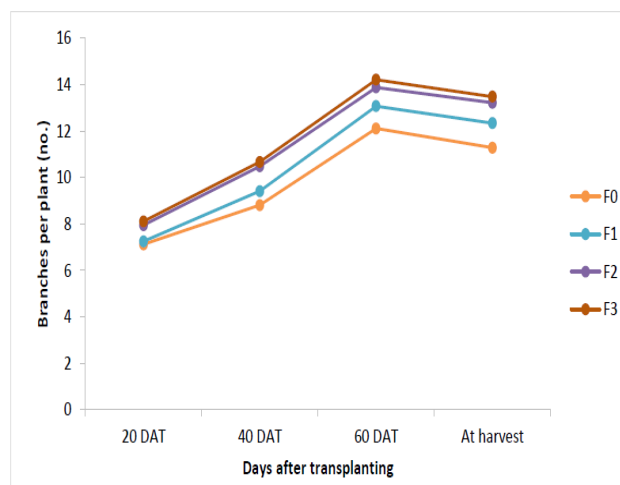


Fig. 4. Influence of inorganic fertilizer number of branches plant⁻¹ on various days after transplanting (LSD_(0.05) = 0.14, 0.13, 0.28 and 0.179 respectively)

Leaf area plant⁻¹ (cm²)

Influence of organic manure

Significant effects of leaf area per plant on different days after transplanting of plant in perilla by reason of the consequence of natural resource elements occurred in (Fig. 5). The diagram showed a steadily decreasing trend at a certain level at 60 DAT with the advances of growth stages and a slight decrease at the harvest stage due to older branches' decay compared to younger ones. The result (9393.1 cm²) showed the maximum result from the treatment OM₄ at 20 DAT, which was statistically similar to OM₂ (9257.9 cm²) and revealed the lowest result from OM₀ (8040.6 cm²). At 40, DAT showed the minimum result (7982.0 cm²) from the treatment OM₀, and the maximum result revealed OM₄ (9120.5 cm²), which was statistically similar to OM₂ (8976.5 cm²). At 60, DAT showed the highest, second highest, and lowest results, OM₄ (8835.7 cm²), OM₂ (8701.9 cm²), and OM₀ (7674.4 cm²), respectively. Janmohammadi *et al.* (2016) reported similar patterns of outcomes in sunflowers.

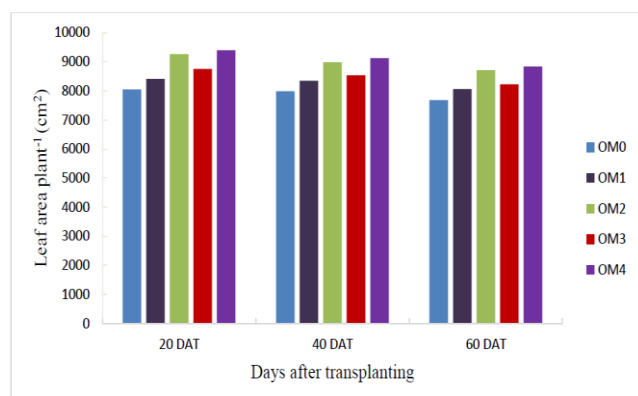


Fig. 5. Influence of organic manure on leaf area plant⁻¹ of SAU perilla-1 on different days after transplanting (LSD (0.05) = 225.58, 162.24, and 138.11, respectively)

Influence of inorganic fertilizer

A situation arose where notable variance in the effect of industrially chemical process materials on leaf area plant⁻¹. The chart exhibited a gradual decrease due to older leaf decay than younger leaf (Fig. 6). At 20, 40, and 60 DAT, the management F₃ exhibited the highest leaf area plant⁻¹ (9096.2 cm², 8916.7cm² and 8625.3 cm², respectively). In contrast, the F₃ and F₂ treatments were statistically similar at the 20, 40, and 60 growth stages (8994.8, 8812.1and 8520.4 cm², respectively). In case of 20, 40, 60, DAT, The plant with the least leaf area per unit from the treatment F₀ (8341.6, 8271.9, and 7956.9 cm²,respectively).

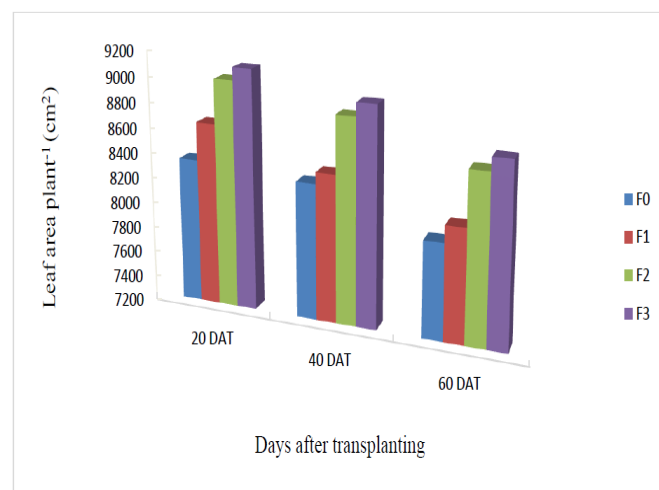


Fig. 6. Influence of inorganic fertilizer on leaf area plant-1 of SAU perilla-1 on different days after transplanting (LSD (0.05) = 101.19, 102.89 and 78.933respectively)
Dry weight plant⁻¹ (g)

Influence of organic manure

Significant effects were observed in the dry weight per perilla plant when the organic manure dosage varied (Fig. 7). The graph displayed a consistent upward trend as the growth stages progressed, with the highest rise observed at 60 DAT, regardless of the type of organic fertilizer used. Poultry litter (OM₄) exhibited the topmost dehydrated bulk

for each collection period, with the subsequent vermicompost (OM₂) including the least dehydrated load was recorded with the zero (OM₀) treatment. The highest perched load was produced at 20, 40, and 60 DAT (3.64g, 10.63g, and 33.55 g, respectively) from the treatment OM₄. The treatment OM₀ resulted including the least dehydrated load crop at 20, 40, and 60 DAT, with values of (2.94g, 7.62g, and 22.55g, respectively) and in the case of 20 DAT OM₄ (3.64g), OM₂ (3.51g) statistically similar followed to 40 DAT OM₄ (10.63g), OM₂ (10.25g) respectively.

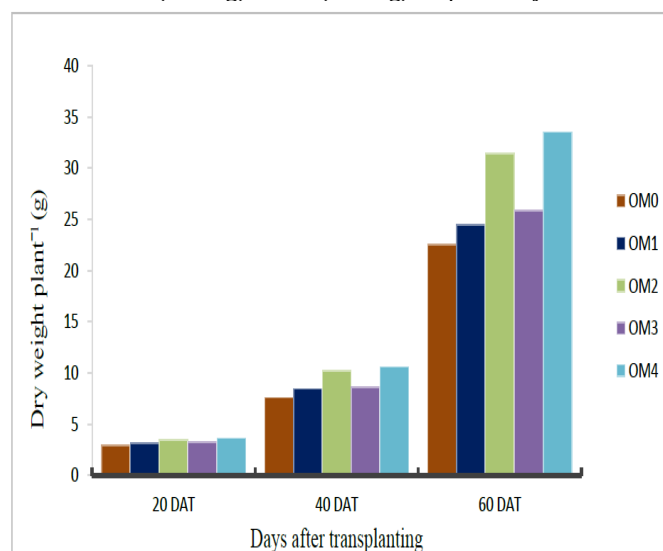


Fig. 7. Influence of natural supplement on plant moisture-free mass of SAU perilla-1 on differentdays after transplanting (LSD (0.05) = 0.07, 0.249, and 0.78, respectively)

Influence of inorganic fertilizer

The dry weight per plant has been displayed in (Fig. 8), illustrating the impact of various doses of inorganic fertilizers. The chart indicates that regardless of the amount of fertilizer used, the dry weight of each plant increased gradually as the growth phases progressed. The growth rate exhibited a significantly greater extent at the later stage (40–60 DAT) than at the early stage (20 DAT). The F₃ (RDF) treatment was superior to other doses on all sample days regarding dry weight per plant. Hussain *et al.* (2010); also reported a greater evaporated particle grain when chemically produced materials were used alone.

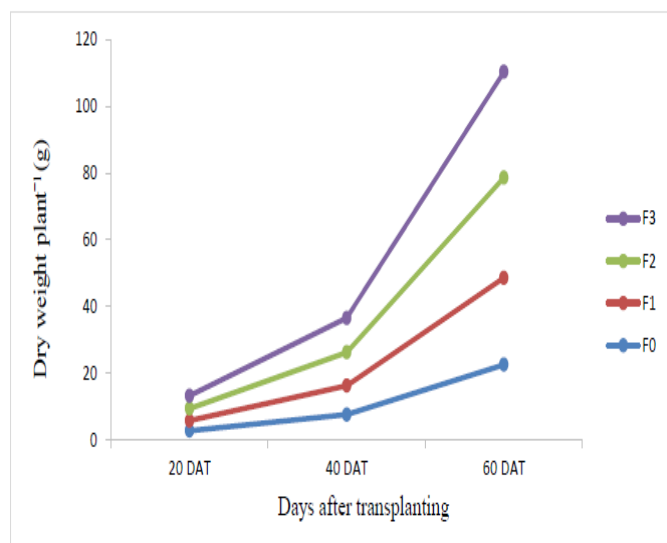


Fig. 8. Influence of synthetic supplement on plant Desiccated mass of SAU perilla-1 on different days after transplanting (LSD_(0.05) = 0.06, 0.14 and 0.53 respectively)

Yield and yield contributing parameter

Seeds branch⁻¹ (no.)

Influence of organic manure

The effect of organic manure induced quantitatively crucial change in the number of seeds per branch for perilla. This is seen in (Fig. 9) and details may be found. The OM₄ treatment revealed the maximum number of seeds per branch, with a recorded value of 1297.9, statistically similar to OM₂ (vermicompost), and the recorded value was 1275.7. Conversely, the OM₀ treatment had the lowest number of seeds per branch, with a value of 964.7. The study found that the number of seeds per branch significantly increased when poultry litter and vermicompost were applied compared to the control. The same outcome was also noted by (Yagoub *et al.*, 2015).

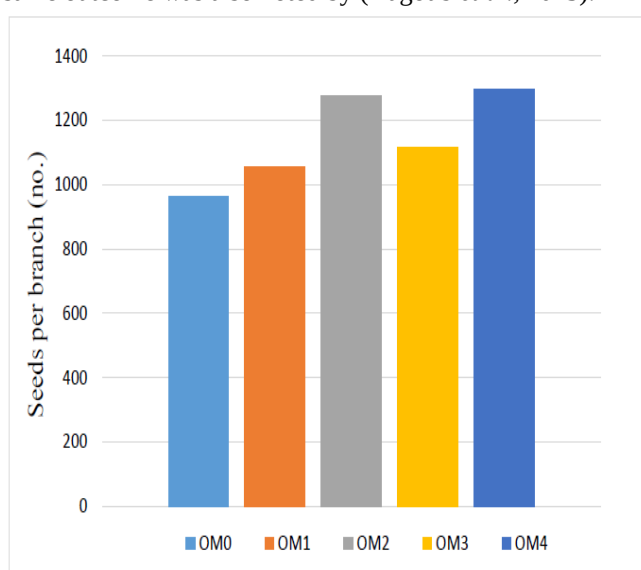


Fig. 9. Influence of organic manure on grains each branch (no.) of SAU perilla-1

(LSD_(0.05) = 30.43)

Influence of inorganic fertilizer

A situation arose where statistically crucial variation in the quantity of perilla seeds per branch due to the application of various amounts of inorganic fertilizers. Details can be found in (Fig. 10), which displays this. The F₃ treatment exhibited the highest seed count per branch, with a recorded value of 1251.9, statistically similar to 1239.2 for the F₂ treatment. In contrast, the F₀ treatment had the lowest seeds per branch, counting 985.5. Compared to the control, the study discovered that applying F₃ and F₂ treatment significantly enhanced the quantity of seeds per branch. Alhasan *et al.* (2020) observed that the study investigated the effects of CO(NH₂)₂ treatment at seven different rates (0, 20, 40, 60, 80, 100, and 120 kg N/ha) on chlorophyll levels, agronomic characteristics and crops outcome production.



Fig. 10. Influence of inorganic fertilizer on seeds per branch (no.) of SAU perilla-1 (LSD_(0.05) = 11.99)

Thousand weight of the seed (g)

Influence of organic manure

The load of one thousand perilla seeds exhibited significant variation on account of various natural supplements (Fig. 11). This OM₄ treatment yielded the maximum weight of thousand grain, measuring 3.93 g, statistically equivalent to the mass of 1000 grains seed yield at specific OM₂ treatment (3.79 g). Likewise, the OM₀ treatment resulted in the lowest load of thousand seeds, measuring 2.73g.

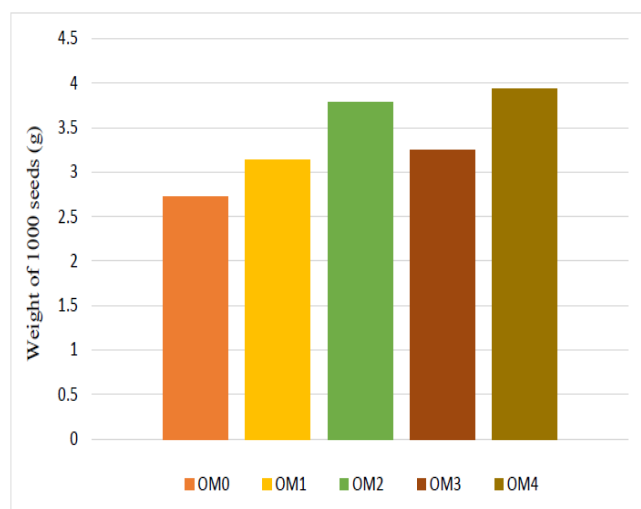


Fig. 11. Influence of natural supplement on weight of 1000 seeds of SAU perilla-1 (LSD_(0.05) = 0.06)

Influence of inorganic fertilizer

The weight of 1000 perilla seeds showed significant fluctuation due to the various amounts of inorganic fertilizers (Fig. 11). The F₃ treatment resulted in the apex mass of thousand seeds, measuring 3.69 g; the second highest was the heaviness of 10 times of 100 grains in the F₂ process (3.58 g). In contrast, the F₀ treatment yielded the lowest negligible weight of one thousand seeds at 3.04g. The result supported the insight of Chariara *et al.* (1989), who revealed that the use of inorganic material augmented the weight of seeds.

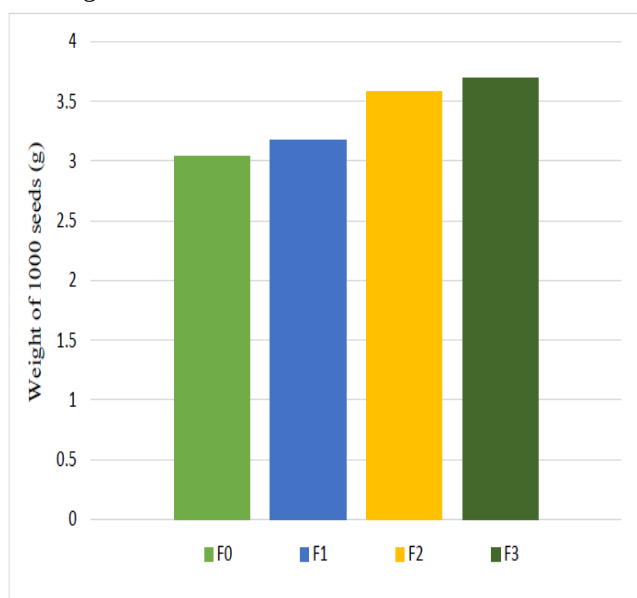


Fig. 12. Influence of inorganic fertilizer on wt. of 1000-seeds per branch (no.) of SAU perilla-1 (LSD_(0.05) = 0.04) Seed yield (kg ha⁻¹)

Influence of organic manure

As illustrated in (Fig. 13), the effect of various organic fertilizers caused a crucial difference in the mass of crop

seed production (kg ha⁻¹) of perilla seeds. In contrast to the OM₀ stage, which yielded the lightest weight of 1072.8 kg ha⁻¹, the OM₄ treatment generated the heaviest crop outcomes load of 1385.7 kg ha⁻¹, statistically similar to the OM₂ treatment (1356.4 kg ha⁻¹). Akbari *et al.* (2011); the individual who said that using organic manure, either on its own or in the addition with industrial chemicals, resulted in a substantial augment in grain and biological yield compared to the control group. Which correlates with the research findings.

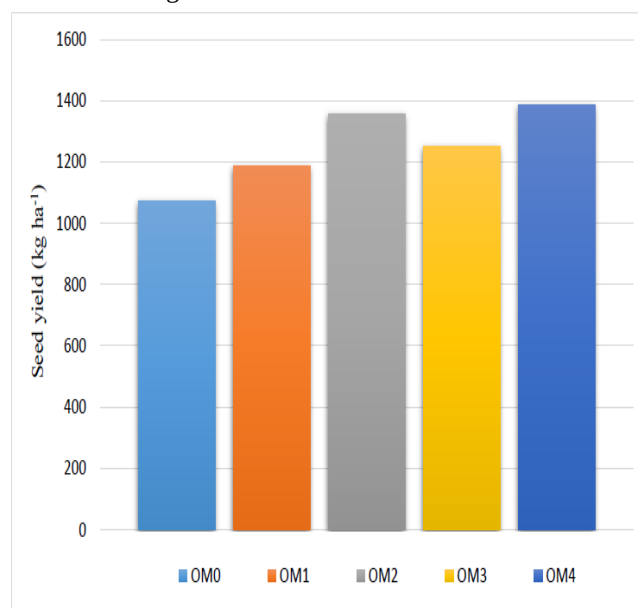


Fig. 13. Influence of organic manure on seed yield (kg ha⁻¹) of SAU perilla-1 (LSD_(0.05) = 27.67)

Influence of inorganic fertilizer

The mass of harvested crop outcomes (kg ha⁻¹) of perilla seeds differ crucially in response the unique amounts of synthetic materials, as shown in (Fig. 14). The F₃ treatment produced the most outstanding seed yield weight of 1323.4 kg ha⁻¹, statistically similar to the F₂ treatment (1304.1 kg ha⁻¹). Conversely, the F₀ process (control) produced the weakest weight of 1161.7 kg ha⁻¹. Ujjinaiah *et al.* (1989) that the exploitation of N₂ in addition with P inorganic shown in augmented grain production of helianthus.

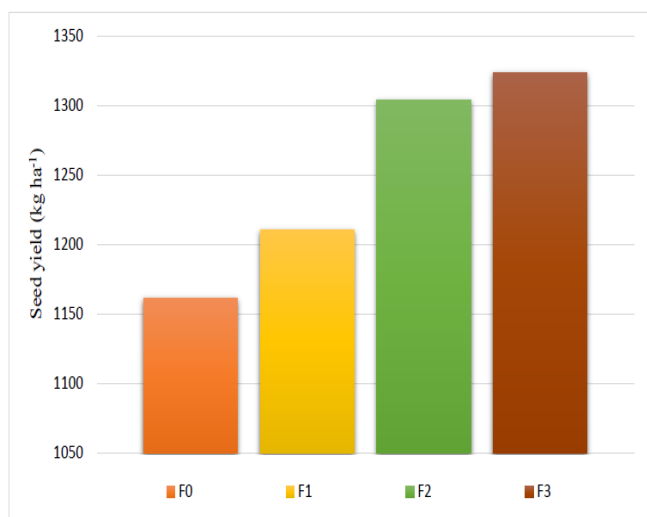


Fig. 14. Influence of synthetic chemicals on grain yield (kg ha⁻¹) of SAU perilla-1 (LSD_(0.05) = 15.26)

CONCLUSION

According to the findings obtained, the result could be finalized that Poultry litter (OM₄) followed by Vermicompost (OM₂), 125% RDF (F₃), and 100% RDF (F₂) resulted in higher seed yield along with related parameters under study. Among the combined effects of treatments OM₄F₃, OM₂F₃, OM₄F₂, and OM₂F₂ were superior in obtaining grain yield.

Conflict of Interest

It is stated that no bias disclosed by the authors.

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