FIMEK

Journal of Agronomy, Technology and Engineering Management

Article

Evaluating Seed Dressing and Soil Application of Vermicompost on Pea (*Pisum sativum*) Growth and Development

Gizem Kamci Tekin [1,*] and Behiye Tuba Bicer [2]

[1] Sirnak University, Agricultural Faculty, İdil, Sirnak, Turkey
[2] Dicle University, Agricultural Faculty, Department of Field Crops 21280 Diyarbakir, Turkey
* Correspondence: e-mail: gzmkmc2@gmail.com

Received: 18 August 2022; Accepted: 4 November 2022

Abstract: The experiment was conducted in 2022 at the research farm of Dicle University of Agricultural Faculty, Diyarbakir, Turkey. The study is to examine the effect of vermicompost, which is an industrial product of organic origin, on the growth of peas. The soil was treated with liquid vermicompost 10 t ha^{-1} with sown. Seed dressing of vermicompost was applied to the seed coat. The experiment was arranged in a randomized complete-block design with three blocks. After 45 days after emergence, plant samples were harvested six times every ten days. Observations were on plant height, leaf area, number of leaves, stipule, tendrils $plant^{-1}$, stem, and leaf dry weight. The effect of vermicompost treatments on seed and soil was significant for plant height, the number of leaves and tendrils per plant, leaf area, and dry stem weight. Vermicompost application on seeds and soil was higher than a control for all traits. Vermicompost application to the soil had a slight advantage over the vermicompost application to the seed.

Keywords: Pea; *Pisum sativum*; vermicompost; leaf area; plant height; GDD.

1. Introduction

The Pea (*Pisum sativum* L.) is an important cool-season vegetable belonging to the Fabaceae family grown worldwide [1].

The soil of peas ranged from sandy to heavy clay well-drained, and between 6 and 7.5. Peas is needed better soil nutrients to support their development, as fertilization is the best method to succeed in all phases of crop development. Fertilization, especially macronutrients, is an important factor in crop production for all biological functions. Chemical fertilizers are required by plants in their growth and development. Nitrogen is an important nutrient, and urea (46% N), water-soluble, is frequently used, but its leaching is decreased the nitrogen content of the soil. To enhance plant nitrogen utilization and minimize environmental pollution, organic or biological nutrients are getting used. Phosphorus is affected plant growth and development and is responsible for the energy required for metabolic processes. It also raises photosynthesis, the activity of rhizobia, and the number of branches and pods per plant in a pea [2]. Continuous use of high phosphorus and nitrogen fertilizers or high rates of manure or manure compost results in phosphorus and nitrogen buildup in the soil. Although phosphate fertilizer applied to soil is bound tightly and resistant to movement in the soil, some runoff may occur. It could then become a major pollution concern in waters such as lakes, rivers, and streams.

It is suggested in pea cultivation to use well-rotted manure or compost at sowing. The use of organic fertilizers is a major component of organic farming practices [3]. Organic manures include basic plant nutrients and enhance crop production per unit area, also providing a successful crop rotation [4]. Animal manure, sewage sludge, and crop residues are used as organic materials. Also in recent years, industrial products in huge amounts were marketed as organic or biological plant

nutrients such as liquid/solid worm manure and pelleted/ poultry manure, and important attention has been paid to these types of manure.

The aim of this study is to examine the effect of vermicompost, which is an industrial product of organic origin, on the growth of peas. Also, the study aimed to reduce the use of inorganic fertilizers to protect soil and crop health and to popularize the use of worm manure.

2. Materials and Methods

A field experiment was conducted in 2022 at the research farm of Dicle University of Agricultural Faculty, Diyarbakir, Turkey. Soil (0–25 cm) texture was clay loam, pH of 8.15, and the total nitrogen content, soil organic matter, and available phosphorus were low (Table 1).

Table 1. Soil analysis before fertilization is a table.

Soil Texture	pH	Lime (%)	C-organic (%)	N-Total (%)	P_2O_5 (kg ha^{-1})	Fe (ppm)	Ca (ppm)	Mg (ppm)
63.2 (clay loam)	8.15	10.59	0.77	0.04	18.8	8.86	10693.1	616.32

Temperature and rainfall for the growing season were presented in Figure 1. February was cold and dry, March was cold but rainy. Although April was quite dry, May was rainy, hot, and humid.

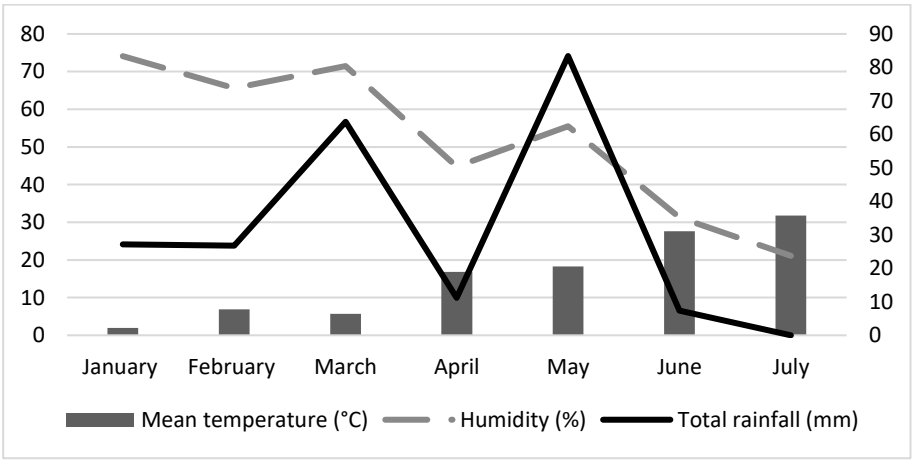

Figure 1. Temperature and rainfall for the growing season.

The chemical composition of liquid vermicompost contained total nitrogen (1.0%), organic matter (40.0%), pH (8.5), humic+fulvic acid (15%), and phosphorus (3.0%). The soil was treated with liquid vermicompost 10 t ha^{-1} with sown. Seed dressing of vermicompost was applied to the seed coat using a micro-pipette and then air dried at 20 °C for 2 h before sowing. In total 1.6 µl was added to the surface of each seed.

Sowing occurred in the first week of February. Pea seeds were sown by hand at a rate of 60 seeds per square meter and a depth of ≈4.5 - 5 cm under wet soil conditions. Each plot included 4 rows spaced at 45 cm. The field experiment was arranged in a randomized complete-block design with three blocks. Weed control was performed manually when required.

After 45 days after emergence, plant samples were harvested 6 times every ten days. Five-eight plants from each plot were randomly selected and measured for plant height, leaf area, number of leaves, stipule, tendrils $plant^{-1}$, stem, and leaf dry weight. Plants were separated as leaf and stem, and they were dried at 70 °C until constant weight. The leaf area was measured by an HP Scanjet 3400C immediately after sampling. Growing degree days were calculated in the formula: Daily GDD (°C) = ((daily max temp °C + daily min temperature °C)/2) - 5.0 °C [5,6].

Data were statistically analyzed in the design of the completely randomized block [7]. Duncan's multiple-range test was used to compare variations between treatment means [8].

3. Results and Discussion

The effect of different applications of liquid vermicompost on the growth and development of peas was investigated. Plant height, leaf area, number of stipules, tendrils, and leaves plant^{-1}, stem, and leaf dry weight were evaluated at different growth stages after emergence. A combined analysis of the applications in all growth stages was made. The effect of vermicompost treatments on seed and soil was significant for plant height, the number of leaves and tendrils per plant, leaf area, and dry stem weight. Vermicompost application on seeds and soil was higher than a control for all traits. The most important response to soil application compared to control was in the plant height (34.95-39.76 cm), the number of leaves plant^{-1} (23.33-28.62), and the number of tendrils per plant (9.16-10.70). The response to seed application compared to control was in the leaf area (219.65-278.27 cm^2) and dry stem weight (0.91-1.31 g) (Table 2). Most researchers showed that ammonium sulfate and compost fertilizers application [9], organic manure, and NPK [10] were increased in plant height, leaves number/plant, shoots fresh and dry weight. Mahto and Yadav [11], reported that the pea plants positively benefited from the vermicompost and vermiwash when applied alone or in combination with inorganic fertilizer. Kumari et al. [12], revealed that control and vermicompost application had the lowest values of crop growth owing to inadequate nutrient availability. Also, they showed that seed inoculation with vermicompost and zinc alone increased dry weight per plant over control.

The growth stages were analyzed separately, and differences in the growth stages were significant for all traits except for plant height. All plant parts started to yellow on the 85 DAE and 95 DAE, and maturity was detected in DAE 95. The number of stipules per plant and leaf area growth continued until the end of 85 DAE (Table 2).

Treatment × each growth stage interaction was important for all traits. Vermicompost application to the soil had a slight advantage over the vermicompost application to the seed. It was assumed that the application of vermicompost to the soil prolonged the generative period. The application of seed dressing of vermicompost was bring out a significant difference, especially in leaf area, leaf dry weight, and the number of tendrils per plant. On the 45th day after emergence, seed dressing of vermicompost for plant height, dry stem weight, number of leaves and tendrils plant^{-1}, and leaf area was lower than the control and soil treatment (Figure 2).

Table 2. Seed dressing and soil application of vermicompost on pea plant traits.

Treatments	Plant height (cm)	Number of nodes plant^{-1}	Number of stipule plant^{-1}	Number of leaves plant^{-1}	Number of tendrils plant^{-1}	Leaf area (cm^2)	Dry leaf weight (g)	Dry stem weight (g)
Control	34.95 ^{b}	11.43	11.12	23.33 ^{c}	9.16 ^{b}	219.65 ^{b}	1.50	0.91 ^{b}
Seed	38.59 ^{a}	12.36	11.54	26.23 ^{b}	10.49 ^{a}	278.27 ^{a}	1.73	1.31 ^{a}
Soil	39.76 ^{a}	12.09	12.03	28.62 ^{a}	10.70 ^{a}	270.80 ^{a}	1.56	1.24 ^{a}
Day After Emergence								
45	25.78	7.89 ^{d}	8.80 ^{c}	18.75 ^{e}	7.37 ^{d}	160.41 ^{c}	0.66 ^{e}	0.27 ^{d}
55	32.30	9.38 ^{d}	10.38 ^{c}	22.73 ^{d}	9.06 ^{c}	220.13 ^{b}	1.18 ^{d}	0.69 ^{c}
65	37.63	11.90 ^{c}	12.26 ^{b}	28.02 ^{c}	10.70 ^{b}	319.50 ^{a}	1.57 ^{c}	1.36 ^{b}
75	43.18	15.51 ^{a}	15.28 ^{a}	37.36 ^{a}	13.81 ^{a}	341.16 ^{a}	2.62 ^{a}	1.73 ^{a}
85	40.71	13.58 ^{b}	15.79 ^{a}	32.99 ^{b}	12.57 ^{a}	336.22 ^{a}	2.18 ^{b}	1.53 ^{ab}
95	46.99	13.50 ^{b}	6.89 ^{d}	16.50 ^{e}	7.20 ^{d}	160.02 ^{c}	1.39 ^{cd}	1.35 ^{b}

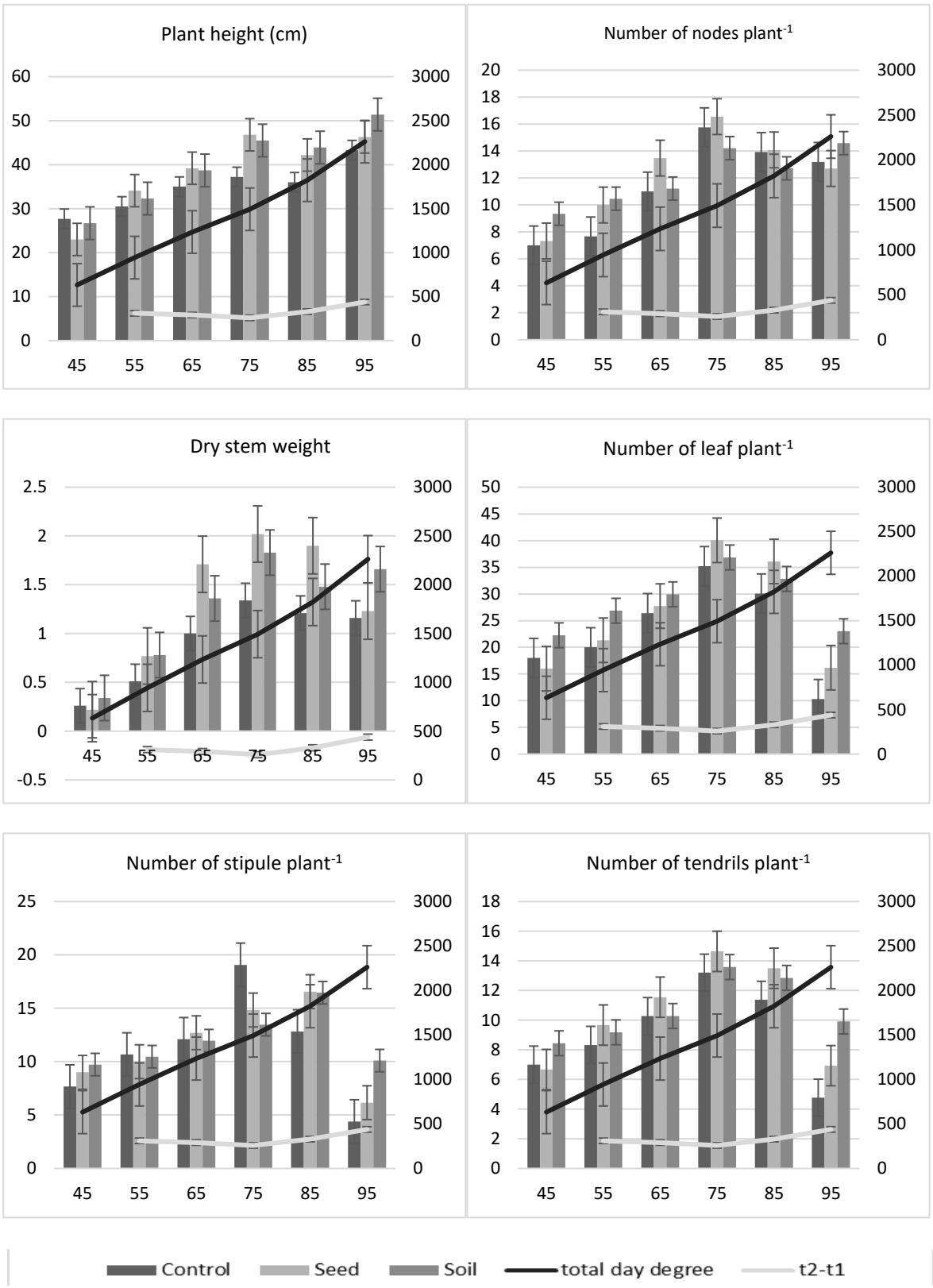

Figure 2. Growth degree days and vermicompost application on soil and seed. Application × DAE on pea plant traits.

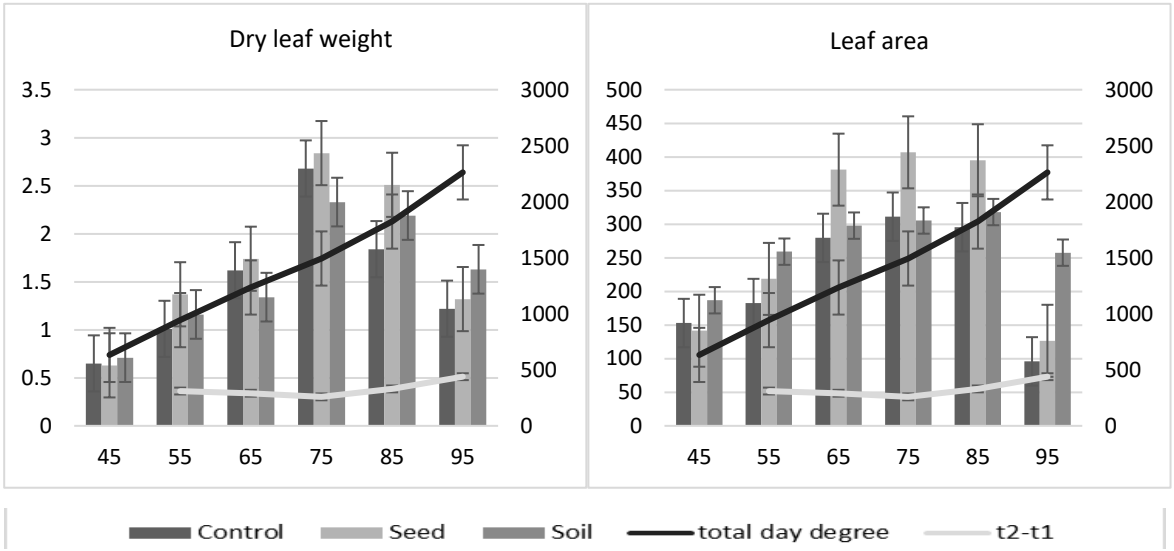

Figure 2 continues. Growth degree days and vermicompost application on soil and seed. Application × DAE on pea plant traits

Flowering time was in 55 to 65 days (GDD: 944 – 1235), and growth and development continued until the end of 75 DAE (GDD 1494) when plants were in the podded stage (Figure 2). After germination, the optimal growth temperature ranges between 10 and 19 °C [13]. A daily mean of 20 °C was found to be near the critical point, with higher temperatures having adverse effects [14]. In our study, February and March were cold, April was dry and May was rainy. Therefore, the plant lifespan was longer.

Fertilizer applications did not affect the period of the vegetative and reproduction phase of the crop, but plant height only continued to increase even at 95 DAE where the total GDD was 2262. Plant height was 27.7 cm in control, 23 cm in seed, and 26.7 cm in the soil at 45 DAE (GDD 633), it gradually increased to 43.3 cm, 46.3 cm, and 51.4 cm at 95 DAE, respectively.

Several nodes, stipules, leaves, and tendrils plant^{-1}, dry leaf and stem weight reached the highest value at 75 DAE, but they decreased sharply at 95 DAE. In the days between 85 (GDD 1823) and 95 days (GDD 2262), the suddenly rising temperature accelerated the crop maturation without changing according to the fertilizer applications. Lorenz and Maynard [15], reported that the pea growth period from sowing to harvest was 56–75 d, and the period was affected by the variety and environmental conditions. Also, soil temperature, soil water content, and sowing depth might affect the emergence and the next growth stages. In April, water stress was retired pea development, and thus the period from emergence to harvest was prolonged.

4. Conclusions

Differences between fertilizer applications on seed and soil were investigated on plant growth and development in peas. After emergence, plants were harvested every 10 days, and plant parts were evaluated separately. Application to seed and soil of vermicompost affected the growth parameters. Vermicompost application to the seed was more effective than the application of vermicompost to the soil. The growing degree days (GDD) of the trial year were determined, and the relationship between the applications and the GDD was examined, but applications were not correlated with the total temperature.

References

[1] Gautam K. K.; Moharana D. P.; Syamal M. M.; Singh V. Comparative investigation of genetic diversity in garden pea *(Pisum sativum* var. hortense L.) for yield and yield attributing characters. *Vegetable Science* **2018**, *45*(2), 281-283.

[2] Husaun J.; Kashyap P.; Prusty A. K.; Dutta D. E. B. A. S. H. I. S.; Sharma S. S.; Panwar A. S.; Kumar S. Effect of phosphorus fertilization on growth, yield and quality of pea (*Pisum sativum*). *The Indian J. Agric. Sci***. 2019,** *89*(8), 87-91.

[3] Berner A.; Hildermann I.; Fliessbach A.; Pfiffner L.; Niggli U.; Mäder P. Crop yield and soil fertility response to reduced tillage under organic management. *Soil and Tillage Research* **2008**, *101*(1-2), 89-96.

[4] Ghosh P.K.; Ramesh P.; Bandyopadhyay K.K.; Tripathi A.K.; Hati K.M.; Misra A.K.; Acharya C.L. Comparative effectiveness of cattle manure, poultry manure, phosphocompost and fertilizer-NPK on three cropping systems in vertisols of semi-arid tropics. I. Crop yields and system performance. *Bioresource technology* **2004**, *95*(1), 77-83.

[5] Mikkelsen S. A. Predicting the date of harvest of vining peas by means of growing-degree-days models. *In Symposium on Timing of Field Production of Vegetables* **1981**, 122, 211-221.

[6] Nugent J. Calculating growing degree days. Michigan State University. **2005**. Retrieved https://www. canr. msu. edu/uploads/files/Research_Center/NW_Mich_Hort/General/CalculatingGrowingDegreeDays.

[7] Gomez K.N.; Gomez A.A. Statistical Procedures for Agricultural Research. (2nd ed), John Wiley and Sons, NewYork **1984**, p. 68 p

[8] Waller R. A.; Duncan D. B. A Bayes Rule for the Sym-metric Multiple Comparison Problem. *Journal of the American Statistical Association* **1969**, 64, 1484-1503; Corrigendum (1972), 67, 253-255.

[9] Eata A.E.M. ; El-Sherbini M.A.A.; Asmaa R.M.; Aisha H.A., Effect of Fertilizer Management on Growth, Yield and Quality of Pea (*Pisum sativum* L.). *Singapore Journal of Scientific Research* **2020**., *10*: 327-335.

[10] El-Salehein A.; Sharaf A.; Fekry W,A. Response of peas to organic manure and NPK fertilization. *Journal of Productivity and Development* **2009**, *14*(3), 627-640.

[11] Mahto T.P.; Yadav R.P. Effect of vermicompost alone and in combination with chemical fertilizer on stem fly incidence and yield attributes in vegetable peas under Bihar conditions. *Journal of Applied Zoological Researches* **2005**, *16*(1), 70-72.

[12] Kumari A.; Singh O. N.; Kumar R. Effect of integrated nutrient management on growth, seed yield and economics of field pea (*Pisum sativum* L.) and soil fertility changes. *Journal of Food legumes* **2012,** *25*(2), 121-124

[13] Swiader J.M.; Ware G.W.; McCollum J.P. Producing vegetable crops. Interstate Publ.,**1992**, Danville, Ill.

[14] Bourgeois G.; Jenni S.; Laurence H.; Tremblay N. Improving the prediction of processing pea maturity based on the growing-degree day approach. *HortScience* **2000**, *35*(4), 611-614.

[15] Lorenz O.A.; Maynard D.N. Knott's handbook for vegetable growers. 3rd ed. Wiley, New York. **1988.**