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STUDY ON THE APPLICATION OF SEAWEED EXTRACT AND NPK FERTILIZER ON THE GROWTH OF BLACK POTATO (*PLECTRANTHUS ROTUNDIFOLIUS*)

Okky Chandra Kumara^{1*}, Dewi Ratna Nurhayati¹, Avisema Sigit Saputro¹

¹Agrotechnology, Faculty of Agriculture, University of Slamet Riyadi, Surakarta

*Corresponding Author email: okkychandrakumara17@gmail.com

Orchid: <https://orcid.org/0009-0009-6967-4576>

ABSTRACT

Black potato (*Plectranthus rotundifolius*) is a potential alternative food crop to substitute rice. However, its low productivity in Indonesia currently averaging around 15 tons/ha is influenced by factors such as sub-optimal nutrient supply and limited availability of high-quality planting materials. This study aims to examine the effect of applying seaweed extract as a biostimulant along with NPK fertilizer (16-16-16) on the growth and yield of black potato. The research was conducted at the Experimental Farm of the Faculty of Agriculture, UNISRI, Surakarta (130 m a.s.l.). A 4 x 4 factorial Completely Randomized Design (CRD) with three replications (totaling 48 experimental units) was employed. The first factor was the dosage of seaweed extract (0, 1, 2, and 3 mL/L), and the second factor was the NPK dosage (0, 200, 400, and 600 kg/ha). Data were analyzed using Analysis of Variance (ANOVA) followed by Honestly Significant Difference (HSD) test at the 5% significance level. The results showed a significant interaction between seaweed extract and NPK fertilizer on plant height, with the best combination observed at 3 mL/L seaweed extract and 600 kg/ha NPK (34.6 cm). Meanwhile, no interaction was found for the number of branches; however, each single factor had a significant effect. The single treatment of 3 mL/L seaweed extract produced the highest number of branches (15.5 branches), while 600 kg/ha NPK alone yielded 15.1 branches.

Keywords: Biostimulant, Black Potato, NPK Fertilizer, Seaweed Extract

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INTRODUCTION

Indonesia is an archipelagic country with a population exceeding 280 million people (BPS, 2025). Along with the rapid rate of population growth and the current shrinking of agricultural land, diversification is necessary to meet the public's food needs. Among various types of plants serving as rice substitutes, tuber crops are worthy candidates for further development. Tuber crops represent a potential alternative food source with a very promising future for commercial expansion in Indonesia (Angely et al., 2023). One commodity starting to gain attention is the black potato, which holds great potential for development in Indonesia.

Black potato is a type of tuber crop rich in nutrients and bioactive compounds. It contains calories, protein, minerals, calcium, phosphorus, iron, vitamin B1, vitamin B2, and vitamin C (Eny et al., 2022). Although not as popular as common potatoes, this plant is gaining attention as a high-value alternative commodity. However, black potato productivity in Indonesia remains low at 15 tons/ha. This low productivity is caused by various factors, one of which is planting material (Widodo et al., 2022). The availability of high-quality potato seed stock remains limited, alongside sub-optimal nutrient supply and pest and disease infestations. Several highland regions have begun cultivating this crop on a small to medium scale.

One effort to increase the productivity of black potato crops is through the application of biostimulants. Biostimulants are non-fertilizer organic compounds capable of stimulating plant growth when applied in small quantities. Seaweed extract is known to contain various compounds that can act as natural biostimulants (Galuh et al., 2025). The utilization of biostimulants exerts many positive effects on plant growth. The application of this extract is expected to enhance both the vegetative and generative growth of black potato plants. This plays an important role in supporting agricultural systems to boost productivity. Thus, the use of biostimulants represents an innovative alternative in black potato cultivation.

Fertilization is also an important factor in increasing the yield of black potato crops. NPK fertilizer is a type of compound fertilizer containing primary macronutrients, namely nitrogen, phosphorus, and potassium (Gumelar, 2017). These three elements are essential for plants to support optimal growth and development. The application of NPK fertilizer with the correct dosage and timing can significantly increase crop productivity. However, improper use can actually reduce efficiency and harm the environment. Therefore, wise and measurable fertilization management is required.

The combination of potato extract biostimulants and NPK fertilizer is expected to provide optimal results in black potato cultivation. Research on this combination still needs to be developed to obtain the most effective formulation. This is important to support the increase of black potato production. With increased production and quality, black potatoes have the potential to become a new leading commodity in Indonesia.

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METHODS

Equipment used included polybags, mulch, hoes, hand trowels, shears, cutters, measuring tapes, digital scales, vernier calipers, cameras, and stationery. Materials consisted of soil, burnt rice husk, seaweed extract, NPK fertilizer, black potato seed tubers, and water. A 4 x 4 factorial Completely Randomized Design (CRD) was implemented with two factors: Factor 1 (Seaweed Extract Dosage): L0 = 0 ml/liter, L1 = 1 ml/liter, L2 = 2 ml/liter, dan L3 = 3 ml/liter. Factor 2 (NPK 16-16-16 Dosage): N0 = 0 kg/ha, N1 = 200 kg/ha, N2 = 400 kg/ha, dan N3 = 600 kg/ha. This yielded 16 treatment combinations, replicated 3 times for a total of 48 experimental units. Data were analyzed using Analysis of Variance (ANOVA), followed by Tukey's Honestly Significant Difference (HSD) test at 5% where significant differences occurred.

RESULTS AND DISCUSSION

3.1.Plant Height

Table 1. Average plant height of black potato under seaweed extract and NPK fertilizer treatments.

NPK	Seaweed extract				Average (N)
	seaweed extract 0 ml/liter	seaweed extract 1 ml/liter	seaweed extract 2 ml/liter	seaweed extract 3 ml/liter	
NPK 0 kg/Ha	26.1 a	34.3 de	29.5 abcde	32 bcde	30.5
NPK 200 kg/Ha	34.1 de	26.1 a	32.3 de	26.5 abc	29.8
NPK 400 kg/Ha	29 abcde	32.8 de	27 abc	28.6 abcd	28.8
NPK 600 kg/Ha	28.8 abcde	26.5 ab	33.6 de	34.6 e	30.9
Average (L)	29.5	30.0	30.6	29.8	

Note: Numbers followed by the same letter within the same row and column show no significant difference, while numbers followed by different letters show significant differences based on the HSD test at the 5% significance level.

The results showed a significant interaction between seaweed extract and NPK fertilizer on the height growth of black potato plants. Table 1 indicates that the best treatment combination was achieved with 3 mL/L seaweed extract and 600 kg/ha NPK fertilizer, resulting in a height of 34.6 cm. This result was significantly different from the lowest treatment combination, which was 0 mL/L seaweed extract and 0 kg/ha NPK fertilizer, yielding 26.1 cm. Plant growth is strongly influenced by nutrient requirements; NPK fertilizer contains three essential nutrients required by plants in large amounts for growth and development (Minangsih et al., 2022). This fertilizer has a balanced nutrient content of 16% N, 16% P, and 16% K. Nitrogen, phosphorus, and potassium play vital

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roles in stimulating vegetative growth (stems and leaves) as well as root development (Laia et al., 2024). In addition, plant height growth can be enhanced by seaweed biostimulants. Seaweed contains plant growth regulators such as auxins, cytokinins, ethylene, abscisic acid, and gibberellins, as well as minerals including Fe, B, Ca, Cu, Cl, K, Mg, and Mn (Santari & Hatta, 2023). These micro-element contents and plant growth regulators thus act to promote plant growth. Integrating organic matter with inorganic fertilizers can enhance the growth, productivity, and nutrient use efficiency of cultivated crops (Nurhayati et al., 2024).

3.2. Number of Branches

Table 2. Average number of branches of black potato under seaweed extract and NPK fertilizer treatments.

NPK	Rumput Laut				Average (N)
	seaweed extract 0 ml/liter	seaweed extract 1 ml/liter	seaweed extract 2 ml/liter	seaweed extract 3 ml/liter	
NPK 0 kg/Ha	8.83	12.17	14.67	14.33	12.5 a
NPK 200 kg/Ha	15.83	14.17	14.17	15.67	14.9 bc
NPK 400 kg/Ha	12.67	12.83	13.67	14.50	13.4 ab
NPK 600 kg/Ha	14.17	13.50	15.00	17.83	15.1 c
Average (L)	12.8 a	13.1 a	14.3 ab	15.5 b	

Note: Numbers followed by the same letter within the same row and column show no significant difference, while numbers followed by different letters show significant differences based on the HSD test at the 5% significance level.

The results of the research analysis showed no interaction effect between seaweed extract and NPK fertilizer. However, each individual treatment exerted a significant effect on the number of branches. The best NPK fertilizer treatment was achieved at NPK 600 kg/ha with a result of 15.1, which was significantly different from the lowest treatment at NPK 0 kg/ha with a result of 12.5. The application of NPK (16-16-16) fertilizer affected plant growth, as the 16% content each of N, P, and K elements provided sufficient dosage to promote branch growth in black potato plants. These results indicate an increase in branch growth alongside higher doses of NPK fertilizer. As the plant develops a complete and well-structured root system, it becomes capable of absorbing nutrients in the form of anions and cations containing N, P, and K elements present in the fertilizer (Ramadhan et al., 2022). Consequently, fulfilling these absorbable nutrient needs continually enhances plant growth.

The best seaweed extract treatment was achieved at 3 mL/L with a result of 15.5, showing a significant difference from the 0 mL/L seaweed extract treatment. Seaweed extract possesses strong potential as a biostimulant. The bioactive compounds contained

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in seaweed extract include plant growth regulators such as auxins, gibberellins, and cytokinins (Noli et al., 2022). Increasing the application of seaweed biostimulant can stimulate hormone activity to a greater extent, thereby triggering the development of roots, stems, and leaves, which ultimately promotes overall plant growth, particularly the number of stems/branches. Seedlings with a more developed root network are more efficient at absorbing nutrients from the nutrient solution. A larger root surface area means that the plant can absorb more nutrients and water simultaneously, facilitating better overall growth, as the plant has sufficient resources to support both shoot and leaf expansion (Nurhayati et al., 2026).

CONCLUSION

Based on the results above, it can be concluded that:

1. The interaction between seaweed extract and NPK fertilizer significantly affected plant height. The best combination was achieved at 3 mL/L seaweed extract and 600 kg/ha NPK, resulting in a height of 34.6 cm.
2. Seaweed extract application significantly affected the number of branches. The best treatment was 3 mL/L seaweed extract, yielding 15.5.
3. NPK fertilizer application significantly affected the number of branches. The best treatment was 600 kg/ha NPK fertilizer, yielding 15.1 branches.

REFERENCES

- Angely, D. R., Nursabrina, A. B., Nikmah, E. S., Rachim, S. D., Marsely, B., Utami, S., & Khotimperwati, L. (2023). Keanekaragaman sumber daya genetik lokal umbi-umbian di Kecamatan Mijen, Kota Semarang, Jawa Tengah. *Jurnal Ilmu Lingkungan*, 22(1), 11–19. <https://doi.org/10.14710/jil.22.1.11-19>
- Badan Pusat Statistik. (2025). *Jumlah penduduk pertengahan tahun (ribu jiwa)*, 2025. <https://www.bps.go.id/id/statistics-table/2/MTk3NSMy/jumlah-penduduk-pertengahan-tahun--ribu-jiwa-.html>
- Gumelar, A. I. (2017). Pengaruh dosis pupuk NPK 16-16-16 Mutiara terhadap pertumbuhan dan hasil tanaman mentimun (*Cucumis sativus* L.) varietas Bandana F1. *Jurnal Agrotek*, 4(2), 2–11. <http://ejournal.unsub.ac.id/index.php/agrotek/article/view/1006/842>
- Laia, J., Harahap, R., & M. (2024). Respon pertumbuhan dan produksi bawang merah (*Allium ascalonium* L.) terhadap pupuk NPK. *Jurnal Agroplasma*, 11(2), 556–563.
- Minangsih, D. M., Yusdian, Y., & Nazar, A. (2022). Pengaruh dosis pupuk kandang ayam dan NPK (16:16:16) terhadap pertumbuhan dan hasil tanaman kentang (*Solanum tuberosum* L.) varietas Granola. *Agro Tatanen: Jurnal Ilmiah Pertanian*, 4(2), 17–26. <https://doi.org/10.55222/agrotatanen.v4i2.820>

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- Nurhayati, D. R., Taryono, T., & Hanudin, E. (2024). Integrated uses of organic and inorganic fertilisers to increase sesame productivity on coastal sand fields. *Journal of Water and Land Development*, (62), 150–156. <https://doi.org/10.24425/jwld.2024.151562>
- Nurhayati, D. R., Yusoff, S. F., Maulidal, E. I., & Zainudin, F. N. (2026). Sustainable hydroponics: Boosting red lettuce growth with photosynthetic bacteria and optimal transplanting. *Journal of Advanced Research in Applied Sciences and Engineering Technology*, (5), 150–160.
- Ramadhan, A., Nurhayati, D. R., & Bahri, S. (2022). Pengaruh pupuk NPK Mutiara (16-16-16) terhadap pertumbuhan beberapa varietas kacang hijau (*Vigna radiata* L.). *Biofarm: Jurnal Ilmiah Pertanian*, 18(1), 48. <https://doi.org/10.31941/biofarm.v18i1.1891>
- Santari, P. T., & Hatta, M. (2023). Pemberian mikoriza dan biostimulan ekstrak rumput laut terhadap pertumbuhan dan hasil jagung di Rasau Jaya, Kalimantan Barat. *Agrikultura*, 34(1), 99. <https://doi.org/10.24198/agrikultura.v34i1.43075>
- Sari, D. N., Togatorop, E. R., Handayani, S., Parwito, P., & Susilo, E. (2022). Pengaruh penggunaan mulsa terhadap pertumbuhan dan hasil kentang (*Solanum tuberosum*) di dataran tinggi. *PUCUK: Jurnal Ilmu Tanaman*, 2(2), 35–40. http://e-journal.biologi.lipi.go.id/index.php/berita_biologi/article/viewFile/505/320
- Suwirmen, Noli, Z. A., & R. (2022). Aplikasi ekstrak *Padina minor* dan *Centella asiatica* sebagai biostimulan terhadap pertumbuhan tanaman kedelai (*Glycine max* (L.) Merr.). *Bioscientist: Jurnal Ilmiah Biologi*, 9(1), 63–71. <https://e-journal.undikma.ac.id/index.php/bioscientist>
- Wibowo, G. A. Y., Triani, N., & R. M. (2025). Pengaruh konsentrasi dan lama perendaman ekstrak rumput laut terhadap perkecambahan dan pertumbuhan vegetatif benih padi. *Jurnal Agrotropika*, 24(2), 257–267.
- Widodo, T. W., Wardana, R., & Trismayanti, I. (2022). Pengaruh media tanam dan nutrisi terhadap pertumbuhan kentang hitam (*Plectranthus rotundifolius*) selama aklimatisasi. *Agriprima: Journal of Applied Agricultural Sciences*, 6(2), 163–171. <https://doi.org/10.25047/agriprima.v6i2.493>