NATIONAL ENVIRONMENTAL SCIENCE ACADEMY (NESA)

International Journal on Agricultural Sciences
http://nesa-india.org | http://journal.nesa-india.org/index/IJAS
IJAS 16(1): 47-68 **(2025)** • ISSN: 0976-450X
https://doi.org/10.53390/IJAS.2025.16106

NANO IONIC FORMULA BIOSTIMULANT FOR ACCELERATED GROWTH AND YIELD OF PECHAY

Alminda M. Fernandez[1]; Jerez B. Borlado[1]; John Paul L. Matuguinas[2]; Jojine S. Cobrado[1,3]; Jhon Paul R. Ambit[3]; Zabdiel L. Zacarias[1]; Ma. Theresa C. Ferolino[1], Honorina D. Rupecio[1]; Saikat K. Basu[4] and Peiman Zandi[5]

[1]Rizal Memorial Colleges, Inc., College of Agriculture, F. Torres St., Davao City, Philippines
[2]Department of Agriculture, Regional Field Office XI, Davao City, Philippines
[3]Jose Maria College Foundation, Inc., College of Agriculture, Sasa, Davao City, Philippines
[4]PFS, Lethbridge, Alberta, Canada
[5]Yibin University, International Faculty of Applied Technology, Yibin, Sichuan, China

Review Paper

Received: **10.03.2025** Revised: **05.05.2025** Accepted: **22.06.2025**

ABSTRACT

This study aimed to verify the efficiency of Essegro Nano Ionic Formula Biostimulant on pechay (Brassica rapa), particularly on its growth and yield performance. The study was conducted at Apokon, Tagum City, with a duration of 2 months from December 2022 to February 2023. A Randomized Complete Block Design (RCBD) was used as the experimental design which was composed of six treatments, and replicated three times. The treatments were: (T1) Control, (T2) RR of inorganic NPK fertilizer based on soil analysis, (T3) RR of inorganic NPK + 0.5 rr of Essegro Nano Ionic Formula Biostimulant, (T4) RR of inorganic NPK + rr of Essegro Nano Ionic Formula Biostimulant, (T5) RR of inorganic NPK + 1.5 rr of Essegro Nano Ionic Formula Biostimulant, and (T6) rr of Essegro Nano Ionic Formula Biostimulant. Data on growth and yield components were gathered and analyzed using Analysis of Variance (ANOVA) and differences between treatments were compared using the Honest Significant Difference (HSD) Test. Based on the results of the study, the growth and yield performance of pechay were significantly affected by Essegro Nano Ionic Formula Biostimulant in terms of root length, plant height, fresh weight, leaf length and width and pechay yield but not the number of leaves. Results showed that T2= RR of inorganic NPK fertilizer based on soil analysis got the longest root length among treatments. Hence, Essegro Nano Ionic Formula Biostimulant did not influence the root length of pechay. The (T4) RR of inorganic NPK + rr of Essegro Nano Ionic Formula Biostimulant increased the fresh weight of pechay up to two times than the (T1) control and (T6) RR of inorganic NPK + rr of Essegro Nano Ionic Formula Biostimulant. Also, (T4) RR of inorganic NPK + rr of Essegro Nano Ionic Formula Biostimulant had the widest leaf which are significantly higher by 33% than the (T1) control and (T6) RR of inorganic NPK + rr of Essegro Nano Ionic Formula Biostimulant. The leaf length of pechay in (T4) RR of inorganic NPK + rr of Essegro Nano Ionic Formula Biostimulant and (T3) RR of inorganic NPK + rr of Essegro Nano Ionic Formula Biostimulant were significantly longer than that of the control (T1) by 35%. Highest height of pechay was observed in (T3) RR of inorganic NPK + rr of Essegro Nano Ionic Formula Biostimulant yet comparable to the rest of the treatments using HSD test. The yield of pechay was increased up to three times in (T4) RR of inorganic NPK + rr of Essegro Nano Ionic Formula Biostimulant and (T5) RR of inorganic NPK + 1.5 rr of Essegro Nano Ionic Formula Biostimulant which than the control (T1). Essegro Nano Ionic Formula Biostimulant therefore increased the growth and yield performance of pechay

No. of Pages: 14 **References: 40**

Keywords: Pechay, Nano Ionic, Biostimulant, Growth, Yield, Brassica rapa.

*Corresponding author: *tondharepr@rknec.edu*

INTRODUCTION

Pechay (*Brassica napus* L.) belongs to the Brassiceae family and is one of the most known vegetables in the Philippines. It is also known as one of the oldest green vegetables in Asia. It therefore plays an important role in the Philippines economy as well as in the nutrition of the Filipino people. Pechay is used mainly for its immature, but fully expanded tender leaves (http://www.darfu4b.da.gov.ph/pechay.html). As reported by Siemonsma & Piluek (1994), the crop is considered the most consumed leafy vegetable in the Philippines and contributes a very good income provider for farmers due to its short duration harvesting. This crop can be harvested 30-45 days after planting, the seedling foundation of this crop strongly affects performance as it contributes to almost half of the duration in cropping.

From 2019 to 2021, an average increase of 0.9 percent was noted in the production of pechay. From 47.30 thousand metric tons in 2019, it went up to 47.50 thousand metric tons in 2020 and increased further to 48.12 thousand metric tons in 2021. The average production of pechay was 47.64 thousand metric tons during the period (PSA 2022). About 86.3 percent of the country's total Chinese pechay production came from the Cordillera Administrative Region. Central Visayas came next with 7.0 percent share. Northern Mindanao, Davao Region and the rest of the country had a combined share of 6.7 percent (PSA 2019). The crop is considered the most consumed leafy vegetable in the Philippines and contributes a very good income provider for farmers due to its short duration harvesting. This crop can be harvested 30-45 days after planting, the seedling foundation of this crop strongly affects performance as it contributes to almost half of the duration in cropping (Siemonsma & Piluek 1994). Hence, a considerate effort to sustain vegetable production through efficient fertilization techniques is a wise alternative.

Types and levels of fertilizer applied to crops are very important in crop production and play an important role in cropping systems. Relying on inorganic or chemical fertilizers is a major constraint due to its prohibitive cost though identified as an important factor in meeting the food requirements of a growing population (Bandera, 2020). According to Ojeniyi (2002) there are certain advantages of inorganic fertilizers which makes them a potent candidate to enhance agricultural productivity. There is no need for direct decomposition as the nutrients in mineral fertilizers are relatively high, and the release of these nutrients is quick. Inorganic fertilizers increase the growth rate and plant's overall productivity more rapidly. There is abundant evidence that inorganic fertilizers can improve crop yield significantly. Nowadays, nanotechnology has been used in many agricultural fields such as production, processing, storing, packaging and transport of agricultural products (Mousavi and Rezai 2011; Ditta 2012). Fertilizer derived from nanotechnology has started to attract attention in agriculture. Nanotechnology can have a profound impact on energy, the economy and environment, by improving fertilizer products. Nanofertilizer can be encapsulated inside nanomaterials, coated with a thin protective polymer film, or delivered as particles or emulsions of nanoscale dimensions (DeRosa et al. 2010). Roshdy and Refaai (2016), revealed that when compared to the usage of conventional fertilizer, the usage of nano-fertilizer that was put to the soil boosted the production of date palms as well as their growth.

Prior studies using various fertilizers and foliar supplements have been tested to maximize the growth and yield of various crops (Magbalot-Fernandez et al. 2024, 2020; Pauya et al. 2024; Fernandez et al. 2023, 2015; Fernandez & De Guzman 2021; Magbalot-Fernandez & De Guzman 2022, 2019; Fernandez & Agan 2021; Magbalot-Fernandez & Montifalcon 2019; Eroy 2019; Montifalcon & Fernandez 2017; Fernandez & Andigan 2017; Fernandez & Sabay 2016; Fernandez and Caballes 2016; Fernandez & Quilab-Tud 2016; Fernandez & Miñoza 2015; Fernandez & Lumbo 2015; Lopez-Fabal et al. 2014; Lo pez-Mosquera et al. 2014; Fernandez & Tipay 2013; Fernandez & De Guzman 2013).

This study is therefore conducted to verify the use of Essegro Nano Ionic Formula Biostimulant for vegetable crops such as pechay.

Objectives:

1. To determine the efficiency of Essegro Nano Ionic Formula Biostimulant on pechay growth and yield performance; and
2. To verify the best treatment combination that will increase the growth and yield performance of pechay.

METHODOLOGY

Site and Duration

To evaluate the efficiency of the Essegro Nano Ionic Formula Biostimulant application on the growth and yield performance of pechay, field experiment was conducted at the experimental area of Apokon, Tagum City for two months. The area has a flat topography with nutrient-deficient soil.

Experimental Design and Layout
The experiment was carried out in Randomized Complete Block Design (RCBD). Field experiment was composed of six treatments replicated three times. There were 128.4 pechay plants in a 12" x 12" planting distance with a plot size of 12m^2 per replication in 3x4 m for a total area of 216 m^2 with a total of 2,311 pechay plants. Each plot was provided with a 1m alleyway.

Soil Analysis
Soil analysis was done to determine the nutrient requirement of the area for pechay. Before the conduct of the experiment, soil samples were collected at random in the area following the standard procedure of the DA Regional Soil Laboratory, Davao City and analyzed for nutrient requirements. Table 1 shows the result of the soil analysis (Appendix A). Based on the soil analysis, the recommended rate of inorganic NPK fertilizer is 150-20-15 kg/ha/year.

Treatments
The recommended rate of fertilizer was applied based on the recommendation of soil analysis. Inorganic fertilizers were purchased based on the recommendation in bags/ha and the Essegro Nano Ionic Formula Biostimulant was applied based on the following treatments: T_1 = control; T_2 = RR of inorganic NPK (150-20-15 kg/ha/year) fertilizer based on soil analysis; T_3 = RR of inorganic NPK (150-20-15 kg/ha/year) + 0.5 rr of Essegro Nano Ionic Formula Biostimulant; T_4 = RR of inorganic NPK (150-20-15 kg/ha/year) + rr of Essegro Nano Ionic Formula Biostimulant; T_5 = RR of inorganic NPK (150-20-15 kg/ha/year) + 1.5 rr of Essegro Nano Ionic Formula Biostimulant; T_6 = rr of Essegro Nano Ionic Formula Biostimulant. The recommended rate of Essegro Nano Ionic Formula Biostimulant WAS applied as foliar spray from sowing and transplanting up to one week before harvest. One tablespoon of Essegro Nano Ionic Formula Biostimulant was dissolved in 20 liters of water and sprayed on pechay based on various treatments.

Cultural Management
Sowing. Pechay can be planted directly or indirectly in the soil. Direct seeding was accomplished through broadcasting or row sowing. Seeds were sown in a prepared seed box with ordinary garden soil. Land preparation. Plowing and harrowing the soil thoroughly makes it more friable and more porous suited for good quality produce. Raised beds 1 meter wide with paths of about 20-25 cm width between the beds are a common practice. The field was plowed and harrowed once using animal-drawn implement.

Transplanting and Thinning
Two to three seedlings were transplanted per hill, one-two weeks after planting from the seed box. One seedling per hill was maintained one week after transplanting. Weeding. Hoeing of the weeds may be necessary at an early stage of weeds growth before the plants shade the spaces in between plants. Manual weeding was done weekly whenever necessary. Watering. To obtain maximum growth and tenderness it must be supplied with adequate moisture. The plants was watered daily whenever necessary using a sprinkler. Pesticide application. Insecticide and fungicide were applied whenever necessary at recommended dosage and interval. Rotation use of pesticides was done to avoid the development of resistance to pests.

Fertilizer Application. The different fertilizer treatments were applied based on soil analysis NPK (150-20-15 kg/ha/year) and manufacturer's recommendation. Basal application of inorganic fertilizers was done one week before planting and side dress application was done two weeks after planting based on the soil analysis. Ten grams each of Ammosul, ammophos, 20g urea and 2.5g MOP were applied basally per quarter per plot per application. This is computed based on the 12 sqm area per plot from the soil analysis NPK (150-20-15 kg/ha/year) recommendation as shown in Appendix A. The 1/3 of the recommended nitrogen fertilizer with the potash and phosphate dressing were applied at 8-14 days before planting. Topdress application with the remaining fertilizer was done 2-5 weeks after planting. The recommended rate of Essegro Nano Ionic Formula Biostimulant was applied as foliar spray from sowing and transplanting up to one week before harvest. One tablespoon of Essegro Nano Ionic Formula Biostimulant was dissolved in 20 liters of water and sprayed on pechay based on various treatments. Approximately 1 liter of foliar spray was applied per plot and increased to 1 liter every week until harvest.

Harvesting
Pechay (pak-choi cultivar) was harvested at maturity, 21 days after transplanting. The pechay was already matured at three weeks after transplanting the 1-2 weeks old seedlings from the seedbed. So it took 35-40 days for pechay from planting to harvesting. Land preparation took 2-3 weeks which covers two months for pechay production from clearing, land preparation upto harvesting. This was based on Davao Area region climatic conditions and years of experience in pechay production and research. Pechay production guide publications may differ in conditions per region. Harvesting of pechay was done manually using cutting scissors. Dried leaves and damaged parts were trimmed off and washed in cleaning running water. Freshly harvested leaves were weighed and recorded.

DATA GATHERED

All marketable plant parts per 3x4 m plot excluding border plants were weighed using a digital weighing scale and converted to tons/ha using the formula:

$$\text{Yield (tons/ha)} = \frac{\text{plot yield (kg)}}{\text{area (sq.m.)}} \times \frac{10{,}000}{1{,}000}$$

The following growth parameters were taken at harvest. Plant heights of ten pechay sample plants per replication were measured from the base up to the tip of the plants using a ruler. The number of leaves were counted each from the ten sample plants per replication. The longest leaf lengths and widest leaf widths of the ten sample plants per replication were measured using a ruler. The root length of the ten sample plants per replication were measured using a ruler. The average fresh weight of the ten sample plants per replication were measured using a digital weighing scale. The incidence of pests and diseases as well as beneficial organisms were also monitored during the conduct of the study. No serious infestations were observed during the conduct of the study. Data were analyzed using Analysis of Variance (ANOVA) and differences between treatments were compared using the Honest Significant Difference (HSD) Test.

RESULTS AND DISCUSSION

Root Length (cm)

There was a significant difference on the root length of pechay as shown in Table 1 at 30 days after transplanting (DAT). Results showed that T_2= RR of inorganic NPK fertilizer based on soil analysis got the longest root length among treatments. This implies that supplementation of Essegro Nano Ionic Formula Biostimulant did not influence the root length of pechay.

Table 1 : Root length (cm) of pechay as influenced by Essegro Nano Ionic Formula Biostimulant at 30 days after transplanting (DAT).

	REPLICATION			
TREATMENT	**I**	**II**	**III**	**MEAN****
T1 – CONTROL	7.90	10.90	9.40	9.40 b
T2 – RR OF INORGANIC NPK.	14.30	12.80	15.80	14.30 a
T3 – RR OF INORGANIC NPK+ 0.5. RR OF Essegro Nano Ionic Formula Biostimulant	10.40	11.80	11.10	11.10 b
T4 – RR OF INORGANIC NPK+ RR OF Essegro Nano Ionic Formula Biostimulant	9.80	9.80	9.80	9.80 b
T5 – RR OF INORGANIC NPK + 1.5. RR OF Essegro Nano Ionic Formula Biostimulant	11.90	10.40	11.40	11.23 b
T6 – RR OF Essegro Nano Ionic Formula Biostimulant	11.25	10.40	12.10	11.25 b

C.V (%) = 9.37 %

** = significant at 1% level

Means with the same letter are not significantly different at 5% level of probability using HSD.

Number of Leaves

The number of leaves of pechay was also not significantly affected by Essegro Nano Ionic Formula Biostimulant at 30 days after transplanting (DAT) as shown in Table 2. This indicates that the number of leaves of pechay in all treatments were significantly comparable which ranged from 7-11 leaves.

Table 2: Number of leaves of pechay as influenced by Essegro Nano Ionic Formula Biostimulant at 30 days after transplanting (DAT).

	REPLICATION			
TREATMENT	**I**	**II**	**III**	**MEAN****
T1 – CONTROL	10.9	10.2	10.5	7.20
T2 – RR OF INORGANIC NPK	11.3	11.3	13.1	11.90
T3 – RR OF INORGANIC NPK+ 0.5 RR OF Essegro Nano Ionic Formula Biostimulant	10.8	10.8	11.1	10.90
T4 – RR OF INORGANIC NPK+ RR OF Essegro Nano Ionic Formula Biostimulant	11.7	11.7	10.9	11.43
T5 – RR OF INORGANIC NPK + 1.5 RR OF Essegro Nano Ionic Formula Biostimulant	11.0	10.3	12.3	11.20
T6 – RR OF Essegro Nano Ionic Formula Biostimulant	9.8	9.5	12.0	10.43

C.V (%) = 21.40 %
ns=not significant

Average Fresh Weight (g) of ten sample plants

The Essegro Nano Ionic Formula Biostimulant significantly affected the average fresh weight of ten sample pechay at 30 days after transplanting (DAT) as shown in Table 3. The average fresh weight of ten sample plants per replication were weighed using a digital weighing scale. The (T4) RR of inorganic NPK + rr of Essegro Nano Ionic Formula Biostimulant had the heaviest weight which are significantly higher than the (T1) control and (T6) RR of inorganic NPK + rr of Essegro Nano Ionic Formula Biostimulant. This indicates that the fresh weight of pechay was increased two times by the application of (T4) RR of inorganic NPK + rr of Essegro Nano Ionic Formula Biostimulant.

Table 3: Average Fresh weight (g) of ten sample pechay as influenced by Essegro Nano Ionic Formula Biostimulant at 30 days after transplanting (DAT).

	REPLICATION			
TREATMENT	**I**	**II**	**III**	**MEAN****
T1 – CONTROL	51.0	69.0	60.0	60.00 c
T2 – RR OF INORGANIC NPK.	112.0	112.0	189.0	137.66 ab
T3 – RR OF INORGANIC NPK+ 0.5. RR OF Essegro Nano Ionic Formula Biostimulant	104.0	143.0	123.5	123.50 ab
T4 – RR OF INORGANIC NPK+ RR OF Essegro Nano Ionic Formula Biostimulant	160.0	160.0	155.0	158.33 a
T5 – RR OF INORGANIC NPK + 1.5. RR OF Essegro Nano Ionic Formula Biostimulant	107.0	116.0	131.0	118.00 abc
T6 – RR OF Essegro Nano Ionic Formula Biostimulant	77.5	51.0	104.0	77.50 bc

C.V (%) = 18.95 %
**=significant at 1% level
Means with the same letter are not significantly different at 5% level of probability using HSD.

Leaf Width

Table 4 shows that the leaf width of pechay was significantly affected by Essegro Nano Ionic Formula Biostimulant at 30 days after transplanting (DAT). (T4) RR of inorganic NPK + rr of Essegro Nano Ionic Formula Biostimulant had the widest leaf which are significantly higher than the (T1) control and (T6) RR of inorganic NPK + rr of Essegro Nano Ionic Formula Biostimulant. This verified that the leaf width of pechay was increased by 33% in (T4) RR of inorganic NPK + rr of Essegro Nano Ionic Formula Biostimulant.

Table 4: Leaf Width (cm) of pechay as influenced by Essegro Nano Ionic Formula Biostimulant at 30 days after transplanting (DAT).

	REPLICATION			
TREATMENT	**I**	**II**	**III**	**MEAN****
T1 – CONTROL	12.50	12.00	12.25	12.25 c
T2 – RR OF INORGANIC NPK BASED ON SOIL ANALYSIS	15.80	14.70	16.90	15.80 ab
T3 – RR OF INORGANIC NPK+ 0.5. RR OF Essegro Nano Ionic Formula Biostimulant	13.80	15.50	14.65	14.65 ab
T4 – RR OF INORGANIC NPK+ RR OF Essegro Nano Ionic Formula Biostimulant	16.20	16.20	15.90	16.10 a
T5 – RR OF INORGANIC NPK + 1.5. RR OF Essegro Nano Ionic Formula Biostimulant	15.10	14.50	14.50	14.70 ab
T6 – RR OF Essegro Nano Ionic Formula Biostimulant	13.65	12.40	14.90	13.65 bc

C.V (%) = 5.43 %

**=significant at 1% level

Means with the same letter are not significantly different at 1% level of probability using HSD.

Leaf Length

The leaf length of pechay was also significantly affected by Essegro Nano Ionic Formula Biostimulant at 30 days after transplanting (DAT) as indicated in Table 5. The leaf length of pechay in (T4) RR of inorganic NPK + rr of Essegro Nano Ionic Formula Biostimulant and (T3) RR of inorganic NPK + rr of Essegro Nano Ionic Formula Biostimulant were significantly longer than that of the control (T1). This means that the (T4) RR of inorganic NPK + rr of Essegro Nano Ionic Formula Biostimulant and (T3) RR of inorganic NPK + rr of Essegro Nano Ionic Formula Biostimulant enhanced the leaf length of pechay by 35%.

Plant Height

The pechay height was further significantly affected by Essegro Nano Ionic Formula Biostimulant at 30 days after transplanting (DAT) (Table 6). Highest height of pechay was observed in (T3) RR of inorganic NPK + rr of Essegro Nano Ionic Formula Biostimulant. However, its was just comparable to the rest of the treatments using the HSD test. Hence, the height of pechay was not increased by supplementation of Essegro Nano Ionic Formula Biostimulant.

Table 5: Leaf Length (cm) of pechay as influenced by Essegro Nano Ionic Formula Biostimulant at 30 days after transplanting (DAT).

	REPLICATION			
TREATMENT	**I**	**II**	**III**	**MEAN****
T1 – CONTROL	12.5	15.5	14.0	14.00 b
T2 – RR OF INORGANIC NPK.	18.0	17.0	19.0	18.00 ab
T3 – RR OF INORGANIC NPK+ 0.5. RR OF Essegro Nano Ionic Formula Biostimulant	18.2	20.2	19.2	19.20 a
T4 – RR OF INORGANIC NPK+. RR OF Essegro Nano Ionic Formula Biostimulant	19.5	19.5	19.5	19.50 a
T5 – RR OF INORGANIC NPK + 1.5. RR OF Essegro Nano Ionic Formula Biostimulant	20.6	17.4	16.7	18.23 ab
T6 – RR OF Essegro Nano Ionic Formula Biostimulant	16.9	14.3	19.5	16.90 ab

C.V (%) = 9.71 %
*=significant at 5% level
Means with the same letter are not significantly different at 1% level of probability using HSD.

Table 6: Plant Height (cm) of pechay as influenced by Essegro Nano Ionic Formula Biostimulant at 30 days after transplanting (DAT).

	REPLICATION			
TREATMENT	**I**	**II**	**III**	**MEAN****
T1 – CONTROL	24.1	24.5	24.3	24.30 a
T2 – RR OF INORGANIC NPK	24.2	24.2	28.4	25.60 a
T3 – RR OF INORGANIC NPK+ 0.5 RR OF Essegro Nano Ionic Formula Biostimulant	27.0	29.2	28.1	28.10 a
T4 – RR OF INORGANIC NPK+ RR OF Essegro Nano Ionic Formula Biostimulant	26.6	25.1	24.3	25.33 a
T5 – RR OF INORGANIC NPK + 1.5. RR OF Essegro Nano Ionic Formula Biostimulant	28.6	26.6	27.7	27.63 a
T6 – RR OF Essegro Nano Ionic Formula Biostimulant	22.4	21.7	26.8	23.63 a

C.V (%) = 6.47 %
*= significant
Means with the same letter are not significantly different at 1% level of probability using HSD.

Yield (tons/ha)

The effect of Essegro Nano Ionic Formula Biostimulant on the yield of pechay per plot was highly significant (Table 7, Figures 1,2). The yield was based on the total harvested marketable pechay per plot excluding borders in a 3x4 m plot and converted to tons/ha. The highest yield of pechay was obtained in (T4) RR of inorganic NPK + rr of Essegro Nano Ionic Formula Biostimulant and (T5) RR of inorganic NPK + 1.5 rr of Essegro Nano Ionic Formula Biostimulant. These were significantly higher than the control (T1). This implies that the Essegro Nano Ionic Formula Biostimulant and RR inorganic fertilizer will increase the yield of pechay up to three times.

The previous study indicated that T3 – (RR of inorganic NPK + 0.5 rr of Essegro Nano Ionic Formula Biostimulant) significantly increased pechay yield by 100 % more compared to the control or no application (Fernandez et al. 2023).

This also supports previous study which increased yield in pechay using FOLF (Eroy 2019). The yield was significantly improved by the mere application of Full On Liquid Fertilizer at its recommended dose (T5) resulting to 86.11% additional yield. However, this yield level was further increased when 50% (T4) or full dose of the reference fertilizer (T6) was added. The recommended rate (rr) of NPK with and without 1.5 rr foliar fertilizer gave the best result on growth and yield of pechay. It increased plant height and length of leaves as much as 45%, width of leaves by 40%, leaf number by 20%, fresh weight up to two times and yield by three times higher (Fernandez & Miñoza 2015). Stimulate hormones increased plant height of pechay by 37%, length of leaves by 44%, width of leaves by 39%, fresh weight by 2 times, yield by 3 times, and number of leaves (Andigan & Fernandez 2017).

The application of RR of inorganic NPK + rr of DR. BO'S FARM ESSENTIALS got the heaviest weight as much as two times, the widest leaf by 100%, the highest height by 53%, and the highest yield of pechay up to three times than the control (Magbalot-Fernandez et al. 2024). Further studies verified that soil supplements with RR inorganic fertilizer increased the growth and yield of pechay (Magbalot-Fernandez et al. 2024; Fernandez et al. 2023; Fernandez & Agan 2021; Eroy 2019). Roshdy and Refaai (2016), revealed that when compared to the usage of conventional fertilizer, the usage of nano-fertilizer that was put to the soil boosted the production of date palms as well as their growth. The effect of nano-fertilizers on the growth of fruit as well as the developmental and phytochemical processes in the date palm fruit was significant.

Table 7: Yield (ton/ha) of pechay as influenced by Essegro Nano Ionic Formula Biostimulant at 30 days after transplanting (DAT).

	REPLICATION			
TREATMENT	**I**	**II**	**III**	**MEAN****
T1 – CONTROL	0.510	0.640	0.600	0.58 b
T2 – RR OF INORGANIC NPK	1.195	1.120	1.270	1.19 ab
T3 – RR OF INORGANIC NPK+ 0.5 RR OF Essegro Nano Ionic Formula Biostimulant	0 .990	1.235	1.115	1.11 ab
T4 – RR OF INORGANIC NPK+ RR OF Essegro Nano Ionic Formula Biostimulant	1.580	2.210	1.895	1.89 a
T5 – RR OF INORGANIC NPK + 1.5 RR OF Essegro Nano Ionic Formula Biostimulant	2.610	1.450	2.080	2.04 a
T6 – RR OF Essegro Nano Ionic Formula Biostimulant	1.030	.510	1.550	1.03 ab

C.V (%) = 27.64 %
**=significant at 1% level
Means with the same letter are not significantly different at 1% level of probability using HSD.

SUMMARY, CONCLUSION AND RECOMMENDATION

The study was conducted at Apokon, Tagum City, with a duration of 2 months which started from December 2022 to February 2023. The objectives of the study were the following: To determine the efficiency of Essegro Nano Ionic Formula Biostimulant on pechay growth and yield performance; and verify the best treatment combination that will increase the growth and yield performance of pechay.

A Randomized Complete Block Design (RCBD) was used as the experimental design which was composed of six treatments, and replicated three times. The treatments were: (T1) Control, (T2) RR of inorganic NPK fertilizer based on soil analysis, (T3) RR of inorganic NPK + 0.5 rr of Essegro Nano Ionic Formula Biostimulant, (T4) RR of inorganic NPK + rr of Essegro Nano Ionic Formula Biostimulant, (T5) RR of inorganic NPK + 1.5 rr of Essegro Nano Ionic Formula Biostimulant, and (T6) rr of Essegro Nano Ionic

Formula Biostimulant. Data on growth and yield components were gathered and analyzed using Analysis of Variance (ANOVA) and differences between treatments were compared using the Honest Significant Difference (HSD) Test. Based on the results of the study, the growth and yield performance of pechay were significantly affected by Essegro Nano Ionic Formula Biostimulant in terms of root length, plant height, fresh weight, leaf length and width and pechay yield. However, the number of leaves did not have significant differences among treatments.

Results showed that T_2= RR of inorganic NPK fertilizer based on soil analysis got the longest root length among treatments. This implies that supplementation of essegro plant biostimulant did not influence the root length of pechay. The (T4) RR of inorganic NPK + rr of Essegro Nano Ionic Formula Biostimulant increased the fresh weight of pechay up to two times which are significantly higher than the (T1) control and (T6) RR of inorganic NPK + rr of Essegro Nano Ionic Formula Biostimulant. Also, (T4) RR of inorganic NPK + rr of Essegro Nano Ionic Formula Biostimulant had the widest leaf which are significantly higher by 33% than the (T1) control and (T6) RR of inorganic NPK + rr of Essegro Nano Ionic Formula Biostimulant. The leaf length of pechay in (T4) RR of inorganic NPK + rr of Essegro Nano Ionic Formula Biostimulant and (T3) RR of inorganic NPK + rr of Essegro Nano Ionic Formula Biostimulant were significantly longer than that of the control (T1) by 35%. Highest height of pechay was observed in (T3) RR of inorganic NPK + rr of Essegro Nano Ionic Formula Biostimulant. However, it was just comparable to the rest of the treatments using the HSD test.

The yield of pechay was increased up to three times in (T4) RR of inorganic NPK + rr of Essegro Nano Ionic Formula Biostimulant and (T_5) RR of inorganic NPK + 1.5 rr of Essegro Nano Ionic Formula Biostimulant which were significantly higher than the control (T1). Essegro Nano Ionic Formula Biostimulant therefore increased the growth and yield performance of pechay (Brassica rapa). The author therefore, recommends the use of RR of inorganic NPK + 1.0-1.5 rr of Essegro Nano Ionic Formula Biostimulant to boost pechay production and to enhance the yield performance of pechay (*Brassica rapa*).

APPENDIX A. Soil Analysis

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Republic of the Philippines
DEPARTMENT OF AGRICULTURE
REGIONAL SOILS LABORATORY
F. Bangoy St., Agdao, Davao City
Tel. No. 227-2925
DA TIN No. 840-000-845-095

SOIL TEST REPORT

Name : **ALMINDA M. FERNANDEZ** Submitted by: **A. FERNANDEZ** Ref. No. : **20-12-0833**
Site of Farm *(Sitio/Brgy/Municipality/Province)* : **APOKON, TAGUM CITY, DAVAO DEL NORTE**
Area Represented *(has.)* : **180 SQ. M.** Topography *(plain/sloping/hilly)*
Water Supply *(Irrigated/Rainfed)* : **RAINFED** Past Fertilizer Applied :
Previous Crops : Date Collected: **DEC. 27, 2020**
Previous Yield *(Cavans/ha.)* : Date Submitted: **DEC. 29, 2020**
Soil Type : **SANDY CLAY LOAM** Date Finished : **JAN. 15, 2021**
Crops to be fertilized : **PECHAY** Contact No. **0926 - 873 0753**

Lab. No.	Field Name	Texture	RESULT OF ANALYSIS: pH (Soil Reaction) 1:1	OM (Wilde's) %	P (Olsen) ppm	K (H2SO4 Ext'n) ppm	CROP VARIETY/ AGE	NUTRIENT REQUIREMENT: N	P_2O_5	K_2O (kgs./tree/yr.)	LIME REQT T/ha.	pH preference
20-2005		MEDIUM	7.2	1.0	25	465	Pechay	150	20	15	-	6.0 - 6.5
			NN	*L*	*M*	*A*						

Fertilizer Recommendation :

Options	Compost/ Organic Fert.	Ammophos (16-20-0)	Ammosul (21-0-0-24)	Mu. Of Potash (0-0-60)	Urea (46-0-0)	Solophos (0-18-0)
	(bags per hectare per season; kilograms per hectare per season)					
Option 1 - 1st app.	20 bags	1 - 2 bags	1.75 - 3.25 bags	13 - 25 kgs	-	-
2nd application	-	-	-	-	2.25 - 4.25 bags	-
Option 2 - 1st app.	20 bags	-	2.5 - 4.75 bags	13 - 25 kgs	-	1.25 - 2.25 bags
2nd application	-	-	-	-	2.25 - 4.25 bags	-

Legend: NN- near neutral L - low M - medium A - adequate

Note: If Compost/Organic Fertilizer is available, apply the minimum amount of the recommended inorganic fertilizer.
Measurement of uncertainty is available upon request of customer.
Reproduction of this report unless otherwise authorized by RSL is punishable by law. Any erasures thereon will invalidate the result.
Result of analysis as per sample submitted by the customer. Samples will be kept only for a month from the date received.
Samples from the same lot, may produce different result.

Placement of Fertilizer:
PECHAY Sensitive to heavy applications of nitrogen. Apply 1/3 of the recommended nitrogen fertilizer with the potash and phosphate dressing 8-14 days before planting.
Topdress with the remaining fertilizer 2-5 weeks after planting.

Analyzed & Certified by:
ADRIENNE MAE B. ZABATE
Registered Chemist
PRC Registration No. 13241

Approved by:
ENGR. ROSALINA B. SALVE
OIC, Regional Soils Laboratory
PRC Registration No. 17642

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Appendix Figures

Figure 1: Effect of Essegro Nano Ionic Formula Biostimulant on pechay growth. (T1) Control, (T2) RR of inorganic NPK fertilizer based on soil analysis, (T3) RR of inorganic NPK + 0.5 rr of Essegro Nano Ionic Formula Biostimulant, (T4) RR of inorganic NPK + rr of Essegro Nano Ionic Formula Biostimulant, (T5) RR of inorganic NPK + 1.5 rr of Essegro Nano Ionic Formula Biostimulant, and (T6) rr of Essegro Nano Ionic Formula Biostimulant.

Figure 2: Harvested pechay at 28 days after transplanting. (T1) Control, (T2) RR of inorganic NPK fertilizer based on soil analysis, (T3) RR of inorganic NPK + 0.5 rr of Essegro Nano Ionic Formula Biostimulant, (T4) RR of inorganic NPK + rr of Essegro Nano Ionic Formula Biostimulant, (T5) RR of inorganic NPK + 1.5 rr of Essegro Nano Ionic Formula Biostimulant, and (T6) rr of Essegro Nano Ionic Formula Biostimulant.

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