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# Application of Various Organic Materials and Urea on Soybean Growth and Production in Nickel Contaminated Soil

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**Abstract**

The research was conducted at the Experimental Garden of Hasanuddin University (UNHAS) located in Baraya, Makassar, South Sulawesi from March to June 2022. This research was in the form of experiments conducted in soybean plant pots. The media used was soil obtained from post-nickel mining in Sorowako, East Luwu Regency, South Sulawesi. Research in the field is arranged according to a Randomized Block Design (RAK) with 3 replications. The treatment design used a 2-factor factorial design. The first factor is the type of Organic Material or Compost (K) consisting of 4 levels, namely; K0 (without organic matter), K1 (Kirinyuh compost), K2 (gamal compost) and K3 (rice husk compost) and the second factor is Urea (U) fertilization treatment consisting of 4 levels, namely; U0 (without Urea fertilizer), U1 (100 kg $ha^{-1}$ Urea), U2 (200 kg $ha^{-1}$ Urea), U3 (300 kg $ha^{-1}$ Urea). The number of pots used was 4 units per treatment so there were 192 units of observation. The two factors tested resulted in 16 treatment combinations. The results showed that gamal compost (*Gliricidia sepium*) gave the best effect in increasing plant height, number of soybean leaves and weight of 100 soybean seeds. The results showed that urea dose of 100 kg $ha^{-1}$ gave the best effect in increasing plant height and number of soybean leaves. The results showed that there was no interaction between the administration of the type of organic matter and the dose of urea

**Keywords:** nickel contaminated soil, organic material, soybean, urea

## A. Introduction

Nickel mining activities have a significant impact on increasing the amount of heavy metals in the environment which affect the quality of land, air and water. Nickel source rock containing nickel according to international trade standards is found at a depth of 20 – 40 meters below the ground surface. The ground cover and vegetation must be excavated to reach rocks containing 3-5% nickel. The former excavation layer is piled up in the area around the mining area and will be backfilled after the mining activities are completed (Sriwahyuni, 2012).

According to Desi Nadalia (2009); that the impact of the stripping method and nickel cover rock (open pitmining) causes changes in the physical, chemical and biological properties of the soil. These changes are in the form of loss of nutrients and soil organic matter content, soil compaction, pollution, changing the composition of the soil layer, erosion and sedimentation and a decrease in the population of soil microorganisms. The loss of top soil results in plants not being able to grow normally so the soil is not productive.

To overcome these problems, it is necessary to develop a post-mining land reclamation technology, especially for agricultural purposes, namely, by providing organic matter and urea fertilizer. The use of organic matter in the soil surface layer, which was carried out by Renault, C. K., Buffa, L. M., and Delfino, M.A., (2004) showed that organic matter as a soil enhancer in post-mining land can improve plant growth, stimulate plant root growth, and increase the fresh weight of several types of plants.

In addition to organic matter, the application of urea ($CO(NH_2)_2$) fertilizer is also needed to increase plant biomass and reduce the negative impact of Ni (nickel). Because Ni plays a role in the formation of available N ($NO_3^-$ and $NH_4^+$) in legumes (Eskew, D.I., Welch, R.M. dan Norvell, W.A., 1984), by applying urea to the soil, nitrogen will be more available to plants to reduce the involvement of Ni in the urease structure (Dixon, N. E., Gazzola, C., Blakeley, R. L. and Zerner, B. 1975) which is absorbed by plants which can cause plants to contain heavy metals.

The main problem that occurs is that the concentration of Ni is very high in the soil, which is not suitable for growing food crops (Duarte, B., M. Delgado, I. Ca_ador., 2007). The effects of excessive Ni poisoning on plants have been widely reported, such as growth inhibition (Molas, 2002), decreased production and fruit quality (Gajewska, E., M. Sklodowska, M. Slaba, J. Mazur, 2006). Nickel can be toxic to plants if the content is more than 1 ppm (Marschner, 2002), but some plants can still grow normally in the range of 1-10 ppm (Reeves and Baker, 2000).

On the other hand, the need for food commodities such as soybeans in Indonesia every year always increases in line with population growth and improvement in per capita income. Domestic production is not able to keep pace with national needs, for example soybean production in 2011 amounted to 851,290 tons of dry beans or decreased by 55,740 tons (6.15%) compared to 2010. Imports of soybeans in the same year reached 2.08 million tons with a value of US$1.24 billion. This import is carried out to meet the national soybean needs every year around 2.3 - 2.4 million tons (BPS, 2012). The decline in soybean production was due to an estimated decrease in harvested area of 55.560 ha (0.58%).

Soybean cultivation area is also expanded and productivity needs to be increased. Efforts to increase soybean production are limited by limited land ownership because some of the productive paddy fields have been converted into non-agricultural land. Behind the limited land resources for the expansion of agricultural areas, there is land that is quite potential to be utilized, namely land after nickel mining. Post-mining or post-mining land generally becomes marginalized and not used even though there is a reclamation area in the post-mining land rehabilitation process which is intended for revegetation and reforestation processes (Sariwahyuni, 2012).

The hypotheses of the research conducted are:

1. Organic matter from the gamal plant (*Gliricidia sepium*) can optimize the growth and production of soybean plants on nickel-contaminated media.
2. Urea dose of 100 kg ha-1 can optimize growth and production of soybean plants on nickel-contaminated media.
3. There is an interaction between the type of organic matter and the dose of urea that is given to optimize the growth and production of soybean plants on nickel contaminated media.

The objectives to be achieved from this research are:

1. Determine the type of organic matter that provides optimum growth and production of soybean plants on nickel-contaminated media.
2. Determine the dose of urea that provides optimum growth and production of nickel-contaminated media soybeans.
3. Knowing the interaction between the type of organic matter and the dose of urea that provides optimum growth and production of soybean plants on nickel-contaminated media.

Usefulness of this research; is expected to be a solution in overcoming heavy metal nickel pollution and at the same time to develop soybean plants in post-nickel mining areas, as well as recommendations from the government and nickel mining companies in South and Southeast Sulawesi in optimizing post-mining land.

## B. Methology

### *1. Place and Time of Research*

The research was conducted at the Experimental Garden of Hasanuddin University (UNHAS) located in Baraya, Makassar, South Sulawesi from March to June 2022.

### *2. Materials and Tools*

The materials used include; Soybean seeds of Tanggamus variety, organic matter/compost (kirinyuh, gamal and rice husks), urea fertilizer, SP – 36, KCl, EM4, Rhizobium, post-nickel mining soil and labels. While the tools used in this study were pots, projection paper, ruler, envelope, sieve (2 mm), oven, scales, planting tools and watering can.

### *3. Research Design*

This research is in the form of an experiment conducted in a pot. The media used was soil obtained from post-nickel mining in Sorowako, East Luwu Regency, South Sulawesi. Research in the field is arranged according to a Randomized Block Design (RAK) with 3 replications. The treatment design used a 2-factor factorial design.

The first factor is the type of Organic Material or Compost (K) consisting of 4 levels, namely; K0 (without organic matter), K1 (Kirinyuh compost), K2 (gamal compost) and K3 (rice husk compost) and the second factor is Urea (U) fertilization treatment consisting of 4 levels, namely; U0 (without Urea fertilizer), U1 (100 kg ha$^{-1}$ Urea), U2 (200 kg ha$^{-1}$Urea), U3 (300 kg ha$^{-1}$ Urea). The number of pots used was 4 units per treatment so there were 192 observation units. The two factors tested resulted in 16 treatment combinations (Table 1).

**Table 1. Combinations of various types of organic matter and tested doses of urea fertilizer**

| Urea Fertilizer Dosage (U) | Types of Organic Ingredients (K) 20.000 kg ha$^{-1}$ | | | |
|---|---|---|---|---|
| | No Organic Ingredients (K0) | Kirinyuh (K1) | Gamal (K2) | Rice Husk (K3) |
| 0 kg ha$^{-1}$ (U0) | K0U0 | K1U0 | K2U0 | K3U0 |
| 100 kg ha$^{-1}$ (U1) | K0U1 | K1U1 | K2U1 | K3U1 |
| 200 kg ha$^{-1}$ (U2) | K0U2 | K1U2 | K2U2 | K3U2 |
| 300 kg ha$^{-1}$ (U3) | K0U3 | K1U3 | K2U3 | K3U3 |

### *4. Procedure*

Soil extraction is carried out at the post-mining location by determining the location of the land extraction using the Global Position System (GPS). Soil was taken at a depth of tillage layer between 0 – 20 cm from the soil surface at several different points at random which were considered to represent the pattern of distribution of composite soil sampling points. Soil media obtained was dried and sieved (2 mm). Then the soil was filled into plastic pots as much as 10 kg pot$^{-1}$ and mixed with compost according to treatment with a dose of each treatment, namely 100 gr pot$^{-1}$.

Soybean seeds of Tanggamus variety were mixed with Rhizobium (±20 g kg$^{-1}$) before planting and planted directly in pots as many as 3 seeds per pot. A week after planting, thinning is done and 1 plant is left. At the same time, SP-36 and KCl fertilizers were given at the same time at a dose of 100 kg ha$^{-1}$ or 0.6 g pot$^{-1}$, respectively. Half the dose of urea was given when the soybean plants were 2 weeks old. Soybeans (early generative phase) were harvested after 12.

### *5. Data Analysis*

Analysis of data measured non-destructively which is carried out every week, namely:

1. Plant height was measured from the base of the stem growing on the soil surface to the highest point of the plant.
2. Calculation of the number of leaves, which is counting all the leaves that show a slightly dark green color, because it is suspected that they are already actively carrying out photosynthesis which supports plant growth.

Variables that are measured destructively at harvest are:

1. Measurement of dry weight (BK), put into a paper bag (silkbag) and oven at a temperature of 75 - 105$^{o}$C for 3-4 days. Dry weight or biomass obtained by weighing each plant part that has reached stable dryness.
2. Seed weight per plant, weighing all the seeds produced in each plant.

3. The weight of 100 seeds, weighing the 100 seeds formed by each plant are needed.
4. Soybean crop production per hectare (ton $ha^{-1}$), obtained from the conversion of seed weight per plant. Calculated by the formula:
   Production per Ha = (Total Population x Seed Weight Per Plant (Kg))/1000
5. Determination of nickel content is carried out by separating the roots and shoots of plants (stems and leaves) to determine the ability of plants to accumulate nickel metal. Preparation for Ni analysis of plant samples was about 100 g of each plant sample washed with 3% HCl, rinsed with distilled water 2-3 times and oven for 6 hours at 105°C. The dry sample was crushed and weighed 100 mg and then dissolved in a mixture of 2 ml of concentrated HNO3 (65%). This solution was heated in an oven at 200°C for 14 hours, until all samples were completely dissolved. The extract (heating) was added with distilled water and put into a volumetric flask until it reached 50 ml. The nickel concentration of the sample solution was measured using Inductively – Coupled Plasma, Optical Emission Spectroscopy ICP-OES (Perkin Elmer Optima 2000 DV).
6. Analysis of soil Ni content by using a dry soil sample that has been pulverized as much as 0.5 grams dissolved in 10 ml of aquaregia (HCl and Nitric Acid 3: 1) in a beaker and heated to dry. The sample was given 5 ml of nitric acid and distilled water and then heated again until dissolved. After the cold solution was added aquades back up to 50 ml. The sample was centrifuged for 10 minutes at a speed of 3000 – 4000 rpm, the supernatant was taken and the heavy metal content was measured using ICP – OES Spectroscopy.
7. Soil analysis was carried out twice, namely before planting and after harvesting. Soil was taken compositely at 3 (three) points at a depth of 0 – 20 cm around the plant roots and air-dried. Soil analysis included: soil structure, bulk density, C – organic (Walkley & Black), N (Kjeldahl), P (Olsen), K, CEC (1 N $NH_4OAc$ pH 7.0).
8. Chemical analysis of organic matter before planting was carried out in the same way as soil analysis (N, P, K and C-organic).

The data from the observation of the estimator parameters was analyzed for variance (Anova) at the 5% level to determine the effect of treatment. If there is a significant (significant) effect on the treatment, a different test is carried out using BNJ at a level of 5% (Sastrosupadi, 2000).

## C. Findings and Discussion

### *1. Plant Height (cm) Soybean*

The results showed that the application of various types of organic compost and urea on nickel contaminated soil and the interaction between the two had no significant effect on plant height at the age of 14 DAP, 28 DAP, 42 DAP, 56 DAP and 70 DAP.

Figure 1 shows that the application of compost organic matter and urea dose on nickel contaminated soil tends to increase soybean plant height without organic matter and urea. The highest average soybean plant height was obtained at the age of 14 DAP in the K2U3 treatment, which was 13.04 cm and the lowest was obtained at the K2U1 treatment, which was 10.67 cm. The highest average soybean plant height at 28 DAP treatment K2U1 was 25.42 cm and the lowest was obtained at K3U1 treatment, which was 18.08 cm. The highest average soybean plant height at 42 DAP treatment K1U1 was 52.94 cm and the lowest was obtained at K0U0 treatment, which was 42.08 cm. The highest average soybean plant height was at 56 DAP in K3U2 treatment, which was 66.56 cm and the lowest was obtained at K0U0 treatment, which was 56.67 cm.

At the end of the observation at the age of 70 DAP, the highest average soybean plant height in the K1U3 treatment was 73.17 cm and the lowest was obtained in the K3U0 treatment, which was 60.83 cm. The application of organic gamal compost (*Gliricidia sepium*) gave the best effect on soybean plant height at the beginning of vegetative growth. This is in line with the results of research by Saraswati (2005) that gamal leaves have a low C/N ratio <15 compared to other organic materials given. contains 0.8 kg Urea, 0.25 kg Phosphate, 0.6 kg Mn and 0.5 Dolomite per 50 kg Gamal leaves (Abeygunawardana, 2005). Because gamal leaves are easy to decompose and quickly provide the nutrients needed for soybeans at the beginning of growth, the application of organic matter for gamal leaves shows the height of soybean plants at the beginning of growth as shown in Figure 1.

The application of urea to soybean plants showed that a dose of 100 kg $ha^{-1}$ showed the best average in soybean plant height compared to other urea doses. This is due to the nature of soybean plants that do not require too high a dose of urea because it can fix N from the air through the roots. The provision of 100 kg $ha^{-1}$ urea, optimally utilized by soybeans for growth.

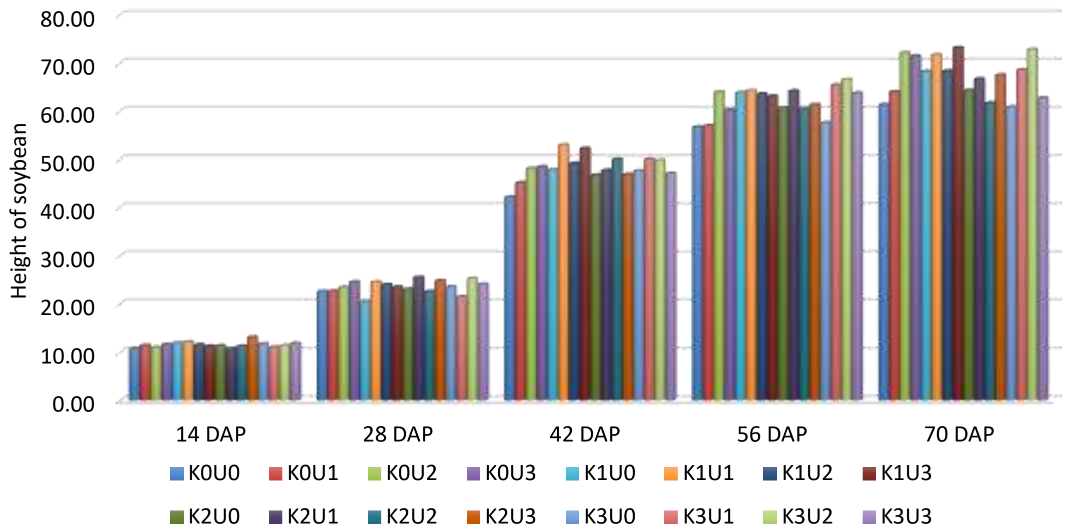


**Figure 1. Average height of soybean plants aged 14 DAP, 28 DAP, 42 DAP, 56 DAP and 70 DAP with the application of various types of organic matter and urea on nickel contaminated soil**

### *2. Number of Soybean Plant Leaves*

The results showed that the application of organic compost and urea on nickel-contaminated soil had no significant effect and the interaction between the two had no significant effect on the number of leaves of soybean plants at the age of 14 DAP, 28 DAP, 42 DAP, 56 DAP and 70 DAP.

Figure 2 shows that the application of organic compost and a dose of urea on nickel contaminated soil tends to increase the number of leaves of soybean plants without organic matter and urea. The highest average number of soybean leaves was obtained at the age of 14 DAP treatment with K2U1 which was 13.75 strands and the lowest was obtained at K2U3 treatment, which was 11.25 strands. The highest average number of soybean leaves at the age of 28 DAP treatment K2U1 was 25 strands and the lowest was obtained at treatment K1U3 which was 20 strands. The highest average number of soybean leaves at the age of 42 DAP treatment K1U2 was 53.25 strands and the lowest was obtained at treatment K0U1 which was 38.25 strands. The highest average number of soybean leaves at the age of 56 DAP treatment K0U1 was 70.75 strands and the lowest was obtained at treatment K0U0 which was 45.75 strands.

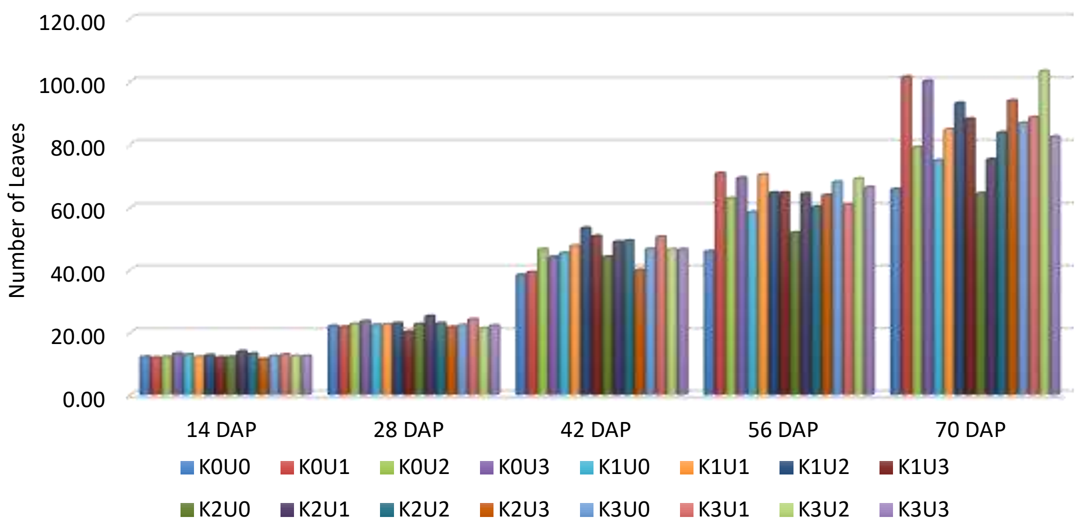

**Figure 2. Average number of leaves of soybean plants at observational ages of 14 DAP, 28 DAP, 42 DAP, 56 DAP and 70 DAP with various types of organic matter and urea treated on nickel contaminated soil**

At the end of the 70 DAP observation, the highest average number of leaves of soybean plants with K3U2 treatment was 103.17 strands and the lowest was obtained in K2U0 treatment, which was 64.3 strands. If seen from the increase in the number of leaves of soybean plants at the beginning of growth, the addition of organic matter from the leaves of Gamal (*Gliricidia sepium*) showed that the addition of leaves was better than other organic materials. This is because organic matter from gamal leaves contributes more N in the vegetative phase, while kirinyuh has more influence on the increase in the number of leaves in the generative phase. Meanwhile, soybean plants require more N in the vegetative phase for this growth because gamal leaves contain 3.15% N, 0.22% P, 2.65% K, 1.35% Ca and 0.41% Mg (Ibrahim, 2001).

### *3. Dry Weight (g) Soybean Plant*

The results showed that the application of organic compost and urea on nickel-contaminated media had no significant effect on the canopy dry weight of soybeans, as well as the interaction between the two treatments had no significant effect on the canopy dry weight of soybeans.

Figure 3 shows that the application of various types of organic matter with various doses of urea on nickel contaminated soil, tends to increase the weight of seeds per soybean plant than without the application of organic matter and urea. The highest average seed weight per soybean plant when given a dose of 300 kg ha$^{-1}$ (U3) of urea was obtained from plants that were given gamal organic matter (K2), which was 5.95 g. The lowest average seed weight per soybean plant was obtained from plants that were given organic gamal also with a dose of urea 200 kg ha$^{-1}$ (U2), which was 5.17 g.

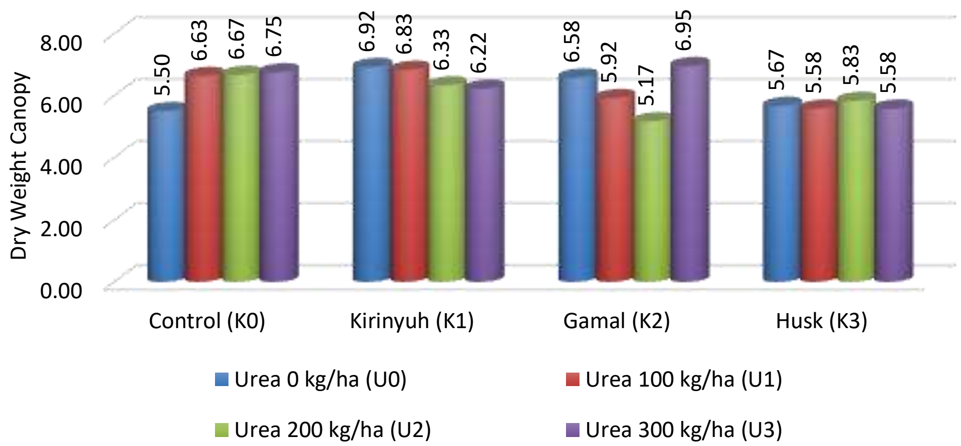


**Figure 3. Average dry weight of soybean canopy with various types of organic matter and urea in nickel contaminated soil**

The results showed that the application of various types of organic matter and urea to nickel contaminated soil had a significant effect on the dry weight of soybean roots, while the interaction between the two treatments did not significantly affect the dry weight of soybean roots.

**Table 2. Average dry weight gram (g) of soybean roots on various types of organic matter and urea dosage**

| Treatment | Control (K0) | Kirinyuh (K1) | Gamal (K2) | Husk (K3) | Average | NP BNJ 0.05 |
|---|---|---|---|---|---|---|
| Urea 0 kg ha$^{-1}$ | 7.80 | 10.70 | 7.70 | 6.30 | 8.13$^{a}$ | |
| Urea 100 kg ha$^{-1}$ | 9.35 | 12.40 | 11.90 | 11.93 | 11.40$^{b}$ | |
| Urea 200 kg ha$^{-1}$ | 11.75 | 14.90 | 11.80 | 14.00 | 13.11$^{b}$ | 2.58 |
| Urea 300 kg ha$^{-1}$ | 10.88 | 11.77 | 9.45 | 7.00 | 9.78$^{ab}$ | |
| Average | 9.95$^{a}$ | 12.44$^{b}$ | 10.21$^{ab}$ | 9.81$^{a}$ | - | |
| NP BNJ 0.05 | | | 2.58 | | | |

**Note: The average value followed by the same letter means that it is not significantly different in the BNJ test at a level of 0.05**

The results of the BNJ 0.05 test (Table 2) showed that the highest average dry weight of soybean roots was obtained with the application of kirinyuh organic matter (K1), which was 12.44 g and was not significantly different from the application of gamal compost organic matter (K2), which was 10. 21 g, but significantly different in the treatment without the addition of organic matter (K0) which was 9.95 g and organic matter of rice husk compost (K3) 9.81 grams.

Based on the results from table 2, the provision of organic matter from kirinyuh shows that the dry weight of soybean roots is heavier, this is because the C/N ratio of kirinyuh is 0.55 higher than gamal 0.39 and rice husks 0.44 based on the results of chemical analysis of organic matter obtained. given. So that the supply of nutrients utilized by soybeans only reaches the roots and increases the dry weight of soybean roots.

The results of the BNJ test at the 0.05 level (Table 2) also showed that the highest average dry weight of the roots was obtained at various doses of urea 200 kg $ha^{-1}$ (U2), which was 13.11 g, not significantly different from the urea dose treatment. 100 kg $ha^{-1}$ (U1) was 12.33 g and the dose of urea 300 kg $ha^{-1}$ (U3) was 11.74 g, but significantly different in the treatment without urea (U0) which was 8.13 g. Seen from table 2, the results of the BNJ test show that without urea fertilizer the root weight of soybean plants was the lowest, which means that there was an effect of urea application on root dry weight.

### *4.Seed Weight per Plant*

The results showed that the application of organic compost and urea to nickel-contaminated soil and the interaction between the two treatments did not significantly affect seed weight per plant.

Figure 4 shows that the application of organic matter with various doses of urea tends to increase seed weight per soybean plant compared to without the application of organic matter and urea. The highest average seed weight per soybean plant at a dose of 300 kg $ha^{-1}$ (U3) of urea was obtained in plants that were given kirinyuh compost (K1), which was 21 g. The lowest average seed weight per soybean plant was obtained in plants that were given rice husk compost and a dose of urea 300 kg $ha^{-1}$ (K3U3), which was 14.2 g.

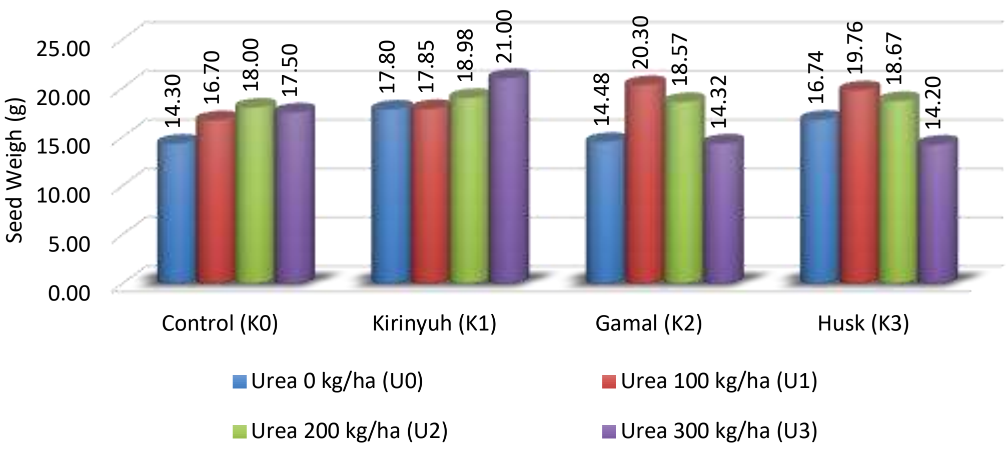


**Figure 4. Average seed weight per plant with various types of organic matter and urea in nickel contaminated soil**

Judging from the results of soil chemical analysis before planting on nickel-contaminated soil, it was 10.74 ppm, an increase with the addition of kirinyuh organic matter increased to 16% - 28.33% P in the soil (*Test results at the Laboratory of Soil and Environmental Conservation, Faculty of Agriculture, Muslim University of Indonesia*), Soybean which is a plant requires more phosphorus (P) for the formation of its seeds than other legumes showing a heavier seed weight.

### *5. Weight of 100 Soybean Plant Seeds*

The results showed that the application of organic compost and urea on nickel contaminated soil and the interaction between the two treatments did not significantly affect the weight of 100 soybean seeds.

Figure 5 shows that the application of organic matter and urea to nickel-contaminated soil tends to increase the weight of 100 soybean seeds compared to no application of organic matter and urea. The average weight of the highest 100 soybean seeds without urea (U0) was obtained from plants that were given gamal compost (K2), which was 11.73 g. The lowest average weight of 100 soybean seeds was obtained from plants without compost (K0) with a dose of urea 100 kg ha$^{-1}$ (U1) which was 9.03 g.

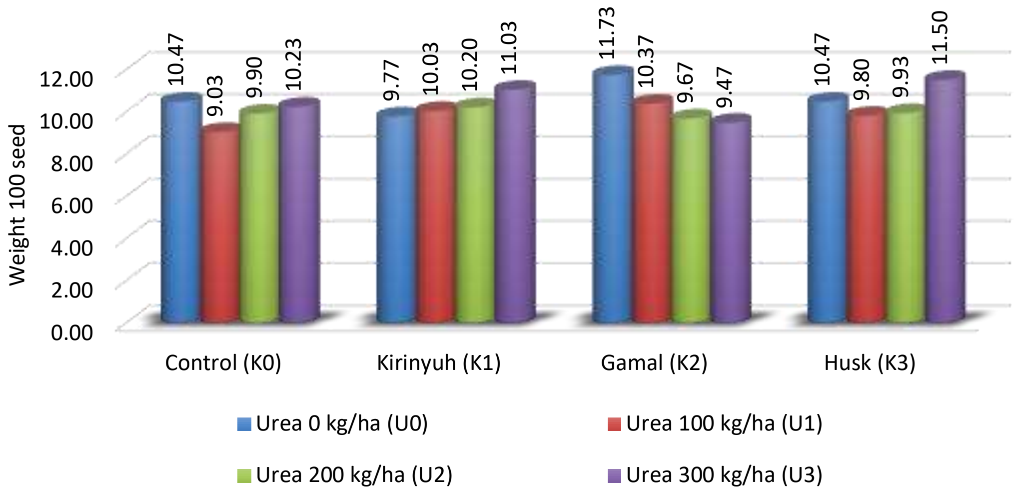


**Figure 5. Average weight of 100 soybean seeds with various types of organic matter and urea on nickel contaminated soil**

If you see in Figure 5 the application of organic matter from gamal can increase the weight of 100 plant seeds without giving urea this is due to the higher P and K content when compared to the given organic matter. The results of the chemical analysis of organic matter given by gamal had P 0.009 ppm and K 2,229.49 ppm and C/N ratio 0.39. Because the supply of nutrients from organic matter from gamal leaves is faster and can also be directly utilized by soybean plants to form more flowers so that the weight of the seeds will be heavier.

### 6. *Soybean Crop Production (tonnes) per Hectare*

The results showed that the application of organic compost and urea on nickel contaminated soil, as well as the interaction between the two treatments did not significantly affect soybean production per hectare.

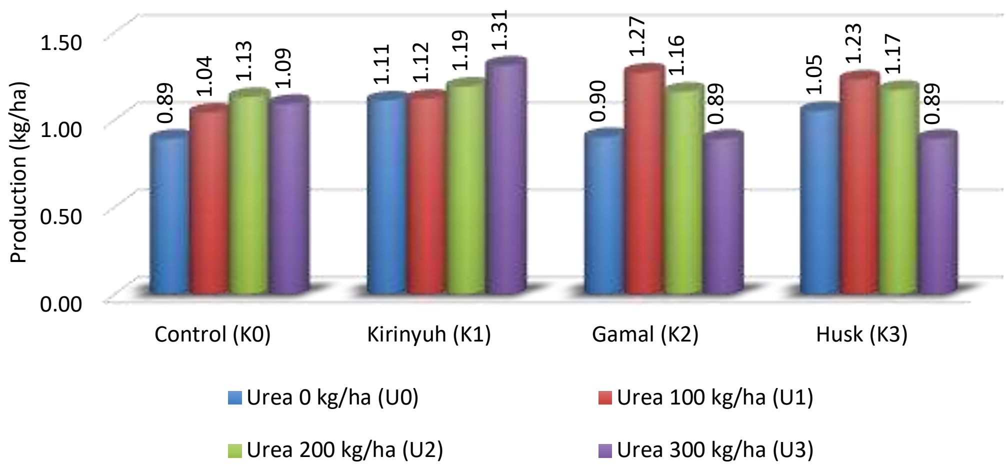


**Figure 6. Average soybean production (tonnes) per hectare with various types of organic matter and urea on nickel contaminated soil**

Figure 6 shows that the application of organic matter and urea on nickel contaminated soil tends to increase soybean crop production per hectare without the addition of organic matter and urea. The highest average production per hectare of soybean plants given a dose of urea 300 kg ha$^{-1}$ (U3) was obtained in plants that were given kirinyuh compost (K1), namely 1.31 tons ha$^{-1}$. The lowest average production per hectare of soybean was obtained from plants without compost (K0) and urea (U0), which was 0.89 tons ha$^{-1}$.

It can be seen in Figure 6, the average soybean production per hectare is below the average yield potential of the Tanggamus variety, which is 1.22 tons ha$^{-1}$. This is due to environmental conditions growing soybeans, so it cannot grow optimally because the planting media is from post-nickel mining soil. Growth inhibition and decreased production and seed quality (Molas, 2002; Gajewska *et al*., 2006) were caused by the high concentration of available Ni in the soil.

### 7. Soybean Plant Nickel Content

The results showed that the treatment with various types of organic compost and urea on nickel contaminated soil could reduce the nickel content in the leaves and roots of soybean plants compared to without the application of organic compost and urea.

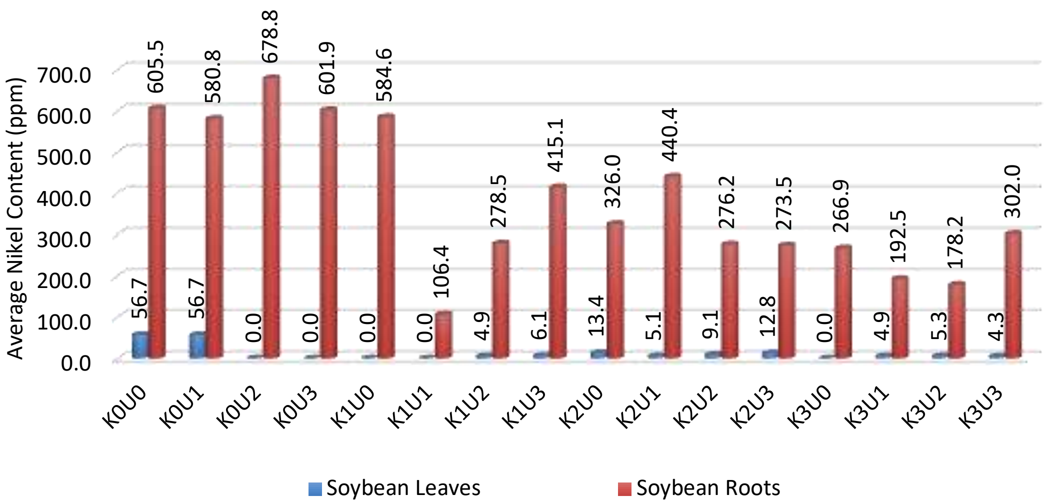


**Figure 7. Average Nickel Content (ppm) in Leaves and Roots of Soybean Plants (*Test Results at the Animal Food Chemistry Laboratory, Department of Nutrition and Animal Feed, Faculty of Animal Husbandry, Hasanuddin University*)**

Figure 7 shows that the application of various types of organic compost and urea on nickel contaminated soil tends to reduce the nickel content of soybean plants. The highest average nickel content in soybean leaves without organic matter and urea dose 100 kg ha$^{-1}$ (K0U1) is 56.68 ppm while the highest average nickel content in soybean roots without organic matter and urea dose 200 kg ha$^{-1}$ (K0U2) which is 678.77 ppm.

If it is seen in Figure 7 that without organic matter (K0) the Ni content in soybean leaves and roots is still higher, when compared with organic matter there is a decrease, which means that organic matter can help in reducing the nickel content in soybean leaves and roots. This is in line with Verloo (1993); Syekfani (2010) that organic matter can chelate metals dissolved in the soil. Organic matter contains organic acids which are negatively charged so that they can react to form bonds with metal cations. Due to the trapping of heavy metals such as nickel in the given organic material, nickel is not directly absorbed by the leaves and roots of soybean plants.

Administration of urea showed toxicity to soybean shoots and roots as found by Eskew *et al.* (1984), who found toxicity to the use of urea in the leaf tips of soybeans grown without nickel.

### 8. Nickel Content in Soil

The results showed that the treatment with various types of compost organic matter could reduce the nickel content in the soil compared to no compost organic matter.

Figure 8 shows that the application of various types of organic compost did not affect the nickel content in the soil. The highest average content of total nickel and nickel available in the soil was obtained with the addition of organic gamal compost and without urea (K2U0), namely 3.695 ppm and 806.66 ppm, respectively.

The test results show that the average Ni content in the soil used is still quite high. So it is necessary to do the right method to improve the quality of critical land after nickel mining into a suitable planting medium, including using accumulator plants or phytoremediation. In this way, it can reduce the Ni content in the soil after nickel mining so that it can be planted and the large area after nickel mining is not marginalized.

The use of organic matter is a method used to overcome the chemical feel of the soil because it is contaminated with heavy metal Ni (Djajakirana, 2001). Agronomic manipulations that can be done to increase plant biomass and accumulation. The use of organic matter will improve soil fertility thereby increasing crop yields and giving urea to take advantage of excess nickel in the media.

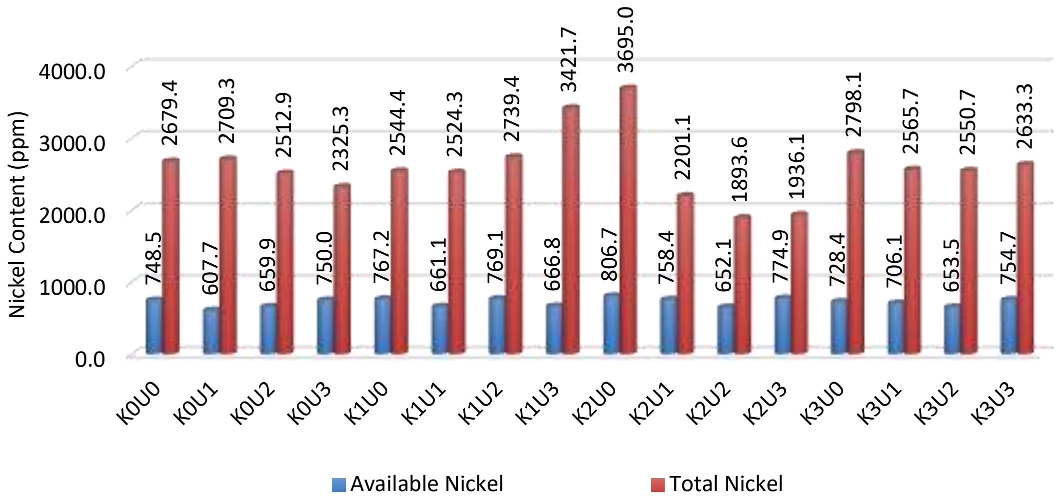


**Figure 8. Average Nickel Content (ppm) in Soil (*Test Results at the Animal Feed Chemistry Laboratory, Department of Nutrition and Animal Feed, Faculty of Animal Husbandry, Hasanuddin University*)**

## D. Conclusion

Based on the results of research conducted, it can be concluded that provision of various types of organic compost tends to increase growth and production and reduce nickel content in soybean plants on nickel contaminated soil. Gamal compost (Gliricidia sepium) gave the best effect in increasing plant height and number of soybean leaves and weight of 100 soybean seeds. Giving various doses of urea can also increase the growth and production of soybean plants which can accumulate nickel in the soil to the leaves. Urea dose of 100 kg ha-1 gave the best effect in increasing the growth of plant height and number of soybean leaves. There is no interaction between the application of organic matter and urea on the growth and production of soybeans.

## E. Recommendation

Based on the research that the author did, it is recommended that further research be carried out on the dose of organic matter from Gamal compost (*Gliricidia sepium*) in improving the structure of nickel-contaminated soil in order to optimize soybean growth and it is also recommended to remediate nickel mining areas before planting cultivated plants so that they are not polluted by heavy metals. nickel which has an impact on human health.

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