# Biomass Production of *Pueraria javanica* Using Rhizobium Inoculant and Urine Bali Cattle in East Borneo

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**ABSTRACT:** This research activity aims to know the productivity of legume cover crop *Pueraria javanica* inoculated Rhizobium and cattle urine. *P. Javanica* legume was planted on 24 plots using size of 3x2 m and planting space of 30 cm in palm oil plantations East Kutai. There were four treatments, with inoculated Rhizobium (R+), without inoculated Rhizobium (R-), urine cattle (U+) and without urine (U-) of the six replications (plots). Rhizobium bacteria inoculated on *P. Javanica* seeds before planting, urine was given after a 2 week old plants. The research design used completely randomized factorial design (2x2) with 6 replication, data were analyzed using ANOVA and continued with Duncan test if the treatment effect on the parameters observed. Data collected were: germination percentage, dry weight yields, leaves and steam weight, leaves and steam ratio, number and weight of root nodule, nutrient content (e.g. organic matter, crude protein, ash, crude fiber, neutral detergent fiber, acid detergent fiber), tannin and fenol. The results showed that percentage germination below 50% and not significantly, interaction Rhizobium and urine were significantly ($P<0.05$) on dry weight production and steam production. There was no effect on other parameters. It was concluded that Rhizobium and urine treatment given better results in crop production.

**Keyword :** *Pueraria javanica*, Rhizobium, Bali Cattle Urine, Production, Nutrient Content

## INTRODUCTION

The development of palm oil plantation area in Borneo is currently rapid and estimated be suitable for cattle farm because they have sufficient feed resources such as oil palm fronds, palm kernel cake as well as the potential sources of feed that are rarely used, legume cover crop. Legumes available were such callopo (*Collopogonium mucunoides*), centro (*Centrocema pubescent*), peuro (*Pueraria phaseoloides var. Javanica*) and mucuna (*Mucuna bracteata*). Legumes are compulsory plants in order to maintain soil moisture, eliminate weeds, increase palm soil fertility (Anonymous, 2009). The production of peuro was 12-20 tons DM/ha/year, callopo and centro reached 6 tons, while mukuna was 22 tons with a crude protein content of 16% after flowering and above 20% before flowering (Legel, 1990).

Peuro productivity in palm oil plantations should be maintained in order to be used as feed crops, by providing inoculant rhizobium and cow urine. The purpose of inoculation was for the gas nitrogen ($N_2$) from the air can be tethered by rhizobium the root nodule bacteria and converted to ammonia by the complex nitrogenized enzyme and nitrogen absorbed by legumes in the form of $NO_3$ (nitrate) and $NH_4$ (ammonium) (Samekto, 2008). Urine produced by the cows as a result of metabolism had a value which is very beneficial. In addition, it contained N and K in which also a plant growth hormone, such as auxin-a, auxin-b and other auxin which was the IAA (Indol Acetic Acid). Auxinis derived from a variety of substances contained in the forage protein from the feed, because itdid not decompose in the body then issued as a filtrate along with urine which secretes specific substances to encourage rooting (Yunita, 2011).

## MATERIALS AND METHODS

This study was conducted in one of the palm tree plantations in the Bengalon District, East Kutai Regency in East Borneo for 4 months, November 2014 - March 2015, with monthly rainfall of 142-430 mm and the number of monthly rain days ranged from 14-19 days. Air temperature ranged 22.60 °C - 35.20 °C and air relative humidity of 72% - 88% (Station of Climatology Tanjung Redep, 2014).

### Materials

The research land for cultivating legume *Pueraria javanica* (peuro) was covering an area of 15 x 15 m, with a number of 24 plots in 3 x 2 m per plot. Soil samples were taken as deep as 20 cm in some places and analyzed at the Laboratory of Soil Faculty of Agriculture UGM ((2014), as in Table 1.

**Table 1.** Analysis of Soil Chemistry, Organic Fertilizer and Bali CowUrine

| No | Parameter | Soil | Fertilizer | Bali Cow Urine |
|---|---|---|---|---|
| 1 | pH (1:2,5) (H2O) | 4.40 | 7.47 | 7.32 |
| 2 | C organic (%) | 9.36 | 17.61 | 0.70 |
| 3 | Organic ingredient (%) | 16.14 | 30.66 | 1.21 |
| 4 | Total N (%) | 0.46 | 1.51 | 0.03 |
| 5 | P Available (ppm) | 2.16 | 0.47 | 0.02 |
| 6 | K Available (me/100 g) | 0.25 | 1.04 | 0.3 |
| 7 | C/N | | 11.66 | |
| 8 | Texture class | Red soil | | |

Seeds of legumes *Pueraria javanica* (PJ) was 150 g (10 kg/ha), organic fertilizers (raw materials: feces, empty fruit bunches of palm tree, ash boiler, 600 kg (4,350 kg/ha) fiber and starter) (Anonymous, 2009), 270 l of Bali cattle urine (5000 l/ha) (Kamara, 2011), 21.6 kg (200 kg / ha) rock phosphate fertilizer (Anonymous, 2009), 3.75 g (25 g / 1 kg of seeds peuro) Rhizobium Legin LCC (*leguminose inoculant cover crop*) (Anonymous, 2014).

### Methodology

There are four combinations of treatments in this research: 1. Treatment with Rhizobium (R+), 2. Treatment without Rhizobium (R-), 3. Treatment with Cow Urine (U +), 4. Treatment Without Bali cow Urine (U-), with each replication of 6 plots.

Peuro legume seeds 150 g wassoaked in a mixture of hot water and cold water (1: 2) for one hour to soften the outer shell of hard seed (Anonymous, 2014). The number of seeds was divided by two. For R +, 50% seed was mixed with 3.75 g rhizobium, and for R- , 50% was without rhizobium. Both were allowed to stands for 6 hours. Planting the seeds of R + and R- was conducted on the afternoon in polybag with a depth of 2 cm, 5 seeds peuro per polybag. After 21 days, legume peuro were transferred to plots of land by leaving one plant per hole. Simultaneously, in each planting hole were given fertilizers, phosphate rock, with a spacing of 30 x 30 cm (Anonymous, 2009). Fertilization used was only organic fertilizer of 0.5 kg/plant (0.15 kg seven days before planting, 0.15 when it is 10 days old, and 0.2 kg when it is 30 days old) and the treatment of cow urine (U+). Urine was given to the plant life of 15 days old and 30 days by way

of sprayed around the plant, diluted with water (1:10). Harvesting can be conducted in 3 month old by cutting the plants 10 cm from the ground.

Parameters measured were (1) the production aspects: nodule (number, weight), the length of legumes, the ratio of leaves : steam, weight leaves and steam, dry weight yeild (DM), organic matter (OM), (2) aspects of the nutrient : proximate analysis, analysis of fiber (NDF, ADF), (3) the aspect of anti-nutrients: tannins and phenols. Legume production data of biomass and nutrients were analyzed with Complete Random Design factorial 2 x 2. If there is a difference, it will be followed by Duncant test.

## RESULTS AND DISCUSSION

### Biomass production of *Pueraria javanica*

Production of dry matter and organic matter of *Peuraria javanica* legumes shown in Table 2.

**Table 2.** Production of *Pueraria javanica* Biomass with Rhizobium and cow urine inoculant treatment

| Rhizobium | Bali cow Urine | | Average |
|---|---|---|---|
| | U- | U+ | |
| Dry matter production per plant (g) | | | |
| R- | 93.22±8.6$^{aA}$ | 104.13±12.59$^{aB}$ | 98.67±14.65 |
| R+ | 109.10±10.92$^{bA}$ | 147.16±12.96$^{bB}$ | 128.13±29.39 |
| Average | 101.16±17.73 | 125.64±30.16 | |
| Dry matter production per $m^2$ (g) | | | |
| R- | 838.98±67.49$^{aA}$ | 937.17±167$^{aB}$ | 888.07±131.82 |
| R+ | 981.88±198.02$^{bA}$ | 1,324.43±210.44$^{bB}$ | 1,153.16±264.49 |
| Average | 910.43±159.57 | 1,130.8±271.49 | |
| Organic matter production per plant (g) | | | |
| R- | 87.18±2.39 | 86.59±2.24 | 86.88±2.21 |
| R+ | 88.36±1.56 | 86.30±3.77 | 87.33±2.93 |
| Average | 87.77±2 | 86.44±2.93 | |
| Leaf Production (g) | | | |
| R- | 38.07±1.35 | 40.49±8.57 | 39.28±5.98 |
| R+ | 45.07±12.87 | 49.78±13.86 | 47.43±12.99 |
| Average | 41.57±9.46 | 45.14±12.01 | |
| Steam production (g) | | | |
| R- | 55.15±8.61 | 63.64±12.59 | 59.4±11.19$^{c}$ |
| R+ | 64.03±10.92 | 97.38±12.96 | 80.7±20.83$^{d}$ |
| Average | 59.59±10.45$^{a}$ | 80.81±21.41$^{b}$ | |
| Ratio steam and leaves | | | |
| R- | 0.73±0.13 | 0.69±0.13 | 0.71±0.13 |
| R+ | 0.73±0.16 | 0.54±0.13 | 0.63±0.17 |
| Average | 0.73±0.13$^{a}$ | 0.61±0.15$^{b}$ | |

Explanation: Different Superscript in the same column and row showed significantly different.

Dry matter production per plant and per $m^2$ was affected by Rhizobium inoculant and cow urine ($P < 0.05$). The highest dry matter production per plant and per $m^2$ was in treatment R+U+ and the lowest was in R-U-. It shows that Rhizobium inoculants as one of a group of bacteria that was enabled as a provider of nutrients for plants. PJ legumes can take N from the air if it hadsymbiosis with Rhizobium bacteria. Before being able to take the N from the air legume, PJ needed N as a starter of early growth, and cow urine can be used because it contains nitrogen (Table 1). Dry Plant weight was a measure of the determination of the quality of plant growth and yield of a crop that was the result of the process of photosynthesis, assimilate and translocation to the decline in plant organs (Yunita, 2011). The influence of the urine was significantly because cow urine contained the hormone *indole acetic acid*, which is known as the main auxin in plants. Auxin is expected to promote the occurrence of the bend in the hair root, which is a prerequisite Rhizobium infection (Gardner *et al,* 1991, Kamara, 2011).

Production of organic materials (BO) no difference among all treatments. The highest BO was R+U and the lowest was R+U +, BO is affected by the ash ingredients in each treatment plant (Table 4).

Leaf production had no differences between treatments.The weight of the stems showed different results ($P < 0.05$), there is an interaction between rhizobium and the urine with the ultimate weight on R+U+ and the lowest of R-U-. It caused by Rhizobium inoculant and cow urine were expected to provide sufficient nutrients for the growth of PJ legumes. The amount of auxin contained by cow urine was in the right amount which then interacts with growth regulator that was existed in cow urine (Yunita, 2011). Germination parameter, plant length, number and weight of nodules were presented in Table 3.

**Table 3.** Germination, Plant Length, Number and Weight of Nodules of *Pueraria javanica* with Rhizobium treatment and Cow Urine

| Rhizobium | Cow Urine | | Average |
|---|---|---|---|
| | U- | U+ | |
| Germination (%) | | | |
| R- | 41.83±11.70 | 42.50±7.21 | 42.17±9.23 |
| R+ | 39.17±4.24 | 43.00±11.2 | 41.08±8.44 |
| Average | 40.5±8.63 | 42.75±8.99 | |
| Plant Length (cm) | | | |
| R- | 297.01±42.76 | 278.7745.03 | 287.89±42.94 |
| R+ | 290.22±44.7 | 323.41±31.9 | 306.82±40.89 |
| Average | 293.62±41.85 | 301.09±43.91 | |
| Number of Nodules | | | |
| R- | 38±20.22 | 39±24.92 | 35±21.83 |
| R+ | 29±12.29 | 25±12.42 | 26±11.92 |
| Average | 33±16.7 | 28±19.62 | |
| Nodule weight (g) | | | |
| R- | 2.73±0.99 | 2.80±0.97 | 2.77±0.94 |
| R+ | 3.00±2.22 | 3.17±1.51 | 3.08±1.82 |
| Average | 2.87±1.65 | 2.98±1.22 | |

Legumes' ability to grow with Rhizobium treatment did not make a difference because of the effects of Rhizobium appeared at days28 (Rao, 2006) and had not received the addition of cow urine. PJ legume length had no difference in the treatments. The longest grow was in the R+U+ with an average gain of 3.6 cm length per day, the shortest on the R-U+ with a gain of 3.1 cm per day. The number and weight of nodules had no difference with rhizobium treatment and urine. The most nodules was R-U+ and the least was on R + U +.This is due to the possibility of nodules in R+U+ had already ripped first.

**Nutrient Value of *Pueraria javanica* Legume**

The value of nutrients and anti-nutrients such as legumes PJ was listed in Table 4.

**Table 4.** *Pueraria javanica* nutrient with Rhizobium inoculant and cow urine treatments (% Dry matter)

| Nutrient | R-U- | R-U+ | R+U- | R+U+ |
|---|---|---|---|---|
| Dry matter | 26.95 | 24.82 | 26.25 | 26.58 |
| crude protein | 22.65 | 22.93 | 23.48 | 23.59 |
| crude fiber | 17.88 | 24.23 | 22.19 | 20.99 |
| Fat | 2.70 | 2.58 | 1.93 | 1.99 |
| Ash | 11.72 | 12.26 | 10.58 | 12.49 |
| NFE | 38.56 | 38.75 | 41.95 | 40.94 |
| TDN | 65.90 | 65.62 | 68.47 | 66.67 |
| NDF | 45.70 | 43.54 | 43.72 | 40.91 |
| ADF | 29.45 | 29.11 | 27.31 | 26.57 |
| Anti-Nutrient | | | | |
| Tannin | 36.74 | 38.74 | 41.23 | 41.17 |
| Fenol | 15.01 | 15.75 | 16.70 | 16.67 |

Rhizobium inoculant treatment and the distribution of cow urine did not make a difference to the nutrition value of legume, almost the same dry matter content of about 26%, the highest crude protein in the R+ U+, for the lowest in R-U-. The highest TDN in R+U- amounted and at the lowest of R-U+.The highest NDF and ADF was in R-U- and the lowest was R+U+. The highesttanninanti-nutrientwas in R+U-and the lowest was in R-U-.The highest phenol was at R+U- and the lowest was at R-U-.

According to Legel (1990), the crude protein content of *Peuraria javanica* before flowering was about 22%, TDN treatment almost equal approximately 65% - 68%. This indicates that the feed plant contains sufficient energy for the needs of cattle feed, while the TDN of PJ legumes of palm plantations in Borneo was around 57%. The fiber content (NDF) 40-45% indicates that PJ legumes do not contain a lot of fiber, compared NDF *Mucuna bracteta* legume by 71% (Sirait, 2009).

## CONCLUSION

Leguminose *Pueraria javanica* showed good growth with the production and relatively high nutrient value with Rhizobium inoculant treatment and the contribution of cow urine, even though nutrient values did not give a significant difference. The highest production of dry matter per $m^2$ was in Rhizobium inoculant and urine of 1,324 g or 1.3 kg DM/$m^2$ and the lowest was 0.83 kg DM/$m^2$ on treatment without rhizobium and without urine.

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