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FORMULATION OF WILD SUNFLOWER (*TITHONIA DIVERSIFOLIA*) – BASED COMPOST IN LA TRINIDAD, BENGUET, PHILIPPINES

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Abstract:

Compost is a simple way of creating what scientists call a positive feedback loop. This study was conducted to determine the pH, N, P, and moisture content; the number of days to decomposition; the percent recovery of composted substrates; and the return on cash expense of producing the formulated sunflower-based compost.

The substrates used in the study were wild sunflower, grass, alnus leaves and banana bract. These were composted until it becomes recognizable. The grass, alnus leaves, and banana bract are constant in weight which is 10 kg each, only the sunflower varied in rate. Different rates of wild sunflower in the treatments were the following: T_1=10 kg, T_2=20 kg, T_3=30 kg, T_4=40 kg and T_5=50 kg.

Results showed that chemical and moisture contents of formulated wild sunflower-based compost were not affected by the different rates of wild sunflower except N. Treatment 4 (4:1:1:1 of wild sunflower, grass, alnus leaves and banana bract) obtained the highest N content with 3.21 %. The lowest was registered from the formulation of 1:1:1:1 of wild sunflower, grass, alnus leaves and banana bract (T_1) with 2.21 %.

The higher the rate of wild sunflower, the early and the higher are the number of days to decompose and the percentage of its recovery, respectively.

Treatment 5 (5:1:1:1 of wild sunflower, grass, alnus leaves and banana bract) gained a higher return on cash expense with 13.05 %.

Keywords: Compost, decomposition, nutrient content, organic, wild sunflower

1.INTRODUCTION

One of the program components of the BSU Organic Agriculture is the production of organic fertilizer. According to the Philippine National Standards/Bureau of Agriculture and Fisheries Product Standards (2016), organic fertilizer refers to the product in solid or liquid form of a plant (except by-product from petroleum industries) or animal origin that has undergone substantial decomposition that can supply available nutrients to the plants with total nitrogen (N), Phosphorous (P_2O_5), and Potassium (K_2O) of 5% to 10%. This may be enriched by microbial inoculants and naturally occurring minerals but no chemical or inorganic fertilizer materials have been used in the production or added to the finished product to affect the nutrient content.

Organic fertilizers do not only supply nitrogen and trace elements, but also contain "humus", whose importance cannot be underestimated (PCARRD, 1999).

The supply of pure organic fertilizers and compost, however, is limited. According to Baguilet (2017), there is no continuous selling of organic fertilizer in the farm supply marketing outlets. Organic practitioners in the provinces of Mountain Province and Benguet are producing their compost from the available substrates in their farm. However, there is no documented analysis of the nutrient content of their produced compost.

Chemical analysis of substrates like wild sunflower and alnus leaves show that these have high nutrient content (Las-igan, 2017) which can be used as substrates in the production of organic fertilizer or compost. The use of these locally available substrates particularly sunflower and alnus including banana bract in the production of organic fertilizer or compost were found and qualified for the fertilizer grade under the Philippine National Standard on organic fertilizer (Wai, 2007). The result of this study will help farmers in utilizing the locality available materials such as wild sunflower, grass, alnus leaves, and banana bract as the main sources of organic fertilizer. This will help the farmers minimize their production costs.

Plants pull carbon dioxide from the air through photosynthesis and transfer a portion of the carbon to the soil through their roots. Soil microorganisms turn the carbon into a stable form commonly known as humus. These are

sequesters of carbon but improves the soil's fertility, boosting plant growth and capture more carbon, and improve the soil's ability to absorb and retain water. Therefore, the application of compost leads to increased plant productivity, soil carbon sequestration and reduced need for commercial feeds (Mercola, 2016). Compost is a simple way of creating what scientists call a positive feedback loop. Compost is rich in nutrients needed by the crops to complete their life cycle to attain better yields.

The study was conducted to determine the influence of the different rates of wild sunflower in the formulation with grass, alnus leaves and banana bract to its nitrogen (%), phosphorus (ppm), moisture (%) and pH value contents. This also assessed its yield and profitability in terms of the number of days to decompose and recovery (%) and return on cash expense (ROCE), respectively.

2.METHODOLOGY

An area of 20 m^2 was cleaned and prepared thoroughly using a mower. The area was divided into three replications. There were five (5) treatments under each replication. Each treatment was measured 1 m X 1 m. The field was laid-out following the Randomized Complete Block Design (RCBD). The treatments were the following:

Treatment Code	Ratio	Description
T_1	1:1:1:1	10 kg of sunflower,10 kg of grass, 10 kg of alnus and 10 kg of banana bract
T_2	2:1:1:1	20 kg of sunflower, 10 kg of grass, 10 kg of alnus, and 10 kg of banana bract
T_3	3:1:1:1	30 kg of sunflower, 10 kg of grass, 10 kg of alnus, and 10 kg of banana bract
T_4	4:1:1:1	40 kg of sunflower, 10 kg of grass, 10 kg of alnus, and 10 kg of banana bract
T_5	5:1:1:1	50 kg of sunflower, 10 kg of grass, 10 kg of alnus, and 10 kg of banana bract

The wild sunflower, grass, alnus leaves, and the banana bracts were collected at Balili, La Trinidad Benguet. After collection, the substrates were chopped for easier decomposition. Then, these substrates were put-in sacks and weighed each. The substrates were piled following the treatments. 10 kg of Grass was piled at the bottom of the 1m x 1m area followed by layers of 10 kg of alnus leaves, 10 kg, 20 kg, 30 kg, 40 kg and 50 kg of wild sunflower in treatments 1, 2, 3, 4 and 5, respectively and 10 kg of banana bract. The 10 kg weight of each grass, alnus leaves and banana bract were constant in all treatments. Only the wild sunflower was varied its rate among treatments as mentioned above. All piles were then watered to maintain moisture. This piling of the substrates step was repeated. After piling, the substrates were covered with blue plastic to preserve heat. After 1 week, the pile were mixed and watered again to maintain the moisture content of the compost. Mixing the substrates were repeated after 2-3 weeks till the substrates cannot be determined.

3.DATA GATHERED:

A. Chemical Analysis of Substrates

1. Total Nitrogen (N) content of the plant (%). The available Nitrogen (N) content of the plant was determined using the Modified Kjeldahl Method. Oven-dried sample plants were used. In the digestion, a 0.2gram tissue sample was weighed and wrapped in a piece of qualitative filter paper and was dropped as a package into a Kjeltec flask. This was added with a 1g salt mixture and 5 mL concentrated H_2SO_4. The sample was digested and stopped when the sample does not contain carbonaceous materials. The flask was cooled and 100 mL of distilled water was slowly added.

The digested solution was distilled. In the distillation, the ammonium-N procedure was received in a 250 ml Erlenmeyer flask containing 20 mL of H_3BO_3N indicator solution. The digested solution was poured with 25mL 10N NaOH down the neck of the Kjeltech tube until the alkali reaches the bottom of the flask without mixing appreciably with the digested sample. When about 150 mL of distillate have been collected, the receiver was lowered. After rinsing the end of the condenser with distilled water, the flask was removed and the distillation was stopped. The ammonium-N in the distillate was determined by titration with 0.025 N standard acid. The color change at the endpoint would be from green to pink. A blank was run following the same procedure. The plant nitrogen content was computed using the formula:

$$\%N = \frac{(T-B) \times N \times 0.14}{S} \times 100\%$$

Where:

T= sample titration, ml of the standard acid
B= blank titration, ml of the standard acid
N= normality of the standard acid
S= oven-dry weight of the sample in g

2. Total Phosphorus (P) content of the plants (ppm). The available Phosphorus (P) content of the plants was analyzed using the Vanadomolybdate Method. The apparatus used was a spectrophotometer and pH meter, while the reagents are the molybdate-vanadate solution, 2N nitric acid, and standard phosphorous solution. In the digestion 5ml of the ash extract was poured into a 50 ml volumetric flask and was added with 5 ml of the molybdate-vanadate solution and then makeup to 5 mL with distilled water. Then 10 mL of 2 N HNO_3 was added and allowed to stand for 20 mins. The percent transmittance at 420 nm was measured and compared with that of the phosphorous standard.

Phosphorous in plant tissue was calculated as:
(for 5ml aliquot);

$$\text{ppm P (in plant tissue)} = \frac{\text{ug P (in solution) X 50/5}}{\text{weight of sample/g}}$$

$$\% P = \text{ppm P } x100/10^6 = \text{ppm P}/ 10^4$$

B. Chemical Analysis of the Compost

1. The total Nitrogen of the compost (%). This was analyzed using the Kjeldahl method. A 1 g of air-dried compost that has been ground to pass 0.50 mm sieve was weighed and wrapped in a piece of qualitative filter paper before dropping as a package into an 800-ml Kjeldahl flask. Then 20 grams of the salt mixture was added, then add 30 ml of sulfuric acid. Regulate heating so that the H_2SO_4 condenses about one-third of the way up the neck of the flask. The flask was rotated at intervals to facilitate the digestion of the sample. When the sample no longer contains carbonaceous materials as shown by the disappearance of blackish color stop the digestion then allow the flask to cool.

The digested solution was distilled. In the distillation, the ammonium-N procedure was received in a 250 ml Erlenmeyer flask containing 25 mL of H_3BO_3N indicator solution. The digested solution was poured with 25mL 10N NaOH down the neck of the Kjeltech tube until the alkali reaches the bottom of the flask without mixing appreciably with the digested sample. When about 150 mL of distillate have been collected, the receiver was lowered. After rinsing the end of the condenser with distilled water, the flask was removed and the distillation was stopped. The ammonium-N in the distillate was determined by titration with 0.05 N standard acid. The color change at the endpoint would be from green to pink. A blank was run following the same procedure. The total nitrogen content was computed using the formula:

$$\%N = \frac{(T-B) \times N \times 0.14}{S} \times 100\%$$

Where:

T= sample titration, ml of the standard acid
B= blank titration, ml of the standard acid
N= normality of the standard acid
S= oven-dry weight of the sample in g

2. Total Phosphorus (P) content of the compost (ppm). The available Phosphorus (P) content of the compost was analyzed using the Vanadomolybdate Method. The apparatus used was a spectrophotometer and pH meter, while the reagents are the molybdate-vanadate solution, 2N nitric acid, and standard phosphorous solution. In the digestion 5ml of the ash, the extract was poured into a 50 ml volumetric flask and was added with 5 ml of the molybdate-vanadate solution and then makeup to 5 mL with distilled water. Then 10 mL of 2 N HNO_3 was added, the solution was mixed and allowed to stand for 20 mins. The percent transmittance at 420nm was measured and compared with that of the phosphorous standard.

Phosphorous in plant tissue was calculated as:
(for 5ml aliquot);

$$\text{ppm P (in plant tissue)} = \frac{\text{ug P (in solution) X 50/5}}{\text{weight of sample/g}}$$

$$\% P = \text{ppm P } x100/10^6 = \text{ppm P}/ 10^4$$

3. pH value of compost. This was determined using the electrometric method. The soil pH meter was used to determine the final pH level of compost using the ratio of 3:1 distilled water to 5g compost.

4. Moisture content. This was determined by the oven-dry method and computed using this formula;

$$Ow = \frac{FW - ODW}{ODW} \times 100$$

Where Ow = sample moisture content is present by weight
FW = weight of the sample before oven drying
DW = weight of the sample after oven drying.

C. Yield

1. Number of days to decomposition. This was determined by examining the physical structure of the compost using the feel method and observation. Compost was observed as soft, porous, and dry. Fully decomposed compost was gauged by its softness and dark color (Brady 1985).

2. Percent Recovery. Matured compost from each treatment was weighed and recorded. The percent recovery was computed using the formula:

$$\% \text{ Recovery} = \frac{\text{Fresh weight of the substrates}}{\text{Weight of matured compost}} \times 100$$

D. Economic Data

1. Return on Investment (ROI) (%). This was taken by recording all expenses and computed using this formula.

$$ROI\% = \frac{\text{Gross Income} - \text{Total Expenses}}{\text{Total Expenses}} \times 100$$

4.STATISTICAL TOOL USED

The data were analyzed using the analysis of variance (ANOVA) of RCBD factorial. The differences between treatment means were determined using the Duncan's Multiple Range Test (DMRT) at a 5% level of significance.

5.RESULTS AND DISCUSSION

5.1Chemical Analysis of Substrates

Nitrogen. Chemical analysis (Table 1) showed that wild sunflower had the highest N content among the substrates with 8.49% followed by alnus leaves and grass with 4.23% and 3.25%, respectively. The lowest N content was registered from banana bract with 0.96%. Batalao (2010) and Pandosen (1986) also analyzed the nutrients content of wild sunflower. They found that N content was higher than other nutrients such as phosphorus and potassium with 5.20 % and 3.76 %, respectively. However, Las-igan (2017) found that wild sunflower took in Nueva Viscaya and alnus leave contain N lower with 1.65 % and 1.97 %, respectively.

Phosphorus. The highest P content was obtained from wild sunflower with 50.5 ppm followed by grass and alnus leaves with 37.5 ppm and 27 ppm, respectively. The lowest was registered from banana bract with 12.5 ppm (Table 1). It implies that sunflower is the best among substrates. However, this result shows that P content of wild sunflower is lower than the analyses of Batalao (2010) and Pandosen (1986) with 2400 ppm and 70 ppm, respectively.

Table 1. Nitrogen and phosphorus content of the substrates used in the formulated wild sunflower based-compost under La Trinidad, Benguet

Chemical Analysis	Wild Sunflower	Alnus leaves	Grass	Banana Bracks
Nitrogen (%)	8.49%	4.23%	3.25%	0.96%
Phosphorus (ppm)	50.50ppm	27.00 ppm	37.5ppm	12.5ppm

5.2Chemical Analysis of the Compost

Table 2 shows that the pH value of the formulated wild sunflower-based compost was not significantly affected by the different rates of a wild sunflower. However, 40 kg of wild sunflower (T_4) obtained the highest pH value of 7.58. This indicates that the higher the rate of nitrogen in the mixture, the higher is the pH value.

Table 2. pH value of the formulated wild sunflower-based compost in La Trinidad, Benguet

TREATMENT CODE	RATIO	DESCRIPTION	pH

T_1	1:1:1:1	10 kg of wild sunflower, 10 kg of Grass, 10 kg of alnus leaves and 10 kg of banana bract	7.03
T_2	2:1:1:1	20 kg of wild sunflower, 10 kg of grass, 10 kg of alnus leaves, and 10 kg of Banana bract	7.16
T_3	3:1:1;1	30 kg of wild sunflower, 10 kg of grass, 10 kg of alnus leaves, and 10 kg of Banana bract	7.54
T_4	4:1:1:1	40 kg of wild sunflower, 10 kg of grass, 10 kg of alnus leaves, and 10 kg of Banana bract	7.58
T_5	5:1:1:1	50 kg of wild sunflower, 10 kg of grass, 10 kg of alnus leaves, and 10 kg of Banana bract	7.41

Table 3 shows that the N content of the compost was significantly affected by the different rates of a wild sunflower. N content of 40 kg kilograms wild sunflower (T_4) was significantly higher than other treatments with 3.21 %. This result might be due to the high ratio of formulated wild sunflower-based compost as well as the high N content of the wild sunflower (Table 1). 50 kg of wild sunflower (T_5) happened to be significantly lower than treatment 4 even though it had a higher rate of sunflower in a mixture. It may be due to the more water-drenched once a week that leads N to leach. Other treatments were drenched with water once a week in a moderate only.

Table 3. Nitrogen content of the formulated wild sunflower-based compost in Trinidad, Benguet

TREATMENT CODE	RATIO	DESCRIPTION	MEAN (%)
T_1	1:1:1:1	10 kg of wild sunflower, 10 kg of grass, 10 kg of alnus leaves, and 10 kg of banana bract	2.21b
T_2	2:1:1:1	20 kg of wild sunflower, 10 kg of grass, 10 kg of alnus leaves, and 10 kg of banana bract	2.24b
T_3	3:1:1;1	30 kg of wild sunflower, 10 kg of grass,10 kg of alnus leaves, and 10 kg of banana bract	2.31b
T_4	4:1:1:1	40 kg of wild sunflower, 10 kg of grass,10 kg of alnus leaves, and 10 kg of banana bract	3.21a
T_5	5:1:1:1	50 kg of wild sunflower, 10 kg of grass, 10 kg of alnus leaves, and 10 kg of banana bract	2.7 b

Means with the same letters are not significantly different at 5% by DMRT

Table 4 shows that the P content was not significantly affected by the different rates of wild sunflower among treatments. However, 50 kg wild sunflower (T_5) obtained the highest P content of 0.09 %. The higher the rate of wild sunflower, the higher is the P content of the compost.

Table 4. Phosphorus content of the Formulated wild sunflower-based compost in La Trinidad, Benguet

TREATMENT CODE	RATIO	DESCRIPTION	MEAN (%)

T_1	1:1:1:1	10 kg of wild sunflower, 10 kg of grass, 10 kg of alnus leaves, and 10 kg of banana bract	0.01
T_2	2:1:1:1	20 kg of sunflower, 10 kg of grass, 10 kg of alnus leaves, and 10 kg of banana bract	0.02
T_3	3:1:1;1	30 kg of sunflower, 10 kg of grass, 10 kg of alnus leaves, and 10 kg of banana bract	0.02
T_4	4:1:1:1	40 kg of sunflower, 10 kg of grass, 10 kg of alnus leaves, and 10 kg of banana bract	0.02
T_5	5:1:1:1	50 kg of sunflower, 10 kg of grass, 10 kg of alnus leaves, and 10 kg of banana bract	0.09

5.3Moisture Content of the Compost

Table 5 shows that the moisture content of the compost was not significantly affected by the different rates of wild sunflower based compost. However, 40 kg of wild sunflower (T_4) gave the highest MC of 43.10 %. This might be due to the high ph-value (Table 2) and nitrogen content (Table 3).

Table 5. Moisture content of the formulated wild sunflower –based compost in La Trinidad, Benguet

TREATMENT CODE	RATIO	DESCRIPTION	MC (%)
T_1	1:1:1:1	10 kg of wild sunflower, 10 kg of grass,10 kg of alnus leaves,and 10 kg of banana bract	32.88
T_2	2:1:1:1	20 kg of wild sunflower, 10 kg of grass,10 kg of alnus leaves, and 10 kg of banana bract	37.23
T_3	3:1:1;1	30 kg of wild sunflower, 10 kg of grass,10 kg of alnus leaves, and 10 kg of banana bract	40. 45
T_4	4:1:1:1	40 kg of wild sunflower, 10 kg of grass,10 kg of alnus leaves, and 10 kg of banana bract	43.10
T_5	5:1:1:1	50 kg of wild sunflower, 10 kg of grass, 10 kg of alnus leaves, and 10 kg of banana bract	38.34

6.YIELD OF THE COMPOST

6.1Number of days to decomposition

Table 6 shows that the number of days to decomposition was significantly affected by the different rates of a wild sunflower. Treatments 4 (4:1:1:1 of wild sunflower, grass, alnus leaves and banana bract) and 5 (5:1:1:1 of wild sunflower, grass, alnus leaves and banana bract) decomposed faster than other treatments with lower rates of sunflower. This result might be due to the higher rates of wild sunflower and its N content. This conforms to the findings of Alexander (1977) that substrates with a high rate of N source decompose faster than those with a low rate of N source. This result implies that a high rate of N source and its N content in substrates helps the materials decompose faster.

Table 6. Number of days to the decomposition of the Formulated wild sunflower-based compost in La Trinidad, Benguet

TREATMENT CODE	RATIO	DESCRIPTION	MEAN
T_1	1:1:1:1	10 kg of wild sunflower, 10 kg of grass, 10 kg of alnus leaves, and 10 kg of banana bract	107a
T_2	2:1:1:1	20 kg of sunflower, 10 kg of grass, 10 kg of alnus leaves, and 10 kg of banana bract	107a
T_3	3:1:1;1	30 kg of sunflower, 10 kg of grass, 10 kg of alnus leaves, and 10 kg of banana bract	101b
T_4	4:1:1:1	40 kg of sunflower, 10 kg of grass, 10 kg of alnus leaves, and 10 kg of banana bract	98c
T_5	5:1:1:1	50 kg of sunflower, 10 kg of grass, 10 kg of alnus leaves, and 10 kg of banana bract	98c

Means with the same letters are not significantly different at 5% by DMRT

6.2Compost Recovery

Table 7 revealed that the recovery of Formulated wild sunflower-based compost was affected by the different rates of wild sunflower. This result shows that the best were 40 kg, 30 kg, and 50 kg wild sunflower with 59.29 %, 58.33 % and 58.12 %, respectively which are significantly different from 20 kg and 10 kg wild sunflower. This might be due to the high rates of N in a mixtures and early decomposition (Table 6). The lowest was obtained from 10 kg wild sunflower with 50.17 %.

Table 7. Compost recovery of the Formulated wild sunflower-based compost in La Trinidad, Benguet

TREATMENT CODE	RATIO	DESCRIPTION	MEAN (%)
T_1	1:1:1:1	10 kg of sunflower, 10 kg of grass, 10 kg of alnus leaves, and 10 kg of banana bract	50.17c
T_2	2:1:1:1	20 kg of sunflower, 10 kg of grass, 10 kg of alnus leaves, and 10 kg of banana bract	54.57b
T_3	3:1:1;1	30 kg of sunflower, 10 kg of grass, 10 kg of alnus leaves, and 10 kg of banana bract	58.33a
T_4	4:1:1:1	40 kg of sunflower, 10 kg of grass, 10 kg of alnus leaves, and 10 kg of banana bract	59.29a
T_5	5:1:1:1	50 kg of sunflower, 10 kg of grass, 10 kg of alnus leaves, and 10 kg of banana bract	58.12a

Means with the same letters are not significantly different at 5% by DMRT

7.ECONOMIC PARAMETERS

Table 8 revealed the return on cash expense (ROCE). This shows that treatment 50 kg wild sunflower (T_5) obtained the highest ROCE with 13.05 % followed by 40 kg wild sunflower (T_4) with 3.14 %. This was because of their higher gross income and slightly low total expense. 10 kg, 20 kg and 30 kg wild sunflower obtained negative ROCE due to their low gross income but high total expense.

ROI is a profitability ratio that calculates the profits of an investment as a percentage of the original cost. For example, formulation of 5:1:1:1 of sunflower, grass, alnus leaves, and banana bract (T_5) got the highest ROI of 13.05 %; it means that in every 1 peso invested, there is a gain of PhP 0.131.

Table 8. Return on cash expense of the formulated wild sunflower-based compost in la Trinidad, Benguet

TREATMENT	TOTAL YIELD INCOME (kg)	GROSS EXPENSE (PHP)	TOTAL INCOME (PHP)	NET (PHP)	ROCE (%)
T_1 – 1:1:1:1	58.80	588.00	746.30	-158.30	-21.20
T_2 – 2:1:1:1	71.50	715.00	791.30	-76.30	-9.64
T_3 – 3:1:1:1	75.00	750.00	793.00	-43.00	-5.42
T_4 – 4:1:1:1	85.50	855.00	829.00	26.00	3.14
T_5 – 5:1:1:1	100.50	1005.00	889.00	116.00	13.05

*Average selling price of compost is Php 10/kg.

8.CONCLUSION

Based on the results of the study, the following conclusions can be drawn:

1. The higher the rate of wild sunflower in a mixture, the higher is the N content of the composted substrates. However, treatment 4 (4:1:1:1 of wild sunflower, grass, alnus leaves and banana bract) got the highest N content with 3.21 % compared to treatment 5 (5:1:1:1 of wild sunflower, grass, alnus leaves and banana bract).

2. Number of days to decomposition was significantly higher in treatments with low rates of wild sunflower (T_1 and T_2). Otherwise, the higher the rate of wild sunflower, the higher is the percentage of compost recovery.

3. Formulation of 5:1:1:1 of wild sunflower, grass, alnus leaves and banana bract (T_5) gained a highest ROCE of 13.05 %. The higher the rate of wild sunflower, the higher is the ROCE.

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