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# Growth and Yield Performance of Promising Napier Grass Accessions as Affected by the Frequency of Chicken Manure Application

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## Abstract

The study compared the effect of single and split chicken manure (CM) application on the growth and yield of promising napier grass accessions, identified the high yielding napier grass accession, and compared the cost benefit ratio of producing napier grass. Three frequencies of chicken manure application - zero, single, and split - were used in fertilizing seven promising accessions of napier grass. The frequencies of fertilizer application were randomly distributed to three horizontal strips while the accessions were randomly distributed to seven vertical strips using the Strip-plot design. Each plot measured 3m x 4m.

Results showed that frequency of CM application significantly affected the number of days to shoot emergence, the number of tiller produced, as well as the height and dry herbage yield of napier grasses. Grasses with single or split CM application produced new shoots earlier and had more tillers than those with zero manure application. Grasses with split CM application were taller and produced higher total dry matter yield than those with single or zero application. In terms of dry matter yield, grasses applied with split manure application (10.13t $ha^{-1}$) produced significantly ($P \leq 0.05$) higher dry matter herbage yield than those with single application (7.44t $ha^{-1}$) during the wet season of the first year observation period. However, grasses applied with either single or split manure produced comparable dry herbage yields with the unfertilized grasses during dry season. In the second year of observation period, grasses either single (6.98 $ha^{-1}$) or split (6.35t $ha^{-1}$) produced significantly more dry herbage yield than the unfertilized grasses (2.93t $ha^{-1}$). Based on the mean yearly dry herbage yield, grasses applied with split manure produced the highest total dry matter herbage yield per year of 12.11 t $ha^{-1}$ while those with zero manure application had 6.24t $ha^{-1}$.

In terms of napier grass accessions, no differences were observed on the number of days to shoot emergence and total dry herbage yield. However, Ex Indonesia produced the highest dry herbage yield and Miniero produced the lowest dry herbage yield.

The marginal benefit cost ratio (3.29) of the split over the single CM application, implies that the former is better than the latter. However, any of the accessions could be used because they have comparable herbage yield.

***Keywords:*** *napier grass, accessions, chicken manure application*

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## Introduction

Livestock manure is an important resource in agriculture, because it contains high levels of nutrients and organic matter (Chen, *et al*, 2001). Studies of Hara (2001) have shown that about 70 to 80% of the nitrogen (N), 60 to 86% of the phosphate ($P_2O_5$), and 80% of the potash ($K_2O$) fed to animals are excreted in the manure. In addition to the nutrients, manure supplies valuable organic matter to help improve soil physical properties and increase the activity of beneficial soil microbes. However, the nutrient content of manure varies according to what is fed to the animals, as well as its collection, handling, and storage method. Generally, the amount of organic fertilizer applied is based on the nitrogen requirement of the crops and the rate of mineralization. Livestock manure varies in its Carbon/Nitrogen (C/N) ratio and nutrient content, but it has higher phosphate and potassium content than most organic wastes (Um and Lee, 2001). According to Brady (1974), the C/N ratio is an indication of the rate of mineralization. The lower the C/N ratio is, the faster the mineralization rate resulting in the release of available N for plants becomes. In addition, Uyanos (2002) found that mineralization rates of organic wastes added into the soil and the amount of the released inorganic nitrogen amount were interrelated with C/N ratios of the organic wastes. When the C/N ratio of the organic wastes was high, the mineralization process was longer but when their C/N ratio was low, mineralization was shorter. The amount of nitrogen released into the soil is higher as the mineralization process is realized in a short time. Likewise, Ulyanos (2002) reported that chicken manure gave the high nitrogen mineralization values after 35 days of incubation. Based on the findings of Schmitt and Rehm (1998), the availability of N in organic fraction for plant use is approximately 35-50% in the first year, 20% in the second year, and 5-10 % in the third year.

Moreover, Tiedjens (1943) claims that chicken manure is usually high in nitrogen and potash and very low in phosphorous. For this reason, one pound of super phosphate should be added for every five pounds of chicken manure when applied to the soil. Dried poultry manure contains 5.0 percent N, 3.0 percent $P_2O_3$, and 1.5 percent $K_2O$ [PCARRD (1978), cited in Rangcapan (1988)].

Gerpacio and Castillo (1975) found that dried chicken manure had 14 percent crude protein content while Blair (1973) noted the presence of 35 percent protein in dried poultry manure. On the other hand, Colligado (1978) asserted that the protein content of the chicken manure ranged from 15-38.06%. He added that variations of the nutrient contents of the chicken manure are due to several factors like feed spillage into the manure, quality of feeds given, age of animals, and moisture content.

According to Mitchell (1995), poultry manure is the most valuable among those produced by livestock. In his report, he emphasized that over fertilization of pastureland with manure causes surface and ground water contamination. He suggested that poultry manure should be applied to match the nutrient needs of the crops. He found that poultry manure contains 1.10% total N, 2.77% $P_2O_5$, 2.04% $K_2O$, 1.79% calcium, 0.38% magnesium, 0.34% sulfur, 332 ppm copper, 11950 ppm iron, 277 ppm manganese, 252 ppm zinc, and 55 ppm boron.

Further, Mitchell noted that one-third of the total N in broiler litter is in the ammonium form ($NH_4$-N) and the rest is an organic form. The amount of N available for plant uptake is ammonium nitrogen plus the amount of organic nitrogen that mineralizes during the growing season. Seventy percent of the total N in broiler litter would be available to the crop a year after application.

Napier grass (*Pennisetum purpureum* Schumach) or elephant grass is the most commonly-utilized improved pasture grass for feeding ruminant animals. It is suited to cut and carry feeding system. It contains 22% dry matter, 12.1% total digestible nutrients, 2.1% crude protein, 0.09% calcium, and 0.08% phosphorus on fresh basis (Committee on Livestock Feed Formulation (1987). It is palatable to cattle, carabaos, and goats.

The growth, yield, and quality of forage crops are affected by the amount of nutrients in the soil. It has been found that fertilizer application increased the yield of napier grass. Since inorganic fertilizer is very expensive, animal manure is an alternative source of nutrients for forage crop production. It could also improve the soil physical and chemical properties. Among the types of animal manure, chicken manure contains the highest amount of nitrogen. However, the amount of nitrogen in the chicken manure is not all immediately available for plant use. It must undergo decomposition before the plants could utilize it and the decomposition process is very slow. Hence, the recommended amount of manure was applied twice a year.

Generally, the study determined the growth and yield performance of promising napier grass accessions as affected by the frequency of chicken manure application. Specifically, it compared the effect of single and split application of chicken manure on the growth and dry herbage yield of promising napier grass accessions; identified the high-yielding napier grass accession in terms of dry matter content; and compared the cost benefit ratio of producing napier grass using either single or split application of chicken manure.

## Methodology

*Locale of the study.* The study was conducted at the experimental farm, a rainfed lowland area, of the Mariano Marcos State University in Batac, Ilocos Norte. The soil is vertisol and classified under the San Fernando soil series, which is relatively deep, clayey, and gray to black on the surface and dark gray to black underneath.

*Weather data.* Data on rainfall, temperature, and evaporation distribution during the study were drawn out from the Agrometeorological Station, MMSU, Batac City, Ilocos Norte. The mean minimum temperature during the two- year observation period ranged from 17–29°C, while mean maximum temperature ranged from 28.5–39°C. The total rainfall was 1777.9mm for the first year and 1927.5mm for the second year observation period. Meanwhile, the mean evaporation ranged from 3.7-6.7mm and the relative humidity ranged from 77–86%.

*Research design and variables.* The experiment was laid out using strip-plot design. The area was divided into three blocks; each one was divided into three horizontal strips and seven vertical strips. The frequency of manure application (Factor A) was randomly assigned to the horizontal strips and the accessions (Factor B) were randomly assigned to vertical strips. Each plot measured 3m x 4m. The following treatments were tested:

Factor A – Frequency of Chicken Manure Application
- F1: Without manure (control)
- F2: Single application
- F3: Split application

Factor B – Napier Accessions
- V1: MMSU (Control)
- V2: Ex Local
- V3; EX CIAT
- V4: Ex Cuba
- V5: Ex Indonesia
- V6: Miniero
- V7: Capricorn

*Management practices.* Chicken manure (layer) was taken from the MMSU Poultry Project in Nagbacsan, City of Batac, Ilocos Norte. Moreover, soil samples were randomly collected from the experimental area using a soil auger. The soil auger was pushed through 0-30cm soil depth. The collected samples were submitted to the Bureau of Soils Laboratory in Laoag City for the analysis of organic matter, soil pH level, soil texture, and for fertilizer recommendation. Based on the soil analysis, 0-15cm soil depth contains 1.44% organic matter, 3.17ppm of phosphorus, 231.55ppm of potassium and soil pH of 7.51. The soil within a 15-30cm depth contains 0.97% organic matter, 4.80ppm of phosphorus, 235.69ppm of potassium and soil pH of 7.80. The soil analysis results were used as bases for the rate of manure applied to the soil. The Laoag Soils Laboratory recommended a fertilizer rate of 80-60-0kg ha$^{-1}$ for nitrogen, phosphorus, and potassium, respectively.

To prepare the experimental area, it was first plowed and harrowed to loosen the soil into smaller soil particles. After that, planting materials were prepared. Mature stem cuttings of different napier grass accessions were taken from the Forage Gene Bank at Sitio Cabanasan, Quiling Sur, Batac City, Ilocos Norte. Then, the mature stems were cut into three nodes each.

The rate of manure applied was based on the nitrogen recommendation of the Bureau of Soils Laboratory. The amount of manure applied was computed using this formula:

$$\text{Amount of manure per plot} = \frac{\text{(Recommended N per ha)(plot size)}}{\text{(10000)(\%N in the manure)}}$$

The recommended amount (29.60kg plot$^{-1}$) of chicken manure was incorporated into the soil before planting for F2 treatment, while for F3 treatment, half of the recommendation (14.80kg plot$^{-1}$) was incorporated into the soil before planting and the other half was applied six months after the first application.

*Planting and other management practices.* Each plot was divided into six rows at 0.5m apart. The stem cuttings of napier grass were planted in each row by sticking the stem in inclined position at a distance of 0.5m per hill. Irrigation was done after each cutting period while weeding was done when necessary. Initial cutting was undertaken three months after planting, while succeeding cuttings were done at 45 days interval.

Then, the napier grass was harvested 90 days after planting and 45 days thereafter. The fresh herbage yields were weighed immediately after cutting to get the yield on fresh basis.

From the harvested fresh samples, 500 grams of napier grass was taken to determine the dry matter content. This was placed in a brown paper bag and dried in the oven until constant weight was obtained. This served as basis in computing for the dry herbage yield of napier grass.

Among the data gathered include days to shoot emergence, plant height, number of tillers, fresh herbage yield, dry herbage yield, survival rate, and marginal benefit cost ratio (MBCR).

*Days to shoot emergence* refers to the number of days from planting until approximately 50% of the plants in every plot developed new shoots.

Meanwhile, *plant height* (cm) was gathered from ten samples taken at random in the inner rows of each plot. It was measured from the base of the plant up to the tip of the longest leaf using a meter stick.

Moreover, the *number of tillers* was determined by counting the number of new shoots per plant of the ten sample plants randomly selected in the inner rows of each plot. That was done a day before the scheduled cutting period.

An area of 2m x 3m was taken at the inner portion of the plot for fresh herbage yield. Fresh herbage yield was taken every 45 days cutting interval. The yield per hectare was computed as:

$$\text{Fresh herbage yield} = \frac{\text{(Yield per sampling area per plot)(10000)}}{\text{(Sampling area)(1000)}}$$

*Dry herbage yield (t ha$^{-1}$).* A sub-sample of 500 g in each plot was taken every cutting period. The samples were chopped 2.5cm long and dried in an oven at 70°C for five days. Dry weight was taken after oven drying. The percent DM and dry herbage yield was computed as:

Dry Herbage Yield = Fresh herbage yield per ha x % DM

Where:

$$DM\ (\%) = \frac{\text{Oven dry weight}}{\text{Sample weight}} \times 100$$

*Survival rate (%).* The number of plants survived in each plot was counted at the end of the study. Survival rate was computed as:

$$\text{Survival rate} = \frac{\text{Number of plants survived}}{\text{Total number of plants per sampling area}} \times 100$$

*Marginal benefit cost ratio (MBCR)*. This was used to compare the added benefit and cost of producing napier grass with single and split application of chicken manure.

$$MBCR = \frac{\text{Added benefit}}{\text{Added cost}}$$

*Where:*

Added cost = cost of producing napier grass with split chicken manure application minus cost of producing napier grass with single application

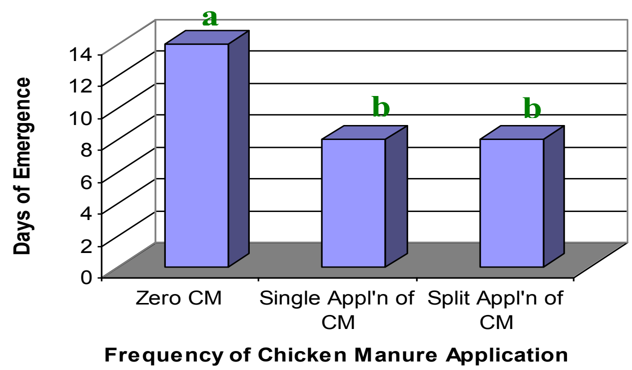
Added benefit = benefit from napier grass production with split chicken manure application minus benefit of producing napier grass with single application

*Data analysis.* All data were tabulated and processed using the analysis of variance (ANOVA) for strip-plot design. Data were further analyzed using combined analyses over seasons and over years. Significant treatment mean differences were compared using Duncan's Multiple Range Test (DMRT) at 5 percent level.

## Results and Discussion

*Number of days to shoot emergence. T*he number of days from planting to shoot emergence of napier grass fertilized with chicken manure is presented in Figure 1. Napier grass fertilized with chicken manure had new shoots at eight days after planting while the unfertilized napier grass developed shoots 14 days after. Results show that new shoots of fertilized plants emerged significantly earlier than the unfertilized plants. This could be due to the effect of the manure applied, which improves soil aeration and root penetration, and increases water holding capacity (Ocampo, 2002).

The different accessions produced new shoots from nine to eleven days after planting. Statistical analysis revealed no significant differences in the number of days to shoot emergence of the different accessions. This means that all napier accessions are statistically comparable in terms of the number of days to shoot emergence. However, its interaction with frequencies of manure application and napier grass accessions was not affected in all.




*Bars marked with a common letter are not significantly different at 5% level of significance using DMRT*

Fig. 1. Days to emergence of promising napier grass accessions as affected by the frequency of chicken manure application.

*Number of tillers.* Figure 2 shows the mean number of tillers per season of promising napier grass accessions as affected by the frequency of chicken manure application. Significant differences ($P \leq 0.05$) were observed on the number of tillers during both wet and dry seasons in the first year observation period. The unfertilized grasses produced the least number of tillers. Their tiller was significantly lesser than those fertilized with the recommended rate of chicken manure. However, grasses with either single or split manure application produced comparable number of tillers.

In the second year observation period, significant ($P \leq 0.05$) mean number of tiller differences was only observed during the dry season. Napier grasses with split manure application produced the most number of tillers (12) followed by single application (10). The unfertilized grasses had the least. However, comparable number of tillers was obtained from grasses with either single or split frequency of manure application. Results showed that napier grass with either single or split application of chicken manure produced comparable number of tillers.

Figure 3 shows the mean number of tillers per season of promising napier grass accessions as affected by the frequency of chicken manure application. All napier accessions produced comparable number of tillers during the dry season of the first year observation period. However, significant ($P \leq 0.05$) tiller differences were obtained among accessions during the wet season. The control and Ex CIAT produced the most number of tillers (15), followed by Ex Indonesia (14). Meanwhile, Miniero and Capricorn (12) had the least.

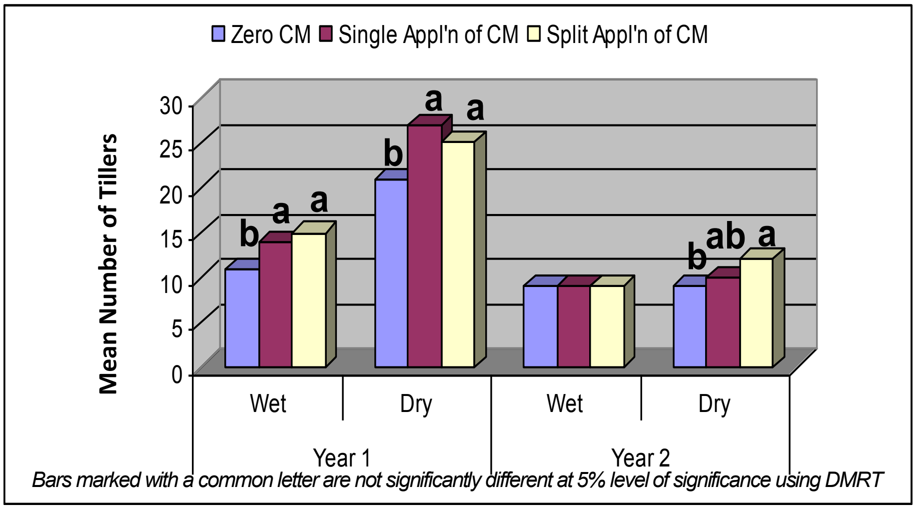



Fig. 2. Mean number of tillers per season of promising napier grass accessions as affected by the frequency of chicken manure application

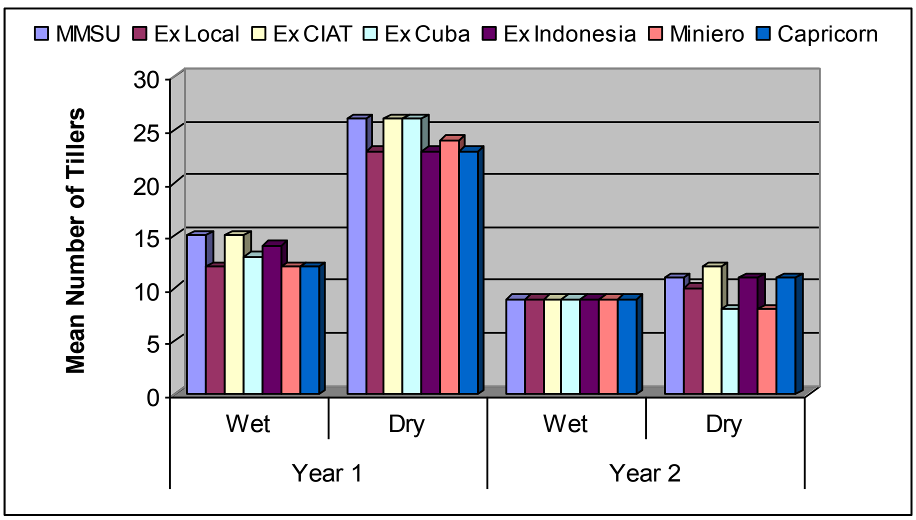



Fig. 3. Mean number of tillers per season of promising napier grass accessions as affected by the frequency of chicken manure application

All accessions produced comparable number of tillers during the wet season in the second year observation period. However, highly significant ($P \leq 0.01$) number of tiller differences was observed among accessions during the dry season. Ex CIAT produced the most number of tillers (12) but that was comparable with the other accessions except Miniero (8) and Ex Cuba (8), which produced the least number of tillers.

Combined analysis over seasons revealed that more tillers were produced during dry season than during wet season. No significant interaction effect was observed between the season and the frequency of manure application, as well as the season and the accessions. Results indicate that more tillers were produced during dry season than during wet season. This could be due to the limited amount of water for the photosynthetic activity of the plants. Combined analysis shows that over the years the number of tillers was significantly lesser during the second year observation period. However, there was no interaction between the year and the frequency of manure application, and between the year and the accessions.

*Plant height.* Figure 4 shows the mean height per season of the promising napier accessions as affected by the frequency of chicken manure application. The mean height of fertilized and unfertilized napier accessions were comparable during the dry season. However, highly significant ($P \leq 0.01$) height differences were observed during the wet season. Grasses with split application of the recommended rate of chicken manure were the tallest (mean height =129.26cm). They were significantly taller than those with single application (mean height = 112.25cm). The unfertilized grasses were the shortest (105.23cm).

During the second year observation period, significant ($P \leq 0.05$) height differences were evident in both seasons. Grasses fertilized with chicken manure, either single or split, were taller than the unfertilized grasses. However during dry season, split application of chicken manure produced significantly taller grasses than those with single and without manure application.

The mean height per season of the different napier accessions for two consecutive years is presented in Figure 5. During the wet season of the first year observation period, Ex local was the tallest, while Ex Cuba was the shortest. The height of Ex Cuba was comparable with other accessions except Ex Local and the control. However during dry season, Miniero was the shortest with a mean height of 73.81cm while Ex Indonesia was the tallest. The height of Miniero was comparable with Ex Cuba but their heights were significantly shorter than the other accessions.

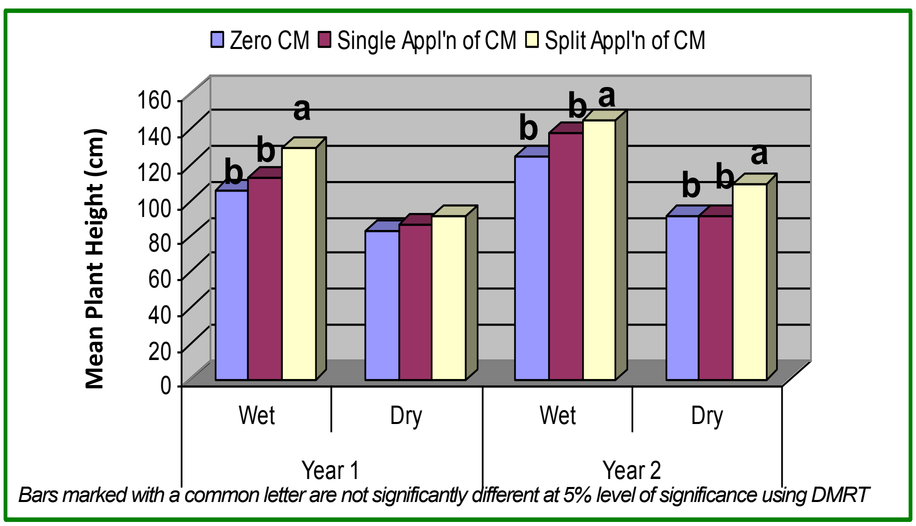



Fig. 4. Mean plant height (cm) per season of promising napier grass accessions as affected by the frequency of chicken manure application.

In the second year observation period, significant ($P \leq 0.05$) and highly significant ($P \leq 0.01$) height differences were observed during the wet and dry seasons. During the wet season, Ex Cuba was the shortest (123.47cm) but it was comparable with Miniero (131.97m), Ex Indonesia (134.56 cm) and Ex CIAT (134.44cm). The tallest grass was Ex Local (143.53cm) but it was comparable with all accessions except Ex Cuba. During the dry season, Miniero (84.43cm) and Ex Cuba (87.99cm) were significantly shorter than other accessions. Capricorn was the tallest, and it was followed by Ex Indonesia (101.34cm). Their heights were comparable with Ex Local and Ex CIAT.

Combined analysis over seasons reveals that heights of all accessions during the wet season were significantly taller than the heights obtained during the dry season. There was no significant interaction between season and frequency of manure application and season and accession. Combined analysis over the years revealed that grasses grown during the second year observation period were significantly taller compared with those obtained during the first year observation period. Among the accessions observed, Ex Local and Capricorn were consistently the tallest, while Ex Cuba and Miniero were the shortest.

*Dry herbage yield*. Figure 6 shows the dry herbage yield per season of promising accessions as affected by frequency of manure application. Grasses with split manure application (10.13t ha $^{-1}$) produced significantly ($P \leq 0.05$) higher dry herbage yield than those with single application (7.44t ha $^{-1}$) during the wet season in the first year observation period. The unfertilized grasses produced the least dry herbage yield of 4.30t ha $^{-1}$. However during the dry season, grasses with either single or split manure application produced comparable dry herbage yields with the unfertilized grasses. This concurred with the findings of Mannetje and Jone (1992) that elephant grass requires water supply and a rich supply of nutrients in order to produce high yields.

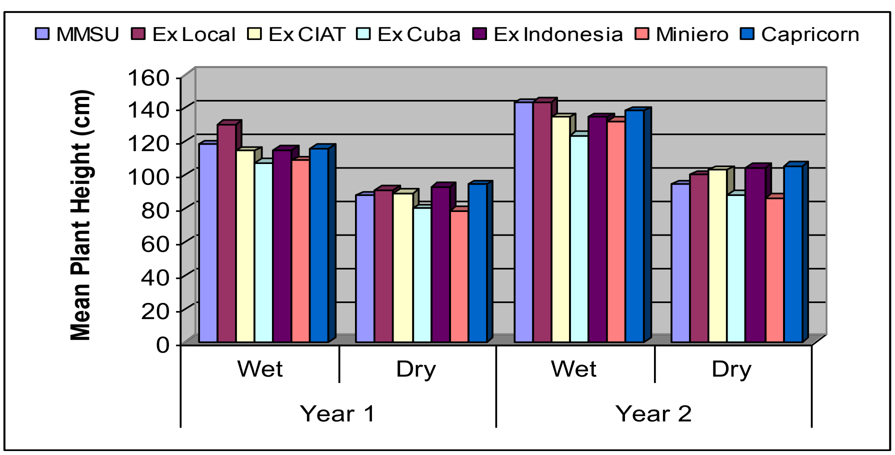



Fig. 5. Mean plant height (cm) per season of promising napier grass accessions as affected by the frequency of chicken manure application

On the other hand, during the wet season in the second year observation period, grasses with either single (6.98t $ha^{-1}$) or split (6.35t $ha^{-1}$) manure application produced significantly more dry herbage yield than that of the unfertilized grasses (2.93t $ha^{-1}$). Horne and Stur (1999) reported that no species produce high yield on infertile soil unless manure or inorganic fertilizer is applied. Nevertheless, comparable dry herbage yield ranging from 2.16 to 3.14t $ha^{-1}$ was obtained from grasses, with and without manure application, produced during the dry season. Forages also need water to grow and take up nutrients from the soil (Stur and Horne, 2001).

Combined analysis over seasons revealed that grasses produced higher dry herbage yield during the wet season than during the dry season. Significant interaction effect was observed between season and frequency of application. The dry herbage yields of grasses with either single or split manure application during the dry season were comparable with those of the unfertilized grasses during the wet season (Table 1). The two frequencies of manure application produced comparable yields both during the wet and dry seasons. Combined analysis over the years indicates that the dry herbage yield significantly decreased under all application frequencies. This implies that the amount of nutrients in the soil and from the manure was insufficient for the vegetative growth of grasses. Stur and Horne (2001) reported that a hectare of napier grass with a dry matter yield of 18t $ha^{-1}$ per year withdrew from the soil 324kg nitrogen, 22kg phosphorus, and 144kg potassium.

De Guzman (1975) found in his study that pastures are usually cut at 30-60-day intervals. It varied with seasons depending on the rate growth and pastures species. Longer cutting intervals led to higher dry matter (DM) yield and lower feeding value.

Figure 7 shows the total dry herbage yield per season of the different napier grass accessions as affected by the frequency of manure application. In terms of the

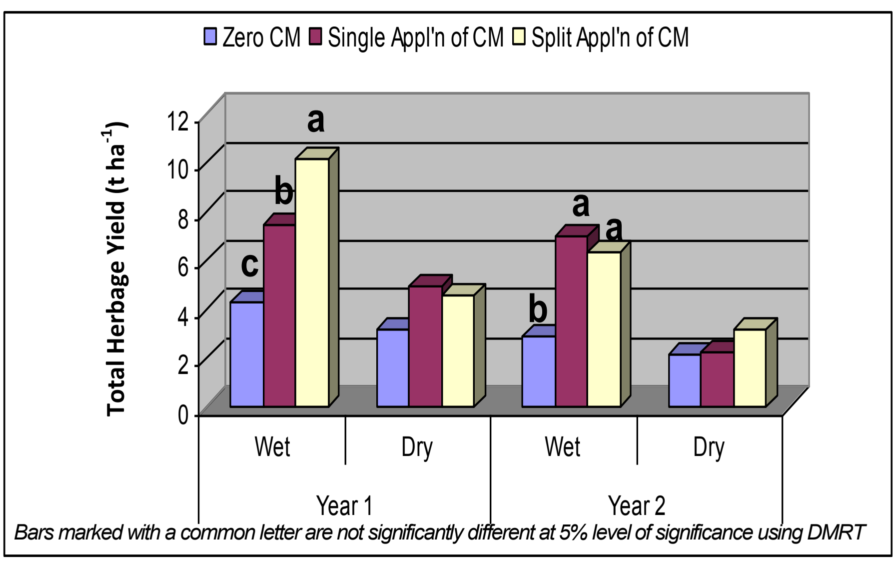



Fig. 6. Total dry herbage yield (t $ha^{-1}$) per season of promising napier grass accessions as affected by the frequency of chicken manure application.

dry herbage yield of the different accessions, highly significant differences were only observed during the dry season in the first year observation period. Ex Indonesia produced the highest dry herbage yield, but it was comparable with that of Ex CIAT, Capricorn, and the control. Miniero had the lowest dry herbage yield of 3.45t $ha^{-1}$ but it was comparable with Ex Cuba and Ex Local.

The mean yearly dry herbage yield is shown in Figure 8. Grasses with split manure application produced the highest total dry herbage yield per year of 12.11t $ha^{-1}$ while only 6.24t $ha^{-1}$ for the grasses with zero manure application. Its yield was significantly higher than those with single manure application. Results showed that split application is better than single application. This could be attributed to the availability of nutrients that resulted in the mineralization of organic matter. Mitchell (1995) reported that 70% of the total N would be available to the crop one year after application.

All accessions had comparable total yearly herbage yield.

*Survival rate.* Grasses applied with chicken manure once had the highest survival rate of 82.54% that was comparable with those split applied having a survival rate of 75.20%. The grasses without chicken manure application had the lowest survival rate of 72.22%. According to Schmitt and Rehm (1998), the lower survival rate of grasses with split application could be due to the burning effect of the top-dressed manure.

*Partial cost and return analysis.* The napier grass with single chicken manure application incurred a partial cost of PhP 5516 while those under split application was PhP 6502 (Table 2). On the other hand, the gross income from grasses with split manure application was PhP 6502 while those under single application was PhP 5516. Comparing split and single application of manure, the former is more beneficial because the MBCR was 3.79. The added expense in fertilization was compensated by the incurred yield.

Table 1.The interaction effect of season and frequency of manure application on dry herbage yield of grasses.

| FREQUENCY OF CHICKEN MANURE APPLICATION | SEASON | |
|---|---|---|
| | WET | DRY |
| Zero Application | $2.93^{bc}$ | $2.16^{c}$ |
| Single Application | $6.98^{a}$ | $2.25^{bc}$ |
| Split Application | $6.35^{a}$ | $3.15^{b}$ |

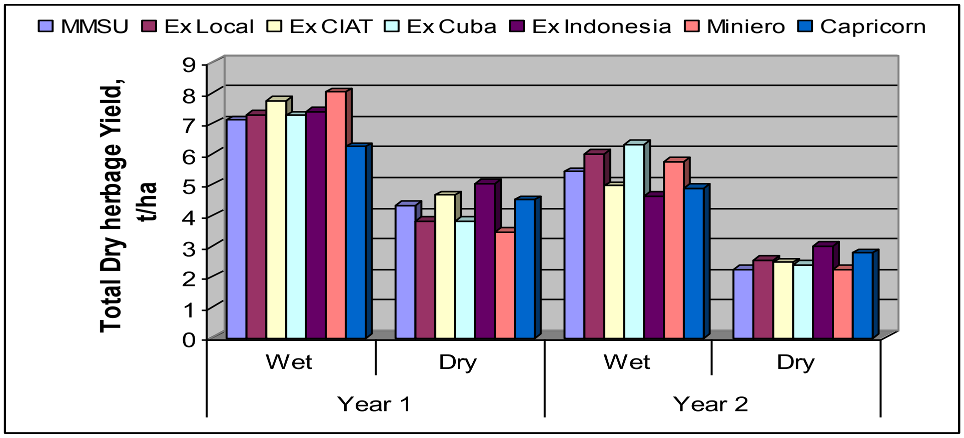



Fig. 7. Total dry herbage yield (t $ha^{-1}$) per season of promising napier grass accessions as affected by the frequency of chicken manure application.

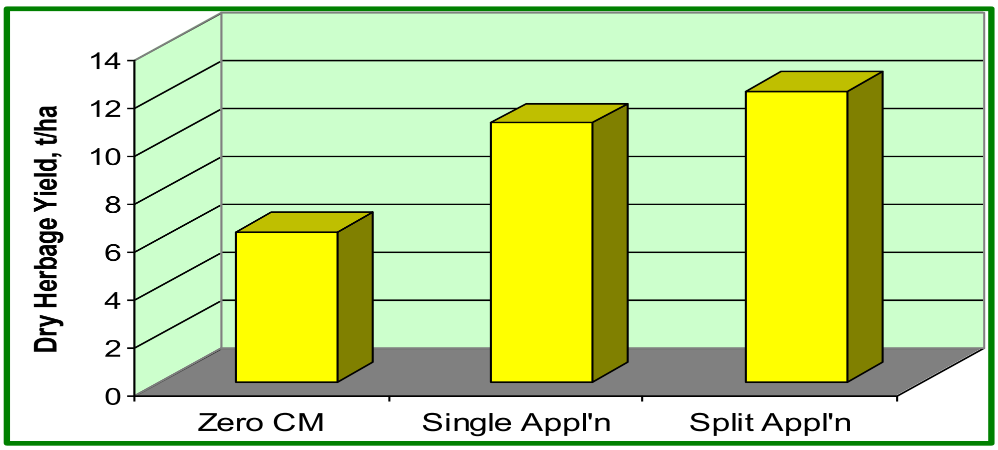



Fig. 8. Mean yearly dry herbage yield (t $ha^{-1}$) of promising napier grass accessions as affected by the frequency of chicken manure application.

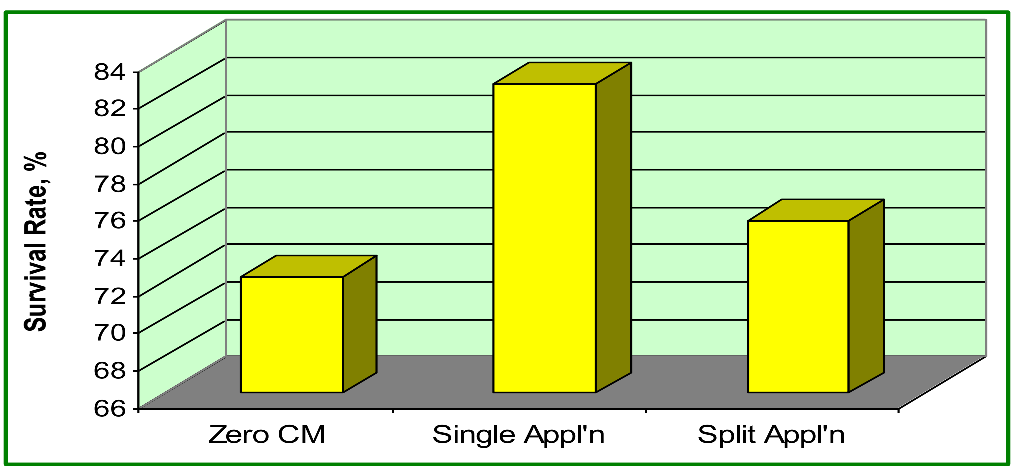



Fig. 9. Survival rate (%) of promising napier grass accessions as affected by the frequency of chicken manure application.

Table 2. Partial cost and return analysis of napier grass accession promising accessions as affected by frequency of manure application.

| ITEM | FREQUENCY OF APPLICATION | |
|---|---|---|
| | Single | Split |
| **Partial Cost of Production** | | |
| Labor Cost on Fertilization, Php | 1575 | 2127 |
| Labor Cost on Harvesting, Php | 2941 | 4375 |
| Total Cost, Php | 5516 | 6502 |
| **Income** | | |
| Fresh Herbage Yield (kg $ha^{-1}$) | 54050 | 60555 |
| Gross Income, Php | 27025 | 30275 |
| Added Benefit, Php | | 3250 |
| Added Cost, Php | | 986 |
| MBCR | | 3.29 |
| Net Benefit | | 2.29 |

Labor Cost – Php 175 per man-day
Fresh napier grass – Php 0.50/kg

## Conclusions and Recommendations

The new shoots of napier grass with either single or split chicken manure application emerged earlier than those without manure application. Likewise, the different napier grass accessions produced new shoots from nine to eleven days.

Grasses with either single or split manure application produced comparable number of tillers but significantly more than those without manure application. Specifically, Ex CIAT, Ex Indonesia, and the control produced the most number of tillers, while Miniero and Ex Cuba produced the least number of tillers.

Meanwhile, grasses with split application were significantly taller than those without manure application but comparable with those, which had single application during the wet season in the first year observation period. Ex Indonesia and Ex Local were the tallest accessions, while Ex Cuba and Miniero were the shortest.

Further, there was a significant interaction effect between season and frequency of chicken manure application on dry herbage yield. The dry herbage yield of grasses with either single or split manure application was significantly higher than those without manure application during the wet season. On the other hand, significant yield differences among accessions were only observed during the dry season in the first year observation period, with Ex Indonesia as the highest yielder while Miniero as the lowest.

Grasses with single application had the highest percent survival rate but comparable with those under split application. The net benefit obtained from grasses with split application over the single chicken manure application was 2.29.

Based on the results, split application of manure is better than single application because the yield increase compensated the added cost incurred in manure application. All accessions had comparable dry herbage yield.

As such, yield evaluation should be done for at least three years to assess the long-term effect of the manure on the yield and quality of grasses. In addition, there should be a periodic soil nutrient evaluation to determine the effect of manure on the physical and chemical properties of the soil.

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