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ABSTRACT

The study was conducted at the Horticulture Experiment Farm, Benguet State University, La Trinidad, Benguet from November 2011 to February 2012 to determine the effects of different rates of organic and inorganic fertilizers on the growth and yield of cauliflower, and the economics of fertilizer application in growing the crop.

Results indicate that plants applied with 120-100-100 kg N-P_2O_5-K_2O/ha plus 2 t/hachicken manure significantly were taller, matured earlier, had bigger curds, and had higher yield with greater return on investment derived.

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INTRODUCTION

Cauliflower (*Brassica oleracea*L. var. *botrytis*L.) belongs to the Mustard or Cruciferae family. The name of this elegant member of the cabbage family comes from the Latin *caulis* (“stalk”) and *floris* (“flower”). Cauliflower comes in three basic colors: white (the most popular and readily available), green and purple (a vibrant violet that turns pale green when cooked). All cauliflower is composed of bunches of tiny florets on clusters of stalks. Some white varieties have a purple or greenish tinge. It is one of the common Brassica crops grown by farmers. It is a good source of vitamin A and sweeter than any of its relatives, it ranks as one of the expensive vegetable in the market. The curd is the edible part which consists of a compact terminal mass of greatly thickened and modified flower structures with sub-tending fleshy stalks. This can be eaten as cooked or pickled (Panas, 1995).

This vegetable is very sensitive to some factors such as pests and diseases, weather condition, and farm management. Most varieties grow well in mid and high elevations during the dry season. Some varieties may perform well during the wet season in these areas. In low elevations, some varieties also perform well especially during the dry cool months. These crops can be planted in most soils but clay loam to sandy loam is best.

Cauliflower is sensitive to high acidity. Where soil reaction ranges from pH 5.5 to 6.6 maximum yields could be obtained. Cauliflower requires a cool, moist growing season. It cannot withstand low temperatures, or too much heat, dry weather and low humidity. It succeeds better when the days are short(Deanon, 1976).

The production of cauliflower hardly copes with the demand because farmers lack technical knowledgein fertilizer management to obtain high yield and quality.

Although this crop is adapted to places having cool climates like Benguet and Mt. Province, it requires adequate mineral nutrition. Thus, the kind and amount of fertilizer applied either organic or inorganic form determine the yield performance of the crop.

The result of this study could serve as a reference in the application of appropriate fertilizers to cauliflower. Therefore, this study aimed to determinethe effectsof different rates of organic and inorganic fertilizers on the growth and yield of cauliflower, the best rateof fertilizerto apply, and the economics ofusing differentfertilizer levels incauliflower production.

The studywas conducted at the Horticulture ExperimentFarm, Benguet State University, La Trinidad, Benguet from November 2011 to February 2012.

REVIEW OF LITERATURE

Fertilizer Application

Applying excessive amounts of fertilizer has negative environmental effects, and wastes the growers' time and money. To avoid over-application, the nutrient status of crops should be assessed. Nutrient deficiency can be detected by visually assessing the physical symptoms of the crop. Nitrogen deficiency, for example has a distinctive presentation in some species.

As proven in some researches (Holmer, 1998; Trüggelmann*et al.*, 2000), the best yield and quality results for vegetable production in Philippine soils are obtained when a combination of organic and inorganic fertilizers is applied. According to the study of Caliag (2011), most of the farmers in Kabayan, Benguet used organic fertilizers (96%) such as chicken manure while some used ashes (26%) and 2% uses compost. They applied fertilizer based on their experience and were based from co-farmers experiences or recommendations. The respondents followed a variety of methods in fertilizer application such as application of organic fertilizers during land preparation and hilling up, organic fertilizers are used as basal and inorganic as side dress and organic and inorganic fertilizers are used at the same time during land preparation. It was noted that farmers used a combination of organic and inorganic fertilizers.

Organic fertilizers such as manure and compost are needed to improve the physical, biological and chemical properties of the soil while inorganic fertilizers such as urea, muriate of potash, and others supply sufficient amounts of readily available nutrients. Organic fertilizers normally do not exceed values of 3% for nitrogen, phosphorous and potassium, those are much higher in inorganic fertilizers (46% N in urea, 46% P_2O_5 in DAP) and 60% K_2O in muriate of potash. If one wishes to grow crops only with organic fertilizers, it has to be considered that tons per hectare must be applied to supply typical crop nutrient needs.

The general method is to apply all of the organic fertilizer, all of the P and part of the other inorganic fertilizers into the soil just prior to planting. This is called basal application. Be sure that all fertilizers are covered with a 3-4 cm layer of soil before setting the plants to avoid burning of the roots. One half of the nutrient amount for N, K and other nutrients are applied one week after transplanting as first side dressing.The remaining balance is given two weeks thereafter (Holmer, 1998).

Effect of Organic Fertilizer

Organic fertilizer is an important ingredient in the soil as it supplies some of the nutrients required by the crop and it promotes favorable soil properties such as granulation, efficient soil aeration and improves the conditions of the soil to boost agricultural production at lesser expense (Bautista and Mabessa, 1977). Although the density of nutrients in organic material is comparatively modest, they have many advantages. The majority of nitrogen supplying organic fertilizers contains insoluble nitrogen and act as a slow-release fertilizer. By their nature, organic fertilizers increase physical and biological nutrient storage mechanisms in soils, mitigating risks of over-fertilization (Stewart *et al*, 2005). According to Tisdale and Nelson (1975), organic fertilizer releases the nutrient elements slowly especially nitrogen for efficient utilization of plants. Once available nutrients are translocated to plants, growth and yield increase.An excess application of organic fertilizers may also result in chemical fixation of micronutrients such as zinc.

Knott (1964) mentioned that the application of organic fertilizers like manure in the soil prior to planting or sowing time provides available nutrients and improve physical condition of the soil that results high yield. Chicken manure fertilizer is very high in nitrogen and also contains a good amount of potassium and phosphorus. The high nitrogen and balanced nutrients is the reason that chicken manure compost is the best kind of manure to use. But, the high nitrogen in the chicken manure is dangerous to plants if the manure has not been properly composted. Raw chicken manure fertilizer can burn and even kill plants if used. Composting chicken manure mellows the nitrogen and makes the manure suitable for the garden.

Similarly, Watts (1972) stated that, chicken dung is the most valuable fertilizers among garden purposes. It has been regarded as the best fertilizer for onions and other garden crops requiring large amount of nitrogen.

As reported by Abadilla (1982) crops fertilized with organic matter have greater resistance to pest and diseases, it also improves the quality of crops, a characteristic that has a definite commercial value.

Brady and Buckman (1960) stated that chicken manure contains 1% nitrogen, 0.8% phosphorus and 0.40% potassium. Deanon (1976), states that under La Trinidad condition it is customary to mix a truckload of compost chicken manure with the soil of a hectare before planting.

Effect of Inorganic Fertilizer

Inorganic fertilizers are designed to give plants all the nutrients-nitrogen, phosphorous and potassium that they need in appropriate proportions and amounts. Hence, plants do not get more of one can of nutrient over the other. Instead it has a balance of all the nutrients it needs and are readily available at a given time. Adding inorganic fertilizers into the soil to be planted makes the soil ideal for planting as it is already enriched with nutrients. They work quickly in small amounts (Edmund, 1975) found that basal applications of N, P, and K are needed to promote the growth of plant stems and leaves.

Bautista and Mabessa (1977) cited that inorganic fertilizer are available for the plant as it dissolved, unlike organic materials that must rot and decay properly before they become beneficial to plant. Martin and Leonard (1970) stated that plants grown with sufficient amount of available nitrogen in the soil makes a thrifty, rapid growth with a healthy deep color. Ample nitrogen has the tendency to encourage stem and leaf development. An adequate amount of potassium in the soil insures greater efficiency in photosynthesis, increase resistance to certain disease, helps to balance an oversupply of nitrogen and aids plants to utilize soil moisture more advantageously.

The main advantage that inorganic fertilizers have over organic fertilizers is that they can be used immediately to rescue dying plants. This is because the nutrients present in them are easily absorbed by the plants and unlike the nutrients present in organic fertilizers; do not need to be broken into primary nutrients for absorption by plants. Another advantage that inorganic fertilizers are that they are easily available at most gardening stores and hence, is quite convenient to use. The main disadvantage of inorganic fertilizers is that it costs much higher than the organic fertilizers. So, if someone is using fertilizers in bulk, organic fertilizers are much more cost effective. The second disadvantage of using inorganic fertilizers is the problem of leaching. The fertilizer and the nutrients getting washed away, is much more prevalent when inorganic fertilizers are used. This is because in inorganic fertilizers, the nutrients are already in their most basic components, and hence, can be washed away easily, if the plant roots are over watered or watered with force.

Rate of Fertilizer Application

In a fertilizer study with cauliflower in Taiwan, Bantoc Jr. (1967) as cited by Alinio (1978) concluded that the best treatment was 200kg of N, 100kg of P_2O_5 and 150 kg of K_2O per hectare.

Further more, Somera (1970) as cited by Alinio (1978) said that cauliflower is more responsive to the application of 200 kg of nitrogen and 270 kilograms of phosphorus with the level of potassium maintained. An increase in the amount of P and K from 270 to 220 kg per hectare decreases yield.

Sucdad (2004) reported that plants applied with either 3 t/ha of chicken manure or 45-45-45 kg of N- P_2O_5-K_2O per hectare plus 1.5 t/ha of chicken manure before transplanting or two weeks after transplanting increased the marketable yield of cabbage and correspondingly the return of investment.

Based on the study of Bilango (2002), 2t/ha of chicken manure plus 60-45-45 kg of N-P_2O_5-K_2O/ha promoted earlier curd formation, heavier curd weight, higher marketable yield and higher return of investment in broccoli. These indicate that combinations of organic and inorganic fertilizer application are necessary to obtain better crop performance and productivity.

MATERIALS AND METHODS

Materials

The materials used in the study were seedlings of cauliflower (White Flash F_1 hybrid cultivar), chicken manure, 14-14-14, urea, insecticides, fungicides, sticks with identifying marks, and farm tools.

Methods

The experiment was laid out following the Randomized Complete Block Design (RCBD) with five treatments replicated four times. The area was divided into four blocks representing the replications.

The treatments were as follows:

Code	Fertilizer rates ($kgN-P_2O_5-K_2O/ha$)
R_1	60-100-100
R_2	120-100-100
R_3	180-100-100
R_4	120-100-100 plus 2 t/ha chicken dung
R_5	2 t/ha chicken dung

Seedling establishment.Seeds of cauliflower were sown in seed trays using compost and garden soil as growing media. Water was supplied regularly and pest control was done when necessary.

Land preparation. An area of $100m^2$ were thoroughly prepared and divided into four blocks consisting of five plots measuring 1 x 5 meters. Holes at a distance of 30cm between rows and 40cm between hills were made.

Transplanting. The seedlings were transplanted four weeks from sowing.

Fertilizer application. Half of the computed amount of fertilizer rates was applied two weeks after transplanting and the other half was applied four weeks after transplanting followed by hilling- up.

Crop maintenance.All other recommended cultural management practices such as irrigation, weeding and insect pest and disease control were followed. Three to five outer leaves were wrapped around the curds for protection from direct sunlight and damage.

Harvesting. Curds were harvested as soon as they reach the proper market size. The usual practice of harvesting in which the curd with the stem is cut was followed. The curds were packed with the outer leaves untrimmed.

Data Gathered:

1. Number of days from transplanting to curd formation. This was taken by counting the number of days from transplanting to the day the curds are visible at the shoot apex of the plants.

2. Number of days from transplanting to curd harvesting. This was obtained by counting the number of days from transplanting to the day the flower buds are tightly closed without any flower bud opened and the curd expanded to its full size.

3. Final plant height (cm). Five samples from each treatment plot were measured from the soil line to the top of the curd before harvesting.

4. Curds stem length (cm). Five samples from each treatment plot were measured from the top of the curd down to the last node of the stem above the ground.

5. Curd diameter (cm). Five sample curds from each treatment were measured

from edge to edge of the curd across the curd surface.

6. Average weight of curds (kg). This wasobtained by using the formula:

$$\text{Average weight of curds} = \frac{\text{Weight of curds per plot}}{\text{Number ofcurds per plot}}$$

7. Weight of marketable curds per plot (kg). This was the weight of the curds harvested without any defects.

8. Weight of non-marketable curds per plot (kg). This was the weight of the curds harvested with defects such as short stem or small curd, rotten curd, and other abnormal formations.

9. Total yield (kg). This was the weight of curds that were harvested.

10.Cost and return analysis. The return on investment (ROI) was computed usingthe formula:

$$\text{ROI (\%)} = \frac{\text{Gross sale/plot} - \text{Total expenses/plot}}{\text{Total expenses/plot}} \times 100$$

11.Other observations. The color of the curds was taken.

12. Soil analysis. Soil samples were taken for analysis before the application of fertilizers. Analysis was done at the Bureau of Soils in Pacdal, Baguio City.

13. Meteorological data. The monthly average relative humidity, minimum and maximum temperature, rainfall, and total bright sunshine during the conduct of the study were taken from the BSU PAG-ASA station.

RESULTS AND DISCUSSION

Number of Days from Transplanting to Curd Formation

Table 1 shows that plants applied with 120-100-100 kg N-P_2O_5-K_2O/ha plus 2 t/ha chicken manure and those applied with 2t/ha chicken manure alone formed curds significantly earlier at 46.5and 47 days, respectively after transplanting compared to the rest of the treatment plants.Theseobservation indicate the beneficial effects of a combination of organic and inorganic fertilizer application to the vegetative growth of plants.

Number ofDays from Transplanting to Curd Harvesting

Application of a combination of inorganic fertilizer at 120-100-100 kg/ha N-P_2O_5-K_2Oplus 2 t/ha chicken manure significantlypromoted earlier harvesting of cauliflower at 54.25 days from transplanting (Table 2).This shows the advantage of organic and inorganic fertilizer application on curd development for earlier harvesting.

Table 1. Number of days from transplanting to curd formation

TREATMENT (kg N-P_2O_5-K_2O/ha)	MEAN
60-100-100	52.75[a]
120-100-100	53.25[a]
180-100-100	54.50[a]
120-100-100 plus 2t/ha chicken dung	46.50[b]
2 t/ha chicken dung	47.00[b]

Means with the same letter are not significantly different at 5% level by DMRT.

Table 2. Number of days from transplanting to curd harvesting

TREATMENT (kg $N-P_2O_5-K_2O$/ha)	MEAN
60-100-100	61.25[a]
120-100-100	60.58[ab]
180-100-100	60.00[b]
120-100-100 plus 2t/ha chicken dung	54.25[d]
2 t/ha chicken dung	56.75[c]

Means with the same letter are not significantly different at 5% level by DMRT.

Final Plant Height and Curd Stem Length

Plants applied with 120-100-100 kg/ha $N-P_2O_5-K_2O$plus 2 t/ha chicken manure were significantly the tallest and had longer curd stem lengthscompared to the other treatment plants (Table 3). Those plants applied with inorganic fertilizer alone had comparatively shorter plant height.

This observation is similar with the findings of Paatan (1997) that the application of a combination of organic and inorganic fertilizersenhanced vegetative growth having taller plants.

Curd Diameter

Results show that application of 120-100-100 kg/ha $N-P_2O_5-K_2O$plus 2 t/ha chicken manure significantly effected wider curd diameter compared to the diameter of the rest of the treatment plants (Table 4).

Thisfinding conforms with the conclusion of Bilango (2002) wherein application of 2t/ha chicken manure plus N-P-K promotes earlier curd formation and harvesting, taller height and longer curd stem length and development of larger and heavier curds of broccoli.

Table 3. Final plant height and curd stem length

TREATMENT (kg N-P_2O_5-K_2O/ha)	FINAL PLANT HEIGHT (cm)	CURD STEM LENGTH (cm)
60-100-100	10.87[c]	9.95[c]
120-100-100	11.36[c]	10.33[c]
180-100-100	10.98[c]	10.04[c]
120-100-100 plus 2t/ha chicken dung	13.46[a]	12.65[a]
2 t/ha chicken dung	12.5[b]	11.55[b]

Means with the same letter are not significantly different at 5% level by DMRT.

Table 4. Curd diameter

TREATMENT (kg N-P_2O_5-K_2O/ha)	MEAN (cm)
60-100-100	7.11[d]
120-100-100	8.13[bc]
180-100-100	7.30[bc]
120-100-100 plus 2t/ha chicken dung	11.00[a]
2 t/ha chicken dung	8.99[b]

Means with the same letter are not significantly different at 5% level by DMRT.

Average Weight of Curds

Table 5 shows that plants applied with 120-100-100 kg/ha N-P_2O_5-K_2Oplus 2 t/ha chicken manure or 2 t/ha chicken manure alone and 120-100-100kg/ha N-P_2O_5-K_2O significantly promoted heavier curd weight.

Marketable, Non-marketable, and Total Yield

Results show that plants applied with 120-100-100 kg/ha N-P_2O_5-$K_2O$and 2 t/ha chicken manure significantly produced higher marketable and total curd yield compared to the yield of the other treatment plants as shown in table 6.

This indicates a complementary effect of the combination of organic and inorganic fertilizer application in enhancing yield.

On the other hand, there were no significant differences obtained on the weight of non-marketable curds.

Table 5. Average weight of curds

TREATMENT (kg N-P_2O_5-K_2O/ha)	MEAN (g)
60-100-100	204.06[c]
120-100-100	311.25[ab]
180-100-100	219.38[bc]
120-100-100 plus 2t/ha chicken dung	476.31[a]
2 t/ha chicken dung	322.34[a]

Means with the same letter are not significantly different at 5% level by DMRT.

Table 6. Marketable, non-marketable,and total yield

TREATMENT (kg $N-P_2O_5-K_2O$/ha)	YIELD (kg/1x5m plot) MARKETABLE	NON-MARKETABLE	TOTAL
60-100-100	2.17[c]	1.64[a]	3.27[c]
120-100-100	2.60[bc]	2.06[a]	4.56[bc]
180-100-100	1.23[c]	2.34[a]	3.57[bc]
120-100-100 plus 2t/ha chicken dung	6.20[a]	1.42[a]	7.62[a]
2 t/ha chicken dung	3.92[b]	1.24[a]	5.16[b]

Means with the same letter are not significantly different at 5% level by DMRT.

Cost and Return Analysis

The highest return of investment (ROI) was obtained from plants applied with 120-100-100 kg/ha $N-P_2O_5-K_2O$plus 2 t/ha chicken manure followed by the application of 2t/ha chicken manure alone. A negative ROI was obtained with the highest inorganic fertilizer rate of 180-100-100kg/ha $N-P_2O_5-K_2O$ (Table 7).

Table 7. Cost and return analysis

ITEMS	T_1	T_2	T_3	T_4	T_5
Marketable yield (kg/1x5m plot)	8.67	10.40	4.92	24.81	15.69
Sales (Php)	130.05	156.00	73.80	372.15	235.35
Farm inputs					
Seeds	55.00	55.00	55.00	55.00	55.00
14-14-14	26.57	43.40	43.40	43.40	-
Urea	1.30	2.61	10.44	2.61	-
Chicken dung	-	-	-	24.00	24.00
Insecticides	18.00	18.00	18 .00	18.00	18.00
Fungicides	13.00	13.00	13.00	13.00	13.00
Total expenses (Php)	113.87	132.01	139.84	156.01	110.00
Net income (Php)	16.18	23.99	-66.04	216.14	125.35
ROI(%)	14.21	18.17	-47.23	138.54	113.94
RANK	4	3	5	1	2

Note: Selling price was Php15.00/ kg.

Legend:

kg $N-P_2O_5-K_2O$/ha

T_1-60-100-100

T_2-120-100-100

T_3-180-100-100

T_4-120-100-100 plus 2 t/ha chicken manure

T_5-2 t/ha chicken manure

Other Observations

Color of the curds

Treatment	Description
60-100-100	slightly yellowish
120-100-100	slightly yellowish
180-100-100	yellowish white
120-100-100 plus 2t/ha chicken manure	white, yellowish white
2 tons/ha chicken manure	light purple

Soil Analysis

The soil in the experiment area prior to fertilizer application had a pH value of 6.59, 0.05% nitrogen, 50 ppm phosphorus, 400 ppmpotassium, and 1 % organic matter. The soil pH obtained meets the pH requirement for cauliflower production which ranges from 5.5 to 6.6 (Deanon, 1976).

Meteorological Data

The minimum and maximum temperature during the study period ranged from 23.9 to 24.66^{0}C and 10.7 to 14.48 ^{0}C, respectively while the relative humidity ranged from 83.63 to 86.90 %. Minimal rainfall of 0.72, 1.4 and 3.4 mm were recorded in December, January and February and sunshine duration was 227.71, 296.95 and 304.1 minutes, respectively.

Table 8. Soil analysis

	pH	N(%)	P,ppm	K,ppm	OM (%)
Initial soil analysis	6.59	0.05	50	400	1.0

Table 9.Meteorological data

MONTH	RAINFALL (mm)	RH (%)	TEMPERATURE (^{0}C)		SUNSHINE DURATION (minutes)
			MAX.	MIN.	
December	0.72	86.90	24.66	14.48	227.71
January	1.40	83.63	24.15	13.10	296.95
February	3.40	86.60	23.90	10.70	304.18

Pictorial Presentation

Fig. 1. Overview of the experiment field 30 days after transplanting

Fig. 2. Vegetative stage of sample plants35 days after transplanting

Plants applied with 60-100-100 kg $N-P_2O_5-K_2O$/ha

Plants applied with120-100-100 kg N-$P_2O_5-K_2O$/ha

Plants applied with 180-100-100 kg
N-P_2O_5

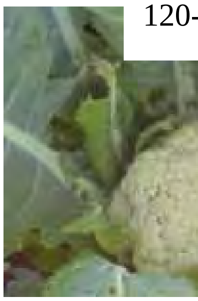
Plants applied with120-100-100 kg
O/ha + 2t/ha chicken
manure

Plants applied with 2 t/ha chicken manure

Fig. 3. Sample curds harvested

60-100-100 kg N-P_2O_5-K_2O/ha

120-100-100kg N-P_2O_5-K_2O/ha



180-100-100kg N-P_2O_5-K_2O/ha

120-100-100 kg N-P_2O_5-K_2O/ha plus 2 t/ha chicken manure

2t/ha chicken manure

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study was conducted at Benguet State University Horticulture ExperimentFarm from November 2011 to February 2012 to determine the performancecauliflower and profitability of growing the crop as affected by different rates of organic and inorganic fertilizer application.

Results reveal that plants applied with 120-100-100 kg/ha N-P_2O_5-K_2Oplus 2 t/ha chicken manure were significantly harvested earlier, taller with longer curd stem and wider curd diameter, and higher in marketable yield from which the highest return of investment of 138.54 % was obtained.

Conclusion

Better growth and yield of cauliflower could be obtained with the application ofacombination of 120-100-100 kg/ha N-P_2O_5-K_2O and 2 t/ha chicken manure in the soil having a pH of 6.59, 0.05% nitrogen, 50 ppm phosphorus, 400 ppm potassium, and 1% organic matter.

Recommendation

It is therefore recommended that cauliflower be applied with 120-100-100 kg N-P_2O_5-K_2O/haplus 2 t/ha chicken manure to obtain high yield and profit.

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APPENDICES

Appendix Table 1. Number of days from transplanting to curd formation

TREATMENT (kg N-P_2O_5-K_2O/ha)	REPLICATION I	II	III	IV	TOTAL	MEAN
60-100-100	52	52	53	54	211	52.75[a]
120-100-100	53	54	53	53	213	53.25[a]
180-100-100	54	55	54	55	218	54.50[a]
120-100-100 plus 2t/ha chicken dung	45	45	49	47	186	46.50[b]
2 t/ha chicken dung	44	46	50	48	188	47.00[b]

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	F VALUE	TABULATED F 5%	1%

Replication	3	14.8	4.93			
Treatment	4	225.7	56.42	32.71**	5.41	3.26
Error	12	20.7	1.73			
TOTAL	19	261.2				

**-highly significant

Coefficient of variation: 2.59%

Appendix table 2. Number of days from transplanting to curd harvesting

TREATMENT (kg N-P_2O_5-K_2O/ha)	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
60-100-100	60	61	62	62	245	61.25^a
120-100-100	60	60.33	60	62	242	60.5^{ab}
180-100-100	59	60	59	62	240	60.00^b
120-100-100 plus 2t/ha chicken dung	53	54	55	55	217	54.25^d
2 t/ha chicken dung	55	56	58	58	227	56.75^c

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	F VALUE	TABULATED F 5%	TABULATED F 1%
Replication	3	15.14	5.05			

Treatment	4	141	35.25	72.11 **	3.26	5.41
Error	12	5.87	0 .49			
TOTAL	19	162				

**-highly significant   Coefficient of variation: 1.19%

Appendix table 3. Final plant height (cm)

TREATMENT (kg N-P_2O_5-K_2O/ha)	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
60-100-100	10.40	11.06	11.14	10.9	43.50	10.87[c]
120-100-100	11.04	10.24	11.68	12.48	45.44	11.36[c]
180-100-100	10.88	10.86	10.74	11.44	43.92	10.98[c]
120-100-100 plus 2t/ha chicken dung	12.76	13.10	13.82	14.16	53.84	13.46[a]
2 t/ha chicken dung	12.82	12.26	12.76	12.16	50	12.5[b]

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	F VALUE	TABULATED F	
					5%	1%

Replication	3	1.82	0.61			
Treatment	4	19.89	4.97	19.34 **	3.26	5.41
Error	12	3.09	0.26			
TOTAL	19	24.80				

**-highly significant Coefficient of variation: 4.29%

Appendix table 4.Curd stem length (cm)

TREATMENT (kg N-P_2O_5-K_2O/ha)	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
60-100-100	9.1	9.6	10.24	9.86	39.8	9.70[C]
120-100-100	10.02	9.36	10.38	11.54	41.3	10.33[C]
180-100-100	9.72	10.26	9.78	10.38	40.14	10.04[C]
120-100-100 plus 2t/ha chicken dung	12.58	12.2	12.81	13.02	50.61	12.65[a]
2 t/ha chicken dung	11.5	11.7	11.66	11.36	46.22	11.56[b]

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	F VALUE	TABULATED F	
					5%	1%

Replication	3	1.42	0.47			
Treatment	4	24.03	6.00	28.25**	3.26	5.41
Error	12	2.55	0.21			
TOTAL	19	28				

**-highly significant   Coefficient of variation: 4.25%

Appendix table 5. Curd diameter (cm)

TREATMENT (kg N-P_2O_5-K_2O/ha)	REPLICATION I	II	III	IV	TOTAL	MEAN
60-100-100	6.23	7.52	8.13	6.54	28.42	7.11^{d}
120-100-100	8.00	7.26	8.39	8.85	32.50	8.13^{bc}
180-100-100	6.42	7.85	7.42	7.49	29.18	7.30^{cd}
120-100-100 plus 2t/ha chicken dung	10.49	10.37	11.92	11.2	43.98	11.00^{a}
2 t/ha chicken dung	9.00	8.96	9.26	8.73	35.95	8.99^{b}

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	F VALUE	TABULATED F 5%	1%

Replication	3	2.56	0.85			
Treatment	4	40.00	10.00	30.65**	3.26	5.41
Error	12	3.91	0.32			
TOTAL	19					

**-highly significant Coefficient of variation: 6.72%

Appendix table 6. Average weight of curds (g)

TREATMENT (kg N-P_2O_5-K_2O/ha)	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
60-100-100	143.75	235.63	230.00	206.88	816.25	204.06^{c}
120-100-100	212.50	381.88	362.50	288.13	1245.00	311.25^{ab}
180-100-100	234.38	248.75	228.13	181.25	658.13	219.38^{bc}
120-100-100 plus 2t/ha chicken dung	355.24	368.75	668.75	512.50	1905.24	476.31^{a}
2 t/ha chicken dung	305.63	268.75	356.25	358.75	1289.38	322.34^{a}

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF	SUM OF SQUARES	MEAN OF SQUARES	F VALUE	TABULATED F

FREEDOM					5%	1%
Replication	3	11205.06	3735.02			
Treatment	4	96508.31	24127.08	7.34**	3.26	5.41
Error	12	39434.02	3286.17			
TOTAL	19	147147.40				

**-highly significant Coefficient of variation: 19.70%

Appendix table 7. Marketable yield (kg/1x5m plot)

TREATMENT (kg N-P_2O_5-K_2O/ha)	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
60-100-100	2.17	2.18	2.42	1.90	8.67	2.17[c]
120-100-100	0.66	2.43	3.41	3.90	10.40	2.60[bc]
180-100-100	0.75	1.27	1.15	1.75	4.92	1.23[c]
120-100-100 plus 2t/ha chicken dung	4.19	4.50	8.90	7.22	24.81	6.20[s]
2 t/ha chicken dung	3.76	3.58	4.5	3.85	15.69	3.92[b]

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF	SUM OF SQUARES	MEAN OF SQUARES	F VALUE	TABULATED F

	FREEDOM				5%	1%
Replication	3	14.72	4.91			
Treatment	4	64.89	16.22	17.19**	3.26	5.41
Error	12	11.33	0.94			
TOTAL	19	90.94				

**-highly significant   Coefficient of variation: 31.18%

Appendix table 8. Non-marketable yield (kg/1x5m plot)

TREATMENT (kg N-P_2O_5-K_2O/ha)	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
60-100-100	2.30	1.59	1.26	1.41	6.56	1.64[a]
120-100-100	3.15	2.40	1.98	0.71	8.24	2.06[a]
180-100-100	3.00	2.71	2.50	1.15	9.36	2.34[a]
120-100-100 plus 2t/ha chicken dung	1.50	1.40	1.80	0.98	5.68	1.42[a]
2 t/ha chicken dung	1.13	0.72	1.20	1.89	4.94	1.24[a]

ANALYSIS OF VARIANCE

SOURCE OF	DEGREES OF	SUM OF SQUARES	MEAN OF SQUARES	F VALUE	TABULATED F

VARIATION	FREEDOM				5%	1%
Replication	3	2.45	0.82			
Treatment	4	3.32	0.83	2.27	3.26	5.41
Error	12	4.390.37				
TOTAL	19 10.15					

Ns-not significant

Coefficient of variation: 34.77%

Appendix table 9. Total yield (kg/1x5m plot)

TREATMENT (kg $N-P_2O_5-K_2O$/ha)	REPLICATION I	II	III	IV	TOTAL	MEAN
60-100-100	2.30	3.77	3.68	3.31	13.06	3.27[c]
120-100-100	3.41	4.83	5.39	4.61	18.64	4.66[bc]
180-100-100	3.75	3.98	3.65	2.90	14.28	3.57[bc]
120-100-100 plus 2t/ha chicken dung	5.69	5.90	10.70	8.20	30.49	7.62[a]
2 t/ha chicken dung	4.89	4.30	5.70	5.74	20.63	5.16[b]

ANALYSIS OF VARIANCE

SOURCE OF	DEGREES	SUM OF	MEAN OF	F VALUE	TABULATED

VARIATION	OF FREEDOM	SQUARES	SQUARES		F 5%	1%
Replication	3	8.77	2.92			
Treatment	4	48.06	12.01	10.86**	3.26	5.41
Error	12	13.28	1.11			
TOTAL	19	46.48				

**-highly significant

Coefficient of variation:21.76%