BIBLIOGRAPHY

DELLIAS, ROLAND JR, C. APRIL 2008. Yield Performance of Broccoli Applied with Varying Rates of Baking Yeast. Benguet State University, La Trinidad, Benguet.

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ABSTRACT

This study was conducted to determine the response of broccoli applied with varying rates of baking yeast in terms of growth and yield, determine the solution concentration of baking yeast for broccoli and to determine the profitability of broccoli following the treatments.

Results showed that the farmer's practice of applying chicken manure as based fertilizer and side dressing with 14-14-14 and 46-0-0 slightly out yielded from the plants applied with 7.5 grams baking yeast in two liters of water, both of which did not differ from the plants applied with 11.25 and 3.75 grams of baking yeast dissolved in two liters of water but significantly differed from the plants not applied with baking yeast. Except the yield, the rest of the data gathered did not show any significant differences. However, the yield obtained was very low compared to normal due to clubroot infection.

In the economic analysis, plants applied with 7.5 grams baking yeast in two liters of water obtained the highest return on investment of 89.92% followed by the farmer's practice with 81.64% ROI. Far below are the plants applied with 11.25 grams baking yeast, no application of baking yeast and the plants applied with 3.75 grams of baking yeast in two liters of water with ROI of 44.90%, 30.79% and 21.56%, respectively.

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INTRODUCTION

Farmers growing vegetables in the Cordillera had been using composed chicken dung at the start of the vegetable industry but in 1970's the use of fresh chicken dung became common in all vegetable growing areas. This might have resulted to the several problems at present. It was mentioned by researchers from Hamburg, Germany, Washington, The Netherlands and in Selangor, Malaysia that pathogenic bacteria, viruses and parasites can be present in chicken manure, some of which can be transmitted to other farm animals and humans (CHIMATRA, 2006).

The use of fresh chicken manure when applied basally, for covering seeds of direct seeded crops or side- dressed as practiced by some farmers will cause seed rotting and maggot infestation. In fact, several farmers are asking the Anchor person of the BSU on the Air program of the University what to spray to their crops being damaged by maggots.

With all the problems mentioned above, efforts should be done to revive the sick soil due to very low or the absence of organic matter to feed the beneficial organisms. The study is then proposed to follow up the study of Debso (2007) who reported that the application of 2.0 kg Plantmate to 1 x 5m plot of broccoli can be an alternative to the farmer's practice of applying chicken dung and complete fertilizer.

If the cost of in puts can be lowered using the newly introduced organic fertilizer in combination with baking yeast, it will benefit the farmer with higher profit to buy his family needs, the consumers with more supply of food, the traders with commodity for business which will propel development in the community. Results of the study will provide information for extension workers to help farmers in the field and researchers for more studies to improve production, which will accrue to science for future generations.

This study was conducted at Balili Experiment Station of Benguet State University, La Trinidad, Benguet from October 2007 to February 2008 to determine the response of broccoli applied with baking yeast in terms of growth and yield; determine the solution concentration of baking yeast for broccoli and to determine the profitability of broccoli following the treatments.

REVIEW OF LITERATURE

Description of the broccoli

Broccoli is closely related to cauliflower since both grown for the clusters of unopened flower buds and tender flower stalks. The Italian word *brocco* means sprout, bud, or shoot, from Latin *brachium* meaning an arm or branch. Broccoli has two different distinct forms. One is “sprouting broccoli”, with makes a somewhat branching cluster of green flower buds atop a thick, green flower stalk, and smaller clusters that arise like “sprouts” from the stems. This form called “calabrese” in Britain is the most commonly grown form in the United States. The height ranges from two to three feet that bears dense cluster of flower buds at the end end axis and branches. The other type of broccoli makes a dense, white “curd” like that of cauliflower and is called “heading broccoli” or “cauliflower broccoli”. This latter form is usually grouped with cauliflower, leaving the term “broccoli” restricted to sprouting varieties.

Broccoli is a plant of the Cabbage family, *Brassicaceae* (formerly *Cruciferae*). It is classified as the *Italica* Cultivar Group of the species *Brassica oleracea.* Broccoli possesses abundant fleshy green flower heads arranged in tree-like fashion on branches sprouting from thick, edible stalk. The large mass of flower heads is surrounded by leaves. Broccoli most closely resembles cauliflower, which is actually just a different cultivar group of the same species, but broccoli is green rather than white.

In the United States, the term refers exclusively to the form with a single large head. This form is called “Calabrese” in the United Kingdom, where sprouting (non-heading) types and those with underdeveloped flower buds are also sold as broccoli.

Importance of Broccoli

Broccoli is important food for mankind. In term of nutrient content, broccoli is one of the best of the vegetable kingdom with its rich in vitamin A and D because of its hearty carotene content. Through a bit on the bitter side, broccoli leaves are completely edible and also contain generous amount of vitamin A. Transversely the nutrition scale, broccoli contains in addition to vitamin B1, B2, B3, B6, iron, magnesium, potassium and zinc. There is nutrition in those stems, such as extra calcium, iron, thiamin, riboflavin and niacin (Bautista and Mabesa, 1977).

Soil and Climatic Requirement of Broccoli

The soil requirement of broccoli must be fertile, well-drained and high organic matter. Lime should be applied if needed. It is important to keep pH levels at optimum because above or below could increase the propensity of the plant to disease and insects (Utzinger, 2000).

Fertility is similar in all the Cole crops, but broccoli requires more boron for normal growth. Boron shortage causes water-soaked areas, internal browning and breakdown of the central tissues of the stem and of the branches of the bud cluster of broccoli (Bantoc, 1969).

Broccoli thrives best in a cool moist climate and it is usually grown in the Philippines through out the year at the higher elevation such as in Benguet and Mountain Province. On the other hand, broccoli can be grown successfully in the lowlands during cool moths. The greatest yield of high quality heads is obtained at relatively cool temperatures. The optimum monthly average temperature is about 15.5 degrees to 18 degrees Celsius while the maximum temperature should not surpass about 24 degrees Celsius (Bantoc, 1969).

Cultural Requirements of Broccoli

Planting seeds. The depth of sowing should be three to four times the diameter of the seed (Edmund, J.B. 1975). In transplanting, Buayan (1999) observed broccoli seedlings to be transplanted 21 to 30 days from sowing. The researcher also found that seedlings of broccoli could be transplanted if two to three leaves are developed or has a height of twenty six centimeter under La Trinidad, Benguet condition. In addition, Bautista and Mabesa (1977) reported that transplanting should be done in the afternoon or during cloudy weather. The plant should be lifted from the seedflats with as much soil intact with the root system as possible. The roots are inserted in holes at appropriate spacing, trampled and watered.

Plant spacing. Broccoli seedlings should be set about 30 to 45 cm rows 90 cm apart. When the double row system is followed seedlings could be spaced thirty centimeters in the row with forty centimeters between rows (Bantoc, 1969)

Irrigation. Broccoli is fast growing succulent plant that requires even soil moisture. Uneven soil moistures will create adverse effects on the broccoli growth. Irrigation is necessary if natural rainfall does not suffice; 1 to 1 ½ inches of water a week is generally an irrigation requirement (Utzinger, 2000).

Harvesting. The central head should be harvested first when it is still tight and compact, with no opened flowers. It takes from 60- 100 days from planting to first harvest depending on climate and cultivar. As much as 5 inches of the flower stalks should be cut along with the buds. Do not allow the stems to become tough and woody. After the central head is removed, side shoots will develop. Although smaller, these should be harvested at 2 to 4 days interval. The entire harvest period may run from 40 to 80 days, depending on the season, crop condition and locality (Utzinger, 2000).

Postharvest. Field crates or baskets are used to pack the broccoli in the field. the crates are then taken to the packing shelter and bunched and iced. The plant needs to be trimmed and graded. The stems are usually cut from six to eight inches in length and the leaves are removed the heads are bunched together tightly with twist tie or rubber bond. Broccoli degrades rather quickly and needs to be precooled at 32 degrees fareignheight by vacuum cooling, hydro cooling or ice. Refrigerated is needed during transport for long distance (Utzinger 2000).

Effect of Organic fertilizer to the Soil

The importance of manure application as a source of essential elements to soil organisms and crops is that manures from various domestic animals increase the aggregation of soil particles and reduces the bulk density (Edmund, 1975). In relation to these animal manures are especially valuable in vegetable gardening for in addition to plant food already present in the soil, the solvent effect of the organic acid that are formed during the decomposition of manure and also by the action of certain bacteria benefits the soil (Lloyd, 1935). Moreover, Andrews W.B. (1947) said that the abundance of organic matter decomposition, the ease of plowing soil water holding capacity that reduces soil erosion via faster percolation. Additionally, Kinoshita (1972) stated that the applications of organic fertilizer in sufficient amounts improve soil structure, soil tilt and aids in the desirable processes in the soil. This does not only increase the quantity of the nutrient elements for plant growth and development but also increases the bulk density, and porosity of the soil that may cause greater aeration favoring different kinds of bacteria for nutrient liberation. Black color from organic matter causes heat absorption, aiding the soil to warm up for the production of available amount of water for uptake (Ware, 1937).

Furthermore, Knott (1976) wrote that rapid decomposition of fresh organic matter contributes most effectively to physical condition of the soil; plenty of moisture, nitrogen, and a warm temperature speed up the rate of decomposition.

Likewise Bunch (2000) stated that soil conversation refers to technique used to reduce water run-off and erosion on hillsides, where as recuperation refers to those that increase medium to long term soil fertility. The addition of major quantities of organic matter to the soil has proven to be the most important and easiest way for small farmers to maintain or enhance the natural productivity of their soils, even those soils so depleted they have been abandoned. This practice of reviving deteriorated soil through heavy organic matter application is now called “soil recuperation”. Although many sources of organic matter may be used, including animal manure, coffee pulp, sugarcane pulp and compost, the least expensive and widely used in Central America is green manure or cover crops.

Effect of Organic Fertilizer to Plant

According to Abadilla (1982), crops applied with organic matter have a greater resistance to pest and diseases. The author mentioned that humic acids and growth substances are absorbs into plant tissue through the roots and that they favor the formation protein by influencing the synthesis of enzymes that will increase the vigor of insect resistance of the plant. Furthermore, soils high in organic matter allow little or no soil borne diseases because of the oxygen- ethylene cycle in the soil. Besides, the sap of the plant fertilized with organic matter is more bactericidal than the plant not fertilized with organic matter. Not only does humus confer immunity to plant pests and diseases, it also earlier and was harvested earlier in the application of chicken manure and 14-14-14.In Cucumber, Cid (2000) found out that farmers practice (handful of chicken manure and 19 grams of 14-14-14/ hole) and 3 tons/ha chicken manure + 61.2 kg of 14-14-14/ha considerably enhanced maturation, increased number of node, flower number, fruit length and weight's of non-marketable and marketable fruits.

Plantmate

The plantmate organic fertilizer product is the result of an accelerated decomposition of biodegradable materials, both of plants and animal origin, through an advance biofermentation process involving more than twenty (20) naturally- occurring beneficial microorganisms to enhance its efficacy as a functional compound.

Plantmate consist of chemical properties such as the total of nitrogen 2.44% (4.14% on dry basis), total phosphorus 3.47% (6.34% on dry basis), total potassium 3.61% (6.13% on dry basis), total calcium 4.46% (7.5% on dry basis), total magnesium 0.19% (0.13% on dry basis). It is also chelated micronutrient and amino acid that is adequate and well balanced. Growth promotants and functional compounds are adequate.

Physical appearance of plantmate is loose, friable and very stable organic matter with high humus content, dark brown to black in color. It is also phytoxicity, which means it does not have any burning effects on plants, safe and no pathogen. The pH is 7.5, which is lightly basic. (Anon. no date)

Uses of Baking Yeast

Yeast is widely distributed in nature and is disseminated by insect carriers and by wind and air currents. A few obligate or facultative parasites among the yeast can cause disease in people, other animals, and plants. They are rich sources of enzymes such as lactase, invertase and catalase, which have commercial importance (Pelczar et al., 1977).

Moreover, Mindell (1985) reported that yeast is known as nature's wonder food, and it does a lot to deserve its reputation. It is an excellent source of protein and a superior source of the natural B complex vitamins. Yeast is one of the richest sources of organic iron and minerals, trace minerals, and amino acids. The author mentioned that there are various sources of yeasts, such as:

1. Liquid yeast from Switzerland and Germany, fed to herbs, honey malt and oranges or grapefruit.

2. Brewer's yeast (from hops, a by-product of beer) sometimes called nutritional yeast.

3. Torula yeast grown on wood pulp and is used in the manufacture of paper or from blackstrap molasses.

4. Whey, a by- product of milk and cheese (best tasting and most potent)

Mindell (1985) mentioned that yeast has all the major B vitamins (except B12), which can be especially bred into it. It contains sixteen amino acids, fourteen or more minerals and seventeen vitamins (except A, E and C). It can be considered a whole food. Yeast can be stirred into liquid, juice or water and taken between meals. Some people who feel fatigued take a tablespoon or more in liquid and feed a return of energy within a minute, and the good effect lasts for several hours. Yeast can also used as a reducing food. This is stirred into liquid and drank just before a meal. It takes the edge of a large appetite and saves one a lot in calories.

In a recent study by Cuaton et al. (1997), the use of baking yeast solutions applied as foliar spray to some vegetables like pechay, peppe, red Creole bulb onion, radish, carrot and peunut demonstrated favorable response to baking yeast solutions at 6, 9 and 12% concentration. Aquino (1998) determined the stage of growth in carrot that will respond to yeast application. The author found that 15 to 30 days after emergence is more responsive to yeast application than any other stage. The heaviest marketable yield with significantly heavier big roots was obtained when the baking yeast was applied 30 days after emergence.

One of the materials already available in the market and convenient to use as growth enhancer is the baker yeast. Some literature disclosed that yeast has the ability to synthesize vitamins, amino acids and proteins and could be used to trigger growth (Robbins, 1964). Yeast that is found in the market belongs to the family *Saccharomycetaceae*. One teaspoon of baker yeast approximately 10 grams contains more than ten billion of cells (Pelczar, 1977). According to Neff, (1964), yeast assay contains 45 to 55% protein, 0.5%, 2.5%fat, 35% to 45% carbohydrates, 5 to 7% ash (minerals and 4% to 6% moisture.

Weier et al. (1982) reported that the growth substances in yeast extract are known to be thiamine, nicothinic acid and pyridoxine all part of vitamin B complex. The effectiveness of yeast in promoting root formation and growth showing characteristic actions similar to the effect of plant hormones was mentioned by Robbins (1964). Plant hormones are different from vitamins for vitamins are usually not considered hormones (Ting, 1982).

In the initial study of Gino (1992) at Mindanao State University, General Santos City, it was disclosed that from the varied concentrations of 3, 6 and 9%, the yeast solution with 9% concentration had produced the highest number of flowers and fruits and the heaviest weight of tomato.

Foliar Spray

Foliar spray provides more rapid utilization and permits the correction of observed deficiencies in less time. When problems of solid fixation exist, foliar application constitutes the most effective means of fertilizer placement. Foliar spray in which urea is used enhances more rapid absorption than soil application (Tisadale, 1996)

According to Donahue (1979), nitrogen, phosphorus, magnesium, calcium, sulfur, iron, boron, copper, and molybdenum have been successfully used to supply nutrients for plant growth by applying them as foliar sprays to the plant. On the other hand, Knott and Deanon (1967) stated that foliar application of microelements has been found effective with plants because of very small quantity of chemicals to be absorbed sufficiently.

Fertilizer chemical applied as foliar spray generally are much more quickly absorbed and utilized by the leaves than when applied to the soil. To be most effective, spray application should be supplemented with soil application (McVickar, 1970).

MATERIALS AND METHODS

Materials

The materials used in the study were the seed of broccoli, chicken dung, seedling tray, media for seedlings (rice hull+ compost+ garden soil), weighing scale, measuring tape, baking yeast, insecticides, fungicides and farm tools and equipment.

Methods

Experimental design and treatments. The experiment was laid out in a Randomized Complete Block Design (RCBD) with five treatments replicated three times. The treatments were as follows:

Treatment code	Rate of application (1m x 5m plot) in kg.
T_1	3.75 grams of baking yeast per 2 liters of water
T_2	7.5 grams of baking yeast per 2 liters of water
T_3	11.25 grams of baking yeast per 2 liters of water
T_4 (farmers practice)	½ can chicken dung + 357.14 g 14-14-14 and 22.22g urea
T_5	no application of baking yeast

Sowing the seeds. The seeds of broccoli cv. Marathon were sown in seedling trays. The soil media used to fill the seedling tray was 1:1:1 mixture of garden soil+ compost+ rice hull. The soil media was sterilized to kill the weed seeds, insect and the numerous soil pathogens, such as those that cause damping off. The seedling trays were filled with sterilized soil media then one seed was sown per hole of the seedling tray. Regular irrigation was done.

Land preparation. An area of 75 sq. m was divided into three blocks with each consisting of 5 plots measuring 1 x 5 meters. The plots were dug and holes were constructed at a distance of 30 cm in rows and 30cm between rows, which will make 15 holes each row or 30 holes each treatment. The organic fertilizer was applied in the holes by dividing the amount by the number of holes (30) then mixed with the soil as base dress.

Transplanting. Three weeks old seedling was transplanted by pushing the outside bottom of the seedling tray for the seedling to come out from the tray then it was transplanted at the middle of the hole where the organic fertilizer was mixed.

Irrigation. Irrigation was done after transplanting and this was done every after three days. Sufficient water was applied during the critical period such as the head initiation, and head formation up to two weeks before harvest.

Hilling- up. Three weeks after transplanting the seedlings, side dress fertilizer was applied uniformly on each plot followed by hilling- up to cover the side dress fertilizer, cover growing weeds and to fix the plot. The farmer's practice follows the rate of fertilizer specified in the treatment.

Baking yeast application. The different concentrations of baking yeast solution based on the treatments were applied 14 days after transplanting the seedlings and it was repeated after 7 days.

Data gathered. The data gathered tabulated, computed and means subjected to variance analysis and means separation test by the Duncan's Multiple Range Test (DMRT) were the following:

1. Number of days from transplanting to curd appearance. This was recorded from transplanting to the day curds that was visible from the shoot apex of the plants.

2. Number of days from transplanting to first curd harvesting. This was the number of days from transplanting to the day first curds attain harvestable stage (flower buds were still tightly closed and curds fully expanded).

3. Final plant height (cm). Ten sample plants per plot were measured from the soil surface to the tip of curd surfaces during harvest.

4. Curd diameter (cm). This was measured from edge to edge crossing the center of the curds during harvest from ten sample curds.

5. Average weight of the individual curd (g). This was taken by dividing the total yield per plot by the number of curds harvested per plot.

6. Total yield (kg). This was the total weight of marketable and non marketable curds per plot.

7. Weight of marketable curd per plot (kg). This was the total weight of marketable curds with out defects that was sold in the market.

8. Weight of non- marketable curds per plot (kg). This was the total weight of non-marketable curds with defects such as small curds, malformed curds and diseased curds.

9. Days from transplanting to last curd harvest. This was the number of days from transplanting to the day last curd was harvested to determine whether the maturity was spread or compact.

10. Diameter of stem (cm). Ten sample plants per plot were measured where the stems enlarged with the used of venier caliper.

11. Curd to plant ratio. This was obtained by dividing the total weight of harvested curds per plot by the total weight of plant debris per plot. Plant debris was the stem with leaves before and after the curd has been harvested including the leaves removed from the stem (4-5 cm) just below the curd. Total weight of all these per plot was used to divide the total weight of curds per plot.

12. Cost and return analysis. All inputs that were used in this study with their values were recorded and the return on investment was computed using the formula:

ROI (%) = Gross sales per plot- total expenses per plot/ total expenses per plot

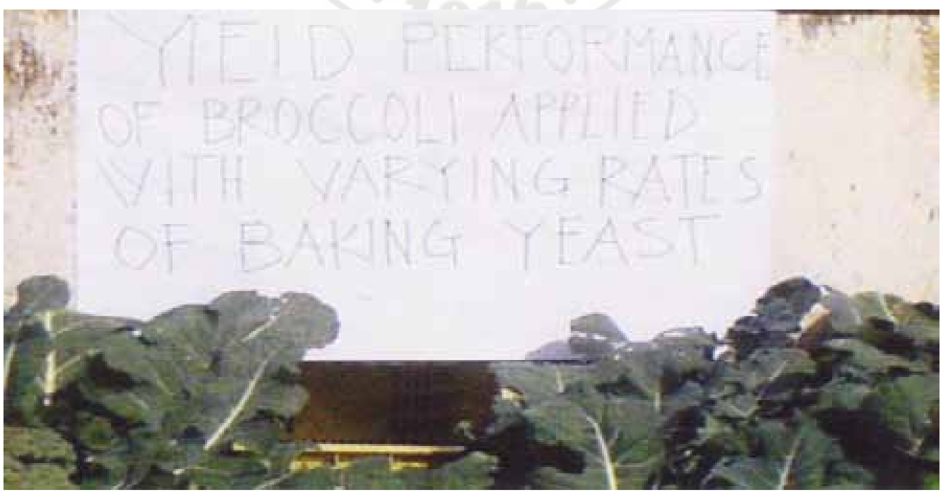

Figure 1. Overview of the area showing the appearance of the plants and the clubroot infection and showing the appearance of the curds from the different treatments.

RESULTS AND DISCUSSION

Days from Transplanting to Curd Appearance

Table 1 shows that there were no significant differences among the treatments in terms of days from transplanting to curd appearance. However, the farmer's practice of applying chicken dung as base dress and side dressing the plants with 14-14-14 and urea has shorter period to curd appearance.

Table 1. Number of days from transplanting to curd appearance

TREATMENTS	MEAN*
3.75 grams per 2 liters of water	67.00[a]
7.5 grams per 2 liters of water	66.67
11.25 grams per 2 liters of water	67.67
½ can chicken dung + 357.14g 14-14-14 and 22.22g urea	65.00
No baking yeast application (control)	68.00

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

Days from Transplanting to First Curd Harvesting

Table 2 shows that the number of days from transplanting to first curd harvesting had no significant differences among the plants applied with varying rates of baking yeast and the plants not applied with baking yeast and the farmer's practice.

Table 2. Number of days from transplanting to first curd harvesting

TREATMENTS	MEAN*
3.75 grams per 2 liters of water	84.67[a]
7.5 grams per 2 liters of water	84.67
11.25 grams per 2 liters of water	84.67
½ can chicken dung + 357.14g 14-14-14 and 22.22g urea	83.67
No baking yeast application (control)	85.67

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

Plant Height

Table 3 shows the final plant height. No significant differences among the treatment means. This result implies that the application of baking yeast, farmer's practice and no application of fertilizer can promote similar plant height. This result might have been affected by the severe infection of clubroot.

Curd Diameter

As shown in Table 4, the diameter of curd produced from the different treatments differs slightly. This means that the application of varying rates of baking yeast and the farmer's practice of base dressing chicken dung and side dressing 14-14-14 have similar curd diameter with those plants not applied with fertilizer. This may also imply that the experiment area has sufficient nutrient elements for the crop.

Table 3. Final Plant Height (cm)

TREATMENTS	MEAN*
3.75 grams per 2 liters of water	30.83[a]
7.5 grams per 2 liters of water	32.30
11.25 grams per 2 liters of water	30.73
½ can chicken dung + 357.14g 14-14-14 and 22.22g urea	32.00
No baking yeast application (control)	31.77

*Means with common letter are not significantly different at 5% level of significance using DMRT.

Table 4. Curd diameter (cm)

TREATMENTS	MEAN*
3.75 grams per 2 liters of water	16.00[a]
7.5 grams per 2 liters of water	17.10
11.25 grams per 2 liters of water	16.40
½ can chicken dung + 357.14g 14-14-14 and 22.22g urea	19.01
No baking yeast application (control)	16.80

*Means with common letter are not significantly different at 5% level of significance using DMRT.

Weight of Individual Curd

Table 5 shows the average weight of the individual curd which did not differ statistically. Broccoli 'Marathon' normally produce 250 to 350 grams curd but the average weight in this study ranged from 113.50 to 144.33 grams which is lower than the normal weight , thus the plants without application of baking yeast and fertilizer has similar curd weight. As mentioned earlier, clubroot infection has affected the weight of curd.

Table 5. Average weight of individual curd (g)

TREATMENTS	MEAN*
3.75 grams per 2 liters of water	114.72[a]
7.5 grams per 2 liters of water	139.15
11.25 grams per 2 liters of water	135.75
½ can chicken dung + 357.14g 14-14-14 and 22.22g urea	144.33
No baking yeast application (control)	113.50

*Means with common letter are not significantly different at 5% level of significance using DMRT.

Total Yield

As presented in Table 6, farmer's practice of applying chicken dung as base dress fertilizer and side dressing with 14-14-14 and the application 7.5g of baking yeast in 2 liters of water produced the heaviest yield per plot, which significantly differed from the yield of plants not applied with baking yeast. Among the plants applied with baking yeast at varying rates did not show significant differences in their total yield per plot. However, 11.25g and 3.75g of baking yeast have similar total yield with the plants not applied with baking yeast.

There were no trends observed in the yield which may be due to the severe infection of clubroot. The yield shown on the table is not an expected yield from 5.0 meter plot.

Table 6. Total Yield (kg)

TREATMENTS	MEAN*
3.75 grams per 2 liters of water	2.00[bc]
7.5 grams per 2 liters of water	3.14[ab]
11.25 grams per 2 liters of water	2.35[bc]
½ can chicken dung + 357.14g 14-14-14 and 22.22g urea	3.65[a]
No baking yeast application (control)	1.80[c]

*Means with common letter are not significantly different at 5% level of significance using DMRT.

Weight of Marketable Curd

The weight of marketable curds per plot follow the same trend of the total yield where the farmer's practice and 7.5g of baking yeast dissolved in 2 liters of water produced similar weight of marketable curds (Table 7). The application of 7.5g of baking yeast did not differ from 11.25 and 3.75g of baking yeast which yielded similarly with the plants not applied with fertilizer.

As mentioned earlier the yield obtained was very low due to the severe clubroot infection.

Weight of Non-marketable Curd

Table 8 shows the weight of non- marketable curd per plot. The weight of non-marketable curds was recorded from very small plants which were infected with clubroot.

Table 7. Weight of marketable curd per plot (kg)

TREATMENTS	MEAN*
3.75 grams per 2 liters of water	1.97[bc]
7.5 grams per 2 liters of water	3.12[ab]
11.25 grams per 2 liters of water	2.33[bc]
½ can chicken dung + 357.14g 14-14-14 and 22.22g urea	3.65[a]
No baking yeast application (control)	1.78[c]

*Means with common letter are not significantly different at 5% level of significance using DMRT.

Table 8. Weight of non- marketable curd per plot (kg)

TREATMENTS	MEAN*
3.75 grams per 2 liters of water	0.02[a]
7.5 grams per 2 liters of water	0.02
11.25 grams per 2 liters of water	0.02
½ can chicken dung + 357.14g 14-14-14 and 22.22g urea	0.00
No baking yeast application (control)	0.02

*Means with common letter are not significantly different at 5% level of significance using DMRT.

Days from transplanting to last curd

Table 9 shows the similar number of days from transplanting to last curd harvest. This result means that plants from the different treatments took 11 to 13 days from the first curd harvest for all the curds to be harvested. In other words, curds from the different treatments matured at the same time.

Table 9. Days from transplanting to last curd harvest

TREATMENTS	MEAN*
3.75 grams per 2 liters of water	96.67[a]
7.5 grams per 2 liters of water	97.00
11.25 grams per 2 liters of water	97.00
½ can chicken dung + 357.14g 14-14-14 and 22.22g urea	97.00
No baking yeast application (control)	97.00

*Means with common letter are not significantly different at 5% level of significance using DMRT.

Diameter of Stem

Table 10 shows that there were no significant differences among the treatment means in terms of diameter of stem. However, some of the plants were infected by clubroot so this might not be the real measurement of the diameter of stem.

Curd to Plant Ratio

Table 11 shows that there were no significant differences among the treatment means in terms of curd to plant ratio. In this study, the application of 7.5g of baking yeast in 2 liters of water resulted to heavier weight of curd from each plant than the rest of the treatment studied. However, this might not be the real ratio due to the infection of clubroot. It might be that the plants applied with 11.25 grams baking yeast in two liters of water happen to have infected plants thus the lowest ratio of 0.25:1, meaning only 25% was the weight of stems and leaves. In other words, only 250 grams is edible from a kilo of the broccoli from the treatment while the 7.5 grams baking yeast per 2 liters of water has almost half of the weight was curd weight.

Table 10. Diameter of stem (cm)

TREATMENTS	MEAN*
3.75 grams per 2 liters of water	3.24[a]
7.5 grams per 2 liters of water	3.25
11.25 grams per 2 liters of water	3.18
½ can chicken dung + 357.14g 14-14-14 and 22.22g urea	3.60
No baking yeast application (control)	2.92

*Means with common letter are not significantly different at 5% level of significance using DMRT.

Table 11. Curd to plant ratio

TREATMENTS	MEAN*
3.75 grams per 2 liters of water	0.28[a]
7.5 grams per 2 liters of water	0.46
11.25 grams per 2 liters of water	0.25
½ can chicken dung + 357.14g 14-14-14 and 22.22g urea	0.34
No baking yeast application (control)	0.28

*Means with common letter are not significantly different at 5% level of significance using DMRT.

Cost and Return Analysis

The significantly heavier weights of marketable yield per plot from the farmer's practice and the 7.5 grams baking yeast per two liters of water resulted to their higher return on investment (Table 12). Even if the farmer's practice slightly out yielded the plants applied with 7.5 grams baking yeast, the economic analysis show's that the plants applied with 7.5 grams baking yeast per two liters of water obtained the highest ROI of 89.92% while the farmer's practice had 81.64%. in descending order, these two were followed by the application of 11.25 grams baking yeast, no application of baking yeast and the application of 3.75 grams baking yeast per two liters of water.

Table 12. Cost and return analysis per treatment of 15m^2 plot

ITEM	T_1	T_2	T_3	T_4	T_5
Marketable yield (kg)	5.90	9.36	7.00	10.95	6.25
Sales	236.00	374.40	280.00	438.00	250.00
Expense					
1. Labor:					
Wedding	18.75	18.75	18.75	18.75	18.75
Digging	16.67	16.67	16.67	16.67	16.67
Sterilizing the media	7.50	7.50	7.50	7.50	7.50
Sowing the seeds	5.00	5.00	5.00	5.00	5.00
Making holes	1.50	1.50	1.50	1.50	1.50
Fertilizer application	2.00	2.00	2.00	2.00	2.00
Transplanting the seedlings	4.17	4.17	4.17	4.17	4.17
Hilling- up	21.25	21.25	21.25	21.25	21.25
Watering the plants	25.00	25.00	25.00	25.00	25.00
2. Seeds	28.50	28.50	28.50	28.50	28.50
3. Baking Yeast	3.00	6.00	9.00	-	-
4. Gasoline	19.20	19.20	19.20	19.20	19.20
5. Fertilizer	35.60	35.60	35.60	85.60	35.60
6. Transportation	6.00	6.00	6.00	6.00	6.00
D. Total Expenses (PhP)	194.14	197.14	200.14	241.14	191.14
E. Net Income (PhP)	41.86	177.26	89.86	196.86	58.86
F. ROI (%)	21.56	89.92	44.90	81.64	30.79

Note: The prevailing price at harvest was at P40.00/ kilo without curd size classification.

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

This study was conducted to determine the response of broccoli applied with varying rates of baking yeast in terms of growth and yield, determine the solution concentration of baking yeast for broccoli and to determine the profitability of broccoli following the treatments.

Results showed that the farmer's practice of applying chicken manure as base fertilizer and side dressing with 14-14-14 and 46-0-0 slightly out yielded from the plants applied with 7.5 grams baking yeast in two liters of water, both of which did not differ from the plants applied with 11.25 and 3.75 grams of baking yeast dissolved in two liters of water but significantly differed from the plants not applied with baking yeast. Except the yield, the rest of the data gathered did not show any significant differences. However, the yield obtained was very low compared to normal due to clubroot infection.

In the economic analysis, plants applied with 7.5 grams baking yeast in two liters of water obtained the highest return on investment of 89.92% followed by the farmer's practice with 81.64% ROI. Far below are the plants applied with 11.25 grams baking yeast, no application of baking yeast and the plants applied with 3.75 grams of baking yeast in two liters of water with ROI of 44.90%, 30.79% and 21.56%, respectively.

Conclusion

Based on the results presented and discussed, the farmer's practice and the application of 7.5 grams baking yeast in two liters of water to broccoli obtained similar yield, but the application of 7.5 grams baking yeast dissolved in two liters of water provided higher return on investment compared to the other treatments studied.

Recommendation

Therefore, it is recommended that 7.5 grams of baking yeast per 2 liters of water plus chicken dung be applied in broccoli plants as alternative for the farmer's practice of applying chicken dung, 14-14-14, and urea to obtained similar yield with higher ROI. If the other kinds of yeast are available in the market, further studies are recommended in other areas and crops.

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APPENDICES

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

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
T_1	65	68	68	201	67.00
T_2	65	68	67	200	66.67
T_3	66	68	68	203	67.67
T_4	63	64	68	195	65.00
T_5	66	69	69	204	68.00
TOTAL	325	337	340	1003	334.34

ANALYSIS OF VARIANCE

Source of Variance	Degrees of Freedom	Sum of Squares	Means of Squares	Computed F	Tabulated F 0.05	0.01
Replication	2	27.73	13.87			
Treatment	4	16.40	4.10	4.32*	3.84	7.01
Error	8	7.60	0.95			
TOTAL	14	51.73				

*= Significant Coefficient of Variance= 1.46%

Appendix Table 2. Number of days from transplanting to first curd harvesting

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
T_1	85	83	86	254	84.67
T_2	85	86	83	254	84.67
T_3	85	83	86	254	84.67
T_4	85	83	83	251	83.67
T_5	85	86	86	257	85.67
TOTAL	425	421	424	1270	423.35

ANALYSIS OF VARIANCE

Source of Variance	Degrees of Freedom	Sum of Squares	Means of Squares	Computed F	Tabulated F 0.05	0.01
Replication	2	1.73				
Treatment	4	6.00	1.50	0.70ns	3.84	7.01
Error	8	15.60	1.95			
TOTAL	14	23.33				

Ns= not Significant Coefficient of Variance= 1.46%

Appendix Table 3. Final plant height (cm)

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
T_1	32.70	28.90	30.90	92.50	30.83
T_2	31.60	32.10	33.20	96.90	32.30
T_3	32.50	30.10	29.60	92.20	30.73
T_4	35.70	29.90	30.40	96.00	32.00
T_5	36.20	30.70	28.40	95.30	31.77
TOTAL	168.70	151.70	152.50	472.90	157.63

ANALYSIS OF VARIANCE

Source of Variance	Degrees of Freedom	Sum of Squares	Means of Squares	Computed F	Tabulated F 0.05	0.01
Replication	2	36.80	13.87			
Treatment	4	5.97	4.10	0.41ns	3.84	7.01
Error	8	29.36	0.95			
TOTAL	14	72.13				

Ns= not Significant

Coefficient of Variance= 6.08%

Appendix Table 4. Curd diameter (cm)

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
T_1	18.30	15.10	14.60	48.00	16.00
T_2	17.40	15.80	18.10	51.30	17.10
T_3	19.40	15.70	14.10	49.20	16.40
T_4	22.60	16.90	17.70	57.20	19.07
T_5	22.50	14.50	13.40	50.40	16.80
TOTAL	100.20	78.00	77.90	256.10	85.37

ANALYSIS OF VARIANCE

Source of Variance	Degrees of Freedom	Sum of Squares	Means of Squares	Computed F	Tabulated F 0.05	0.01
Replication	2	66.01	33.01			
Treatment	4	16.96	4.24	1.21ns	3.84	7.01
Error	8	28.00	3.50			
TOTAL	14	110.97				

Ns= not Significant

Coefficient of Variance= 10.96%

Appendix Table 5. Average weight of the individual curd (g)

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
T_1	109.75	107.50	126.92	344.17	114.72
T_2	168.04	128.57	120.83	417.44	139.15
T_3	122.92	138.89	145.45	407.26	135.75
T_4	172.41	137.50	123.08	432.99	144.33
T_5	117.31	118.18	105.00	340.49	113.50
TOTAL	690.43	630.64	621.28	1942.35	647.45

ANALYSIS OF VARIANCE

Source of Variance	Degrees of Freedom	Sum of Squares	Means of Squares	Computed F	Tabulated F 0.05	0.01
Replication	2	562.95	13.87			
Treatment	4	2479.64	4.10	1.90ns	3.84	7.01
Error	8	2608.84	0.95			
TOTAL	14	5651.43				

Ns= not Significant

Coefficient of Variance= 13.95%

Appendix Table 6. Total yield (kg)

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
T_1	2.20	2.15	1.65	6.00	2.00
T_2	4.71	1.80	2.90	9.41	3.29
T_3	2.95	2.50	1.60	7.05	2.35
T_4	5.00	2.75	3.20	10.95	3.65
T_5	3.05	1.30	1.05	5.40	1.80
TOTAL	17.91	10.50	10.40	41.56	13.09

ANALYSIS OF VARIANCE

Source of Variance	Degrees of Freedom	Sum of Squares	Means of Squares	Computed F	Tabulated F 0.05	Tabulated F 0.01
Replication	2	7.40	3.70			
Treatment	4	7.36	1.84	4.54*	3.84	7.01
Error	8	3.24	0.41			
TOTAL	14	18.00				

*= Significant Coefficient of Variance= 24.60%

Appendix Table 7. Weight of marketable curd per plot (kg)

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
T_1	2.20	2.15	1.55	5.90	1.97
T_2	4.66	1.80	2.90	9.36	3.12
T_3	2.90	2.50	1.60	7.00	2.33
T_4	5.00	2.75	3.20	10.95	3.65
T_5	3.00	1.30	1.05	5.35	1.78
TOTAL	17.76	10.50	10.30	38.56	12.85

ANALYSIS OF VARIANCE

Source of Variance	Degrees of Freedom	Sum of Squares	Means of Squares	Computed F	Tabulated F 0.05	0.01
Replication	2	7.21	3.60			
Treatment	4	7.52	1.88	4.74*	3.84	7.01
Error	8	3.17	0.40			
TOTAL	14	17.90				

*= Significant Coefficient of Variance= 24.50%

Appendix Table 8. Weight of non- marketable curd per plot (kg)

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
T_1	-	-	0.05	0.05	0.02
T_2	0.05	-	-	0.05	0.02
T_3	0.05	-	-	0.05	0.02
T_4	-	-	-	0.00	0.00
T_5	0.05	-	-	0.05	0.02
TOTAL	0.15	0.00	0.0 5	0.20	0.08

ANALYSIS OF VARIANCE

Source of Variance	Degrees of Freedom	Sum of Squares	Means of Squares	Computed F	Tabulated F 0.05	0.01
Replication	2	0.00	0.00			
Treatment	4	0.00	0.00	0.31ns	3.84	7.01
Error	8	0.00	0.00			
TOTAL	14	0.00				

Ns= not Significant

Coefficient of Variance= 174.55%

Appendix Table 9. Days from transplanting to last curd harvest

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
T_1	99	96	96	291	97
T_2	99	96	96	291	97
T_3	99	96	96	291	97
T_4	99	96	96	291	97
T_5	99	96	96	291	97
TOTAL	495	480	480	1455	485

ANALYSIS OF VARIANCE

Source of Variance	Degrees of Freedom	Sum of Squares	Means of Squares	Computed F	Tabulated F 0.05	0.01
Replication	2	26.13	13.07			
Treatment	4	0.27	0.07	1.00ns	3.84	7.01
Error	8	0.53	0.07			
TOTAL	14	26.93				

Ns= not Significant

Coefficient of Variance= 0.27%

Appendix Table 10. Diameter of stem (cm)

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
T_1	2.97	3.46	3.28	9.71	3.24
T_2	3.31	3.33	3.10	9.74	3.25
T_3	3.25	3.30	2.98	9.53	3.18
T_4	4.10	3.34	3.36	10.80	3.60
T_5	3.43	2.72	2.62	8.77	2.92
TOTAL	17.06	16.15	15.34	48.55	16.19

ANALYSIS OF VARIANCE

Source of Variance	Degrees of Freedom	Sum of Squares	Means of Squares	Computed F	Tabulated F 0.05	Tabulated F 0.01
Replication	2	0.39	0.19			
Treatment	4	0.70	0.18	1.06ns	3.84	7.01
Error	8	1.32	0.17			
TOTAL	14	2.41				

Ns= not Significant   Coefficient of Variance= 12.55%

Appendix Table 11. Curd to plant ratio

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
T_1	0.28	0.29	0.27	0.84	0.28
T_2	0.80	0.23	0.36	1.39	0.46
T_3	0.30	0.22	0.23	0.75	0.25
T_4	0.35	0.33	0.33	1.01	0.34
T_5	0.36	0.26	0.23	0.85	0.28
TOTAL	2.09	1.33	1.42	4.84	1.61

ANALYSIS OF VARIANCE

Source of Variance	Degrees of Freedom	Sum of Squares	Means of Squares	Computed F	Tabulated F 0.05	Tabulated F 0.01
Replication	2	0.07	0.03			
Treatment	4	0.09	0.02	1.40ns	3.84	7.01
Error	8	0.12	0.02			
TOTAL	14	0.28				

Ns= not Significant

Coefficient of Variance= 38.43%