BIBLIOGRAPHY

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ABSTRACT

The study was conducted to determine the effect and to determine the best methods of sowing and to evaluate also the yield of cabbage using different methods of seed sowing.

It was consistently observed on the different methods of sowing seeds that used plastic cups (treatment 3), seed box sowing (treatment 4), and polyethylene plastic bags sowing (treatment 6) had the heaviest average weight of heads from 0.84 to 0.95 kg and having also the highest marketable heads from (25.33 to 28.67 kg/plot), yield per plot (26.42 to 29.17 kg/plot) and computed marketable yield per hectare from (52.83 to 58.33 tons/hectare. This was followed by direct seeding of 26.33 kg/plot (treatment 1), open field sowing of 26.08 (treatment 5), and seedling tray sowing had the least yield of 24.33 kg/plot.

The direct seeding (treatment 1) were harvested 89 days from planting followed by the used plastic cups (treatment 3), seed box sowing (treatment 4) open field sowing (treatment 5), and sowing in polyethylene plastic bags. Lastly, nursery bed sowing (treatment 2) was the last to reach the harvesting stage of 98 days from planting.

However, all the treatments showed very firm heads except for treatment 2 which was son in the nursery bed with firm heads. Among the 7 treatments, sowing in polyethylene plastic bags (treatment 6), direct seeding (treatment 1), used plastic cups (treatment 3) were identified to have the higher yield potentials (ROI) of 49.08%, 43.05% and 41.56% respectively.

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INTRODUCTION

Cabbage (*Brassica oleracea var. capitata* L.) is one of the important leafy vegetable produced and eaten in all parts of the world. It is a crop commercially grown in highland areas of the country particularly in Benguet and Mountin Province and is one of the main sources of income of the people. In fact, it is one of the two leading vegetables crop being grown in the Cordillera Region. However, some farmer's cannot make the most profit in the production of the crop due to the lack of knowledge in proper methods of sowing seeds that must be used. During the 1970's, Tamayo (1935) reported that 46.5M worth of cabbage was marketed every year making it number one among the ten listed major leafy vegetable in the Philippines. However, the planting materials are 100% imported due to lack of chilling temperature in the country that promotes flowering of cabbage.

As described by Lloyd (1935), cabbage seedling production is not one of the easiest activities because all garden soils appear to have been infected with club root and other diseases. There are some farmers with newly opened operated areas but complained of cabbage plants infected with club root which might have been transferred through infected seedling and tools. Damping-off appears to be common in garden soil before sowing the seed but they require additional cost and time. Cabbage production starts from seeding established in seed bed which is a common practice of farmers. Vegetable production according to Work (1995), moisture control is the grower's most effective means of managing the growth of his plants, and is important for growth of damping-off. In general, it is better to water the in the morning so that the plant and the soil surface can

dry off before night. If the weather is cool and cloudy, water lightly: if warm and bright, more water will be needed.

Proper seed bed preparation is important for the successful field sowing (Hartman, 1968), the requirements of a good seed bed are (a) initial supply of sufficient moisture to carry the seed bed through germination and early seedling period, (b) good physical condition that allows moisture to be supplied continuously to seed, (c) good aeration.

This study was conducted to determine the effect of different methods of sowing seeds on the growth and yield of cabbage; to determine the best methods to be used in growing cabbage seedlings and evaluate the yield of cabbage using different methods of seed sowing.

This study was conducted at Benguet State University Experimental Station, Balili, La Trinidad, Benguet on October 2007 to January 2008

REVIEW OF LITERATURE

The Cabbage Plant

The cabbage plant locally known as daun Kobis, belongs to the cruciferea or mustard family, and known by the botanical name *Brassica oleracea var. capitata* L. it is a biennial crop with a short thickened stem rounded by a series of developing expanded leaves in whorls which from compact head (Tindall, 1983)

Cabbage is a shallow rooted crop. Its root reaches 30cm only above the soil layer. The crop has a very limited area for water and nutrients absorption, thus, water should be applied often enough in order to replace the water expenditures of the plant. Cabbage plant supplied abundantly with water has more rapid and succulent growth than those crop less supplied. Rapid growth in many varieties of cabbage plants means earlier marketable condition and large head size. Cabbage heads of good quality are therefore dependent and a considerable extend upon the moisture supply avail to the plant (Bautista 1983).

Cabbage is a cool season crop that generally thrives best at a temperature of 50 to 70^0 F (Thompson and Kelly, 1975) According to watts (1972), the solidity and thickness, crispiness and taste of cabbage are greatly affected by climate. As cited by cape (1980) he reported that in places where altitude is 700 to 2,00m above sea level, cabbage be grown any time of the year. He further added that at low elevation cabbage grows best during the cool months from October to March. The same source also noted that cabbage originated from Southern Europe and Mediterranean region, where it has been grown for at least 300 years and is widely distribute through out the tropics. The nutritional value of

cabbage is relatively high, although less than many other crops used in tropical areas as leaf vegetables (Tindall, 1983).

Gardner (1949) suggested that the seedlings that are about to transplanted from cold frames, hotbed, or greenhouses to field or garden are hardened. The result of this treatment, he stated, is a less succulent, tougher and hardier plant that is better able to survive the transplanting shock.

Kinoshita (1972) mentioned that transplanting can be best carried out when seedling have 5 true leaves in the seed bed.

According to Reily (1991) he stated that cabbage may be planted often early potatoes, peas, beans, spinach, or other early crops, or it may be set between rows of crops before these are harvested.

Cabbage should be harvested when the head is firm. Late varieties are best for storage and should be harvested before the head is too mature. The head is severed from stem with a knife (Richey and Schillertter, 1940).

Nutritional Value

Cabbage is a well-liked vegetable. It can be sautéed, boiled with other vegetables and meat, or prepared as salad. Cabbage contains 92% water, but it is quiet high in vitamin C or ascorbic acid. However, cooked cabbage contains less ascorbic acid and thiamine than raw cabbage green heads are more nutritious than the white ones because they have carotenoids or vitamin A.

Infact, some vegetables have higher vitamin C than the best source of fruits and that much of the vitamin C is lost in vegetable during cooking since this is a nutrients easily destroyed by heat (Bawang and Kudan, 1989). Ascorbic acid prevents scurvy,

while thiamine, known as vitamin B is necessary for growth and reproduction. Vitamin A prevents night blindness, increase the resistant of the body to infection and necessary for the normal functioning of the glands (Bantoc, 1976) he added that the crop contains 92.1% water and 82% portion. As food that cabbage contains 209.0% potassium, 62.0% vitamin A, 58% calcium and other minor elements.

Bantoc, (1976) reported that cabbage contains sin gram compound which is also known as crystalline glycoside which gives the characteristics flavor or taste in raw vegetables that is why cabbage can be eaten as salad or can be used as flavoring.

Soil and Climatic Requirement

The largest and heaviest are produced in areas with low temperature because cabbage is a crop that originated from temperate countries (Bautista and Dela Cruz, 1977).

At high elevation like the Mountain Province, Kanlaon,Occidental Negros, and Mt. Matutum in Mindanao, the crop can be grown profitability the whole year round because of the cool climate. At low elevation, it can be grown during the cool month of the year. The optimum monthly temperature requirement of cabbage is 5 to15 ^{o}C and the maximum monthly temperature should not be more than 24^{o} C (Bautista and Dela Cruz, 1977).

Thompson and Kelly (1957) forwarded that cabbage can be grown on all type of soil from sands, mucks, and heavy soils. They stated that for a very early crop, sandy or loamy soils are considered the best. They same source suggested that for a late crop where high yield is desirable, the most important consideration would be clay loam and silky soils. Tindall (1983), added that the soil media for cabbage production should be

well provided with organic matter and have good water holding capacity with a pH value of 6.0 to 7.0

Bautista and Mabesa (1977) stated that the direct seeding is more common practice than transplanting. It require less labor and shorten the time for the crop; but this practice have many disadvantages such as more seeds are needed to plant a particular area and disease control becomes a problem. (Aromin, 1968) also reported that the direct seedling cabbage gave poor result as compared to transplanting the seedlings.

In vegetable seedling, Hartman (1968) claimed that direct seeding is more economical since it utilize no special plant growing facilities, it involves no individual handling of seedlings and it is a standard method of growing many commercially cultivated vegetables as it is a standard method of growing many commercially cultivated vegetables as it is demand less time and it enhance continuous and rapid development of seedlings with check in growth which is associated with transplanting.

Advantages and Disadvantages of Transplanting

There are some different methods of establishing seedlings for transplanting. Bautista and Mabesa (1977) reported that transplanting can be produced in seed bed, containers, and other materials which can be used in establishing seedlings as well as seed will germinate and grow. The methods to be used depend on the grower and the available facilities. In 1972, Kinoshita mentioned that using good planting materials for a seed is a means of improving the raising of seedlings. In addition, Knott and Deanon (1967) in their experiment with Erikhuizen Glory in Nueva Ecija involving four, six, eight, and ten week old seedlings transplanted to the field on the same data, found that four week-old plants received the least check in growth from transplanting. Thus, the

given heads are significantly greater in circumference and weight than older seedlings that were transplanted. Growth was earlier compared to the most common practices in sowing the seeds in a seed bed which is 6-8 weeks old before time for transplanting in the field (Thompson, (1931).

Knott (1955) found that the degree of checking a transplanted seedling has relation to the age. In addition, he reported that seedling whose first true leaves are just beginning to show can be transplanted with little check because the effect of the shift will be outgrown by the harvest. The seedlings are watered just before transplanting to enable easy removal from the nursery (Sahadevan).

The Seed Bed

The seed bed should be in an open, sunny but sheltered position. Ideally, make a seed bed on soil manures for a previous crop. If this is not possible, in autumn apply well-rooted manure or garden compost and leave the plot to weather over the winter (Biggs, 1994).

Sowing

Biggs (1994) cited that if the seed bed is dry, water thoroughly before sowing. Use a foot board to avoid compacting the surface of the bed while sowing.

MATERIALS AND METHODS

Materials

The materials used in the experiment were the following: urea, 14-14-14, cabbage seeds "Scorpio", tags, meter stick, used plastics cups (5-10 cm diameter), polyethylene plastics bags (2x5 inches), seedling tray, seed boxes (18x26x3 inches), chicken dung, knapsack sprayer, weighing scale, garden tools.

Methods

An area of 105m^2 was prepared for the experiment. The area was divided into three blocks to represent the replication. Each block was divided into seven plots measuring 1x5 to represent the treatments. The experiment was laid out following the randomized complete block design represent the different treatments (RCBD) with three replications per treatment. The following treatments were as follows:

Code	Treatments
T_1	direct seeding
T_2	seed bed sowing (nursery bed)
T_3	used plastics cups (5-10 cm diameter)
T_4	seed box sowing (18x26x3 inches)
T_5	seed bed sowing (open field)
T_6	sowing in polyethylene plastics bags (3x5 inches)
T_7	seedling tray sowing

Prior to land preparation, seeds of "Scorpio" were germinated following the treatments. The seedlings were hardened after four weeks from sowing before transplanting to avoid transplanting shock.

The experiment plots were dug, leveled and holed before planting following the distance of 30x30 cm both ways. The double-row bed methods were used with 15 plants in one row or 30 plants per plot.

Prior to transplanting, the applications of chicken dung with a rate of one had full per hole were applied and mixed thoroughly with the soil before transplanting the four week-old seedlings to their assigned plots late in the afternoon. These was followed by irrigation, which were twice a week up to head maturity.

Two weeks after transplanting, complete and urea fertilizer side dress at the rate of 428g per plot (14.3g/plant) followed by hilling-up.

To ensure optimum growth and yield crop protection and cultural management practices necessary for cabbage production was employed to all the treatment plots. Such as: irrigation, hilling-up, weeding and control of pest and diseases.

Data Gathered

The data gathered subjected to variance analysis and mean separation by Duncan's Multiple Range Test (DMRT) was the following:

1. Days to head formation. The number of days from sowing to head formation was counted.

2. Percentage heading. This was computed by using the

Formula:

$$\text{Heading (\%)} = \frac{\text{Number head harvested}}{\text{Total number of plants/plot}} \times 100$$

3. Days to harvest. This was the number of days from sowing to head harvesting was determined by holding the head to feel the firmness. .

4. Head firmness. Ten sample plants per treatment were selected at random and head firmness was determined by "feel" method. The following scale was used

Scale	Description
4	very firm
3	firms
2	slightly firm
1	flabby

5. Equatorial circumference of heads (cm). Ten heads were selected at random per plot then the equatorial circumference was measured.

6. Average weight of heads (kg). This was determined by:

$$\text{Average weight of heads} = \frac{\text{Total weight per plot}}{\text{Number of heads per plot}}$$

7. Weight of marketable heads (kg). This was the weight of all the heads per plot with out any defects and is saleable.

8. Weight of non- marketable heads (kg). This was the weight of flabby heads, small heads plants which head formed that are considered unfit for the market.

9. Total yield (kg). This was the weight of marketable and non-marketable heads per plot.

10. Computed yield per hectare (ton). The marketable yield per plot was converted to per hectare basis by multiplying the yield per plot by 2,000. Two thousand is the number of plots per hectare based on 1x5m plot that was used in the study.

11. Economic analysis. The cost of seedling production for each treatment was recorded. This includes the cost of material used, labor in preparing the seed bed, mixing the media etc. The return on investment (ROI) from the treatment was computed using the formula:

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

RESULTS AND DISCUSSIONS

Days to Head Formation

As presented in table 1, the different methods of sowing had significant differences in the number of days to head formation. Results showed that the shortest period of head formation was observed from treatment 1 or direct seeding. It was followed by treatment 6 which was sown in polyethylene plastic bags and then treatment 3 using plastic cups, treatment 4 utilizing a seed box, and treatment 5 which is seed bed sowing in open field all which indicated longer head formation from transplanting but comparable with each other. Meanwhile, treatment 7 which was sown in seedling tray significantly formed heads longer than the other treatment. On the other hand, treatment 2 which was sown in the nursery bed took the longest period to head formation from transplanting stage.

Cabbage seeds germinated thou direct seeding was the earliest to form heads because there were no transplanting shock and disturbance of the growth. Similarly, Hartman and Kester (1967) claimed that direct seeding is more economical since it utilizes no special plant growing facilities, it involves no individual handling of seedlings and it is standard methods of growing many commercially grown cultivated vegetables as it demands less time and it enhances continuous and rapid development of seedlings with check in growth which is associated with transplanting

Percentage Heading

As shown in table 1, the different treatments significantly differed in the heading percentage. The highest heading percentage was obtained from treatment 6 which were sown in polyethylene plastics bags. This was followed by treatment 3 which was sown in used plastics cups and treatment 4 which was sown in seed box and treatment 5 that was sown in open field indicated the higher heading percentage but did not statistically differed with each other. Likewise, the former treatments are also comparable to treatment 1 or direct seeding. Treatment 7 which was sown in seedling tray had significantly lower heading percentage as compared to the other treatments with 94% except for the treatment 2 which attained the lowest heading percentage of 90%.

The results were influenced by the different methods of sowing. Environmental conditions influenced the growth yielding ability of plants. Ware et.al. (1975) explained that control of soil moisture is important. Sudden increase in soil moisture through heavy rains may cause damage especially during vegetative stage. Seedling sown in nursery bed attained the least heading percentage because it is not totally exposed to sunlight during the early vegetative growth that probably might have cause the low heading percentage.

Table 1. Days to head formation and percentage heading

TREATMENTS	DAYS TO HEAD FORMATION	PERCENTAGE HEADING (%)
Direct seeding	60[e]	95.33[ab]
Nursery bed	68[a]	90[c]
Used plastic cups	64[c]	96[ab]
Seed box	64[c]	96[ab]
Open field	64[c]	95[ab]
PEP bags	62[d]	98.67[ab]
Seedling tray	65[b]	94[b]

Means with a common letters are not significantly different at 5% level by DMRT

Days to Harvest

There were significant differences on the number of days from sowing up to harvesting among the treatment that as observed in table 2. The number of days to harvesting varied according to the different methods of sowing.

The earliest to mature and reach harvesting stage earlier among the different treatments were the cabbage that was directly seeded. It was followed by treatment 3 which was sown in used plastic cups, treatment 4 (seed box sowing), treatment 5 seed bed sowing in open field, and treatment 6 which was sown on individual polyethylene plastic bags. Treatment 7 indicated longer maturity than the other except treatment 2 (seed bed sowing in the nursery) which was the last to attain the maturity and reach the harvesting stage.

Bautista and Mabesa (1977) stated that direct seeding method is a more common practice than transplanting because no transplanting shock which leads to earlier in harvesting. Compared to direct seeding, transplanted seedlings especially seedlings transplanted from the nursery where in the growth was disturb as it took more time to recover might have caused additional days to reach the harvesting stage.

Head Firmness

In head firmness (table 2) cabbages head produced mostly from the different treatments had very firm heads except for treatment 2 which was sown in the nursery bed as having produce firm heads. Each treatment had its sown head firmness characteristics as emphasized by Lorenz and Maynard (1986) that each produce must have the characteristics desired by the packers, shippers, wholesalers, retailers, and consumers.

Bawang (2005) cited that backyard and small scale cabbage production seedlings are started in seed boxes and in commercial forms. Seedbeds and seed boxes are usually prepared in areas that are fully exposed to sunlight. This maybe the reason why cabbage heads which was sown in the nursery bed produced slightly firm and flabby heads. Based on some observations very firm cabbage heads is mostly preferred by consumers.

Table 2. Days to harvest and head firmness

TREATMENTS	DAYS TO HARVEST	HEAD FIRMNESS
Direct seeding	89[d]	very firm
Nursery bed	98[a]	firm
Used plastic cups	90[c]	very firm
Seed box	90[c]	very firm
Open field	90[c]	very firm
PEP bags	90[c]	very firm
Seedling tray	92[b]	very firm

Means with a common letters are not significantly different at 5% level by DMRT

Equatorial Circumference (cm)

This results in table 3 shows that the different treatments significantly differed in equatorial circumference. This results revealed that the treatment 6 which were sown in polyethylene plastic bags had significantly wider equatorial circumference over the treatment 5 (open field) and treatment 7 (seedling tray). This was followed by treatment 1 (direct seeding), treatment 3 (used plastic cups), and treatment 4 (seed box sowing) but are comparable with each other. Treatment 2 (nursery bed) produced the least equatorial circumference of heads.

According to Gutierrez (2000), cabbage seeds sown in polyethylene plastic bags produced bigger heads over those raised using normal seed bed, commercial seed box and recycled plastic cups during harvesting.

This conforms to the findings of Knott (1935) that seedlings planted at four weeks old received the least check in growth from transplanting thus, it produced heads with significantly greater circumference and heavier weight over the older transplanted seedlings.

Average Weight of Heads (kg)

It was observed from the result in table 3 that the heaviest average head weight of cabbage as affected by the different treatments studied was produced from treatment 6 (Polyethylene plastic bags) but did not significantly differ with treatment 4 (seed box sowing). Similarly, treatment 4 differed significantly from treatments 3 and 5, which was sown in used plastic cups and open field beds. Treatment 1, 2 and 7 which was sown directly, sown in nursery beds and sown in seedling trays, respectively had also comparable average head weights and produced the lightest average head weight with a means of 0.74 kg/head.

This findings on treatment 6 which sown in polyethylene plastic bags and treatment 4 sown in the seed box may imply that is a suitable and well adapted method of germinating cabbage seeds if the weight of heads are to be considered.

Table 3. Equatorial circumference (cm) and average weight of heads (kg/plot)

TREATMENTS	EQUATORIAL CIRCUMFERENCE (cm)	AVERAGE WEIGHT OF HEADS (kg/plot)
Direct seeding	46.5[d]	0.74[c]
Nursery bed	45.83[cd]	0.74[c]
Used plastic cups	46.5[d]	0.84[b]
Seed box	46.83[cd]	0.92[a]
Open field	47.5[b]	0.81[b]
PEP bags	48.5[a]	0.95[a]
Seedling tray	47.5[b]	0.74[c]

Means with a common letters are not significantly different at 5% level by DMRT

Weight of Marketable Heads (kg/plot)

As presented in table 4, treatment 6 which was sown in polyethylene plastic bags significantly attained the highest marketable yield but statistically comparable with treatment 4 (seed box sowing). Treatment 3, germinated in (used plastic cups) produced slightly higher marketable yields over treatments 1 and 2 which sown directly and sown in the nursery bed which in turn did not differ significantly with treatment 7 (seedling tray) and treatment 5 (open field). The former treatments had significantly lower marketable heads than the other treatments except for treatment 2 which was sown in the nursery bed that produced the lowest weight of marketable heads with a mean of 22.33 kg/plot.

According to Gutierrez, as previously mentioned (2000), seedlings in polyethylene plastic bags and seed boxes outweighed the fresh weight from seedling sown in recycled plastic cups and commercial seed boxes.

Moreover, growing seedlings in used plastic cups, fruit juice, containers, and plastic bags have higher head diameter, weight of individual head that resulted to heavier marketable heads per plot (Tegwa, 1996).

Weight of Non-marketable Heads (kg)

Table 4 shows that treatment 2 which was sown in nursery bed produced the heaviest non-marketable heads which significantly differed from the other treatment but comparable with treatment 5 which was sown in open field. It was followed by treatment 1, 7 which are directly seeded and sown in seedling tray. Further comparison showed that treatment 4 (seed box sowing) and treatment 6 (sown in polyethylene plastic bags) have similar non-marketable yield and the least weight of non-marketable heads.

According to the results, it could be presumed that cabbage seeds that are germinated in individual polyethylene plastic bags will produce lesser weight of heads considered unfit for the market as compared to the other methods which showed heavier weight of non-marketable cabbage heads.

Table 4. Weight of marketable (kg/plot) and non- marketable heads (kg)

TREATMENTS	WEIGHT OF MARKETABLE HEADS (kg/plot)	WEIGHT OF NON-MARKETABLE HEADS (kg/plot)
Direct seeding	25[b]	1.33[bc]
Nursery bed	22.33[c]	2[a]
Used plastic cups	25.33[b]	1.08[cd]
Seed box	27.67[a]	0.58[de]
Open field	24.33[b]	1.75[ab]
PEP bags	28.67[a]	0.5[e]
Seedling tray	24.67[b]	1.33[bc]

Means with a common letters are not significantly different at 5% level by DMRT

Total Yield

The highest total yield per plot (table 9) was attained by the cabbage heads with polyethylene plastic bag seed sowing but did not differ significantly with treatment 4 or seed box sowing. This was followed by the treatments that were sown in used plastic cups, Treatment 1 which is direct seeding, Treatment 5 sown in open field and treatment 1 which is direct seeding. Treatment 5 sown in open field and Treatment 7 which was seedling tray sowing. While the least total yield per plot was recorded in treatment 2 or nursery bed sowing this produced 24.33 kg/plot.

As previously discussed Tegwa (1996), reported that the use of plastic cups, fruit juice containers, and polyethylene plastic bags have higher head diameter, weight of

individual head that resulted to heavier marketable heads per plot and total yield per plot compared to seed bed method and direct seeding.

Computed Marketable Yield

The highest computed marketable yield of cabbage heads per hectares as presented in table 5 was noted on treatment 6 or polyethylene plastic bags sowing. This was followed by treatment 4 (seed box sowing). On the other hand, statistical analysis indicated that treatment 3 (used plastic cups), treatment 1 (direct seeding), treatment 5 (open field sowing) and treatment 7 (seedling tray sowing) had similar computed marketable yield per hectare. Nursery bed sowing (treatment 2) produced the lowest computed marketable yield of cabbage heads hectare with 48.67 tons.

The marketable, total and computed yield were significantly higher by transplanting younger seedlings at three or four weeks old. This implies that higher yield in cabbage is obtained by transplanting younger seedlings based on the past study of Palsaen (2004)

Table 5. Total yield (kg/plot) and computed marketable yield (tons/ha)

TREATMENTS	TOTAL YIELD (kg/plot)	COMPUTED MARKEATBLE YIELD (tons/ha)
Direct seeding	26.33[b]	52.67[b]
Nursery bed	24.33[c]	48.67[c]
Used plastic cups	26.42[b]	52.83[b]
Seed box	28.26[a]	56.5[a]
Open field	26.08[b]	52.25[b]
PEP bags	29.17[a]	58.33[a]
Seedling tray	26[b]	52[b]

Means with a common letters are not significantly different at 5% level by DMRT

Return on Investment

Table 11 shows that treatment 6 (sown in polyethylene plastic bags) had the highest return on investment (ROI) of 49.08%. This was followed by treatment 1 (direct seeding) with 43.05% and treatment 3 or used plastic cups with 41.56% on return on investment. This was further followed by treatment 5 and 4 which was sown in open field and in seed box sowing with 37.51 % and 37.22%. It shows that the treatment 2 and 7 obtained the least return on investment.

Table 6. Cost and return analysis of 105m^2

TREATMENTS	T_1	T_2	T_3	T_4	T_5	T_6	T_7
Marketable	75	67	76	83	73	86	74
A. SALES	375	335	380	415	365	430	370
B.EXPENSES							
1. FERTILIZER							
a. Chicken manure	62.86	62.86	62.86	62.86	62.86	62.86	62.86
b. Urea	16	16	16	16	16	16	16
c.Complete	14.29	14.29	14.29	14.29	14.29	14.29	14.29
2. INSECTICIDE							
a. Steward	25.71	25.71	25.71	25.71	25.71	25.71	25.71
3. FUNGICIDE							
a. Daconil	21.43	21.43	21.43	21.43	21.43	21.43	21.43
4.SEEDLING TRAY							50
5. PEP BAGS						20	
6. SEED BOX MATERIAL							
a. 2x2x12 wood				30			
7. GASOLINE	32.14	32.14	32.14	32.14	32.14	32.14	32.14
8. LABOR	89.71	93	96	100	93	96	91
TOTAL EXPENSES	262.14	265.43	268.43	302.43	265.43	288.43	313.43
C.NET PROFIT	112.86	69.57	111.57	112.57	99.57	141.57	56.57
D. ROI (%)	43.05	26.21	41.56	37.22	37.51	49.08	18.05
RANK	2	6	3	5	4	1	7

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study was conducted from October 2007 to January 20008 to evaluate the different methods of sowing seeds on the growth and yield of cabbage.

Results of the study indicated that sowing in polyethylene plastic bags (Treatment 6) attained the highest heading percentage of 98.67% while nursery bed sowing had the lowest heading percentage of 90%.

For maturity, head formation started with in 60 to 68 days after sowing and head harvesting was done 89 to 98 days from sowing. Direct seeding and polyethylene plastic bags were the first treatments harvested. Results showed that the earliest to initiate head formation was the first to be harvested.

In terms of yield, polyethylene plastic bag sowing (Treatment 6), produced the biggest equatorial circumference (48.5 cm) and nursery bed sowing (Treatment 2) produced the least equatorial circumference of 45.83cm of heads. As well as having the heaviest weight per head (0.74 to 0.95kg) resulting to a higher total yield per plot (28.26 to 29.17) and computed marketable yield per hectare (48.67 to 58.33 tons per hectare). This was followed by used plastic cups, treatment 1 which is direct seeding, treatment 5 sown in open field and treatment 7 which was seeding tray sowing with tremendously lower yield per plot of 26 to 26.42. The remaining treatment had the lowest yield range of 24.33 or 48.67 tons per hectare.

Nursery bed sowing (Treatment 2) produced the heaviest non-marketable heads of 2kg per plot. Open field sowing (Treatment 5), direct sowing (Treatment 1), and

seedling tray sowing, and used plastic cups sowing produced non-marketable head with a range of 0.5 to 0.58kg per plot.

Regarding head firmness, all the treatments had very firm heads except for nursery bed sowing (treatment 2) with firm heads.

Economically, the highest return on investment was obtained from treatment 6 (sown in polyethylene plastic bags) of 49.08% with a selling price of P5.00 per kilogram followed by treatment 1 (direct seeding), treatment 3 (used plastic cups).Treatment 5 (open field sowing), treatment 4 (seed box sowing), treatment 2 (nursery bed) and treatment 7 (seedling tray sowing) with a return on investments of 43.05%, 41.56%, 37.51%, 37.22%, 26.21% and 18.05% respectively.

Conclusion

Based on the result presented and discussed, the polyethylene plastic sowing out yielded the rest of the treatments studied. It had the highest total yield resulted to highest return on investment of 49.08%.

Recommendation

From the preceding results and discussions, it is therefore recommended that sowing in polyethylene plastic bags is the best method to be used in sowing seeds of cabbage. Based on the yield performance, the polyethylene plastic bag sowing attained the highest return on investment.

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APPENDICES

Appendix Table 1. Days to head formation

TREATMENTS	REPLICATIONS I	II	III	TOTAL	MEAN
T1	60	60	60	180	60
T2	68	68	68	204	68
T3	64	64	64	192	64
T4	64	64	64	192	64
T5	64	64	64	192	64
T6	62	62	62	186	62
T7	65	65	65	195	65

Analysis of Variance

Source of variation	Degrees of freedom	Sum of squares	Mean of square	Computed F	TABULAR F 0.05	0.01
Replication	2	68	0.000			
Treatment	6	64	18.428	99999.99**	0.0001	
Error	12	64	0.000			
TOTAL	20	64				

** Highly significant

Coefficient of Variation = 0%

Appendix Table 2. Percentage heading (%)

TREATMENT S	REPLICATIONS I	II	III	TOTAL	MEAN
T_1	100	93	93	286	95.33
T_2	90	90	90	240	90
T_3	96	96	96	288	96
T_4	96	96	96	288	96
T_5	96	93	96	285	95
T_6	100	100	96	295	98.67
T_7	93	93	96	282	94

Analysis of Variance

Source of variation	Degrees of freedom	Sum of squares	Mean of square	Computed F	TABULAR F 0.05	0.01
Replication	2	8.000	4.000			
Treatment	6	124.666	20.777	5.27**	0.0071	
Error	12	47.333	3.944			
TOTAL	20	180.000				

** Highly significant

Coefficient of Variation = 2.09%

Appendix Table 3. Days to head harvest

TREATMENTS	REPLICATIONS				
	I	II	III	TOTAL	MEAN
T_1	89	89	89	267	89
T_2	98	98	98	294	98
T_3	90	90	90	270	90
T_4	90	90	90	270	90
T_5	90	90	90	270	90
T_6	90	90	90	270	90
T_7	92	92	92	276	92

Analysis of Variance

Source of variation	Degrees of freedom	Sum of squares	Mean of square	Computed F	TABULAR F 0.05	TABULAR F 0.01
Replication	2	0.000	0.000			
Treatment	6	172.285	28.714	99999.99**	0.0001	
Error	12	0.000	0.000			
TOTAL	20	172.285				

** Highly significant

Coefficient of Variation = 0%

Appendix Table 4. Equatorial circumference (cm)

TREATMENTS	REPLICATIONS I	II	III	TOTAL	MEAN
T1	46.5	47.5	45.5	139.5	46.5
T2	45.5	46.5	45.5	137.5	45.83
T3	46.5	46.5	4.5	139.5	46.5
T4	47.5	46.5	46.5	140.5	46.83
T5	47.5	47.5	47.5	142.5	47.5
T6	48.5	48.5	48.5	145.5	48.5
T7	47.5	47.5	47.5	142.5	47.5

Analysis of Variance

Source of variation	Degrees of freedom	Sum of squares	Mean of square	Computed F	TABULAR F 0.05	0.01
Replication	2	46.5	47.5			
Treatment	6	45.5	46.5	10.43**	0.0004	
Error	12	46.5	46.5			
TOTAL	20	47.5				

** Highly significant

Coefficient of Variation = 1.00%

Appendix Table 5. Average weight of marketable heads (kg)

TREATMENTS	REPLICATIONS I	II	III	TOTAL	MEAN
T_1	0.74	0.74	0.74	2.222	0.74
T_2	0.73	0.7	0.76	2.222	0.74
T_3	0.83	0.86	0.83	2..52	0.84
T_4	0.93	0.9	0.93	2.76	0.92
T_5	0.76	0.83	0.83	2.42	0.81
T_6	0.96	0.96	0.93	2.85	0.95
T_7	0.73	0.73	0.76	2.222	0.74

Analysis of Variance

Source of variation	Degrees of freedom	Sum of squares	Mean of square	Computed F	TABULAR F 0.05	0.01
Replication	2	0.000	0.000			
Treatment	6	0.140	0.023	50.79**	0.0001	
Error	12	0.005	0.000			
TOTAL	20	0.146				

** Highly significant

Coefficient of Variation = 2.615%

Appendix Table 6. Weight of marketable heads (kg/plot)

TREATMENTS	REPLICATIONS I	II	III	TOTAL	MEAN
T_1	25	25	25	75	25
T_2	22	22	23	67	22.33
T_3	25	26	25	76	25.33
T_4	28	27	28	83	27.67
T_5	23	25	25	73	24.33
T_6	28	29	29	86	28.67
T_7	23	25	26	74	24.67

Analysis of Variance

Source of variation	Degrees of freedom	Sum of squares	Mean of square	Computed F	TABULAR F 0.05	0.01
Replication	2	3.714	13.523			
Treatment	6	81.142	0.523	25.82**	0.0001	
Error	12	6.285				
TOTAL	20	91.142				

** Highly significant

Coefficient of Variation = 2.846 %

Appendix Table 7. Weight of non- marketable (kg/plot)

TREATMENTS	REPLICATIONS I	II	III	TOTAL	MEAN
T_1	1.5	1.5	1	4	1.33
T_2	2	2.5	1.5	6	2
T_3	1	0.75	1.5	3.25	1.08
T_4	0.75	0.74	0.25	1.75	1.08
T_5	2	1.75	1.5	5.25	1.75
T_6	0.75	0.25	0.5	1.5	0.5
T_7	1.5	1.5	1	4	1.33

Analysis of Variance

Source of variation	Degrees of freedom	Sum of squares	Mean of square	Computed F	TABULAR F 0.05	0.01
Replication	2	0.398	0.199			
Treatment	6	5.571	0.928	9.75**	0.0005	
Error	12	1.142	0.095			
TOTAL	20	7.113				

** Highly significant

Coefficient of Variation = 25.167%

Appendix Table 8. Total yield (kg)

TREATMENTS	REPLICATIONS I	II	III	TOTAL	MEAN
T_1	26.5	26.5	26	79	26.33
T_2	24	24.5	24.5	73	24.33
T_3	26	26.75	26.5	79.25	26.42
T_4	28.75	27.75	28.25	84.78	28.26
T_5	25	26.75	26.5	78.25	26.08
T_6	28.75	29.5	29.5	87.5	29.17
T_7	24.5	26.5	27	78	29.17

Analysis of Variance

Source of variation	Degrees of freedom	Sum of squares	Mean of square	Computed F	TABULAR F 0.05	0.01
Replication	2	45.476	1.021			
Treatment	6	4.667	7.579	19.49**	0.0001	
Error	12	52.185	0.389			
TOTAL	20	52.185				

** Highly significant

Coefficient of Variation = 2.340%

Appendix Table 9. Computed marketable yields (tons/ha)

TREATMENTS	REPLICATIONS I	II	III	TOTAL	MEAN
T_1	53.00	53.00	52.00	158	52.67
T_2	48.00	49.00	49.00	146	48.67
T_3	52.00	53.50	53.00	158.5	52.83
T_4	57.50	5.50	56.50	169.5	56.5
T_5	50.00	53.75	53.00	156.75	52.25
T_6	57.50	58.50	59.00	175	58.33
T_7	49.00	53.00	54.00	156	52

Analysis of Variance

Source of variation	Degrees of freedom	Sum of squares	Mean of square	Computed F	TABULAR F 0.05	0.01
Replication	2	7.542	3.771			
Treatment	6	184.280	30.713	22.11**	0.0001	
Error	12	16.667	1.389			
TOTAL	20	208.488				

** Highly significant

Coefficient of Variation = 2.212%