BIBLIOGRAPHY

GUZMAN, JASPER K. APRIL 2011. Growth, Yield and Profitability of Green Onion (*Allium fistulosum* L.) at Different Plant Densities. Banengbeng, Sablan, Benguet.

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ABSTRACT

The study was conducted at Banengbeng, Sablan, Benguet from August to October, 2010 to determine the effect of different plant densities on the growth, yield and profitability of green onion, and the best plant spacing for green onion production under Banengbeng, Sablan, Benguet condition.

Results of the study show that except weight of plants harvested per plot where the 30 cm x 15 cm obtained significantly lower weight, the rest of the data gathered on growth and yield did not differ significantly.

In terms of profitability, the highest net income of P386.50 or 111.48% return on expenses from 20 square meters was obtained from green onion plants spaced at 15 x 15 cm. This was followed by spacing plants at 20 cm x 15 cm, 25 cm x 15 cm and 30 cm x 15 cm with P323.20, P305.10 and 100.30, ROI; respectively. It was also observed that the net income from green onions decrease as the plant spacing becomes wider with lower population per area.

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INTRODUCTION

Green onion (*Allium fistulosum L.*) is one of the vegetable crops planted by farmers as main crop during rainy season, intercrop or mixed crop during dry season. Some farmers plant two rows where in the use of land is not maximized.

Green onion is used mostly as seasoning in soups. It is also used as topping in a recipe like cake, salad, bread and also junk foods. Most of buyers of green onions are large business like hotel, restaurant, and bakery and also in fast food. The leafy part of green onion is the main part that is used in cooking. Aromatic flavor of leaves is appreciated especially among Russians, where they used as raw in various salads or as delicious filling in pies.

Some of the farmers plant onion as their intercrop to other vegetables to maximize the use of area but they even do not know if the plant is compatible to each other. Gardeners in Benguet said that onion is the easiest vegetable to grow. Plant density also has been recognized as a major factor in determining the degree of competition between plants.

There had been few studies and limited information regarding the plant densities in green onion. Information that will be gathered from the study will help the farmers, extension workers, researchers and the following generation who will engage in vegetable production. This research will also raise the standard of living for the farmers due to higher profit, but also increase the volume of production of the country. Increases in production will also encourage development in the community where the farmers are living and the expansion of industry.

The study was conducted to: 1) determine the effect of different plant densities on the growth and yield of green onion; 2) determine the plant density appropriate for green onion that

will optimize yield per unit area; and 3) determine the profitability of green onion at different plant densities.

The study was conducted at the area of Oring, Banengbeng, Sablan Benguet from August to October 2010.

REVIEW OF LITERATURE

Description of the Crop

Onion is a vegetable that has a strong odor and flavor. Onion ranked as one of the world's most popular foods. They are use chiefly as a seasoning and are eaten raw, cooked, dehydrated and pickled. When cut, it gives a vapor that causes people's eyes to water. Onions differ in strength of their flavor. People use such strong tasting onions as the Southport yellow globe in soups and stews. Mild onions, including the tallow Bermuda and sweet Spanish are often eaten raw in salads or sandwiches. Onions are harvested when their bulb are immature are called green onion or salad onions. Green onions are sold with their leaves attached. Onions probably first grew in central or Southwestern Asia. Today, onions are grown throughout the world. The leading onion-growing countries include China, India and United States (Hughes, 1997).

Green onions have small white bases or ends that vary in size depending on when they were harvested. Most will have slight roundness to the base but they have not developed into full bulbs. They are available year round but their prime season is spring and summer (Anonymous, n.d.).

Nutritional Value

According to Bonar (1994), onions contain few calories, an appreciable amount of calcium and some vitamin C but their nutritional value is not high, despite their reputed medicinal qualities.

Economic Value

According to Bonar (1994), onions are possibly the most widely used vegetable in the world. No casserole or stew is complete without them and they are added two thousands of other dishes as a moisturizer and flavoring. On their own, they can be baked or boiled, or made into a delicious sauce or soup. Moreover, the author mentioned that the onion is one of the longest and most widely used vegetables, with and recorded history reaching back 3,500 B.C.

Medicinal Value

Bonar (1994) stated that the ancient Egyptians though so highly of the onion that they were used in medicine and mummification, and the slaves building the pyramids ate onions as well as garlic and radishes. Nero ate them to cure colds and the Romans belief in their medicinal use and along side the liking for the flavor, and they were used for sleeplessness, cough, sore throats and stomach.

Soil Climatic Requirements

The onion is cool season plant that will grow well over a wide range of temperature. Onion seed will germinate best near 65^0 F. Best growth and quality are obtained if the temperature is cool during the early development and warm near maturity. A dry atmosphere at harvest is desirable to obtain satisfactory curing, and to thrive well to irrigation in many areas (McCollum, 1980).

Effect of Plant Spacing/Plant Density

The field spacing and plant population are those that maximize yield and quality without unduly increasing production cost (Anonymous, 1990). As a rule, all crops tended to increase

yield per unit area as plant population increased, but up to a certain limit. The author also added that beyond this limit, the yield may not increase further and may even drop.

Bautista and Mabesa (1970) stated that as plant population per unit area increased, the yield per unit area will also increase until the spacing is so close that excessive competitions between rows and in rows among plants occur. With each grower's situation, wider spacing is needed where the plant requirements for moistures and nutrients cannot be met at a closer spacing, where growing large vegetables is desirable and where the variety requires such spacing.

Colbong (1985) reported that wider spacing of radish plants enhanced early maturity produced the most number of leaves, larger and longer roots and increased heavier weight of individual roots.

On one hand, Thompson (1959) said that close spacing of sweet potatoes increase yield of marketable roots while Martin and Leonard (1970) stated that thinner spacing in the same crop tends to produced fewer but large roots.

In 1972, Watts added that the proper distance between plants depend upon the variety, purpose of the crop, fertility of the soil, and method of cultivation, spacing and harvesting.

MATERIALS AND METHODS

Materials

The materials used in the study were green onion suckers (Boltsville), decomposed chicken manure, pesticides, farm tools, watering cans, foot rule, pegs, and record book.

Method

Experimental design and treatments. The experimental layout was the Randomized Complete Block Design (RCBD). The treatments which were replicated four times were the following.

Code	Distance of Planting	Row of Plants	Number of Plants
T_1	30 x 15 cm	2 rows	66 plants
T_2	25 x 15 cm	3 rows	99 plants
T_3	20 x 15 cm	4 rows	132 plants
T_4	15 x 15 cm	5 rows	165 plants

Land preparation. Sixteen plots measuring 1m x 5m (80 sq m) were dug 30 cm deep for the study. After digging, the plots were applied with compost chicken dung as fertilizer base-dress. This was mixed with the soil thoroughly. The plot surface was leveled and lines were made to indicate where the green onion suckers were planted.

Planting. Two green onion suckers were planted on each hill about five centimeters deep following the distance and number of plant rows specified in the treatment (Figure 1).

Fig.1. The upper photo shows the plants at 1 week old while the lower photo Shows plants stand at 15 days from planting

Irrigation. The plants were irrigated by bucket overhead using two cans (16 liters capacity) of water per plot. This was done every three days or twice a week if it did not rain.

Side dressing and hilling-up. Three weeks after planting, 14-14-14 at the rate of 120-120-120 kg of N-P_2O-K_2O per hectare or 428.57g per plot of 1m x 5m was applied. This fertilizer was evenly distributed in between the plants followed by hilling-up to cover the fertilizer, growing weeds and fix the plots to prevent water run-off.

Crop maintenance. All the plants were taken cared off equally up to the termination of the study. If the plants were infected with disease, fungicide was applied and when insects damage the plants, insecticide was applied.

Data gathering. Seventy days after planting, the plants were uprooted and the following data were gathered:

1. Plant height (cm). This was obtained 70 days from planting. Ten sample plants were uprooted randomly from each plot and were measured from the base of the leaf sheath to the tip of the longest leaf. The measurement were added then divided by 10 to get the average per plant.

2. Number of suckers produced per plant. The number of plants per hill from ten sample plants were counted and recorded.

3. Weight of plants per plot (kg). This was the total weight of plants that was harvested per plot.

4. Weight per bunch (g). The total weight of 10 sample plants per plot was divided by the10 samples to obtain the weight of plants per bunch.

Documentation. This was photographed after transplanting, during growth and harvest.

5. Economic analysis. All inputs like the planting materials, fertilizers, pesticides, labor, etc., were recorded and so with the sales in order to compute for the return on expenses using the formula:

$$\text{ROE (\%)} = \frac{\text{Gross Sales/Plot} - \text{Total Expenses/ Plot}}{\text{Total Expenses/ Plot}} \times 100$$

RESULTS AND DISCUSSION

Plant Height

Table 1 shows the plant height measured from the different plant densities. As presented, there was a corresponding increase in height as the distance of planting was reduced. In other words, the closer the distance of planting, where there were more plants grown per square meter, and also had taller plants. However, there were no significant differences in plant heights of green onions grown in the different plant spacings (Figure 2).

Number of Suckers Produced per Plant

There were no significant differences observed among the plant spacing studied as presented in Table 2. It was expected that the number of suckers will be more from wider spacings which had decreased as the spacing also decrease. The trend was shown from 25 x 15 cm, 20 x 15 cm, and 15 x 15 cm where the numbers of suckers were there was a corresponding decrease in the number of suckers produced per plant as the spacing decreased; but the 30 x 15 cm spacing did not produce the most suckers as expected. This result might imply that even if the distance between rows of plants were farther apart if the distance in rows is all the same. It will result to similar number of suckers to be produced per plant.

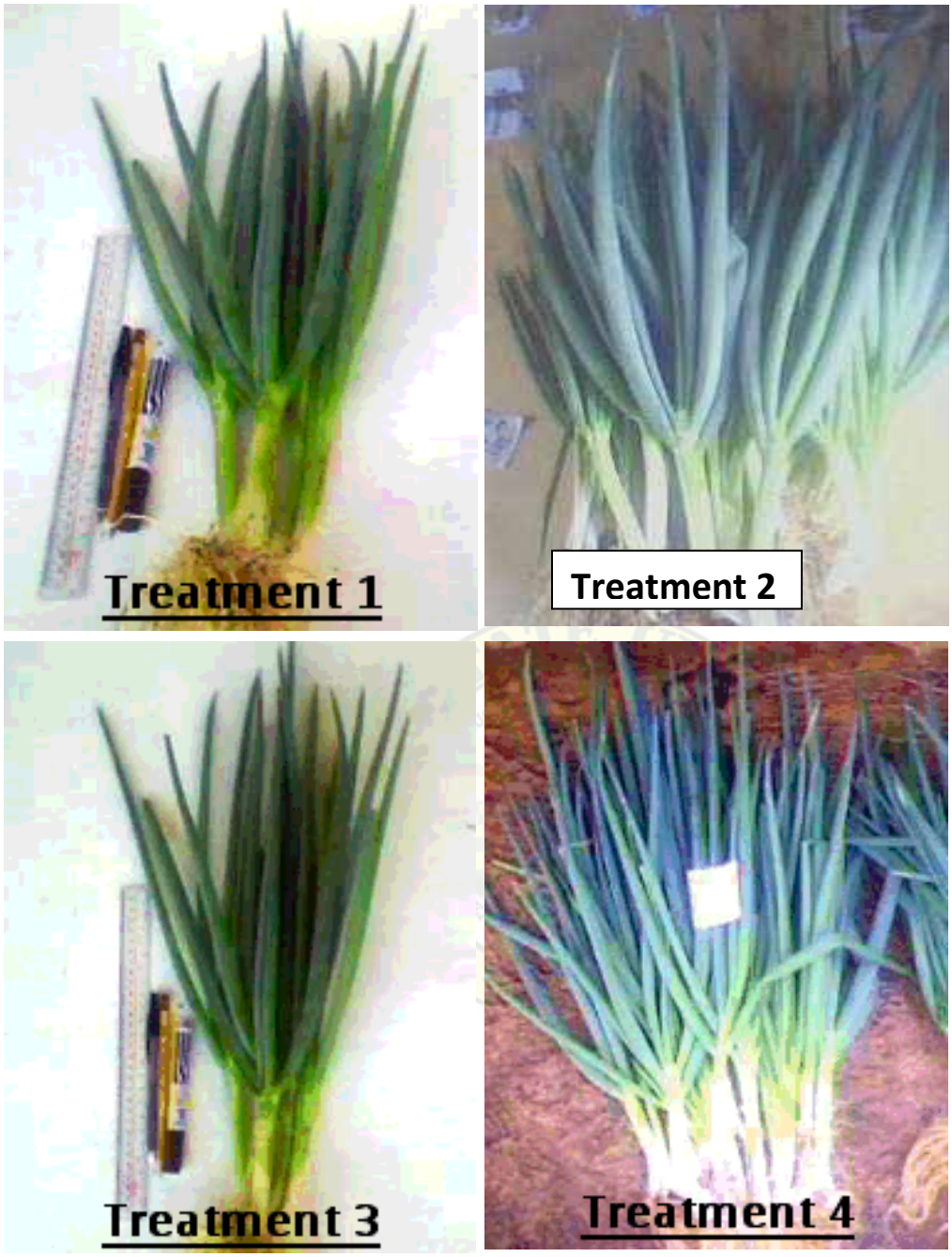

Figure 2. Green onions grown at different spacing at harvest

Table 1. Plant height of green onion from the different spacings at harvest

TREATMENT	MEAN (cm)
30 x 15 cm	55.21[a]
25 x 15 cm	57.65[a]
20 x 15 cm	57.78[a]
15 x 15 cm	58.78[a]

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

Table 2. Number of suckers produced per plant

TREATMENT	MEAN
30 x 15 cm	48.00[a]
25 x 15 cm	52.50[a]
20 x 15 cm	47.75[a]
15 x 15 cm	47.50[a]

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

Weight of Plants per Plot

As shown in Table 3, the weight of plants harvested per plot increased as the plant spacing was made closer. Apparently, green onion planted at 25 x 15 cm, 20 x 15 cm and 15 x 15 cm slightly differed among themselves in plant weight per plot but significantly heavier than the weight of plants from the 30 x 15 cm spacing. There were slight differences among the different plant spacings in the plant height and number of suckers per plant but the lowest height and number of suckers from the 30 x 15 cm spacing resulted to the significantly lower weight of plants harvested per plot. According to some

Table 3. Weight of plants harvested per plot

TREATMENT	MEAN (kg)
30 x 15 cm	4.22[b]
25 x 15 cm	6.47[a]
20 x 15 cm	6.82[a]
15 x 15 cm	7.63[a]

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

authors, all crops tend to increase yield per unit area as plant population increase, but up to a certain limit and beyond this the yield starts to drop (Anon.1990; Anon. 2009). Bautista and Mabesa (1970) explained that when the spacing is so close, excessive competition between rows and in rows among plants occur resulting to yield reduction. However, the yield increase observed in this study is very slight among the treatments and the peak of yield was not reached and the drop of yield due to severe competition was not attained because the variation in spacing was only in the distance between rows but the distance of plants in rows was all the same at 15 cm which is the ideal distance for green onion. The results might have been different when the distance of plants in rows was varied from wide to close spacing.

Weight per Bunch

There were no significant differences observed among the plant spacings in terms of weight per bunch as presented in Table 4. As was explained earlier, it appears that when the spacing in between rows with changes by 5 cm; and the spacing in rows is measured at 15 cm in all treatments, the weight per bunch did not differ significantly. Spacing green onion at 15 cm in rows seem to be appropriate for the plant and even if

Table 4.Weight per bunch from the different densities

TREATMENT	MEAN (g)
30 x 15 cm	159.52[a]
25 x 15 cm	162.67[a]
20 x 15 cm	163.10[a]
15 x 15 cm	157.20[a]

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

we vary the spacings between rows do not have significant influence in the weight of plant per bunch. Apparently, the weight per bunch decrease as the spacings were made closer because of competition among plants and plant parts. However, the competition was not severe may be due to the plant characteristic where the leaves are usually erect.

Economic Analysis

As shown in Table 5, the net income from the different spacings of green onion studied increased as the spacing was decreased from P100.30 to P386.50. In other words, when the spacing was 15 x 15 cm, the return on expenses was 111.48% or P1.11 for every peso spent in the production. As the spacings became wider from 20 x 15 cm, 25 x 15 cm, and 30 x 15 cm, the net income reduced to P323.20, P305.10 and P100.30, respectively. While the statistical analysis did not show significant differences among the plant spacings, the difference of 13.65 kg of yield between 15 x 15 cm and 30 x 15 cm would mean P327.60 which when converted to hectare basis will be P163, 800.00. This amount will mean a lot to a farmer already. Even the difference

between the 15 x 15 cm and 20 x 15 cm which is 6.0 kg will still give P14, 125.00 per hectare advantage of 15 x 15 cm over 20 x 15 cm spacing with the selling price of P24.00 per kilo.

Table 5. Economic analysis from the 20 square meter area of green at Banengbeng, Sablan, Benguet

ITEM	PLANT SPACING (cm)			
	30 x 15	25 x 15	20 x 15	15 x 15
YIELD (kg)	16.90	25.90	27.30	30.55
SALES (P)	405.60	621.60	655.20	733.20
Expenses				
Planting materials	28.80	39.00	56.40	70.20
14-14-14	31.50	31.50	31.50	31.50
Labor cost				
Cleaning	47.50	47.50	47.50	47.50
Digging plots	47.50	47.50	47.50	47.50
Irrigating	45.00	45.00	45.00	45.00
Harvesting	50.00	50.00	50.00	50.00
Transportation	10.00	10.00	10.00	10.00
Total Expenses	305.30	316.60	332.00	346.70
Net Income	100.30	305.10	323.20	386.50
ROE (%)	32.85	96.40	97.35	111.48
RANK	4	3	2	1

Note: The selling prize per kilo during harvest was P 24.

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Summary

The study was conducted from August to October 2010 at Oring, Banengbeng, Sablan, Benguet to evaluate the growth, yield and profitability of green onion in different plant densities.

Results of the study shows that except the weight of plants harvested per plot where the 30 cm x 15 cm obtained significantly lower weight, the rest of the data gathered on growth and yield did not differ significantly.

In terms of profitability, green onions spaced at 15 cm x 15 cm obtained the highest net income of P386.50 or 111.48% return on expenses from 20 square meters. This was followed by 20 cm x 15 cm, 25 cm x 15 cm and 30 cm x 15 cm with P323.20, P305.10 and P100.30, respectively. Obviously, the net income from green onions decrease as the plant spacing becomes wider.

Conclusion

Based on the results presented and discussed, 15 cm x 15 cm plant spacing in green onion produced heavier yield with higher net income than those spacings with wider distance between rows from 20 to 30 cm. When the spacing was 15 x 15 cm, the return on expenses was 111.48% or P1.11 for every peso spent in the production.

Recommendations

It is therefore recommended that green onion be planted 15 cm x 15 cm (in rows and in between rows) in Oring, Banengbeng, Sablan, Benguet. The difference of 13.65 kg of yield between 15 x 15 cm and 30 x 15 cm would mean P327.60 which when converted to hectare basis will be P163,800.00. This amount will mean a lot to a farmer already. It is further recommended

that closer spacings be evaluated with longer maturity days of harvesting than the 70 days used in this study.

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APPENDICES

Appendix Table 1. Plant height (cm)

TREATMENT	REPLICATION 1	11	111	1V	TOTAL	MEAN
30 x 15 cm	56.75	57.19	49.54	57.36	220.84	55.21
25 x 15 cm	56.40	54.81	55.25	64.16	230.62	57.65
20 x 15 cm	55.35	57.51	56.36	61.93	231.15	57.78
15 x 15 cm	57.65	60.69	57.21	59.60	235.15	58.78

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F 0.05	0.01
Block	4	79.85501	26.6167			
Treatment	4	27.72079	9.2401	1.53^{ns}	3.86	6.99
Error	9	54.2600	6.0289			
TOTAL	17	161.8302				

ns = not significant Coefficient of variation = 4.28%

Appendix Table 2. Number of suckers produced per plant

TREATMENT	REPLICATION				TOTAL	MEAN
	1	11	111	1V		
30 x 15 cm	58	50	35	49	192	48.00
25 x 15 cm	57	49	51	53	210	52.50
20 x 15 cm	48	53	49	41	191	47.75
15 x 15 cm	44	45	55	46	190	47.50

ANALYSIS OF VARIANCE

SUM OF SQUARES	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F
Block	4	51.6875	17.2292		
Treatment	4	68.1875	22.7292	0.50^{ns}	3.86
Error	9	409.0625	45.4514		
TOTAL	17	528.9375			

ns= not significant Coefficient of variation=13.78%

Appendix Table 3. Weight of plants per plot

TREATMENT	REPLICATION 1	11	111	1V	TOTAL	MEAN
30 x 15 cm	4.50	5.20	3.30	3.90	16.90	4.22
25 x 15 cm	7.40	6.60	6.0	5.90	25.90	6.47
20 x 15 cm	5.20	8.20	7.0	6.90	27.30	6.82
15 x 15 cm	6.50	6.50	9.90	7.65	30.55	7.63

ANALYSIS OF VARIANCE

SUM OF SQUARES	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F	
Block	4	1.4917	0.4972			
Treatment	4	25.6017	8.5339	5.41*	3.86	6.99
Error	9	14.1977	1.5775			
TOTAL	17	41.2911				

*= significant Coefficient of variation =19.97%

Appendix Table 4. Weight per bunch (g)

TREATMENT	REPLICATION 1	11	111	1V	TOTAL	MEAN
30 x 15 cm	16.00	157.30	162.80	152.00	638.10	159.52
25 x 15 cm	190.10	165.40	211.90	176.20	265.70	662.67
20 x 15 cm	127.50	198.40	166.50	160.00	652.4	163.10
15 x 15 cm	126.70	154.50	179.80	143.80	604.8	157.20

ANALYSIS OF VARIANCE

SUM OF SQUARES	DEGREES OF FREEDOM	SUMOF SQUARES	MEAN OF SQUARES	COMPUTED F	TABULAR F	
Treatment	4	742176.5150	247392.1717			
Block	4	764565.470	254855.1583	1.10^{ns}	3.86	6.99
Error	9	2090106.1800	232234.0200			
TOTAL	17	3596848.1700				

ns= not significant Coefficient of variation =169.61