BIBLIOGRAPHY

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ABSTRACT

The study was conducted at the Benguet State University Experimental farm in Balili, La Trinidad, Benguet from October 2005 to January 2006 to determine the growth and yield of cucumber planted from plots with and without digging, and determine the profitability of cucumber production on the cost of land preparation and yield per treatment.

Results revealed that the three plot preparations did not significantly affect the growth and total yield of cucumber in terms of the number of days from planting to first flower bud appearance, vine length, percentage fruit set, non-marketable fruits, total yield, fruit yield per plant, computed yield, fruit diameter and fruit length. However, the farmer's practice of cleaning and digging the plots produced the heaviest marketable fruits which significantly outweighed the marketable yields of the other two plot preparations. The thesis area was deficient with potassium element as determined in a soil analysis at the Soil Science Department.

The highest return on investment (ROI) of 111.61% was obtained from plots following the farmer's practice (cleaned and cultivated plots) followed by previously dug and mulched plots with rice straw with 55.91% and cleaned plots without digging with 40.99%.

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INTRODUCTION

Cucumber called Pipino in Tagalog and Kassimon by the Kankana-eys is a major crop in Kapangan, Benguet and other parts of the region for its long fleshy fruit that is eaten as salad vegetable or used for pickling. Aside from the diseases affecting the plant during production, the profitability of cucumber is affected by the high cos of labor, which was estimated by Kudan (2001) to be 64.4% to 68% of the production cost based on a three-year (1989-1992) seed production project when the daily wage was PhP 65.00. Land preparation was mentioned to require more man-days in vegetable production, which can be reduced if machine is used. According to Murakami (1991), mulch with less tillage is not only effective soil protection but also reduce plowing labor.

Locally, farmers always dig the plots every time they plant vegetable and it takes 135 to 177 man-days to dig one hectare. Mulching will not only conserve soil moisture, control weed growth and decrease soil temperature but also keep the soil loose, thus, there is no need to cultivate the soil for the succeeding crop. This observation will remain an assumption if it will not be studied. On the other hand, Locan-eo (1991) had determined that rice bean can be grown without tillage with no marked difference on the growth and yield with those with tillage. If this is possible in cucumber, it will eliminate the cost of labor in preparing the plots before planting the seeds, reducing cost of production and increasing profit.

With the continuing increase of prices in farm inputs, efforts in reducing production cost while improving yield will increase the profit. If applying mulch during a cropping will eliminate plot digging in the succeeding cropping, then this will reduce labor cost. Similarly, if just cleaning the area and planting the seeds of cucumber without digging the plots will produce profit for the grower, then this should be documented. It is not only the profit derived but also the protection of the soil from erosion will be realized which is important for long term crop production. Result of the study will not only be used by the following generation in their crop production but also be added to the body of knowledge already generated from other experiments in the field of agriculture.

The study was conducted at the Benguet State University Experimental farm in Balili, La Trinidad, Benguet from October 2005 to January 2006 to determine the growth and yield of cucumber planted from plots with and without digging, and determine the profitability of cucumber production on the cost of land preparation and yield per treatment.

REVIEW OF LITERATURE

Description of Cucumber

Cucumber (*Cucumis sativus*) is a trailing or climbing plant of the *Cucurbitaceae* family. It is a tender annual with a rough, succulent, trailing stem and hairy leaves with three to five pointed lobes. The stem bears branched tendrils by which the plant can be trained to supports. Fresh cucumbers should be firm, well shaped, and bright green color (Lawrence, 1981).

Cucumber is extensively grown in frames or on trellises and it should yield harvestable fruits 75 to 100 days from planting. However, harvesting is not on the basis of maturity but on size, depending on the purpose for which it is used (Tindall, 1983).

Importance of Cucumber

Cucumber is cultivated for its long fleshy fruit that is eaten as salad vegetable or used for pickling and for pharmaceutical preparations. The young leaves are consumed as salad or cooked and seed kernels are also occasionally eaten. Nutritionally, cucumber contains 96.40% water, 12 calories of food energy, 0.06 gm protein, 0.20 gm fat, 2.40 gm total carbohydrates, 0.50 gm fiber, 0.40 gm ash, 0.02 mg thiamine, 0.02 mg riboflavin, 0.10 mg niacin, 10 mg ascorbic acid, 19 mg calcium, 12 mg phosphorus, 122 mg potassium, 0.4 mg iron, and 5 mg sodium (Knott and Deanon, 1967).

Soil and Climatic Adaptation

Cucumber can be grown anywhere in temperate regions where conditions are favorable. Most suitable in well-drained, slightly acidic, loamy soil with an abundance of organic matter. It requires a warm climate with an optimum range of day-night temperature of 21-28^{0}C (Tindall, 1983).

<u>Effects of Mulch on Plants</u>

Mulching vegetables increases yield, promotes earlier harvest and reduces fruit defects (Courter and Hopen, 1970). Although all environmental factors are interrelated, changes in soil moisture are usually important factors that determine crop response to mulching. Similarly, Schilliter and Richey (1974) stated that mulches of all types can afford some protection against damage caused by low temperature and relative humidity. The decrease in the loss of water prevent the soil from cooling as low as a degree and a great depth and prevents rapid changes in temperature. The effects were cited in a study conducted by Hughes and Leonard (1970), that plots mulched with rice straw gave an increased yield of tomatoes for 24%, 35% for sweet corn, 32% for cabbage, and 10% for lima beans, respectively, more than the unmulched plots. Related to this is a study conducted at Balanga, Bataan, mulching with the use of dried rice straw increases mung bean yield by up to 200 kg with the application of high rates of fertilizer. Petate (1978) found that the green onion mulched with rice straw had the highest total splits produced per plot and the heaviest marketable yield with 6.32 kg and the mulched plots produced the tallest.

Under South Carolina conditions, Robbins and Schalk (1982) discovered that black polyethylene mulches increases the yield and early fruit set of spring grown tomatoes. Black polyethylene mulches increases soil temperatures resulting in higher yields of sweet corn than those from unmulched soil. It reduces the incidence of aphids, thrips, leaf miners, and *Diabrotica* sp. on field ornamental and vegetable crops. The roots of tomatoes grew deeper under transparent mulch, a reduction of 50% in water losses due to evaporation was realized using clear polyethylene plastic mulch in soybean field.

Moreover, Gary (1960) claimed that mulch reduces water loss and have many advantage from common farming such as higher yield and saving from operating cost on land preparation and cultivation. Is a study conducted by Tian *et al.* (1997), mulching reduce soil temperature, increased root density, enhance lateral growth and abundance of root under the mulch to higher nutrient absorption.

With regards to weeds, Carantes (1997) found that *Galinsoga palviflora* is the most common weed species that compete with the growth of Chinese cabbage. He postulated that these weeds must be controlled in their early growth stage to lessen production cost. Baker (1985) reported that organic mulches prevent soil crusting, control weeds, prevent erosion, lessen fruit rot, conserve soil moisture, and reduce summer temperature after the soil warms. He further recommended that the farmer apply organic mulches at a depth of 0 to 2 inches around growing plants with organic materials such as sawdust, leaves, rice hulls, and others. Villareal and Wallace (1969) despite the application of high rate fertilizers. They also found that the control of weeds was promoted, soil moisture was conserved, soil temperature was regulated, and the soil was enriched in mulched plots. Edmund (1964) stated that the primary purposes of mulching is to promote growth, development, and high yield because it reduces the role of evaporation during summer on the surface of the soil thus conserving soil moisture. They stated further that straw, leaves, and sawdust are good mulching materials.

Aklan and Quisumbing (1975) found that coconut leaves as the mulching material in giner significantly increase the height, doubled the number of tiller and increased yield from 18-27 t/ha. However, Hastie (1985), pointed out that mulches such as straw, grass clipping and well decayed compost are ideal materials. These are placed around the plants to prevent competition of weeds and grasses. They also prevent erosion by absorbing the impact of raindrops and irrigation water, and conserve soil moisture by acting as a barrier against evaporation. Moreover, Ikeda (1990) found out that mulch application will keep the fruit from directly touching the soil to avoid spoilage and to sustain humidity of soil and maintain low temperature.

Ricotta and Masiunas (1992), found that mulch plots covered with black polyethylene conserve more moisture that the unmulched plots. Likewise, soil temperature increased and sometimes hastened the growth of the crop, thus, it leads to earlier production.

Talekar and Griggs (1981) in their work on mulching reported that rice straw mulching increased the yield of Chinese cabbage from 24.5 to 27.9 tons per hectare over the non-mulch. They observed that the fresh weight quality of non-wrapper leaves in mulched plots were intact while in unmulched plots were partially rotten.

Teasdale *et al.* (1996) pointed out that plant-mulched plots contained more leaf nitrogen than those from bare soil. They also found that mulches formed an effective layer of organic residue that suppressed the growth of weeds, released nutrients and improved soil fertility and water holding capacity. Nnadi *et al.* (1984) studied the effects of mulch and nitrogen on maize. They concluded that maize crop was taller and more vigorous that the unmulched. They also claimed that mulch provides better soil moisture, temperature regimes and reduces weed competition.

<u>Effects of Tillage in Plants</u>

Most crops will generally require additional tillage and intertillage, the cultivation of the spaces between plots, to increase production. Nevertheless, minimum tillage which is reduction of land preparation employed in crop production could also reduce cost (Foth and Turk, 1951). It may be wise to reduce tillage operations to obtain more profits.

In 1991, Lecan-eo reported that rice bean can be grown with or without tillage and the growth and yield has no marked differences. Rice bean grown in plots not tilled have shorter plants but matured earlier than plants grown with tillage. However, plants with tillage had slightly higher seed yield.

Several reports were written on the effects of tillage to the soil and to the plants. Tillage is one of the practices used in creating the proper environment for seeds, seedlings and plant roots. This includes the volume of soil, water management, fertilizer and insect control materials (Anon., 1972). In practice, tillage cause the formation of an aggregate top layer on relatively high porosity overlying an undisturbed subsoil (Hillel and Hadas, 1970). In their experiment under laboratory conditions, they found that there were optimal aggregate size ranges and depths of top layer which result in maximal reduction of evaporative losses from soil columns. Hughes and Henson (1930) reported that through tillage, roots are allowed to penetrate deeply in search of required nutrients in the soil. Finally, Foth (1972) stated that the production of most crops generally require at least some tillage.

Zero tillage, a minor research job of the International Rice Research (IRRI), produced 150 cavans of palay per hectare. As the name implies, there is no cultivation carried in the field. Seedbed preparation, weeding, transplanting and other major work on the farm are eliminated. The rice is sown directly in the field. Also, Julian (1980) recommended that plots should not be dug in growing corn. Hence, with land preparation which does not require much labor and capital, profit can be increased.

With the result of the experiments related to farmers situation, minimum tillage in growing potato will be a great help in terms of economics. This will save money, time and effort from the additional cost of land preparation. Their inputs being reduced, the farmers may obtain higher income (Balog-as, 1980). As reported by Ibis (1983), that plants on plots that were dug ones registered the highest mean height compared to plants on plots not dug. This result implies that cultivation or tillage is of great importance when it comes to growth. Root elongation is faster for nutrient absorption, so there is greater increase in height with increase in tillage.

Furthermore, Toledo (1975) stated that minimum tillage showed slight increase in growth, head weight, mean yield of vegetative parts over traditional tillage. The cost of land preparation is lowered through minimum tillage in the culture of cabbage. He also mentioned that the effect of minimum tillage did not show any significant differences on growth increment, mean head weight and mean weight of the vegetative parts of the cabbage plant.

A study found that the yield of wheat and barley, when planted after cotton and grain sorghum under minimum tillage practices, remained as high as when crops were produced under maximum tillage practices (Wraker and Lehman, 1974).

Grafts and Robins (1962) mentioned that there are evidences that the primary purpose of tillage is the destruction of weeds and reduction of weed seeds on the soil rather than its effect on the physical properties and the chemical and biological activities of the soil. Ware and McColumn (1975) stated that tillage improves physical condition, reduces the number of insects because of the exposure to weather.

MATERIALS AND METHODS

Materials

The materials used were cucumber seeds ('General Lee F_1'), trellis, 14-14-14, chicken dung, insecticides, fungicides, rice straw and farm tools.

Methods

The experiment was laid out in a randomized complete block design (RCBD) with four replications. The treatments were the following:

Treatment Code	Treatment Description
T_1	Previously dug with mulched and the seeds were planted
T_2	Previously dug without digging and the seeds were planted
T_3	Farmer's practice (cleaned and dug)

Land preparation. An area of 65 m^2 was divided into four blocks. Each block consisted of three plots measuring 1 m x 5 m. One plot in each block was dug, applied with one-half can (16L capacity) chicken dung, mixed thoroughly with the soil, then was mulched with rice straw at about six inches thick in early October. The two plots in each block were left and at the end of October 2005, the other plots were dug and applied with chicken manure following the farmer's practice of preparing the plot for planting, while the other plot was cleaned only from weeds.

Planting the seeds. On the first week of November 2005, the plots were planted at a distance of 30 cm between hills and 30 cm between rows. There were 17 hills per row or 34 hills per plot planted with two seeds per hill or a total of 68 seeds per plot.

Side dressing and trellising. Two weeks after emergence, the plants were side dressed with 14-14-14 at the rate of 150-150-150 kg N-P_2O-K_2O/ha or 536 grams per 1 m x 5 m plot. This was followed by hilling-up to cover the side dress fertilizer and the growing weeds. The mulched plots were not be hilled-up, but the fertilizer was buried near the roots and covered with soil and the mulch. After hilling-up, trellises were placed at the middle of the plant rows for the plants to climb.

Care and management. The plants were irrigated twice a week from planting to the last harvest, and the vines were directed and secured to the trellis as they grow up. Plants were sprayed with pesticides when needed, and weeds were removed in all treatments throughout the duration of the study.

Harvesting. The fruits were harvested when they reached their full size and were still green in order to stimulate the plants to produce more fruits.

Data gathering. The data gathered, tabulated, computed and subjected to mean separation test using the Duncan's multiple range test (DMRT) were the following:

1. Number of days from transplanting to first flower bud appearance. The number of days from planting the seeds to the appearance of the first male or female flower was recorded.

2. Vine length (cm). Ten sample plants per plot were measured from the first node to the tip of the shoot during the last harvest.

3. Percentage of fruit setting (%). Ten female flowers per plot were tagged and the percentage of fruit set was obtained by the formula:

$$\text{Fruit set (\%)} = \frac{\text{Total number of fruits formed}}{\text{Total number of tagged flowers}} \times 100$$

4. Marketable fruits per plot (kg). This was the weight of fruits from first to the last harvest without any defects such as very small, malformed, damaged, and very short.

5. Non-marketable fruits per plot (kg). This was the weight of fruits that were very small, curved, misshapen, very short or damaged, which was not sold from first to last harvest.

6. Total yield (kg). The weight of marketable and non-marketable fruits per plot from first to the last harvest.

7. Fruit yield per plant (g). The total yield per plot was divided by the number of plants per plot that produced fruit.

8. Yield per hectare (t/ha). The yield per plot was multiplied by 2,000 then divided by 1,000. Two thousand is the number of plots per hectare based on 1 m x 5 m plot used in the study while 1,000 was the weight of one ton.

9. Fruit diameter (cm). Ten marketable fruits per plot were picked at random and the diameter at the mid-section was measured with the use of a Vernier caliper.

10. Length of fruit (cm). Ten marketable fruits per plot was picked at random and were measured from the anterior to the stylar end of the fruit with the use of a ruler.

11. Percentage survival. This was taken by counting all the surviving plants during the last harvest and computed using the formula:

Survival (%) = Number of survivors ¸ Total number of seeds planted x %

11. Return on investment (%). This was computed by using the formula:

$$\text{ROI (\%)} = \frac{\text{Net Income per Treatment Plot}}{\text{Total Expenses per Treatment Plot}} \times 100$$

12. Documentation of the study through pictures.

RESULTS AND DISCUSSION

<u>Number of Days from Planting to First Flower Bud Appearance and Vine Length</u>

The number of days from planting the seeds to first flower bud appearance and vine length are shown in Table 1. It was observed that the cucumber plants had similar number of days to produce flower buds from the different plot preparations prior to planting. These results mean that land preparation can not influence the number of days to flowering of cucumber plants. The same observations was made by Locan-eo (1991) in rice bean planted on dug plots and not dug plots, which flowered at the same time.

Table 1 shows that there were no significant differences on the average vine length among the plants from the different plot preparations. These findings are similar to the observations of Locan-eo (1991) in rice bean where plants on dug plots were slightly taller than those plants without digging the plots.

Table 1. Number of days from planting to first flower bud appearance and vine length

TREATMENT	DAYS TO FLOWER BUD APPEARANCE	VINE LENGTH (cm)
Previously dug with mulched and the seeds were planted	31.25a	957.18a
Previously dug without digging and the seeds were planted	30.25a	955.13a

Farmer's practice (cleaned and dug)	29.75a	1184.73a

In a column, means with a common letter are not significantly different at 5% level by DMRT

Percentage Fruit Set and
Yield per Plant

As presented in Table 2, there were no significant differences on the percentage of fruit set among the plants from the different plot preparations. Numerically, the percentage of fruit set was higher from the plants grown on plots previously dug and mulched.

Table 2 shows that there was no statistical differences on the yield per plant in the three plot preparations. This means that whether the plots are dug or not before planting, the yield of individual cucumber plants will not significantly differ.

Marketable and Non-marketable
Fruit Yield

Table 3 shows significantly heavier marketable fruits obtained from plots following the farmer's practice of cleaning and digging the plots compared to those plots without digging and the plots dug previously and mulched. The higher weight of marketable fruits from the recently cleaned and dug plots may be due to easier root penetration to a deeper layer in search of required nutrients in the soil as explained by Hughes and Henson (1930) or

Table 2. Percentage fruit set and yield per plant

TREATMENT	FRUIT SET (%)	YIELD PER PLANT (g)
Previously dug with mulched and the seeds were planted	62.5a	158.38a

Previously dug without digging and the seeds were planted	60.0a	165.44a
Farmer's practice (cleaned and dug)	60.0a	180.67a

In a column, means with a common letter are not significantly different at 5% level by DMRT

Table 3. Marketable and non-marketable fruits

TREATMENT	MARKETABLE FRUITS (kg)	NON-MARKETABLE FRUITS (kg)
Previously dug with mulched and the seeds were planted	4.13b	1.88a
Previously dug without digging and the seeds were planted	4.13b	2.00a
Farmer's practice (cleaned and dug)	6.63a	1.75a

In a column, means with a common letter are not significantly different at 5% level by DMRT

due to more number of plants that produced fruits. The farmer's practice had an average of 45 plants while the cleaned plots without digging had 37 plants and the plots previously dug and mulched had 36 plants.

There were no significant differences on the weight of non-marketable fruits as shown in Table 3. This means that all the plants from the different plots produced similar non-marketable fruits, which were mostly malformed (pointed) fruits. The production of malformed fruits may be an indication of potassium-deficient soil which was confirmed by the soil analysis done at the

Soil Science Department. The potassium requirement for cucumber is 30-60 kg/ha but the analysis indicated lower than this requirement.

Plant Survival, Total and Computed Yield

The percentage of plant survival is shown in Table 4. There were no significant differences indicated among the three plot preparations on the percentage of plant survival. However, the difference of 12% advantage by the farmer's practice over the two plot preparations may mean a difference in yield performance. The presence of mulch provided

Table 4. Plant survival, total and computed yield

TREATMENT	SURVIVAL (%)	TOTAL YIELD (kg)	COMPUTED YIELD (t/ha)
Previously dug with mulched and the seeds were planted	53.31a	6.00a	12.00a
Previously dug without digging and the seeds were planted	54.05a	6.13a	12.25a
Farmer's practice (cleaned and dug)	66.18a	8.38a	16.75a

In a column, means with a common letter are not significantly different at 5% level by DMRT

a hiding place for cutworm to eat the emerging plants. There were no significant differences noted on the total and computed yield as influenced by the different plot preparations for planting as shown in Table 4. Numerically, total and computed yield were higher from the plants grown from plots cleaned and dug before planting compared to the other two plot preparations, but the higher yield was due to more plants that survived. These results were similar to the observations of Locan-eo (1991) in rice bean where plants on dug plots had slightly higher seed yield.

Fruit Diameter and Length

Results show that there were no significant differences on the average fruit diameter and length as shown in Table 5. However, plots cleaned and cultivated plots (farmer's practice) had longer fruits and bigger fruit diameter. This might imply that cultivated plots have deeper root penetration thus, more food supply resulting to longer fruit length and bigger fruit diameter.

Table 5. Average fruit diameter and length

TREATMENT	LENGTH (cm)	DIAMETER (cm)
Previously dug with mulched and the seeds were planted	4.36a	15.40a
Previously dug without digging and the seeds were planted	4.43a	15.52a
Farmer's practice (cleaned and dug)	4.51a	16.37a

In a column, means with a common letter are not significantly different at 5% level by DMRT

Economic Analysis

The profitability of growing cucumber depends on the yield and expenses incurred in producing the crop (Table 6). Thus, plots prepared following the farmer's practice (cleaned and cultivated plots) which had the most number of plants per plot of 45 and also had the heaviest marketable yield, highest expenses and the highest return on investment of 111.61%. The previously dug and mulched plots with rice straw follows with 55.91% ROI and cleaned plot without digging had the lowest return on investment of 40.99%. The number of plants that survived and produced fruits is the factor that affected the differences in economic analysis. The farmer's practice had 45 plants while the previously dug and mulched and the plots without digging have 36 and 37 plants per plot, respectively. The presence of mulch provided the cutworms a place to hide then feed on the emerging plants.

Table 6. Cost and return analysis

PARTICULAR	TREATMENT		
	seeds were planted	and the seeds were planted	Previously dug with Previously dug Farmer's practice mulched and the without digging (cleaned and dug)
Marketable yield (kg)	16.50	16.50	26.50
Sales (PhP)	412.50	412.50	662.50
Expenses (PhP)			
Seeds	43.00	43.00	43.00
Chicken manure	51.68	51.68	51.68
14-14-14	30.00	30.00	30.00
16-16-16	6.67	6.67	6.67
Fungicide	36.56	36.56	36.56
Gasoline	35.00	35.00	35.00
Land preparation	-	16.00	36.50
Fertilizer application	3.00	12.00	12.00

and hilling-up			
Trellising	2.00	2.00	2.00
Spraying	16.67	16.67	16.67
Irrigation	40.00	40.00	40.00
Weeding	-	3.00	3.00
Total Expenses (PhP)	264.58	292.58	313.08
Net profit (PhP)	147.92	119.92	349.42
ROI (%)	55.91	40.99	111.61
Rank	2	3	1

Average selling price = PhP 25.00/kg

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

This study was conducted from October 2005 to January 2006 at the Benguet State University Experimental Farm in Balili, La Trinidad, Benguet to determine the growth and yield of cucumber plants grown in plots with and without digging; and determine the profitability of cucumber production on cost of land preparation and yield per treatment.

Results revealed that the three plot preparations did not significantly affect the number of days from planting to first flower bud appearance, vine length, percentage fruit set, non-marketable fruits, total yield, fruit yield per plant, computed yield, fruit diameter and fruit length. However, plots prepared following the farmer's practice produced the highest marketable fruits with 26.50 kg per 1 m x 5 m plot . Plots previously dug and mulched plots with rice straw and the plots without digging have lower weight of marketable fruits of 16.50 kg per plant, each apparently due to lesser plant survivors of 36 and 37 plants per plot, respectively compared to the 45 plant survivors from plots prepared following the farmer's practice.

The highest return on investment (ROI) with 111.61% was obtained from plots following the farmer's practice (cleaned and cultivated plots) followed by previously dug and mulched plots with rice straw with 55.91% and cleaned plot without digging with 40.99%.

Conclusion

Based on the results, it is concluded that cucumber seeds planted on plots with the three methods of preparation have similar growth and total yield, but on profitability, the farmer's practice of cleaning and digging the plots provides higher return on investment due to significantly heavier marketable fruits compared to the two other methods of plot preparations.

Recommendation

It is therefore recommended, that plots should be cleaned of weeds and dug before planting the seeds of cucumber to obtained higher return on investment. It is also recommended that this study should be verified because the number of plant survivors were more from the farmer's practice (45 plants) compared to the other two treatments (36 and 37 plants), these differences might be an effect of the treatments and this will change the economic analysis if the plant number are the same in all treatments. Other vegetable crops should also be studied as the cost of labor is the biggest factor that affects profitability in manually operated farms.

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APPENDICES

Appendix Table 1. Number of days from planting to first flower bud appearance

TREATMENT	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
T_1	33.0	32.0	31.0	29.0	125.0	31.25
T_2	32.0	29.0	30.0	30.0	121.0	30.25
T_3	30.0	30.0	30.0	29.0	119.0	29.75

Analysis of Variance

Source of variation	Degrees of freedom	Sum of squares	Mean square	Computed F	TABULAR F 0.05	0.01
Replication		3	8.250	2.750		
Treatment		2 10.92	4.667	2.333	2.33ns	5.14
Error			6	6.000	1.000	
Total			11	18.917		

ns = Not significant

Coefficient of variation = 3.29%

Appendix Table 2. Vine length (cm)

TREATMENT	REPLICATION I	II	III	IV	TOTAL	MEAN
T_1	761.5	917.8	878.8	1270.6	3828.7	957.18
T_2	722.2	1111.3	967.2	1019.8	3820.5	955.13
T_3	1096.4	1125.1	1277.8	1277.8	4738.9	1184.73

Analysis of Variance

Source of variation	Degrees of freedom	Sum of squares	Mean square	Computed F	TABULAR F 0.05	0.01
Replication	3	0.165	0.055			
Treatment	2	0.143	0.071	5.03ns	5.14	10.92
Error	6	0.085	0..014			
Total	11	0.393				

ns = Not significant

Coefficient of variation = 11.54%

Appendix Table 3. Percentage fruit setting

TREATMENT	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
T_1	70.0	50.0	60.0	70.0	250.0	62.50
T_2	60.0	50.0	70.0	60.0	240.0	60.00
T_3	50.0	50.0	70.0	70.0	240.0	60.00

Analysis of Variance

Source of variation	Degrees of freedom	Sum of squares	Mean square	Computed F	TABULAR F 0.05	0.01
Replication		3	558.333	186.111		
Treatment		2 10.92	16.667	8.333	0.16ns	5.14
Error			6	316.6677	52.778	
Total			11	891.667		

ns = Not significant Coefficient of variation = 11.94%

Appendix Table 4. Fruit yield per plant (g)

TREATMENT	REPLICATION I	II	III	IV	TOTAL	MEAN
T_1	140.00	141.03	145.83	216.67	643.53	160.88
T_2	163.46	156.25	168.92	176.14	664.77	166.19
T_3	150.00	135.14	207.55	230.00	722.69	180.67

Analysis of Variance

Source of variation	Degrees of freedom	Sum of squares	Mean square	Computed F	TABULAR F 0.05	0.01
Replication	3	6763.328	2254.443			
Treatment	2	1038.188	519.094	1.11ns	5.14	10.92
Error	6	2813.676	468.946			
Total	11	10615.191				

ns = Not significant

Coefficient of variation = 12.88%

Appendix Table 5. Marketable fruits (kg/plot)

TREATMENT	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
T_1	2.00	3.25	3.50	4.75	16.50	4.13
T_2	2.50	4.00	4.25	5.75	16.50	4.13
T_3	4.25	3.50	8.50	10.25	26.50	6.63

Analysis of Variance

Source of variation	Degrees of freedom	Sum of squares	Mean square	Computed F	TABULAR F 0.05	TABULAR F 0.01
Replication	3	29.563	9.854			
Treatment	2	23.177	11.583	5.98*	5.14	10.92
Error	6	11.625	2.571			
Total	11	64.354				

* = Significant

Coefficient of variation = 23.52%

Appendix Table 6. Non-marketable fruits (kg/plot)

TREATMENT	REPLICATION I	II	III	IV	TOTAL	MEAN
T_1	1.50	2.25	1.75	2.00	7.50	1.88
T_2	1.75	2.25	2.00	2.00	8.00	2.00
T_3	1.75	1.50	2.50	1.25	7.00	1.75

Analysis of Variance

Source of variation	Degrees of freedom	Sum of squares	Mean square	Computed F	TABULAR F 0.05	0.01
Replication	3	0.354	0.118			
Treatment	2	0.125	0.063	0.39ns	5.14	10.92
Error	6	0.958	0.160			
Total	11	1.438				

ns = Not significant

Coefficient of variation = 21.31%

Appendix Table 7. Total yield (kg/plot)

TREATMENT	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
T_1						3.50 5.50 5.25 9.75 24.00 6.00
T_2						4.25 6.25 6.25 7.75 24.50 6.13
T_3	6.00	5.00	11.00	11.50	33.50	8.38

Analysis of Variance

Source of variation	Degrees of freedom	Sum of squares	Mean square	Computed F	TABULAR F 0.05	TABULAR F 0.01
Replication		3	45.802	15.267		
Treatment		2 10.92	14.632	7.316	2.85ns	5.14
Error			6	15.428	2.571	
Total			11	75.862		

ns = Not significant Coefficient of variation = 23.52%

Appendix Table 8. Computed yield (t/ha)

TREATMENT	REPLICATION I	II	III	IV	TOTAL	MEAN	
T_1							
							7.00
						11.00	
						10.50	
						19.50	48.00
							12.00
T_2							
							8.50
						12.50	
						12.50	
						15.50	49.00
							12.25
T_3	12.00	10.00	22.00	23.00	67.00	16.75	

Analysis of Variance

Source of variation	Degrees of freedom	Sum of squares	Mean square	Computed F	TABULAR F 0.05	0.01
Replication		3	181.167	60.389		
Treatment		2 10.92	57.167	28.583	2.73ns	5.14
Error			6	62.833	10.472	
Total			11	301.167		

ns = Not significant

Coefficient of variation = 23.68%

Appendix Table 9. Fruit diameter (cm)

TREATMENT	REPLICATION I	II	III	IV	TOTAL	MEAN
T_1	1.50	2.25	1.75	2.00	7.50	1.88
T_2	1.75	2.25	2.00	2.00	8.00	2.00
T_3	1.75	1.50	2.50	1.25	7.00	1.75

Analysis of Variance

Source of variation	Degrees of freedom	Sum of squares	Mean square	Computed F	TABULAR F 0.05	0.01
Replication	3	0.043	0.014			
Treatment	2	0.044	0.022	2.37ns	5.14	10.92
Error	6	0.055	0.009			
Total	11	0.142				

ns = Not significant

Coefficient of variation = 2.16%

Appendix Table 10. Fruit length (cm)

TREATMENT	REPLICATION I	II	III	IV	TOTAL	MEAN
T_1	13.83	16.43	14.80	16.52	61.58	15.40
T_2	14.86	15.86	15.78	15.57	62.07	15.52
T_3	14.76	17.14	16.88	16.68	65.46	16.37

Analysis of Variance

Source of variation	Degrees of freedom	Sum of squares	Mean square	Computed F	TABULAR F 0.05	0.01
Replication	3	7.181	2.394			
Treatment	2	2.232	1.116	3.16ns	5.14	10.92
Error	6	2.121	0.354			
Total	11	11.535				

ns = Not significant

Coefficient of variation = 3.77%

Appendix Table 11. Plant survival (%)

TREATMENT	REPLICATION I	II	III	IV	TOTAL	MEAN
T_1	36.76	57.35	52.94	66.18	213.23	53.31
T_2	33.24	58.82	54.41	64.71	216.18	54.05
T_3	58.82	54.41	77.94	73.53	264.70	66.18

Analysis of Variance

Source of variation	Degrees of freedom	Sum of squares	Mean square	Computed F	TABULAR F 0.05	TABULAR F 0.01
Replication	3	892.692	297.564			
Treatment	2	417.671	208.836	3.74ns	5.14	10.92
Error	6	334.802	55.800			
Total	11	1645.166				

ns = Not significant

Coefficient of variation = 12.91%