BIBLIOGRAPHY

WASING, DEVENS T. APRIL 2010. Seedling Emergence and Growth of Tamarillo Seeds (*Solanum betaceum L.*) as Affected by Different Growing Media. Benguet State University, La Trinidad, Benguet.

Adviser: Franklin G. Bawang, MSc.

ABSTRACT

The study was conducted at Pomology project, Benguet State University from November 2009 to February 2010 to determine the best growing media that will promote/enhance seed germination and seedling emergence of tamarillo seeds and to find out the effects of the different media and the seedling growth of tamarillo grown from seeds.

Results revealed that there were significant differences observed among the different media used. The seeds sown in garden soil + coco coir dust + alnus compost + sand had the least number of days to complete emergence with a mean of 19.33 days. Furthermore seeds sown in garden soil + coco coir dust + alnus compost + sand attained the highest percentage of seedling emergence with a mean of 96.67%. With regards to the percentage of normal seedlings, the seeds sown in garden soil + alnus compost attained the highest percentage of normal seedlings with a mean of 90.00%. Likewise, seeds sown in the media garden soil + alnus compost attained significant results in terms of: weekly growth increment with a mean of 8.17 cm; the seedling height at 60 days from seedling emergence with a mean of 9.13 cm; the seedling height at 90 days from seedling emergence with a mean of 11.83 cm; the number of leaves 60 days from seedling emergence with a mean of 5.17; the number of leaves 90 days from seedling emergence with a mean of 6.00; and for seedling vigor having the most vigorous and excellent growth with dark green leaves. Meanwhile, the seeds sown in garden soil, garden soil + alnus compost, coco coir dust + alnus compost + sand and garden soil + coco coir dust + alnus compost + sand attained the shortest days for transplanting age with a mean of 75.33 days.

TABLE OF CONTENTS

INTRODUCTION

The tamarillo is the edible fruit of *Solanum betaceum L*, a species of small tree or shrub in the flowering plant family Solanaceae. It is egg-shaped, with a thin deep red or yellow skin and a soft flesh (when ripe), with dark-colored seeds occupying about one third of the interior.

The tamarillo is generally believed to be native to the Andes of Peru and probably also, Chile, Ecuador and Bolivia. It is cultivated and naturalized in Argentina, Brazil, Colombia and Venezuela. It is widely grown in New Zealand as a commercial crop. Seed from Argentina were imported by the U. S. Dept. of Agriculture in 1913 and such plant was fruiting at the Plant Introduction Station at Chico, Calif. in1915.

Prior to 1967, the tamarillo was known as the "tree tomato" in New Zealand, but a new name was chosen by the New Zealand Tree Tomato Promotions Council in order to distinguish it from the ordinary garden tomato and increase its exotic appeal. The choice is variously explained by similarity to the word "tomato", the Spanish word "Amarillo", meaning yellow, and a variation on the Maori word "tama", for leadership". It is still called Tree Tomato in most of the world.

The fruit is eaten by scooping the flesh from a halved fruit, but in New Zealand children palpate the ripe fruit until it is soft then bite off the stem end and squeeze the flesh directly into the mouths. When lightly sugared and cooled, the flesh makes a refreshing breakfast dish. In addition, they give a unique flavor when added to stews, hollandaise, chutneys, and curries. They are also tasty and decorative in, for example, radicchio salads. Appetizing desserts using this fruit include bavarois and combined with apples in a strudel. In Colombia, Ecuador and Sumatra, fresh tamarillos are frequently blended together with water and sugar to make a juice. It is also available as a commercially pasteurized puree.

In country where tamarillo is a popular food item, it is made into mousse, jam, jelly, chutney, and added to ice cream and yogurt, baked, and cooked as a substitute for tomato. Filipinos know Spanish tomato only as a fresh fruit but due to its natural tartness, consumption is limited. As such, during its peak production months from July to October, much of the fruit are not disposed off by local fruit stands there by limiting market expansion of tamarillo production.

Tamarillo are nutrient-packed with protein, fiber, nitrogen calcium, phosphorous, iron, carotene, thiamine, riboflavin and ascorbic acid among others based on chemical analysis in Ecuador, Guatemala and India and also by the Food and Nutrition Research Center-National Institute of Science and Technology.

Tamarillo fruit can be potentially grown in backyard for availability and use. However, mass production could be a problem under high demand because it is not much popular in the locality specially for processing. So, it is therefore imperative to conduct this study to be able to determine the best growing media that is suitable for growing tamarillos.

The result of this study will provide information to researchers interested to work on tamarillo fruit in order to help in the improvement of tamarillo fruit production and to encourage farmers or fruit growers to produce tamarillo fruit due to its good potential in the market especially when it is processed. Since tamarillo fruit is not much popular in terms of production, this study is important as far as introduction is concerned.

The study was conducted to determine the best growing media that will promote/enhance seed germination and seedling emergence of tamarillo seeds; to find out the effects of the different growing media on the seedling and growth of tamarillo grown from seeds.

The study was conducted at the Pomology Project, Benguet State University, La Trinidad, Benguet from November 2009 to February 2010.

REVIEW OF LITERATURE

Description of Tamarillo Fruit

The tamarillo is small, attractive, half-woody, evergreen or partially deciduous, shrub or small tree. It is also brittle and shallow-rooted, growing to a height of 10 to 18 ft. The alternate, evergreen leaves are muskily odorous and more or less heart-shaped at the base and ovate, pointed at the apex. They are 4 to 13 ½ inches long and 1 ½ to 4 ¾ inches broad, thin softly hairy, with conspicuous veins. The leaves are fairy easily tattered by strong winds. The fragrant ½ to ¾ inch flowers are borne in small, loose clusters near the branch tips. They have 5 pale pink or lavender, pointed lobes, 5 prominent yellow stamens and green-purple calyx. Tamarillo flowers are normally self-pollinating. If wind is completely cut off so as not to stir branches, this may adversely affect pollination unless there are bees to transfer the pollen. Unpollinated flowers will drop prematurely. Flowers are usually borne in late summer or fall, but may appear at any time. The long-stalked, dangling fruit, borne singly or in clusters of 3 to 12, is smooth egg-shaped but pointed at the both ends. It ranges in size from 2 to 4 inches long and 1 ½ to 2 inches in width. Skin color may be solid deep purple, blood red, orange or yellow, or red and yellow, and may have faint dark longitudinal stripes. Flesh color varies accordingly from orange-red or orange to yellow or cream yellow. While the skin is somewhat tough and unpleasant in flavor, the outer layer of the flesh is slightly firm, succulent and bland, and the pulp surrounding the seed in two lengthwise compartments is soft, juicy, and sweet. The yellow types are usually a little sweeter. The pulp is black in dark purple and red fruits and yellow in yellow and orange fruit. The edible seeds are thin, nearly flat, circular, larger and harder than those of the true tomato (Facciola, 1990).

Seed Emergence

The seed is the most important stage in the life cycle of the higher seed producing plants with respect to survival of species (Antolin, 2001 as cited by Agnaya, 2004).

Aspilan (1998) stated that seedling establishment is a critical phase in the production cycle of crops. Seedling uniformity and percentage emergence of direct seeded crops have great importance on the final yield and quality.

The same author stated that a production cycle should have yield of high quality products. Germination of seeds must be rapid and uniform under environmental and biological stresses; however, it can affect germination and seedling growth. Seed germination involves complex mechanism and processes many of which are only partially revealed and understood.

Growing Media

The actual nutrient requirements of horticultural crops are based on several parameters. They include soil diagnosis to determine the total nutrients, the available nutrients and the factors contributing to a nutrient unavailability and plant diagnosis to determine the actual amount of nutrients absorbed by the plant. Together, these are correlated to establish a relationship between development and the nutrients concentration of the plant tissue as influenced by the leaves of various nutrients in the soil (Poincelot, 1980).

Brady (1984) as cited by Andres (2006) stated that the organic matter is composed of living or dead plants and animal residues, which are very active and important portion of the soilage. They protect soil against erosion; supplies cementing substance for desirable aggregation formation and is loosen the soil to provide better aeration and water movement.

Organic matter has several functions as stated by Donahue (1971). The same author (Donahue, 1971) stated that coarse organic matter on the surfaces reduces the impact of falling raindrops and permits clear water to seep gently into the soil. Surface run-off and erosion are thus reduced, and as a result, there is more available water for plant growth. A fresh organic mailer provides food for such soil life like earthworms, ant and rodents. These animals help to permit plants not to obtain oxygen to release carbon dioxide as they grow. Organic mulches also reduce the evaporation losses of water. As organic matter decomposes, it supplies some nutrients needed by the growing plants. These nutrients are in harmony with the needs of the plant. When the environmental conditions are favorable for rapid growth, the same conditions favor a rapid release of nutrients from the organic matter. As organic matter contains a large part of the total reserves of Boron (B) and Molybdenum (Mo), 5 to 60% of the phosphorous reserves, up to 80% of the Sulfur and practically all of the Nitrogen. A soil with high organic matter has more available water capacity for plant growth than the same soil with less organic matter. Humus, a decomposed organic matter provides a store house for exchangeable and available cat ions: K, Ca and Mg are temporary. Humus holds ammonium ions in an exchangeable available form.

Jankowiak (1978) as cited by Andres (2006), stated that compost encourages the formation of vigorous roots, which in turn produce a healthy plant which is capable of taking in more food and water.

Thompson and Troech (1978) claimed that the nutrients release from well rotten compost is probably better balanced and regulated than the fresh manure whereby gardeners can therefore apply larger amounts of compost than the use of fresh manure, without danger of injuring plants. They added that the use of compost also results in humus formation and promotes good soil structure. Composts also supply nutrients such as nitrogen, phosphorous and sulfur which are essential for plant growth.

Since about 1990, the use of coir dust is dramatically increasing. Coir dust is the pithy materials left after coir fiber is extracted from coconut husks. It is produced in Sri Lanka, Indonesia, Philippines and potentially in other tropical countries with extensive coconut plantations. Coir dust is being dried and often compressed in block before being exported. It has excellent physical properties and does not suffer from the water-repellency problems of other organic materials. Its water holding characteristics are better than most peats because of its finer pore structure. Coir dust main potential use is increasing the water holding capacity of barks and saw dust without unacceptable reduction in air-filled porosity. All coir products have a very high potassium contents and very low calcium contents. Their pH generally close to 6 so there is no possibility of using liming materials to supply calcium (Handrek and Black, 1993).

Antonio (2000) found that based on the result of his study, the best media composition is 1:1:1 hortiperl + chopped coconut husk + coco saw dust + dried alnus leaves compost. It promoted earlier flowering, faster flower development and promoted higher yield of cut flowers per plant with a Return on Investment (ROI) of 54.52 %. The author also recommended the use of hortiperl as a component of the growing media for anthurium production due to the benefits that the growers derived from it. Such as it has good moisture holding capacity, well-drained and aerated, it is sterile and does not decompose than other potting media used in anthurium farm which have to be replenished.

On the other hand, Handreck (1993) enumerated the advantages of coco coir dust over peat moss including the chemical properties. The electrical conductivity of 250 *u*S/cm is so high for vegetables like cabbage compared to the ideal electrical conductivity of 2 to 3. The excessive salts present in the media of 250, 000 milligrams per kilo of coco coir dust may be toxic to cabbage seedlings especially that the pH is strongly acidic. Moreover, coco coir dust may be deficient from nitrogen element as almost all the seedlings show nitrogen deficiency in which the green leaves becoming yellow, bronzed, pink or purple as they age (purple tinge on old leaves) described by Scaife and Turner (1983).

Manure stimulates the work of soil microbes that unlock plant food held in soil borne mineral compounds. It adds nutrients and humus to the soil, aids in composting operations and in its green state will provide heat for cold frames (compositions) as it decomposes. Lastly, it improves the physical condition of heavy soil (Jankowiak, 1978).

Foth and Turk (1972) a cited by Andres (2006) noted that rotten manure is a rich food constituent. This concentration of plant nutrient is due to shrinkage in dry weight, which could automatically raise the level of plant food.

Christopher (1958) stated that fresh manure is relatively higher in nitrogen and potassium than in phosphorous. He further stated that manure may increase water holding capacity, improve structure and provide a satisfactory medium in which various desirable bacteria may develop. It supplies many of the chemicals recognized as minor elements and in all probability, some other elements and possibly hormones which is yet to be recognized.

Laurie (1956) stated that humus increases the power of the soil to hold water soluble materials in water. Its colloidal properties permit absorption to gases and their retention. These same colloidal properties improve the structure, making it granular. He further stated that humus aids in the absorption of gases and their retention of soil heat. It also makes potassium and phosphorous compounds available through the acids that are formed in the process of decompositions; soil nitrogen which is normally derived from the decomposition of humus is helpful in the growth of organisms needed in the soil.

Incorporation of these different organic matters in the soil is very important especially to horticultural crops that they may enhance the growth of the crops (Laurie, 1956).

Climatic and Soil Adaptability

The tamarillo is a subtropical rather than tropical and flourishes between 5,000 to 10,000 ft. in its Andean homeland. In cooler climates it succeeds at lower elevations, but does best where the temperature remains above 50 ^{0}F. The plant is grown casually in California and occasionally in Florida. Tamarillos have been successfully grown in such northern California locations as San Rafael and Santa Rosa. Frost at 28 ^{0}F kills small branches and foliage of mature trees but not the largest branches and main stem. The tree will recover if such frosts are not prolonged or frequent. However, seedlings and cuttings are readily killed by frost during their first year.

Protection from wind is necessary as the tree is shallow rooted and easily blown over. It is also brittle and its branches are easily broken by gusts, especially when laden with fruit. Tamarillos have been grown as houseplants for years. They fruit satisfactorily in northern greenhouses.

Propagation

Seeds and cuttings may be used for propagation. Seeds product a high-branched, erect tree, while cutting develop into a short, bushy plant with low-lying branches. The tree does not always come true from seed, but is most likely to if one is careful to take seed from red fruits with black seed pulp or yellow fruits with yellow seed pulp. Germination is accelerated by placing washed and dried seed in a freezer for 24 hours before planting out. Cuttings should be of 1 to 2 year-old wood 3/8 to 1 inch thick and 18 to 30 inches long. The leaves are removed and the base cut square below a node. Cuttings can be planted directly in the ground, but should not be permitted to fruit the first year.

MATERIALS AND METHODS

Materials

To successfully carry-out the activities in this study, the following materials were used: tamarillo seeds, growing media (sand, garden soil, alnus compost, coco coir dust), water, ruler polyethylene bags (3” x 5”) and labeling materials.

Methods

Experimental design and treatments. The experiment was laid out using Randomized Complete Block Design (RCBD) with eight (8) treatments that was replicated three (3) times. The treatments were as follows:

CODE	DESCRIPTION
T_1	Garden soil (control)
T_2	1:1 garden soil + coco coir dust
T_3	1:1 garden soil + alnus compost
T_4	1:1 coco coir dust + alnus compost
T_5	1:1:1 garden soil + coco coir dust + alnus compost
T_6	1:1:1 garden soil + coco coir dust + sand
T_7	1:1:1 coco coir dust + alnus compost + sand
T_8	1:1:1:1 garden soil + coco coir dust + alnus compost + sand

Figure 1 shows an over view of the experimental area.

Figure 1. Over view of the experimental area.

Preparation of growing media. The different growing media were mixed following the indicated ratio and were placed in the black polyethylene bags (3" x 5") where the tamarillo seeds were sown.

Seed extraction. The tamarillo seeds were collected at Bakun, Benguet from a high yielding mother plant and fully ripe with a color of orange or yellow. The fruit were cut at the apex and the seeds were extracted and washed in order to have partial removal of the seeds parchment or mucilage.

Drying duration of seeds. The tamarillo seeds that were extracted were selected at uniform size and about 240 seeds. The seeds then were air dried for 30 minutes.

Sowing the seeds. Then after 30 minutes drying of tamarillo seeds, these were sown at horizontal position.

Care and management. The recommended cultural management practices such as weeding, irrigation and control of insect pests and diseases were followed to insure excellent emergence performance.

Data Gathered

The data gathered were as follows:

1. Number of days to initial emergence. This was taken by counting the number of days from sowing of seeds up to initial seedling emergence.

2. Number of days to complete emergence. This was taken by counting the number of days from sowing of seeds up to complete seedling emergence.

3. Percentage of emergence. This was taken by using the formula:

$$\text{Emergence percentage} = \frac{\text{No. of Germinant}}{\text{Total No. of Seedlings}} \times 100$$

4. Percentage of normal seedlings. This was taken by using the formula:

$$\% \text{ of normal seedlings} = \frac{\text{No. of Normal Seedlings}}{\text{Total No. of Seedlings}} \times 100$$

5. Number of days to first appearance of leaves. This was taken by counting the number of days from sowing to first appearance of leaves.

6. Growth increment. This was taken weekly until transplanting by measuring the height of the seedlings from the base up to tip.

7. Seedling height (cm). This was taken from the base up to tip of the seedlings at 60 days and 90 days from seedling emergence.

8. Number of leaves. This was taken by counting the number of leaves at 60 days and 90 days from seedling emergence.

9. Seedling vigor. This was taken by using the scale sixty days from planting.

Rating	Description
1	most vigorous – excellent growth with dark green leaves
2	vigorous – good growth with green leaves
3	less vigorous – slightly good growth with light green leaves
4	poor – poor growth with yellow leaves

10. Transplanting age. This was taken by counting the days from sowing to transplanting.

11. Documentation of the study through pictures. This was taken during the entire duration of the study.

RESULTS AND DISCUSSION

Number of Days to Initial Emergence

As presented in Table 1, there were no significant statistical differences observed among the different media used in the study on the number of days to initial emergence of tamarillo seeds. However, the numerical results showed that seeds sown in garden soil as the control, garden soil + alnus compost, garden soil + coco coir dust + sand, coco coir dust + alnus compost + sand, and garden soil + coco coir dust + alnus compost + sand were the earlier seedlings to emerge with a mean of 17.00 days. This was followed by the seeds sown in a media combination of garden soil + coco coir dust + alnus compost having slightly higher number of days to initial emergence. The treatment media of garden soil + coco coir dust with a mean of 18.67 days was the last to attain initial emergence.

The results may imply that as to initial emergence, garden soil combined with alnus compost, coco coir dust, and sand will promote earlier seedling emergence of tamarillo seeds.

The results agree with the findings of Bisley (2008) that a mixture of 1:1:1:1 garden soil + sand + alnus compost and a part of sawdust induces shorter days for papaya seedling to emergence.

Table 1. Number of days to initial emergence

TREATMENT	NUMBER OF DAYS
Garden soil (control)	17.00[a]
Garden soil + coco coir dust	18.67[a]
Garden soil + alnus compost	17.00[a]
Coco coir dust + alnus compost	18.33[a]
Garden soil + coco coir dust + alnus compost	17.67[a]
Garden soil + coco coir dust + sand	17.00[a]
Coco coir dust + alnus compost + sand	17.00[a]
Garden soil + coco coir dust + alnus compost + sand	17.00[a]

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

Number of Days to Complete Emergence

The results in Table 2, shows that there were highly significant statistical differences observed among the various media used in the study affecting the number of days to complete emergence. The results showed that the seed sown in garden soil + coco coir dust + alnus compost + sand had the least number of days to complete emergence with a mean of 19.33 days. This was followed by seeds sown in coco coir dust + alnus compost + sand but are statistically comparable with the seeds sown in garden soil + coco coir dust + sand, garden soil + alnus compost and the control. While the seeds sown in garden soil + coco coir dust attained the longest number of days to complete emergence with a mean of 22. 67 days.

Table 2. Number of days to complete emergence

TREATMENT	NUMBER OF DAYS
Garden soil (control)	20.67[bcd]
Garden soil + coco coir dust	22.67[a]
Garden soil + alnus compost	20.67[bcd]
Coco coir dust + alnus compost	22.33[ab]
Garden soil + coco coir dust + alnus compost	21.33[abc]
Garden soil + coco coir dust + sand	20.00[cd]
Coco coir dust + alnus compost + sand	19.67[cd]
Garden soil + coco coir dust + alnus compost + sand	19.33[d]

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

The result implies that a mixture of garden soil + coco coir dust + alnus compost + sand induced shorter days as far as complete emergence is concerned.

The result corroborates with the findings of Ngalides (2009) that using garden soil, sawdust, alnus compost and coco coir dust will enhance complete seedling emergence of avocado seeds.

Percentage of Emergence

Table 3 reveals that there were significant statistical differences on the percentage of emergence of tamarillo seeds as affected by the different growing media. The result shows that the seeds sown in garden soil + coco coir dust + alnus compost + sand attained the highest percentage of seedling emergence with a mean of 96.67% emergence but are not statistically different with the seeds sown in the media combinations of garden

Table 3. Percentage of emergence

TREATMENT	PERCENTAGE
Garden soil (control)	96.33^{ab}
Garden soil + coco coir dust	66.67^{c}
Garden soil + alnus compost	93.33^{ab}
Coco coir dust + alnus compost	76.67^{bc}
Garden soil + coco coir dust + alnus compost	93.33^{ab}
Garden soil + coco coir dust + sand	83.33^{abc}
Coco coir dust + alnus compost + sand	86.67^{ab}
Garden soil + coco coir dust + alnus compost + sand	96.67^{a}

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

soil, garden soil + alnus compost, garden soil + alnus compost + coco coir coir dust, and coco coir dust + alnus compost + sand. While the seed sown in garden soil + coco coir dust had the lowest percentage of seedling emergence with a mean of 66.67% emergence.

The result implies that a mixture of garden soil + coco coir dust + alnus compost + sand could enhance higher percentage emergence of tamarillo seeds.

As previously mentioned, the result corroborates with the findings of Ngalides (2009) that using garden soil, sawdust, alnus compost and coco coir dust will enhance higher percentage of seedling emergence of avocado seeds.

Percentage of Normal Seedling

With regards to the percentage of normal seedlings, there were highly significant statistical differences that were observed as shown in Table 4. The result showed that the seeds sown in garden soil + alnus compost attained the highest percentage of normal seedlings with a mean of 90.00%. It was followed by the seeds sown in garden soil + coco coir dust + alnus compost, and garden soil + coco coir dust + alnus compost + sand with means of 86.67% but are statistically comparable also with the seeds sown using coco coir dust + alnus compost + sand, and the control. While the seeds sown in garden soil + coco coir dust had the lowest percentage of normal seedlings with a mean of 30%.

Table 4. Percentage of normal seedlings

TREATMENT	PERCENTAGE
Garden soil (control)	80.00[ab]
Garden soil + coco coir dust	30.00[c]
Garden soil + alnus compost	90.00[a]
Coco coir dust + alnus compost	60.00[b]
Garden soil + coco coir dust + alnus compost	86.67[a]
Garden soil + coco coir dust + sand	36.67[c]
Coco coir dust + alnus compost + sand	83.33[a]
Garden soil + coco coir dust + alnus compost + sand	86.67[a]

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

The result revealed that a mixture of garden soil + alnus compost promoted higher percentage of normal seedlings. And as stated by Laurie (1956), the incorporation of organic matters in the soil is very important especially to horticultural crops that they may enhance the growth of the crops.

Number of Days to First Appearance of Leaves

As present in Table 5, there were no statistical differences observed among the media used in the study. However, numerical figures showed that seeds sown in media composition using garden soil, garden soil + alnus compost, garden soil + coco coir dust + sand, coco coir dust + alnus compost + sand, and garden soil + coco coir dust + alnus compost + sand had the shortest number of days to leaf development within 22.00 days. While the seeds sown in coco coir dust + alnus compost had higher number of days to first appearance of leaves with a mean of 24.67 days.

The results show that among the treatments used, seeds of tamarillo could be sown in any of the media combination used in the study if the number of days to first appearance of leaves is to be considered.

Table 5. Number of days to first appearance of leaves

TREATMENT	NUMBER OF DAYS
Garden soil (control)	22.00[a]
Garden soil + coco coir dust	24.00[a]
Garden soil + alnus compost	22.00[a]
Coco coir dust + alnus compost	24.67[a]
Garden soil + coco coir dust + alnus compost	23.33[a]
Garden soil + coco coir dust + sand	22.00[a]
Coco coir dust + alnus compost + sand	22.00[a]
Garden soil + coco coir dust + alnus compost + sand	22.00[a]

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

Growth Increment

Table 6 shows highly significant statistical differences observed among the media used regarding the weekly growth increment. Statistical results showed that seeds sown in garden soil + alnus compost attained the highest weekly growth increment with a mean of 8.17 cm. It was followed by seeds sown in garden soil with a mean of 6.00 cm. It was then followed further by seeds sown in coco coir dust + alnus compost + sand, coco coir dust + alnus compost, and garden soil + coco coir dust + alnus compost having means of 4.87, 4.47 and 4.30, respectively. While the seeds sown in garden soil + coco coir dust had the lowest weekly growth increment with a mean of 2.47 cm.

The result implies that mixture of garden soil + alnus compost promoted good germination of tamarillo seeds in terms of weekly growth increment. Likewise, the same

Table 6. Growth increment

TREATMENT	GROWTH INCREMENT (cm)
Garden soil (control)	6.00[b]
Garden soil + coco coir dust	2.47[e]
Garden soil + alnus compost	8.17[a]
Coco coir dust + alnus compost	4.47[cd]
Garden soil + coco coir dust + alnus compost	4.30[cd]
Garden soil + coco coir dust + sand	2.50[e]
Coco coir dust + alnus compost + sand	4.87[bc]
Garden soil + coco coir dust + alnus compost + sand	3.35[de]

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

observation agrees with the findings of Gawaban (1999) that a media 1:1:1 alnus, compost and garden soil, significantly improved the vegetative growth of impatiens and produced taller plants.

Seedling Height at 60 Days from Seedling Emergence

The results in Table 7.a. shows that there were highly significant differences observed among the media used in the study affecting seedling height at 60 days from seedling emergence. Statistically, the results showed that seeds sown in garden soil + alnus compost obtained the highest mean of 9.13 cm. This was followed by seeds sown in garden soil only with a mean of 7.57 cm. It was followed further by seeds sown in garden soil + coco coir dust + alnus compost having a mean of 5.97 cm and the seeds sown in

Table 7.a. Seedling height at 60 days from seedling emergence

TREATMENTS	HEIGHT (cm)
Garden soil (control)	7.57^{b}
Garden soil + coco coir dust	3.23^{e}
Garden soil + alnus compost	9.13^{a}
Coco coir dust + alnus compost	5.15^{cd}
Garden soil + coco coir dust + alnus compost	5.97^{c}
Garden soil + coco coir dust + sand	3.00^{e}
Coco coir dust + alnus compost + sand	4.53^{d}
Garden soil + coco coir dust + alnus compost + sand	5.55^{cd}

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

garden soil + coco coir dust + alnus compost + sand with a mean of 5.55 cm. While the seeds sown in garden soil + coco coir dust + sand had the lowest mean of 2.98 cm.

The results agree with the findings of Gawaban (1999) that a media 1:1:1 alnus, compost and garden soil, significantly improved the vegetative growth of impatiens and produced taller plants. Figure 2 shows an over view of the study 60 days from seedling emergence.

Figure 2. Overview of the study 60 days from seedling emergence

Seedling Height at 90 Days from Seedling Emergence

There were highly significant statistical differences observed among the media used in the study affecting seedling height at 90 days from seedling emergence (Table 7.b.). The results showed that seeds sown in garden soil + alnus compost obtained the highest mean of 11.83 cm. This was followed by seeds sown in garden soil + coco coir dust + alnus compost, and garden soil + coco coir dust + alnus compost + sand with means of 7.77 cm, 7.50 cm and 7.38 cm, respectively. While the seeds sown in garden soil + coco coir dust had the lowest mean of 3.93 cm. As previously stated, the result corroborates with the findings of Gawaban (1999) that a media 1:1:1 alnus, compost and garden soil, significantly improved the vegetative growth of impatiens and produced taller plants.

Table 7.b. Seedling height at 90 days from seedling emergence

TREATMENT	HEIGHT (cm)
Garden soil (control)	9.80[b]
Garden soil + coco coir dust	3.93[d]
Garden soil + alnus compost	11.83[a]
Coco coir dust + alnus compost	7.50[c]
Garden soil + coco coir dust + alnus compost	7.77[c]
Garden soil + coco coir dust + sand	4.25[d]
Coco coir dust + alnus compost + sand	6.95[c]
Garden soil + coco coir dust + alnus compost + sand	7.38[c]

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

Number of Leaves at 60 days from Seedling Emergence

There were highly significant statistical differences that were observed in Table 8.a. among the media used that affected the number of leaves 60 days from seedling emergence. The results showed that the seeds sown in garden soil + alnus compost had the highest number of leaves with a mean of 5.17. This was followed by seeds sown using garden soil with a mean of 5.00. All the other seeds sown in the various media had a number of leaves ranging from more than 2 to 4 on 60 days from seedling emergence. While the seeds sown in coco coir dust + alnus compost + sand obtained the lowest number of leaves with a mean of 2.17.

Table 8.a. Number of leaves at 60 days from seedling emergence

TREATMENT	NUMBER OF LEAVES
Garden soil (control)	5.00[ab]
Garden soil + coco coir dust	3.33[cde]
Garden soil + alnus compost	5.17[a]
Coco coir dust + alnus compost	3.63[bcd]
Garden soil + coco coir dust + alnus compost	4.50[abc]
Garden soil + coco coir dust + sand	2.67[de]
Coco coir dust + alnus compost + sand	2.17[e]
Garden soil + coco coir dust + alnus compost + sand	3.83[abcd]

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

Number of Leaves at 90 days from Seedling Emergence

As shown in Table 8.b., there were highly significant statistical differences that were observed among the media used that affected the number of leaves 90 days from seedling emergence. The results showed that the seeds sown in garden soil + alnus compost had the highest number of leaves with a mean of 6.00, but one not statistically different with the control. All the other seeds produce leaves ranging from 3 to 5 on 90 days from seedling emergence. While the seeds sown in garden soil + coco coir dust attained the lowest number of leaves with a mean 3.67.

Table 8.b. Number of leaves at 90 days from seedling emergence

TREATMENT	NUMBER OF LEAVES
Garden soil (control)	5.17[ab]
Garden soil + coco coir dust	3.67[c]
Garden soil + alnus compost	6.00[a]
Coco coir dust + alnus compost	4.67[bc]
Garden soil + coco coir dust + alnus compost	4.67[bc]
Garden soil + coco coir dust + sand	4.17[bc]
Coco coir dust + alnus compost + sand	3.83[c]
Garden soil + coco coir dust + alnus compost + sand	4.50[bc]

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

Seedling Vigor

Table 9 shows that there were highly significant statistical differences observed among the media used in the study affecting the seedling vigor of tamarillo seedlings. The result revealed that the seeds sown in garden soil + alnus compost had the highest rating with a mean of 1.33. It was followed by seeds sown in coco coir dust + alnus compost + sand, and garden soil + coco coir dust + alnus compost + sand having identical means of 2.67. While the seeds sown in a mixture of garden soil + coco coir dust, and garden soil + coco coir dust + sand had the lowest rating with a mean of 3.67.

The result corroborates with the findings of Gawaban (1999) that a media 1:1:1 alnus, compost and garden soil, significantly improved the vegetative growth of impatiens and produced taller plants.

On the other hand, Handreck (1993) enumerated the advantages of coco coir dust over peat moss including the chemical properties. The electrical conductivity of 250 *u*S/cm is so high for vegetables like cabbage compared to the ideal electrical conductivity of 2 to 3. The excessive salts present in the media of 250, 000 milligrams per kilo of coco coir dust may be toxic to cabbage seedlings especially that the pH is strongly acidic. Moreover, coco coir dust may be deficient from nitrogen element as almost all the seedlings show nitrogen deficiency in which the green leaves becoming yellow, bronzed, pink or purple as they age (purple tinge on old leaves) described by Scaife and Turner (1983). However, the results showed that seeds sown in garden soil, garden soil + alnus compost, garden soil + coco coir dust + sand, coco coir dust + alnus compost + sand, and garden soil + coco coir dust + alnus compost + sand had the shortest number of days to leaf development.

Table 9. Seedling vigor

TREATMENT	SEEDLING VIGOR
Garden soil (control)	2.33^{c}
Garden soil + coco coir dust	3.67^{a}
Garden soil + alnus compost	1.33^{d}
Coco coir dust + alnus compost	3.33^{ab}
Garden soil + coco coir dust + alnus compost	3.33^{ab}
Garden soil + coco coir dust + sand	3.67^{a}
Coco coir dust + alnus compost + sand	2.67^{bc}
Garden soil + coco coir dust + alnus compost + sand	2.67^{bc}

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

Rating	Description
1	most vigorous – excellent growth with dark green leaves
2	vigorous – good growth with green leaves
3	less vigorous – slightly good growth with light green leaves
4	poor – poor growth with yellow leaves

Transplanting Age

The data in Table 10 shows that there were highly significant differences observed among the treatments with regards to age of transplanting. The results showed that the seeds sown in garden soil, garden soil + alnus compost, coco coir dust + alnus compost + sand and garden soil + coco coir dust + alnus compost + sand attained the shortest days for transplanting age with a mean of 75.33 days. While the seeds sown in

Table 10. Transplanting age

TREATMENT	AGE
Garden soil (control)	75.33^{c}
Garden soil + coco coir dust	111.33^{a}
Garden soil + alnus compost	75.33^{c}
Coco coir dust + alnus compost	92.67^{b}
Garden soil + coco coir dust + alnus compost	92.67^{b}
Garden soil + coco coir dust + sand	111.33^{a}
Coco coir dust + alnus compost + sand	75.33^{c}
Garden soil + coco coir dust + alnus compost + sand	75.33^{c}

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

garden soil + coco coir dust, and garden soil + coco coir dust + sand had the longest days for transplanting age with a mean of 111.33 days.

The result implies that using garden soil, alnus compost, coco coir dust, and sand will enhance shorter duration and readiness for transplanting of tamarillo seedlings. Figure 3 shows the overview of the seedlings ready for transplanting 90 days from seedling emergence.

Figure 3. Overview of the seedlings ready for transplanting 90 days from seedling emergence.

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The study was conducted at the Pomology project, Benguet State University from the month of November 2009 to February 2010 to determine the best growing media that will promote/enhance seed germination and seedling emergence of tamarillo seeds and to find out the effects of the different growing media on the seedling and growth of tamarillo grown from seeds.

Significant differences were not observed on the number of days to seed germination, and number of days to first appearance of leaves. While significant differences were only observed regarding the percentage of emergence. Highly significant differences was also observed on the Number of days to complete emergence, Percentage of normal seedlings, Growth increment, Seedling height at 60 and 90 days from seedling emergence, Number of leaves at 60 and 90 days from seedling emergence, seedling vigor and transplanting age. The results revealed that the media mixture differed much in their effects on the tamarillo seed germination including seedling growth.

The seeds sown in garden soil as the control, garden soil + alnus compost, garden soil + coco coir dust + sand, coco coir dust + alnus compost + sand, and garden soil + coco coir dust + alnus compost + sand were the earlier seedlings to emerge and had the shortest number of days to leaf development. The mixture of garden soil + coco coir dust + alnus compost + sand had the least number of days to complete emergence of the seeds. Meanwhile, a mixture of garden soil + coco coir dust + alnus compost + sand could enhance good emergence of tamarillo seeds. The combination of garden soil + alnus compost attained the highest percentage of normal seedlings. Furthermore garden mixture

of soil + alnus compost attained the highest weekly growth increment, highest seedling height at 60 and 90 days from seedling emergence, highest number of leaves 60 and 90 days, and highest rating for seedling vigor.

Lastly the seeds sown in garden soil, garden soil + alnus compost, coco coir dust + alnus compost + sand, and garden soil + coco coir dust + alnus compost + sand enhanced shorter duration and readiness for transplanting of tamarillo seedlings.

Conclusions

Based from all the results that was observed, the use of 1:1 garden soil + alnus compost can be used as a media in germinating tamarillo seeds. This can promote higher percentage of normal seedlings, enhances good weekly growth increment, seedling height, more number of leaves, and induced the growth of more vigorous seedlings having excellent growth with dark green leaves. On the other hand, coco coir dust had side effects on the growth of tamarillo seedlings where the leaves of tamarillo seedlings became yellow and with stunted growth.

Recommendations

From the preceding results and discussions, the combination of garden soil and alnus compost is recommended as a growing media to be used in germinating tamarillo seeds. The use of undecompose coco coir dust should be avoided as this material seems to affect the normality of seedlings and seedling growth as well.

LITERATURE CITED

AGNAYA, J. C. 2004. Effect of cold stratification perion on the germination of Benguet wild tea. BS Thesis. Benguet State University, La Trinidad, Benguet. pp. 3-4.

ANDRES, R. S. 2006. Growth and flowering of angel's wing (*Spathiphylum kochi L.*) as affected by different potting media mixtures. BS Thesis. Benguet State University, La Trinidad, Benguet. p. 26.

ANTONIO, T. D. 2000. Effect of horticultural perlite on the growth, flowering, quality and cut flower yield of potted anthurium 'Kansako'. BS Thesis. Benguet State University, La Trinidad, Benguet. pp. 3, 6.

ASPILAN, A. F. 1998. Improvement in the germinability of carrot (*Caocac carota L.*) seed by sea water pre-sowing treatment. BS Thesis. Benguet State University, La Trinidad, Benguet. p. 3.

BISLEY, M. B. 2008. Germination of papaya (*Carica papaya*) seeds and seedling characteristics as affected by different growing media in Camp 3, Tuba, Benguet. BS Thesis. Benguet State University, La Trinidad, Benguet. pp. 16-28.

CHRISTOPHER, E. P. 1958. Introductory Horticulture. Mcgraw-Hill Book Company. New York, U. S. A. p. 90.

DONAHUE, R. L. 1971. An Introduction to Soils and Plant Growth. Third Edition. Prentice Hall Inc. New Jersey. pp. 483-484.

FACCIOLA, S. 1990. Cornucopia: A Source Book of Edible Plants. Kampong Publications. pp. 204-208.

GAWABAN, J. B. 1999. Response of containers grown impatients sultanii to different potting media. BS Thesis. Benguet State University, La Trinidad, Benguet. p. 18.

HANDRECK, K. A. 1993. Properties of coir dust, and its use in the formulation of soilless potting media. Community Soil and Plant Analysis. 24: 349-363.

HANDRECK, K. A. and N. P. BLACK. 1994. Properties of Coir Dust, and Its Use in the Formulation of Soil less potting media. Community Soil and Plant Analysis. 24: 349-363.

LAURIE, A. D. 1956. Commercial Flower Forcing. 6th ed. New York, Toronto, London. Mcgraw-Hill Publication in Agricultural Science.

NGALIDES, E. A. 2009. Germination of avocado (*Persea americana*) seeds and seedling characteristics as affected by different growing media. BS Thesis. Benguet State University, La Trinidad, Benguet.

SCAIFE, A. and M. TURNER. 1983. Diagnosis of Mineral Disorder in Plants. Volume 2: Vegetables. London. Ministry of Agriculture and Food/ Agricultural Research Council. pp. 21-22.

THOMPSON, L. M. and F. R. TROECH. 1978. Soils and Soil Fertility. 4th ed. McGraw-Hill, Inc. New York. p. 232.

APPENDICES

Appendix Table 1. Number of days to initial emergence

TREATMENT	REPLICATION				
	I	II	III	TOTAL	MEAN
T_1	17	17	17	51	17[a]
T_2	19	17	20	56	18.67[a]
T_3	17	17	17	51	17[a]
T_4	19	19	17	55	18.33[a]
T_5	19	17	17	53	17.67[a]
T_6	17	17	17	51	17[a]
T_7	17	17	17	51	17[a]
T_8	17	17	17	51	17[a]

ANALYSIS OF VARIANCE

Source of variation	Degrees of Freedom	Sum of Squares	Mean Squares	Computed F	Tabular F .05	Tabular F .01
Replication	2	1.083	0.542			
Treatment	7	9.958	1.423	2.23ns	2.77	4.28
Error	14	8.917	0.637			
Total	23	19.958				

ns - not significant

Coefficient of variation = 4.57%

Appendix Table 2. Number of days to complete emergence

TREATMENT	REPLICATION				
	I	II	III	TOTAL	MEAN
T_1	22	20	20	62	20.67^{bcd}
T_2	24	21	23	68	22.67^{a}
T_3	21	21	20	62	20.67^{bcd}
T_4	23	23	21	67	22.33^{ab}
T_5	24	19	21	64	21.33^{abc}
T_6	21	19	20	60	20.00^{cd}
T_7	20	20	19	59	19.67^{cd}
T_8	20	19	19	58	19.33^{d}

ANALYSIS OF VARIANCE

Source of variation	Degrees of Freedom	Sum of Squares	Mean Squares	Computed F	Tabular F .05	Tabular F .01
Replication	2	13.083	6.542			
Treatment	7	30.667	4.381	4.5153**	2.77	4.28
Error	14	13.583	0.970			
Total	23	57.333				

**Highly significant — Coefficient of variation = 4.73%

Appendix Table 3. Percentage of emergence

TREATMENT	REPLICATION				
	I	II	III	TOTAL	MEAN
T_1	100	100	80	280	93.33[ab]
T_2	60	70	70	200	66.67[c]
T_3	90	100	90	280	93.33[ab]
T_4	70	80	80	230	76.67[bc]
T_5	100	90	90	280	93.33[ab]
T_6	70	90	90	250	83.33[abc]
T_7	70	90	100	260	86.67[ab]
T_8	100	90	100	290	96.67[a]

ANALYSIS OF VARIANCE

Source of variation	Degrees of Freedom	Sum of Squares	Mean Squares	Computed F	Tabular F .05	Tabular F .01
Replication	2	175.000	87.500			
Treatment	7	2229.167	318.452	3.8489*	2.77	4.28
Error	14	1158.333	82.738			
Total	23	3562.500				

*Significant　　　　Coefficient of variation = 10.55%

Appendix Table 4. Percentage of normal seedlings

TREATMENT	REPLICATION				
	I	II	III	TOTAL	MEAN
T_1	70	80	90	240	80^{ab}
T_2	30	40	20	90	30^{c}
T_3	90	100	80	270	90^{a}
T_4	70	50	60	180	60^{b}
T_5	80	90	90	260	86.67^{a}
T_6	40	50	20	110	36.67^{c}
T_7	60	90	100	250	83.33^{a}
T_8	70	90	100	260	86.67^{a}

ANALYSIS OF VARIANCE

Source of variation	Degrees of Freedom	Sum of Squares	Mean Squares	Computed F	Tabular F	
					.05	.01
Replication	2	408.333	204.167			
Treatment	7	12116.667	1730.952	10.7306**	2.77	4.28
Error	14	2258.333	161.310			
Total	23	14783.333				

**Highly significant

Coefficient of variation = 18.63 %

Appendix Table 5. Number of days to first appearance of leaves

TREATMENT	REPLICATION				
	I	II	III	TOTAL	MEAN
T_1	22	22	22	66	22[a]
T_2	25	22	25	72	24[a]
T_3	22	22	22	66	22[a]
T_4	26	26	22	74	24.67[a]
T_5	26	22	22	70	23.33[a]
T_6	22	22	22	66	22[a]
T_7	22	22	22	66	22[a]
T_8	22	22	22	66	22[a]

ANALYSIS OF VARIANCE

Source of variation	Degrees of Freedom	Sum of Squares	Mean Squares	Computed F	Tabular F .05	Tabular F .01
Replication	2	4.750	2.375			
Treatment	7	25.167	3.595	2.23ns	2.77	4.28
Error	14	22.583	1.613			
Total	23	52.500				

ns - not significant

Coefficient of variation = 5.58%

Appendix Table 6. Growth increment

TREATMENT	REPLICATION				
	I	II	III	TOTAL	MEAN
T_1	5.55	6.55	5.9	18	6^{b}
T_2	1.95	2.75	2.7	7.40	2.47^{a}
T_3	9.5	7.7	7.3	24.50	8.17^{cd}
T_4	4.75	4.05	4.6	13.40	4.47^{cd}
T_5	4.15	5	3.75	12.90	4.30^{e}
T_6	3.35	1.95	2.2	7.50	2.50^{e}
T_7	4.66	4.6	5.35	14.61	4.87^{bc}
T_8	3.55	2.85	3.65	10.05	3.35^{de}

ANALYSIS OF VARIANCE

Source of variation	Degrees of Freedom	Sum of Squares	Mean Squares	Computed F	Tabular F	
					.05	.01
Replication	2	0.337	0.168			
Treatment	7	75.983	10.855	24.2922**	2.77	4.28
Error	14	6.256	0.447			
Total	23	82.575				

**Highly significant

Coefficient of variation = 14.81%

Appendix Table 7.a. Seedling height at 60 days from seedling emergence

TREATMENT	REPLICATION				
	I	II	III	TOTAL	MEAN
T_1	6.9	7.7	8.1	27.70	7.57[b]
T_2	3	3.4	3.3	9.70	3.23[e]
T_3	8.2	10.1	9.1	27.40	9.13[a]
T_4	6.3	4.3	4.85	15.45	5.15[cd]
T_5	6.2	5.5	6.2	17.90	5.97[c]
T_6	3.15	2.8	3	8.95	2.98[e]
T_7	5.1	4.15	4.35	13.60	4.53[d]
T_8	5.6	5.55	5.5	16.65	5.55[cd]

ANALYSIS OF VARIANCE

Source of variation	Degrees of Freedom	Sum of Squares	Mean Squares	Computed F	Tabular F .05	Tabular F .01
Replication	2	0.071	0.036			
Treatment	7	90.657	12.951	32.3861**	2.77	4.28
Error	14	5.599	0.400			
Total	23	96.327				

**Highly significant   Coefficient of variation = 11.47%

Appendix Table 7.b. Seedling height at 90 days from seedling emergence

TREATMENT	REPLICATION				
	I	II	III	TOTAL	MEAN
T_1	9.85	9.8	9.75	29.40	9.80[b]
T_2	3.55	3.95	4.3	11.80	3.93[d]
T_3	11.65	12.5	11.35	35.50	11.83[a]
T_4	8.4	6.8	7.3	22.50	7.50[c]
T_5	7.8	7.6	7.9	23.30	7.77[c]
T_6	4.6	4.05	4.1	12.75	4.25[d]
T_7	6.7	6.75	7.4	20.85	6.95[c]
T_8	7.7	7.1	7.35	22.15	7.38[c]

ANALYSIS OF VARIANCE

Source of variation	Degrees of Freedom	Sum of Squares	Mean Squares	Computed F	Tabular F .05	Tabular F .01
Replication	2	0.181	0.09			
Treatment	7	143.088	20.441	99.5108**	2.77	4.28
Error	14	2.876	0.205			
Total	23	146.145				

**Highly significant

Coefficient of variation = 6.10%

Appendix Table 8.a. Number of leaves at 60 days from seedling emergence

TREATMENT	REPLICATION				
	I	II	III	TOTAL	MEAN
T_1	5	5	5	15	5^{ab}
T_2	3	3	4	10	3.33^{cde}
T_3	5	5.5	5	15.50	5.16^{a}
T_4	5	2.4	3.5	10.90	3.63^{bcd}
T_5	5	4	4.5	13.50	4.50^{abc}
T_6	2	4	2	8.00	2.66^{de}
T_7	2.5	2	2	6.50	2.16^{e}
T_8	4	3.5	4	11.50	3.83^{abcd}

ANALYSIS OF VARIANCE

Source of variation	Degrees of Freedom	Sum of Squares	Mean Squares	Computed F	Tabular F .05	Tabular F .01
Replication	2	0.292	0.146			
Treatment	7	23.986	3.427	6.4414**	2.77	4.28
Error	14	7.447	0.532			
Total	23	31.726				

**Highly significant

Coefficient of variation = 19.26%

Appendix Table 8.b. Number of leaves at 90 days from seedling emergence

TREATMENT	REPLICATION				
	I	II	III	TOTAL	MEAN
T_1	6	4.5	5	15.50	5.17[ab]
T_2	3	3.5	4.5	11.00	3.67[c]
T_3	6	6	6	18.00	6.00[a]
T_4	5	4.5	4.5	14.00	4.67[bc]
T_5	5	4.5	4.5	14.00	4.67[bc]
T_6	4.5	4	4	12.50	4.17[bc]
T_7	3	3.5	5	11.50	3.83[c]
T_8	5	4	4.5	13.50	4.50[bc]

ANALYSIS OF VARIANCE

Source of variation	Degrees of Freedom	Sum of Squares	Mean Squares	Computed F	Tabular F .05	Tabular F .01
Replication	2	0.896	0.448			
Treatment	7	11.833	1.690	5.1403**	2.77	4.28
Error	14	4.604	0.329			
Total	23	17.333				

**Highly significant　　　　Coefficient of variation = 12.51%

Appendix Table 9. Seedling vigor

TREATMENT	REPLICATION				
	I	II	III	TOTAL	MEAN
T_1	2	3	2	7	2.33^{c}
T_2	3	4	4	11	3.67^{a}
T_3	1	2	1	4	1.33^{d}
T_4	3	4	3	10	3.33^{ab}
T_5	3	3	4	10	3.33^{ab}
T_6	3	4	4	11	3.67^{a}
T_7	2	3	3	8	2.67^{bc}
T_8	2	3	3	8	2.67^{bc}

ANALYSIS OF VARIANCE

Source of variation	Degrees of Freedom	Sum of Squares	Mean Squares	Computed F	Tabular F .05	Tabular F .01
Replication	2	3.250	1.625			
Treatment	7	13.292	1.899	12.7600**	2.77	4.28
Error	14	2.083	0.149			
Total	23	18.625				

**Highly significant

Coefficient of variation = 13.42%

Appendix Table 10. Transplanting age

TREATMENT	REPLICATION				
	I	II	III	TOTAL	MEAN
T_1	72	77	77	226	75.33[c]
T_2	77	108	113	334	111.33[a]
T_3	113	72	77	226	75.33[c]
T_4	91	96	91	278	92.67[b]
T_5	91	91	96	278	92.67[b]
T_6	108	113	113	334	111.33[a]
T_7	72	77	77	226	75.33[c]
T_8	72	77	77	226	75.33[c]

ANALYSIS OF VARIANCE

Source of variation	Degrees of Freedom	Sum of Squares	Mean Squares	Computed F	Tabular F .05	Tabular F .01
Replication	2	39.583	19.792			
Treatment	7	5312.000	758.857	113.3227**	2.77	4.28
Error	14	93.750	6.696			
Total	23	5445.333				

**Highly significant

Coefficient of variation = 2.92%