BIBLIOGRAPHY

DORIAN, LEONARD J. APRIL 2009. Germination of Passion Fruit (*Passiflora edulis L.*) Seeds and Seedling Growth as Affected by Different Growing Media. Benguet State University, La Trinidad, Benguet.

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ABSTRACT

The study was conducted at the Pomology project, Benguet State University from November 2008 to February 2009 to determine the best growing media suitable for germination of passion fruit seeds and to find out the effects of the different growing media on the germination of passion fruit seeds.

Results revealed that there were significant differences observed among the different growing media used. Seeds sown in a media mixture of garden soil and sawdust, garden soil (control), sand + sawdust + ricehull + alnus compost and garden soil + sawdust + alnus compost + sand showed the earliest number of days to emergence with a mean of 12.00 days. With regards to first appearance of leaves, all the different media mixtures used enhanced shorter duration of leaf development except for the combinations of alnus compost + sawdust + ricehull with a mean of 27.00 days. Furthermore, seeds sown in a mixture of garden soil (control) + coco soil + alnus compost had shorter duration to reach transplanting stage as well as having the highest number of roots produced with longer length of roots and shoots. All media mixtures

enhanced 100% normal seedlings except for the combination of garden soil (control), sand + ricehull + coco soil and garden soil + coco soil + ricehull with a mean of 96.67% and 93.33% respectively. Meanwhile, all media mixtures promoted excellent growth as well as 100% emergence of passion fruit seedlings.

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INTRODUCTION

Passion fruit (*Passiflora edulis S.*) is a plant cultivated commercially for its fruits. It belongs to the family *passifloraceae*. It is native to South America and widely grown in India, New Zealand, the Caribbean, Brazil, Southern Florida, Hawaii, Australia, East Africa, Israel and South Africa. It can also be grown in the different parts of the Philippines as well as in the Province of Benguet, where it is grown only in backyard gardens.

The passion fruit is round to oval, yellow or dark purple at maturity, with a soft to firm, juicy interior filled with numerous seeds. The fruits can be grown to eat or for its juice, which is often added to other fruit juices to enhance flavor and aroma.

The two types of passion fruit have greatly different exterior appearances. The bright yellow variety of passion fruit also known as the golden passion fruit, can grow up to the size of a grape fruit having smooth, glossy light and airy rind and has been used as a rootstock for purple passion fruit in other countries. Under this variety, there are two cultivars, the Brazilian golden, which is somewhat tart. It produces extremely vigorous vine, requiring cross-pollination. It has extra large fragrant flowers colored white with a dark center, blooming during mid-summer. The other cultivar is the golden giant, a large yellow-fruited cultivar that originated in Australia.

The dark purple passion fruit variety is smaller than a lemon with a dry, wrinkled rind at maturity. Under this variety, there are seven cultivars, such as Black Knight, developed in Massachusetts by Patrick Worley. It has fragrant, dark-black fruit, the size and shape of large egg. It is a vigorous, compact vine, self-pollinated and very fruitful.

Edgehill, originating in California is similar to Black Knight but more vigorous, larger growing and with larger purple fruit. Frederick cultivar also originating in California developed by Patrick Worky from the cross between Kahuna and Brazilian Golden cultivar, nearly oval fruit and juicing with extremely vigorous, self-fruitful vine and productive. The Kahuna cultivar is very large, medium purple fruit with sweet subacid flavor. It is good for juicing, vigorous, productive and self-fertile vine. It is produced over a long season and has large and attractive foliage. Paul Ecke also originating in California has medium sized purple fruit of very good quality, suitable for juicing and eating. It is compact and very productive vine. Purple giant has very large fruit, dark-purple when mature. Lastly, the red rover, originating also in California by Patrick Worky from crossing Kahuna and Brazilian Golden cultivar having medium to large, roundest fruit. Rinds are attractive and colored red. It is sweet and good for eating and juicing, very vigorous, compact and s elf-fertile vine.

Passion fruit juice is a good source of ascorbic acid (Vitamin C) and carotenoids (Vitamin A). It is rich flavored and strongly, but pleasantly aromatic. The undiluted juice is highly concentrated but is an excellent additive to other fruit juices, or it may be drunk as an aide if water and sugar are added. Seeds with the surroundings sacs are often added to fruit salad in other countries. Fruit of the purple passion fruit may be eaten by itself, seeds and all. The juice of the giant granadilla has a milder flavor than that of the others and is used in confections or drinks. Its melon like edible flash also can be pulverized and used in pies.

Passion fruit can be potentially grown with in a structure or in backyards for easy availability and use. However, mass production could be come 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 g rowing media that is suitable for growing of passion fruit and to determine of the different growing media mixture will affect the seedling characteristics that will be produced.

The result of this study will provide information to researchers interested to work on passion fruit in order to help in the improvement of passion fruit production and to encourage farmers or fruit growers to produce passion fruit due to its good potential in the market especially when it is processed. Since passion 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 suitable for germination of passion fruit seeds; and to find out the effects of the different growing media on the germination of passion fruit seeds.

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

REVIEW OF LITERATURE

Description of Passion Fruit

The passion fruit vine is a shallow-rooted, woody, perennial, and climbing by means of tendrils. The alternate, evergreen leaves, deeply 3-lobed when mature, are finely toothed, 3 to 8 inches (7.5-20 cm) long, deep-green and glossy above, paler and dull beneath, and, like the young stems and tendrils, tinged with red or purple, especially in the yellow form. A single, fragrant flower, 2 to 3 inches (5-7.5 cm) wide, is borne at each rode on the new growth. The bloom, clasped by 3 large, green, leaf like bracts, consists of 5 greenish-white sepals, 5 white petals, a pringe like corona of straight, white tipped rays, rich purple at the base, also 5 stamens with large anthers, the ovary, and triple-branched style forming a prominent central structure. The lower of the yellow is more showy, with more intense color. The nearly round or ovoid fruit, 1 ½ to 3 inches (4-7.5 cm) wide, has a tough rind, smooth, waxy, ranging in hue from dark-purple with faint, fine white specks, to light-yellow or pumpkin-color. It is 1/8 inch (3 mm) thick, adhering to a ¼ inch (6 mm) layer of white pith. Within is a cavity more or less pilled with an aromatic mass of double-walled, membianass sacs filled with orange-colored, pulpy juice and as many as 250 small, hard, dark-brown or black, pitted seeds. The flavor is appealing, musky, guava-like, subacid to acid (Morton, 1987).

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 it loosen the soil to provide better aeration and water movement.

Ware (1937) as cited by Sumakey (2004) added that organic matter improves physical condition and chemical properties of the soil. Chemical properties may include the following materials depending on the kind of plant and its state of decomposition, carbohydrates, sugars, starch, cellulose, lighting, tannin, fats, oil, waxes, resin, portions, pigments and minerals such as calcium (Ca), phosphorous (P), sulfur (S), Iron (Fe), Magnesium (Mg), and Potassium (K). These properties of the soil raise the capacity of the heavy soil and lessen surface on-off, leaching and erosion. It also enhances the porosity of the soil organic matter like compost, which contains 25%N, 0.03% Mg, and organic matter content of 5-6%.

Jankowiak (1978) as cited by Andres (2006), stated that compost encourages the formation of vigorous roots, which in turn produce a healthy plant, one, 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 regulates than that from 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. Compost also supply nutrients such as nitrogen, phosphorous and sulfur which are essential for plant growth.

Einert (1972) as cited by Andres (2006) stated that rice hull provides high to medium texture with good drainage and aeration and does not affect soil pH. He further stated that maximum effectiveness is obtained when rice hull is not more than 20% by volume of potting mixture.

Handreck and Black (1994) stated that whole rice hull is moderately resistant to decomposition. They hold little water and improve aeration. They are useful light weight component of mixes for orchids and are also to increase the porosity of bedding mixture based on peat. The same author mentioned that many grades of sand are available. Those with mainly medium to very coarse sizes (0.25-2 mm) are generally preferred. Finer grades can be used to increase water holding capacity of mixes that's other component is coarser.

Donahue (1979) stated that sawdust is good bedding mixture material since it absorbs liquid and is a good soil conditioner. The greatest resistant of lignin to decomposition offers intriguing possibilities in Horticulture and the use of sawdust a common surplus material, which frequently is obtained free of charge. He furthered that sawdust is composed of 4 lbs nitrogen, 2 lbs potassium and 4 lbs phosphorous per ton of sawdust or an oven dry weight basis.

Baldwin and Wesin (1997) as cited by Aladog (2006) found that the use of organic mulches such as untreated sawdust or straw will aid in controlling weeds and conserve soil moisture and texture.

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).

The same author stated that chicken manure is generally the highest in all levels of plant nutrients, sometimes up to four times as rich as cow manure, but it contains far less humus. Horse manure is a little higher in most nutrients than cow and has the advantage along with chicken and sheep of being "hotter" that is; it decomposes faster and generates a higher composting temperature. Cow and hog manure are cool, these wetter and do not have as much nutrient.

He further stated that compost, manures and most mulches are both humus builders and excellent sources of macro and micro nutrients and these make excellent natural fertilizers.

Foth and Turk (1972) as 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 and soluble materials in water. Its colloidal properties permit absorption of gases and their retention (power of retaining). These same colloidal properties improve the structure, making it granular.

Further, humus aids in the absorption of gases and their retention of soil heat (Laurie, 1950). 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, 1950).

Climatic and Soil Adaptability

The purple passion fruit is subtropical and prefers a frost-free climate. However, there are cultivars that can thrive in temperatures into the upper 20's (^{o}F) without serious damage. The vines may lose some of their leaves in cool winters. The roots often resprout even if the top is killed. The plant does not grow well in intense summer heat. The yellow passion fruit is tropical or near tropical and is much more intolerant of frost. (Ortho Books, 1985).

Passion fruit vines prefer a slightly acid soil, but the yellow passion fruit vine will tolerate alkaline soils if adequate micro nutrients are added. Well-drained soil is essential. Otherwise, root problems develop that soon destroy these plants (Popenoe, 1974).

Propagation

All passion fruits can be propagated from seeds, which should be fresh (less than 1 year old) because seeds lose viability rapidly. Seeds may be sown in flats or pots of sterile and kept in a most place shaded from direct sunlight. Seeds ordinarily germinate 10-20 days (2-4 weeks) and young plants g row rapidly. Seedlings should be potted individually in small containers as soon as practical after germination. They can be transferred to a permanent location when they are 25-40 cm (10-16 inches) tall (Samson, 1986).

MATERIALS AND METHODS

Materials

To successfully carry-out the activities in this study, the following materials were used: passion fruit seeds, growing media (sand, soil, compost alnus, sawdust, rice hull, coco soil), water, ruler, polyethylene bags (3 x 7) and labeling materials.

Methods

Experimental design and treatments. The experiment was laid out using Randomized Complete Block Design (RCBD) with ten (10) 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 + sawdust
T_3	1:1garden soil + rice hull
T_4	1:1:1 compost alnus + sawdust + rice hull
T_5	1:1:1 sand + rice hull + coco soil
T_6	1:1:1 garden soil + coco soil + compost alnus
T_7	1:1:1 garden soil + rice hull + compost alnus
T_8	1:1:1 garden soil + coco soil + rice hull
T_9	1:1:1:1 sand + sawdust + rice hull + compost alnus
T_{10}	1:1:1:1 garden soil + sawdust + compost alnus + sand

Preparation of growing media. The different growing media were mixed following the indicated ratio and were placed in black polyethylene bags (3 x 7) where the passion fruit seeds were sown.

Seed extraction. The passion fruit seeds were obtained from the mature and good quality passion fruits. The fruits were cut and the seeds were extracted and washed in order to have partial removal of the seeds parchment or mucilage, then the seeds were sown directly to the prepared growing media.

Sowing the seeds. The passion fruits were collected from a high yielding mother plants containing about 250 seeds per fruit. The seeds were collected in Sayangan, Atok, choosing only desirable seeds to ensure good germination. The seeds were sown in flat position.

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

Data Gathered

The data gathered were as follows:

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

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

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

$$\text{Emergence percentage} = \frac{\text{No. of germinant}}{\text{No. of seeds sown}} \times 100$$

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

$$\text{\% of normal seedlings} = \frac{\text{No. of normal seedlings}}{\text{No. of seeds sown}} \times 100$$

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. Root length (cm). This was measured from the node of developing root up to the tip of the seedling roots of two randomly selected sample seedlings, sixty days from sowing the seeds.

7. Shoot length (cm). This was measured from the base up to the tip of the seedlings of two randomly selected sample seedlings.

8. Seedling vigor. This will be taken by using this scale:

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

9. Number of days to readiness for transplanting. This was taken by counting the number of days from sowing the seeds to transplanting stage.

10. Percentage of abnormal seedlings. This was taken by using the formula:

$$\text{\% of abnormal seedlings} = \frac{\text{Number of abnormal seedlings}}{\text{Number of seeds sown}} \times 100$$

11. Root number. This was taken by counting the roots of the destructive samples.

12. Documentation of the study through pictures. The pictures were taken during planting stage and seedling stage.

RESULTS AND DISCUSSIONS

Number of Days to Initial Emergence

As presented in Table 1 there were significant differences observed among the different media used in the study on the number of days to initial emergence. Statistically, the results showed that the seeds sown in garden soil (control), garden soil + sawdust, sand + sawdust + ricehull + alnus compost and garden soil + sawdust + alnus compost + sand were the earlier seedlings to emerge with a mean of 12.00 days. This was followed by the seeds sown in a media combinations of garden soil + ricehull and garden soil + coco soil + ricehull + coco soil, garden soil + coco soil + alnus compost and garden soil + ricehull + alnus compost + sawdust + ricehull having more days to emerge with a mean of 18.33 days.

The result implies that as to the number of days to initial emergence, the combination of garden soil + sawdust + sand + ricehull + alnus compost as a germination media promote earlier seedling emergence of passion fruit seeds.

Table 1. Number of days to initial emergence

TREATMENT	MEAN
Garden soil (control)	12.00 ^{b}
1:1 garden soil + sawdust	12.00 ^{b}
1:1 garden soil + ricehull	13.33 ^{b}
1:1:1 alnus compost + sawdust + ricehull	18.33 ^{a}
1:1:1 sand + ricehull + coco soil	14.67 ^{ab}
1:1:1 garden soil + coco soil + alnus compost	14.67 ^{ab}
1:1:1 garden soil + ricehull + alnus compost	14.67 ^{ab}
1:1:1 garden soil + coco soil + ricehull	13.33 ^{b}
1:1:1:1 sand + sawdust + ricehull + alnus compost	12.00 ^{b}
1:1:1:1 garden soil + sawdust + alnus compost + sand	12.00 ^{b}

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

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

Number of Days to Complete Emergence

As shown in Table 2, there were significantly differences observed among the various media used in the study. Statistically, the results showed that seeds sown in garden soil + sawdust was the fastest to complete seedling emergence with a mean of 23.00 days. This was followed by the seedlings produced in garden soil + cocol soil + ricehull with a mean of 25.00 days. The seeds germinated using a media combination of sand + sawdust + ricehull + alnus compost, sand + ricehull + cocol soil, garden soil + coco soil + alnus compost and garden soil + ricehull attained a mean of 30.67, 35.55, 36.00 and 39.33 days respectively. This was followed by seeds sown in garden soil (control), garden soil + sawdust + compost alnus + sand and compost alnus + sawdust + ricehull with a mean of 40.67, 41.33 and 46.00 days successively. While the seeds sown in garden soil + ricehull + alnus compost attained the longest number of days to complete emergence with a mean of 59.67 days.

The result may imply that a mixture of 1:1 garden soil + sawdust will induce 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 soil will enhance seedling growth and complete emergence of avocado seeds.

Table 2. Number of days to complete emergence

TREATMENT	MEAN
Garden soil (control)	40.67[ab]
1:1 garden soil + sawdust	23.00 [b]
1:1 garden soil + ricehull	39.33[ab]
1:1:1 alnus compost + sawdust + ricehull	46.00[ab]
1:1:1 sand + ricehull + coco soil	35.33[ab]
1:1:1 garden soil + coco soil + alnus compost	36.00[ab]
1:1:1 garden soil + ricehull + alnus compost	59.67 [a]
1:1:1 garden soil + coco soil + ricehull	25.00 [b]
1:1:1:1 sand + sawdust + ricehull + alnus compost	30.67 [b]
1:1:1:1 garden soil + sawdust + alnus compost + sand	41.33[ab]

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

Number of days to First Appearance of Leaves

With regards to the number of days to first appearance of leaves, there were slight differences observed among the media used as shown in Table 3. Statistically, the results showed that seeds sown in garden soil which is the control, garden soil + sawdust, garden soil + ricehull, sand + ricehull + coco soil, garden soil + coco soil + alnus compost, garden soil + rice hull + alnus compost, garden soil + coco soil + ricehull, sand + alnus compost + sand had the fastest leaf development and produced leaves with a mean of 25.00 days. This was followed by the seeds sown in alnus compost + sawdust + ricehull with a mean of 27.00 days.

The result shows that among the different treatments that were used, seeds sown in alnus compost + sawdust + ricehull had a longer duration to form leaves as compared to the other germination media treatments.

Table 3. Number of days to first appearance of leaves

TREATMENT	MEAN
Garden soil (control)	25.00 [b]
1:1 garden soil + sawdust	25.00 [b]
1:1 garden soil + ricehull	25.00 [b]
1:1:1 alnus compost + sawdust + ricehull	27.00 [a]
1:1:1 sand + ricehull + coco soil	25.00 [b]
1:1:1 garden soil + coco soil + alnus compost	25.00 [b]
1:1:1 garden soil + ricehull + alnus compost	25.00 [b]
1:1:1 garden soil + coco soil + ricehull	25.00 [b]
1:1:1:1 sand + sawdust + ricehull + alnus compost	25.00 [b]
1:1:1:1 garden soil + sawdust + alnus compost + sand	25.00 [b]

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

The above results agree with the earlier findings of Acop (1987) that part of garden soil + alnus leaves compost + horse manure gave the tallest and highest leaf count in chrysanthemum.

Number of Days to Readiness for Transplanting

Table 4 shows that there were highly significant differences observed among the treatments used regarding the number of days to readiness for transplanting. Numerically, the results showed that seeds sown in garden soil which is the control and garden soil + coco soil + alnus compost is the fastest to reach the transplanting stage with a mean of 85.00 days, which is slightly earlier than the seeds sown in garden soil + sawdust, alnus compost + sawdust + ricehull and garden soil + rice hull + alnus compost with a mean of 86.00 and 86.33 days respectively. This was followed by seeds sown in garden soil + coco soil + ricehull which is a little bit earlier than seeds sown in sand + sawdust + ricehull + alnus compost and garden soil + sawdust + ricehull + alnus compost and garden soil + sawdust + alnus compost + sand with a mean 88.33 and 88.67 days

Table 4. Number of days to readiness for transplanting

TREATMENT	MEAN
Garden soil (control)	85.00 [c]
1:1 garden soil + sawdust	86.00[bc]
1:1 garden soil + ricehull	89.33 [a]
1:1:1 alnus compost + sawdust + ricehull	86.00[bc]
1:1:1 sand + ricehull + coco soil	89.33 [a]
1:1:1 garden soil + coco soil + alnus compost	85.00 [c]
1:1:1 garden soil + ricehull + alnus compost	86.33 [b]
1:1:1 garden soil + coco soil + ricehull	88.33 [a]
1:1:1:1 sand + sawdust + ricehull + alnus compost	88.67 [a]
1:1:1:1 garden soil + sawdust + alnus compost + sand	88.67 [a]

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

successively. The seeds sown in garden soil + ricehull and sand + ricehull + coco soil were the last to reach the transplanting stage with a mean of 89.33 days.

The results may imply that using garden soil + coco soil + alnus compost will enhance shorter duration to readiness for transplanting of passion fruit seedlings.

Number of Roots

As shown in Table 5, there were highly significant differences that were noted on the different media used that affected the root number 60 days from sowing. Statistical results showed that seeds sown in garden soil + coco soil + alnus compost had the highest number of roots with a mean of 141.67, followed by the seeds sown in garden soil which is the control and garden soil + rice hull + alnus compost with a mean of 90.67 and 91.67 respectively. The seeds sown in alnus compost + sawdust + ricehull, garden soil + coco soil + ricehull, garden soil + sawdust + alnus compost + sand and sand + ricehull + coco soil attained means of 59.33, 56.67, 51.00 and 50.00 respectively. The seeds sown in sand + sawdust

Table 5. Number of roots

TREATMENT	MEAN
Garden soil (control)	91.67 [b]
1:1 garden soil + sawdust	45.33 [c]
1:1 garden soil + ricehull	48.33 [c]
1:1:1 alnus compost + sawdust + ricehull	59.33 [c]
1:1:1 sand + ricehull + coco soil	50.00 [c]
1:1:1 garden soil + coco soil + alnus compost	141.67 [a]
1:1:1 garden soil + ricehull + alnus compost	90.67 [b]
1:1:1 garden soil + coco soil + ricehull	56.67 [c]
1:1:1:1 sand + sawdust + ricehull + alnus compost	49.00 [c]
1:1:1:1 garden soil + sawdust + alnus compost + sand	51.00 [c]

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

+ ricehull + alnus compost, garden soil + ricehull and garden soil + sawdust had the least number of roots with a mean of 49.00, 48.33 and 45.33 respectively.

The results revealed that a mixture of garden soil + coco soil + alnus compost promoted good germination of passion fruit seeds in terms of root number.

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

Percentage of Emergence

As presented in Table 6, there were no significant differences observed on the percentage of emergence as affected by the different growing media. The results showed that all the different growing media used favored the emergence of passion fruit seeds with 100% emergence. Based on the findings, all various media combinations could enhance good percentage of emergence of passion fruit seeds.

Table 6. Percentage of emergence

TREATMENT	MEAN
Garden soil (control)	100 [a]
1:1 garden soil + sawdust	100 [a]
1:1 garden soil + ricehull	100 [a]
1:1:1 alnus compost + sawdust + ricehull	100 [a]
1:1:1 sand + ricehull + coco soil	100 [a]
1:1:1 garden soil + coco soil + alnus compost	100 [a]
1:1:1 garden soil + ricehull + alnus compost	100 [a]
1:1:1 garden soil + coco soil + ricehull	100 [a]
1:1:1:1 sand + sawdust + ricehull + alnus compost	100 [a]
1:1:1:1 garden soil + sawdust + alnus compost + sand	100 [a]

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

Percentage of Normal Seedlings

With regards to the percentage of normal seedlings, there were significant differences that were observed as shown in Table 7. The results showed that seeds sown in garden soil + sawdust, garden soil + ricehull, alnus compost + sawdust + ricehull, garden soil + coco soil + alnus compost, garden soil + ricehull + alnus compost, sand + sawdust + ricehull + alnus compost and garden soil + sawdust + alnus compost + sand attained the 100% normal seedlings. This was followed by seeds sown in garden soil (control), sand + ricehull + coco soil and garden soil + coco soil + ricehull with a mean of 96.67% and 93.33% respectively.

The results revealed that all the media combinations with mixtures of ricehulls reduced the percentage of normal seedlings. Likewise, the same observations agree with the findings of Bisley (2008) that media mixed with ricehull affected the lowest percentage of normal seedlings of papaya.

Table 7. Percentage of normal seedlings

TREATMENT	MEAN
Garden soil (control)	96.67 [ab]
1:1 garden soil + sawdust	100.00 [a]
1:1 garden soil + ricehull	100.00 [a]
1:1:1 alnus compost + sawdust + ricehull	100.00 [a]
1:1:1 sand + ricehull + coco soil	96.67 [ab]
1:1:1 garden soil + coco soil + alnus compost	100.00 [a]
1:1:1 garden soil + ricehull + alnus compost	100.00 [a]
1:1:1 garden soil + coco soil + ricehull	93.33 [b]
1:1:1:1 sand + sawdust + ricehull + alnus compost	100.00 [a]
1:1:1:1 garden soil + sawdust + alnus compost + sand	100.00 [a]

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

Percentage of Abnormal Seedlings

Table 8 shows that there were significant differences observed among the media used in the study. Numerically, the results showed that seeds sown in garden soil + coco soil + ricehull had the highest percentage of abnormal seedlings. This was followed by the seeds sown in the garden soil (control) and sand + ricehull + coco soil with a mean of 3.33%

The result shows that seeds sown in all growing media mixed with ricehull attained higher percentage of abnormal seedlings which corroborated with the result of Bisley (2008) that media mixed with ricehull attained the highest percentage of abnormal seedlings of papaya.

Table 8. Percentage of abnormal seedlings

TREATMENT	MEAN
Garden soil (control)	3.33[ab]
1:1 garden soil + sawdust	0.00 [b]
1:1 garden soil + ricehull	0.00 [b]
1:1:1 alnus compost + sawdust + ricehull	0.00 [b]
1:1:1 sand + ricehull + coco soil	3.33[ab]
1:1:1 garden soil + coco soil + alnus compost	0.00 [b]
1:1:1 garden soil + ricehull + alnus compost	0.00 [b]
1:1:1 garden soil + coco soil + ricehull	6.67 [a]
1:1:1:1 sand + sawdust + ricehull + alnus compost	0.00 [b]
1:1:1:1 garden soil + sawdust + alnus compost + sand	0.00 [b]

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

Root Length

Table 9 reveals that significant differences were observed among the different treatments that were used in the study affecting root length 60 days from sowing. The results showed that seedlings from seeds sown in garden soil + coco soil + alnus compost had the longest roots with a mean of 20.68 cm followed by the seeds sown in garden soil + rice hull + compost alnus, garden soil (control) and garden soil + sawdust with a mean of 17.95 cm, 17.92 cm and 17.12 cm respectively. Moreover, seeds sown in garden soil + ricehull and alnus compost + sawdust + ricehull attained a mean of 15.92 and 15.27,respectively. As compared to the seeds sown in garden soil + coco soil + ricehull and sand + ricehull + coco soil with a mean of 14.92 cm and 14.10 cm respectively the seeds sown in sand + sawdust + ricehull + alnus compost had a mean of 11.02 cm. While the media used that induced the shortest root length with a mean of 10.27 cm was garden soil + sawdust + alnus compost + sand.

Table 9. Root length (cm)

TREATMENT	MEAN
Garden soil (control)	17.92 [a]
1:1 garden soil + sawdust	17.12 [ab]
1:1 garden soil + ricehull	15.92[abc]
1:1:1 alnus compost + sawdust + ricehull	15.27[abc]
1:1:1 sand + ricehull + coco soil	14.10[abc]
1:1:1 garden soil + coco soil + alnus compost	20.68 [a]
1:1:1 garden soil + ricehull + alnus compost	15.95 [a]
1:1:1 garden soil + coco soil + ricehull	14.92[abc]
1:1:1:1 sand + sawdust + ricehull + alnus compost	11.02 [bc]
1:1:1:1 garden soil + sawdust + alnus compost + sand	10.27 [c]

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

These results may imply that using alternative media such as garden soil + coco soil + alnus compost could be effective in the germination of passion fruit seeds and promote seedling growth in terms of root length.

These coincide with the findings of Ngalides (2009) that the media combination of garden soil + coco soil + alnus compost + ricehull could promote longer roots of avocado seeds.

<u>Shoot Length</u>

As shown in Table 10, there were significant differences observed among the media used in the study affecting shoot length 60 days from sowing. Statistically, the results showed that seeds sown in garden soil + coco soil + alnus compost obtained the highest mean of 5.87 cm a little bit higher compared to the seeds sown in garden soil + ricehull + alnus compost and sand + ricehull + coco soil with a mean of 5.15 and 5.03, respectively. This was followed by the seeds sown in garden soil (control) and garden soil + sawdust that attained a mean of 4.7 and 4.5 cm successively. Moreover, seeds

Table 10. Shoot length (cm)

TREATMENT	MEAN
Garden soil (control)	4.7 [b]
1:1 garden soil + sawdust	4.5 [bc]
1:1 garden soil + ricehull	3.7 [cd]
1:1:1 alnus compost + sawdust + ricehull	3.87 [cd]
1:1:1 sand + ricehull + coco soil	5.03 [b]
1:1:1 garden soil + coco soil + alnus compost	5.87 [a]
1:1:1 garden soil + ricehull + alnus compost	5.15 [ab]
1:1:1 garden soil + coco soil + ricehull	3.15 [d]
1:1:1:1 sand + sawdust + ricehull + alnus compost	3.08 [d]
1:1:1:1 garden soil + sawdust + alnus compost + sand	3.63 [d]

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

sown in alnus compost + sawdust + ricehull, garden soil + sawdust + alnus compost + sand, garden soil + coco soil + ricehull, sand + sawdust + ricehull + alnus compost and garden soil + rice hull had a mean of 3.87 cm, 3.63 cm, 3.15 cm, 3.08 and 3.7 cm respectively.

These results agree with the findings of Walang (2007) that a combination of garden soil + alnus compost and so with the addition of sand and coco soil will promote seed germination in terms of shoot length.

Seedling Vigor

Table 11 shows significant differences observed among the treatments used in the study affecting the seedling vigor of passion fruit seedlings. The results revealed that seeds sown in the garden soil (control), alnus compost + sawdust + ricehull, garden soil + coco soil + alnus compost and garden soil + ricehull + alnus compost promoted excellent growth of seedlings. This was followed by seeds sown in garden soil + ricehull,

Table 11. Seedling vigor

TREATMENT	MEAN
Garden soil (control)	1.00 [b]
1:1 garden soil + sawdust	2.33 [a]
1:1 garden soil + ricehull	2.67 [a]
1:1:1 alnus compost + sawdust + ricehull	1.00 [b]
1:1:1 sand + ricehull + coco soil	2.33 [a]
1:1:1 garden soil + coco soil + alnus compost	1.00 [b]
1:1:1 garden soil + ricehull + alnus compost	1.00 [b]
1:1:1 garden soil + coco soil + ricehull	2.67 [a]
1:1:1:1 sand + sawdust + ricehull + alnus compost	2.33 [a]
1:1:1:1 garden soil + sawdust + alnus compost + sand	2.67 [a]

Means with the same letter are not significant different at 5% level of DMRT
Rating: 1 – most vigorous, 2 – vigorous, 3 – less vigorous and 4 – poor

garden soil + coco soil + ricehull and garden soil + ricehull, garden soil + coco soil + ricehull and garden soil + sawdust + alnus compost + sand with a mean of 2.67 a little bit higher compared to the seeds sown in garden soil + sawdust, sand + ricehull + coco soil and sand + sawdust + ricehull + alnus compost with a mean of 2.33.

This result corroborates with the findings of Walang (2007) that a combination of garden soil, sawdust, sand with alnus compost will promote good seedling vigor of cacao.

Figure 1. Overview of the experimental area

Figure 2. Overview of the study 60 days from sowing of passion fruit seeds

Figure 3. Overview of the destructive samples for number and length of roots

Figure 4. Overview of the seedlings ready for transplanting 90 days from sowing seeds

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study was conducted at the Pomology project, Benguet State University from the month of November 2008 to February 2009 to determine the best growing media suitable for germination of passion fruit seeds and to find out the effects of the different growing media on the germination of passion fruit seeds.

Significant differences were not observed on the number of days to first appearance of leaves and root length. While significant differences were observed regarding the number of days to initial emergence, number of days to complete emergence, percentage of normal seedlings, percentage of abnormal seedlings and percentage of emergence. The results revealed that the media mixtures differed much in their effects on the passion fruit seed germination including seedling growth.

Highly significant differences were also observed on the number of roots, number of days to readiness for transplanting, shoot length and seedling vigor.

Passion fruit seeds sown in garden soil + sawdust + sand + ricehull + alnus compost had shorter days to initial emergence. The mixture of garden soil + sawdust + coco soil + ricehull effected the fastest days to complete the emergence of the seeds. Meanwhile, all media mixture enhanced shorter days to first appearance of leaves except for the mixture of alnus compost + sawdust + ricehull. The combination of garden soil + coco soil + alnus compost induced shorter days for the readiness of the seedlings for transplanting as well as the number of roots, root length and shoot length. Likewise, all the media mixture favored the complete emergence of passion fruit seeds. Furthermore,

combination of garden soil + sawdust + ricehull + alnus compost + coco soil + sand promoted the normality of passion fruit seedlings while garden soil + sand + ricehull + coco soil affected the normality of seedlings.

Lastly, garden soil + sawdust + ricehull + coco soil + alnus compost promoted vigorous passion fruit seedlings.

Conclusion

Based from all the results that was observed, the use of media combinations such as 1:1:1 garden soil + coco soil + alnus compost enhanced the production of more roots and promoted longer roots and shoot length. Likewise, using 1:1:1:1 garden soil + alnus compost + sawdust + ricehull + coco soil as an alternative media or an addition to the growing media could enhance the production of excellent and vigorous passion fruit seedlings. In some cases, ricehull had significantly affected on the growth of passion fruit seeds. It affected the normality of seedlings and seedling growth as well.

Recommendation

From the preceding results and discussions, the combination of garden soil + coco soil + alnus compost is recommended as a growing media to be used in germinating passion fruit seeds.

The above mentioned mixtures were likewise observed to have promoted or enhanced excellent and vigorous seedlings having more number of roots, longer root and shoot length as well as earlier appearance of leaves.

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APPENDICES

Appendix Table 1. Number of days to initial emergence

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
T_1	12	12	12	36	12.00 [b]
T_2	12	12	12	36	12.00 [b]
T_3	12	16	12	40	13.33 [b]
T_4	21	12	22	55	18.22 [a]
T_5	12	16	16	44	14.67[ab]
T_6	12	16	16	44	14.67[ab]
T_7	12	16	16	44	14.67[ab]
T_8	12	12	16	40	13.33 [b]
T_9	12	12	12	36	12.00 [b]
T_{10}	12	12	12	36	12.00 [b]

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F .05	.01
Replication	2	14.600	7.300			
Treatment	9	108.300	12.033	2.18ns	0.2913	0.0763
Error	18	99.400	5.522			
TOTAL	29	222.300	24.855			

ns – not significant coefficient of variation = 17.15%

Appendix Table 2. Number of days to complete emergence

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
T_1	35	21	66	122	40.67[ab]
T_2	23	23	23	69	23.00 [b]
T_3	24	35	59	118	39.30[ab]
T_4	66	36	36	138	46.00[ab]
T_5	24	24	58	106	35.33[ab]
T_6	24	24	60	108	36.00[ab]
T_7	62	58	59	179	59.67 [a]
T_8	27	24	24	75	25.00 [b]
T_9	32	30	30	92	30.67 [b]
T_{10}	28	34	62	124	41.33[ab]

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F .05	.01
Replication	2	1564.800	782.400			
Treatment	9	3034.300	337.144	1.99ns	0.2240	0.1020
Error	18	3047.200	169.288			
TOTAL	29	7646.300	1288.832			

ns – not significant

coefficient of variation = 34.51%

Appendix Table 3. Number of days to first appearance of leaves

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
T_1	25	26	24	75	25 [b]
T_2	25	25	25	75	25 [b]
T_3	25	25	25	75	25 [b]
T_4	28	25	28	81	27 [b]
T_5	25	25	25	75	25 [b]
T_6	25	25	25	75	25 [b]
T_7	25	25	25	75	25 [b]
T_8	25	25	25	75	25 [b]
T_9	25	25	25	75	25 [b]
T_{10}	25	25	25	75	25 [b]

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F .05	.01
Replication	2	0.200	0.100			
Treatment	9	10.800	1.200	2.77*	0.7962	0.0315
Error	18	7.800	0.433			
TOTAL	29	18.800	1.733			

* - significant coefficient of variation = 2.61%

Appendix Table 4. Number of days to readiness for transplanting

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
T_1	85	85	85	255	85.00 ^{c}
T_2	86	87	85	258	86.00^{bc}
T_3	89	90	89	268	89.33 ^{a}
T_4	87	85	86	258	86.00^{bc}
T_5	89	89	90	268	89.33 ^{a}
T_6	85	85	85	255	85.00 ^{c}
T_7	87	86	86	259	86.33 ^{b}
T_8	89	88	88	265	88.33 ^{a}
T_9	89	88	89	266	88.67 ^{a}
T_{10}	89	88	89	266	88.67 ^{a}

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F .05	.01
Replication	2	0.867	0.433			
Treatment	9	83.867	0.318	23.51**	0.3563	0.0001
Error	18	7.133	0.396			
TOTAL	29	91.867	10.147			

** - highly significant coefficient of variation = 0.72%

Appendix Table 5. Number of roots

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
T_1	105	105	65	275	91.67 [b]
T_2	45	36	55	136	45.33 [c]
T_3	42	55	48	145	48.33 [c]
T_4	60	80	38	178	59.33 [c]
T_5	55	41	54	150	50.00 [c]
T_6	155	145	125	425	141.67 [a]
T_7	81	95	96	272	90.67 [b]
T_8	38	61	71	170	56.67 [c]
T_9	53	47	47	147	49.00 [c]
T_{10}	48	47	58	153	51.00 [c]

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F .05	.01
Replication	2	151.667	75.833			
Treatment	9	25732.300	2859.144	14.86**	0.6799	0.0001
Error	18	3463.000	192.389			
TOTAL	29	29346.967	3127.366			

** - highly significant coefficient of variation = 20.29%

Appendix Table 6. Percentage of emergence

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
T_1	100	100	100	300	100[a]
T_2	100	100	100	300	100[a]
T_3	100	100	100	300	100[a]
T_4	100	100	100	300	100[a]
T_5	100	100	100	300	100[a]
T_6	100	100	100	300	100[a]
T_7	100	100	100	300	100[a]
T_8	100	100	100	300	100[a]
T_9	100	100	100	300	100[a]
T_{10}	100	100	100	300	100[a]

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F .05	.01
Replication	2					
Treatment	9					
Error	18					
TOTAL	29					

** - highly significant coefficient of variation = %

Appendix Table 7. Percentage of normal seedlings

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
T_1	90	100	100	290	96.67[ab]
T_2	100	100	100	300	100.00[a]
T_3	100	100	100	300	100.00[a]
T_4	100	100	100	300	100.00[a]
T_5	100	100	100	290	96.67[ab]
T_6	100	100	100	300	100.00[a]
T_7	100	100	100	300	100.00[a]
T_8	90	100	90	280	93.33[b]
T_9	100	100	100	300	100.00[a]
T_{10}	100	100	100	300	100.00[a]

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F .05	.01
Replication	2	6.667	3.333			
Treatment	9	146.667	16.296	1.52ns	0.7370	0.2156
Error	18	193.333	10.741			
TOTAL	29	346.667	30.37			

ns – not significant coefficient of variation = 3.32 %

Appendix Table 8. Percentage of abnormal seedlings

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
T_1	10	0	0	10	3.33[ab]
T_2	0	0	0	0	0.00 [b]
T_3	0	0	0	0	0.00 [b]
T_4	0	0	0	0	0.00 [b]
T_5	0	10	0	10	3.33[ab]
T_6	0	0	0	0	0.00 [b]
T_7	0	0	0	0	0.00 [b]
T_8	10	0	10	20	6.67 [a]
T_9	0	0	0	0	0.00 [b]
T_{10}	0	0	0	0	0.00 [b]

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F .05	.01
Replication	2	2.408	1.204			
Treatment	9	52.972	5.886	1.52ns	0.7370	0.2156
Error	18	69.828	3.879			
TOTAL	29	125.208	10.969			

ns - not significant coefficient of variation = 12.89%

Appendix Table 9. Root length (cm)

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
T_1	17.25	20.75	15.75	53.75	17.92 [a]
T_2	17.10	14.20	20.05	57.35	17.12 [ab]
T_3	16.75	15.45	15.55	47.75	15.92[abc]
T_4	9.90	16.80	19.10	45.80	15.27[abc]
T_5	15.35	16.75	10.20	42.30	14.10[abc]
T_6	23.15	17.95	20.95	62.05	20.68 [a]
T_7	24.20	15.25	14.40	53.85	17.95 [a]
T_8	10.75	18.95	15.05	44.75	14.92[abc]
T_9	10.45	10.75	11.85	33.05	11.02 [bc]
T_{10}	8.50	11.55	10.75	30.80	10.27 [c]

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F .05	.01
Replication	2	1.588	0.794			
Treatment	9	274.012	30.446	2.59*	0.9350	0.0410
Error	18	211.696	11.761			
TOTAL	29	487.296	43.001			

* - significant coefficient of variation = 22.10%

Appendix Table 10. Shoot length (cm)

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
T_1	5.15	4.25	4.70	14.10	4.70[b]
T_2	4.50	4.45	4.55	13.50	4.50[bc]
T_3	3.75	3.90	3.45	11.10	3.70[cd]
T_4	3.45	4.00	4.15	11.60	3.87[cd]
T_5	5.20	5.25	4.65	15.10	5.03[b]
T_6	5.65	6.40	5.55	17.60	5.87[a]
T_7	6.15	4.40	4.90	15.45	5.15[ab]
T_8	3.20	3.10	3.15	9.45	3.15[d]
T_9	2.55	3.55	3.15	9.25	3.08[d]
T_{10}	3.40	3.50	4.00	10.90	3.63[d]

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F .05	.01
Replication	2	0.30	0.015			
Treatment	9	23.099	2.567	12.31**	0.9305	0.0001
Error	18	3.753	0.209			
TOTAL	29	26.882	2.791			

** - highly significant coefficient of variation = 10.70%

Appendix Table 11. Seedling vigor

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
T_1	1	1	1	3	1.00 [b]
T_2	3	2	2	7	2.33 [a]
T_3	3	2	3	8	2.67 [a]
T_4	1	1	1	3	1.00 [b]
T_5	2	3	2	7	2.33 [a]
T_6	1	1	1	3	1.00 [b]
T_7	1	1	1	3	1.00 [b]
T_8	2	3	3	8	2.67 [a]
T_9	3	2	2	7	2.33 [a]
T_{10}	3	2	3	8	2.67 [a]

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F .05	.01
Replication	2	0.200	0.100			
Treatment	9	16.700	1.856	8.79**	0.6302	0.0001
Error	18	3.800	0.211			
TOTAL	29	20.700	2.167			

** - highly significant coefficient of variation = 24.18%