Selected RRIM 2000 Series Rubber Seed Clones Identification Through Physical Properties Using Statistical Analysis

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***Abstract*— The main objective of this research work is to recognize selected rubber seed series clones using physical properties based on mass, volume and density. There are five types of clones from the species Hevea brasiliensis of rubber seed have been used as samples in this project which are RRIM2007, RRIM2009, RRIM2012, RRIM2016 and RRIM2025. A weighing scale and graduated cylinder were used in order to differentiate the physical properties of each sample. The weighing scale is used to determine the mass of samples, while the water displacement technique is used to determine the volume of the sample. Another 150 samples are used for testing and the analysis is done using SPSS software to identify the clones correctly. From the observed one-way ANOVA and error plot measurement, three clone series are shown significantly different from each other in mass and volume classification but for density it is hardly differentiated the clones as the clone does not show a clear difference between each other. As a conclusion, RRIM2007, RRIM2012, RRIM2025 can be used in order to recognize mass and volume between clones while it is not recognized to differentiate sample clones using density properties.**

Keywords: Mass, Volume, Density, Rubber seed clones, ANOVA, SPSS.

I. INTRODUCTION

Rubber tree is an important plant in the world to supply the raw material for manufacturing. In order to increase the production from rubber trees, the seeds planted must be from the best quality of rubber tree. There are many differences of intensity of brown color and pattern on the seed's surface based on clone series. Previously the rubber seed's inspector can only look from the surface of seeds to decide the type of clones. However, these methods will consume time, percentage of accuracy and as well as cost in order to trained new worker or farmer with regards to the identification of rubber seed clones [1].

Previously the best rubber series clone was recognized based on shape and texture of the rubber series seeds through the image processing and wavelet technique that were introduced by the previous project student, Hajar Mohd Salleh and Erna Asmalina Bt Anua [2]. This project is different from the previous project, and this paper is the first introduced in recognizing of rubbers seed clone by using physical properties.

II. CLONAL CHARACTERISTIC

Figure below shows the types of clones that been used as samples to make an analysis on this project.

Figure 1(a): RRIM2007

RRIM2007: The seed is medium in size, smooth, shining and brownish seed coat. It has a square shape. Overall growth of the clone is average and seed production is good [4].

Figure 1(b): RRIM2009

RRIM2009: The seed is small in size, smooth and shining with light brownish seed coat. It has square to slightly rounded shape. Overall growth and seed production of this clone is good. This is the best type of clone and was recommended for both latex and timber production [3].

Figure 1(c): RRIM2012

RRIM2012: The size is small, smooth, shining with faint brownish seed coat. It has squar to slightly rectangular shape. Overall growth of the clone is good and seed production is good [4].

Figure 1(d): RRIM2016

RRIM2016: The seed features of this clone are most likely same with RRIM2009 but it has a square shaped of seed. Overall growth and seed production of the clone is very good. This clone was also recommended for latex and timber production [3].

Figure 1(e): RRIM2025

RRIM2025: The seed is large in size, rectangular, light brown and shining seed coat. The dorsal with brown striations is flat with less pronounced ridge. The ventral is flat lateral cheeks, slightly grooved and depressed posterior. Overall growth and seed production of the clone is good. The clone is recommended for both latex and timber production [2].

III. METHODOLOGY

The process of recognizing the rubber seed series clones can be simplified as below.

Figure 2: Methodology flowchart

A. Rubber seed samples

In this project, there are five types of rubber seed clones have been selected for recognition of its clone. These five clones are RRIM2007, RRIM2009, RRIM2012, RRIM2016 and RRIM2025. From these five types of rubber seed clones, there are 30 for each sample of data has been collected. All samples were collected at Rubber Research Institute of Malaysia (RRIM), Sungai Buloh and each data samples were tested under environment at the Advanced Signal Processing (ASP) Lab, Faculty of Electrical Engineering UiTM Shah Alam.

B. Mass data collection

Figure 3: Arrangement and seed positon during mass data collection

The mass of each samples rubber seeds were acquired by using a SF-400A Electronic Compact scale, which has maximum 500g loads with two decimal places accuracy. It has digital reading and four modes of units can be chosen such as grams(g), ounces(Oz), tael(tl) and carat(ct). For this research grams(g) unit is been used. Plastic blockers are used when a rubber seed is placed on the weighing scale. This procedure is important because to prevent any interference from the environment such as wind since the rubber seeds are very light in weight and the weighing scale is very sensitive due to any movement of load above it.

C. Volume data collection

The volume of each samples rubber seeds were acquired by using garduated cylinder. Volume is measured in "cubic" units. Since the rubber seeds have irregular shape, the water displacement was introduced through this research in order to get volume of each seed sample. To measure volume of an irregular shape it is easiest to use a graduated cylinder as it has volume measurements along the side. Fill it with enough water and record the initial measurement. Then add the object into the graduated cylinder that has been filled water and measure the final measurement. Subtract the measurement, to get the amount of water displaced. The volume of water displaced will gives the volume of the object.

Two graduated cylinder were used to take reading which is 100ml and 250ml graduated cylinder. When read a scale on the side of a graduated cylinder, it's important to consider for the meniscus in measurement. The eye must be in line with the center of the meniscus level.

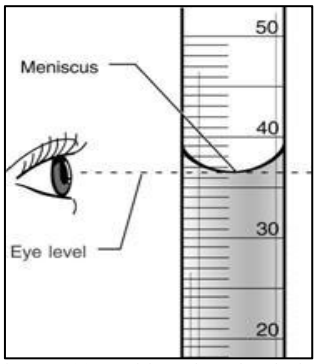

Figure 4 (a): Position of eye level after considering meniscus

Water displacement is the best method to measure volume of irregular shape. For this research one milliliter(1mL) of water will displaced a volume of 1 cubic centimeter (1cm3). The seeds must submerged into the water in oder to get their exact volume. But, the density of rubber seed is less than water and this will make the seeds floating at the surface of water. To overcome this problem, a load which has more density than water is attached above the rubber seed to make the seed fully sink. Before that take the volume of the load and substract it with the final reading to get the exact reading of the seeds.

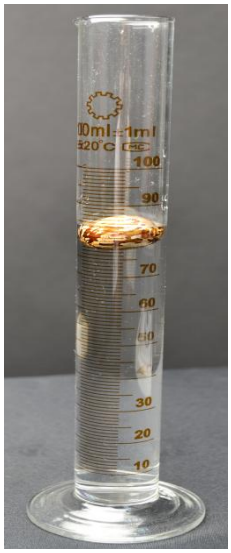
Figure 4(b): Seed floating at the surface


Figure 4(c): Seed sink with help a load

D. Density data collection

Density of each samples is acquired by calculate from the mass and the volume of the seeds. All data recorded during mass and volume data collection are used to find the density of the rubber seeds. The equation for density is given below:

$$\rho = \frac{m}{v}$$

Where,

ρ = *density* (g/cm^3)
m = *mass* (g)
v = *volume* (cm^3)

IV. RESULT AND DISCUSSION

SPSS software has been used to analysis on each data that has been recorded. As a result, two major tests which are one-way ANOVA and error plot are able to prove that:

A. One-way ANOVA

Critical value,α usually set as 0.05.

H_0 = There are no significant differences in mass between the rubber seeds clones' mean

H_1 = There is a significant difference in mass between the rubber seeds clones' mean

MASS

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	197.717	4	49.429	180.093	.000
Within Groups	39.797	145	.274		
Total	237.514	149			

TABLE 1(a): ANOVA TABLE FOR MASS

Table 1(a) shows there is a significant difference in mass between the types of clones for all rubber seed series, the null (H_0) hypothesis can be rejected and the alternative (H_1) hypothesis is accepted since the F_{MASS} (4, 145) = 180.093 and $F_{0.05}$ (4,145) = 2.43, which F_{MASS} (4, 145) > $F_{0.05}$ (4,145) . From the table also show that p-value < 0.05.

H_0 = There are no significant differences in volume between the rubber seeds clones' mean

H_1 = There is a significant difference in volume between the rubber seeds clones' mean

VOLUME

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	625.943	4	156.486	420.583	.000
Within Groups	53.950	145	.372		
Total	679.893	149			

TABLE 1(b): ANOVA TABLE FOR VOLUME

Table 1(b) shows there is a significant difference in volume between the types of clones for all rubber seed series, the null (H_0) hypothesis can be rejected and the alternative (H_1) hypothesis is accepted since the F_{VOLUME} (4, 145) = 420.583 and $F_{0.05}$ (4,145) = 2.43 which F_{VOLUME} (4, 145) > $F_{0.05}$ (4,145). From the table also show that p-value < 0.05.

H_0 = There are no significant differences in density between the rubber seeds clones' mean

H_1 = There is a significant difference in density between the rubber seeds clones' mean

DENSITY

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.042	4	.010	1.780	.136
Within Groups	.849	145	.006		
Total	.890	149			

TABLE 1(c): ANOVA TABLE FOR DENSITY

Table 1(c) shows there is a no significant difference in density between the types of clones for all rubber seed series, the null (H_0) hypothesis can be accepted and the alternative (H_1) hypothesis is rejected since the $F_{DENSITY}$ (4, 145) = 1.780 and $F_{0.05}$ (4,145) = 2.43 which $F_{DENSITY}$ (4, 145) < $F_{0.05}$ (4,145). From the table also show that p-value > 0.05.

B. Multiple Comparisons

Table 2(a) below showed the comparison between mean of mass and significant values for all series clones with each other. The result shows that RRIM2007, RRIM2012 and RRIM2025 have the entire mean significant below than 0.05. So, all the evidence is proved to assume only RRIM2009 and RRIM2016 are no significantly different between each other. Whereas others series clones are significantly different between each other.

TABLE 2(a): MULTIPLE COMPARISONS OF MASS

(I) CLONE	(J) CLONE	Mean Difference (I-J)	Std. Error	Sig.
RRIM 2007	RRIM 2009	1.33567*	.13527	.000
	RRIM 2012	.49033*	.13527	.004
	RRIM 2016	1.19333*	.13527	.000
	RRIM 2025	-1.84833*	.13527	.000
RRIM 2009	RRIM 2007	-1.33567*	.13527	.000
	RRIM 2012	-.84533*	.13527	.000
	RRIM 2016	-.14233	.13527	.830
	RRIM 2025	-3.18400*	.13527	.000
RRIM 2012	RRIM 2007	-.49033*	.13527	.004
	RRIM 2009	.84533*	.13527	.000
	RRIM 2016	.70300*	.13527	.000
	RRIM 2025	-2.33867*	.13527	.000
RRIM 2016	RRIM 2007	-1.19333*	.13527	.000
	RRIM 2009	.14233	.13527	.830
	RRIM 2012	-.70300*	.13527	.000
	RRIM 2025	-3.04167*	.13527	.000
RRIM 2025	RRIM 2007	1.84833*	.13527	.000
	RRIM 2009	3.18400*	.13527	.000
	RRIM 2012	2.33867*	.13527	.000
	RRIM 2016	3.04167*	.13527	.000

*. The mean difference is significant at the 0.05 level.

Table 2(b) below showed the comparison between mean of volume and significant values for all series clones with each other. The result shows that RRIM2007, RRIM2012 and RRIM2025 have the entire mean significant below than 0.05. So, all the evidence is proved to assume only RRIM2009 and RRIM2016 are no significantly different between each other. Whereas others series clones are significantly different between each other.

TABLE 2(b): MULTIPLE COMPARISONS OF VOLUME

(I) CLONE	(J) CLONE	Mean Difference (I-J)	Std. Error	Sig.
RRIM 2007	RRIM 2009	2.3833*	.1575	.000
	RRIM 2012	1.0667*	.1575	.000
	RRIM 2016	2.2833*	.1575	.000
	RRIM 2025	-3.1833*	.1575	.000
RRIM 2009	RRIM 2007	-2.3833*	.1575	.000
	RRIM 2012	-1.3167*	.1575	.000
	RRIM 2016	-.1000	.1575	.969
	RRIM 2025	-5.5667*	.1575	.000
RRIM 2012	RRIM 2007	-1.0667*	.1575	.000
	RRIM 2009	1.3167*	.1575	.000
	RRIM 2016	1.2167*	.1575	.000
	RRIM 2025	-4.2500*	.1575	.000
RRIM 2016	RRIM 2007	-2.2833*	.1575	.000
	RRIM 2009	.1000	.1575	.969
	RRIM 2012	-1.2167*	.1575	.000
	RRIM 2025	-5.4667*	.1575	.000
RRIM 2025	RRIM 2007	3.1833*	.1575	.000
	RRIM 2009	5.5667*	.1575	.000
	RRIM 2012	4.2500*	.1575	.000
	RRIM 2016	5.4667*	.1575	.000

*. The mean difference is significant at the 0.05 level.

Table 2(c) shows the comparison between mean of density and significant values for all series clones with each other. The result shows that none of the clones have the entire mean significant below than 0.05. So, all the evidence is proved to assume none of the clones are significantly different between each other.

TABLE 2(C): MULTIPLE COMPARISONS OF DENSITY

(I) CLONE	(J) CLONE	Mean Difference (I-J)	Std. Error	Sig.
RRIM 2007	RRIM 2009	-.018600	.019751	.880
	RRIM 2012	-.031833	.019751	.492
	RRIM 2016	-.040767	.019751	.241
	RRIM 2025	.000833	.019751	1.000
RRIM 2009	RRIM 2007	.018600	.019751	.880
	RRIM 2012	-.013233	.019751	.963
	RRIM 2016	-.022167	.019751	.795
	RRIM 2025	.019433	.019751	.862
RRIM 2012	RRIM 2007	.031833	.019751	.492
	RRIM 2009	.013233	.019751	.963
	RRIM 2016	-.008933	.019751	.991
	RRIM 2025	.032667	.019751	.466
RRIM 2016	RRIM 2007	.040767	.019751	.241
	RRIM 2009	.022167	.019751	.795
	RRIM 2012	.008933	.019751	.991
	RRIM 2025	.041600	.019751	.223
RRIM 2025	RRIM 2007	-.000833	.019751	1.000
	RRIM 2009	-.019433	.019751	.862
	RRIM 2012	-.032667	.019751	.466
	RRIM 2016	-.041600	.019751	.223

C. Error plots

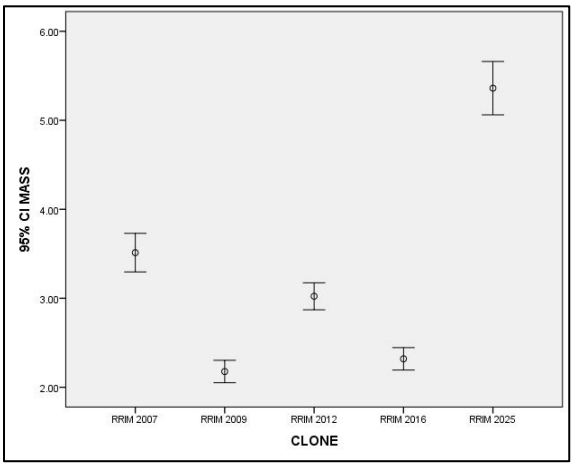

Figure 3(a): Error plot for mass comparison

Figure 3(a) shows the error plots based on the sample mass of rubber seeds. From observation, RRIM2009 and RRIM2016 show almost similar each other, so there is no significantly different between rubber seed series but it is significantly different with RRIM2007, RRIM2012 and RRIM2025 clone series. The author noted that the best recognize by using mass of seed only for RRIM2007, RRIM2012 and RRIM2025.

TABLE 3(A): DESCRIPTIVE STATISTICS OF MASS

MASS

	N	Mean	Minimum	Maximum
RRIM 2007	30	3.5127	1.97	4.18
RRIM 2009	30	2.1770	1.57	2.95
RRIM 2012	30	3.0223	1.71	3.64
RRIM 2016	30	2.3193	.97	2.80
RRIM 2025	30	5.3610	3.44	6.64
Total	150	3.2785	.97	6.64

Table 3(a) shows the Descriptive Statistics of mass due to minimum, maximum and mean value for all type of clone.

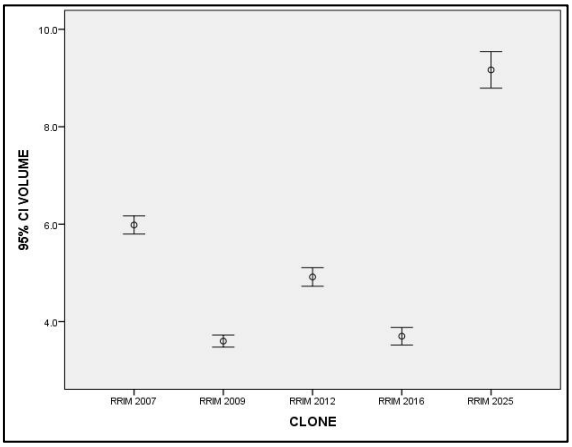

Figure 3(b): Error plot for volume comparison

Figure 3(b) shows the error plots based on the sample volume of rubber seeds. From observation, RRIM2009 and RRIM2016 show almost similar each other, so there is no significantly different between rubber seed series but it is significantly different with RRIM2007, RRIM2012 and RRIM2025 clone series. The author noted that the best recognize by using volume of seed only for RRIM2007, RRIM2012 and RRIM2025

TABLE 3(b): DESCRIPTIVE STATISTICS FOR VOLUME

VOLUME

	N	Mean	Minimum	Maximum
RRIM 2007	30	5.983	5.0	6.5
RRIM 2009	30	3.600	3.0	4.5
RRIM 2012	30	4.917	4.0	5.5
RRIM 2016	30	3.700	2.5	4.5
RRIM 2025	30	9.167	7.5	11.0
Total	150	5.473	2.5	11.0

Table 3(b) shows the Descriptive Statistics of volume due to minimum, maximum and mean value for all type of clone.

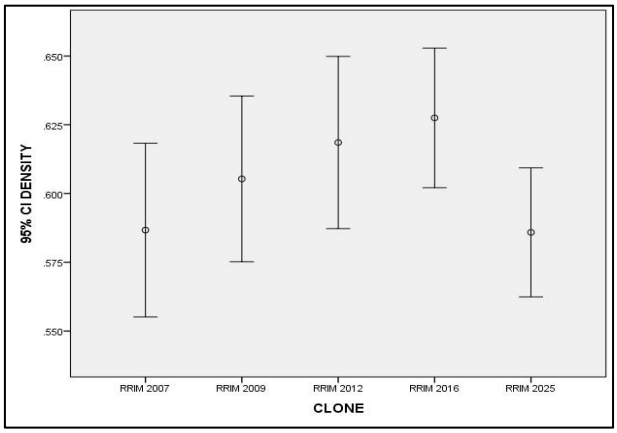

Figure 3(c): Error plot for density comparison

Figure 3(c) shows the error plots based on the sample density of rubber seeds. From observation, all series clone show almost similar each other, so there is no significantly different between rubber seed series. The author noted that it hardly to recognize seed series using denstiy comparison.

TABLE 3(c): DESCRIPTIVE STATISTICS FOR DENSITY

DENSITY

	N	Mean	Minimum	Maximum
RRIM 2007	30	.58673	.370	.724
RRIM 2009	30	.60533	.449	.757
RRIM 2012	30	.61857	.342	.725
RRIM 2016	30	.62750	.388	.730
RRIM 2025	30	.58590	.459	.688
Total	150	.60481	.342	.757

Table 3(c) shows the Descriptive Statistics of radius due to minimum, maximum and mean value for all type of clone.

V. CONCLUSION AND FUTURE RECOMMENDATION

A. Conclusion

This paper is mainly present a contibution in the field of physical properties of recognizing selected best series clones for rubber tree indusry. Physical properties like mass, volume and density are useful features use to discriminate between clones. The five clone series which are RRIM2007, RRIM2009, RRIM2012, RRIM2016 and RRIM2025 were tested to discriminate between each other. From the observation using one-way ANOVA and error plots, it can be concluded density property of rubber seed clone can not discriminate each type of clone series. As for mass and volume properties for RRIM2007, RRIM2012 and RRIM2025 are discriminate each other but for RRIM2009 and RR2016 clone is not discriminate each other. It can be concluded that for mass and volume the accuracy is still not high enaough in order to differentiate type of rubber seed clones while for density it is not recommended for discriminate each clones as the result for this method may not show a clear differences between each other.

B. Future recommendation

From the result obtained, the accuracy for mass and volume is not high enough in order to recognize different type of rubber tree seed clones. So, as a recommendation for future analysis, it is recommended that more types of rubber seed clones can be use as sample. To date, there are 33 clones under the RRIM2000 series rubber clone[5]. Other parameters also should be used in order to increase the accuracy

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