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Effect of Spreader Drone Heights towards Granules Distribution

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ABSTRACT

In current years, drone technology has been vigorous in the industry. For example, in agriculture, the drone was involved, such as precision agriculture monitoring, soil, field analysis, planting crops, crop monitoring, etc. Therefore, this paper aims to evaluate the performance container toward granule distribution via a spreader drone. The objective is to measure the container's capacity and efficiency that use as a medium to distribute the granules. In this study, two different granule size-types were prepared to research by utilizing the grid system area as big as 80 inches x 120 inches. This grid system was set in nine (9) plots in the same regions for study observation. Plus, two types of height have been used, which is 1.2 meter and 2.0 meter. From the result, the capability of the container distributor was achieved by granules distributed uniformly. The findings have been derived from experimental, the all granules type has shown a fair distribution, especially at 2.0 meter and has covered more than 88% at all area observation.

Keywords: Drone, Granule, Unmanned Aerial Vehicle (UAV).

1. INTRODUCTION

Unmanned Aerial Vehicle (UAV), technically known as a drone, is a flying machine without a human pilot. It has become more popular because of its adaptability and the simplicity of making a trip to places that are inaccessible to humans. This drone can be controlled or monitored from the ground by pilots without the need to drive it [1]. There are many ways to classify drones, such as size, design, and function according to the needs and application used. This UAV is also available with an autopilot by applying the Geographic Positioning System (GPS). Drones are used in a large number of areas. Furthermore, when it comes to their possibilities, there is no limit. As a result, the application areas are vast today, and drones are growing worldwide. In particular micro-drones have been widely used lately due to their small size. It is widely used for engineering, construction and pre-construction work, military, governmental, civilian and commercial purposes, and is widely used by consumers, also known as hobbyists [2].

In this modern area, agriculture should provide the right technology and good improvement [3] because agriculture is a crucial food source for human beings living on earth. One of the farming

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tools used by drones offers relief for modern-day farmers. Drones are explicitly applied to agriculture in the agricultural system to boost crop production and track crop growth. By using the most advanced in the production or advancement of sensors and digital imaging technologies, farmers would be able to use drones to get a lot of insight into their fields. Thus, the knowledge obtained from the facility also proves useful in growing crop yield and farm production. Farmers may use and control drones to capture aerial-view photographs of their fields. There are three distinct ways of seeing farmers by drones. The first and foremost is by looking at the crops from a bird's eye view; this particular view will reveal several things, such as irrigation issues, soil variation, and the pest and fungal infestations are the most relevant [4].

The second view is well-recognized and well-known as multispectral images, where these images are used to display an infrared view and a visual range. When these viewpoints are consolidated, the farmer will be prepared to see the distinctions between safe and unwholesome crops. This distinction is not apparent to the naked eye; therefore, by having the ability to see products from these perspectives will enable farmers to monitor crop growth and crop production. Moreover, drones can be used as crops monitoring for farmers from time to time, whenever they want to. Apart from that, the farmer would also be able to use this information to display the variations in crops over time, thereby showing where 'trouble spots' might be located. It demonstrates the advantage of using drones by distinguishing between these trouble spots, that farmers can enhance and enhance crop management, and increase overall crop production [4].

1.1 Research Motivation

The inspiration of the present design of the granule drone was the spraying drone. These types of drones are the first to construct the useful for the seed and fertilizer sowing purposes. Agronomists are currently using drones for pesticide spray sprinkles, and drones can hold around 15 liters of pesticide at one time and cover a pervasive area in a time. This makes easy for farmers to handle the drone and on the field in predefined examples to cover the most intense territory with a pesticide, which ends up being a fast and productive way to shower pesticides. In India, individual farms are small, and drones are useless due to the price. So, they think it's easier to get services from organizations than to purchase. Plus, there are large companies that are competent and have an excellent income to operate this service. A gathering of farmers may get the benefits from these organizations and spray them in their region. At that point, we started to build up our underlying thinking and inquired about the long-term changes that are currently being made as an agribusiness robot.

2. METHODOLOGY

Conceptual design is a process in which many prototypes of drones and containers are created for the granule container. These concepts are then evaluated, and the best idea that appears to be important is chosen. The modeling of the granule container, as shown in Figure 1 was performed using the SolidWork software. This concept design uses an acrylic plate and three tubes. The acrylic diameter is 120 mm, and the tube height for the granule place is 125 mm. Besides, the components used in this product are DC brushless motors and distributor. In this fabrication, the pipe tubes is used to hold the granules before the spreader distributor was funtions. Apart from that, the drone with a low speed movement of 16 m/s and DC motor which turn the spreader distributor would push out all granules from the granule container.

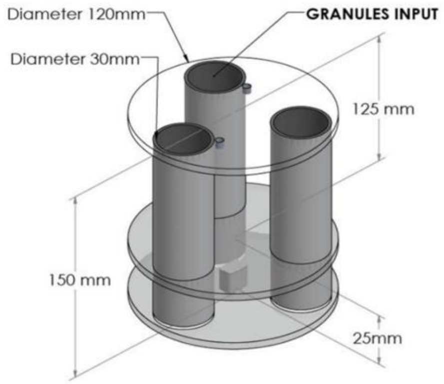


Figure 1. Granule container.

2.1 Granule

In this project, the different size of the material was used to test the new design of granule container distributor. Two different sizes of the granule were used to identify the distribution of the materials. Technically, the various sizes and weights of the material will have an effect on the distance distribution. The details of the materials were started below:

Granule A: 4 mm Granule B: 5 mm

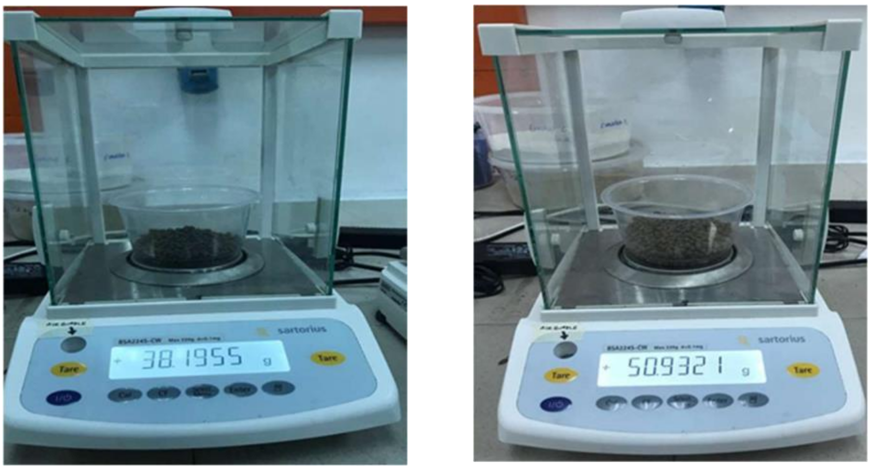
Figure 2. Type of granule A and granule B.

2.1.1 Physical Size of Granule Used

The granule chosen in this study consisted of different granule sizes, the granule type A was 4 mm, and the granule type B was 5 mm. The granule size was not significantly further; the granule weight of granule type A was 0.0291g and granule type B was 0.0412g. These two factors have greatly affected the space in the granule tube of the granule container and the granules distribution. Another aspect is that the pore conditions of granule A were very similar to each other and indicated a smooth distribution of granules when it was in action. When looking at granule B, the size is larger than granule A. This physical granule and pore space were very large. Therefore, when the distribution process has been carried out the type of granule A is less slippery. However, the type B granule causes the blade to be trapped on the vessel pipe.

(x) (y)

Figure 3. Granule weight used in the present study; granules A – 0.0291g and (b) granules B – 0.0412g.



(x) (y)

Figure 4. Total granule weight used for the granule's distribution; (a) granules A – 38.1955g and (b) granules B – 50.9321g.

2.1.2 Drone and Container for Granules Distributor

Below is the drone, along with the granule distributor conrainer. At the bottom of the drone, the landing gear is fixed to the base. The purpose of this frame is to hold the container using the bolt and nut. The ideas for the formation of a granule container is challenging and strategic. The container has to be neat, long-lasting, and straightforward so that the container is well position and smoothly processed. There are three-hole pipes in the granule bottle, as shown in Figure 1 and Figure 5. It's a place to bring all the granule in. The arcylic plate, as at the bottom of the jar, was rotated and the granules were distributed across the grid systems. The process to deliver the granules was started when the drone was in the desired position (centre axis) and at the selected height. By using the DC motor, the granule container was in place and the hole at the bottom of the pipe (spreader distributor) was rotated.

The parameter of 2032 mm × 304 mm (one plots) was covering nine plots and the grid diagram area as shown in Figure 6 have been selected to assess the efficacy of the granule distribution. The grid systems were mounted on the ground using a raphia string labelled A1, A2, A3, B1, B2, B3, C1, C2 and C3. The granules were therefore measured only in this area. Due to this result, the output of the container at the selected height will be calculated. After the drone and container containing granules (Type A and Type B) were fully assembled, the drone was positioned at point B2 as the centre point for this study. The drone had started to fly, and the granule distributor would be able to turn on. The operator controlled the drone and began to distribute all the granules until the end. All types of granules with selected heights have been monitor, so the same process could be repeated.

Figure 5. Drone along with container granules distributor.

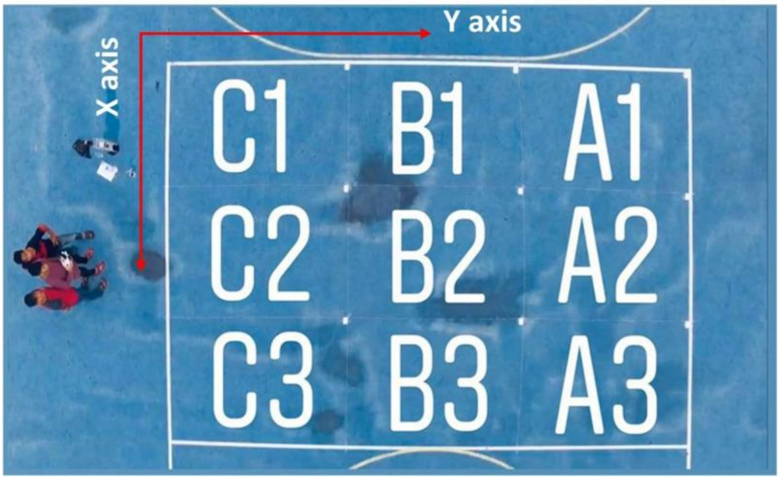


Figure 6. Actual of grid system area.

3. RESULTS AND DISCUSSION

The data involved in this study are discussed in this section. The findings were obtained from the experiment work that was carried out. The granule is selected as the reference material for deciding the distribution's outcome and the height chosen is 1.2 m and 2.0 m. Parameter was selected to measure the efficiency of granule distribution in deliver the granule and to justify the output and strength of the container distributor being worked. All results were shown in Table 1 was presented in the graph as shown in Figure 7 to the Figure 12.

Table 1 The results of granulars distributed

Type	Grid System Area	1.2 Meter Height	2.0 Meter Height
Granule A (GA)	A1	50	146
	A2	64	115
	A3	16	102
	B1	29	164
	B2	100	125
	B3	44	208
	C1	110	138
	C2	106	165
	C3	16	114
Granule B (GB)	A1	107	92
	A2	96	115
	A3	107	110
	B1	119	141
	B2	201	216
	B3	107	100
	C1	97	102
	C2	147	173
	C3	108	93

3.1 Horizontal Granules Distribution

Figures 7, Figure 8 and Figure 9 shows the horizontal distribution of granules at the coordinates A1, A2, A3, B1, B2, B3, C1, C2 and C3. At the first stage, the granules were set as GA (1.2 m), GA (2.0 m), GB (1.2 m), GB (2.0 m) and for the Granule A(GA) in Figure 8 below the graph ha shows the horizontal distribution of granules at coordinates B1, B2 and B3. Moreover, in same figure (Figure 8) GB (2.0 m) the grid at B1 and B2 rose sharply, but unexpected to the grid at B3 was declined. At the same time, the graph in the Figure 9 at GA (1.2 m) shows a sharp decrease at the grid of C3. Moreover, Figure 8 reveals that GB (2.0 meter) at coordinate B2 has the highest number of granules, which is 216, while GA (1.2 meters) has the lowest number of granules at coordinate C3, which is 16. The GB (2.0 meter) at the grid of B2 has the highest number of granules due to the soft wind movement that made the drone moving closer to the grid of B2. In addition, the GA (1.2 metre) at the C3 grid has the lowest number of granules. This granule distribution in this area is caused of soft wind movements too. The drones just move out to the C3 grid were the centre axis of the grid is in B2, thus, fewer granules are distributed at the C3 coordinate.

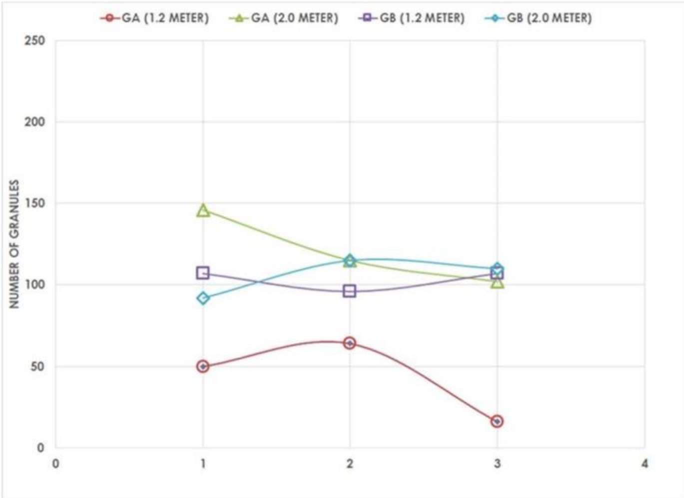


Figure 7. Types of granules at coordinates A1, A2 and A3.

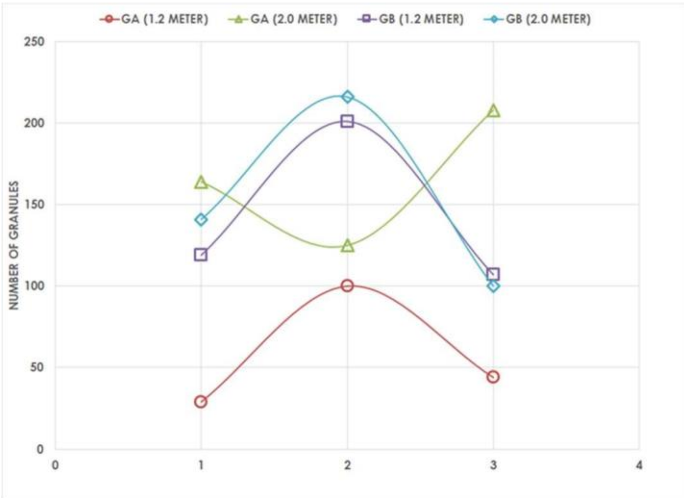


Figure 8. Types of granules at coordinates B1, B2 and B3.

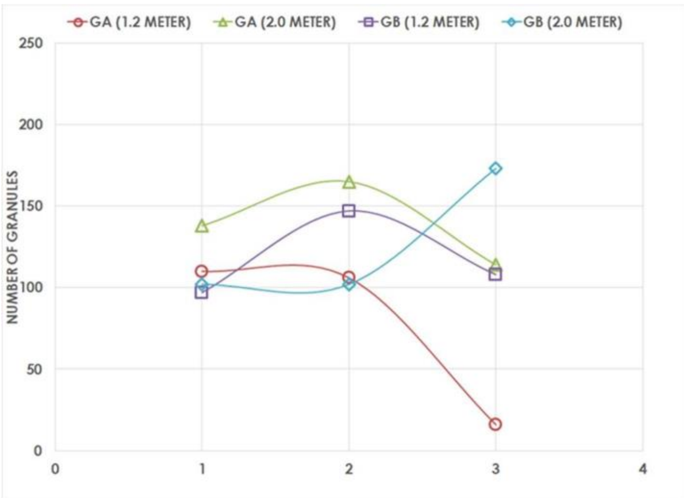


Figure 9. Types of granules at coordinates C1, C2 and C3.

3.2 Vertical Granules Distribution

Figure 10, Figure 11 and Figure 12 below display the granules' vertical distribution at the coordinates A1, A2, A3, B1, B2, B3, C1, C2 and C3. First, GA (1.2 m), GA (2.0 m), GB (1.2 m), GB (2.0m) are indicated ass Granule A and B at a height of 1.2m and 2.0m, respectively. Next the vertical distribution of granules at the grid of A2, B2 and C2 was shown in Figure 6 and Figure 11. Below. It was shown that at GB (2.0 m) the coordinates A2 and B2 rose sharply, but unexpectedly the coordinates C2 declined. Although Figure 4.12 illustrated, the GA (1.2 m) rise up from the A3 and B3 grids and then fall to the C3 grids. Moreover, Figure 12 indicates that GB (2.0 meter) at coordinate B2 has the highest number of granules of 216, while GA (1.2 meter) has the lowest number of granules of 16 at grid of A3. As in Figure 11 the GB (2.0 m) at coordinate B2 has the highest number of granules due the effect of the wind blow that made the drone travel closer to the coordinate B2. Thus, the distribution at coordinate B2 is the highest number of granules. Besides, for GA (1.2 m) at the A3 grid has the lowest number of granules which distributed in that area. This condition was occurred due to the strong wind carry the drones far from the center axis to the A3 grid; thus, fewer granules are distributed in that area.

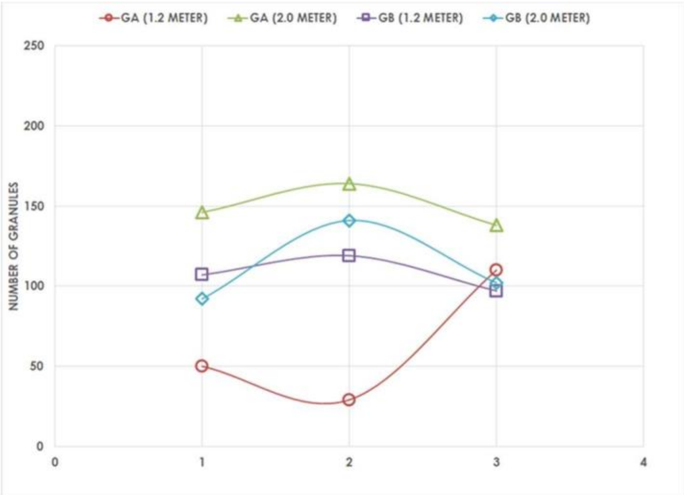


Figure 10. Types of granules at coordinates A1, B1 and C1.

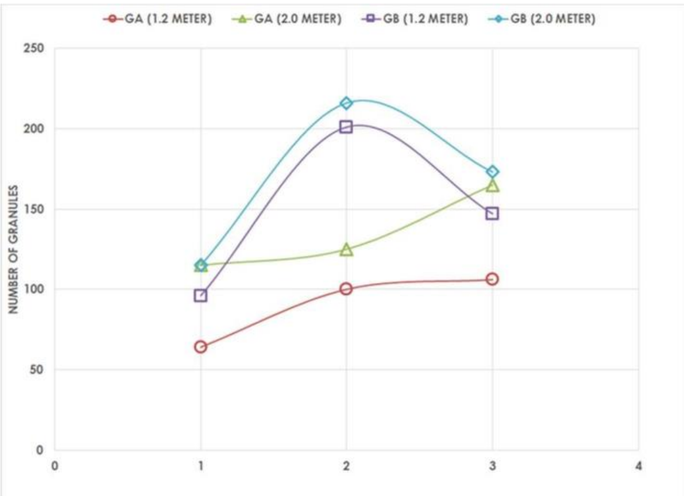


Figure 11. Types of granules at coordinates A2, B2 and C2.

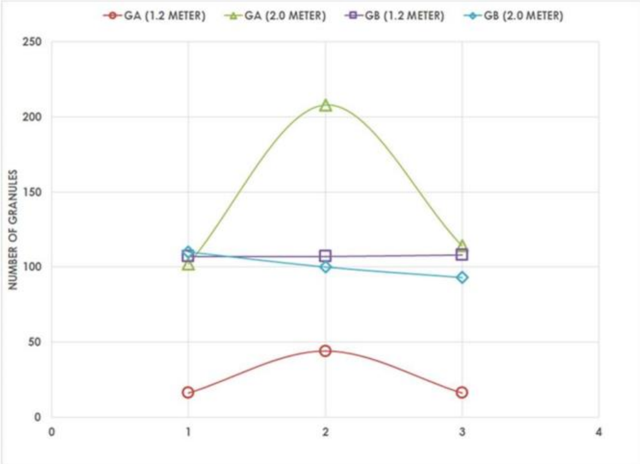


Figure 12. Types of granules at coordinates A3, B3 and C3.

3.3 Summary of Granules Type A

The height of the spreader container was set at 1.2 m and 2 m from the gorund, and each pipe tube has 125 mm height. The design or the weight of the granule container is depending on the drone rotor's power and the size of the drone itself. The drone and the container loaded with granules cannot be raised more than drone and container weight ratio must low or equal of 1/1 and 1/2. The weight for granule A + cotainer is 38.1955 (three tubes cylinder granule). The small drone only has the ability to lift up the both items not more than the ratio of 1/3 at 38.1955 g. The calculation of the granules for a weight of 38.1955 g. is equal to 1313 granules. The data collected from the grid system comprises more than 535 granules at the height of 1.2 m and 1277 granules at the height of 2 m. Both granules values of 535 granules and 1277 granules are described in percentages to the total of granule weight, each would benefit 40.75 per cent at 1.2 m height and 97.12 per cent at 2 m height. The results of this experiment showed that the percentages of both granules were inside the grid system and the remaining percentages of granules remained outside the grid. It shows that the distribution of granules from the container spreader is working well and the granule has been continuously distributed across all grid system. The results of the distribution can be seen in the Figure 8 to 12. Below is the example of the weight to the type A granules ratio as shown in the Table 2. As for the dron (DJI Phantom 3) weights is 1.2 kg. To fabricate the spreader container, the weight must be half of the drone's weight, which is 600 g. During the preparation the total container granule weight and the granule type A is 538 g.

Table 2 Estimation on granules A weight

Ratio	Weight (gram)
1/3	38 gram
1/2	57 gram
1/1	114 gram

3.4 Summary of Granules Type B

The height of the spreader container was 2.0 m from the ground. The weight for granule type B is 50,9321 g. The ability of the drone to lift up when the weight for the granules was 1/3 from the drone weight. A total of 50,9321 g is the cumulative weight from the three pipe tubes. From the calculation of the granules for a weight of 50,9321 g is equivalent to 1236 granules. The data obtained using the grid system consists of more than 1089 granules at a height of 1.2 m and 1151 granules at a height of 2 m. Then, if both granule values of 1089 granules and 1151 granules are converted into percentages, 88.11 per cent will gain by 1.2 m in height and 93.12 per cent by 2 m in height. It means that the percentages of both granules were within the grid structure, It means that the percentages of both granules were inside the grid system while the remaining percentages of granules were outside the grid system. It has shown that the distribution of the container spreader is working very well same as the condition on granule type A. The results of the distribution are shown in the Table 3. Below is the weight ratio of type B granules; next, DJI Phantom 3 Norm's total weight is 1.2 kg. To invent a container, the weight must be half the drone's weight, which is 600. The weight of the container after weighing is 500, and after the addition of 50, for type B granules, the weight of the container containing the granules was 550, respectively. In conclusion, the drone limit was reached to lift the container containing granules.

Table 3 Estimation on granules B weight

Ratio	Weight (gram)
1/3	50 gram
1/2	75 gram
1/1	150 gram

3.5 FACTORS THAT AFFECTING THE GRANULE DISTRIBUTOR

In this section, the discussion is more to the problems arose during the experiment. For example, the material clogged in the pipe tubes and would not fall during the spinning blade because the granule was light, small in size and the surface of the granule was too rough. Therefore, the granule did not come out of the granule distributor. Due on this matter, the area was not filled by the granule. This may cause the container be insufficient for a specific form of granules. Overall, the container design could cover the entire region with an adequate granule quantity, and the unit was powerful and substantial. The next issues are to control the drones in selected place. During the drone was in selected height, the wind intrusion was blow away the granule from the potential grid. However, some interesting happens when the wind intusion occured, the experiment is still running smoothly. In addition, the condition of the weather, the pellet stuck to the blade during the delivery process, and the drone's size is among the focal factors. Unpredictable weather conditions cause the delivery process to be disrupted, it would make the drone maneuvers challenging to control. Another issues on the granules motion that the granules will fall as the rotation of the blade occurs. These issues were occurred on both types of granules where the granules were stuck at the blade just after the granule want come out.

4. CONCLUSIONS

The main focused on this study is to fabricate and improve a spreader drone granule distributor and define the efficiency of the new model has been achieved. The study's key was to provide farmers with a new design which consider on light weight, small size, and easy to operate the agricultural technology equipment. Some parameters were selected to determine the granule distribution container's performance and how strength the granule container. Due on this matter, the new model performance would be identified on the time and granule distance. There were some issues that may have influenced the distribution of the granule during the experimental work indirectly, it would impact the results. Overall, the spreader drone granule distributor's invention was intended to become useful agricultural tools for the farmer. It could be inferred that the project was successful.

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