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Some Physical Properties of Paddy Seeds and Fertilizer

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A B S T R A C T

Knowledge on physical properties of seeds is one of the most important parameter before designing of agricultural machines or any other equipment. The variety of paddy seeds taken for the study was Karma Mahsuri and shape was cylindrical while variety of fertilizer taken for study was DAP granules and shape was round. The research work was carried out in the laboratory at the Department of Farm Machinery and Power, SVCAET&RS, IGKV, Raipur. The main aim of the study was to determine the physical properties of paddy seeds and fertilizer (DAP granules) which will be beneficial for designing of sowing related machines like Paddy drum seeders, seed drills and seed cum fertilizer drills. Test Parameters taken for the study were geometric dimensions of Paddy seeds and DAP granules i.e. Average length (L), width (W) and thickness (T), Geometric mean diameter (D_p), Sphericity (ϕ), Mass and Bulk density. The results showed that the average length, width and thickness of paddy seeds varied from 8.61 to 11.29 mm, 2.55 to 3.03 mm and 2.08 to 2.50 mm respectively while DAP granules varied from 5.43 to 6.39 mm, 4.74 to 5.29 mm and 3.10 to 3.30 mm respectively. The bulk density by Mohsenin method for paddy seed was observed as 603 kg/m^3 whereas the average weight of 1000 paddy seeds sample was measured as 35 gm. The Geometric mean diameter (D_p) by Mohsenin method and Sphericity by Sahay and Singh method for paddy was 3.90 mm and 0.41 while for DAP granules it was 4.57 mm and 0.76 respectively.

Introduction

Agriculture is the backbone of most economies in India and quality seed is the fuel for agricultural development. Rice (*Oryzae sativa*) belongs to the grass family Oryzeae, and is one of the leading food crops in the world. As, it is an important source of energy it is considered to be the second most highly-consumed food source on the planet earth (Anonymous, 2011).

India is the second largest producer after china with the production of 264.77 million tonnes with the productivity of 2415.8 kg/ha in 2013-14. (Source: Directorate of Economics and Statistics, Department of Agriculture and Cooperation). Rice being the main source of

livelihood for more than 120-150 million rural household is the backbone of the India Agriculture. It occupies about 23.3 per cent of the food grain production and 55 per cent of cereal production. The rice plays a vital role in the national food security (Anonymous, 2013).

Chhattisgarh popularly known as "Rice bowl of India" occupies an area of around 47.85 lakh hectares with the production of 6717 and 759.3 metric tones in *kharif* and *rabi* season with the productivity of 1983 kg per hectare of rice during the year 2013-14. (Source: Directorate of Economics and Statistics, Department of Agriculture, Chhattisgarh) (FAOSTATS, 2001).

The first experiments with 'fertilizer' started in the 17th century. The first phosphate fertilizers were ground bones treated with sulphuric acid. The first superphosphate production was started in 1842. Ammonium phosphate fertilizers first became available in the 1960s, and DAP rapidly became the most popular in this class of products.

Di-Ammonium Phosphate (DAP) is the world's most widely used Phosphorus fertilizer. It is made from two common constituents in the fertilizer industry – Nitrogen (N) and Phosphorus (P).

It is the most popular phosphatic fertiliser because of its high analysis and good physical properties. The composition of DAP is N-18% and P_2O_5 -46% [FAOSTATS, 2010].

In, Chhattisgarh state, there are many varieties of paddy seeds which are developed in Indira Gandhi Agricultural University, Raipur and some of common varieties are like Mahamaya, Poornima, Danteshwari, Bambleshwari and Karma Mahsuri among which we have taken Karma Mahsuri seeds for study because it can be grown in all regions of Chhattisgarh state.

Similarly, DAP are most common fertilizer used in rice cultivation. It is relatively high in nutrient content and its excellent physical properties make it a popular choice in farming and other industries. So, keeping all the above facts and points an attempt have been made to study on some of the physical properties of paddy seeds and fertilizer so, that it will be somehow useful for manufacturers, researchers while designing of sowing related machines such as paddy drum seeders (Mahilang, 2015).

Materials and Methods

Geometric dimensions of paddy seeds and fertilizer (DAP granules)

Geometric dimensions of paddy seeds and DAP granules are determined by length, width and thickness.10 randomly selected paddy seeds and fertilizer (DAP granules) were measured by using the measuring scale and digital Vernier caliper.

Average length (L), width (W) and thickness (T)

Average length (L), width (W) and thickness (T) is calculated as followed (Mohsenin, 1986).

$$L = \frac{\sum_{i=1}^{n} L}{n} \quad \dots (2.1)$$

$$W = \frac{\sum_{i=1}^{n} W}{n} \quad \dots (2.2)$$

$$T = \frac{\sum_{i=1}^{n} T}{n} \quad \dots (2.3)$$

Where,

L = largest intercept (length), mm;
W= width, mm; and
T = Thickness, mm.

Geometric mean diameter (Dp)

The geometric mean diameter (Dp) was calculated by using the following relationship (Mohsenin, 1986).

$$D_P = (LWT)^{\frac{1}{3}} \quad ...(2.4)$$

Where,

L = largest intercept (length), mm;
W= width, mm; and
T = Thickness, mm.

Sphericity (ϕ)

Sphericity defines the ratio of the diameter of a sphere of the same volume as that of the particle and the diameter of the smallest circumscribing sphere or generally the largest diameter of the particle (Sahay and Singh, 1994). This parameter shows the shape character of paddy seeds relative to the sphere having the same volume.

Sphericity

$$= \sqrt{\frac{\text{Volume of particles}}{\text{Volume of circumdsribed Sphere}}}$$

$$= \frac{(LWT)^{1/3}}{L} \quad ... (2.5)$$

Where,

L = largest intercept (length), mm;
W= width, mm; and
T = Thickness, mm.

Mass of paddy seeds and fertilizer (DAP granules)

To Obtained the mass, 1000 randomly selected paddy seeds and fertilizer (DAP granules) were counted and weighed by using electronic balance with a least count up to 0.001g. The average weight of 1 seeds

was.037g whereas the average weight of fertilizer (DAP granules) was 0.035g.

Bulk density of paddy seeds

Bulk density of paddy seeds was calculated by placing the sample of paddy seeds in a cylinder which has 7 cm of diameter and 9.6 cm of length. The sample placed in the cylinder is then weighed by using electronic balance with least count of 1g. Bulk density was calculated by using the relationship (Mohsenin, 1986).

$$b_d = \frac{W_t}{L \times \left(\frac{\pi d^2}{4}\right)} \quad ...(2.6)$$

Where,

b_d = Bulk density, kg/m^3;
W_t = Weight of sample, kg;
L = Length of cylinder, m; and
d = Diameter of cylinder.

Results and Discussion

Physical characteristics of paddy seeds and fertilizer (DAP Granules)

Size and unit mass of paddy seeds

The variety of paddy seeds taken for the study was Karma Mahsuri and shape was cylindrical. Table 1 shows the size and unit mass distribution of paddy seed.

The length was found to be in range of 8.61 to 11.29 mm with the average length of 9.50 mm. The SD and coefficient of variance was calculated to be 0.729 cm and 7.673 per cent respectively. Similarly width varies from 2.55 to 3.03 mm with average width of 2.82 mm. The SD and coefficient of variance was calculated to be 0.143 cm and 5.070 per cent respectively. The thickness varies between 2.08 to 2.50 mm with average thickness of

2.22 mm. The SD and coefficient of variance was calculated to be 0.133 cm and 5.990 per cent respectively.

The geometric mean diameter and sphericity of paddy seeds were found to be 3.90 and 0.41 on average of 10 paddy seeds. The SD of geometric mean diameter and sphericity was found to be 0.029 cm and 0.004 percent respectively. The coefficient of Variance for geometric mean diameter and sphericity was observed to be 0.743 and 0.975 percent respectively.

Size and unit mass of fertilizer (DAP granules)

The fertilizer taken for this study was DAP granules because it is commonly used by the farmers at the time of line sowing. The shape of DAP was round. Table 2 shows the size and unit mass distribution of fertilizer.

The length was found to be in range of 5.43 to 6.39 mm with the average length of 5.99 mm.

The SD and coefficient of variance was calculated to be 0.338 cm and 5.642 per cent respectively. Similarly width varies from 4.74 to 5.29 mm with average width of 5.03 mm. The SD and coefficient of variance was calculated to be 0.212 cm and 4.212 per cent respectively.

The thickness varies between 3.10 to 3.30 mm with average thickness of 3.19 mm. The SD and coefficient of variance was calculated to be 0.075 cm and 2.35 per cent respectively.

Fig.1 Measurement of dimensions of paddy seeds and DAP granules using digital vernier caliper

Fig.2 1000 samples of fertilizer (DAP granules) and paddy seeds

Fig.3 Measurement of mass of 1000 samples of paddy seeds and fertilizer
(DAP) by electronics balance

Table.1 Geometric properties of selected paddy seeds

S. No.	Length, mm	Width, mm	Thickness, mm	Geometric mean dia, mm	Sphericity	Weight of 1000 seeds, g
1.	9.30	2.92	2.22	3.92	0.42	37
2.	11.29	2.85	2.36	4.24	0.37	
3.	9.57	3.03	2.30	4.05	0.42	
4.	9.25	2.79	2.22	3.85	0.41	
5.	8.61	2.83	2.11	3.71	0.43	
6.	9.69	2.75	2.08	3.81	0.39	
7.	8.72	2.80	2.10	3.72	0.42	
8.	9.67	2.73	2.12	3.82	0.39	
9.	9.53	2.55	2.25	3.79	0.39	
10.	9.37	3.03	2.50	4.14	0.44	
Avg	**9.50**	**2.82**	**2.22**	**3.90**	**0.41**	
Range	**8.61 - 11.29**	**2.55 - 3.03**	**2.08 - 2.50**	**3.71 – 4.24**	**0.37 – 0.44**	
SD	0.729	0.143	0.133	0.029	0.004	
CV	7.673	5.070	5.990	0.743	0.975	

Table.2 Geometric properties of selected fertilizer (DAP granules)

S. No.	Length, Mm	Width, mm	Thickness, mm	Geometric mean diameter, mm	Sphericity	Weight of 1000 DAP granules, gm
1.	6.13	5.29	3.12	4.65	0.75	**35**
2.	6.22	5.21	3.14	4.66	0.74	
3.	5.43	5.27	3.22	4.51	0.83	
4.	6.08	5.03	3.30	4.65	0.76	
5.	6.23	4.85	3.15	4.56	0.73	
6.	5.45	4.74	3.10	4.31	0.79	
7.	6.11	4.90	3.17	4.56	0.74	
8.	6.39	5.19	3.28	4.77	0.74	
9.	5.71	5.10	3.14	4.50	0.78	
10.	6.17	4.74	3.29	4.58	0.74	
Avg	**5.99**	**5.03**	**3.19**	**4.57**	**0.76**	
Range	**5.43 - 6.39**	**4.74 - 5.29**	**3.10 - 3.30**	**4.31 –4.77**	**0.73 - 0.84**	
SD	0.338	0.212	0.075	0.0137	0.0008	
CV	5.642	4.212	2.35	0.299	0.105	

Table.3 Determination of bulk density of paddy seeds

Sample No	Sample weight, (g)	Volume of cylinder, (cm3)	Bulk density, (kg/m3)	Moisture Content
Sample I	220.00	369.26	595.78	5.05
Sample II	218.00	369.26	590.36	5.20
Sample III	230.00	369.26	622.86	5.34
Mean	**222.67**	**369.26**	**603.00**	**5.19**
Range	**218 – 230**		**590.36- 595.78**	**5.05-5.34**

The geometric mean diameter and sphericity of fertilizer were found to be 4.57 and 0.76 cm on average of 10 DAP granules. The SD of geometric mean diameter and sphericity was found to be 0.0137 and 0.0008 respectively. The coefficient of variation for geometric mean diameter and sphericity was observed to be 0.299 and 0.105 percent respectively.

Bulk density of paddy seeds

Bulk density of paddy seeds is an important parameter for designing of capacity of drums.

Three replicated trials were conducted using a cylindrical beaker having diameter 7 cm and length of 9.6 cm.

Average weight of sample was found to be 222.67 g and the bulk density obtained was 603 kg/m^3. The range of bulk density varied from 590.36 to 595.78 kg/m^3.Table 3 shows bulk density of paddy seeds (Fig. 1–3).

The following conclusions are drawn from this investigation on physical properties of paddy seed and fertilizer. The variety of the paddy seed taken for study was Karma

Mahsuri. The average length, width and thickness of paddy seed was 9.50 mm, 2.82 mm and 2.22 mm respectively and average weight of 1000 paddy seeds was 37 gm. The variety of the fertilizers taken for study was DAP. The average length, width and thickness of paddy seed was 5.99 mm, 5.03 mm and 3.19 mm respectively and average weight of 1000 paddy seeds was 35 gm. From engineering, point of view this all information are useful for designing of sowing related machines like seed cum fertilizer applicator, paddy drum seeders using Karma Mahsuri as paddy seed and DAP granules as fertilizer.

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