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Physical properties of seeds and its effect on seed drill performance

■ **P.K. GURU, P.S. TIWARI** AND **R.K. NAIK**

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See end of the Paper for authors' affiliation

Correspondence to :

P.K. GURU
Indira Gandhi Krishi Vishwavidyalaya, RAIPUR (C.G.) INDIA
Email : prabhatkumarguru@gmail.com

■ **ABSTRACT :** The site specific application of seed to maintain crop growth is an essential part of precision agriculture and is required to minimize the cost of production. In this study database of selected seed was generated, which used to further development of precision seed will drill to enable variable-rate application with a significant reduced error compared to current seed applicators. The laboratory setup was designed and fabricated. The experiment conducted for three different exposures, two crops, six varieties, and their different seed sizes. The result showed the significant difference in seed delivery rate of seed drill at 1 % level of significance.

■ **KEY WORDS :** Seed drill, Fluted roller, Physical properties of seeds

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Precision farming provides a new solution using a systems approach for today's agricultural issues such as the need to balance productivity with environmental concerns. It is based on advanced information technology. It includes describing and modeling variations in soils and plant species and integrating agricultural practices to meet site-specific requirements. It aims at increased economic returns, as well as at reducing the energy input and the environmental impact of agriculture. Precision farming includes application of fertilizer, sowing, irrigation, harvesting etc. It is apparent that there is a tremendous scope for precision farming in India. The technology of precision agriculture, such as the variable-rate seed application aims to develop the capability of site-specific crop management. Seeds are one of the most expensive inputs, therefore it's important for growers to plant the right amount of seed to minimize input costs and increase profitability. Seeding rate, plant population, and row spacing are tied together. If the population is above the optimum, the plant growth may be poor due to competition for nutrient, light and space. On the other hand, if it is below optimum then the nutrients, space and light will not be utilized for their fullest, thus resulting in poor yield.

Soybean has now been established as one of the most important oilseed crops in the world, accounting for more than 50% of oilseeds production and 30% of the total supply of all vegetable oils. It is a unique two-in-one crop, having both high quality protein (43%) and oil (20%) content. Wheat (*Triticum* spp.) is world's most widely cultivated food crop and in India, it is the second important staple cereal food. As a *Rabi* season (winter) crop, wheat played vital role in stabilizing the food grain production in the country. It is mostly eaten in the form of *chapattis.* It was found these two crops are most suitable for our experiment.

■ METHODOLOGY

Seed specification:

Quality of seeds:

The quality and variability of seed are important factors which affects germination**.** The seed of popular varieties of wheat and soybean are selected for experiment. The varieties selected of wheat were HI 8498, HI 306, HI 8627 and soybean varieties were JS 9560, JS 9305, and JS 335. The seed of the following varieties collected from authorized sources, purity and germination percentage of seeds was 95 per cent. Seed material quality is improved by cleaning and grading. Uniform size of seed is important to achieve good performance of precision drill. The size of cells or grooves of metering device was selected based on seed size. Thus, grading and cleaning of seeds with variable sizes of soybean and wheat is desirable to select the proper seed rate.

Cleaning of seeds:

The cleaning of seeds is very necessary before start the experiment. The impurities of seeds were removed manually and make it sure that the seeds contains no impurity after cleaning.

Grading of seeds:

Seed size is the main factor that affects seeding rates. Seeds originating from the same seed lot contain different seed sizes and can affect seedling establishment, growth and yield. The samples selected for experiment were pre graded so the grading was done according to that the each sample of seeds approximately divided into three grades. Sieves were used for grading. The aim behind grading of seeds was to conduct the experiment with high precision. For soybean bolder seeds like JS 9560 and JS 9305, the sieves used were 5.6mm and 5.5 mm. Another small seed variety of soybean JS 335 was graded through the sieve size of 4.75 mm and 3.2 mm. Grading of wheat seeds was done through the small sieve size of 3.2 mm and 2.8 mm. The samples of each variety were graded into three grades, total 18 samples of different seed size were obtained. After grading all samples, the samples were packed into the air tight polythene bag so that the moisture content of seeds was maintained.

Wheat and soybean 1000 seed weight:

The 1000 seed weight method was used for recommending seed rate; the number of seeds to be planted for an area can be computed.The 1000 seed weight is affected the seed rate of variety, so it is very necessary to calculate the 1000 grain weight for precision sowing. The difference between the seed rate for different variety of different samples were calculated through the 1000 grain weight. The 1000 grains of each sample were counted and weighed through a 0.1 mm accuracy weighing machine.

Bulk density of seeds:

Bulk density of seeds was calculated by placing the sample of seeds in a round cylinder which has volume of 10 cm^3. The seeds were dropped from hopper into the cylinder from a height of 10 cm and excess seeds were removed by passing a wooden stick across the top surface. The sample placed in the cylinder was then weighed by using electronic balance with least count of 0.1g. Bulk density was calculated by using the relationship:

$$\mathbf{Bd} = \frac{\mathbf{Wt}}{\mathbf{V}}$$

where,

B_d = Bulk density, g/cm^3;

W_t = Weight of sample, g;

V = volume of cylinder, cm^3.

Moisture content of the seeds:

The moisture content can be determined by oven dry method, which is a direct method. The grain was weighed and dried, then weighed again according to standardized procedures. The moisture content was calculated using the moisture content equations. Grain moisture content is expressed as a percentage of moisture based on wet weight (wet basis) or dry matter (dry basis). Wet basis moisture content is generally used. Dry basis is used primarily in research. So dry basis method of moisture content determination was used. The sample of soybean and wheat of 25 to 30 g of seed were taken and placed at air oven at 130^0C temperature for 72 to 96 hours. Afterwards, the samples were taken out from oven and placed in desiccators to cool down to room temperature. Moisture content of samples was measured based on drop in weight from initial weight of samples (Sahay and Singh, 1998). Then values were placed in following formula for calculation of moisture content:

$$\mathbf{Md} = \frac{\mathbf{w - d}}{\mathbf{d}} \mathbf{x\,100}$$

where,

w = wet weight;

d = dry weight;

M = moisture content on per cent basis.

RESULTS AND DISCUSSION

The experimental findings obtained from the present study have been discussed in following heads:

Physical properties of wheat and soybean:

Moisture content of seeds:

The moisture content of seeds used for the laboratory studies of different varieties and grades are presented in Table 1. The moisture content of wheat ranged from 12.36 to 16.28% and of soybean ranged from 9.89 to 14.94%. The SD and co-efficient of variance for soybean are 2.63% and 2.10. The SD and co-efficient of variance for wheat were 2.04% and 2.12, respectively.

Bulk density of seeds:

The bulk density of seeds is an important parameter for designing of box capacity and for optimization the seed rate of the crop. Three replications were made for each sample for more accuracy. A cylindrical beaker having volume of 10 cm^3 was used for calculating the bulk density of seeds. Weight of each sample was measured using a 0.1 g accuracy weighing machine. The bulk density of soybean seeds varied from 6.7 to 7.1 g/cm^3. The bulk density of wheat seed varied from 7.4 to 8.2 g/cm^3 (Table 1).

Weight of 1000 seeds:

The 1000 grain weight is an important parameter which affects the seed rate, so it is very necessary to calculate the 1000 grain weight for precision sowing. Table 1 shows the 1000 grain weight of soybean and wheat seeds. The SD and co-efficient of variance for soybean seeds were 4.64% and 2.10 and SD and co-efficient of variance for wheat seeds were 3.37% and 3.17, respectively.

Effect of different exposures on seed delivery:

The test was conducted for three different exposure length of fluted roller. At full exposure the exposure length was 30 mm, for half exposure the exposure length was 15 mm and for 3/4 exposure it was 22.5 mm. For more accuracy of experiment, three replications of each reading were taken and averages were taken for final database. Recommendation of exposure length was made according the actual amount of

Table 1 : Moisture content, 1000 grain weight and bulk density

Crop	Variety	Seed size (mm)	1000 grain weight (g)	Moisture content (%)	Bulk density (g/cm³)
Soybean	JS 9560	> 5.6	143	9.89	6.9
		5.5-5.6	122	9.89	6.8
		<5.5	105	9.89	6.8
	JS 9305	> 5.6	155	11.11	6.7
		5.5-5.6	134	11.11	6.7
		< 5.5	125	11.11	6.6
	JS 335	> 4.75	68	14.94	7.1
		3.2-4.75	52	14.94	6.9
		< 3.2	40	14.94	7
Wheat	HI 8498	> 3.2	47	16.28	8.2
		2.8-3.2	45	16.28	8.1
		< 2.8	42	16.28	8
	HI 306	> 3.2	45	13.64	8
		2.8-3.2	41	13.64	7.8
		< 2.8	39	13.64	7.6
	HI 8627	> 3.2	43	12.36	7.9
		2.8-3.2	41	12.36	7.7
		< 2.8	36	12.36	7.4

Table 2 : Recommendation of exposure length of fluted roller for optimum seed rate

Crop	Variety	Seed size (mm)	Required amount of seed/ meter length (g)	Actual amount of seed per meter length (g) for different exposures			Recommended exposures
				Full	3/4th	Half	
Soybean	JS 9560	> 5.6	4.5	4.721	3.55	2.532	Full exp
		5.5-5.6	4.5	4.617	3.465	2.476	Full exp
		< 5.5	4.5	4.552	3.43	2.441	Full exp
	JS 9305	> 5.6	4.5	4.532	3.453	2.431	Full exp
		5.5-5.6	4.5	4.371	3.333	2.345	Full exp
		< 5.5	4.5	4.369	3.324	2.346	Full exp
	JS 335	> 4.75	4.5	5.87	4.638	3.452	3/4 exp
		3.2-4.75	4.5	5.384	4.112	3.029	3/4 exp
		< 3.2	4.5	5.162	3.852	2.879	3/4 exp
Wheat	HI 8498	> 3.2	2.25	5.801	4.388	3.264	Half exp
		2.8-3.2	2.25	5.757	4.351	3.239	Half exp
		< 2.8	2.25	5.303	4.035	2.974	Half exp
	HI 306	> 3.2	2.25	5.424	3.994	3.053	Half exp
		2.8-3.2	2.25	5.145	3.788	2.895	Half exp
		< 2.8	2.25	5.144	3.789	2.897	Half exp
	HI 8627	> 3.2	2.25	5.187	3.94	2.922	Half exp
		2.8-3.2	2.25	5.081	3.708	2.862	Half exp
		< 2.8	2.25	4.743	3.249	2.644	Half exp

seed delivery per meter length and the required amount of seed per meter length. Table 2 shows the recommendation of different exposures for 100 kg/ha seed rate and 45 cm row spacing of soybean and 22.5 cm row spacing of wheat (Antoini *et al*., 1965).

The experiment was conducted for three different exposures, two crops, six varieties, and their different seed sizes. The result found that the different exposure, crops, varieties and size were significantly different at 1 % level of significance. The different exposures with the different crop varieties significantly differed at 1 % level of significance. The different varieties with the different seed size were also significantly differed at 1 % level of significance.

Conclusion:

The test was conducted for three different exposure length of fluted roller. The exposure length of fluted roller for sowing of wheat was found less (15 mm). For soybean variety JS 335 the exposure length (22.5 mm) and soybean variety JS 9560 and JS 9305 fluted roller exposure length of 30 mm was found suitable. The seed delivery per revolution of feed shaft for small seed size varieties had more seed delivery rate as compared to medium and bold seed varieties. For soybean JS 335 variety, the seed delivery rate was more as compared to the JS 9560 and JS 9305. The seed delivery rate of wheat seed HI 8498 was more than the other two varieties HI 306 and HI 8627.

Authors' affiliations:

P.S. TIWARI, Farm Mechanization Division, Central Institute of Agricultural Engineering, BHOPAL (M.P.) INDIA

R.K. NAIK, Department of Farm Machinery and Power Engineering, Indira Gandhi Krishi Vishwavidyalaya, RAIPUR (C.G.) INDIA

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