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Physical Purity Test in Paddy

Physical purity test is an essential part of routine seed testing (physical purity, moisture, germination and other distinguishable variety) done by recognised seed testing laboratory, Government of India. Though various purity components such as pure seed, inert matter, weed seed and other crop seed, are identified in this test, seed samples are also tested for presence of other distinguishable variety (ODV), objectionable weed seed and huskless seed so as to determine the quality of a seed lot required for meeting the seed standards for seed certification so as to deliver superior quality seed to the beneficiary.

INTRODUCTION

Seed is the vital and principal input of agricultural production that decides performance of crop in the field. Rice seed with superior quality embodies viability ($\geq 80\%$), purity with fullness and uniform grain size, unaccompanied by weed seed, insect, disease and other inert matters. Every country has its own regulatory system to control the quality of seed. In India, the Seed act 1966, provided the impetus for the establishment of official seed certification agencies by the states. These certification agencies entrusted with responsibility of testing the seed quality. The quality of seed is regulated both at field level and after harvest of the seed by these certification agencies.

PURPOSE OF THE PHYSICAL PURITY TEST

- To determine the purity components on the basis of weight of the sample under consideration and the results are expressed as weight percentage.
- To identify various species of seeds and inert matter present in the sample.

NEED OF THE PHYSICAL PURITY TEST

- To judge the quality of the seed lot by Seed Certification or Seed Law Enforcement Agencies.
- The pure seed components obtained by the physical purity test are further used to test the viability of the seed lot.

SAMPLE SIZE

The sample sent to the seed testing station either by a company, private person or sampling agency, is called submitted sample. The size of the submitted sample for paddy seed is at least 400g. The size of the working sample (drawn from submitted sample) for paddy seed is 40g (minimum size). In case of pelleted seed, submitted sample is not less than 7500 pellets. Working sample consisting of ≥ 2500 pellets depelleted by soaking in water followed by shaking in fine mesh sieves (0.5-1.00 mm). Then the depelleted seed are subjected to drying on filter paper for 12 hrs followed by oven drying at **130°C** for two hours. Purity analysis of the dried depelleted seeds is done as in case of non-pelleted seeds

MATERIALS REQUIRED FOR THE TEST

A. Seed divider: Seed divider is used to reduce the sample size of submitted sample (seed samples received in the laboratory) to obtain working sample for carrying out the purity test. Mostly mechanical seed divider such as Boerner/Soil type/Gamet type divider based on principle of centrifugal force are used to mix the submitted sample uniformly and getting the desired sample of similarly size.

I) BOERNER DIVIDER

It consists of a hopper, a cone and series of baffles that direct the seeds into two spouts. Valve present at the base of the hopper help in holding the seeds. On releasing the valve, the seeds fall over the cone by gravity. The baffles which are of equal size, spaced at equal distance alternately arranged in circle and are directed inward; distribute the seed equally in two spouts.



II) SOIL DIVIDER

This divider consists of a hopper with attached channels (arranged in a row), a frame work to hold the hopper, two receiving pans and a pouring pan. When seeds are placed on hopper, it passed through the channels and equally falls into the two receiving pans.



III) GAMET DIVIDER

This divider consists of a hopper, baffle, two spouts and a rubber spinner that rotates by an electric motor. Through hopper when seed lands on spinner, it throws out seed by centrifugal force and collected seeds are divided into two equal parts by a stationary baffle and deposited in each spout.



WHILE MIXING AND DIVIDING THE SEED, FOLLOWING GUIDELINES NEED TO BE FOLLOWED

- The divider and the container to collect the seed should be cleaned prior to use.
- The whole submitted sample should be used for dividing the sample.
- Sample collected in the receiving pans should be recombined and again pass through the divider.
- The process should be repeated twice in order to uniformly mix the submitted sample.
- Seed collected in one container should be kept aside in order reduce the sample size.
- Contents of other container should be subjected to division till desired sample size is obtained.

B) OPTICAL AIDS

A magnifying glass of 3-5 times magnification is useful.

C) BALANCES

Balances intended for weighing samples, sub-samples, fractions and components must meet certain requirements regarding precision. The whole range of weights between 0.5 and 1000g can be determined with two balances: an analytical balance (capacity 160-200 g) with ability to read 0.1 mg, and a precision balance with about 1 kg capacity, allowing 10mg to read accurately.

D) WEIGHING TABLE

All balances should be placed on a weighing table consisting of a strong slab (8cm thick) with vibration protection.

E) PURITY WORK BOARD / DIAPHNOSCOPE

It consists of a wooden board with a white area that reflects light by an electric bulb fitted under the

board and the board is attached with a magnifying glass. Seeds are placed on the illuminated area so as to separate the purity components of the samples efficiently as observed through the lens.



F) VARIOUS OTHER EQUIPMENTS

- i. Spoons, spatula, forceps, scalpel needles, shallow trays, funnels, watch glass, etc. are always needed for a normal purity analysis.
- ii. Small metal containers to receive the working sample and its components.

G) STORAGE UNIT

Storage units with space for storing the seed are needed. The seeds are put into glass test tubes/jars/plastic container that are properly labelled and stored in the storage units.

WORKING PROCEDURE OF THE PURITY TEST

A) Working sample and weight of the purity components

In case of paddy, purity analysis shall be made on a working sample of not less than 40 g. One working sample of the prescribed weight (40g)

Table 1. Weight and the decimal places for working sample and its components.

Weight of the working sample(g)	The number of decimal places	Example
<1	4	0.6432
1-9.999	3	6.432
10-99.99	2	64.32
100-999.9	1	643.2
1000 or more	0	6432

drawn from the submitted sample or two sub-samples of at least half of the prescribed weight (20g), drawn independently can be used for purity analysis. The number of decimal places to which the working sample and the components of the working sample should be weighed is given below. As per the Table 1, since the weight of the working sample

is within the range of 10-99.99 g so the working sample and its components should be weighed up to two decimal places in case of paddy.

B) Separation

- i. The working sample is spread on the purity board.
- ii. Each particle is viewed individually under transmitted light based on physical appearance (shape, size, colour, glossiness and surface texture).
- iii. All other seeds and inert matter particles present are removed leaving the pure seed and divided into the three components (pure seed, other seed and inert matter) as described below.
- iv. Each purity component part is weighed in grams to the minimum number of two decimal places and the percentage is calculated (by weight) and recorded on the purity form.
- v. The purity components are retained for future reference.

DEFINITIONS OF THREE PURITY COMPONENTS

In India, the purity components are arranged into four groups (pure seed, other crop seed, weed seed and inert matter). However international certificate mentions only three components instead of four: other crop seed and weed seed have been combined into one fraction, called other seeds. The descriptions of these three components as given in the ISTA (International Seed Testing Association) Rules are given below.

A. PURE SEED

- i. The pure seed shall refer to the species (*Oryza sativa*) stated by the sender. It includes all botanical varieties and cultivars of that species.
- ii. Spikelet with glumes, lemma and palea enclosing a caryopsis excluding the awn in case length of awn is longer than the length of the floret.
- iii. Floret, with or without lemma/ floret with lemma and palea enclosing a caryopsis excluding the awn when length of awn is longer than the length of the floret.
- iv. Caryopsis.
- v. Piece of caryopsis larger than one-half the original size.

Table 2. Indian minimum seed certification standards for foundation and certified seed

Sl.No	Components	Standards for each class	
		Foundation	Certified
1	Pure seed (minimum)	98.0%	98.0%
2	Inert matter (maximum)	2.0%	2.0%
3	Huskless seeds (maximum)	2.0%	2.0%
4	Other crop seeds (maximum)	10/kg	20/kg
5	Other distinguishable varieties (maximum)	10/kg	20/kg
6	Total weed seeds (maximum)	10/kg	20/kg
7	*Objectionable weed seeds (maximum)	2/kg	5/kg
8	Seeds infected by paddy bunt (<i>Neovossiahorrida</i> (Tak.) Padwick & Azmatulla Khan) (maximum)	0.10% (by number)	0.50% (by number)
9	Germination (minimum)	80.00 %	80.00%
10	Moisture (maximum)	13.00 %	13.00 %
11	For vapour-proof containers (maximum)	8.00 %	8.00 %

*Objectionable weed shall be: wild rice (*Oryza sativa* L. var. *fatua prain*) (syn. *O. sativa* L. f. *spontanea* Rosch.)

vi. The above structures even if immature, undersized, shrivelled, diseased or germinated, provided they can definitely be identified as of that *Oryza sativa* shall be regarded as pure seed in case of paddy.

vii. Pure pellets in case of pelleted seed shall include (1) entire pellets regardless of presence or absence of seed inside (2) broken and damaged pellets containing seed with more than half of the seed surface covered by pelleting material.

B) OTHER CROP SEED

Seed and seed-like structures of any plant species other than that of pure seed are referred as other crop seed.

C) WEED SEED

Seed of weeds or noxious weed as specified under Seed Act 1966, are weed seed.

D) INERT MATTER

Inert matter shall include (i) pieces of broken or damaged caryopsis one half the original size or less, (ii) paddy seeds with awns longer than length of floret, (iii) soil, sand, stones, stems, leaves, pieces of bark, flower, nematode galls fungus bodies (such as bunt or smut balls) and all other matter that are not seeds.

The seed standards for different class of seed prescribed by Indian Minimum Seed Certification Standard are described in Table 2.

CALCULATION AND EXPRESSION OF RESULTS

A) IN CASE OF ONE WHOLE WORKING SAMPLE

i. The weights of all the purity component fractions

obtained from the working sample are expressed in percentage weight basis. The sum of all the components must be compared with the original weight (40g) as check against gain or loss. The test is repeated if discrepancy of more than 5% of the initial weight is observed and the result of the retest is then reported.

ii. The weight of each of the purity component shall be reported to two decimal places. Percentages must be based on the sum of the weights of the components and not on the initial weight of the working sample (% of component = [weight of the component/total weight of all components]*100)

iii. All components added together should be total 100.0%

iv. If result of any component is nil then the result must be reported as 0.0%.

v. If any component found is less than 0.05%, it is reported as "trace" component. In this case, all components are added excluding the "trace" component and the sum is adjusted to 100.0% by adding or subtracting accordingly from the pure seed fraction. If a-correction of more than 0.1% is necessary, then calculation error should be checked.

B) IN CASE OF TWO HALF WORKING SAMPLES

i. For each half working sample, each component is expressed as percentage by weight to two decimal places. Percentage of each component from each half of working sample then added together and the average percentage by weight for each component is calculated.

ii. The difference for each component of the two half working samples shall not be in excess of the tolerance as prescribed by ISTA (Table 1). If all the

components are within the tolerance, then average of each component is calculated and round to one decimal place. This tolerance limit varies if test is done within the laboratory and between the laboratories (Eg: if purity component of two working samples are 98.10% and 97.30% then the average of two is 97.70. This value falls between

97.50-97.74 in the tolerance table (Table 1), for which the tolerance value is 1.63. This indicates that the difference between two component values is permissible up to 1.63. In this case the difference is 0.80 and result is acceptable)

iii. If values of any components are beyond tolerance limit, then more pairs (but not more than

Table 3. Tolerances for comparing duplicate working samples from the same submitted sample for any component of a purity sample for either chaffy or non-chaffy seeds (Probability 5%)

Average Analysis of two half samples or two whole samples (%)	Tolerances for difference between		
	2	Half working samples	Whole working samples
1	2	3	4
99.95-100.00	0.00-0.04	0.23	0.16
99.90-99.94	0.05-0.09	0.34	0.24
99.85-99.89	0.10-0.14	0.42	0.30
99.80-99.84	0.15-0.19	0.49	0.35
99.75-99.79	0.20-0.24	0.55	0.39
99.70-99.74	0.25-0.29	0.59	0.42
99.65-99.69	0.30-0.34	0.65	0.46
99.60-99.64	0.35-0.39	0.69	0.49
99.55-99.59	0.40-0.44	0.74	0.52
99.50-99.54	0.45-0.49	0.76	0.54
99.40-99.49	0.50-0.59	0.82	0.58
99.30-99.39	0.60-0.69	0.89	0.63
99.20-99.29	0.70-0.79	0.95	0.67
99.10-99.19	0.80-0.89	1.00	0.71
99.00-99.09	0.90-0.99	1.06	0.75
98.75-98.99	1.00-1.24	1.15	0.81
98.50-98.74	1.25-1.49	1.26	0.89
98.25-98.49	1.50-1.74	1.37	0.97
98.00-98.24	1.75-1.99	1.47	1.04
97.75-97.99	2.00-2.24	1.54	1.09
97.50-97.74	2.25-2.49	1.63	1.15
97.25-97.49	2.50-2.74	1.70	1.20
97.00-97.24	2.75-2.99	1.78	1.26
96.50-96.99	3.00-3.49	1.88	1.33
96.00-96.49	3.50-3.99	1.99	1.41
95.50-95.99	4.00-4.49	2.12	1.50
95.00-95.49	4.50-4.99	2.22	1.57
94.00-94.99	5.00-5.99	2.38	1.68
93.00-93.99	6.00-6.99	2.56	1.81
92.00-92.99	7.00-7.99	2.73	1.93
91.00-91.99	8.00-8.99	2.90	2.05
90.00-90.99	9.00-9.99	3.04	2.15
88.00-89.99	10.00-11.99	3.25	2.30
86.00-87.99	12.00-13.99	3.49	2.47
84.00-85.99	14.00-15.99	3.70	2.62
82.00-83.99	16.00-17.99	3.90	2.76
80.00-81.99	18.00-19.99	4.07	2.88
78.00-79.99	20.00-21.99	4.23	2.99
76.00-77.99	22.00-23.99	4.37	3.09
74.00-75.99	24.00-25.99	4.50	3.18
72.00-73.99	26.00-27.99	4.61	3.26
70.00-71.99	28.00-29.99	4.71	3.33
65.00-69.99	30.00-34.99	4.86	3.44
60.00-64.99	35.00-39.99	5.02	3.55
50.00-59.99	40.00-49.99	5.16	3.65

four pairs in all) are analysed until a pair is obtained which has its members within tolerance.

C) IN CASE OF TWO OR MORE WHOLE WORKING SAMPLES

- i. When two complete tests have been carried out, result is calculated as duplicate analysis with two half working samples as described in section 'b' and the appropriate tolerance is calculated.
- ii. If the difference between the results exceeds the tolerance limit then one more working sample is analysed. If the highest and lowest results do not differ by more than twice the tolerance value, the weighted average of the three is reported.
- iii. For each of the samples to be included in the final result, the weights of each fraction is added together and result is calculated and value is expressed according to procedures described in section (a) above. The results are averaged and round it to two decimal places again.

REPORTING RESULTS

- i. The result of each purity component shall be reported to one decimal place and the sum of percentage of all the components must be 100.
- ii. Any component less than 0.05% shall be reported as "Trace".
- iii. The percentages of pure seed, other seed and inert matter must be reported in the spaces provided on the Analysis Certificate. If the result for a component is nil, this must be shown as '-0.0-' in the appropriate space.
- iv. The Latin name of the species of pure seed must be reported on the Analysis Certificate. The kind of inert matter and the Latin name of each species of other seed must be reported.
- v. When a particular kind of inert matter, species of other seed is found to the extent of 1 % or more and when at the request of the sender, a particular species has been determined and found present to the extent of 0.1% or more, the percentage of such material must be shown on the Analysis Certificate.

SPECIAL TESTS RELATED TO PURITY ANALYSIS

The purity analyst is required to do certain test in addition to physical purity, required for meeting seed certification standards prescribed by Indian Minimum Seed Certification Standard (IMSCS: Table 2)

1. DETERMINATION OF OTHER DISTINGUISHABLE VARIETIES

It is done in a working sample of 400g (whole submitted sample) based on the physical traits of the seeds under magnification. The availability of true to type samples for comparison is a must for this determination. The result is reported as number/kg.

2. DETERMINATION OF NUMBER OF OBJECTIONABLE WEED SEED (OWS)

The minimum weight of working sample for this test is 400g (whole submitted sample). The sample is placed on a purity work board and objectionable weed seeds and inseparable other crop seeds, if present, are separated and reported as number / kg.

3. DETERMINATION OF HUSKLESS SEED

It is determined in a working sample consists of 400 seeds drawn randomly from the pure seed component and completely husk less seed are separated (partly huskless seeds should be excluded) and their number counted. The result is expressed as percentage of huskless seeds (by number).

CONCLUSION

The physical purity test including above special tests increases the pure seed component by eliminating the inert matter, help in raising a pure crop by discarding other crop seed, weed seeds, and diseased seed. Thus it helps in maintaining seed quality and providing quality seed to the beneficiaries.

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