Report of
Evaluation of Automated Soil Testing Machine

DHARTI KA DOCTOR

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Evaluation of Automated Soil Testing Machine

"*DHARTI KA DOCTOR*"

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PREFACE

Soil health assessment is key to successful crop production and optimal use of the resources. The cropping system intensification to meet the nation's food security and meeting the targets of the land degradation neutrality as signatory of the UNCCD are the two competing targets faced by the scientific community and policy makers. Assessment of the soil health is key to success of the strategies adopted for arresting land degradation and sustainable soil health management.

The ICAR–Central Soil Salinity Research Institute (CSSRI) is a premier constituent unit under the Indian Council of Agricultural Research with a broad national mandate on the development, assessment and management of technologies for salty lands and waters. The Bharuwa Agri Science Pvt. Ltd., Kankhal, Haridwar, Uttarakhand sponsored a project to the ICAR-CSSRI under a memorandum of understanding (MOU) for evaluation of the automated Soil Testing Machine "DHARTI KA DOCTOR" developed by their in house research had development activities. The Terms of Reference of MOU was to evaluate the performance of the machine in comparison to the standard analystical procedures recommended for analysis of soil for developing soil health card.

The project team thanks the Bharuwa Agri Science Pvt. Ltd., Kankhal, for providing the opportunity to evaluate the machine at ICAR-CSSRI. We express our gratitude to Dr. R. K. Yadav, Director ICAR-CSSRI for entrusting this responsibility to this team of scientist. The team records its gratitude to Dr. Ashok Mehta, ex-Additional Director General, ICAR and consultant to the The Bharuwa Agri Science Pvt. Ltd., Kankhal, Haridwar, Uttarakhand for providing this opportunity to ICAR-CSSRI.

All the basic material for this evaluation work was provided by Dr Rishi Kumar and his team of scientists Dr Ashutosh Gupta, Dr Anamika and Dr.Vikrant Verma. In addition, they offered technical and other operational support for evaluation process at ICAR-CSSRI, Karnal. The research Team would like to officially thank them for outstanding support throughout the evaluation process.

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INTRODUCTION

The inherent soil constraints and nutrient deficiencies are the major concern in India and farmers often cultivate soil without any soil testing and scientific recommendation. This cause wasteful investment and the increase in cost of production, minimized farm profits and soil health deterioration. Soil testing has received renewed attention because of increased focus on soil health management in government policies. ICAR, SAU, NGO and other stakeholders are engaged in the soil fertility evaluation throughout the country. About 600 soil testing laboratories are in working mode. Now, reorientation, reconstruction with improved mandate for increased coverage of soil health assessment is necessary to restore our soil. This soil health assessment should be emphasized with site–specific nutrient management; and need based fertilizer recommendation. Accurate and precise recommendation for application of micronutrient must be an indispensable part of this operation. Application of nutrient without necessary correction of hidden problem of soil may not serve the overall objective of soil health assessment. Additionally, blanket application of costly inputs *viz*., fertilizer especially micronutrient may increase the cost of cultivation. Therefore, Government of India has launched a scheme to provide 'Soil Health Card' to every farmer in a Mission mode approach. This card carry crop wise recommendations of nutrients/or fertilizers required to improve productivity through using appropriate inputs. Central Government also assists State Governments for setting up of Soil Testing Laboratories for issuing Soil Health Cards to farmers. State Governments have adopted innovative practices like involvement of state agricultural universities, agriculture graduate students, NGOs and private sectors in soil testing, determining relative soil health of villages, etc., by issuing Soil Health Cards. A Soil Health Card displays soil health indicators and associated descriptive terms. The indicators are typically based on early warning of deficiency/hidden–hunger/toxicity of essential nutrients, meeting specific need viz., problem in soil acidity/salinity/ alkalinity, farmers' practical experience and knowledge of local natural resources. Few states including Tamil Nadu, Gujarat, Andhra Pradesh and Haryana are successfully distributing such cards. The soil health card, issued after testing soil, help the farmers to avoid excess use of costly fertilizers, which in turn reduce the cost of cultivation and boost farm growth on a sustainable basis.

Soil in arable land in different parts of the country is low in nitrogen nd organic carbon. It is also highlighted by the distribution of the soil samples in different fertility classes of different states. In Andhra Pradesh, soil is low in nitrogen (83.4%) and organic carbon (70.5%), with high potassium (73.3%) and has alkaline pH (80.8%). Arunachal Pradesh shows low nitrogen

(60.1%) and organic carbon (70.7%), with medium phosphorus (71.5%) and acidic pH (83.0%). Assam has higher nitrogen (19.7%) with medium phosphorus (91.4%) and potassium (49.5%), and neutral pH. Bihar's soil is low in nitrogen (61.8%) but high in potassium (66.7%) with neutral pH (55.2%). Chhattisgarh also has low nitrogen (74.4%) and high potassium (77.3%) with neutral pH (51.5%). Delhi shows low nitrogen (95.2%), variable phosphorus and potassium, and neutral pH. Goa's soil has medium nitrogen (70.5%), high potassium (38.9%), and neutral pH (98.8%). Gujarat is low in nitrogen (74.6%) but high in potassium (77.7%) with alkaline soils (52.9%). Himachal Pradesh has medium nitrogen (43.1%), phosphorus (79.4%), potassium (59.9%), and neutral pH (55.2%). In Jammu & Kashmir, nitrogen is higher (14.4%) with medium phosphorus (85.4%), potassium (54.5%), and neutral pH (66.3%). Jharkhand has low nitrogen (52.9%), medium phosphorus (86.6%), potassium (57.6%), and acidic pH (87.4%). Karnataka shows low nitrogen (57.2%), high potassium (68.1%), and neutral pH (34.8%). Kerala's soil is medium in nitrogen (58.7%) and phosphorus (72.5%) with acidic pH. Similarly, Madhya Pradesh reports low nitrogen (69.0%), high potassium (75.4%), and neutral pH (60.0%).

The limited availability of the soil testing facility had opened the avenue for the small soil testing kits capable of rapid analysis at farmers' doorstep. Bharuwa Agri Science Pvt Ltd, Kankhal, Haridwar 249405 Uttarakhand has developed Automated Soil Testing Machine (*Dharti ka Doctor*). It is considered as convenient to carry out the soil testing and claimed equivalent to a small laboratory. The Automated Soil Testing Machine developed by Bharuwa Agri Science can analyse several parameters pH, electrical conductivity (EC), soil organic carbon (OC), nitrogen (N), phosphorous (P), potassium (K), zinc (Zn), sulphur (S), boron (B), iron (Fe), manganese (Mn), and copper (Cu). This machine analyse the soil using the coded reagents supplied by the Bharuwa Agri Science Pvt Ltd. Result output of the machine is fertility rating in two to five classes for different parameters. These ratings are used for the recommendation of the fertilizers for different crops. Fertilizers recommendation is either through fertilizers or combination of fertilizers and other organic sources. Reliability, portability, and excellent output quality are the best the attributes of any Soil Testing Machine apart. Therefore, this study was planned to compare the analytical accuracy of this machine in comparison to the standard laboratory methods prescribed for the soil health card.

1. METHODOLOGY

As per the term of reference (ToR) the all the ten parameters were analysed using the method prescribed by the manufacturer of the "*Dharti ka Doctor*" and soil fertility ratings observed were compared with the rating of same soil samples with standard soil testing methods adopted in soil testing laboratories for development of the soil health card. Results are presented after suitable statistical analysis.

2.1 Soil sampling

Soil samples of different cropping systems from the farmers' field of Karnal, Kaithal and Panipat district of Haryana were collected for the study. The top ~ 2.0 cm of soil layer of each site was removed to minimize anthropogenic contamination. Further, one hundred sixteen surfaces soil samples (0–15 cm) were collected with the help of a soil auger from the agricultural land in the pre-monsoon season in the year 2024. The soil samples were air–dried in the shade, homogenized, and processed to pass through 2.0 mm nylon sieve.

2.2 Analytical procedures

Two set of soils samples were tested for the 12 parameters of the soil health card using automated soil testing machine '*Dharti ka Doctor*'. The standard protocols described with the machine were used as outlined in the standard operating brochure provided with '*Dharti ka Doctor*'. Another two sets of soil samples were analyzed by adopting the standard methods adopted in the soil testing laboratories of the country engaged in soil testing. A brief of the same are described in following sections:

2.2.1 Soil pH

In laboratory, the soil pH was determined by the glass electrode method (Systronics µpH system 362) in the ratio of one part of the soil to two parts of deionized water (pH_w), as described by Page et al. (1982). Samples were kept 30 minutes with intermittent stirring and pH was measured.

2.2.2 Electrical conductivity

The soil salinity measure by estimation of the electrical conductivity (EC) of soil and water suspension prepared in 1:2 soil: water ratio with the help of a conductivity meter (Systronics conductivity meter 306µc) as described in Page et al. (1982). After measurement of the pH suspension was allowed to settle and electrical conductivity was measured by immersing the electrode in clear supernatant.

2.2.3 Soil organic carbon

Wet oxidation method was followed to estimate organic C using 1.0 *N* $K_2Cr_2O_7$ added to the one gram soil (< 2.0 mm). The amount of the 1.0 *N* $K_2Cr_2O_7$ used in oxidation of the organic carbon was determined by titrating it with 0.5 *N* ferrous ammonium sulphate and converted to soil organic carbon utilizing the method described in Jackson (1967)

2.2.4 Available nitrogen

The alkaline permanganate method measured the available soil nitrogen by taking 10.0 g of soil in a Kjeldahl flask and collecting the distillate into a 10 ml solution of 4.0% boric acid – mixed indicator in distillation set of Pelican equipments Classic–DX VATS(B). Amount of the ammonia released and trapped in boric acid were titrated with 0.01*N* H_2SO_4 and utilized for computing available N kg ha^{-1} (Subbiah and Asija 1956).

2.2.5 Available phosphorus

Available phosphorus was determined spectrophotometrically using the ascorbic acid reductant method. The Olsen's extractant (soil $pH_{1:2}$> 6.0) were used for extracting available P and the absorbance of the blue color of the sample solutions was measured by a Spectrophotometer (UV–Vis spectrophotometer, Analytik Jena) at 720 nm (Jackson 1973).

2.2.6 Available potassium

Available potassium was determined in neutral normal ammonium acetate extract using a flame photometer (Flame photometer128µcSystronics).

2.2.7Available sulphur

The available sulphur in soil was estimated following the turbidimetric method by extracting the sulfur with 0.1 *M* $CaCl_2$, precipitating it with a barium chloride solution, and then analyzing it turbidimetrically (SI98713; Hanna, Romania) (Chesnin and Yien 1951).

2.2.8 Available Zn, Cu, Mn, and Fe

Plant available (DTPA–extractable) cationic micronutrients Zn, Cu, Mn, and Fe in soils were extracted using DTPA (0.005 *M* DTPA + 0.01 *M* $CaCl_2$ + 0.1 *M* TEA, pH 7.3) at 1:2 soil to extractant ratio and determined on atomic absorption spectrophotometer (Spectrum instruments Z–xpress–8000)(Lindsay and Norvell 1978).

2.2.9 Available B

Plant–available B in the soils was extracted in 0.02 *M* calcium chloride ($CaCl_2$). The five milliliter of the extract was taken in 20 ml polypropylene tube, 2 ml of buffer solution 2 ml of EDTA solution, 1 ml of azomethine – H reagent were added, the content was vortexed and allowed the content to stand for one hour for color development and measure absorbance of the red colour of the sample solutions by a Spectrophotometer (UV–Vis spectrophotometer, Analytik Jena) at 420 nm (Berger and Truog 1939).

2.3 Statistical analysis

Windows based SPSS programme (SPSS Inc., Chicago, IL, USA) was used to perform nonparametric test to capture the statistical significance of different parameters of soil collected from different regions. Each fertility class were given weight for carrying the non-paramteric test for comparison of the test methods (Annexure I-III). The Mann Whitney *U* test was used to perform the analysis of variance of test methods for different parameters.A value of $P < 0.05$ was considered statistically significant for distinguishing the responses in the compared groups using the rank means.

2. RESULTS

3.1 Soil pH

About 232 observation of pH were recorded by each methodology. Soil samples were in the ranges of medium (63.8%) to strongly (36.2%) alkaline reactions. Irrespective of the alkalinity class the both the methods showed 95.3% similarity (**Table 1**). Both the analytical procedures showed 94 and 95.9% similarity for strongly and medium alkaline soil classes.

Table 1. Comparison of the methods for pH class estimation

Group	Strongly alkaline	Medium alkaline	Total
Dharti Ka Doctor	79	142	221
Standard laboratory procedure	84	148	232
Similarity (%)	94.0	95.9	95.3
P (%)	0.12	0.1	0.84
Sample distribution (%)	36.2	63.8	–

3.2 Soil electrical conductivity (EC)

Almost all samples (98.7%) were normal and salt–free in nature irrespective of analyses of both soil testing machine '*Dharti ka Doctor*' and soil analyzed by following the standard procedures in the laboratory (**Table 2**).

Table 2. Comparison of the methods for determination of soil salinity class

Group (dS m^{-1})	Saline (4–8)	Salt free (0–2)	Total
Dharti Ka Doctor	3	229	232
Standard laboratory procedure	3	229	232
Similarity (%)	100.0	100.0	100.0
Sample distribution (%)	1.3	98.7	–

3.3 Soil organic carbon

Samples used for analysis were from variable category. About 39.2% and 35.3% samples were in the low and medium in range, respectively. While 12.5, 7.3 and 5.6% of sample were high, very low and very high category in soil organic carbon content, respectively. These samples were analysed using both soil testing machine '*Dharti ka Doctor*' and soil analyzed by following the standard procedures in the laboratory (**Table 3**). Both the analytical procedures showed more than 92% similarity for all soil classes of organic carbon content.

Table 3. Comparison of the methods estimation of soil organic carbon class for soil fertility rating

Group (%)	Very low <0.25	Low (0.25–0.50)	Medium (0.50–0.75)	High (0.75–1.0)	Very high (>1.00)	Total
Dharti Ka Doctor	16	86	79	28	12	221
Standard laboratory procedure	17	91	82	29	13	232
Similarity (%)	94.1	94.5	96.3	96.6	92.3	95.3
Sample distribution (%)	7.3	39.2	35.3	12.5	5.6	100
P (%)	0.78	0.17	0.08	0.23	0.23	0.8

3.4 Available nitrogen

A large number of samples were very low (42.2%) and low (49.1%) in range. While 4.3, 2.6 and 1.7% of sample were very high, high and medium in available nitrogen content irrespective of analyses by both the methods using '*Dharti ka Doctor*' and soil analyzed following the standard procedures in the laboratory (**Table 4**). Both the analytical procedures showed more than 95% similarity in all soil classes of available nitrogen content.

Table 4. Comparison of the methods of available nitrogen class for soil fertility rating

Group (kg ha^{-1})	Very Low (< 140)	Low (140–280)	Medium (280–560)	High (560–700)	Very high (>700)	Total
Dharti Ka Doctor	94	108	4	6	10	222
Standard laboratory procedure	98	114	4	6	10	232
Similarity (%)	95.9	94.7	100.0	100.0	100.0	95.7
P (%)	0.04	0.28	1	1	1	0.12
Sample distribution (%)	42.2	49.1	1.7	2.6	4.3	100

3.5 Available phosphorus

About 37.1, 29.3 and 29.3% samples were in medium, high and very high range, respectively. Only 2.6 and 1.7% of sample were low and very low in available phosphorous content. Across the category both the method of analyses using '*Dharti ka Doctor*' and soil analyzed by following the standard procedures in the laboratory had similar results (**Table 5**). Both the analytical procedures showed more than 91.9, 95.6 and 97.1% similarity for medium, high and very high and 66.6 and 75% similarity for low and very low soil classes of available phosphorous content.

Table 5. Comparison of the methods of available phosphorous class for soil fertility rating

Group (kg ha^{-1})	Very Low (< 5)	Low (5–10)	Medium (10–25)	High (25–40)	Very high (> 40)	Total
Dharti Ka Doctor	3	4	79	65	66	213
Standard laboratory procedure	4	6	86	68	68	232
Similarity (%)	75.0	66.6	91.9	95.6	97.1	91.8
P (%)	0.69	0.7	0.9	0.8	0.9	0.98
Sample distribution (%)	1.7	2.6	37.1	29.3	29.3	100

3.6 Available potassium

The samples used for analysis were distributed in all the categories except in very low. Different categories were represented by about 53.4, 26.7, 10.3 and 9.5% samples in medium, high, very low and low range, respectively. All the categories were having high similarity by both the methods of analyses using '*Dharti ka Doctor*' and soil analyzed by following the standard procedures in the laboratory (**Table 6**). Both the analytical procedures showed 88.7% and above similarity for soil classes of available potassium content.

Table 6. Comparison of the methods of available potassium class for soil fertility rating

Group (kg ha^{-1})	Very Low (< 60)	Low (60–120)	Medium (120-280)	High (280–560)	Very high (> 560)	Total
Dharti Ka Doctor	0	20	115	55	24	214
Standard laboratory procedure	0	22	124	62	24	232
Similarity (%)	NA	90.9	92.7	88.7	100.0	92.2
P (%)	NA	0.15	1	0.69	1	0.87
Sample distribution (%)	0.0	9.5	53.4	26.7	10.3	100

NA: not applicable

3.7 Available sulphur

A large number of sample (81.5%) had sufficient available S irrespective of analyses both soil testing machine '*Dharti ka Doctor*' (189) and soil analyzed by following the standard procedures in the laboratory (189) (**Table 7**). Rest of the sample ~18.5% showed deficient in available S. Both the analytical procedure showed 95.3 and 100% similarity for soil classes deficient and sufficient in available S.

Table 7. Comparison of the methods of available sulphur class for soil fertility rating

Group ($mg\ kg^{-1}$)	Deficient (<10)	Sufficient (>10)	Total
Dharti Ka Doctor	41	189	230
Standard laboratory procedure	43	189	232
Similarity (%)	95.3	100.0	99.1
P (%)	0.04	1	0.62
Sample distribution (%)	18.5	81.5	100

3.8 Available boron

About 56.9% soil sample were in deficient and 43.1% sufficient in available B irrespective of analyses both soil testing kit machine '*Dharti ka Doctor*' and soil analyzed by following the standard procedures in the laboratory (**Table 8).** Both the analytical procedure showed 92.0 and 98.5% similarity for sufficient and deficient in available B in soil classes.

Table 8. Comparison of the methods of available boron class for soil fertility rating

Group ($mg\ kg^{-1}$)	Deficient (<0.5)	Sufficient (>0.5)	Total
Dharti Ka Doctor	130	92	222
Standard laboratory procedure	132	100	232
Similarity (%)	98.5	92.0	95.7
P (%)	0.4	1	0.67
Sample distribution (%)	56.9	43.1	100

3.9 Available Zn

About 64.7% soil samples were deficient and 35.3% were sufficient in available (DTPA) Zn irrespective of analyses by both the methods using soil testing kit '*Dharti ka Doctor*' and soil analyzed by following the standard procedures (DTPA Zn) in the laboratory (STV) (**Table 9).**

Both the analytical procedure showed 93.9 and 96.7% similarity for sufficient and deficient in available Zn in both soil classes.

Table 9. Comparison of the methods of available zinc (DTPA Zn) class for soil fertility rating

Group (mg kg^{-1})	Deficient (<0.6)	Sufficient (>0.6)	Total
Dharti Ka Doctor	145	77	222
Standard laboratory procedure	150	82	232
Similarity (%)	96.7	93.9	95.7
P (%)	0.06	0.06	1
Sample distribution (%)	64.7	35.3	100

3.10 Available Cu

All the soil sample were sufficient in available Cu irrespective of analyses both soil testing kit machine '*Dharti ka Doctor*' and soil analyzed by following the standard procedures (DTPA Cu) in the laboratory (STV) (**Table 10).** Both the analytical procedure showed 100% similarity in available Cu in soil classes.

Table 10. Comparison of the methods of available copper (DTPA Cu) class for soil fertility rating

Group (ppm)	Deficient (<0.2)	Sufficient (>0.2)	Overall
Dharti ka Doctor	0	232	232
Standard laboratory procedure	0	232	232
Similarity (%)	NA	100.0	100.0
P (%)	NA	1	1
Sample distribution (%)	0.0	100.0	100

NA: not applicable

3.11 Available Fe

Soil sample were present in both the categories. About 80.2% had sufficient and 19.8% in deficient in available Fe estimated by bothe the methods using '*Dharti ka Doctor*' and soil analyzed by following the standard procedures (DTPA Fe) in the laboratory (**Table 11).** Both the analytical procedure showed 97.8 and 93.5% similarity for sufficient and deficient in available Fe in soil classes.

Table 11. Comparison of the methods of available iron (DTPA-Fe) class for soil fertility rating

Group (mg kg^{-1})	Deficient (<5)	Sufficient (>5)	Total
Dharti Ka Doctor	43	182	225
Standard Laboratory procedure	46	186	232
Similarity (%)	93.5	97.8	97.0
P (%)	0.6	0.5	0.81
Sample distribution (%)	19.8	80.2	100

3.12 Available Mn

All the soil sample were sufficient in available Mn irrespective of analyses both soil testing machine '*Dharti ka Doctor*' and soil analyzed by following the standard procedures (DTPA Mn) in the laboratory (**Table 12).** Both the analytical procedure showed cent present similarity in available Mn in soil classes.

Table 12. Comparison of the methods of available manganese (DTPA Mn) class for soil fertility rating

Group (mg kg^{-1})	Deficient (<2)	Sufficient (>2)	Total
Dharti Ka Doctor	2	230	232
Standard laboratory procedure	2	230	232
Similarity (%)	100.0	100.0	100.0
P (%)	1	1	1
Sample distribution (%)	0.9	99.1	100

3. SUMMARY AND CONCLUSION

The soil health card parameters analysed for 116 samples in duplicate showed similarity in the soil fertility rating developed by both soil testing methods namely soil testing machine '*Dharti ka Doctor*' and soil analyzed following the standard procedures in the laboratory. Parameter wise results are summarized as below:

(i) Soil pH and electrical conductivity showed 95.3%, and 100% similarity, respectively.

(ii) Soil organic carbon, available nitrogen, phosphorus, and potassium showed 91.8–95.7%, similarity in different soil fertility classes.

(iii) The available sulphur and available boron showed 99.1 and 95.7% similarity, respectively.

(iv) The available Zn, Cu, Fe and Mn showed 95.7–100% similarity by both methods.

The DKD interface installed in the machine provides a holistic solution for soil management and the issue the customezed Soil Health Cards depending upon the soil fertility rating and choice of crop and sorces of nutrients available with farmer. The application is equipped to support a range of languages, including Hindi and English, as well as additional languages such as Punjabi, Kannada, Telugu, Tamil, Marathi, Bengali, Gujarati, Malayalam, Assamese, and Oriya. This extensive linguistic support ensures that users from diverse language backgrounds can effectively engage with and benefit from the machine.

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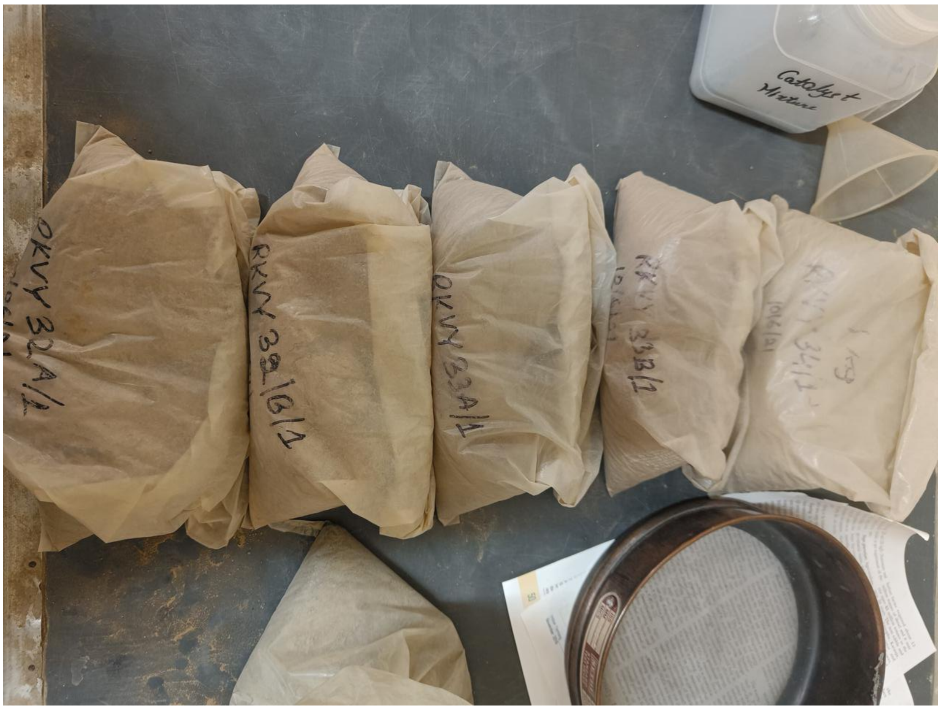
6. PHOTO GALLERY

Automated Soil Testing Machine '*Dharti Ka Doctor*'

Baharua technical staff Demonstrating Soil testing procedure using automated soil testing machine '*Dharti ka Doctor*'

Reagent used for the analysis using *Dharti ka Doctor*’



Sample processing for analysis

Preparation of soil samples for analysis

Samples ready for reading by the *Dharti ka Doctor*'

Values of the soil parameters used for the fertility rating for fertilizer recommendation

Parameters	Class (weight)				
	Very Low (1)	Low (2)	Medium (3)	High (4)	Very high (5)
Walkley Black organic carbon (%)	<0.25	0.25-0.5	0.5-0.75	0.75-1.0	>1.0
Available Nitrogen (kg ha^{-1})	<140	140-280	280-560	560-700	>700
Available P (kg ha^{-1})	<5	5-10	10-25	25-40	>40
Available K (kg ha^{-1})	<60	60-120	120-280	280-560	>560

Values of the soil parameters used for the pH and soil salinity rating for fertilizer recommendation

pH (1:2 soil: water)		
Class	Weight	Range
Strongly Alkaline	1	>8.5
Moderately Alkaline	2	7.1-8.5
Neutral	3	7
Slightly Acidic	–1	6.6-6.9
Moderately Acidic	–2	5.6-6.5
Highly Acidic	–3	4.6-5.5
Strongly Acidic	–4	3.5-4.6
Acid sulphate	–5	<3.5
EC (1:2 soil: water)		
Class	Weight	Range (ds m^{-1})
Salt free	4	0-2
Slightly saline	3	4-8
Moderately saline	2	8-15
Highly saline	1	>15

Values of the soil parameters used for the Sulphur and micronutrients rating for fertilizer recommendation

Nutrients (mg kg^{-1})	Class (weight)	
	Deficient (1)	Sufficient (2)
Available S	<10	>10
Available B	<0.5	>0.5
Available Zn	<0.6	>0.6
Available Cu	<0.2	>0.2
Available Fe	<5	>5
Available Mn	<2	>2

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Report of Evaluation of Automated Soil Testing Machine

Technical Support and design by
Sh. Yudhvir Singh Ahlawat

For more information visit: www.cssri.res.in

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