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RESEARCH PAPER

Evaluation of soil fertility status of adopted villages in Hoshiarpur district of Punjab

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Abstract : Krishi Vigyan Kendra, Hoshiarpur analyzed 267 geo referenced soil samples from the adopted villages *viz.*, Todarpur, Bachhohi, Budhabar, Chaggran and Jhonowal to determine the soil fertility status. The soil parameters *i.e.* soil pH, soil organic carbon, available phosphorus, available potassium, available zinc, available iron, available manganese and available copper were determined. The soil pH varied from 6.5-9.3. Maximum soil samples *i.e.* 100 per cent from villages Bachhohi, Chaggran and Jhonowal fall under neutral category and 47.8 per cent soil samples from village Todarpur belong to moderately alkaline category. The electrical conductivity of the soil samples of different villages ranged from 0.16-0.67 mmhos/cm. In case of soil organic carbon, 36.8 per cent soil samples from village Bachhohi fall under low soil organic carbon category, 68.3 per cent soil samples from village Jhonowal fall under medium soil organic carbon category and 72.5 per cent soil samples from village Todarpur fall under high soil organic carbon category. The minimum available phosphorus (4.4 kg/acre) in the soil samples was observed in the village Bachhohi while maximum available phosphorus (13.8 kg/acre) was observed in the soil samples of village Budhabar. The soil samples of different villages except Budhabar fall under low potassium category. Majority of the soil samples from different villages belong to normal zinc and iron category. The available manganese from different villages ranged from 0.98-48.18 kg/acre. All the soil samples from different villages belong to normal copper category.

Key Words : Adopted villages, Soil pH, Soil organic carbon, Available phosphorus, Available potassium

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INTRODUCTION

The Punjab comprising 1.53 per cent of the total geographical area of the country is producing 20-30 per cent of wheat, 10-12 per cent of rice, 9-11 per cent of cotton, 20-30 per cent of honey, 45-50 per cent of mushroom and 9-10 per cent of milk of the country production. The Punjab State became the main producer of food grains (from 3.16 million tonnes in 1960-61 to 26 million tonnes in 2007-08) and still maintaining the lead. Consequently the major cropping system in this state is rice-wheat, spread over 60 per cent of the cultivated area; and the average productivity of rice (unhusked Paddy) and wheat is 6.0 and 4.7 t/ha, respectively which is considered almost at par with those of the developed countries. The cropping intensity, irrigated area, number of tube-wells, number of tractors and fertilizer use is

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188 per cent, 97 per cent, 12.7 lakh, 4.59 lakh and 236.4 kg/ha, respectively (Gill, 2011). It has been estimated that a productivity of 10.5 t/ha exhausts 600-700 kg/ha $N\text{-}P_2O_5\text{-}K_2O$ while the addition through the recommended dose is only 390 kg/ha. Such a negative balance cumulatively affects soil health. Secondly, on account of decontrol use of phosphorus and potassium fertilizers, the $N\text{-}P_2O_5\text{-}K_2O$ is being used in the proportion of 18.4:5.9:1 against the recommended ratio of 4:2:1 is another serious concern (Gill, 2012). In production agriculture, soil nutrients get depleted with time and farmer's tendency of over usage of fertilizers has already been observed. Farmers generally apply over dose of nitrogen and phosphorus fertilizer than recommended rates and at the same time ignore the replenishment of other nutrients especially micronutrients. Such an imbalanced use of fertilizer not only induces the deficiency of potassium, sulphur and micronutrients in the soil, but it also proves uneconomic and environmentally unsafe (Shukla *et al.*, 2003). Actually, due to intensive cultivation and excessive application of chemical fertilizers, irrigation and pesticides, soils have become deficient in most of macro as well as micronutrients resulting in stagnation or declined yield. The organic matter status in soils is declining regularly, which influences almost all the component of soil and decline crop productivity (Dhaliwal *et al.*, 2013). Above factors, in turn have considerably decreased the productivity potential of rice-wheat cropping system. Moreover, scientists have registered a negative balance of nutrients in Punjab soils after harvest of these two crops (Dhaliwal *et al.*, 2013).

More important is the adoption of integrated nutrient management approach. The substitution of 25 per cent nitrogen through organic source may help to recuperate the soil health by improving the soil fertility. The farmers need to be acquainted about the re-cycling of the crop residue either by mixing into the soil or by making the compost. There is a time gap of three months after harvesting of wheat and sowing of *Kharif* crops. This period can be beneficially utilized by growing green manure or summer mungbean. The research investigations have revealed that incorporation of green manure before paddy transplanting helps to save 50 per cent of the applied nitrogen. Likewise the incorporation of the pulse crop residue after picking the pods increases the organic matter into the soil hence, saves 33 per cent nitrogen (Gill, 2012). Similarly, the beneficial effect of farm yard manure can be accrued if supplemented with chemical fertilizer.

The balanced use of nutrients needs to be encouraged by creating awareness among the farming community. The availability of macro and micronutrients to plants is influenced by several soil characteristics. A detailed study on status of macro nutrients had been conducted in the five adopted villages of Krishi Vigyan Kendra, Hoshiarpur *viz.*, Todarpur, Jhonowal, Bachhohi, Chaggran and Budhabar.

MATERIAL AND METHODS

A total of 267 geo-referenced soil samples were collected at 0-15 cm with the help of an auger during *Kharif* 2017 and latitude and longitude of the sampling sites were recorded using global positioning system (GPS). The location of the adopted villages is shown in Fig. A. Table A shows the village wise number of soil samples collected for macronutrient and micronutrient analysis. The samples were air-dried, ground, passed through 2-mm sieve and stored in properly labelled plastic bags for analysis. The pH and EC of the soils were determined in 1:2 soil-water suspensions using a glass electrode pH meter and conductivity meter respectively (Jackson, 1973). The organic carbon was determined

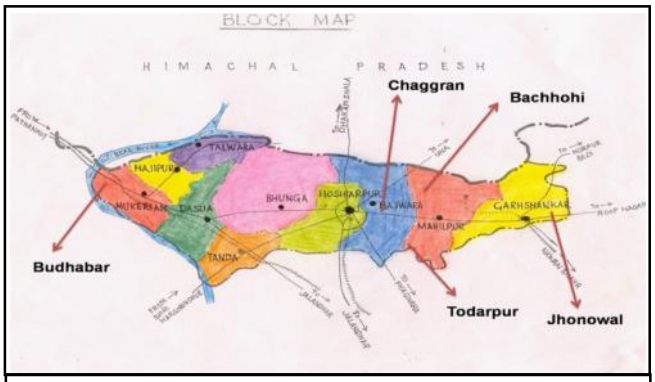

Fig. A : Location map of adopted villages

Table A: Details of soil samples collected in adopted villages of district Hoshiarpur

Village	No. of soil samples
Jhonowal	62
Bachhohi	69
Chaggran	40
Todarpur	70
Budhabar	26
Total	267

by wet digestion method (Walkley and Black, 1934). The available phosphorus (P) in the soil was extracted by employing Olsen extractant (0.5M $NaHCO_3$, pH 8.5) as described by Olsen *et al*. (1954) and the available potassium (K) was extracted by using neutral ammonium acetate and the content was determined by aspirating the extract into flame photometer (Jackson, 1973). The plant available Fe, Cu, Zn and Mn in soil samples were extracted with DTPA (0.005 M DTPA + 0.01 M $CaCl_2$ + 0.1 M triethanolamine, pH 7.3) as per method described by Lindsay and Norvell (1978) and concentration of Fe, Cu, Zn and Mn in the DTPA extract was determined using atomic absorption spectrophotometer (AAS).

RESULTS AND DISCUSSION

The data recorded of various soil parameters of different villages are described in Table 1. The macro and micro nutrient analysis of soil samples from different villages of district Hoshiarpur was done.

Macro nutrient analysis of soil samples:

The graphical representation of macro nutrients having mean values of soil organic carbon (%), available phosphorus and available potassium is shown in Fig. 1.

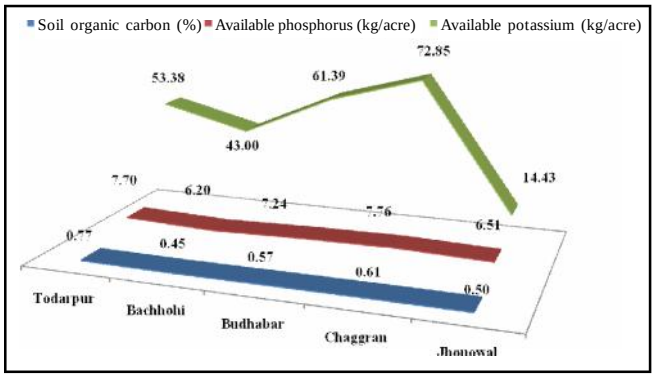

Fig. 1 : Macro nutrient analysis of soil samples

Soil pH:

Based on soil pH, the soil samples are categorized into three categories *viz.*, neutral category having soil pH 6.5-8.7; moderately alkaline category having soil pH values ranges from 8.8-9.3 and alkaline category having soil pH value greater than 9.3. After testing the soil samples, the soil pH values of soil samples of different villages ranged from 6.5-9.3. The minimum soil pH value (6.5) was observed in the soil samples of village Bachhohi while maximum soil pH value (9.3) was observed in village Todarpur. The mean pH values of 8.52, 7.45, 7.62, 7.04 and 7.08 were observed in villages Todarpur, Bacchohi, Budhabar, Chaggran and Jhonowal, respectively. In Todarpur village, 52.2 per cent soil samples fall under neutral category, while 47.8 per cent soil samples fall under moderately alkaline category. In Bachhohi, Chaggran and Jhonowal village, all the soil samples belong to neutral category. In Budhabar village, majority of soil samples (96.0%) belong to neutral category while 4 per cent soil samples falls under moderately alkaline category. Based on statistical analysis for soil pH, maximum co-efficient of variation (9.28%) was observed in the soil samples of village Budhabar while minimum co-efficient of variation (2.62%) was observed in village Chaggran.

Electrical conductivity:

The electrical conductivity of the soil samples of different villages ranged from 0.16-0.67 mmhos/cm. Minimum electrical conductivity value (0.16 mmhos/cm) was observed in village Budhabar while maximum value of electrical conductivity (0.67 mmhos/cm) was observed in village Todarpur. Based on statistical analysis for electrical conductivity, maximum co-efficient of variation (50.11%) was observed in the soil samples of village Budhabar while minimum co-efficient of variation (20.71%) was observed in village Todarpur.

Soil organic carbon:

Based on soil organic carbon, the soil samples are categorized into three categories *viz.*, low soil organic carbon category having soil organic carbon value less than 4 per cent; medium soil organic carbon category having soil organic carbon value ranges from 0.4 per cent-0.75 per cent and high soil organic carbon category having soil organic carbon value greater than 0.75 per cent. The soil organic carbon of soil samples of different villages ranged from 0.09-0.9 per cent. The minimum soil organic carbon (0.09%) was observed in village Bachhohi and Jhonowal while maximum soil organic carbon (0.9%) was observed in the soil samples of Chaggran.

In village Todarpur, soil analysis categorized 27.5 per cent soil samples under medium soil organic carbon category while 72.5 per cent soil samples under high soil organic carbon category. The analysis of soils of village Bachhohi revealed that 36.8 per cent soil samples belong to low soil organic carbon category, 57.4 per cent soil

Table 1 : Data of various soil parameters of different villages of Hoshiarpur district

Villages	Values	Soil parameters								
		Soil pH	Electrical conductivity (mmhos/cm)	Soil organic carbon (%)	Available phosphorus (kg/acre)	Available potassium (kg/acre)	Available zinc (kg/acre)	Available iron (kg/acre)	Available manganese (kg/acre)	Available copper (kg/acre)
Todarpur	Minimum	7.2	0.27	0.62	5.5	36.4	0.5	2.62	2.02	0.6
	Maximum	9.3	0.67	0.88	9.6	68.9	3.16	25.38	11.22	3.1
	Mean	8.52	0.46	0.77	7.70	53.38	1.96	15.20	3.81	1.79
	Median	8.60	0.45	0.78	7.8	53.2	2.04	14.94	3.4	1.86
	Mode	9.0	0.39	0.8	9.2	50.9	2.5	10.96	3.04	1.6
	Standard deviation	0.59	0.10	0.06	1.14	7.62	0.67	4.23	1.33	0.55
	Variance	0.35	0.01	0.00	1.30	58.01	0.45	17.85	1.76	0.31
	Co-efficient of variation	6.91	20.71	7.18	14.79	14.27	34.17	27.79	34.82	30.92
Bachhohi	Minimum	6.5	0.22	0.09	4.4	14.4	0.34	1.14	0.98	0.20
	Maximum	8.7	0.55	0.86	12.2	60.7	6.60	39.40	23.94	18.80
	Mean	7.45	0.35	0.45	6.20	43.00	1.03	6.90	5.04	1.28
	Median	7.40	0.30	0.44	5.90	42.45	0.74	4.90	3.58	0.48
	Mode	7.40	0.26	0.60	5.90	57.20	0.62	4.90	1.60	0.46
	Standard deviation	0.45	0.10	0.17	1.22	10.32	1.03	7.72	4.61	3.59
	Variance	0.20	0.01	0.03	1.49	106.48	1.05	59.66	21.24	12.89
	Co-efficient of variation	6.02	29.42	38.99	19.73	24.00	99.83	111.93	91.42	280.42
Budhabar	Minimum	6.70	0.16	0.26	4.60	53.80	0.38	0.32	2.16	1.20
	Maximum	9.10	0.61	0.85	13.80	70.20	3.56	45.44	48.18	3.38
	Mean	7.62	0.28	0.57	7.24	61.39	2.03	30.38	11.91	2.14
	Median	7.50	0.20	0.53	6.80	60.40	2.24	39.58	4.48	2.12
	Mode	7.40	0.20	0.52	6.40	59.60	1.94	42.70	2.34	2.00
	Standard deviation	0.71	0.14	0.17	1.97	4.01	0.93	16.52	14.41	0.54
	Variance	0.50	0.02	0.03	3.89	16.09	0.87	272.81	207.76	0.29
	Co-efficient of variation	9.28	50.11	29.23	27.24	6.53	46.05	54.36	121.04	25.13
Chaggran	Minimum	6.7	0.3	0.1	4.7	43.8	0.52	2.32	5.50	0.60
	Maximum	7.4	0.6	0.9	16.1	235.2	3.42	31.98	22.70	2.28
	Mean	7.04	0.39	0.61	7.76	72.85	1.70	12.51	15.23	1.17
	Median	7.00	0.36	0.72	7.90	58.40	1.48	9.88	15.48	1.06
	Mode	6.90	0.36	0.80	8.30	52.70	2.80	7.06	16.46	1.30
	Standard deviation	0.18	0.08	0.24	2.57	39.56	0.97	8.37	4.78	0.38
	Variance	0.03	0.01	0.06	6.60	1564.61	0.95	70.01	22.85	0.15
	Co-efficient of variation	2.62	21.67	39.25	33.13	54.30	57.22	66.90	31.38	32.76
Jhonowal	Minimum	6.6	0.26	0.09	4.8	7.4	0.16	2.56	2.18	0.22
	Maximum	7.9	0.61	0.76	12.3	48.3	2.24	31.92	26.48	1.86
	Mean	7.08	0.34	0.50	6.51	14.43	0.69	17.08	11.29	1.08
	Median	7.00	0.32	0.55	5.55	11.75	0.60	18.29	9.10	1.04
	Mode	6.90	0.29	0.59	4.80	9.00	0.50	24.42	8.38	1.02
	Standard deviation	0.23	0.07	0.19	2.18	8.15	0.40	7.96	6.48	0.31
	Variance	0.05	0.01	0.04	4.77	66.48	0.16	63.37	42.02	0.10
	Co-efficient of variation	3.24	21.10	38.69	33.53	56.49	58.37	46.61	57.42	29.02

samples belong to medium soil organic carbon category and 5.9 per cent soil samples belong to high soil organic carbon category. In village Budhabar, 12.0 per cent soil samples fall under low soil organic carbon category, 68.0 per cent soil samples fall under medium soil organic carbon category and 20.0 per cent soil samples fall under high soil organic carbon category. In village Chaggran, 41.0 per cent soil samples fall under high soil organic carbon category followed by 35.9 per cent soil samples under medium soil organic carbon category and 23.1 per cent soil samples fall under low soil organic carbon category. In village Jhonowal, majority soil samples (68.3%) belong to medium soil organic carbon followed by 30.0 per cent soil samples belong to low soil organic carbon category and 1.7 per cent soil samples fall under high soil organic carbon category. Based on statistical analysis for soil organic carbon, maximum co-efficient of variation (39.25%) was observed in the soil samples of village Chaggran while minimum co-efficient of variation (7.18%) was observed in village Todarpur.

Available phosphorus:

Based on available phosphorus, the soil samples are categorized into four categories *viz.*, low phosphorus category having value of available phosphorus less than 5kg/acre, medium phosphorus category having value of available phosphorus ranges from 5-9 kg/acre, high phosphorus category having value of available phosphorus ranges from 9-20kg/acre and very high phosphorus category having value of available phosphorus greater than 20kg/acre. The available phosphorus of soil samples of different villages ranged from 4.4-13.8kg/acre. The minimum available phosphorus (4.4 kg/acre) in the soil samples was observed in the village Bachhohi while maximum available phosphorus (13.8 kg/acre) in the soil samples of village Budhabar.

In Todarpur, 81.2 per cent soil samples belong to medium phosphorus category while 18.8 per cent soil samples belong to high phosphorus category. In village Bachhohi, majority of soil samples (88.2%) fall under medium phosphorus category, followed by 7.4 per cent soil samples falling under low phosphorus category and 4.4 per cent soil sample falling under high phosphorus category. In village Budhabar, 72.0 per cent soil samples belong to medium phosphorus category, 16.0 per cent soil samples belong to high phosphorus category and 12.0 per cent soil samples belong to low phosphorus category. In village Chaggran, majority of soil samples (64.1%) belong to medium phosphorus category followed by 25.6 per cent soil samples belonging to high phosphorus category and 10.3 per cent soil samples belong to low phosphorus category. In village Jhonowal, 66.7 per cent soil samples belong to medium phosphorus category, 21.7 per cent soil samples belong to low phosphorus category and 11.7 per cent soil samples belong to high phosphorus category. Based on statistical analysis for available phosphorus, maximum co-efficient of variation (33.53%) was observed in the soil samples of village Jhonowal while minimum co-efficient of variation (14.79%) was observed in village Todarpur.

Available potassium:

Based on available potassium, the soil samples are categorized into two categories *viz*., low potassium category having value of available potassium less than equal to 55 kg/acre and normal potassium category having value of available potassium greater than 55 kg/acre. The soil available potassium of soil samples of different villages ranged from 7.4-235.2 kg/acre. The minimum soil available potassium (7.4kg/acre) was observed in village Jhonowal while maximum soil available potassium (235.2 kg/acre) was observed in the soil samples of Chaggran.

Soil analysis categorized 50.7 per cent soil samples under low potassium category and 49.3 per cent soil samples under normal potassium category for Todarpur village. The analysis of soil samples of village Bachhohi revealed that 86.8 per cent soil samples fall under low potassium category and 13.2 per cent soil samples fall under medium potassium category. In village Budhabar, 4.0 per cent soil samples fall under low potassium category and 96.0 per cent soil samples fall under normal potassium category. In Chaggran, 35.9 per cent soil samples fall under low potassium category and 64.1 per cent soil samples fall under normal potassium category. All the soil samples in village Jhonowal belong to low potassium category. Based on statistical analysis for available potassium, maximum co-efficient of variation (56.49%) was observed in the soil samples of village Jhonowal while minimum co-efficient of variation (6.53%) was observed in village Budhabar.

The graphical representation of micro nutrients having mean values of available zinc (kg/acre), available iron (kg/acre), available manganese (kg/acre) and available copper (kg/acre) is shown in Fig. 2.

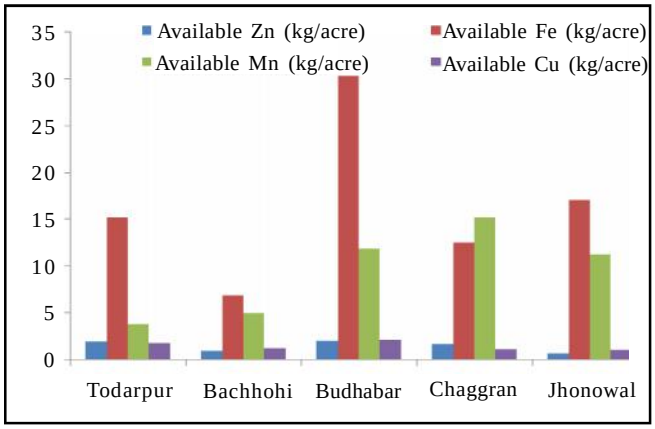

Fig. 2 : Micro nutrient analysis of soil samples

Available zinc:

Based on available zinc, the soil samples are categorized into two categories *viz.*, deficient zinc category having value of available zinc less than 0.6 kg/acre and normal zinc category having value of available zinc greater than equal to 0.6 kg/acre. The soil available zinc of soil samples of different villages ranged from 0.16-6.60 kg/acre. The minimum soil available zinc (0.16 kg/acre) was observed in village Jhonowal while maximum soil available zinc 6.60 kg/acre) was observed in the soil samples of Bachhohi. Majority of the soil samples *i.e*. 98.6 per cent from village Todarpur, 64.7 per cent from village Bachhohi, 88.0 per cent from village Budhabar, 92.0 per cent from village Chaggran and 53.3 per cent soil samples from village Jhonowal belong to normal zinc category. The co-efficient of variation (34.17%) for available zinc was minimum for village Todarpur.

Available iron:

Based on available iron, the soil samples are categorized into two categories *viz.*, deficient iron category having value of available iron less than 4.5 kg/acre and normal iron category having value of available iron greater than equal to 4.5 kg/acre. Minimum value of available iron (0.32 kg/acre) and maximum value of available iron (45.44 kg/acre) was observed in the soil samples from village Budhabar. Majority of the soil samples *i.e*. 98.6 per cent from village Todarpur, 62.7 per cent from village Bachhohi, 88.0 per cent from village Budhabar and Chaggran and 96.7 per cent from village Jhonowal belong to normal iron category. The co-efficient of variation (27.79%) for available iron was minimum for village Todarpur.

Available manganese:

Based on available manganese, the soil samples are categorized into two categories *viz.*, deficient manganese category having value of available manganese less than 3.5 kg/acre and normal manganese category having value of available iron greater than equal to 3.5 kg/acre. Minimum value of available manganese (0.98 kg/acre) was determined in the soil samples from village Bachhohi while maximum value of available manganese (48.18 kg/acre) was observed in the soil samples from village Budhabar. In Todarpur, 52.2 per cent soil samples fall under deficient manganese category and rest 47.8 per cent soil samples belong to normal manganese category. In Bachhohi village, 52.9 per cent soil samples belong to normal manganese category and 47.1 per cent belong to deficient manganese category. In Budhabar village, 68.0 per cent soil samples belong to normal manganese category while 32.0 per cent soil samples fall under deficient manganese category. All the soil samples from village Chaggran belong to normal manganese category. In village Jhonowal, majority (96.7%) of the soil samples fall under normal manganese category while rest of 3.3 per cent soil samples fall under deficient manganese category. The co-efficient of variation (31.38%) for available manganese was minimum for village Chaggran.

Available copper:

Based on available copper, the soil samples are categorized into two categories *viz.*, deficient copper category having value of available copper less than 0.2 kg/acre and normal copper category having value of available copper greater than equal to 0.2 kg/acre. Minimum value of available copper (0.20 kg/acre) and maximum value of available copper (18.80 kg/acre) was observed in the soil samples from village Bachhohi. All the soil samples from village Todarpur, Bachhohi, Budhabar, Chaggran and Jhonowal belong to normal copper category. Minimum co-efficient of variation (25.13%) for available copper was observed for village Budhabar.

Soil texture:

The soil texture for Todarpur, Bachhohi, Chaggran and Budhabar village is loamy sand and for Jhonowal village, the soil texture is of clay loam type.

REFERENCES

Dhaliwal, S.S., Walia, S.S., Walia, M.K. and Manchanda,

J.S. (2013). Build up of macro, micro and secondary nutrients in site specific nutrient management experiment under rice-wheat system. *Internat. J. Sci. Environ. & Technol.*, **2**(2):236-244.

Gill, M.S. (2011). Extension manual on farmers own innovations – Way to sustainability and profitability under Punjab conditions, Directorate of Extension Education, Punjab Agricultural University, Ludhiana, Punjab (India) pp. 1.

Gill, M.S. (2012). Growth, challenges and new initiatives. Souvenir of 7th National Conference on Krishi Vigyan Kendras-2012, Integrating Technologies and best practice. Punjab Agricultural University, Ludhiana, Punjab (India) pp. 19-21.

Jackson, M. L. (1973). *Soil chemical analysis.* Prentice Hall of India Pvt. Ltd., New Delhi, India.

Lindsay, W.L. and Norvell, W.L. (1978). Development of a DTPA soil test for zinc, iron, manganese and copper. *Soil Sci. Soc. America J.*, **42** : 421-428.

Olsen, S. R., Cole, C. V., Watanabe, F. S. and Dean, L. A. (1954). Estimation of available phosphorus in soils by extraction with $NaHCO_3$, USDA Cir.939. U.S. Washington.

Shukla, A.K., Sharma, S.K., Tiwari, R. and Tiwari, K.N. (2005). Nutrient depletion in the rice-wheat cropping system of the Indo-Gangetic plains. *Better Crops.*, **89** (2): 28-31.

Walkley, A. and Black, I.A. (1934). An examination of the Degtjareff method for determining soil organic matter and a proposed modification of the chronic acid titration method. *Soil Science* **37**: 29-38.