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Tanmoy Majhi
Research Scholar, Department of Soil and Water Engineering, Faculty of Agricultural Engineering, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal, India

Nabanita Sarkar
Research Scholar, Department of Soil and Water Engineering, Faculty of Agricultural Engineering, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal, India

Correspondence
Nabanita Sarkar
Research Scholar, Department of Soil and Water Engineering, Faculty of Agricultural Engineering, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal, India

Study on soil moisture variations in responding to Tensiometer and soil moisture meter with respect to gravimetric method

Tanmoy Majhi and Nabanita Sarkar

Abstract
The field experiment was conducted at the Instructional Farm of Faculty of Agricultural Engineering, BCKV, Mohanpur, Nadia, West Bengal during the year of 2017-18. In this study the volumetric soil moisture contents were calculated by using tensiometer, soil moisture meter and gravimetric method. The variations of volumetric soil moisture contents obtained from tensiometer and soil moisture meter were examined with respect to gravimetric method which was considered as reference method. It was estimated that the coefficient of variation (CV) and standard deviation (STD) were 0.237, 6.78 and 0.247, 6.59 respectively for tensiometer and soil moisture meter. The volumetric soil moisture by tensiometer and soil moisture meter were estimated from the equations of the curves, $y = 0.0091x^2 + 0.7791x + 7.0596$ and $y = -0.024x^2 + 2.3447x - 9.9318$ which were generated by plotting volumetric soil moisture content under tensiometer and soil moisture meter against volumetric soil moisture by gravimetric method (observed data). By using these developed equations the soil moisture data for tensiometer and soil moisture meter were estimated. The average of the observed soil moisture values by gravimetric method and estimated soil moisture under tensiometer and soil moisture meter were 29.48, 37.99 and 37.93 respectively. The difference of values was 8.51% and 5.45% higher in comparison to gravimetric method. Finally after statistical test the highest and lowest percentage deviation values calculated were 10.85, 8.02 and 12.86, 0.71 respectively for tensiometer and soil moisture meter.

Keywords: Tensiometer, soil moisture meter, gravimetric method, coefficient of Varaiation, and standard deviation

Introduction
One of the most important terminologies, “Soil moisture”, has long been of interest in agriculture but the availability. Of soil moisture measuring instrument has long been a serious problem because suitable apparatus has not been developed. Determination of soil moisture is one of the most difficult measurements required in the field of hydrology. Tensiometer measures the capillary tension of soil water over the range from zero to about one atmosphere. Since capillary tension is a function of the percentage of water in a soil, tensiometers are very useful as continuous reading instruments for estimating moisture content of soil in place. In drier soils at the higher tensions, tensiometers become inoperative due to the entry of air through the porous point. Tensiometer, soil moisture meter and gravimetric method were evaluated for their response to changes in soil moisture content. In gravimetric method the original soil moisture content is calculated by weighing the soil sample before and after drying it. The gravimetric method is the oldest but still continues to be the most widely used method for obtaining data on soil moisture. Because it is the only direct way of measuring soil moisture, whereas Soil moisture meters measure the volumetric moisture content in soil since the direct gravimetric measurement of free soil moisture requires removing, drying, and weighting of a sample. Soil moisture meters, particularly digital type which provide instant reading, measure the volumetric water content by using some other property of the soil, such as dielectric constant, electrical resistance or as a proxy for the moisture content and the relation between the measured property and soil moisture may vary depending on environmental factors such as soil type, temperature, or electric conductivity. Measuring or monitoring soil moisture content can help to determine when to irrigate, how much water to apply, adequacy of wetting, patterns of soil moisture extraction by roots, and trends in increasing or decreasing soil moisture content with time [1]. Such information can help in improving crop yield, increase irrigation efficiency, stretch limited water supplies and reduce

Nonpoint-source pollution. Despite having the disadvantage of the gravimetric method is the time and effort required to obtain data but this method is concluded to be the most satisfactory method for most problems requiring onetime moisture-content data, whereas tensiometers are affected by temperature.

Material and methods

The field experiment was conducted at the Instructional Farm of Faculty of Agricultural Engineering, BCKV, Mohanpur, Nadia, West Bengal during the year of 2017-18. The rainfall during the monsoon months from June to September constitutes about 70 percent of the annual rainfall. Maximum rain occurs in the months of July-August. Temperature ranges from 27 ^{0}C to 42 ^{0}C (minimum to maximum) with a maximum humidity of 96 percent (Anonymous 2019) [2]. May is the hottest month of the year. The average temperature ranges from 37.6 ^{0}C to 25.4 ^{0}C during summer months and between 23.7 ^{0}C to 8.5 ^{0}C during winter months. Pre monsoon rain is common in the month of April – May. Monsoon stops by October. Nadia district has an average of 1300 mm annual rainfall and 160 – 170 rainy days each year. Daily Meteorological data from 29th March to 31 stmay 2018 were collected from Agricultural Meteorology and Physics Department, B.C.K.V., Mohanpur, Nadia. The soil physical characteristics were analyzed for soil's bulk densiy, porosity, textural class, water holding capacity and soil moisture versus tension. The soil sample was collected from the Instructional Farm of the site from the depth of (0-15) cm. In the experimental plot, furrows were made manually. A total number of 3 furrows were constructed. Brinjal crop was grown on the ridges of each furrow. Irrigation was done by taking evaporation and tensiometer reading on daily basis.

Table 1: The details of the plot are given as

Experimental plot area	10.8 m^2 (4.5 m X 2.4 m)
Furrow length	4.5 m
Furrow bottom width	3.0 m
Furrow top width	0.8 m
Furrow depth	0.25 m
Side slope	2: 1
Bed slope	0.2%
Furrow cross sectional area	0.163 m^2
Row to row spacing	1.0 m
Plant to plant spacing	0.6 m

Tensiometer preparation and installation

A tensiometer is basically a fluid filled plastic tube with a Porous Ceramic tip on one end with a vacuum gauge on the other. Tensiometer installation was done (few days after transplanting) after either irrigation or rainfall when the soil is moist. Soil moisture values recorded by different instrument were collected every day at 12:00 pm. Tensiometer reading was taken by installing the tensiometer at 15 cm depth. Total three tensiometers were installed in the experimental plot [4]. Unlike tensiometer soil moisture meter provide direct measurement of soil moisture. Lutron PMS-714 moisture meter was used for this purpose.

Soil moisture by gravimetric method

To measure the soil moisture by using gravimetric method soil samples were collected using auger. Collected samples were sent to soil laboratory and after drying the samples at 105 ^{0}C for 24 hours soil moisture values were obtained.

Results and discussion

Soil parameters

The Bouyoucous Hydrometer method of determination of soil texture revealed that the relative proportions of soil particles for the examined sample were: 37.3% of clay content, 27.8% of silt content and 38.3% of sand content. These percentages were located on a Soil Texture Triangle and the soil was classified as clay loam. The analysis of physical soil characteristics using the Soil Core Sampler yielded the following results: bulk density of 1.31 g/cm3, particle density of 2.58 g/cm3, porosity of 47.23% and maximum Water Holding Capacity of 48.3%.Volumetric soil moisture contents at various tensions as recorded using the Porous Plate apparatus

Estimation of soil moisture with the help of soil moisture characteristic curve

The volumetric soil moisture contents estimated using the equation $\Theta = 99.811\Psi - 0.213$ which we got from soil moisture characteristic curve [3].

Determination of volumetric soil moisture content measured by Gravimetric method

Volumetric moisture content is simply the ratio of water volume to soil volume and gravimetric moisture content measures weight rather than volume. So, after multiplying the gravimetric moisture content by bulk density of soil, the volumetric soil moisture content was obtained. As the bulk density of soil is 1.31gm/cm3, so the calculated volumetric soil moisture contents of different days are listed below (Table 2).

Table 2: Conversion of gravimetric moisture content to volumetric moisture content

Date	Soil moisture in dry wt. basis (%)	Soil moisture in Vol basis (%)
29-Mar	25.29	33.13
2-Apr	22.32	29.24
3-Apr	20.73	27.15
4-Apr	24.56	32.18
5-Apr	20.59	26.97
6-Apr	21.51	28.18
9-Apr	25.28	33.12
10-Apr	29.11	38.14
11-Apr	24.59	32.21
12-Apr	20.50	26.85
13-Apr	32.70	42.84
16-Apr	19.58	25.65
17-Apr	17.79	23.31
18-Apr	24.16	31.65
19-Apr	20.79	27.24

20-Apr	19.52	25.57
23-Apr	24.60	32.23
24-Apr	20.72	27.14
25-Apr	19.02	24.91
26-Apr	23.06	30.21
27-Apr	20.11	26.34
3-May	20.87	27.34
4-May	25.17	32.97
7-May	22.65	29.67
8-May	22.69	29.72
10-May	23.83	31.22
11-May	24.64	32.28
15-May	22.23	29.12
16-May	26.37	34.54
17-May	26.57	34.81
18-May	20.08	26.31
21-May	20.06	26.28
25-May	20.92	27.41
27-May	19.73	25.84
28-May	23.08	30.24
29-May	21.79	28.54
30-May	19.37	25.38
31-May	18.56	24.32

Soil moisture by using soil moisture meter

The volumetric soil moisture content recorded by digital soil moisture meter on different days.

Examination of variation of soil moisture

The variation of soil moisture with reference to gravimetric method was examined (Table 3).

Table 3: Variation of soil moisture (obtained from tensiometer) with reference to gravimetric method

Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8
Date	**No. of Days**	**Tensiometer (vol. m.c.)%**	**Vol. m.c. from gravimetric (%)**	**Standard Deviation**	**Mean of Col. 3 and Col. 4**	**RMSE***	**Coefficient of Variation (CV)**
29-Mar	1	44.36	33.13		38.745		
2-Apr	5	41.72	29.24		35.48		
3-Apr	6	39.79	27.15		33.47		
4-Apr	7	40.38	32.18		36.28		
5-Apr	8	39.24	26.97		33.105		
6-Apr	9	36.01	28.18		32.095		
9-Apr	12	50.28	33.12		41.7		
10-Apr	13	52.73	38.14		45.435		
11-Apr	14	43.38	32.21		37.795		
12-Apr	15	34.09	26.85		30.47		
13-Apr	16	56.06	42.84	6.78	49.45	9.205	0.2376
16-Apr	19	30.31	25.65		27.98		
17-Apr	20	34.49	23.31		28.9		
18-Apr	21	40.91	31.65		36.28		
19-Apr	22	32.37	27.24		29.805		
20-Apr	23	31.45	25.57		28.51		
23-Apr	26	48.04	32.23		40.135		
24-Apr	27	33.18	27.14		30.16		
25-Apr	28	30.11	24.91		27.51		
26-Apr	29	35.39	30.21		32.8		
27-Apr	30	35.39	26.34		30.865		
3-May	36	32.27	27.34		29.805		

* refer to Root Mean Squared Error (RMSE)= $\sqrt{\frac{1}{n}\sum_{i=1}^{n}(h_{oi}-h_{pi})^2}$, where $(h_{oi}-h_{pi})$ = Col 3- Col 4

4-May	37	37.73	32.97		35.35
7-May	40	36.42	29.67		33.04
8-May	41	38.83	29.72		34.27
10-May	43	36.11	31.22		33.66
11-May	44	41.04	32.28		36.66
15-May	48	36.17	29.12		32.64
16-May	49	44.83	34.54		39.68
17-May	50	39.35	34.81		37.08
18-May	51	34.59	26.31		30.45
21-May	54	31.34	26.28		28.81
25-May	58	35.39	27.41		31.4
27-May	60	31.34	25.84		28.59
28-May	61	40.38	30.24		35.31
29-May	62	36.67	28.54		32.60
30-May	63	33.56	25.38		29.47
31-May	64	31.29	24.32		27.80

The estimated CV value 0.2376 indicates a relatively low value, so this CV Value may be acceptable to develop the method of correction [5].

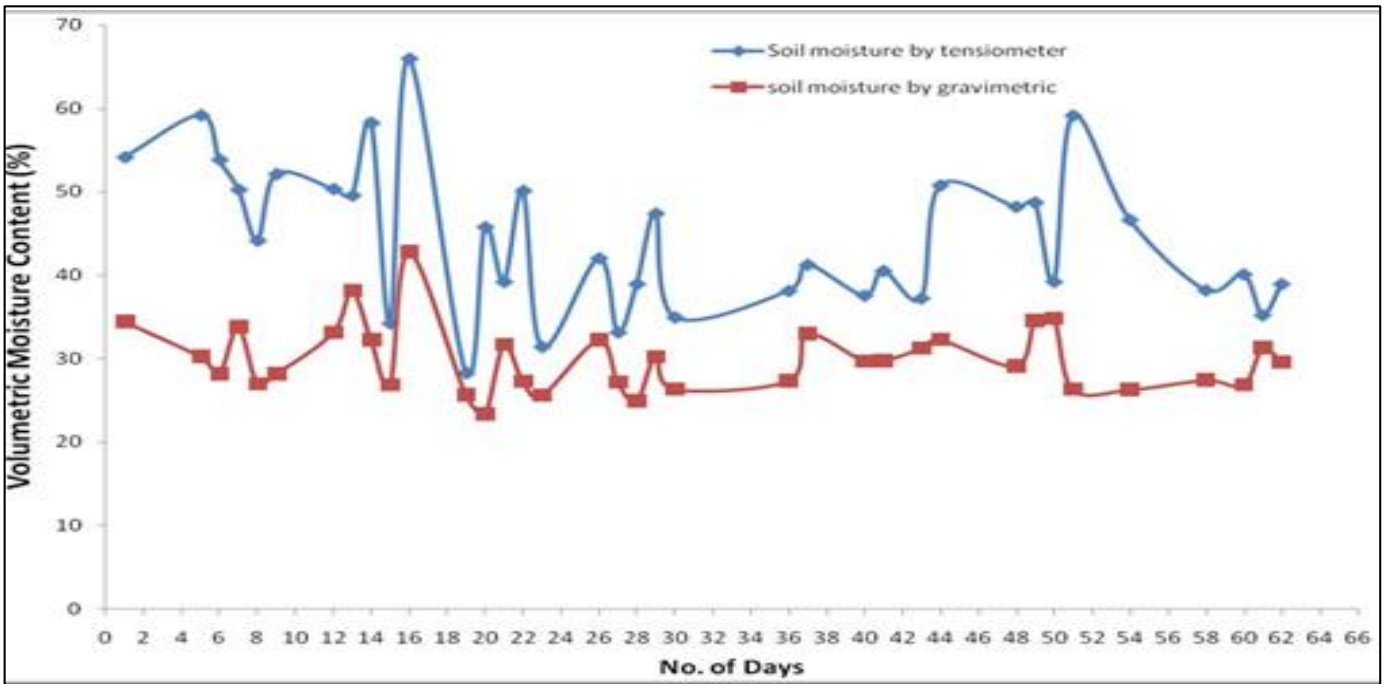

Fig 1: Variation of soil moisture (obtained from tensiometer) with reference to gravimetric method.

Table 4: Variation of soil moisture (obtained from tensiometer) with reference to gravimetric method

Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8
Date	**No. of Days**	**Moisture meter readings (%)**	**Vol. m.c. from gravimetric (%)**	**Standard Deviation**	**Mean of Col. 3 and Col. 4**	**RMSE**	**Coefficient of Variation (CV)**
29-Mar	1	45.8	33.13	6.5902	39.465	9.767	0.247
2-Apr	5	46.7	29.24		37.97		
3-Apr	6	40.5	27.15		33.825		
4-Apr	7	47.6	32.18		39.89		
5-Apr	8	41.5	26.97		34.235		
6-Apr	9	33.9	28.18		31.04		
9-Apr	12	39.45	33.12		36.285		
10-Apr	13	49.25	38.14		43.695		
16-Apr	19	34.52	25.65				30.085
17-Apr	20	31.8	23.31				27.555
18-Apr	21	38.7	31.65				35.175
19-Apr	22	39.5	27.24				33.37
20-Apr	23	43.45	25.57				34.51
23-Apr	26	45.75	32.23				38.99
24-Apr	27	34.1	27.14				30.62
25-Apr	28	26.8	24.91				25.855
26-Apr	29	37.85	30.21				34.03
27-Apr	30	41.65	26.34				33.995
3-May	36	29.48	27.34				28.41
4-May	37	34.25	32.97				33.61
7-May	40	36.84	29.67				33.255
8-May	41	33.45	29.72				31.585
10-May	43	31.35	31.22				31.285
11-May	44	34.6	32.28				33.44
15-May	48	38.12	29.12				33.62
16-May	49	48.5	34.54				41.52
17-May	50	36.3	34.81				35.555
18-May	51	36.75	26.31				31.53
21-May	54	37.5	26.28				31.89
25-May	58	35.54	27.41				31.475
27-May	60	32.87	25.84				29.355
28-May	61	41.6	30.24				35.92
29-May	62	34.17	28.54				31.355
30-May	63	33.56	25.38				29.47
31-May	64	31.29	24.32				27.805

The estimated CV value 0.247 indicates relatively low variation and standard deviation comes out 6.5902. This CV value and standard deviation value can be acceptable to develop the method of correction.

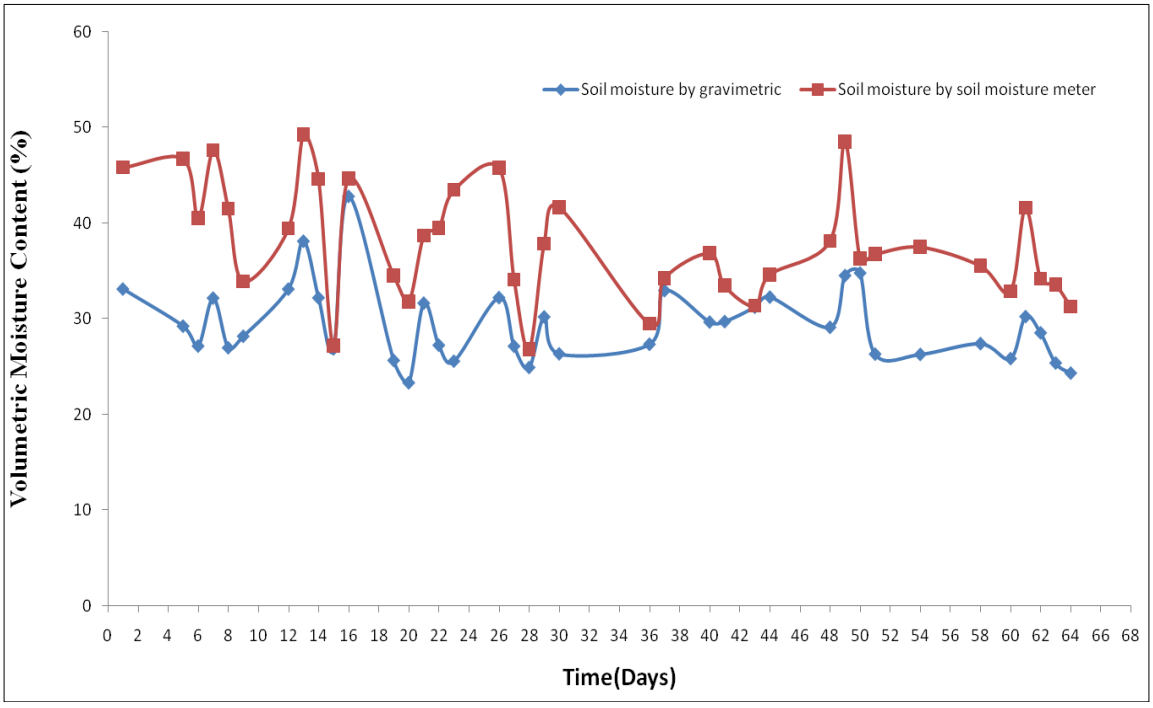

Fig 2: Variation of soil moisture (obtained from soil moisture meter) with reference to gravimetric

Development of the method of correction

The soil moisture data as recorded by tensiometer and soil moisture meter were processed to compare with soil moisture measured by gravimetric method. The gravimetric soil moisture vs soil moisture under tensiometer and gravimetric soil moisture vs soil moisture by soil moisture meter were tried to relate in linear, power, exponential and polynomial form of equation (fig 3, fig 4 and table 5, table 6.). Among these equations, the equations y = 0.0091x2 + 0.7791x + 7.0596 and y = -0.024x2 + 2.3447x - 9.9318 showed the best correlation by the least

Square values (R2) 0.768 and 0.323 which were the maximum among the equations, though the values do not prove any strong correlation. In general the difference of soil moisture percent as obtained from tensiometer and soil moisture meter with the soil moisture percent under gravimetric method are considerable [6]. Thus there is some reason to belief that the soil moisture characteristic curve used for calculating the soil moisture and the digital soil moisture readings are may be erroneous.

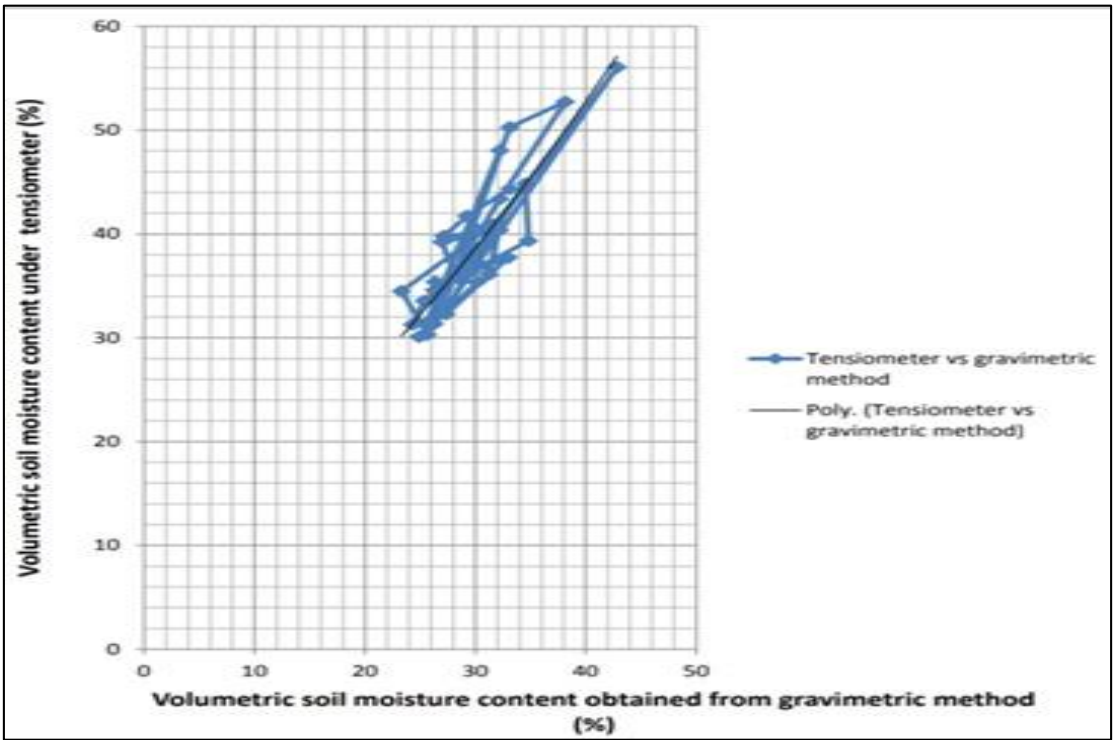

Fig 4: Volumetric soil moisture content under tensiometer vs volumetric

Soil moisture content obtained from gravimetric method from the Fig 4. The equation of the curve generated was y = 0.0091x2 + 0.7791x + 7.0596, where y represents volumetric Soil moisture content using tensiometer (%) and x represents volumetric soil moisture content using gravimetric method (%).

Table 4: Estimation of volumetric soil moisture value in case of tensiometer for different volumetric soil moisture content using gravimetric method

Observed data (volumetric soil moisture Values obtained from gravimetric method, %)	Estimated volumetric soil moisture content, %
33.13	42.75
29.24	37.53
27.15	34.84
32.18	41.45
26.97	34.62
28.18	36.16
33.12	42.73
38.14	49.86
32.21	41.49
26.85	34.46
42.84	56.95
25.65	32.96
23.31	30.11
31.65	40.73
27.24	34.96
25.57	32.86
32.23	41.52
27.14	34.83
24.91	32.05
30.21	38.81
26.34	33.82
27.34	35.08
32.97	42.53
29.67	38.09
29.72	38.16
31.22	40.15
32.28	41.58
29.12	37.38
34.54	44.70
34.81	45.08
26.31	33.78
26.28	33.75
27.41	35.17
25.84	33.20
30.24	38.85
28.54	36.62
25.38	32.63
24.32	31.33
Average = 29.48	Average = 37.99
Difference between average	8.51

Volumetric soil moisture contents using Soil moisture meter plotted against volumetric soil moisture content using Gravimetric method and equation y = -0.024x2 + 2.3447x - 9.9318 was generated.

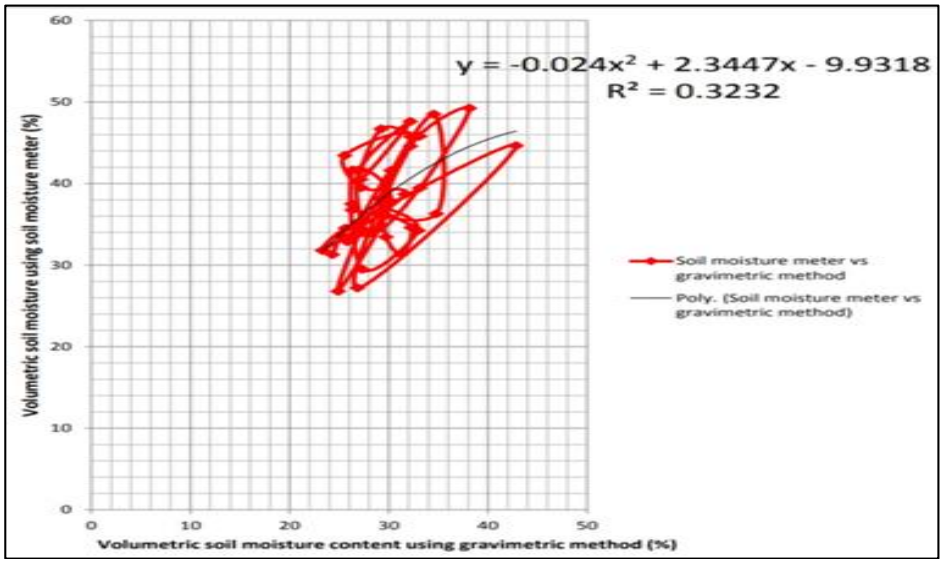

Fig 5: Volumetric soil moisture content under soil moisture meter vs volumetric soil moisture content by gravimetric method

Table 6: Estimation of volumetric soil moisture value in case of soil moisture meter for different volumetric soil moisture content using gravimetric method

Observed data (volumetric soil moisture values obtained from gravimetric method, %)	Estimated volumetric soil moisture content, %
33.13	41.38
29.24	38.09
27.15	36.02
32.18	40.65
26.97	35.83
28.18	37.06
33.12	41.38
38.14	44.56
32.21	40.67
26.85	35.70
42.84	46.44
25.65	34.40
23.31	31.67
31.65	40.22
27.24	36.11
25.57	34.31
32.23	40.69
27.14	36.01
24.91	33.57
30.21	38.98
26.34	35.16
27.34	36.21
32.97	41.26
29.67	38.49
29.72	38.53
31.22	39.86
32.28	40.73
29.12	37.97
34.54	42.40
34.81	42.58
26.31	35.13
26.28	35.09
27.41	36.29
25.84	34.61
30.24	39.00
28.54	37.42
25.38	34.10
24.32	32.88
Average = 29.48	Average = 37.93
Difference between average	8.45

From the above tables the one thing has come out clear that for a specific observed data i.e. volumetric soil moisture content (obtained from gravimetric method), the estimated volumetric soil moisture content in case of soil moisture meter and tensiometer was found out such way that for observed value of 28.18% the estimated volumetric soil moisture content in case of tensiometer and soil moisture meter came out 36.16% and 37.06% respectively.

Statistical test

Generated or estimated values of a particular parameter with respect to any category of model has often been compared With their counterparts based on observations. The comparison has been expressed as "percentage explained" and "percentage deviation" which has been determined as follows:

Percentage explained = [(ST – SE)/ST]*100

Where, ST= (Yobserved) 2 - (Yobserved/N) 2

SE = (Yobserved - Ygenerated) 2

In which y is any set of data as observed or estimated and N is the number of data sets.

Yobserved = Volumetric soil moisture content obtained from gravimetric method,

Ygenerated (t) = Generated volumetric soil moisture content obtained from tensiometer,

Ygenerated (s) = Generated volumetric soil moisture content obtained from soil moisture meter. Percentage deviation = 100 - Percentage explained.

Table 7: Calculation of percent deviation and percent explained in case of tensiometer

No of Days (N)	Yobserved	Ygenerated (t)	(Yobserved/N)	SE	ST	Percentage explained	Percent deviation
1	33.13	42.75	0.87	92.46	1096.84	91.57	8.43
2	29.24	37.53	0.77	68.75	854.39	91.95	8.05
3	27.15	34.84	0.71	59.18	736.61	91.97	8.03
4	32.18	41.45	0.85	85.88	1034.84	91.70	8.30
5	26.97	34.62	0.71	58.45	726.88	91.96	8.04

6	28.18	36.16	0.74	63.65	793.56	91.98	8.02
7	33.12	42.73	0.87	92.39	1096.17	91.57	8.43
8	38.14	49.86	1.00	137.41	1453.65	90.55	9.45
9	32.21	41.49	0.85	86.08	1036.77	91.70	8.30
10	26.85	34.46	0.71	57.96	720.42	91.95	8.05
11	42.84	56.95	1.13	199.06	1833.99	89.15	10.85
12	25.65	32.96	0.68	53.46	657.47	91.87	8.13
13	23.31	30.11	0.61	46.21	542.98	91.49	8.51
14	31.65	40.73	0.83	82.44	1001.03	91.76	8.24
15	27.24	34.96	0.72	59.55	741.50	91.97	8.03
16	25.57	32.86	0.67	53.18	653.37	91.86	8.14
17	32.23	41.52	0.85	86.21	1038.05	91.69	8.31
18	27.14	34.83	0.71	59.14	736.07	91.97	8.03
19	24.91	32.05	0.66	50.96	620.08	91.78	8.22
20	30.21	38.81	0.80	73.90	912.01	91.90	8.10
21	26.34	33.82	0.69	55.98	693.32	91.93	8.07
22	27.34	35.08	0.72	59.97	746.96	91.97	8.03
23	32.97	42.53	0.87	91.31	1086.27	91.59	8.41
24	29.67	38.09	0.78	70.98	879.70	91.93	8.07
25	29.72	38.16	0.78	71.24	882.67	91.93	8.07
26	31.22	40.15	0.82	79.77	974.01	91.81	8.19
27	32.28	41.58	0.85	86.55	1041.28	91.69	8.31
28	29.12	37.38	0.77	68.15	847.39	91.96	8.04
29	34.54	44.70	0.91	103.28	1192.19	91.34	8.66
30	34.81	45.08	0.92	105.51	1210.90	91.29	8.71
31	26.31	33.78	0.69	55.87	691.74	91.92	8.08
32	26.28	33.75	0.69	55.75	690.16	91.92	8.08
33	27.41	35.17	0.72	60.27	750.79	91.97	8.03
34	25.84	33.20	0.68	54.14	667.24	91.89	8.11
35	30.24	38.85	0.80	74.06	913.82	91.90	8.10
36	28.54	36.62	0.75	65.33	813.97	91.97	8.03
37	25.38	32.63	0.67	52.52	643.70	91.84	8.16
38	24.32	31.33	0.64	49.10	591.05	91.69	8.31

Table 8: Calculation of percent deviation and percent explained in case of Moisture meter

No of days (N)	Observed	Generated(S)	(Observed/N)	SE	ST	Percentage explained	Percent deviation
1	33.13	42.75	0.87	68.12	1096.84	93.79	6.21
2	29.24	37.53	0.77	78.29	854.39	90.84	9.16
3	27.15	34.84	0.71	78.64	736.61	89.32	10.68
4	32.18	41.45	0.85	71.67	1034.84	93.07	6.93
5	26.97	34.62	0.71	78.49	726.88	89.20	10.80
6	28.18	36.16	0.74	78.93	793.56	90.05	9.95
7	33.12	42.73	0.87	68.16	1096.17	93.78	6.22
8	38.14	49.86	1.00	41.18	1453.65	97.17	2.83
9	32.21	41.49	0.85	71.57	1036.77	93.10	6.90
10	26.85	34.46	0.71	78.38	720.42	89.12	10.88
11	42.84	56.95	1.13	12.96	1833.99	99.29	0.71
12	25.65	32.96	0.68	76.61	657.47	88.35	11.65
13	23.31	30.11	0.61	69.84	542.98	87.14	12.86
14	31.65	40.73	0.83	73.36	1001.03	92.67	7.33
15	27.24	34.96	0.72	78.70	741.50	89.39	10.61
16	25.57	32.86	0.67	76.44	653.37	88.30	11.70
17	32.23	41.52	0.85	71.50	1038.05	93.11	6.89
18	27.14	34.83	0.71	78.63	736.07	89.32	10.68
19	24.91	32.05	0.66	74.92	620.08	87.92	12.08
20	30.21	38.81	0.80	76.87	912.01	91.57	8.43
21	26.34	33.82	0.69	77.77	693.32	88.78	11.22
22	27.34	35.08	0.72	78.76	746.96	89.46	10.54
23	32.97	42.53	0.87	68.76	1086.27	93.67	6.33
24	29.67	38.09	0.78	77.76	879.70	91.16	8.84
25	29.72	38.16	0.78	77.69	882.67	91.20	8.80
26	31.22	40.15	0.82	74.58	974.01	92.34	7.66
27	32.28	41.58	0.85	71.32	1041.28	93.15	6.85
28	29.12	37.38	0.77	78.41	847.39	90.75	9.25
29	34.54	44.70	0.91	61.76	1192.19	94.82	5.18
30	34.81	45.08	0.92	60.40	1210.90	95.01	4.99
31	26.31	33.78	0.69	77.73	691.74	88.76	11.24
32	26.28	33.75	0.69	77.69	690.16	88.74	11.26

33	27.41	35.17	0.72	78.79	750.79	89.51	10.49
34	25.84	33.20	0.68	76.97	667.24	88.47	11.53
35	30.24	38.85	0.80	76.82	913.82	91.59	8.41
36	28.54	36.62	0.75	78.82	813.97	90.32	9.68
37	25.38	32.63	0.67	76.04	643.70	88.19	11.81
38	24.32	31.33	0.64	73.27	591.05	87.60	12.40

Summery and conclusion

The gravimetric moisture content was converted to volumetric moisture content for comparison with soil moisture meter readings and soil moisture content obtained from tensiometer. The variations of soil moisture values obtained by tensiometer and soil moisture meter with reference to gravimetric method were examined. The moisture from tensiometer compared to gravimetric method and the standard deviation (STD) and coefficient of variation (CV) came out 6.78 and 0.2376 respectively. Similarly STD and CV determined from the comparison between soil moisture meter readings and gravimetric readings were 6.59 and 0.247 respectively. The average of the observed soil moisture values by gravimetric method and estimated soil moisture under tensiometer and soil moisture meter were 29.48, 37.99 and 37.93 respectively. The difference of values was 8.51% and 5.45% higher in comparison to gravimetric method. Percentage explained and percentage deviation are calculated by using the formulas, percentage explained = [(ST – SE)/ST]*100 and Percentage deviation = (100 - Percentage explained) in case of tensiometer and soil moisture meter. The highest and lowest percentage deviation values calculated were 10.85, 8.02 and 12.86, 0.71 respectively for tensiometer and soil moisture meter. The actual soil moisture content maybe found out unless we compare the soil moisture meter reading or tensiometer outcomes with a reliable soil moisture measuring instrument or method like gravimetric method. Measurement of this correct soil moisture content can help in proper irrigation scheduling and the trend in increasing or decreasing the soil moisture content with time can be determined. Such information may be purposefully useful in improving crop yield, increase irrigation efficiency. As the soil moisture meter may not provide correct soil moisture readings instantly because of some inbuilt calibration problem, so development of method of correction is so much necessary for this instrument. On the other hand, the correct moisture values from known tension values may not be calculated properly (as porous plate apparatus limited to less than 1 atmosphere tension) from the soil moisture characteristics curves, so in determining the correct soil moisture status the method of development was necessary when this instrument was used in the field [7].

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