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Analysis of Water Transmission Behaviour in Sandy Loam Soil under Different Tillage Operations of Mould Board Plough applying /Using Different Infiltration Models

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Abstract- The present research work was performed to investigate the effect of tillage intensity to the water transmission behavior for sandy loam soil in terms of infiltration rates and cumulative infiltration and its validation with different infiltration models. An experiment was conducted on the sandy loam soil having particle density 2.49 g/cm^3, moderately well drained and kept fallow since many years. The experiment was laid out in a RCBD with three replications and experimental treatments include MB_0 = Unploughed soil, MB_1 = 1 crosswise passing of a Plough Mouldboard plough, MB_2 = 2 crosswise passing of a Raja MB Plough, and MB_3 = 3 crosswise passing of a Raja MB Plough accordingly. The results revealed that the soil condition directly affects the infiltration rate and cumulative infiltration accordingly. The obtained results showed that the constant infiltration rate for unploughed and ploughed sandy loam soils by using tillage operations are found to be 5.340, 7.832, 8.096, and 8.103 cm / hr for MB_1, MB_2, MB_3, and MB_4 respectively. The measured infiltration rates, cumulative infiltration and its validation with other models for sandy loam soil under different tillage operations are elaborated in Table 01 (11.63118 &12.61353) – Table 08 (209.8315 &213.3462) respectively. The model validation showed that the highest cumulative infiltration (303.772 cm) was found under MB_3 treatment and the lowest cumulative infiltration (192.54 cm) was recorded under MB_1 treatment for Horton's Model. Likewise, the highest rate of infiltration (58.14 cm/hr) was found under MB_3 treatment and lowest rate of infiltration (36.72 cm/hr) was found under MB_1 treatment respectively. Rate of infiltration was greater under three passing of a Raja MB Plough and lower under one passing of a Raja MB Plough. Thus, there was a strong correlation of field data with Horton's model and hence, it is concluded that Horton's model is appropriate model with high significant results of correlation coefficient and standard error. The results achieved by Horton's Model along with other models are almost same along with the trend as shown in Figure 2.1 – Figure 2.8 which indicate the relationship between cumulative infiltration against the time. Different crosswise application of Raja MB Plough had a direct effect on cumulative infiltration and the rate of soil water infiltration due to the tillage intensity. The statistical data showed that the treatment MB_3 demonstrated better performance as compared to the other treatments. The MB_1 treatments showed less effective results when compared with different infiltration models. Hence, it can be concluded from the present research that different tillage intensities and infiltration are directly proportional to each other and can improve operation of water-harvesting, irrigation and fertigation criteria for plants for long term basis.
Keywords: Infiltration, Cumulative Infiltration, Sandy Loam Soil, Mould board plough, Horton's Model validation.

I. INTRODUCTION

Infiltration is the process by which water on the ground surface enters the soil profile vertically. Infiltration rate in general soil science the infiltration rate is the velocity or speed at which (rainfall or irrigation) water enters into the soil. It is usually measured by the depth (in mm or cm) of the water layer that can enter the soil in one hour (Ayu, et al., 2013) [1]. Accurate determination of infiltration rates is an important factor in reliable prediction of surface runoff. The water is driven into the porous soil by force of gravity and capillary attraction. First the water saturate soil pores between particles and then the extra water moves down due to resulting gravitational force. Factors affecting the infiltration process are soil properties, initial moisture content, rainfall rates,

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surface sealing and crusting, layered soils, and movement and entrapment of soil air (Jagdale et al., 2012) [2]. The infiltration plays an important role in generation of runoff volume, if infiltration rate of given soil is less than intensity of rainfall then it results in either accumulation of water on soil surface or in runoff. In order to determine the infiltration rate at any time approximate infiltration rate equations have been developed. Most of these equations are empirical i.e. they are based on observed behavior. In some equations the parameters have no physical meaning (Antigha et al., 2012) [3].

The different soil conditions affect the soil infiltration rate. It has been noticed from past studies that different tillage operations may influence the physical properties of soil such as soil bulk density, soil moisture content, soil porosity (Ranjan et al., 2006) [4]. The advantages of different tillage systems are moisture conservation, reduction of soil erosion, less labour and energy requirement, more timely planting of crops and increased intensity of land use (Diamond et al., 2006) [5]. It also increases the cumulative infiltration rate. As a result soil becomes permeable, aerated and has a good physical condition for crop production (Rahman et al., 2013) [6].

By keeping the discussed facts in view in present research study the constant infiltration rates of different soils under different soil conditions were calculated by double ring infiltrometer method, and compared with calculated values from Kostiakov, Modified Kostiakov, Horton's and Green-Ampt infiltration models. And assessment of the suitability of different models for estimation of infiltration rate of particular soil under particular soil conditions was carried out with correlation coefficient and standard error as a tool.

II. MATERIALS AND METHODS

A. Location

The experiment was carried out at Rajput Farm, Tando Allahyar Sindh Pakistan, during the Rabi season of the year 2013-2014. The study was performed to investigate the effect of tillage intensity to the water transmission behavior for sandy loam soil in terms of infiltration rates and cumulative infiltration (base flow) and its validation with different infiltration models.

B. Field Experimental Procedure

In order to achieve the objective of the research work initially one acre land was selected for the experiment. The soil of the experimental site was sandy loam in texture having particle density 2.49 g/cm^3, moderately well drained and kept fallow since many years. The experiment was laid out in a RCBD with three replications and experimental treatments include MB_0 = Unploughed soil, MB_1 = 1 crosswise passing of a Raja MB Plough, MB_2 = 2 crosswise passing of a Raja MB Plough, and MB_3 = 3 crosswise passing of a Raja MB Plough accordingly. After the completion of land preparation operation the land was then divided into four sub-blocks in such a way that the total numbers of plots were twelve and the size of unit plot was 4 m x 4 m having spacing of plot to plot 2 m and block to block 1.0 m. Figure 1(a) – 1(c) describes the overall ploughing operation which were studied during this research study.

Double ring infiltrometer method was used for measurement of infiltration rates from all the plots. The apparatus was set on the plots in such a way that initially the inner ring of 30 cm diameter with the cutting edge facing down on the ground was placed and the diving plate was set on the top of the inner ring accordingly. Then impact absorbing hammer was used to insert the inner infiltration ring about 10 cm vertically into the soil. Then the outer ring of 60cm diameter with the cutting edge facing down around the inner ring was set and installed accordingly. After that the measuring bridge with measuring point Hook gauge on the inner ring was installed. With the objective to protect ground surface when pouring the water a sponge was placed on the ground and the outer and inner ring was filled with water respectively. The observations for infiltration rate were carried out on inner ring with field type point gauge and stop watch and after achieving the constant value of infiltration rate the experiment was stopped accordingly. Finally the field data for infiltration rate was put into the standard formulas (infiltration models) for further analysis and comparison.

Fig: 1(a) Power Tillage Treatment by Raja MB Plough Side View

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Fig: 1(b) Power Tillage Treatment by Raja MB Plough Front View

Fig: 1(c) Ploughing action Raja MB Plough in Experimental field Plot

C. Analysis of Infiltration Rate by different Infiltration equations

In order to determine the infiltration rate at any time approximate infiltration rate equations have been developed. Most of these equations are empirical i.e. they are based on observed behavior. In some equations the parameters have no physical meaning. The following infiltration models were assessed for finding best fitting model to observed field infiltration rate data.

D. Green and Ampt Model

Earliest equation was proposed by Green and Ampt (1911) and derived the following equation:

$$F = m + n/f$$

Where

f is infiltration capacity.

F is cumulative infiltration. Where as (m ,n) Green and Ampt parameters of infiltration.

E. Kostiakov Model

The next equation (1932) was proposed by Kostiakov, and is given by:

$$f = atb$$

Where

f is cumulative infiltration at any time t. (t is time in min).

a and b are constants

The above equation due to shortcomings was re-modified and presented as Modified Kostiakov Model which is given below:

$$f = atb + c$$

Where

f is cumulative infiltration at any time t. (t is time in min.)

a, b and c are constants whose values depends on factors of soil type.

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F. Horton's Model

The Horton developed a model to compute the infiltration in (1940). It is a 3 parameter model derived to further alleviate the problems in the asymptotic limits of the Kostiakov model.

Horton expressed decrease of infiltration capacity with time as an exponential decrease up to base flow infiltration rate modified form is.

$$f = fc + (fo - fc)\ e\text{-}kt$$

Where

f is infiltration capacity at any time t. (t is time in hours.)

fc is final steady state infiltration capacity.

fo is initial infiltration capacity.

k Horton's constant representing rate of decrease in infiltration capacity.

III.RESULTS AND DISCUSSION

The subject research was carried out to analyze the water transmission behavior for sandy loam soil under different tillage operations of Raja MB Plough and its comparison with different infiltration models. The measured infiltration rates, cumulative infiltration and its validation with other models for sandy loam soil under different tillage operations are elaborated in Table 01 – Table 08(209.8315 &213.3462) respectively. A graphical correlation of infiltration rate and cumulative infiltration versus time along with other infiltration validation is shown in Fig. 2.1 – 2.8 at (75 minutes is 10 cm/hr, and 40 minutes the cumulative rate is 150 for the all models) respectively.

Table 01: Calculated Infiltration Rates from Different Infiltration Models for Unploughed Sandy Loam Soil.

Time	Observed Infiltration	Infiltration rate by Horton's Model	Infiltration rate by Green – Ampt model	Infiltration rate by Kostiakov model	Infiltration rate by modified Kostiakov model
Min	(cm/hr)	(cm/hr)	(cm/hr)	(cm/hr)	(cm/hr)
5	36.72	30.52	52.87	53.04	58.92
10	29.52	29.78	26.22	19.92	10.8
20	23.04	24.97	13.71	13.82	9.9
30	17.46	21.35	11.65	12.18	9.96
60	11.04	12.81	10.38	10.48	10.52
90	7.74	7.62	9.65	9.18	10.26
125	5.64	5.71	9.22	8.04	9.78
170	5.34	5.44	8.3	6.69	8.9
200	5.34	5.44	8.45	7.74	9.18
230	5.34	5.44	8.33	6.65	9.48
260	5.34	5.44	8.33	6.65	8.78
290	5.34	5.44	8.33	6.65	8.78
Mean	-	11.63118	12.61353	11.68765	12.12412
Standard Deviation	-	9.460856	11.50317	11.41628	12.30661
Stand error	-	2.294595	2.789929	2.768854	2.984792
Correlation Coefficient	-	0.978182	0.885562	0.870681	0.71746

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Table 02: Calculated Infiltration Rates from Different Infiltration Models for Ploughed Sandy Loam Soil with 1 Crosswise Passing of a Raja MB Plough.

Time	Observed Infiltration	Infiltration rate by Horton's Model	Infiltration rate by Green – Ampt model	Infiltration rate by Kostiakov model	Infiltration rate by modified Kostiakov model
Min	(cm/hr)	(cm/hr)	(cm/hr)	(cm/hr)	(cm/hr)
5	53.856	47.656	70.006	70.176	76.056
10	43.296	43.556	39.996	33.696	24.576
20	33.792	35.722	24.462	24.572	20.652
30	25.608	29.498	19.798	20.328	18.108
60	16.192	17.962	15.532	15.632	15.672
90	11.352	11.232	13.262	12.792	13.872
125	8.272	8.342	11.852	10.672	12.412
170	7.832	7.932	10.792	9.182	11.392
200	7.832	7.932	10.942	10.232	11.672
230	7.832	7.932	10.822	9.142	11.972
260	7.832	7.932	10.822	9.142	11.272
290	7.832	7.932	10.822	9.142	11.272
Mean	-	16.91658824	17.8989412	16.9730588	17.4095294
Standard Deviation	-	14.01584706	15.7441835	15.6078685	15.951804
Stand error	-	3.399342228	3.81852537	3.78546415	3.86888075
Correlation Coefficient	-	0.990118329	0.94064476	0.93304511	0.84331596

Table 03: Calculated Infiltration Rates from Different Infiltration Models for Ploughed Sandy Loam Soil with 2 Crosswise Passing of a Raja MB Plough.

Time	Observed Infiltration	Infiltration rate by Horton's Model	Infiltration rate by Green – Ampt model	Infiltration rate by Kostiakov model	Infiltration rate by modified Kostiakov model
Min	(cm/hr)	(cm/hr)	(cm/hr)	(cm/hr)	(cm/hr)
5	56.304	50.104	72.454	72.624	78.504
10	45.264	45.524	41.964	35.664	26.544
20	35.328	37.258	25.998	26.108	22.188
30	26.772	30.662	20.962	21.492	19.272
60	16.928	18.698	16.268	16.368	16.408
90	11.868	11.748	13.778	13.308	14.388
125	8.648	8.718	12.228	11.048	12.788
170	8.188	8.288	11.148	9.538	11.748
200	8.155	8.126	11.056	9.515	11.541
230	8.096	8.196	11.086	9.406	12.236

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260	8.096	8.196	11.086	9.406	11.536
290	8.096	8.196	11.086	9.406	11.536
Mean	-	17.64588235	18.6235294	17.6487647	18.1197059
Standard Deviation	-	14.68761498	16.3817356	16.2660763	16.5308761
Stand error	-	3.562269879	3.97315449	3.94510298	4.00932638
Correlation Coefficient	-	0.990978435	0.94540118	0.93894189	0.85529943

Table 04: Calculated Infiltration Rates from Different Infiltration Models for Ploughed Sandy Loam Soil with 3 Crosswise Passing of a Raja MB Plough.

Time	Observed Infiltration	Infiltration rate by Horton's Model	Infiltration rate by Green – Ampt model	Infiltration rate by Kostiakov model	Infiltration rate by modified Kostiakov model
Min	(cm/hr)	(cm/hr)	(cm/hr)	(cm/hr)	(cm/hr)
5	58.14	51.94	74.29	74.46	80.34
10	46.74	47	43.44	37.14	28.02
20	36.48	38.41	27.15	27.26	23.34
30	27.645	31.535	21.835	22.365	20.145
60	17.48	19.25	16.82	16.92	16.96
90	12.255	12.135	14.165	13.695	14.775
125	8.93	9	12.51	11.33	13.07
170	8.455	8.555	11.415	9.805	12.015
200	8.36	8.46	11.47	10.76	12.2
230	8.17	8.27	11.16	9.48	12.31
260	8.1035	8.2035	11.0935	9.4135	11.5435
290	8.1035	8.2035	11.0935	9.4135	11.5435
Mean	-	18.17423529	19.1565882	18.2307059	18.6671765
Standard Deviation	-	15.20474086	16.8675686	16.7260615	16.9647545
Stand error	-	3.687691328	4.09098629	4.05666577	4.11455735
Correlation Coefficient	-	0.991602167	0.9484877	0.94196546	0.86296787

Table 05: Calculated Cumulative Infiltration from Different Infiltration Models for Unploughed Sandy Loam Soil.

Time	Observed Cumulative Infiltration	Cumulative Infiltration rate by Horton's Model	Cumulative Infiltration rate by Green – Ampt model	Cumulative Infiltration rate by Kostiakov model	Cumulative Infiltration rate by modified Kostiakov model
Min	cm	cm	cm	cm	cm
5	36.72	30.52	52.87	53.04	58.92
10	66.24	60.3	79.09	72.96	69.72

20	89.28	85.27	92.8	86.78	79.62
30	106.74	106.62	104.45	98.96	89.58
60	131.22	135.97	125.44	120.96	110.74
90	148.32	152.91	144.76	139.77	131.29
125	160.32	164.91	163.45	156.55	151.27
170	171.18	175.97	180.99	171	169.89
200	176.52	181.41	189.44	178.74	179.07
230	181.86	186.85	197.77	185.39	188.55
260	187.2	192.29	206.1	192.04	197.33
290	192.54	197.73	214.43	198.69	206.11
Mean	-	133.466471	136.981176	129.927647	126.8129
Standard Deviation	-	58.6345327	58.2617378	54.419053	56.02637
Stand error	-	14.220963	14.130547	13.198559	13.58839
Correlation Coefficient	-	0.99919848	0.98801476	0.99121275	0.973022

Table 06: Calculated Cumulative Infiltration from Different Infiltration Models for Ploughed Sandy Loam Soil with 1 Crosswise Passing of a Raja MB Plough.

Time	Observed Cumulative Infiltration	Cumulative Infiltration rate by Horton's Model	Cumulative Infiltration rate by Green – Ampt model	Cumulative Infiltration rate by Kostiakov model	Cumulative Infiltration rate by modified Kostiakov model
Min	cm	cm	cm	cm	cm
5	53.856	47.656	70.006	70.176	76.056
10	97.152	91.212	110.002	103.872	100.632
20	130.944	126.934	134.464	128.444	121.284
30	156.552	156.432	154.262	148.772	139.392
60	192.456	197.206	186.676	182.196	171.976
90	217.536	222.126	213.976	208.986	200.506
125	235.136	239.726	238.266	231.366	226.086
170	251.064	255.854	260.874	250.884	249.774
200	258.896	263.786	271.816	261.116	261.446
230	266.728	271.718	282.638	270.258	273.418
260	274.56	279.65	293.46	279.4	284.69
290	282.392	287.582	304.282	288.542	295.962
Mean	-	194.6662	198.1809	191.1274	188.0127
Standard Deviation	-	84.42812	83.85505	80.07303	81.35625
Stand error	-	20.47683	20.33784	19.42056	19.73179
Correlation Coefficient	-	0.999613	0.994232	0.995951	0.987298

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Table 07: Calculated Cumulative Infiltration from Different Infiltration Models for Ploughed Sandy Loam Soil with 2 Crosswise Passing of a Raja MB Plough..

Time	Observed Cumulative Infiltration	Cumulative Infiltration rate by Horton's Model	Cumulative Infiltration rate by Green – Ampt model	Cumulative Infiltration rate by Kostiakov model	Cumulative Infiltration rate by modified Kostiakov model
Min	cm	cm	cm	cm	cm
5	56.304	50.104	72.454	72.624	78.504
10	101.568	95.628	114.418	108.288	105.048
20	136.896	132.886	140.416	134.396	127.236
30	163.668	163.548	161.378	155.888	146.508
60	201.204	205.954	195.424	190.944	180.724
90	227.424	232.014	223.864	218.874	210.394
125	245.824	250.414	248.954	242.054	236.774
170	262.476	267.266	272.286	262.296	261.186
200	270.631	275.392	283.342	271.811	272.727
230	278.727	283.588	294.428	281.217	284.963
260	286.823	291.784	305.514	290.623	296.499
290	294.919	299.98	316.6	300.029	308.035
Mean	-	203.3385	206.8344	199.5853	196.6085
Standard Deviation	-	88.03899	87.41656	83.42797	84.82097
Stand error	-	21.35259	21.20163	20.23426	20.57211
Correlation Coefficient	-	0.999643	0.994756	0.996513	0.988532

Table 08: Calculated Cumulative Infiltration from Different Infiltration Models for Ploughed Sandy Loam Soil with 3 Crosswise Passing of a Raja MB Plough.

Time	Observed Cumulative Infiltration	Cumulative Infiltration rate by Horton's Model	Cumulative Infiltration rate by Green – Ampt model	Cumulative Infiltration rate by Kostiakov model	Cumulative Infiltration rate by modified Kostiakov model
Min	cm	cm	cm	cm	cm
5	58.14	51.94	74.29	74.46	80.34
10	104.88	98.94	117.73	111.6	108.36
20	141.36	137.35	144.88	138.86	131.7
30	169.005	168.885	166.715	161.225	151.845
60	207.765	212.515	201.985	197.505	187.285
90	234.84	239.43	231.28	226.29	217.81
125	253.84	258.43	256.97	250.07	244.79
170	271.035	275.825	280.845	270.855	269.745
200	279.395	284.285	292.315	281.615	281.945
230	287.565	292.555	303.475	291.095	294.255

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260	295.6685	300.7585	314.5685	300.5085	305.7985
290	303.772	308.962	325.662	309.922	317.342
Mean	-	209.8315	213.3462	206.2927	203.178
Standard Deviation	-	90.73107	90.1074	86.34078	87.56
Stand error	-	22.00552	21.85426	20.94072	21.23642
Correlation Coefficient	-	0.999666	0.995002	0.996521	0.989046

The results were found that the values of parameters regarding infiltration rate and cumulative infiltration vary from unploughed soil to the ploughed soil with different number of tillage operations of Raja MB plough. The statistical data and various infiltration models results showed different results for each tillage operation. From analysis it is found that initially infiltration rates were high in all experiments and decreased with time up to steady infiltration rate base flow acquired. Likewise, the highest rate of infiltration (58.14 cm/hr) was found under MB_3 treatment and lowest rate of infiltration (36.72 cm/hr) was found under MB_1 treatment respectively. Rate of infiltration was greater due to three passing of a Raja MB plough and lower under one passing of a Raja MB plough.

The model validation showed that the highest cumulative infiltration (303.772 cm) was found under MB_3 treatment and the lowest cumulative infiltration (192.54 cm) was recorded under MB_1 treatment for Horton's Model. Likewise, the highest rate of infiltration (58.14 cm/hr) was found under MB_3 treatment and lowest rate of infiltration (36.72 cm/hr) was found under MB_1 treatment respectively. Rate of infiltration was greater under three passing of a Raja MB plough and lower under one passing of a Raja MB plough. Thus, there was a strong correlation of field data with Horton's model and hence, it is concluded that Horton's model is appropriate model with high significant results of correlation coefficient and minimum standard error. The results achieved by Horton's Model along with other models are almost same along with the trend as shown in Figure 2.1 – Figure 2.8 which shows the relationship between the infiltration rates and cumulative infiltration against the time. From the graphs of infiltration rates against time it was confirmed that initially infiltration rates were high and decreased with time up to constant infiltration rate / base flow.

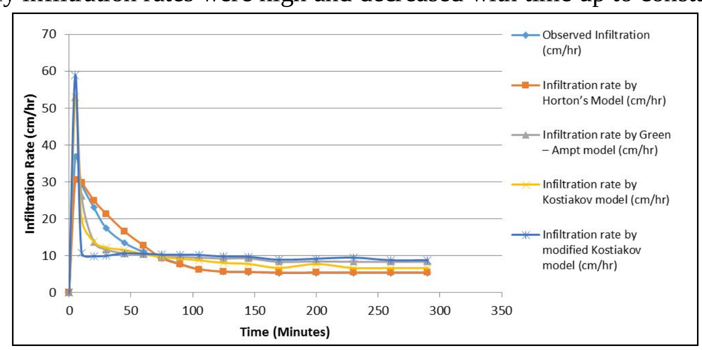

Figure 2.1: Observed and Calculated Infiltration Rate against Different Time Interval for Unploughed Sandy Loam Soil.

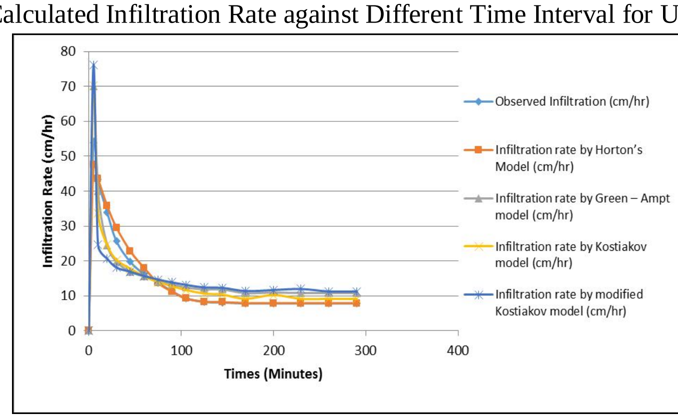

Figure 2.2: Observed and Calculated Infiltration Rate against Different Time Interval for Ploughed Sandy Loam Soil with 1 Crosswise Passing of a Raja MB plough.

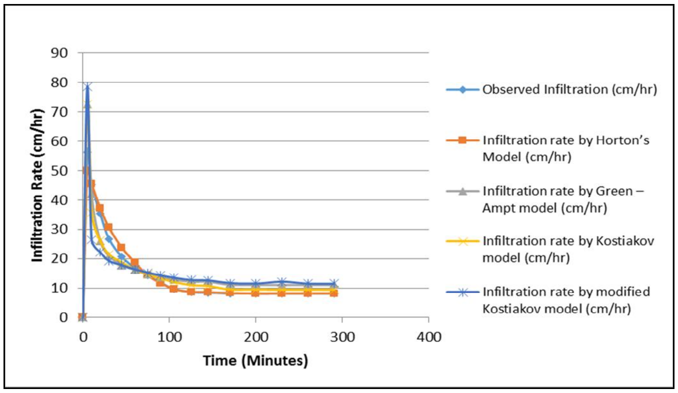

Figure 2.3: Observed and Calculated Infiltration Rate against Different Time Interval for Ploughed Sandy Loam Soil with 2 Crosswise Passing of a Raja MB plough.

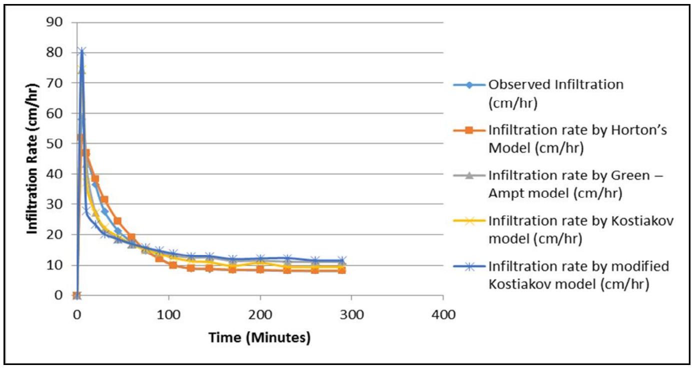

Figure 2.4: Observed and Calculated Infiltration Rate against Different Time Interval for Ploughed Sandy Loam Soil with 3 Crosswise Passing of a Raja MB plough.

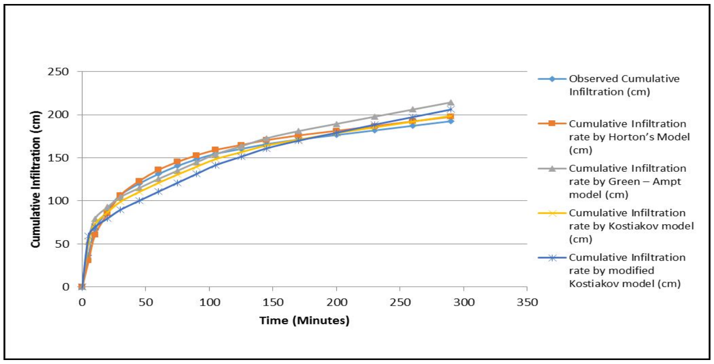

Figure 2.5: Observed and Calculated Cumulative Infiltration against Different Time Interval for Unploughed Sandy Loam Soil.

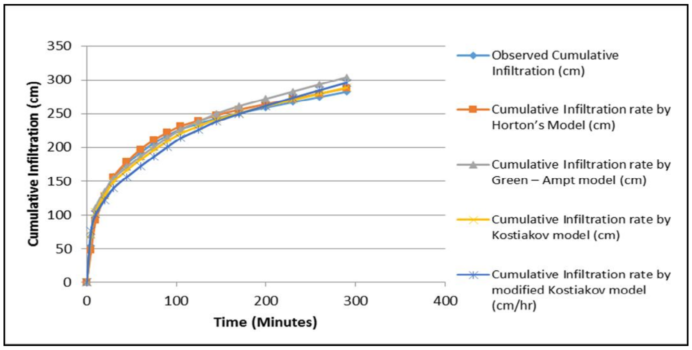

Figure 2.6: Observed and Calculated Cumulative Infiltration against Different Time Interval for Ploughed Sandy Loam Soil with 1 Crosswise Passing of a Raja MB plough.

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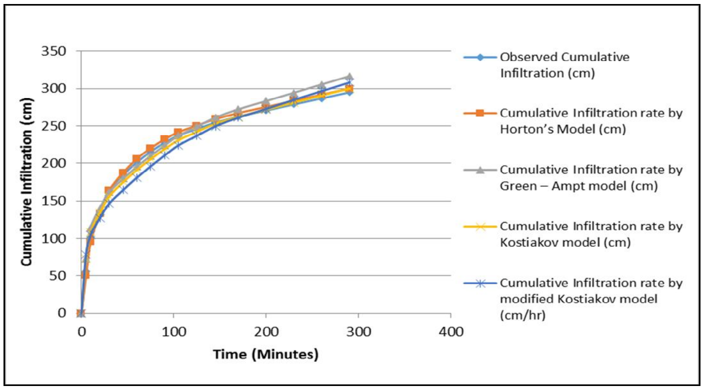

Figure 2.7: Observed and Calculated Cumulative Infiltration against Different Time Interval for Ploughed Sandy Loam Soil with 2 Crosswise Passing of a Raja MB plough.

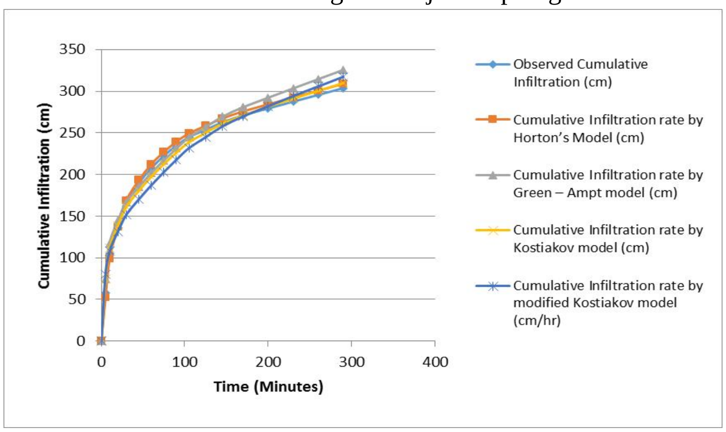

Figure 2.8: Observed and Calculated Cumulative Infiltration against Different Time Interval for Ploughed Sandy Loam Soil with 3 Crosswise Passing of a Raja MB plough.

IV. CONCLUSIONS

From the present research work it was found that the soil condition directly affects the infiltration rate and cumulative infiltration accordingly. The obtained results showed that the constant infiltration rate for unploughed and ploughed sandy loam soils by using tillage operations are found to be 5.340, 7.832, 8.096, and 8.103 cm / hr for MB_1, MB_2, MB_3, and MB_4 Respectively. The measured infiltration rates, cumulated infiltration and its validation with other models for sandy loam soil under different tillage operations are elaborated in Table 01 – Table 08 respectively. The field results showed that the highest cumulative infiltration (303.772 cm) was found under MB_3 treatment and the lowest cumulative infiltration (192.54 cm) was recorded under MB_1 treatment. It has been noticed that cumulative infiltration was found to be higher under three passing of a Raja MB plough and lower under one passing of a Raja MB plough. Likewise, the highest rate of infiltration (58.14 cm/hr) was found under MB_3 treatment and lowest rate of infiltration (36.72 cm/hr) was found under MB_1 treatment respectively. Rate of infiltration was greater under three passing of a Raja MB plough and lower under one passing of a Raja MB plough.

The model validation showed that the highest cumulative infiltration (303.772 cm) was found under MB_3 treatment and the lowest cumulative infiltration (192.54 cm) was recorded under MB_1 treatment for Horton's Model. Likewise, the highest rate of infiltration (58.14 cm/hr) was found under MB_3 treatment and lowest rate of infiltration (36.72 cm/hr) was found under MB_1 treatment respectively. Rate of infiltration was greater under three passing of a Raja MB plough and lower under one passing of a Raja MB plough. Thus, there was a strong correlation of field data with Horton's model and hence, it is concluded that Horton's model is most appropriate model with high significant results of correlation coefficient and minimum standard error.

The results achieved by Horton's Model along with other models are almost same along with the trend as shown in Figure 2.1 – Figure 2.8 which shows the relationship between the infiltration rates and cumulative infiltration against the time. From the graphs of infiltration rates against time it was found that initially infiltration rates were high and decreased with time up to constant infiltration rate. Different crosswise application of Raja MB plough had a direct effect on cumulative infiltration and the rate of soil water infiltration due to the tillage intensity. The statistical data showed that the treatment MB_3 demonstrated better performance as compared to the other treatments. The MB_1 treatments showed less effective results when compared with different infiltration models. Hence, it can be concluded from the present research that different tillage number of operations and infiltration are directly proportional to each other and can improve operation of water-harvesting, irrigation and fertigation criteria for plants on long term basis.

V. ACKNOWLEDGEMENTS

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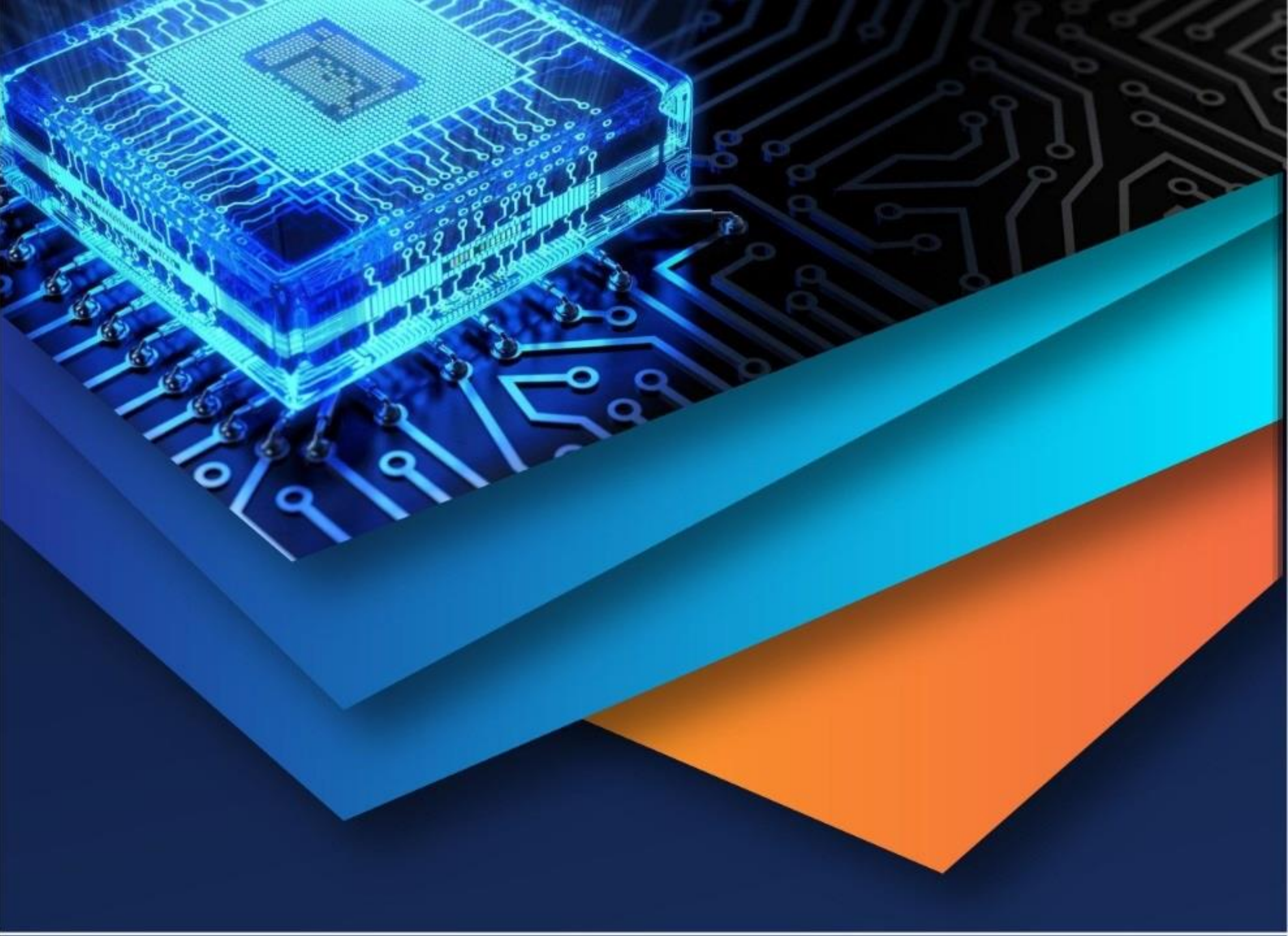

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