The Efficiency of Some Infiltration Models in Three Rangeland Conditions (Case Study: Savojbolagh Rangelands)

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Key words : Horton's equation , Kostiakov's equation , Green-Ampt's equation , rangeland , Savojbolagh region

Introduction Infiltration is one of the important hydrological processes and its accurate quantification is essential for many studies . Infiltration can be either measured in the field or estimated using mathematical models which vary from empirical to physically based models , including physically based models (e .g . Green and Ampt , 1911 , Richards , 1931 , Philip , 1957 , Morel-Seytoux , 1978 , Haverkamp *et al* . , 1990 and Corradini *et al* . , 1994) , conceptual models (e .g . Nash , 1957 and Diskin and Nazimov , 1995) , or empirical relations (e .g . Horton , 1933 , Kostiakov , 1932 , Holtan , 1961 and Soil Conservation Service-USDA , 1972) (Chahinian *et al* . , 2005) .The objective of this paper is to compare the performance of three widely used infiltration models with infiltration measured in Central Iran .

Material and methods The study field is located in South-west of Tehran province and South-west of Nazarabad city in Savojbolagh experimental rangeland site located . The slope , elevation and annual precipitation of the study field are 0-2 percent , 1150-1180m and 229 .3mm , respectively . The climate is also cold dry according to Emberger climatic classification system . The rangelands of the study area are steppe that was divided into three regions (critical , key and reference sites) with attention to utilization type and different grazing intensities which each region comprises 5 ha in the area . The critical , key and reference sites were selected in regions with annual long and heavy grazing , proper grazing and desertification station of Savojbolagh region with no grazing condition grazed over past 13 years , respectively . The infiltration rate was determined by using concentric ring infiltrometer in three mentioned regions (i .e . critical , key and reference sites) in May , June and September of 2004 and 2005 . First , the rings were inserted into the soil at the minimum depth necessary to prevent lateral leakage from the rings . Then , water was applied at a constant depth . Finally , infiltration rate was directly determined by reading of the burettes at 1 , 5 , 10 , 30 , 60 , 90 and 120 minutes intervals . Table 1 shows average infiltration rate in different times .

Table 1 *Avarage infiltration rate (mm) in different times .*

Site	Year	2004							2005						
	Time(min) Month	1	5	10	30	60	90	120	1	5	10	30	60	90	120
Key	May	20	9 .13	9 .37	5 .23	4 .02	3 .48	3 .11	67 .21	9 .13	6 .83	3 .49	3 .05	2 .61	2 .47
	June	27	12 .2	9 .83	6 .01	5 .04	4 .54	4 .34	30	9	8 .33	5 .83	4 .08	4 .02	3 .87
	September	20	9 .73	8 .07	5 .49	4 .25	3 .79	3 .53	67 .17	9 .27	7 .23	5 .11	4 .07	3 .65	3 .38
Reference	May	33 .18	11 .33	8 .17	5 .04	4 .09	3 .35	3 .01	20	6 .83	5 .83	3 .29	2 .58	2 .25	2 .01
	June	67 .21	13	10	6 .27	5 .24	4 .53	4 .39	25	7 .1	5 .3	3 .33	2 .61	2 .36	2 .18
	September	33 .14	10 .17	7 .93	5 .61	4 .68	4 .19	3 .9	33 .13	5 .6	5 .63	3 .44	2 .78	2 .49	2 .27
Critical	May	15	8 .87	7 .7	3 .85	2 .88	2 .55	2 .32	33 .18	7 .33	5 .73	2 .84	2 .79	2 .44	2 .35
	June	33 .14	10 .33	8 .83	5 .77	4 .39	3 .94	3 .80	15	6	6 .5	3 .42	2 .66	2 .44	2 .19
	September	33 .11	8 .93	7 .07	4 .89	3 .91	3 .52	3 .24	33 .11	6 .93	6	4 .02	3 .23	2 .87	2 .64

Three algebraic infiltration equations (Kostiakov's , Horton's and Green and Ampt's) were examined to determine the best fitted formula to the collected infiltrometer data . For this reason , infiltrometer data of 2004 was applied to compute the models . Then , the estimated models efficiency was determined by using relative error index and infiltrometer data of 2005 . If the relative error index was under 40 percent , model will be selected (Das , 2000) .

Results and discussion The results of current research indicate that , Horton's equation provided a best fit to the infiltrometer data . Horton's equation was better than Kostiakov's and Green-Ampt's equation . The relative error for Horton equation was 14 .59% , 20 .84% , and 80 .31% for the Kostiakov model and Green-Ampt model , respectively . The relative error percent increase in each three models with increase of infiltration time .

Conclusions Since relative error of Horton and Kostiakov equations was lower than 40% , these models were selected as the best equations in this research . This result is the similar to those obtained by Gifford (1976) and Oku (2005) .