Rainfall Intensity Effects

on Runoff and Sediment Losses from a Colorado Alfisol

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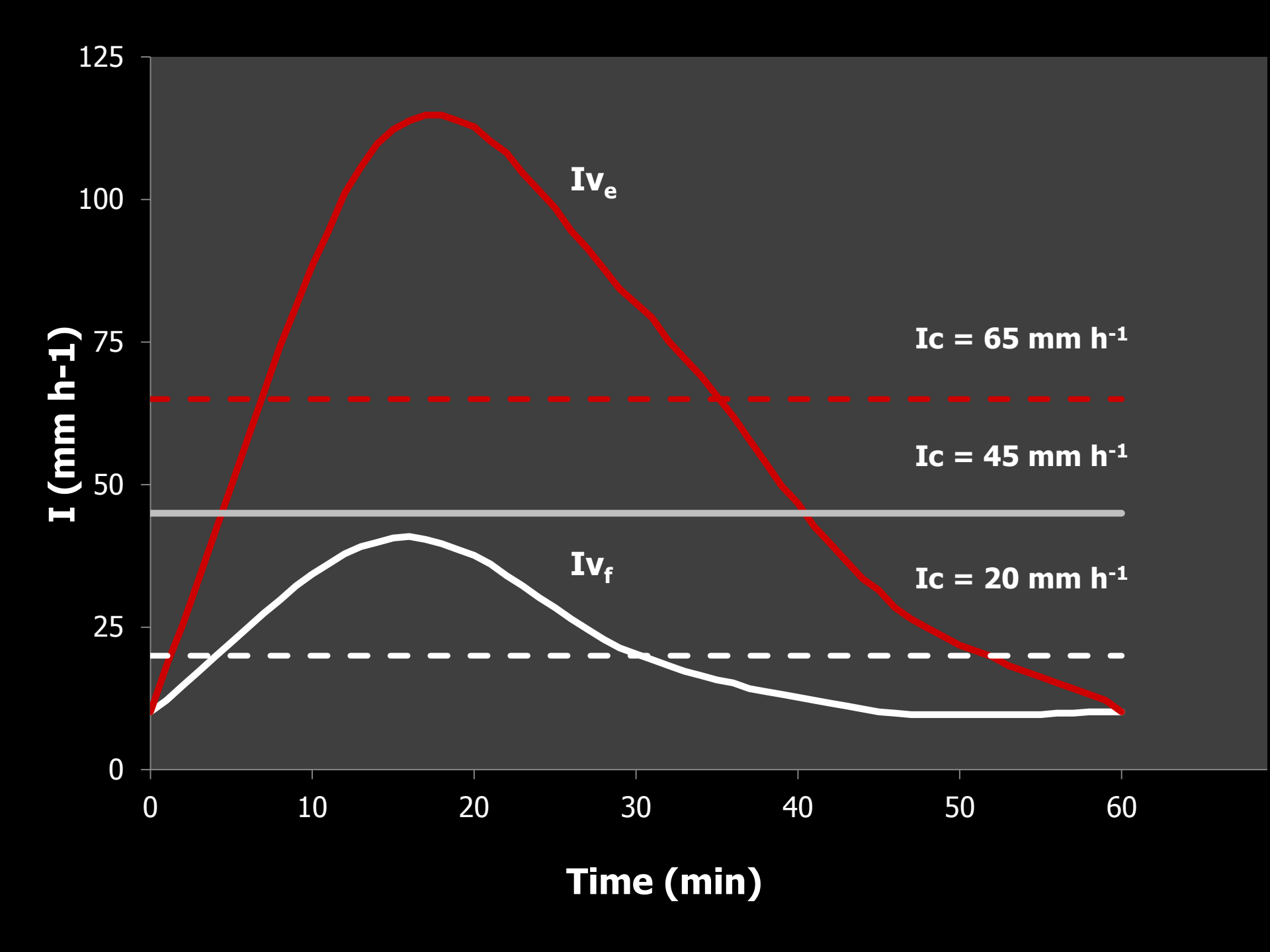
Objective

Quantify effects of constant (I_c) and variable (I_v) rainfall intensity patterns (frequent, I_{vf}; extreme, I_{ve}) on runoff and sediment losses from a conventionally tilled Ft. Collins sandy clay loam.

Methods

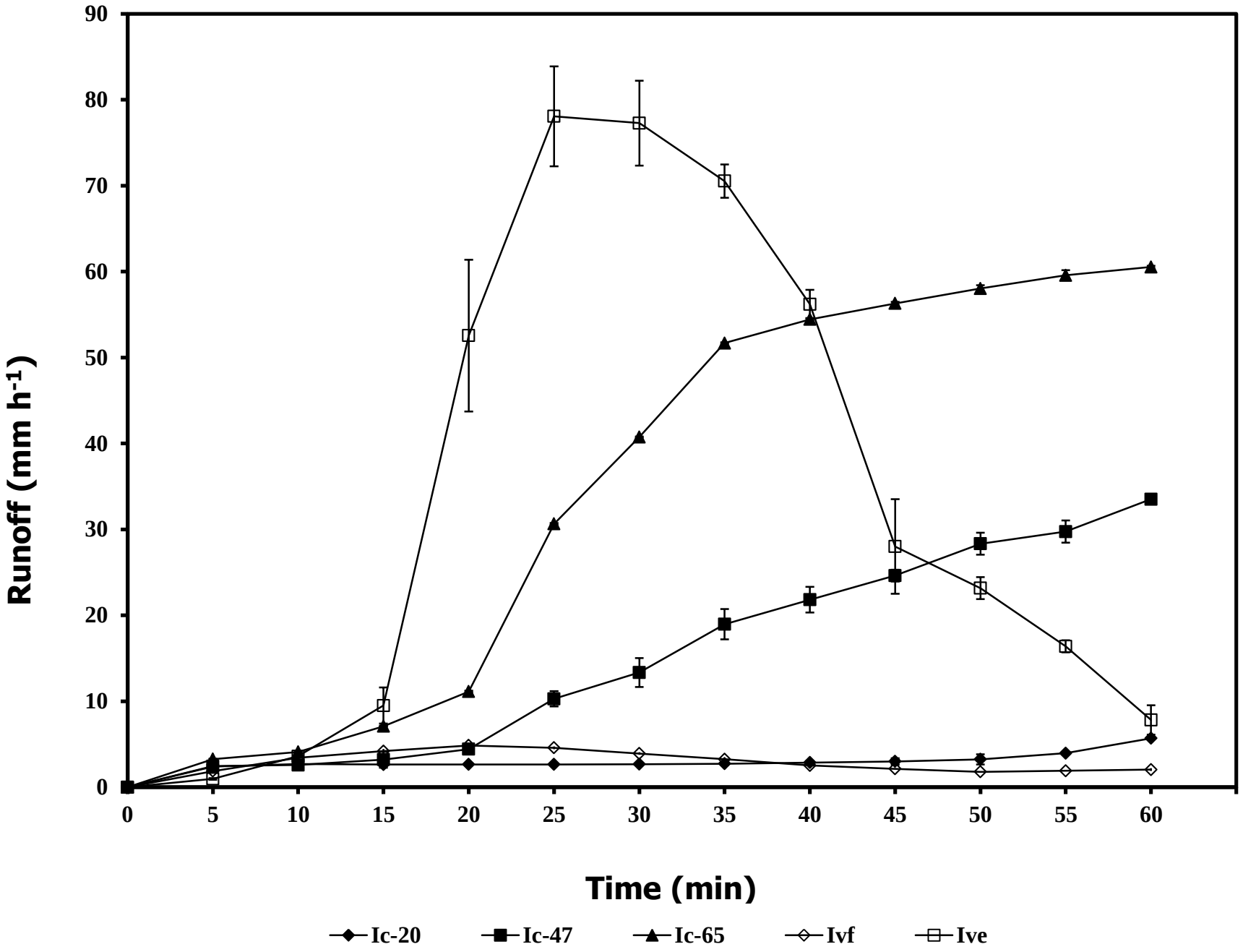

125
100
75
50
25
0
I (mm h-1)
0
10
20
30
40
50
60
Time (min)
Ive
Ivf
Ic = 65 mm h-1
Ic = 45 mm h-1
Ic = 20 mm h-1

Methods

- Runoff (R) and sediment (E) were measured continuously from each 6-m^2 plot at 5-min intervals.
- Treatments (5 rainfall intensity patterns, I_c=20 mm/h, I_{vf}, I_c=45 mm/h, I_c=65 mm/h, I_{ve}).
- n=3

Results

Intensity mm h^{-1}	Runoff % rain applied
20	16 a
I_{vf}	15 a
47	34 b
65	55 c
I_{ve}	57 c

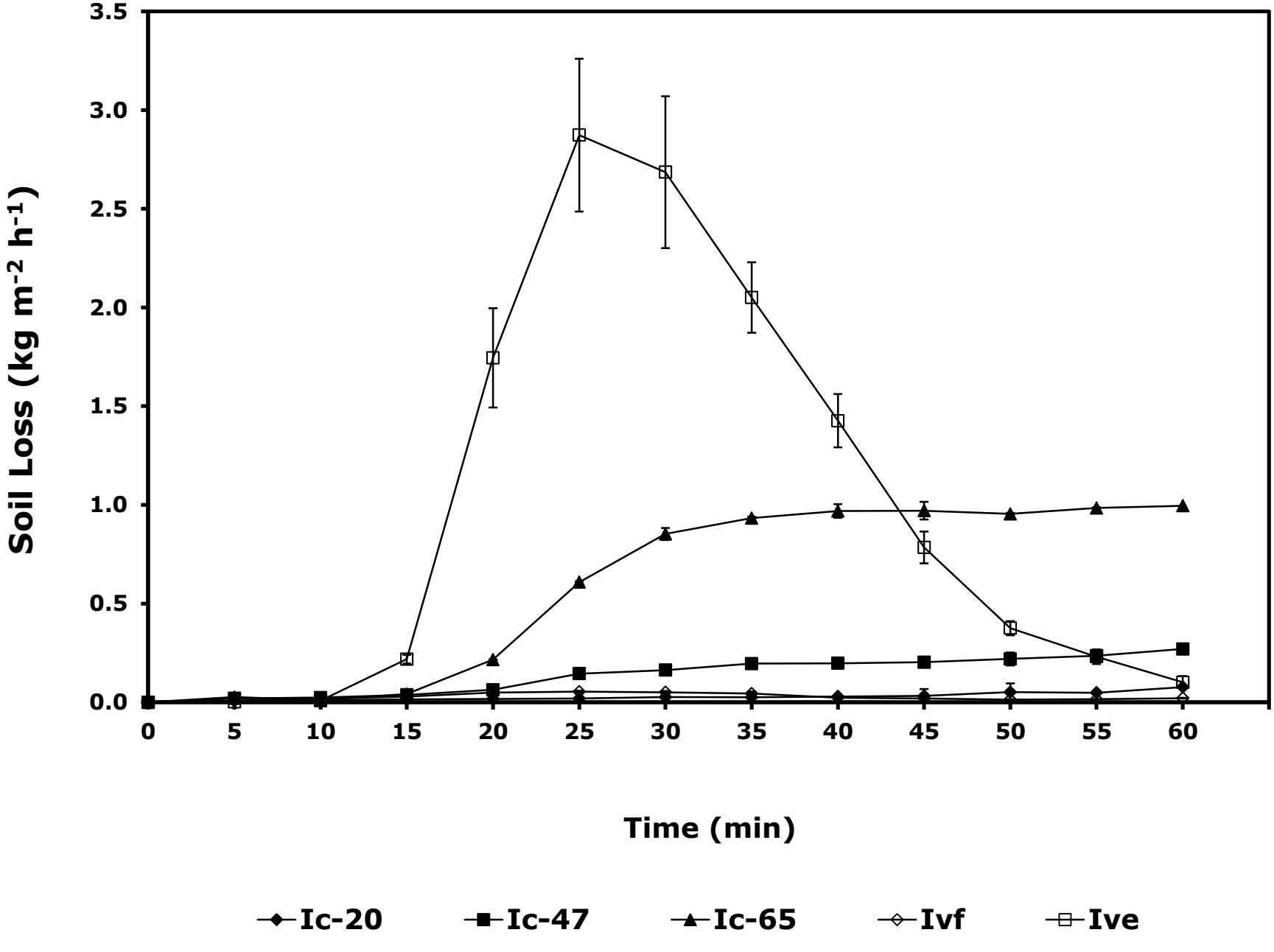

Runoff (mm h-1)
90
80
70
60
50
40
30
20
10
0
0
5
10
15
20
25
30
35
40
45
50
55
60
Time (min)
Ic-20
Ic-47
Ic-65
Ivf
Ive

Results

Intensity mm h^{-1}	R_{max} mm h^{-1}
20	6 a
I_{vf}	5 a
47	33 b
65	62 c
I_{ve}	79 d

Results

Intensity mm h^{-1}	E kg ha^{-1}
20	278 a
I_{vf}	268 a
47	1382 b
65	5732 c
I_{ve}	9680 d


Soil Loss (kg m-2 h-1)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
5
10
15
20
25
30
35
40
45
50
55
60
Time (min)
Ic-20
Ic-47
Ic-65
Ivf
Ive

Results

Intensity mm h^{-1}	E_{max} kg m^{-2} h^{-1}	
20	0.08	b
I_{vf}	0.06	a
47	0.25	c
65	0.99	d
I_{ve}	2.87	e

Results

Intensity mm h^{-1}	dINF
20	3 a
I_{vf}	28 b
47	31 b
65	58 c
I_{ve}	88 d

Conclusions

I_c Events

- Increasing I_c 2.3- & 1.4-fold increased R (16-55%) 5.9- & 2.4-fold & R_{max} 5.8- & 1.9-fold, respectively.
- Increasing I_c 2.3- & 1.4-fold increased E (278-5732 kg/ha) 4.9- & 4.1-fold & E_{max} 3.1- & 3.9-fold, respectively.

Conclusions

I_c (20 mm/h) vs. I_{vf} Events

- Similar R parameters (NS).
- Similar E losses (NS).
- E_{max} values: I_c 33% greater than I_{vf}.

Conclusions

I_c (65 mm/h) vs. I_{ve} Events

- Similar R losses (NS).
- I_{ve} had 1.7-fold increase in E, 28% higher R_{max}, & 2.9-fold higher E_{max} losses than I_c.

Conclusions

I_{vf} vs. I_{ve} Events

R, R_{max}, E, & E_{max} for I_{ve} were 11.7-, 16.1-, 36-, & 48-fold greater than corresponding values for I_{vf}, respectively.

R_{max}=11 & 69% of I_{max} & occurred 4 & 9 min after I_{max}.

Conclusions

- Results show pronounced effect of I patterns, esp. I_{ve} patterns, on R & E values.
- More accurate measure of R, E, tR_{max} & tE_{max} obtained with I_v patterns (derived from natural rainfall).
- Models would under predict R, E, & agrichemical losses when developed from I_c data, esp. for tR_{max}, E, & tE_{max} & extreme rainfall events.