Infiltration Process in Gravelly-Soil Slopes as Affected by Storm Patterns

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INTRODUCTION

Taiwan
- Total area: 36,000 km²
- Highest elevation: 3,952 m
- Average annual rainfall: 2,500 mm
INTRODUCTION

Gravelly soil

Folk (1954)
Volumetric gravel content: 5~30%

Infiltration

Wu (1988)
Gravel mulching on soil surface or embedded in soil matrix

Runoff

Available water capacity

Land use
Storm distribution patterns

**Lu (2004)**

Produced runoff volume

- most: backward storms
- medium: central- and uniform distributed
- least: forward distributed
MATERIAL AND METHODS

Experiment Site

- No. 4 Experiment Station at National Pingtung University of Science and Technology, Taiwan
- The runoff plot measures 20m long and 3m wide with average gradient of 40%
MATERIAL AND METHODS

- Sand
- Silt
- Grave

- Clay
- Grave
MATERIAL AND METHODS

- It required three rolls of straw mat with 100mm of overlap to fully cover the width of the runoff plot.
- Iron wire pins were used along the edges and at the overlap of straw mat to fix mats in place.
- The averaged mulch coverage along the slope was 68.32%.
MATERIAL AND METHODS

Layout of Soil Moisture Sensors and Locations of Measurement Sections

- Soil moisture smart sensors were buried 200mm beneath the soil.
- Volumetric soil water contents were logged using a digital data logger.
## RESULTS AND DISCUSSION

<table>
<thead>
<tr>
<th>Date of storm event (MM/DD)</th>
<th>Total precipitation (mm)</th>
<th>Storm duration (h)</th>
<th>Average intensity (mm/h)</th>
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</thead>
<tbody>
<tr>
<td>06/03</td>
<td>19.2</td>
<td>15.7</td>
<td>1.22</td>
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<td>06/10-11</td>
<td>144.2</td>
<td>29.4</td>
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<td>06/12</td>
<td>29.8</td>
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<td>06/13-14</td>
<td>95.8</td>
<td>26.2</td>
<td>3.65</td>
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<td>06/24</td>
<td>43.0</td>
<td>8.8</td>
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<td>06/25</td>
<td>94.4</td>
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<td>23.6</td>
<td>1.2</td>
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<td>06/29</td>
<td>51.2</td>
<td>4.2</td>
<td>12.19</td>
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</table>
RESULTS AND DISCUSSION

Storm Pattern

Effective storms are considered as positive skew when peak precipitation appears in the first half of the storm duration, and are considered as negative skew when peak precipitation appears in the second half of the storm duration.
RESULTS AND DISCUSSION

The Effect of Storm Pattern

![Diagram showing rainfall and volumetric soil water content over time. The graph includes timelines for 06/09 to 06/12, with various times marked (14:24, 21:36, 04:48, 12:00, 19:12, 02:24, 09:36, 16:48, 00:00, 07:12). The rainfall is categorized into Positive Skew and Negative Skew. The volumetric soil water content is shown for US-20, MS-20, and DS-20, with peaks at 4.6hr, 6.7hr, and 6.6hr.]
RESULTS AND DISCUSSION

The Effect of Storm Pattern

- Volumetric soil water content (%)
- Time (hh:mm)
- Response time is within 10 min
- Response time is within 36 min

- Rainfall (mm)
- 06/23 06/24 06/25 06/27 06/26
- 0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0

Positive Skew
RESULTS AND DISCUSSION

’Threshold’ Water Content

![Graph showing rainfall and volumetric soil water content over time, with response times indicated.]

- Positive Skew
- Negative Skew

Response time of US and MS is within 5 min but DS is within 20 min.
Straw mat mulch has the capability of retaining rainwater so that the effect of rainfall pattern; regardless positive- and negative skew; is masked.

Straw mat mulch is able to release the retained moisture to the soil gradually, hence, the soil water content remains a steady but slow decline as storm ceases.

The volumetric soil moisture threshold was found to be in the neighborhood of 50%. If the initial soil moisture is less than the threshold, gravelly soil requires longer reaction time to reflect the soil water influx; regardless the antecedent precipitation conditions.
Thank You!