TECHNICAL NOTES

Some Water Movement Patterns Over and Through Pinyon–Juniper Litter[1]

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Highlight

Fluorescent dye patterns depicting water movement over and through pinyon–juniper litter accumulations varied somewhat according to canopy density of the trees. Where the canopy was closed, or nearly so, the dye was confined to the surface 1 inch of litter, with no lateral movement indicated. Where the tree canopy was broken or open, dye was found to a maximum of 6 inches beneath the litter and lateral downhill movement of at least 25 inches was indicated on the litter surface. Where dye had penetrated the litter, both a streaked and a uniform (even wetting front) pattern of water movement were observed.

Patterns of water movement in natural plant communities have been of interest for many years. Such patterns may exist due to unique spatial and temporal characteristics of rainfall, or because of characteristics of the flora which influence interception, transpiration, etc., and/or because of soil characteristics peculiar to a given site.

Importance of litter as a hydrologic factor in the pinyon–juniper (P–J) type has been noted by Scholl (1969). He found that resistance to wetting in the surface soils of a P–J watershed near Flagstaff, Arizona, increased from completely wettable in open areas to highly nonwettable in the litter under the juniper canopy. Similar findings have occurred in other vegetation types. Apparently organic unknowns which accumulate from litter decomposition or fungal activity cause the wettability problems.

The purpose of this study was to study patterns of water movement over and through pinyon–juniper leaf litter.

Methods

Water movement was traced on a pinyon–juniper (*Pinus monophylla, P. edulis–Juniperus osteosperma*) site in Southeastern Utah (45 miles west of Blanding, Utah) through use of two water soluble fluorescent dyes, Pyranine[2] and Kiton Yellow.[3] Pyranine will fluoresce in damp soil and Kiton Yellow fluoresces in the dry state.

During mid-June of 1969, 27 bands of dye powder (1 part Kiton Yellow to 1 part Pyranine) about 3 inches wide were put on the litter covered interspace between suitable pinyon and juniper trees (Fig. 1). The dyes were applied from a salt shaker at a rate of about 200 g/m^2, as recommended by Reynolds (1966). The dye transects varied from 48 to 170 inches in length and each ran from the base of one tree to the base of a nearby adjacent one. Maximum depth of litter was approximately 2.5 inches, with an average of about 1.5 inches.

In early September trenches were excavated along 20 randomly selected bands to study vertical dye penetration patterns. The remaining 7 bands were used to study water movement patterns over the litter surface. All measurements were made at night using a battery powered UVL-21 ultra-violet lamp.

Results

Penetration of dye into the litter was variable and type of pattern appeared related to tree canopy density. Where canopies were closed, or nearly so, the dye was confined to the surface 1 inch of litter, with no lateral movement indicated. Since total rainfall during the study period measured near normal (3.80 inches compared with probable normal range of 1.9 to 5.7 inches), throughfall and foliage drip are probably minimal under the closed canopies except in the case of large storms.

Where canopies were somewhat broken, dye patterns indicated rather nonhomogeneous vertical water movement, as shown in Figure 2. Similar irregular drainage patterns in wood-

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[2]Verona Dyestuffs, Springfield Road, P.O. Box 385, Union, New Jersey.

[3]Keystone Ingham Corp., 8726 Cleta Street, Downey, California.

FIG. 1. Litter accumulation beneath two adjacent juniper trees. A band of dye powder would run from the base of one tree to the base of the other.

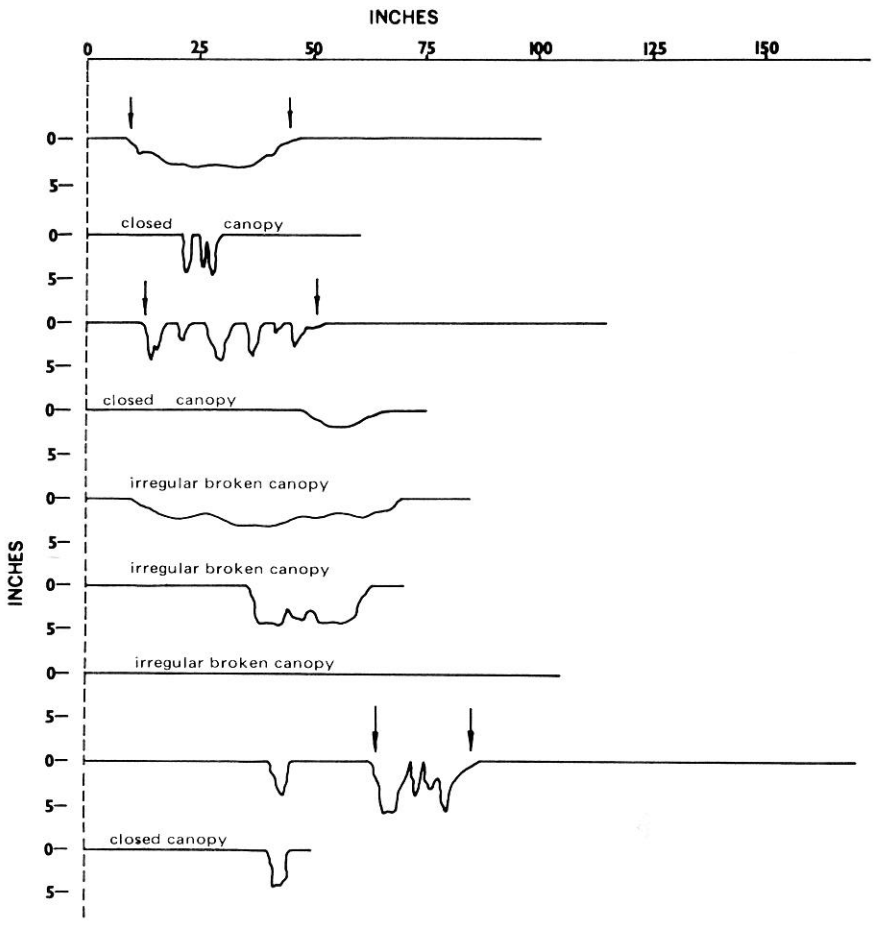

FIG. 2. Examples of some vertical dye penetration patterns through pinyon–juniper litter. Arrows indicate that portion of dye band over which the canopy was open.

land environments have been shown by Voigt (1960), Rutter (1964), and Reynolds (1966). Little or no dye movement was indicated next to either pinyon or juniper tree trunks, indicating that perhaps stemflow is rather insignificant in this type. Maximum depth of dye penetration beneath the litter surface along any excavated transect was 6 inches.

Some lateral flow over the litter surface also occurred where canopies were broken or open. Maximum indicated distance of overland flow was 25 inches, with vertical penetration into the litter of 1 inch or less. There were no indications of lateral flow within the litter cover. The overland flow may result when litter accumulations become dry and unwettable.

Conclusions

The influence of litter on hydrologic behavior of natural plant communities is not well defined. This study has shown that patterns of water movement upon and through pinyon–juniper litter are variable and are somewhat related to tree canopy density. Where the canopy is open, water may move uniformly through the litter or along pathways which result in a streaked dye pattern. Where water cannot penetrate the litter, then overland flow may occur for at least short distances.

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