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Evaluating sediment transport capacity relationships for use in ephemeral gully erosion models

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Abstract On cropland, ephemeral gully erosion in the USA may contribute up to 40% of the sediment delivered to the edge of the field. Well-tested, physically- and process-based tools for field and watershed scale prediction of gully erosion are lacking due to the fact that the complex nature of migrating headcuts is poorly understood. Understanding sediment transport capacity downstream of migrating headcuts is essential, as sediment deposition often leads to temporary storage that controls downstream water elevation, which in turn affects the rate of headcut migration. Current process-based gully erosion prediction technology used by the Agricultural Research Service (ARS) is based on characterizing the headcut migration rate, which requires the deposition depth as input to the model. Alternatively, the deposition depth can be calculated if downstream sediment transport capacity can be predicted. Data collected at the ARS-National Sedimentation Laboratory were used to test existing sediment transport relationships for the five sediment size classes (clay, silt, sand, small aggregates, large aggregates) typically used in ARS soil erosion models. The results show that the transport rate can be satisfactorily predicted for sand and large aggregate size fractions using common transport relationships based on unit stream power theory. The fractional content of the sand and large aggregate size classes can be computed using standard relationships, which are based on soil texture, previously developed by ARS. The transport of clays, silts and small aggregates is detachment limited and must therefore be computed using improved soil detachment relationships for ephemeral gullies.

Key words erosion; sediment; gully; transport capacity