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**WIND EROSION IN HAWKE'S BAY:  
THE INFLUENCE OF SOIL AGGREGATE SIZE  
AND CULTIVATION MANAGEMENT ON  
SEDIMENT FLUX**

A thesis presented in partial fulfilment of the requirements  
for the degree of  
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“What now remains compared to what existed is like the skeleton of a sick man, all the fat and soft earth having wasted away, and only the bare framework of the land being left.”

*Plato describing effects of erosion in classical Greece (cited in Clark et al., 1985).*

## Abstract

The influence of soil aggregate size and cultivation management on sediment flux of two Hawke's Bay soils was investigated. Hawke's Bay Regional Council initiated, and partially funded, the project after they identified wind erosion as a significant land management issue in their region.

Wind erosion was simulated on Pakipaki sandy loam (Typic Sandy Recent Soil) and Takapau silt loam (Typic Orthic Allophanic Soil) soil types using a portable wind tunnel. Three different cultivation treatments were applied to research sites on each soil, with eight replicates of each treatment positioned via a split-plot, randomised block trial design. Treatments were designed to produce a range of soil aggregate size distributions. A minimum tillage treatment was also simulated. At each plot, surface (10 mm depth) soil samples were collected for gravimetric moisture content, soil aggregate size and aggregate stability tests. Surface roughness and vegetative cover were measured only on Takapau plots.

The Takapau silt loam plots were very susceptible to aggregate breakdown under cultivation, with only a quarter of soil aggregates over 0.85 mm in size after one pass with the cultivator. Two additional passes did not cause a significant change in aggregate size. Minimum tillage on the Takapau plots lead to markedly lower mean sediment flux rates ( $0.2 \text{ gm}^{-1}\text{s}^{-1}$ ) compared to one pass with a cultivator ( $3.4 \text{ gm}^{-1}\text{s}^{-1}$ ).

The Pakipaki sandy loam exhibited higher resistance to aggregate breakdown compared to Takapau silt loam. After one pass of the cultivator 50 percent of aggregates measured were over 0.85 mm in size, reducing to 45 and 43.3 percent after two and three passes respectively. Data collected from Pakipaki plots suggest decreasing soil aggregate size leads to increasing erosion rates. The relationship was not significant ( $P < 0.05$ ) primarily due to a high variance in results within treatments. Minimum tillage on the Pakipaki sandy loam also resulted in considerably lower mean sediment flux ( $0.03 \text{ gm}^{-1}\text{s}^{-1}$ ) than the least cultivated plots ( $1.8 \text{ gm}^{-1}\text{s}^{-1}$ ).

The results highlighted some important implications for cultivation management in Hawke's Bay. Use of conventional cultivation techniques on Takapau silt loam soils should be avoided due to the high risk of aggregate breakdown and the subsequent wind erosion risk. Minimum or no-tillage with maximum retention of vegetative residue is the most appropriate for continued arable farming on such soils. In comparison, soil structural characteristics of the Pakipaki sandy loam soil allow for greater manipulation of aggregate size through cultivation. However, the sediment flux measured off Pakipaki plots indicates other wind erosion control techniques, such as windbreaks and stubble retention, should be utilised in conjunction with maintenance of large aggregate size to adequately control soil wind erosion.

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