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Foreword

The world population is expected to increase from approximately 4.5 billion in 1980 to 6.3 billion in the year 2000 if the present rate of population growth does not change. The world's food production must increase at the rate of 2% per year to maintain the same food supply/population ratio we have today, but even more would be needed to improve diets in developing countries. At the same time that increased food production is needed, millions of acres of land are being subjected to major soil erosion losses. This combination of events has led many to conclude that losses in soil productivity due to erosion are such that we will not be able to maintain current levels of agricultural production, much less meet the growing needs of the future.

Yet, in spite of obvious soil erosion losses, the productivity of much of our land has steadily increased during the past 40 to 50 years. This increased productivity in spite of erosion losses has supported the concept of tolerable rates of erosion for given soils below which there is no significant decrease in productivity.

While the concept of a tolerable rate of soil loss or T-value has been widely used, there are still many unanswered questions and concerns about the impact soil erosion may be having on our nonrenewable soil resources. More specifically, the question is raised as to whether soils can experience a certain rate of erosion without there being a corresponding decrease in productivity which has been offset by the application of new technology. It was because of these uncertainties that a symposium was held during the 1979 annual meetings of the American Society of Agronomy and the Soil Science Society of America. The objective of the symposium was to further examine the factors involved in the tolerable soil loss concept and either to suggest means of more accurately determining such tolerable loss levels or to identify areas of research needed to establish those levels for given soils. This publication reports the proceedings of the symposium. The contributing authors are highly qualified and their efforts along with those of the organizers and the editors are greatly appreciated.

C. O. Gardner, ASA President, 1982
R. G. Gast, SSSA President, 1982

Preface

Intolerable soil losses from soil erosion were undoubtedly recognized for centuries, but expressions of concern in the United States were infrequent until the late 1920 and early 1930 era. Bennett and Lowdermilk (1938) stated that soil loss from soil erosion was perhaps "the most potent single factor contributing to the deterioration of productive land." Out of the paradox between intolerable soil loss from man-accelerated erosion and the inevitable loss from geologic erosion came the idea of a tolerable soil loss. Early attempts to quantify soil erosion, also in about 1940, prompted the concept further, when in 1947 a soil loss tolerance in cropland was formally applied to some prominent soil types. At this time, the soil loss tolerance was defined as the "maximum average annual permissible soil loss without decreasing productivity" (Browning et al., 1947).

Widespread application of a soil loss tolerance (T-value) has occurred since 1962, when T-values were determined by the U.S. Soil Conservation Service for most of the major soil types in the United States. At this same time, the T-value was defined as "the maximum level of soil erosion that will permit a high level of crop productivity to be sustained economically and indefinitely" (Wischmeier and Smith, 1978). Throughout the development and use of the T-value, there has been disagreement about definition and intended use.

The T-value has been used since 1962 as a conservation planning guide. All soils in the USA have been assigned T-values ranging from 4.5 to 11.2 metric tons/ha per year (2 to 5 tons/acre per year). The magnitudes of the T-values are based on soil depth, prior erosion, and other factors affecting soil productivity. In the erosion control planning process, soil loss estimates for a particular site determined by the Universal Soil Loss Equation are compared with a T-value for that site. Any cropping and management combination for which the predicted erosion rate is less than the T-value may be expected to provide satisfactory erosion control. This strategy has been followed by the Soil Conservation Service in the USA since the early 1960s.

However, numerous factors in the last few years have coalesced to warrant a critical evaluation of the true meaning and use of the T value. These are: (1) increasing evidence of soil deterioration from soil erosion, (2) a recognition that technological advances may no longer be sufficient to counter productivity losses in severely eroded soil, (3) a transition from continued and unlimited expansion of cropland to one of cropland loss from urban expansion, (4) governmental policies of agricultural export to counter a negative balance of trade, and (5) increasing public concern over costs and public responsibility for effective conservation policies. Recent estimates indicate that over 27% of the cropland in the United States has erosion rates exceeding tolerable soil loss, that 23% of the cropland exceeds the maximum tolerable soil loss of 11.2 metric tons/ha per year (5 tons/acre per year), and that 10% exceeds 22.4 metric tons/ha per year (10 tons/acre per year) (CNI, 1978).

This background of ambiguous T-value definition, differing opinion of intended use, and more pressures on our limited soil resource prompted the Soil Science Society of America to hold a symposium, Determinants of Soil Loss Tolerance, at their 1979 annual meeting in Fort Collins, Colorado. This special publication is a collection of 12 papers given at the symposium, plus two papers solicited later to enhance coverage of the symposium. Objectives of this symposium and this publication are to:

a) review the perspective of accelerated erosion and its effect on world civilization;
b) review current guidelines and rationale for the determination and use of soil loss tolerance;
c) suggest improved criteria for determining soil loss tolerance values for cropland, forest, and rangeland; and
d) define areas of research needs to support and improve criteria for soil loss tolerance.

Although the original T-value definition was concerned with a physical limitation of the soil to produce forage and harvestable crops, this proceedings displays repeated, and generally unsuccessful, attempts to incorporate other damages into the T-value. Some of these are on-site damages related to nutrient loss or gully formation; while off-site damages proposed to be included are water quality and sedimentation, or social and economic considerations related to governmental policy. The symposium shows that these on and off-site damages are not readily incorporated into a single T-value. Although the symposium focused primarily on tolerable soil loss in a cropland system, range and forest lands also have a need for the control of soil loss. Existing T-value concepts and guidelines originated for cropland are not necessarily suitable for range and forest lands.

The participants at the Fort Collins Symposium possibly raised more questions than they answered. It is quite obvious from the review that there is no unanimity of opinion concerning even the philosophy of T-values. There was the agreement that the present system has major weaknesses based on lack of sufficient scientific data to first, adequately predict rates of soil formation, and second, to predict the effects of erosion on soil productivity. Certainly, research efforts need to be expanded in these two critical areas. There was, also, the agreement that to be workable, T-values must be acceptable socially and politically as well as scientifically.

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