# Tribological investigation of agricultural tools


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## MOTIVATION

The agricultural sector faces a huge challenge to achieve sustainable development besides tackling the effects of global warming. Wear of agricultural parts may play an important role in the future where the productivity of the food has to meet the growing population. Besides the productivity, the cost involved in the wear of agricultural tools is also significantly high. Downtime due to the replacement of worn agricultural machine parts affects the production and influences the lead time in the season of seeding and planting crops.

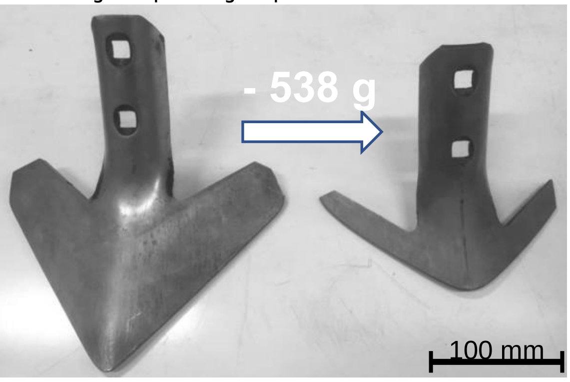


*Figure 1 Wear of agricultural tine after 145 km operation in sandy loam*

During the IMMARS project, research at Soete Laboratory focuses on the wear analysis to experimentally simulate the wear at laboratory scale in order to characterize the wear performance and understand the material behaviour to aid a proper material selection. The results and knowledge gained in this work is to support the main project objective to develop an enhanced numerical model to link the surface state (i.e. topography, composition and structure), the level of residual stresses at the surface and the microstructure to the abrasion resistance and to validate the predictive capability of the micro-and macroscale models. The multiscale modelling approach enables to perform design optimization of microstructures with tailored property profiles.

## OBJECTIVES

In order to suggest a better performing material for the agricultural machine part, the following steps are to be realized.

1. In-field investigation of the agricultural machine parts and identify the dominant wear mechanisms. The analysis is supported with a literature review.

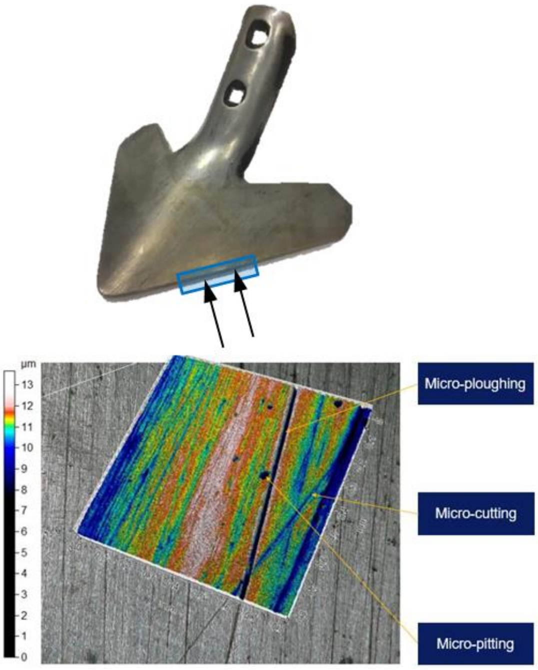


*Figure 2 3D topography of the tine cutting side after 60 km*

2. Define and relate representative lab-scale tests to the in-field investigation, including possible test-rig development.
3. For the material selection grades from lightweight materials, nano-composites, wear resistant grades

GHENT UNIVERSITY SOETE LABORATORY RWTH VTT Technische Universität Braunschweig OCAS etc. are to be considered. After material filtering, choosing the best material for the application (more wear resistant) is to be done after performing wear tests and comparing the candidate materials.

4. For an in-depth understanding of the material behaviour, connection of the wear test results to materials properties and coupling back to literature models is considered.

## Approach

During the in-field investigation of the real machine part, the weight and dimensions of the component are registered after defined intervals. The change in hardness and in the microstructure, as well as the evolution of the surface topography, are to be investigated. 3D non-contact optical profilometry is used to reveal the dominant wear micro-mechanism acting on different segments of the component. In the lab-scale testing, the conditions are set to reproduce the identified wear mechanism. The sequence of events involved in the material removal process during the wear test is monitored on-line using optical cameras and microscopes.

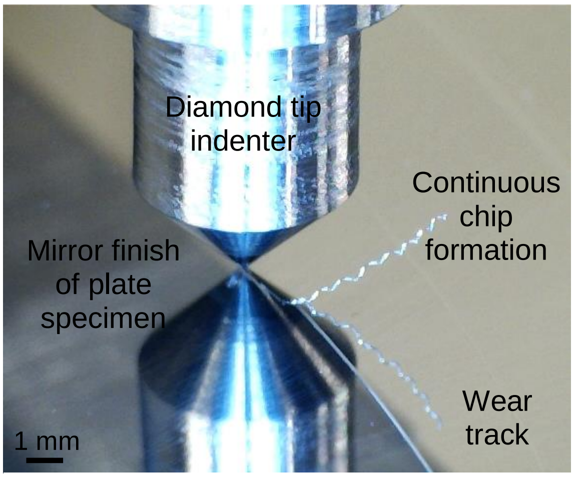


*Figure 3 Material removal through micro-cutting during abrasive scratch tests*

The characteristic features of the wear micro-mechanisms observed on the microscopy images of the contact surface of the worn samples verifies the material removal process. The findings are also confirmed with SEM investigation. The wear performance of the materials is compared both in micro and macro scale wear tests. The test results show different material responses given for each identified wear micro-mechanism, which are connected to the material properties and are coupled to literature wear models in order to help understand and predict the material wear behaviour.

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