Journal of Archaeological Science 37 (2010) 1716–1724

Contents lists available at ScienceDirect

Journal of Archaeological Science

journal homepage: http://www.elsevier.com/locate/jas

Tracing sickle blade levels of wear and discard patterns: a new sickle gloss quantification method

Jacob Vardi [a,*], Amir Golan [b], Daniel Levy [b], Isaac Gilead [a]

[a] Archaeology Division, Ben-Gurion University of the Negev, Beer Sheva, Israel
[b] Department of Physics, Ben-Gurion University of the Negev, Beer Sheva, Israel

ARTICLE INFO

Article history:
Received 29 July 2009
Received in revised form
22 December 2009
Accepted 22 January 2010

Keywords:
Chalcolithic
Beer Sheva
Sickle blades
Gloss quantification
Wear
Abrasion
Laser
Northern Negev

ABSTRACT

Although sickle blades gloss is known to form during the harvest, which is a dynamic process and although it is known to be a type of wear which is the outcome of the repetitive encounters between the sickle blades working edges and plant stems; there is no common way to quantify its intensity. Since there is no consensus over a specific scale that will enable the estimation of the amount of wear, based on the quantification of gloss brightness intensity. In this paper we propose a new measurement system which is based on the projection of laser (He–Ne) beam on glossed sickle blades and an analysis of the reflected images. The results form a relative scale from which it is possible to infer on the sickle blades level of wear, and to create discard models.

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1. Introduction

Gloss bearing blades are a well known phenomenon in those lithic assemblages dated to late prehistoric periods (i.e. late Epipalaeolithic and post-Epipalaeolithic periods). These blades are frequently found at sites located in Mediterranean climatic zones. In some periods, glossed blades are even found at sites situated in semi-arid environments. The ratio of glossed to unglossed blades at sites dating from the Neolithic period onwards, is considered to be evidence of a subsistence economy that is partially or entirely based on cereal agriculture (Rosen, 1997).

The sheen on sickle blades has attracted the attention of scholars since the early days of archaeology (Curwen, 1930; Spurrel, 1892; Vayson, 1919). Its relation to the actual act of cutting plant stems (especially cereals) was already observed in the early experiments made by Curwen (1930). Since Curwen, there have been additional investigations devoted to the study of sickle gloss (Anderson, 1980, 1999; Korobkova, 1981; Semenov, 1968; Unger-Hamilton, 1983, 1984, 1988, 1989, 1991; Witthoft, 1967). Researches included in addition to the microscopic analysis of gloss on archaeological specimens, also the study of the mechanisms behind its accumulation rate in relation to the intensity of harvesting cereals or other plant types. These studies were often supported by experimental work using replicated sickles that were analyzed for the assessment of gloss buildup (Anderson, 1980, 1999; Unger-Hamilton, 1988, 1989, 1991). Most of these experiments concluded that the gloss present on the working edge of sickle blades is a result of the repetitive friction between the cutting edge and the plant tissue. In particular, it is often claimed that this gloss is actually plant residue that accumulated on blade (Anderson, 1980; Anderson et al., 2006; Kaminska-Szymaczak, 2002; Witthoft, 1967),

Our view is based on studies that show that the gloss (among other polishes) result from the smoothing process of the sickle blade micro-relief (Korobkova, 1996; Rosen and Shugar, 2007). In addition, a Scanning Electron Microscope analysis conducted in a recent study, of glossed and unglossed areas of flint sickle blades from Tell Jemme (2nd millennia BCE, see Figs. 1–3) shows that there is no accumulation of foreign substances on any of the examined worn (glossed) sickle blade working edges (Rosen and Shugar, 2007).

As has been noted above, several studies have shown that brightness intensities of the sickle gloss is eventually "time dependent" (Quintero et al., 1997; Unger-Hamilton, 1989; Yamada, 2000). This means that the longer the harvest session is, the

* Corresponding author. Archaeology Division, Ben-Gurion University of the Negev, P.O.B. 653, 84105 Beer Sheva, Israel. Tel.: +972 (0)8 6461092.
E-mail address: jacobv@bgu.ac.il (J. Vardi).

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doi:10.1016/j.jas.2010.01.031

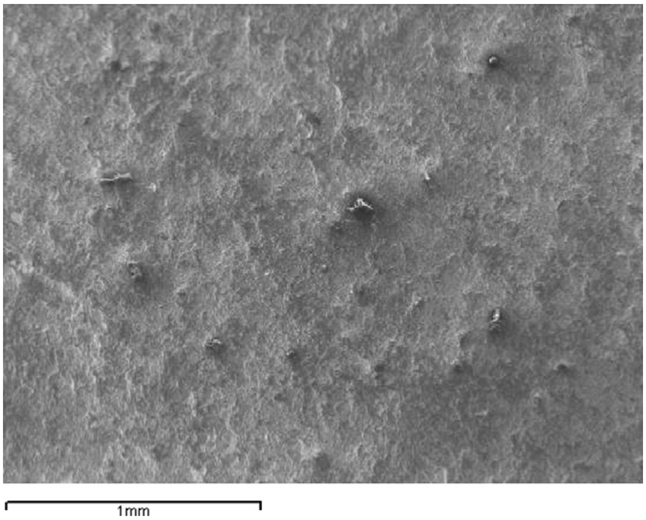

Fig. 1. Gloss free area of a sickle blade from Tell Jemme; SEM scan X50 (courtesy of Steve Rosen).

glossier the sickle blade working edge gets. However, differences in the rate of sickle gloss accumulation can occur for different reasons. Factors such as the thickness and structure of the crop type stems and their moisture content influence the rapidity of the sickle gloss buildup. In general thicker plant stems are richer in fibers and cause more wear in comparison to thinner ones. For example the cutting of reeds might enhance the rapidity of gloss buildup compare to straw (Unger-Hamilton, 1991). Another important factor is the type of raw material. Fine grained flint types appear to produce strong gloss more rapidly in comparison to grainier ones. This means that they become blunter more quickly. For example, sickle blades that were made of fine grained raw material seem to be more lustrous (Balcer and Schild, 1980; Levi-Sala, 1996; Quintero et al., 1997; Unger-Hamilton, 1983, 1988).

The rapidity of gloss buildup might be influenced also by the human factor that should also be taken into consideration. The physical strength of different reapers influences the amount of strokes used in the harvest. Simply put, stronger reapers harvest more stems and therefore their sickle will become blunt more rapidly (Anderson, 1999).

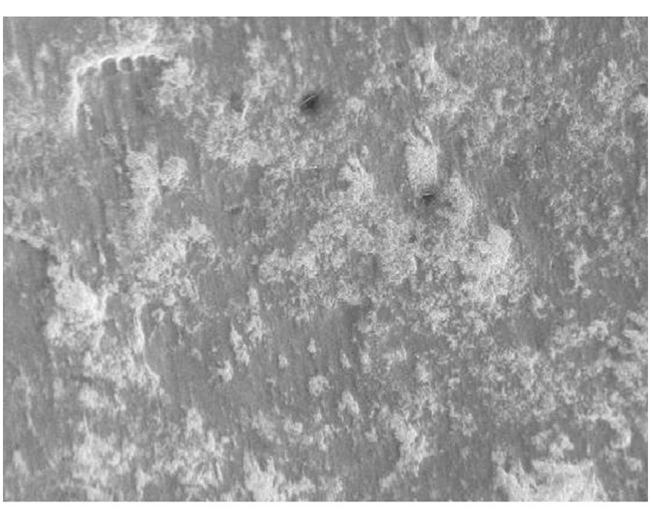

Fig. 2. Partially leveled (=partially glossed) working edge micro-relief of a sickle blade from Tell Jemme; SEM scan X50 (courtesy of Steve Rosen).

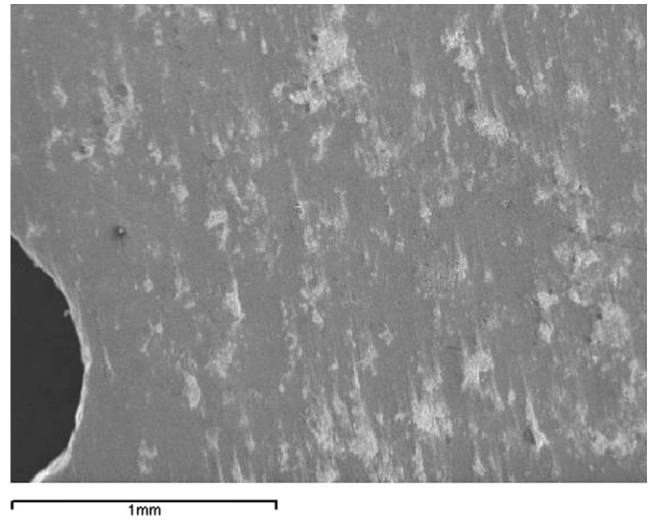

Fig. 3. Worn (smoothened) sickle blade working edge from Tell Jemme SEM scan; X50 (courtesy of Steve Rosen).

Sickle gloss can accumulate on one or two of the blade's lateral edges, and/or on the dorsal or ventral faces or both (Rosen, 1997: 28, Table 2.3). The dimensions of the gloss coverage and its extension towards the interior of the sickle blade is interpreted as evidence of intensity of harvesting (Garfinkel et al., 2002; Gopher, 1989; Gopher et al., 2001; Khalaily et al., 2003; Rosen and Shugar, 2007). The width of the glossed area is also the result of different hafting techniques used by communities of diverse cultural traditions (Cauvin, 1973, 1983; Copeland and Verhoeven, 1996; Olzewski, 1994; Stordeur, 1987; Yamada, 2000, 2003). It is acknowledged that the intensity of gloss is associated with the level of wear, however, this attribute is not quantified in terms of brightness.

Previous studies have attempted to quantify light reflections of abraded flint tools surfaces with different kinds of polish. For instance, Keeley (1980) dealt with the quantification of light reflectivity from the polished surfaces of flint tools long before the advent of digital image analysis. Grace and associates used digital image processing as a mean to quantify levels of use wear (Grace et al., 1985). In particular, they saw a need to establish an objective technique to quantify micro-wear polish. Unfortunately, their research lead them to conclude that "in the case of archaeological specimens that information is irrecoverable" (Grace et al., 1985: 118). In a subsequent study, González-Urquijo and Ibáñz-Estévez (2003) used image analysis in order to verify differences in the wear patterns created by the tribulation of flint tools on different materials, such as antler, bone, and wood. González-Urquijo and Ibáñz-Estévez research did not include sickle gloss. While this methodological approach is novel in archaeology, in other discipline the quantitative evaluation of the level of brightness found on polished surfaces of different mineralogical compositions is not new (Erdogan, 2000).

2. The problem

Several problems occur when it comes to the study of sickle gloss. The first is that currently, there is no common method to quantify the intensity of sickle gloss. Other ways of quantification of use wear are highly complicated, less efficient and costly. Many reports mention the appearance of gloss as a trait with several appearances (starting from absent and ending by strong or very bright). Although it is known that sickles were used in a dynamic process, little attention has been given to the meaning of the

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