

Assessment of a Method of Photo Analysis for Demonstrating Soil Quality

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PROJECT SUMMARY

The "soil your undies" experiment has been implemented in the past to visually demonstrate microbial activity in soil (Fig. 1). However, this demonstration lacks a quantitative evaluation and ability to statistically analyze effects of different management practices. This study was undertaken to assess the reliability of photo imaging software to quantify degradation of cotton fabric in agricultural soils under different management practices.



Figure 1. "Soil your undies" experiment photo (Source: oregonlive.com)

METHODS

White, 100% cotton fabric cloths were cut into 29.21×29.84 cm (11.5×11.75 in) pieces and placed flat inside non-degradable mesh bags ($48 \text{ cm} \times 48 \text{ cm}$, $18.9 \text{ in} \times 18.9 \text{ in}$). Sixty mesh bags were buried at 5 cm (2 in) depth in a field planted with corn in May of 2021 (day 0) (Fig. 2). The sixty bags were arranged in 12 plots to which one of three soil treatments (swine slurry, swine slurry + woodchips, and control plots with no amendments) with four replications per treatment were also applied (Fig. 3). Swine slurry (SS) was applied at a rate of $39,687.06 \text{ L-ha}^{-1}$ (4,242 gal-ac⁻¹) and woody biomass was top-dressed over SS (SSWB) at a rate of 21.52 Mg-ha^{-1} (9.6 tons-ac⁻¹). Control (CON) plots received only inorganic fertilizer.



Figure 2. Mesh bags placement between crop rows

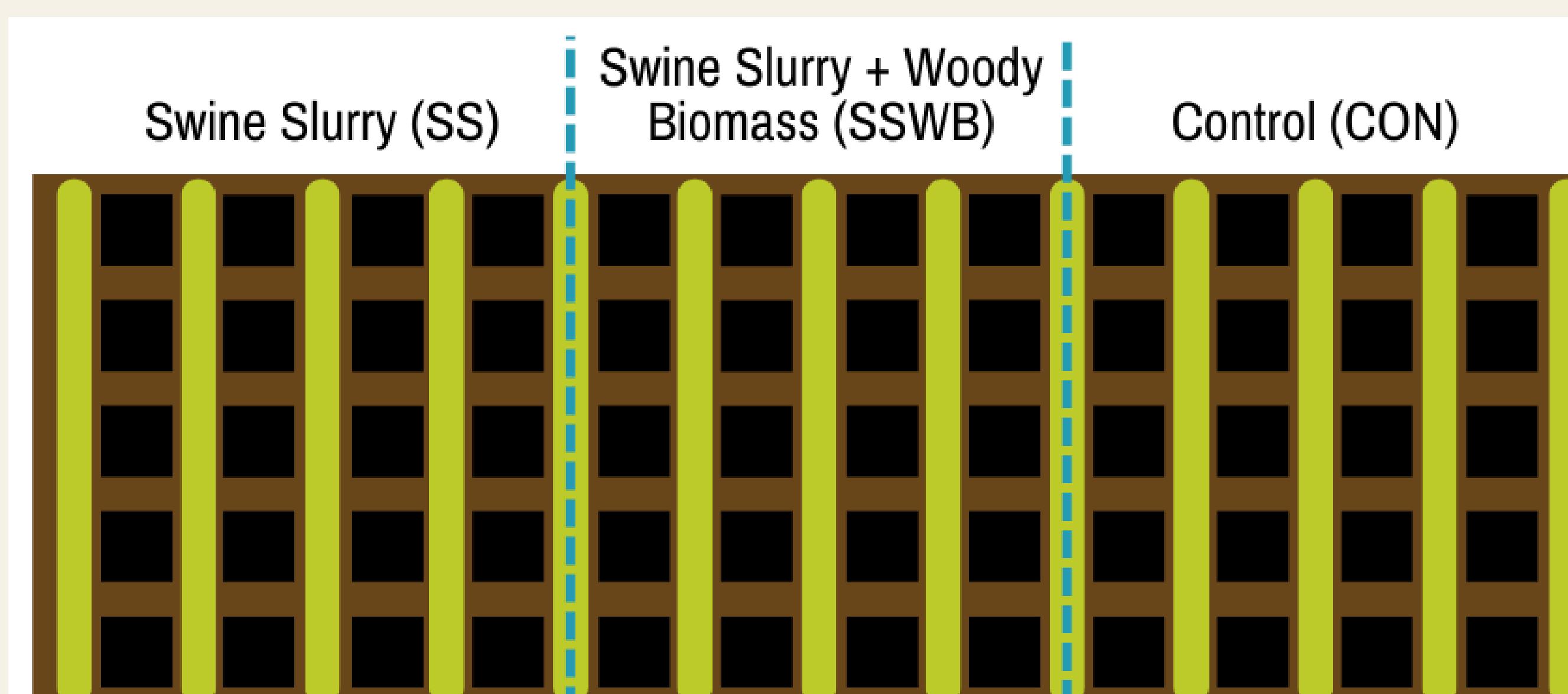


Figure 3. Simplified representation of the study design having four replicates of three treatments in a randomized block design

One bag was randomly retrieved from each plot on days 25, 54, 81, 99, and 128 and transported to the laboratory for processing. Soil was gently removed from the exterior surface of each bag before cutting bags open to reveal remaining fabric.

Fabric pieces were photographed within a pre-measured area of 29.21×29.84 cm (11.5×11.75 in) on a black laboratory countertop using an iPad mounted on a tripod directly overhead (Fig 4) and photographs were analyzed using Photoshop and ImageJ software to quantify "dark" versus "light" pixels, representing degraded and remaining fabric, respectively.

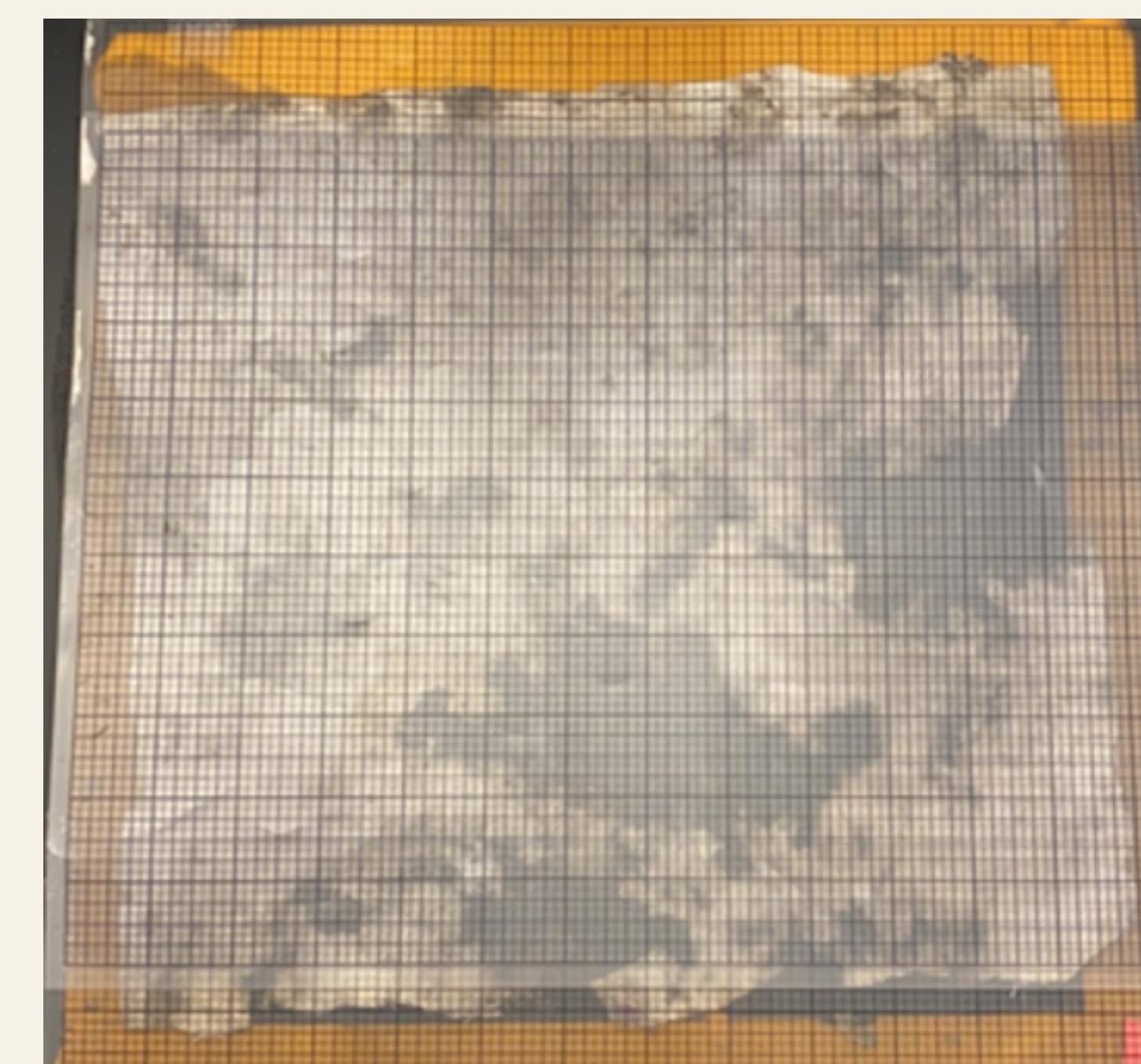


Figure 4. Fabric prepared for photographing (above) and analyzed by software (below)

RESULTS & CONCLUSIONS

The three methods for quantifying degradation of fabric samples did not differ significantly for the 48 samples analyzed to date (Fig. 6). Method comparison between each photo analysis method and manual hand count values produced scatter plots (Figs. 7 & 8) for which least squares regression lines demonstrate very good fits for both photo analysis methods.

Both Photoshop and ImageJ appear to be well-suited to accurately estimate the area of fabric degradation. Preparing samples and utilizing these software applications is somewhat time-consuming and requires knowledge of methods to manipulate photo colors to obtain the most accurate result. Therefore, while photo analysis appears to be a suitable method for quantifying degradation of cotton fabric with known initial dimensions, simplifying the analysis will be important to encourage use of this new method for demonstrating impacts of soil management practices on soil biological activity in a field setting.

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PERCENT DEGRADATION OF FABRIC QUANTIFIED BY THREE ANALYSIS METHODS

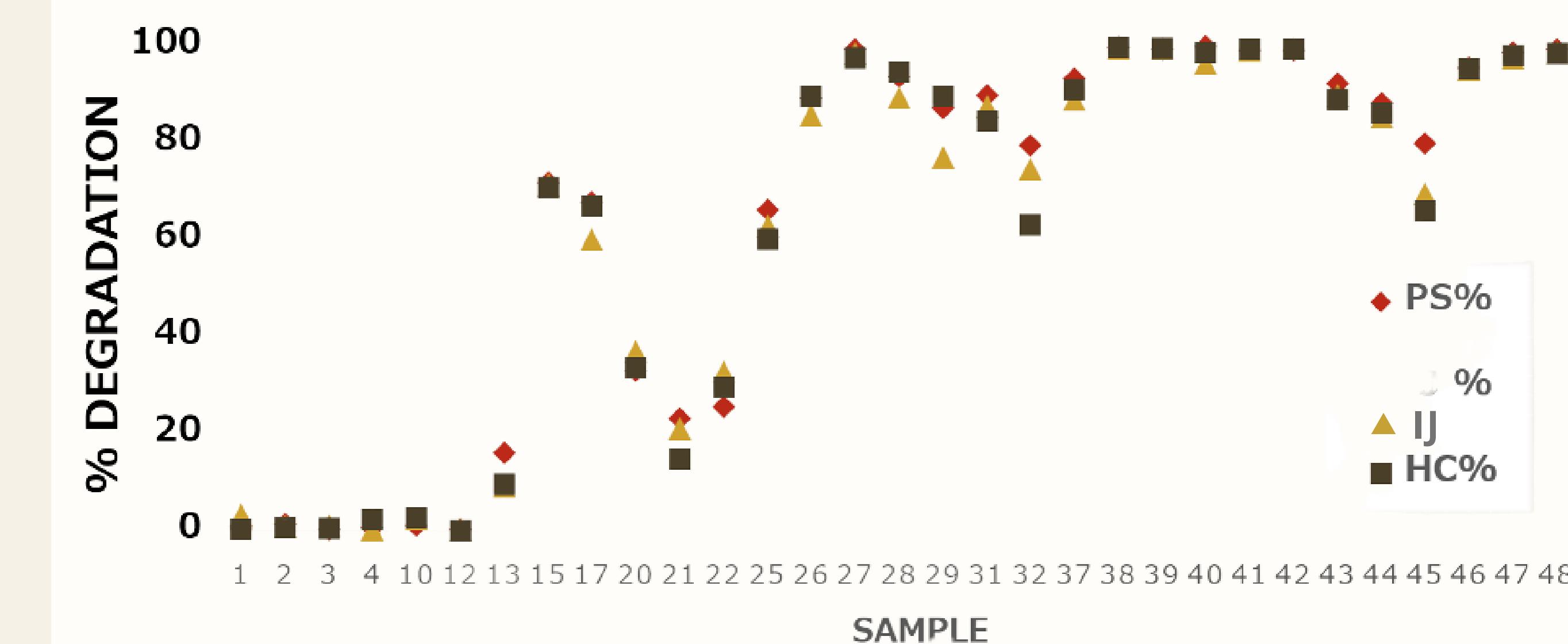


Figure 6. Percent degradation of fabric by hand count (HC), Photoshop (PS), and ImageJ (IJ) analysis methods

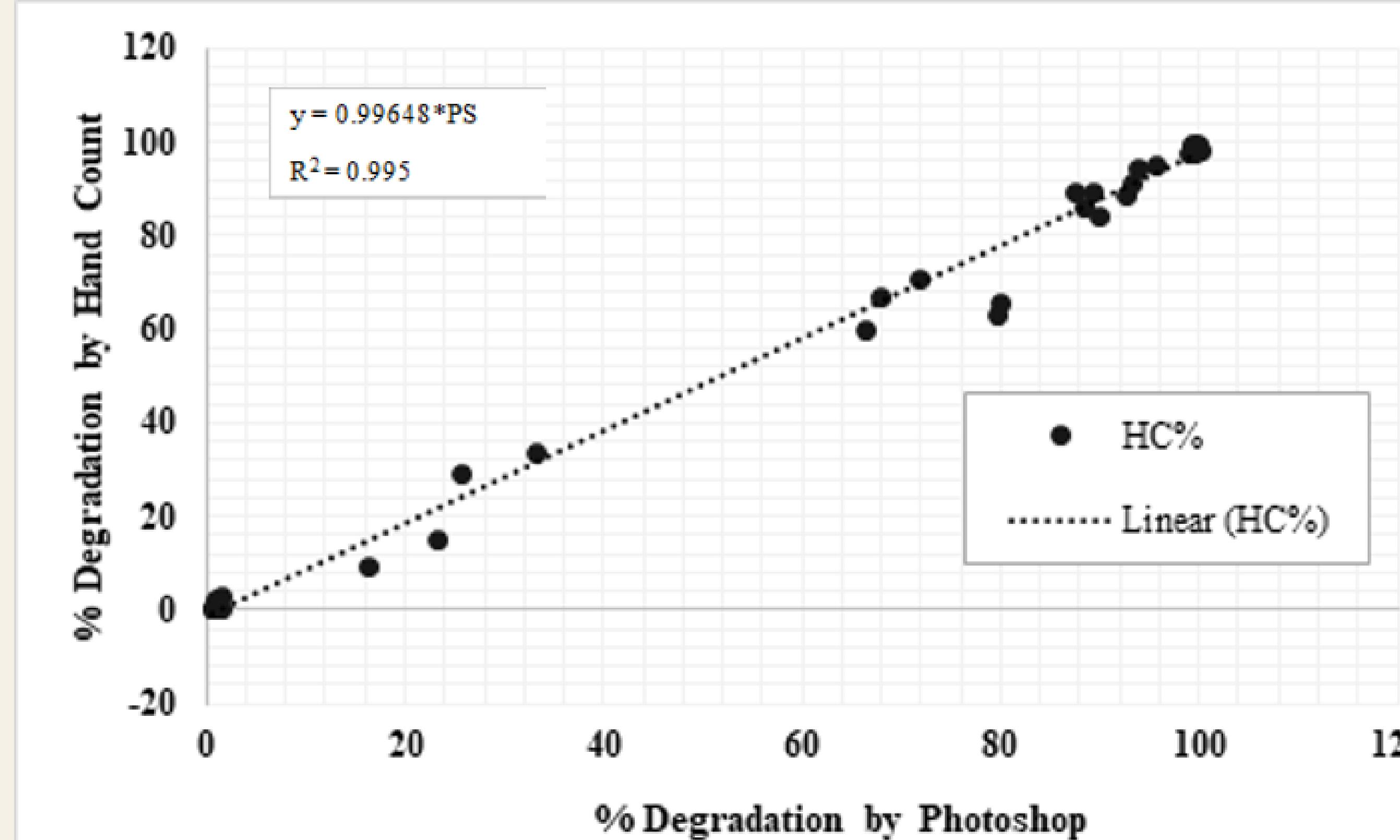


Figure 7. Linear regression model for estimated percent fabric degradation via Photoshop versus hand count

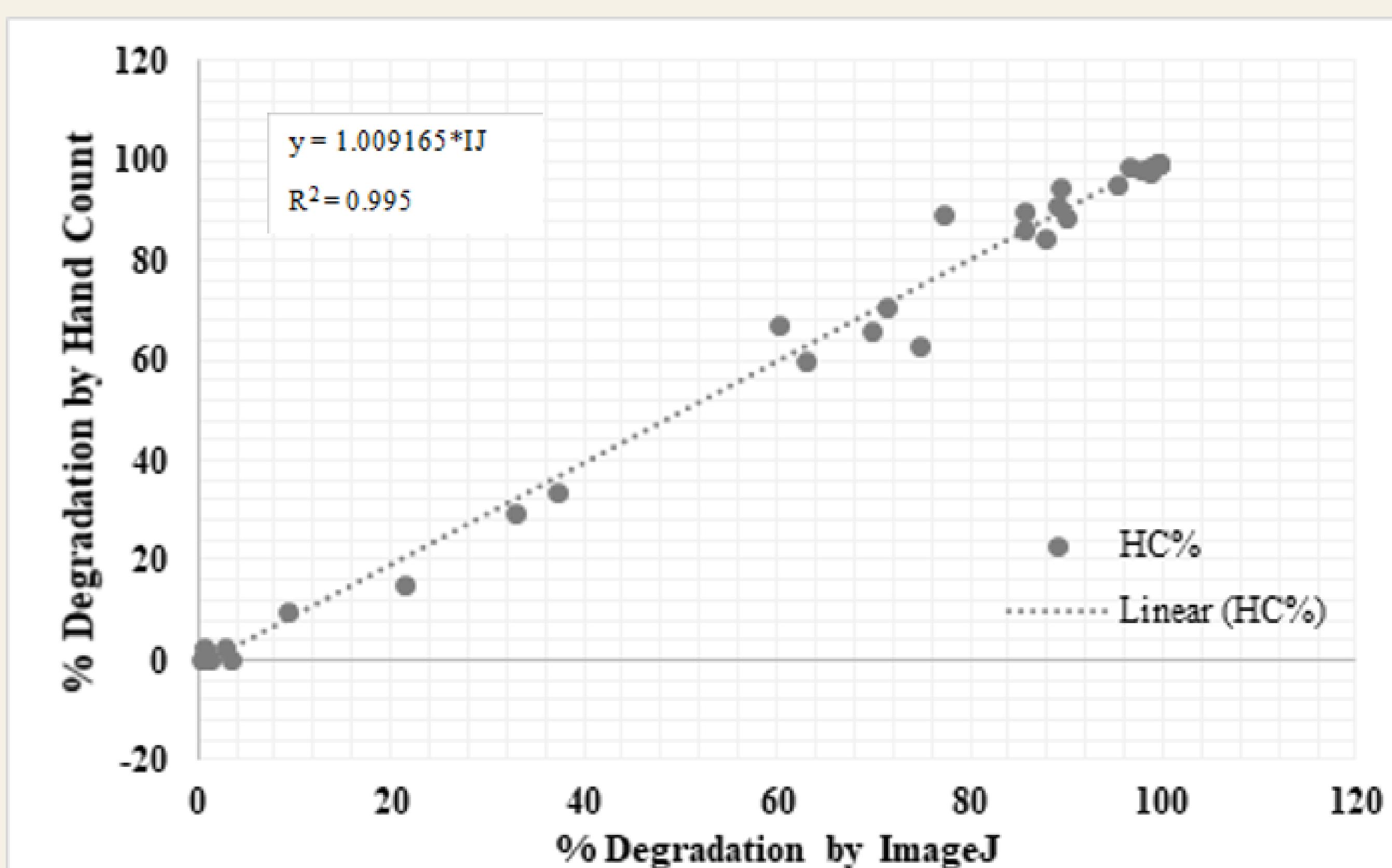


Figure 8. Linear regression model for estimated percent fabric degradation via ImageJ versus hand count