

How the cuticle of soil-digging beetles can help us achieve non-stick surfaces for soil tillage tools: a review

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OBJECTIVE OF THE REVIEW:



- ♦ What is the best topographical pattern that should be used to enhance the functional property of non-stickiness?
- ♦ Is it possible to find a characteristic pattern common to all species?
- ♦ Will such a pattern depend on the physical properties of the soil where these beetle species live?
- ♦ Is it more effective to use topographic patterns with protrusions or dimples?

KEYWORDS:

dung beetles cuticle biomimetic adhesion soil tillage

SEARCH ENGINES:



Table: Summary of results

SEARCH RESULTS	
N° of references found	50 approximately
N° of matches between search engines	3
References with 100% match	13
Time period covered by the references	2001 at 2025
Species of dung beetle Scarabaeidae studied (*)	13

(*) *Anomiopsoides fedemariai*, *Canthon mutabilis*, *Copris ochus* Motschulsky, *Dicranocara deschodti*, *Eucranium arachnoides*, *Gymnopleurus mopsus* Pallas, *Malagoniella argentina*, *Ontherus sulcator*, *Onthophagus lenziiharokfi*, *Scarabaeus typhoon* Fischer, *Sulcophanaeus imperator*, *S. menelas*.

- 1- All references agree that the cuticular microtopography of dung beetles is non-smooth or rough with convex domes, concave dips or with wavy shape.
- 2- The number of dung beetle species of Sacarabeidae family is limited although this family accounts for 8 % of the order Coleoptera. Many studies focus on a single species: *Copris ochus* Motschulsky
- 3- Methods for studying the cuticle include observation with stereoscopic microscopes, scanning electron microscopy, contact angle measurement and study of nanomechanical properties.
- 4- No extensive studies of the microtopography of dung beetles revealing the surface pattern of the cuticle were found in the references reviewed.
- 5- The references propose new biomimetic implements for tillage the soil; in all cases, the designs can reduce resistance to tillage, achieve greater energy efficiency and better soil conservation.

CONCLUSION: We are still far from understanding what is the best topographical pattern with non-stickiness properties. We need to conduct much more detailed and comprehensive studies of the cuticular surface of different species of dung beetles, considering also the physical characteristics of the soils in which they live.

REFERENCES

