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White Grubs (Scarabaeidae) as Major Root Pests of Sugarcane: Ecology and Control Strategies in Kolhapur

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Abstract: ***White grubs (larvae of Scarab beetles) are among the most destructive subterranean pests of sugarcane in Kolhapur district, Maharashtra. The present study investigated species composition, seasonal abundance, crop damage, and the relative effectiveness of different management practices. Field surveys across major sugarcane-growing talukas revealed a complex dominated by Holotrichia serrata, followed by H. fissa and Leucopholis lepidophora. Larval populations peaked during the monsoon months (July–September), coinciding with rapid cane root development and resulting in severe yellowing, wilting, and patchy field mortality. Infestation levels above six larvae per square meter caused yield reductions ranging from 20–35%. Management trials demonstrated that cultural practices combined with biological agents (Metarhizium anisopliae) significantly suppressed grub populations, while chemical soil treatments were effective but raised environmental concerns. Integrated Pest Management (IPM)-combining deep ploughing, light trapping, biological control, and judicious insecticide use-achieved the highest population reduction and yield recovery. The findings emphasize the need for species-specific monitoring, timely interventions, and greater farmer awareness to sustainably manage white grub infestations in Kolhapur's sugarcane ecosystems.***

Keywords: Sugarcane, White grub, *Holotrichia serrata*, Scarabaeidae, Root pest, Population dynamics, Seasonal abundance, Yield loss, Kolhapur, Maharashtra

1. Introduction

Sugarcane (*Saccharum officinarum* L.) is a major commercial crop of Kolhapur district, supporting sugar industries and farmer livelihoods throughout Western Maharashtra. However, soil-dwelling insect pests, particularly white grubs, have become one of the most persistent production constraints. During recent years, farmers across Hatkanangle, Shirol, Karveer, and Panhala talukas have reported increasing incidence of wilting, patchy plant mortality, and poor ratoon establishment.

White grubs, the larvae of Scarabaeidae beetles, feed extensively on tender roots and basal stalk tissues, severely disrupting nutrient and water uptake. Typical symptoms include progressive yellowing, reduced tillering, and irregular patches of dried cane clumps that can be easily uprooted. Because the damage occurs underground, infestations often remain unnoticed until yield losses are irreversible.

To better understand the problem, a systematic survey was conducted during 2023–2024 across 40 representative sugarcane fields in Kolhapur. Grub infestation was recorded in 72.5% of surveyed fields**,** with mean densities ranging from 2.3 to 7.8 larvae m^{-2}**.** The highest incidence occurred in fields with continuous cane cultivation and heavy organic residues. Species identification revealed a predominance of *Holotrichia serrata* (58% of collected larvae), followed by *H. fissa* (22%) and *Leucopholis lepidophora* (20%). Yield assessments showed that fields harboring more than six larvae per square meter experienced 20–35% reduction in cane tonnage compared with non-infested fields.

These observations indicate that white grubs have attained major pest status in Kolhapur's sugarcane ecosystem, driven by favorable monsoon conditions, cropping continuity, and limited adoption of preventive measures. Although chemical control options are available, their indiscriminate use risks environmental contamination and suppression of beneficial organisms. Consequently, there is an urgent need to develop and promote integrated pest management (IPM) strategies that combine cultural, biological, and judicious chemical approaches tailored to local agro-ecological conditions.

The present study was therefore undertaken to document the species complex of white grubs in Kolhapur, analyze their seasonal abundance and associated crop loss, and evaluate practical management strategies for sustainable suppression of this root pest.

2. Materials and Methods

Study Area

The investigation was carried out during the 2023–2024 cropping seasons in major sugarcane-growing talukas of Kolhapur district, Maharashtra (Hatkanangle, Shirol, Karveer, and Panhala). The region receives 900–1,200 mm annual rainfall, predominantly during June–September. Soils range from sandy-loam to clay-loam and sugarcane is cultivated mainly under irrigated conditions.

Field Selection and Survey Design

A total of 40 representative fields (0.5–1.0 ha each) were selected using stratified random sampling to cover different soil types, crop ages, and management practices. Each field was visited three times during the season (pre-monsoon, mid-monsoon, and post-monsoon).

Grub Sampling and Identification

In each field, five 1 m^2 quadrats were laid diagonally. Soil was excavated to 20–30 cm depth, and all white grubs were

collected, counted, and categorized by instar stage. Larvae were preserved in 70% ethanol and identified to species using standard taxonomic keys under a stereomicroscope. Species composition (%) was calculated based on total individuals recorded.

Assessment of Crop Damage

Visual damage was scored using a four-grade scale:
0 = healthy clump; 1 = yellowing; 2 = partial wilting; 3 = dead clump.

The proportion of damaged clumps per field was computed. In selected paired plots (infested vs. apparently healthy), yield (t ha^{-1}) was recorded at harvest to estimate relative loss.

Environmental and Field Variables

For each site, ancillary information previous crop, ratoon status, organic manure use, irrigation frequency, and weed cover was recorded through farmer interviews and field observation to relate infestation levels with field conditions.

3. Results and Discussion

Field surveys conducted across eight sugarcane fields in Kolhapur revealed that white grub density ranged from 3–10 larvae m^{-2}, with associated root damage between 8–28%. A progressive decline in cane vigor and tiller number was recorded at higher infestation levels, ultimately reducing yields from 98 t ha^{-1} in lightly infested fields to 68 t ha^{-1} under severe attack. These findings confirm the status of white grubs as serious subterranean pests of sugarcane, consistent with earlier observations in western India (Patel & Patel, 2018).(Table-no.1.)

The observed negative correlation between grub density and yield reflects the characteristic root-pruning behavior of Scarabaeidae larvae. Feeding damage disrupts water uptake and nutrient flow several weeks before external symptoms appear, causing leaf yellowing, patchy field appearance, and premature stool drying. Similar symptom progression was reported by Shinde et al. (2019), who emphasized that visual assessment often underestimates early damage.

Larval populations increased sharply during the monsoon months (June–August), peaking in July. Adult beetle emergence coincided with the first rainfall events, when moist soil favors oviposition. The tendency of farmers to retain ratoon crops and apply large quantities of organic manure likely creates favorable microhabitats for larval survival. Comparable associations between continuous cane monoculture and grub build-up have been documented in other sugarcane belts (Loganathan & Regupathy, 2017; Allsopp, 2020).

Spatial variability across fields indicates that infestation is influenced by soil texture, drainage, and local vegetation that supports adult beetles. Reports from similar agroclimatic zones note that sandy-loam soils facilitate larval movement and feeding (Foster, 2016).

Management trials showed clear differences among tested interventions. Soil drenching with recommended insecticides resulted in ~62% population reduction, while entomopathogenic fungi (Metarhizium/Beauveria) provided ~55% suppression. Deep summer ploughing reduced populations by 38%, most likely by exposing larvae and pupae to predators and desiccation. Light trapping yielded only 25% reduction, reflecting the dispersed and prolonged flight of adults.

These results highlight that no single tactic provides complete control a conclusion echoed by Jhala (2015) and Singh & Varma (2018), who reported superior outcomes when cultural, biological, and chemical methods are combined. Biological control, in particular, appears promising under Kolhapur's humid conditions, where fungal pathogens persist longer in soil (Inglis et al., 2020; Wraight et al., 2021). However, efficacy is highly dependent on timing, soil moisture, and formulation.

Although insecticides gave rapid suppression, many farmers applied them after visible wilting, when root systems were already damaged. Preventive strategies deep ploughing before planting, weed removal around field borders, synchronized planting, and monitoring adult flights can substantially reduce infestations while minimizing chemical load. Long-term studies demonstrate that integrated programs conserve beneficial soil fauna and maintain yield stability (Rao & Prasad, 2016; Sahayaraj, 2019).

Table 1: Field incidence of white grubs in surveyed sugarcane fields (Kolhapur).

Site	Grub density (larvae m^2)	Root damage (%)	Yield (t ha^{-1})
Field-1	4	10	92
Field-2	7	18	80
Field-3	9	25	72
Field-4	6	15	84
Field-5	3	8	98
Field-6	8	22	75
Field-7	10	28	68
Field-8	5	12	90

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this research work. All experiments, data collection, and interpretations were conducted objectively and without any commercial or financial relationships that could be construed as a potential conflict.

4. Conclusion

The present investigation confirms that white grubs (Scarabaeidae) are persistent and economically important root pests of sugarcane in Kolhapur**.** Field surveys showed substantial variation in grub density across sites, with higher populations strongly associated with yield reduction and poor ratoon establishment. Seasonal studies indicated that population peaks coincide with the onset of monsoon rains, highlighting the importance of timely monitoring and preventive action.

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