



Potential yield losses caused by the adults of *Schizonycha ruficollis* on pomegranate (*Punica granatum*) flowers

M A RASHMI¹, KOLLA SREEDEVI², ABRAHAM VERGHES^{3*} and RAGHAVENDRA V G¹

ICAR-Indian Institute of Horticultural Research, Bengaluru, Karnataka 560 089, India

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Pomegranate (*Punica granatum* L.) is an important fruit crop of India. It is attacked by more than 50 species of insects in India. The fruit crop that is capturing international attention for its rich antioxidants and nutraceutical value, is pomegranate. The demand for the fruit is rapidly increasing in elite markets and nearly 5% of the production in India is being exported (National Horticulture Board 2023). It is fast catching up as a ‘cash’ crop. Maharashtra is the chief pomegranate growing state with 1763 thousand tonnes (54.85% share) followed by Gujarat 684.32 thousand tonnes (21.28%) and Karnataka 305.72 thousand tonnes (9.51%) (APEDA 2023, Marathe *et al.* 2022). India ranks seventh in production of pomegranates in the world and the total area under cultivation is around 2,75,500 hectares (APEDA 2023). In 2022–23, an estimated 62,280 tonnes of pomegranate worth \$58.36 million was exported to United Arab Emirates (UAE), Bangladesh, Nepal, Netherlands, Saudi Arabia, Sri Lanka, Thailand, Bahrain and Oman. The crop is sought after by farmers for its profitable yield and short economic yield-age (18 months after planting). Once, deemed a semi-arid crop, pomegranate today is being grown in non-arid regions under drip irrigation like the south-east Karnataka districts (Bangalore Rural, Chikaballapura, Kolar) and Chittoor in Andhra Pradesh (National Horticulture Board 2023).

The Rashvee-International Phytosanitary Research and Services (R-IPRS) and ICAR-National Bureau of Agricultural Insect Resources, Bengaluru, Karnataka as part of pest vigilance have been surveying the pomegranate areas in south Karnataka to observe the pest occurrence along with its incidence levels to alert and advocate to the farmers on its management. Other biotic stresses on pomegranate include nodal blight [*Xanthomonas axonopodis* pv.

punicae (Xap)], Scolytid beetles [*Xyleborus perforans* (Wollaston)], mealybugs (Several pseudococcids) and fruit borer (*Deudorix isocrates*). In recent times, fruit sucking moths (*Eudocima fullonica*) that occurs only between June and November (CROPSAP 2013) has also become a yield constraint.

In 2022, during May–June, white grub adult beetles were observed feeding on the pomegranate flowers in Kadehalli (Devanahalli taluk, Karnataka). The loss of flowers due to these adult beetles feeding was estimated to be around 10% according to a farmer, Sri Nagaraj Gowda. The adults were identified as a Melolonthine beetle [*Schizonycha ruficollis* (Fabricius)] belonging to the subfamily Melolonthinae of Scarabaeidae. This orchard was selected for subsequent observation and monitoring in 2023 anticipating the beetle appearance as most of the scarabaeids have such annual migration cycles (Ritcher 1958). The phytophagous Scarabaeidae comprises five subfamilies, Melolonthinae, Sericinae, Rutelinae, Dynastinae and Cetoniinae, of which white grubs belong to the former four subfamilies and the speciose is Melolonthinae with 11,000 species under 750 genera worldwide (Bouchard *et al.* 2011). The most predominant and ubiquitous genera in Melolonthinae are *Holotrichia*, *Brahmina*, *Sophrops*, *Leucopholis* and *Schizonycha*. All these are economically important defoliators feeding on crops, horticultural trees and forest trees.

Diagnostic characters of Schizonycha ruficollis: The species belongs to subfamily Melolonthinae of phytophagous Scarabaeidae, which can be easily identified by the equal clefted tarsal claws and presence of frontal and clypeal carina (Fig. 1). The lamellate antennae and dentate foretibiae of the beetle are the most characteristic features of Scarabaeidae and visible post abdominal spiracle distinguishes it from the coprophagous scarabaeids. The sclerotized labrum, without the exposed mandibles from above distinguishes the species from its sister group, Dynastinae and equal tarsal claws differentiates from Rutelinae. The presence of hind tibial spurs to one side of

¹Rashvee-International Phytosanitary Research and Services Pvt. Ltd., Bengaluru; ²ICAR- National Bureau of Agricultural Insect Resources, Bengaluru, Karnataka; ³ICAR-Indian Institute of Horticultural Research, Bengaluru, Karnataka. *Corresponding author email: abraham.avergis@gmail.com



Fig. 1 Frontal and clypeal carina.

Fig. 2 Clefted tarsal claws of *S. ruficollis*.Fig. 3 Adult beetle of *S. ruficollis*.

the tarsal segments distinguishes it from Sericinae where they occur on either side of the tarsal segments (Fig. 2). The body is testaceous, elytra smooth without ridges (Fig. 3).

The study area was an orchard that was well-maintained, comprising of 1050 pomegranate trees (cv Bhagwa) in three acres of land (spacing row to row 13 ft, plant to plant 8 ft). The agronomical practices like leaf shedding, mild pruning and fertilizer applications, nutritional sprays and regular drip irrigation were followed. In April 2023, damaged flowers with mainly sepals and petals eaten were sighted and beetle species was confirmed, to a very minor extent leaves were also nibbled (Supplementary Fig. 1–5). On further examination, the adult of *Schizonycha ruficollis* beetles were seen cutting the flowers (Supplementary Fig. 1) towards dusk. So, a systematic sampling plan was carried out on every 25th tree in the orchard along a diagonal transect. Total sample size was 48. In each tree, the number of female, male and intermediate flowers were counted and among them the damaged flowers were also counted. The mean damage and percentage female flowers damaged were calculated and are presented in Table 1.

The field also had border crops of neem trees, *Melia rubra* (4 years) and *Azadirachta indica* (5 years of age) (Supplementary Fig. 2). It is known that neem tree attracts the adult beetle, (Ritcher 1958) and hence it was speculated, that, neem attracted the beetles primarily and being quick to adapt to hosts, the proximally occurring pomegranate became an easy victim. In order to further confirm the potential population of adults, lights traps were set near the fields. In a week 226 adults were caught. It was found that rains influenced the emergence of the adults and trap catches. Total rainfall during April and May was 24.8 mm and 154.8 mm, respectively.

Schizonycha ruficollis beetles infested 35.45% of the pomegranate plants (n = 48). The male flowers had 19.21% damage, bisexual flowers had 15.43% and intermediate flowers had 0.81% damage. The damaged bisexual flowers, easily discernible in the field with eaten and dried petals and calyx, failed to set fruits (Supplementary Fig. 3). This was also the case in 2022 as corroborated by the farmer. Observation of 2023 showed that all the flowers damaged eventually dried. The calyx/sepals and reproductive parts that

Table 1 *Schizonycha ruficollis* damage on pomegranate flowers

Parameter	Mean*	SD
Mean male flowers/tree	318.75	42.58302
Mean bisexual flowers/tree	223.52	14.10747
Mean Intermediate flowers/tree	10.85	3.730208
Mean total flowers	553.13	41.35914
Mean damaged male flowers	19.20	24.82103
Mean damaged bisexual flowers	15.43	21.2101
Mean damaged intermediate flowers	0.81	1.178825
Damage of bisexual flowers (%)	6.91	
Trees visited and damaged by beetles (%)	35.45	

*n, 48 trees; SD, Standard deviation.

showed eaten symptoms failed to set fruits (Supplementary Fig. 4). The damage percentage of economically important bisexual flowers and male flowers were 6.91 and 6.026 respectively.

Among the beetle pests the most important is the shot hole borer (*Xyleborus* spp.). The adult beetles bore holes on the roots and lower part of the main trunk. In the nest they cultivate a fungus on which the grubs feed. Infested trees show heavy bearing, yellowing of leaves and over all the tree begins to wilt. The wilting of the tree is due to damage to xylem and phloem tissues by the beetle. If control measures are not initiated at this stage, the adult beetles spread to other trees in the orchard and cause damage (Verghese and Jayanthi 2001).

Another beetle pest is the stem borer (*Coelosterna spinator* Fab.) like the adults of the root grubs the adults of this beetle is also active in the night. These beetles also attack the tree during the onset of monsoon. The eggs hatch in the fortnight and the grubs bore into the main stem. This also results in yellowing and death of the tree. On pomegranate flowers the major insect pest seen are thrips (*Rhipiphorothrips cruentatus*), the aphids (*Aphis punicae*) the mealybugs (*Maconellicoccus hirsutus*), *Planococcus* spp. and sometimes *Icerya purchasi* Maskell (Verghese and Jayanthi 2001).

This is the first report of *Schizonycha ruficollis* on the flowers of pomegranate. It's larval infestation on pomegranate roots was observed in Lepakshi (Andhra Pradesh) and also on guava, rose and grapevine (Batra et

al. 1973, Sreedevi *et al.* 2019). Farmers resort to routine chemical sprays on pomegranate and so, after a week, the damage by adults ceased, but defoliation on *M. rubra* and *A. indica* was regularly seen up to June. Adults after mating would lay eggs in the root zone and thereafter die, and by June/July however grubs which hatch can potentially infest the roots (Sreedevi *et al.* 2019). Due to the adult beetles feeding, about 7% loss (mainly damage to female flowers) was recorded. In economic terms this would be 367 kg/acre working out to a loss of ₹53215 to the farmers @₹145/kg, the prevalent farm gate rate. *Schizonycha ruficollis* is a potential economical pest on commercial pomegranate especially if the flowers synchronize with adult emergence. Weather models should be developed as this beetle is dependent on rainfall like the weather models developed in *Bactrocera dorsalis* (Verghese *et al.* 2006).

SUMMARY

Pomegranate is an important fruit crop that is capturing international attention for its rich antioxidants and nutraceutical value. The demand for the fruit is rapidly increasing in major national and international markets. Therefore, any serious pest is of great importance and here we report the severe incidence of adult beetles of *Schizonycha ruficollis* that resulted in potential yield loss due to its feeding on pomegranate flowers in Devanahalli, Karnataka. Usually June/July adult beetle emerge and feed on hosts like neem and *Melia rubra* which the farmers plant them as wind breaks along the borders. These attract the beetles into pomegranate field and the pomegranate flowers are then infested by the adult beetles. The pomegranate on an average possess 223 female flowers per tree, which when damaged fails to set fruits causing economic loss. A documentation study during 2023 was taken up to evaluate the crop loss caused by *S. ruficollis* in pomegranate resulted in potential seven percent yield loss accounting to ₹53215/acre at the farm gate price. This loss can be avoided by initiating a management practice at the first site of the beetles especially after the first monsoon rain. This study also helped us to alert pomegranate exporters and extension officials about the need of preventive measures to avoid the yield loss.

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