

# 골프장에서 녹색콩풍뎡이 성충의 활동과 분포

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## Distribution and adult activity of *Popillia quadriguttata* (Coleoptera: Scarabaeidae) in golf courses in Korea

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### 1. Introduction

*Popillia quadriguttata* (Fabricius), known from Korea, China, Taiwan, and Vietnam (Kim 2001), feeds on many ornamental plants and some agricultural crops including soybean and corn (Guo 1983). Because adults cause feeding damage to many landscape plants and the larvae damage the roots of turfgrasses, this insect is an important pest for Korean golf courses. The damage to golf courses by *P. quadriguttata* and other scarab larvae is compounded by wild animals, particularly magpies, that dig-up turf while searching for larvae to eat. In Korea, *P. quadriguttata* was originally thought to be the Japanese beetle, *Popillia japonica* Newman, because of their similar appearance. Therefore, publications before 1990 refer to *P. quadriguttata* as *P. japonica* (Ku et al. 1999). More recently Kim et al. (1990) referred to what was thought to be the Japanese beetle as *P. uchidai*. Now this species has been re-examined and identified as *P. quadriguttata* (Ku et al. 1999). Still, most of the golf course superintendents in Korea call this the Japanese beetle or the Korean Japanese beetle. However, scientists now agree that *P. quadriguttata* is found in Korea and China but not in Japan while the Japanese beetle (*P. japonica*) is found in Japan but not in Korea and China (Ku et al. 1999). *Popillia quadriguttata* also differs from the Japanese beetle in life history and host range. Japanese beetle feeds on more than 300 species in 79 families (Potter and Held, 2002) while *P. quadriguttata* appears to feed on fewer plant species. When trees, shrubs, flowers, grasses and weeds were examined on golf courses in Korea, Lee et al. (2002) found *P. quadriguttata* feeding on 26 species of plants in 18 families. When 69 plant species in 33 families were also tested as food for *P. quadriguttata* in the laboratory, the beetles fed on 30 plant species in 19 families (Lee et al. 2002). In this study we test the use of Japonilure plus PEG to monitor for the presence of *P. quadriguttata* and other species of scarab beetles on golf courses in Korea. We also use the Japonilure plus PEG to determine what time of year and what time of day *P. quadriguttata* adults are most active. This information is critical for golf course superintendents looking for *P. quadriguttata*, and in the future it may also help in the search for natural enemies of *P. quadriguttata* in Korean, for

use in biological control of its sibling species, *Popillia japonica*.

## 2. Material and Methods

Studies were conducted at five golf courses Anyang Golf Club at Gunpo (3735'N, 12694'E), Seven Hills Golf Club at Anseong (3700'N, 12731'E), Glanrose Golf Club at Yongin (3729'N, 12721'E) in Gyeonggi Province in central Korea, Yongwon Golf Club at Jinhae (3500'N, 12883'E) in Gyeongnam Province in southern Korea, and Jeju Golf Club at Jeju (3318'N, 12636'E) in Jeju Province, an isolated subtropical island in southern Korea. The lures we used were developed for the Japanese beetle, and consisted of the pheromone, (R,Z)-5-(1-Decenyl) dihydro-2(3H)-furanone (TRC INC. Salinas, CA), and the feeding attractant, PEG, 16 Phenethyl propionate-Eugenol-Geraniol (TRC INC. Salinas, CA). Traps were hung in trees near the fairways, tees and greens, at 1.5 m above the ground. Daily activity of adults was observed in July, 2000 with pheromone traps and with visual counts at Yongwon Golf Club in Jinhae in Gyeongnam Province. Adults were counted by walking the length of the fairway or green and observing all adults within one mower-width (4.2 m-wide swath in the fairway, 1.6 m-wide swath on the green). The mower width provided an easily observed swath to sample because the grass is cut in straight strips the length of the fairways and greens. Observers walked an entire swath of each fairway or tee, counting adults. Visual counts of adults per swath were transformed to adults per 100 m<sup>2</sup>. Observations were made at each site on July 10-11, July 12-13 and July 21-22, 2000. The seasonal activity of *P. quadriguttata* adults was observed at the Jeju Golf Club in 2000 and 2001. In 2000 the traps were installed at ten sites. The traps were installed in the nearest tree to the locations listed above, at a height of 1.5 m on July 1. In 2001 the traps were installed in the same places on July 1 and were emptied on July 7, 21, 28, August 11, 30 and September 10. Activity of adults was observed throughout the season with pheromone traps and by visual search from 2000 through 2002. *Popillia quadriguttata* adults were trapped in the summer of 2000 with Japanese beetle traps at Anyang, Glanrose, Seven Hills and Yongwon Golf Clubs. Larvae were collected from the same holes at the same golf clubs in late August, 2000. *Popillia quadriguttata* larvae were sampled in late August at four locations in each fairway by removing a 30 cm × 30 cm square of turf and soil to a depth of 8 cm, with a shovel. The turf roots and soil were torn apart to search for larvae. The larvae were identified as explained by Choo et al. (1999).

## 3. Results

A total of nineteen scarab species in 13 genera were collected from Japanese beetle traps at the golf club study sites. The number of *P. quadriguttata* caught in traps was much higher than that of the other scarabs. The abundance of *P. quadriguttata* varied considerably

among the different golf clubs.

The number of *P. quadriguttata* adults collected in pheromone traps was greatest at 14:00. This differs slightly from the visual counts which peaked at 12:00. The density of beetles in visual counts at 12:00 (32 beetles/m<sup>2</sup>) was greater than counts at any other time of day except counts made at 14:00. The number of *P. quadriguttata* adults collected in Japanese beetle traps generally showed a positive correlation with the density of adults determined by visual counts ( $R^2=0.5258$ ,  $P=0.0001$ ).

At Jeju Golf Club the numbers of *P. quadriguttata* trapped at each hole in 2000 correlated well with trap catches at the same holes the following year, in 2001 ( $R^2=0.7331$ ,  $P=0.0246$ ).

The total number of adults/trap collected throughout the period of adult activity at Yongwon Golf Club varied from year to year. In 2000 we trapped a total of 455 adults/trap, in 2001, 1,232 adults/trap, and in 2002, 1,257 adults per trap. Trap catches during the week of peak adult activity also varied from year to year and reflected the total seasonal catches. In 2000 a peak catch of 28.4 adults/trap/day was collected the week of July 1 to 6. In 2001 the peak catch of 59.8 adults/trap/day occurred during the week of July 5 to 13. In 2002 a peak of 108.5 adults/trap/day were captured the week of July 2 to 6. Trap catches during the peak week were different from other weeks in 2001, 2002, and 2003. Adult activity as measured by visual counts in fairways, tees and greens peaked a week earlier at Yongwon in 2002, when compared with the catches in Japanese beetle traps. The greatest adult activity was observed on June 28 when we counted 31.1 adults/100 m<sup>2</sup>. The count on June 28 was higher than counts on other sample dates. Adults were more active in fairways and roughs than in tees or greens.

There was a positive correlation between the adult activity in July and larval density in late August. Larval density was higher at the sites where adult numbers had been high in July ( $R^2=0.7354$ ,  $P=0.0027$ ). The mean density of *P. quadriguttata* larvae was not significantly different among the different golf clubs. The highest density of larvae was 54.5/m<sup>2</sup> at Yongwon Golf Club, followed by Anyang Golf Club with 36.7/m<sup>2</sup>. No larvae were collected from Seven Hills Golf Club where no adults were found, and none from Glanrose Golf Club where very few adults were found (0.3 adults/trap/day).

## References

- Guo, S. Y., 1983: *Popillia quadriguttata* Fabricius. Pp. 215-216. In Chinese forest insects. 1107pp. Chinese Forest Science Research Institute. Beijing.
- Kim, J. I., 2001: Economic insects of Korea 10, Coleoptera (Scarabaeoidea II). 197pp. Junghaeng-Sa. Seoul, Korea.
- Kim, S. H., M. H. Lee, J. H. Kim, and M. S. Kim., 1990: Species and seasonal fluctuation

- of chafers in pasture. *Res. Rept. RDA(C.P)*. **32**, 64-69.
- Ku, D. S., S. B. Ahn, K. J. Hong, S. H. Lee, and J. I. Kim., 1999: Does the Japanese beetle (*Popillia japonica* Newman) distribute in Korea or not? *Korean J. Appl. Entomol.* **38**, 171-176.
- Lee, D. W., H. Y. Choo, J. M. Chung, S. M. Lee, and Y. B. Sagong., 2002: Host plants of *Popillia quadriguttata*(Coleoptera: Scarabaeidae). *Korean J. Appl. Entomol.* **41**, 15-19.
- Potter, D. A. and D. W. Held., 2002: Biology and management of the Japanese beetle. *Ann. Rev. Entomol.* **47**, 175-205.