

## Are rodent population eruptions in southeast Asia associated with quantity or quality of food?

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DOI: 10.5073/jka.2011.432.095

### Abstract

Rice field rat's population occasionally undergoes widespread eruption in Indonesia, Vietnam, the Philippines, and Myanmar following extreme weather event. Asynchronous or aseasonal planting of crops in response to unusual weather events can extend the period that high quality food is available to rodents. Consequently, rodents may extend their breeding season and a population eruption is more likely to occur. However, it is unclear the association between the quality and quantity of food and the reproductive success of female rice field rats. An improved understanding of the effects of food availability and quality on rodent reproduction could enable better forecasts of rodent outbreaks in response to unusual weather events which could lead to asynchronous or aseasonal planting of crops. We studied how the breeding performance of the rice field rat, *Rattus argentiventer*, responded to food supply at different stages of the rice crop in the Philippines. Our results suggest that rice plants at the booting to ripening stages provided high quality food for rice field rats and it drove higher conception rate of female rats at these stages of the rice crop. We contend that the extension of the growing season by 3 to 4 weeks provides high quality food for rodents for an extended period, which in turn provides sufficient conditions for a population eruption. Therefore we recommend that synchronous planting is the effective proactive action for rodent management.

Keywords: asynchronous planting, breeding, *Rattus argentiventer*, rice field rats, rodent outbreaks

### Introduction

Food quantity and quality influence the reproductive ability of female rodents (Bomford, 1987; Leirs et al., 1994). The main drivers leading to rodent outbreaks in Southeast Asia seem to be increasing cropping intensities, or changes in agricultural cropping systems related to unusual weather events (Singleton et al., 2010). This can provide high quality food for rodents for longer periods of time per year and lead to an extended breeding season of rodents. However, knowledge about the effect of food availability and quality on reproductive success of rice field rats is still lacking. A better understanding of the factors that influence the breeding dynamics of rice field rats could lead to better forecasts of rodent population eruptions. In turn, this could provide smallholder farmers in Southeast Asia with the opportunity of taking proactive actions for rodent management before high populations of rodents occur. The objective of this study was to determine the importance of food quantity and quality for the reproductive success of *R. argentiventer*.

### Materials and methods

The study was conducted in irrigated rice cropping systems in Mindoro, Philippines. Kill-trapping was conducted at different crop stages - tillering, booting (early stage of flowering), ripening (two weeks before harvest), and stubble (two weeks after harvest) - to collect adult female *R. argentiventer*. The estimated time of conception of breeding females, and litter size were assessed. Stomach contents of females were collected to identify their diet at each crop stage. The quality of food was estimated by assays of protein content of rice plants and grain sampled at the main crop stages. Grain which was spilled in the rice field during harvest was sampled two weeks after harvest to estimate the availability of food during the stubble stage.

### Results

Conception rates were highest at the early booting to ripening stages (51.2 and 36.4% respectively) and lowest at tillering and stubble stages (2.7 and 15.2% respectively). The litter size was highest at ripening

and lowest at the tillering stage ( $12.33 \pm 0.89$  and  $9.22 \pm 0.86$  respectively). The majority of stomach contents at the various crop stages were as follows: (i) tillering stage: rice plant parts, the golden apple snail, and dicotyledonous leaves (ii) booting stage: leaf sheaths and young panicles of rice plant, (iii) ripening stage: rice plant parts and rice grains (iv) stubble stage: rice grains. The highest protein content of rice plants was at the early flowering stage followed by the milky stage. The amount of spilled grain in the rice field was  $400 \pm 20.3$  kg/ ha.

## Discussion

The highest conception rates were occurred at early flowering stage (booting stage) and ripening stage. The litter size was also highest at these times. The main stomach content of *R. argentiventer* at the early flowering stage was leaf sheaths and young panicles of rice plants. At the ripening stage, the main stomach contents were rice plant parts and rice grains. The highest protein content was detected at those two stages as was the highest rate of conceptions. Therefore, we conclude that the quality of the rice plant at the early flowering to ripening stage strongly influences the breeding success of *R. argentiventer*. There was plenty of spilled grain ( $400 \pm 20.3$  kg/ ha) inside the rice field at stubble stage. However, breeding success at this stage and at the tillering stage, based on estimated time of conception, was low. Therefore the quality of food appears to be a more important factor driving reproductive success of rice field rats than quantity of food. Our study supports the contention (Lam, 1983; Leung et al., 1999) that the quality of food is the main driver for rodent population eruptions in Southeast Asia. Further, an extension of the period of planting by just 3 to 4 weeks would provide high quality food for rodents for a longer time. Maintaining synchronous planting is the simplest and most effective strategy to prevent rodent population eruptions.

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