

Distance-Dependent Effects of Electromagnetic Radiation from Mobile Towers on Honeybees (*Apis cerana*): A Field Observation Study in Muzaffarpur, Bihar

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Abstract

The rapid expansion of mobile communication infrastructure has raised concerns about the ecological effects of radiofrequency electromagnetic radiation (RF-EMR) on pollinators. This field study investigated the distance-dependent effects of an active mobile communication tower on *Apis cerana* colonies in Muzaffarpur, Bihar. Eighteen colonies were placed at six distances (25, 50, 100, 200, 300, and 500 m) from the tower at Pokhraise, while six additional colonies were maintained at a tower-free control site in Karja (~18 km away). Five colony-level parameters – foraging activity, mortality, disoriented flight, brood condition, and colony strength – were recorded weekly over seven observation periods during the litchi foraging season. Spearman rank correlation revealed strong, statistically significant distance-dependent gradients across all parameters ($|r_s| = 0.856\text{--}0.964$; $p < 0.001$). Foraging activity increased approximately fourfold from 25 m to 500 m, while mortality and disoriented flight declined sharply with increasing distance. Brood condition and colony strength improved from poor (~1) near the tower to excellent (~4) at 500 m. Mann-Whitney U tests showed no significant differences between Pokhraise 500 m and Karja control colonies for foraging activity, brood condition, and colony strength, validating 500 m as a low-exposure reference. These findings provide field-based evidence that proximity to mobile towers is associated with measurable adverse effects on *Apis cerana* colonies and suggest maintaining apiaries at least 300–500 m from active towers to reduce colony-level stress.

Keywords

Apis cerana, electromagnetic radiation, mobile communication tower, honeybee colony health, pollinator conservation.