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НАУКОВИХ ДОСЛІДЖЕНЬ**

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# ТВАРИННИЦТВО, АКВАКУЛЬТУРА ТА ДОБРОБУТ ТВАРИН

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## SEASONAL MANAGEMENT OF HONEY BEE COLONIES

Seasonal changes in environmental conditions create different challenges for honey bee colonies and require corresponding adjustments in their management. Colony strength, availability and quality of feed resources, preparation for wintering, overwintering success, and subsequent development are closely interconnected stages of the annual production cycle. Management decisions made during one period may therefore influence colony condition during subsequent seasons. From this perspective, feeding should be considered not only as a means of compensating for temporary feed deficiency but also as an important component of maintaining colony development and preparing bees for periods of increased environmental and physiological challenge.

The biological consequences of stress depend on the ability of an organism to maintain its functions under unfavourable conditions. Studies in farm animals demonstrate that differences in stress resistance can be associated with productive and reproductive characteristics [1, 2]. Although the biological organisation and stress responses of cattle and honey bees are fundamentally different, these findings illustrate a broader principle relevant to animal production: the consequences of environmental and technological challenges should be evaluated through their effects on biological function rather than through the external stressor alone.

For honey bee colonies, this principle is particularly important because the colony functions as an integrated biological system whose condition changes throughout the year. Seasonal management must therefore account for both current requirements and the subsequent stage of colony development. Periods of limited natural forage, preparation for wintering and the transition from winter dormancy to active development represent management points at which nutritional support may have consequences extending beyond the period of feed supplementation itself.

Stimulating nutrition can contribute to colony growth and development when natural forage conditions are insufficient to support the desired level of activity. Research on bee colonies receiving stimulating feeding demonstrated changes in indicators characterising their growth and development [3]. These observations support the practical importance of adjusting nutritional management to the biological requirements of colonies during

particular periods rather than considering supplementary feeding independently of the seasonal production cycle.

Preparation for wintering represents one of the most critical stages of seasonal management. During winter, colonies depend largely on previously accumulated and additionally provided feed resources, while opportunities to compensate for deficiencies are limited. Consequently, both the quantity and composition of supplementary feed become important management considerations. The inclusion of protein components in “Kandy” has been investigated as an approach to preparing bee colonies for wintering, demonstrating the practical relevance of modifying supplementary diets according to seasonal requirements [5].

However, the effectiveness of pre-winter feeding should not be evaluated solely by whether colonies consume the supplied feed. The biological value of nutritional management becomes clearer when wintering outcomes and subsequent colony development are considered together. Recent observations have shown that the efficiency of feed paste consumption is associated with wintering success and with subsequent development of honey bee colonies [6]. This relationship emphasises that management interventions before and during winter may have consequences that become apparent after the period of direct nutritional support has ended.

Such delayed effects are important for interpreting seasonal management. A colony that survives winter cannot necessarily be considered equally successful if it enters the following period with reduced strength or limited capacity for development. Conversely, effective preparation for wintering may provide benefits that extend into subsequent colony growth. Assessment of management practices should therefore include not only immediate feed consumption and overwintering outcomes but also indicators describing colony condition after winter.

Environmental conditions should also be considered when interpreting these responses. In livestock production, integrated assessment of thermal exposure together with productivity and animal-based indicators has demonstrated that the duration and accumulation of environmental load, as well as opportunities for recovery, may be relevant to biological and productive outcomes [4]. The specific indicators used for cattle cannot be transferred directly to honey bees, but the methodological principle is useful: environmental conditions and biological responses should be evaluated together when assessing the effectiveness of management.

This perspective suggests that seasonal management of honey bee colonies can be considered as a continuous sequence rather than a set of independent interventions. Colony condition → nutritional support → preparation for wintering → overwintering outcome → subsequent development represents an interconnected management pathway. Information obtained at each stage can therefore contribute to decisions at the next stage of the annual cycle.

From a practical perspective, such an approach emphasises timely assessment of colony condition and adjustment of supplementary feeding to seasonal requirements. Stimulating feeding may support colony development during appropriate periods, while pre-winter nutritional management should focus on creating conditions that favour successful overwintering and adequate post-winter development. Evaluation of the resulting colony response provides feedback for subsequent management decisions.

In conclusion, effective seasonal management of honey bee colonies requires consideration of the continuity between nutritional support, preparation for wintering, overwintering success and subsequent colony development. Available evidence indicates that supplementary feeding can influence colony growth and that the efficiency of feed consumption during the wintering period may be related to later colony performance. Therefore, management practices should be evaluated across successive stages of the seasonal cycle rather than exclusively by their immediate effects. Such an approach can contribute to maintaining colony strength and improving the consistency of beekeeping management under changing seasonal conditions.

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