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## Impact of herbal powders on prevalence and level of varroosis infestation (*Varroa destructor*) in honeybee (*Apis mellifera*. L.) colonies in Tarai regions of Uttarakhand

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### Abstract

Honeybee products have various properties like antioxidant, antimicrobial and anti-inflammatory. Although, various biological constraints create a menace to this pollinating insect. Out of biotic constraints, the ectoparasitic mite, *Varroa destructor* is the major concern to honeybee colonies. In this experiment, different herbal powders are used to fight against *V. destructor*. aromatic plants are used for making powders to test their varroacidal activity in the field conditions against honeybees. For present experiment to check their varroacidal activity against honeybees colonies sugar powder, thyme powder and neem seed powder are used. This experiment is mainly develop for an ecofriendly module to restraint varroa mites. Sugar and thyme powder found as promising as well as safe natural product for control of *Varroa destructor* and cause not affect the colony strength of honeybees.

**Keywords:** Biodiversity, venom, medicinal, varroacidal, extract

### Introduction

Honeybees are crucial part of the biodiversity on which we all depend for our survival. They provide various standard honeybee product like honey, royal jelly and pollen, beeswax, propolis and bee venom. *Apis mellifera* L. is highly valued not only for their several products with nutritional and medicinal values but also their efficient role as pollinators (Patel and Mall, 2015) [10]. Besides this, honeybees contribute to both food supply and biodiversity conservation. Because honeybees are a major source of revenue for beekeepers through the sale of honey bee products from their hives, this can also help to decrease misery of beekeeper in developing countries (Gratzer *et al.*, 2021) [5]. But varroasis, an ectoparasite of honeybees, presents a serious threat to the beekeeping industry. As stated by (Rosenkranz *et al.*, 2010) [12], Asia is a native host where varroa mites were originally discovered. But in the start of the 20th century, the mite changed hosts to the Italian honeybee and throughout the all over the World (Roberts *et al.*, 2015; Fazier *et al.*, 2010, Muli *et al.*, 2014) [11, 3, 9].

Varroa mites caused disease known as 'varroosis'. There are four major species *Varroa destructor*, *V. jacobsoni*, *V. rindereri*, and *V. under woodi* attack honeybee colonies worldwide. (Dietemann *et al.*, 2013; Conte *et al.*, 2020; Hristov *et al.*, 2020) [1, 2, 6]. Larval and adult stages of varroa mite feeds on the hemolymph and fat tissues and causes varroosis due to which honeybee's body weight to decrease and shorten the lifespan of adult bees. Varroa mite transmit various viral disease like acute bee paralysis virus (ABPV), sac brood virus (SBV) and deformed wing virus (DWV) in honeybee colonies (Locke *et al.*, 2021) [8].

Beekeeping play as an integral role of the economy of several Asian and European countries (Shenkute *et al.*, 2012; Tulu *et al.*, 2020; Tulu *et al.*, 2023) [15, 16, 17]. In contrast to the subsector's potential, the advantages that are currently being realized are extremely meager. While there are a number of factors that affect it, the primary ones are pests and diseases that affect honeybees. Varroosis is the major concern in honeybee colonies that affected honey production in Ethiopia (Shegaw *et al.*, 2022; Gela *et al.*, 2023) [14, 4]. The majority of beekeepers are unaware to possible preventive measures because of difficulty in identify the varroa mite. So, in current study we tested the essential oils, plant leaf powders and plant extracts to overcome the *v. destructor* in honeybee colonies of Pantnagar.

## Materials and Methods

The field experiment was conducted during May 2023 to October 2023 at Honey bee Research centre HBRTC Pantnagar, at Govind Ballabh Pant University of Agriculture and Technology, Pantnagar. Sugar powder, neem seed powder and thyme powder were used varroa mites. Thirty colonies of the *A. mellifera* were selected on the basis of bee-strength and the infestation of mites, to check the infestation of *V. destructor*. Pre-treatment data of mite infestation was recorded from selected colonies. For this purpose, 150- 160 bees infested with mite were collected randomly (Lee *et al.*, 2010) [7]. The application of sugar powder, thyme powder and neem seed powder were done by pouring the dust on upper side of each frame with dose rate of 125 g /hive and 5g/hive and 1g/hive for all three treatments, respectively. Control colonies were left untreated. The experiment was replicated thrice. To monitor mite population before and after treatments, a white paper sheet was placed in all hives bottom prior to each treatment under the wire/wood frame, where falling mites were trapped and the fallen mites were counted after sieving the debris collected on bee board bottom (Sammataro *et al.*, 2005) [13]. After 24 hrs of treatment data was recorded and white paper was replaced after each interval. The hive entrance remained open during the experiment and application of dusting was carried out after sunset, when all honeybees had returned to the hives.

## Results

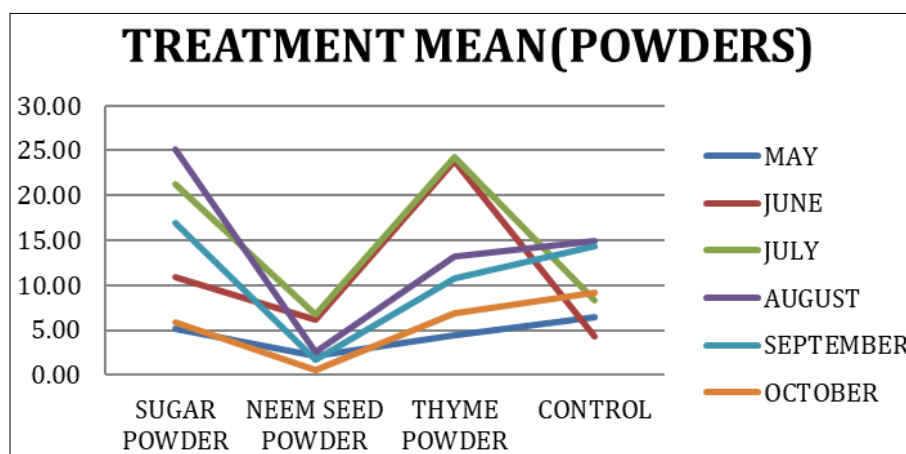
The results showed that high mean mortality (25.18 mites/hive/day) was observed in August when powdered sugar was applied at 125g /hive under field conditions, followed by 21.26 mites/hive/day mortality was observed in the month of July. In September, there is significant reduction of mite population was observed (16.95mites/hive/day). After that thyme powder was observed as excellent tool to control mite populations in bee

hives as maximum control was observed in the month of July i.e. 24.20 mites/day/hive after that second best efficacy was observed in the month of June as 23.82 mites/hive/day was observed to be fallen dead mites on bee hive bottom board on an average throughout the month. In the month of August and September, the thyme powder performed better as mite mortality on an average 13.19 and 10.81 mites/hive/day basis and kept the bee hives devoid of mites in most conducive environment (Fig. 1)

**Table 1:** mean mortality population of *Varroa destructor* through herbal powders over the months

Months	Sugar powder	Neem seed powder	Thyme powder	Control
May	5.20	2.13	4.38	6.46
June	10.96	6.09	23.82	4.27
July	21.26	6.71	24.20	8.24
August	25.18	2.55	13.19	14.96
September	16.95	1.69	10.81	14.28
October	5.82	0.56	6.84	9.12
CD	4.49	2.51	6.62	2.77
SE(d)	1.99	1.11	2.93	1.22
SE(m)	1.41	0.79	2.07	0.86
CV	17.11	41.46	25.89	15.73

Neem seed powder found to be less effective in comparison to other two treatments utilized in this experiment. Neem seed powder shown maximum mite killing in the month of June and July i.e. only 6.09 and 6.71 mites/hive/day respectively that is even lesser than control population. This shows that there is no impact or very less almost nonsignificant in bee hives when we talk about controlling mites. There is some population found to be dead in control bee hives where no treatments were used the death of mites could be natural or might be due to less availability of food and other things (Table 1).



**Fig 2:** Mortality efficiency of different herbal powders of *Varroa destructor*

The maximum control was observed in the month of June to August. May and October seems to have less killing of mites due to less population of mites available in that particular time zone.

## Discussion

Sugar powder and thyme powder was proved to be best to control varroa mites and did not affect the bee-strength. Whereas, neem seed powder did not show any significant

control in mite population but it was also did not affect the bee-strength. These herbal powders proved to be harmless to the honeybees and safe to the environment. The use of eco-friendly powders may competent into IPM for the management of varroa mite in honeybee colonies.

## Conclusion

In conclusion, the study underscores the efficacy of powdered sugar and thyme powder in controlling Varroa

destructor mites in bee hives, with significant reductions observed in mite populations, particularly during peak infestation months. Neem seed powder, while less effective, still demonstrated some control. Importantly, all herbal powders were found to be harmless to honeybees and environmentally safe. These findings highlight the potential of eco-friendly solutions in Integrated Pest Management strategies for sustainable beekeeping practices.

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