

Original Research Article

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Prevalence of *Nosema* Infection of Honey Bees Colonies in Parts of Nasarawa and Plateau States, Nigeria

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ABSTRACT

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Nosema is a microsporidian parasite of honey bees causing high losses in apiculture and consequently in agriculture. A study was carried out to determine the prevalence of *Nosema* spp in some apiaries in Nasarawa and Plateau States, Nigeria. A total of 71 samples from a cohort of 20 colonies kept in four apiaries in parts of Nasarawa and Plateau states were collected and examined for the prevalence of *Nosema* infection from June to September, November and December 2013, then January and March 2014. A non-quantitative microscopy method was used to examine for *Nosema* spp in the honey bees. The data were subjected to Chi-square analysis. The highest prevalence (55 %) was observed in Berg apiaries in Karu L.G.A. of Nasarawa state. There is no significant difference ($P > 0.05$) in the infection of bees between the apiaries, as well as in relation within the rainy or dry season. The infection was generally higher in the rainy season than in the dry season, with the highest prevalence of 71.4 % during the months of August. However, there is a significant difference ($P < 0.05$) in nosemosis infection between the seasons. The significance of the research is discussed.

Introduction

Honey bees are the most important pollinators of many agricultural commodities which depend on insect pollination. On a global scale honey bees provide approximately 90 % of commercial pollination in agricultural and hence honey bees health is of crucial importance not only for apiculture but also for agriculture and human food security (Klee *et al.*, 2007). Unfortunately, today's beekeepers face significant hurdles to maintain healthy colonies that are capable of crop pollination

because of dramatic honey bee colony mortalities in many regions of the world.

A great deal of attention has focused on these mortalities because humanity's reliance on pollinator-dependent crops has increased significantly in the last half century (Aizen and Harder, 2009). Honey bee mortality is believed to result from multiple stressors acting alone or in combination, including nutritional deficiencies, management issues, agro-

chemicals, and especially introduced parasites (Williams *et al.*, 2010).

N. ceranae is an important pathogen of honeybee colonies (Higes *et al.*, 2013). Two microsporidian species have been found to be pathogenic for the western honey bee *Apis mellifera*, *Nosema apis* and *Nosema ceranae* (Fries *et al.*, 2006) while *Nosema apis* infection is restricted to the mid gut epithelium of adult bees. *Nosema ceranae* was shown to also infect other tissues (Gisder *et al.*, 2010). Recent studies suggest that *Nosema ceranae* might be more virulent than *Nosema apis* to both individual bees (Higes *et al.*, 2007) and bee colonist (Higes *et al.*, 2008). *Nosema* was detected in 528 (44%) of the New York and 300 (29%) of the South Dakota sampled apiaries. Comparative rates of *N. ceranae* and *N. apis* infection using molecular diagnostics on managed honey bee colonies from New York and South Dakota showed that *N. ceranae* was more prevalence than *N. apis* with 96.8 % and 0.8 % respectively in New York While out of the 122 (42%) PCR-positive samples for South Dakota samples, all were *N. ceranae* (Szalanski *et al.*, 2013). In a study to investigate and determine the presence of *N. ceranae*, its prevalence and distribution in all 21 districts of Croatia, Gajger *et al.*, (2010) reported that *N. ceranae* was the only nosema species found to infect honeybees from our widespread geographic collection in Croatia. Not only does *N. ceranae* causes a clear pathology on honeybees at both the individual and colony levels, but it also has significant effects on the production of honeybee products (Higes *et al.*, 2013). However, virulence and assertiveness of *Nosema ceranae* are obviously influenced by climate (Fries, 2010). Both species cause chronic disease that can shorten the adult lifespan and impact hive health and productivity and when infections reach high levels in apiaries, honey production and pollination

services can be severely impacted (Bailey and Bail, 1991). Most other *Nosema* species, including the bumble bee pathogen, *Nosema bombi*, develop in most body tissues causing systemic infections rather than being restricted to one tissue. Many *Nosema* species infect the ovaries of reproductive female hosts and are transmitted from the infected females to their offspring (Becnel and Andreadis, 1999) but though *Nosema apis* infection in honey bee queens may affect the development of eggs and even stop reproduction (Liu, 1992). The pathogen is not transmitted through the eggs to the offspring (Webster *et al.*, 2008). The need for research in this field has become urgent. In particular, since the effects of this new parasite suggested a more severe impact on colony health compared to infections by *Nosema apis* (Higes *et al.*, 2008). Therefore, this study aimed at determining the prevalence of *Nosema spp* in colonies of some apiaries in Jos North and Bassa LGA, Plateau state and Auta balefi Karu L.G.A. Nasarawa state.

Materials and Methods

Study Area

The study areas include Jos wild Life Park apiaries in Jos-south L.G.A., Federal college of forestry Jos apiary in Jos-north L.G.A. and Gana apiary in Bassa L.G.A. of Plateau state. Berge honey Auta balefi apiaries Karu L.G.A. of Nasarawa state. The vegetation type is savannah with most of the areas covered with Short grasses and shrubs. The average daily temperature is between 18°C and 22°C. There are two seasons, the rainy season (April to October) and the dry season (November to March). The dry season is characterized by cool dry dusty harmatan wind which blows south from the Sahara. At the height of hamatan in December and January, the temperature rises again,

attaining a maximum of 31°C between February and April. The mean annual rainfall is recorded during the wet season months of July and August.

Collection of Samples

Four apiaries managed by hobbyist beekeepers in Nasarawa and Plateau States were monitored for *Nosema* infection in June to September, November and December 2013, January, and March 2014. A total of 71 samples from honey bee colonies kept in four apiaries were collected. Thirty to fifty bees were collected during each sampling from; under the lid, outside the cluster or from the hive entrance just before or after flight. The bees were kept in plastic containers with holes and either brought directly alive to be analysed freshly in the laboratory or stored in 70 % ethanol and examined within three days.

Microscopic Examination of Samples

This was carried out with slide modification according to the methods describe by Lotfi *et al.*, (2009); Gajger *et al.*, (2010). Thirty adult bees were randomly selected from each sample and suspensions were created by adding 10 ml distilled water to the abdomens of bees from a single colony, which was crushed using mortar and pestle. A drop from each sample was microscopically examined at 400× magnification for the presence of *Nosema* sp. spores.

Statistical Analysis

Data obtained were subjected to Chi square analysis using SPSS. Values with $P < 0.05$ were considered significant.

Results and Discussion

Of the 71 samples were examined, 25

samples (35.21 %) were positive for nosemosis infection (Table 1). In the Berg apiaries Karu L.G.A., Nasarawa State, 11 colonies (55 %) out of the 20 samples examined, were found to be infected. There was no visible signs of infection from samples of honey bees' colonies in Gana apiary in Bassa L.G.A. However, those from Jos Wild Life Park in Jos-south L.G.A. and College of forestry in Jos North L.G.A. Plateau State showed that 10 (34.48 %) and 4 (25 %) samples respectively were positive for *Nosema*. There was no significant difference ($P > 0.05$) in the prevalence of *Nosema spp* in honey bee between the different apiaries.

The proportion of sample positive for *Nosema spp* in the cohort monitored was generally higher in the rainy season compared with the prevalence recorded during the dry season. In the rainy season, the highest prevalence (71.43 %) was recorded in August 2013 (Table 2). The dry season had lowest prevalence (10 %) in the month of January 2014 (Table 3). The prevalence according to season showed that 47.22 % of the samples examined were positive for nosemosis infection during the rainy season, while 22.86 % were found to be positive for nosemosis infection during the dry season (Table 4). Statistical analysis showed that there was a significant difference ($P < 0.05$) in infection of nosemosis in relation to the seasons.

The high prevalence of *Nosema* infection of the honey bees during the rainy season than in the dry reported in this study is in accord with Akinwande *et al.*, (2013) also reported high prevalence of *Nosema* infection in Lagos, Ogun and Osun States, in the south-western parts of Nigeria during the rainy season than in the dry season. The north-central regions of Nigeria are characterized by tropical climate and moderate humidity.

Table.1 Prevalence of *Nosema* Spores in Common Samples from Some Apiaries in Nassarawa and Plateau States

Names of Apiaries	Number examined	Number Positive	% Positive
Wildlife park. Jos-south L.G.A.	29	10	34.48
Gana apiary. Bassa L.G.A.	6	0	00
College of Forestry Jos. Jos-north L.G.A.	16	4	25
Berg apiary. Karu L.G.A.	20	11	55
TOTAL	71	25	35.21

Table.2 Prevalence of *Nosema* Infection in Different Colonies of Honey Bees during the Rainy Season

Months	Number examined	Number Positive	% Positive
June 2013	11	5	45.45
July 2013	10	5	50
August 2013	7	5	71.43
September 2013	8	2	25.0
TOTAL	36	17	47.22

Table.3 Prevalence of *Nosema* Infection in Different Colonies of Honey Bees during the Dry Season

Months	Number examined	Number Positive	% Positive
November 2013	11	2	18.18
December 2013	9	2	22.22
January 2014	10	1	10
March 2014	5	3	60
TOTAL	35	8	22.86

Table.4 Prevalence of *Nosema* Infection in Honey Bees in Relation to the Seasons

Seasons	Number examined	Number Positive	% Positive
Wet	36	17	47.22
Dry	35	8	22.86
TOTAL	71	25	35.21

This however brings about suitable conditions for the abundant occurrence of *Nosema* in apiaries. The infection of the honey bee colonies was of its utmost level in the spring (59.5%), however the amount was considered to be low in the summer (3.33 %) and no infection was observed during the fall (autumn) (Lotfi *et al.*, 2009). The differences in prevalence in months reported in this study is contrary with Martin-Harnandez *et al.*, (2007) who report the absence of differences in the number of positive samples between months, showing evident lack of seasonality, and indicating a change in the clinical and epidemiological patterns of nosema disease. This variation could probably be due differences in environmental, climatic and management conditions.

Higes *et al.*, (2013) reported that environmental conditions also strongly influence many parasitic relationships and, regardless of the effects of altitude, flora and colony management, in warm countries like Spain the influence of temperature on the consequences of *N. ceranae* has been observed. The fact is that *N. ceranae* is highly prevalent in warmer areas and its presence in the colony is very high. The absence of *Nosema* infection in Gana apiary could probably be due to good management system and fewer number of bees in that farm since all other apiaries were established in 2005 except that of Gana apiary which was established in 2013, and it had few numbers of bees compared with others. This inter colony variation in nosemosis could also be seen within bees in the same colony. Mulholland *et al.*, (2012) reported considerable intra-colony variation in infection intensity among individual workers with a higher percentage of low-level infections detected by PCR than by spore counting. Colonies generally had the highest percentage of infected bees in early summer

(June) and the lowest levels in the fall (September).

From this study, it is obvious that *Nosema* infection occurred in colonies of in honey bees in some apiaries in Nasarawa and Plateau States. It therefore confirms that the disease has presumably been transferred from its original host *Apis ceranae* to *Apis mellifera* (Klee, *et al.*, 2007). Although no Clinical signs of the disease were seen in the honey bees. This infection could probably be due to consumption of little amount of spores while they forage about. Similarly, mild subclinical infection could be achieved by inducing infected bees to feed on more protein rich materials rather than carbohydrate (Fries, 1993).

The present data raised a strong need for epidemiological and pathogenic studies to identify this emerging parasite. Higes *et al.*, (2006) suggested that *Nosema ceranae* is a serious threat to the global bee keeping industry and natural biodiversity. The problem faced in the control of nosemosis caused by this parasite is in their asymptomatic duration (Martin-Harnandez, 2007). Bee keepers devote insufficient attention or often neglect nosemosis, because of its lack of symptoms. Currently, bee keepers in other parts of the world are using fumagillin, which is effective against *Nosema apis* infections. Fumagillin's impact on *Nosema ceranae* is still under evaluation (William *et al.*, 2008). Bee keepers should employ prophylactic practices such as keeping colonies in sunny locations so as to reduce monitor *Nosema* levels. Colonies could receive good nutrition by planting of flowering tree crops that are rich in protein. Awareness should be created particularly to apiculturists and people who venture in apiculture on the identification and control of nosemosis.

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