POPULATION VARIATION OF PLANT-PARASITIC NEMATODES INFECTED IN RICE FIELD FROM KYAING PHAUNG VILLAGE, KYAING TONG TOWNSHIP

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Abstract

In Myanmar, rice is the national food crop. Rice production needed for local consumption as well as for export. Root-rot disease occurred in some rice growing areas of the country; however, information about the disease was very limited. Therefore, the present study was conducted two rice farms (Hmawbe- 3) according to different situation. One was sandy and flooding area (Site- I) and another one was muddy and non-flooding area (Site-2) from the Kyaing Phaung Village during the rainy season of 2018. The soil and roots samples were randomly collected (one center and four corners) from both farms fortnightly. The collected samples were taken to the laboratory of Zoology Department, Kyaing Tong University. The nematodes extraction was done from soil and roots separately by Whitehead Tray method. The extracted nematodes were examined using the stereo and compound microscopes and indentified down to genus level. Total seven genera of plant- parasite nematodes were recorded from both study sites. Among them the number of *Hirschmenniella oryzae* (root-rot nematode) were highest during July and gradually reduced on September however *Meloidogynes* spp. (root-knot nematode) were sudden rise until the harvesting time in both study sites. Therefore, it may be assumed that the root damage nematodes were distributed around the rice field of Kyaing Phaung village. The present findings would be helpful towards the management of agriculture including the rice and other crops at the East Shan State.

Keywords: Rice field, nematodes, Hmawbe-3, plant-parasitic

Introduction

Rice is the dominant staple food crop in the developing countries. Almost 90 percent of rice is produce and consumed in Asia, and 96 percent in developing countries (FAO, 2004). In Myanmar, rice is the stable food for all people. Rice production needed for local consumption as well as for export. However, rice crop is subjected to a number of pests and diseases and plant parasitic nematodes are generally regarded as potentially serious constraints to crop productively. Among the rice diseases, nematode infestation can result in yield losses of up to 30 percent in general (Doberman and Fairhurst, 2000).

Over 150 species of nematodes parasitize rice. Some have a geographically restricted distribution, while others occur throughout the rice-growing regions of the world. Nematodes parasites on rice may be divided into foliar parasites and root parasites. Injury from foliar parasites produces distinctive symptoms, while above ground symptoms of root damage can be difficult to diagnose. Most nematode species are specific to a particular rice growing environment; however, some species occur across a range of environments. Communities of several potential pest species of nematodes can occur in the same field, which complicates management decisions. In the dynamic and hydrologically heterogeneous conditions of small rice farms, nematode communities may be particularly diverse (DFID, 2004).

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Nematodes can cause significant yield losses through direct pathogenic effects; for instance, by suppressing seedling establishment and growth, and yield. Nematodes can interact with other soil biotic and abiotic factors, and influence rice-weed competition. Nematode attack can induce symptoms of water stress and intensify symptoms under low water availability, reducing a crop's ability to recover from drought stress (DFID, 2004).

The main rice growing areas of Myanmar are divided into three regions according to different types of soils and climates. They are upper Myanmar, lower Myanmar and delta region (Ye Goung, Khin Win and Win Htin, 1978).

The nature of East Shan state was included in upland region. Especially, Kyaing Tong region have low rainfall and plenty of mountain ranges around the area. It has also cultivated rice plant as main crop for local consume. In the past, emphasis had been placed on nematode disease of rice such as Ufra, white tip, root-knot in Myanmar. But information of the nematodes disease from Kyaing Tong region was poor. Of these regards;

- To record the root nematodes and other plant- parasitic nematodes from the rice field
- To compare the nematodes population from different situation of rice field
- To investigate the population fluctuation of plant parasitic nematodes during the study period

Materials and Methods

The recent survey was carried out from June to December, 2018 in Kyaing Phaung village, Kyaing Tong Township, East of Shan State. In the hmawbe-3 rice field, soil and roots were collected fortnightly from two different situation of farms (one was flooding and sandy area and other was no flooding and muddy field).

Sample collection

Rice plants with roots and soils sample were collected from both rice fields. Soil and roots samples were taken randomly from five different sites (four corners and one center) at a depth of about 15 cm. Collected samples were placed in each plastic bag, attached with labels containing sampling date, locality, and sites number. Samples are stored in a cool place.

Nematode extraction from soil samples

Nematodes were extracted by using the Whitehead tray Method (Whitehead, 1965). Randomly collected soil samples from each field were thoroughly mixed and 100 ml was taken out for nematode extraction. Firstly, 100 ml of soil subsample was spread in a thin layer over a muslin cloth in a plastic sieve. The sieve was placed in a plastic tray. About 250 ml of tap water was carefully added down from the edge of the tray until the soil layer looked wet. Then the set of nematodes extracted tray was place about 24 hours.

Collecting, Counting and Identification of extracted nematodes

Secondly, the sieve was removed and about 250 ml of nematode suspension in the tray was poured into a glass beaker (300 ml Pyrex) and left for 2-3 hours to settle the nematodes at the bottom of beaker. After which upper portion of suspension was discarded and remaining 25 ml of nematode suspension in the beaker was thoroughly shaken and 1 ml of the nematode

suspension was taken by pipette and added into a counting dish where rice nematodes was examined and counted under dissecting microscope. Then these nematodes were identified under compound microscope according to Chitwood, (1950) Gooedy, Bridge, Hunt, (2002).

Nematode extraction from rice roots

Infected rice root samples were washed with tap water and cut into small pieces about 1 mm long then mixed together. The mixture of root was taken for extraction of nematodes by Whitehead tray method. Extraction, identification and counting were done like the soil samples procedure.

A. Study site-1

B. Study site-2

C. Rice plant Sample

D. Infected root

E. Nematodes extraction from soil

F. Nematodes extraction from root

Plate 1. Study sites, rice samples and nematodes extraction

Results

Total seven genera of plant-parasitic nematodes belonging to two orders and seven families were recorded during study period. Out of them, five genera of plant-parasitic nematodes were recorded from rice root samples in both study sites and four genera of plant-parasitic nematodes from soil samples of site-1 while five genera of plant-parasitic nematodes in soil samples of site-2 were recorded (Plate 1).

Among them, *Hirschmanniella oryzae* and *Meloidogyne* spp. were recorded from roots throughout the study period in both sites (Plate 1A, 1B).

The number of *Hirschmanniella oryzae* from roots were gradually increase until the harvesting time in site-1 , although the number of them were more reduced in harvesting time than the initial of transplanting time in site-2. The peak numbers of them were recorded in 45 days after transplanting in both sites (Fig 3). Almost the recorded numbers were juvenile, some were female and males were rare.

The numbers of *Meloidogyne* spp. were alternated increase and decrease almost the roots samples in both sites. However the populations of them were peak in harvesting time at roots sample of site-1 (Fig 4). All recorded *Meloidogyne* spp. were only juvenile stage.

Moreover in the root samples of both sites, *Tylenchus* sp. and *Helicotylenchus* sp. were also recorded. But *Aphelenchus* sp. was found just only in site-1 and *Aphelenchoides* sp. was recorded only in site-2. All of them were occasionally recorded during study period in both site, therefore the population of them were fewer than the previous mention genera (Table 2,4).

In soil samples, four genera of plant-parasitic nematodes in site-1 and five genera of plant-parasitic nematodes in site-2 were recorded during the study period. Among them *Hirschmaniella oryzae* and *Meloidogyne* spp. were recorded throughout the study period except the 4th sample (60 days after transplanting). However, the populations of them were fewer than the root samples (Table 3, 5).

The rest genera, *Tylenchus* sp. and *Criconema* sp. were occasionally found in both sites throughout the study period. The *Helicotylenchus* sp. was recorded only in 45 days after transplanting (3rd sample) at study site-2. The populations of them were very low in number during the recent study.

A. *Hirschmeniella oryzae*
Female (100x)

B. *Hirschmeniella oryzae*
Male (100x)

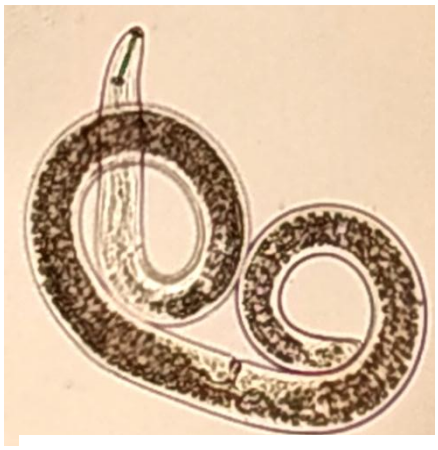
C. *Meloidogyne* sp.
Juvenile (100x)

D. *Meloidogyne* sp.
Juvenile (100x)

E. *Aphelenchus* sp.
Male (100x)

F. *Aphelenchoides* sp.
female (100x)

G. *Tylenchus* sp.
Male (100x)



H. *Helicotylenchus* sp.
Female (100x)

I. *Criconema* sp.
Female (100x)

Plate 2 Recorded plant-parasitic nematodes from two study sites

Table 1 Systematic position of recorded plant-parasitic nematodes

Sr. No	Class	Order	Family	Genus	Species	Habitat
1.	Phasmidia	Tylenchida	Paratylenchida	*Hirschmanniella*	*oryzae*	Root
2.			meloidogynidae	*Meloidogyne*	spp.	Root
3.			Tylenchidae	*Tylenchus*	sp.	Soil
4.			Hoplolaimidae	*Helicotylenchus*	sp.	Soil
5.			Criconematidae	*Criconema*	sp.	Soil
6.		Aphelenchida	Aphelenchidae	*Aphelenchus*	sp.	Soil
7.			Aphelenchoididae	*Aphelenchoides*	sp.	Soil

Table 2 Recorded numbers of plant-parasitic nematodes from root samples of site-1

Site 1 (Root samples)	1st sample	2nd sample	3rd sample	4th sample	5th sample	6th sample	Total	Mean± SD
Hirschmenniella oryzae	158	417	2550	950	767	962	5804	967.33 ± 837.04
Meloidogyne spp.	0	25	100	33	1008	4938	6104	1017.33± 1959.68
Helicotylenchus sp.	0	100	0	0	0	0	100	16.67 ± 40.82
Tylenchus sp.	0	0	0	0	25	0	25	4.17 ± 10.21
Aphelenchus sp.	0	0	0	8	0	0	8	1.33 ± 3.27
Total	**158**	**542**	**2650**	**991**	**1800**	**5900**	**12041**	

Table 3 Recorded numbers of plant-parasitic nematodes from soil samples of site-1

Site 1 (Soil samples)	1st sample	2nd sample	3rd sample	4th sample	5th sample	6th sample	Total	Mean ± SD
Hirschmenniella oryzae	1	5	8	8	4	63	89	14.88 ± 23.74
Meloidogyne spp.	6	4	83	3	8	692	796	132.67 ± 257.78
Criconema sp.	0	0	42	3	1	0	46	7.67 ± 16.86
Tylenchus sp.	1	0	42	1	2	12	58	9.67 ± 16.45
Total	**8**	**9**	**175**	**15**	**15**	**767**	**989**	

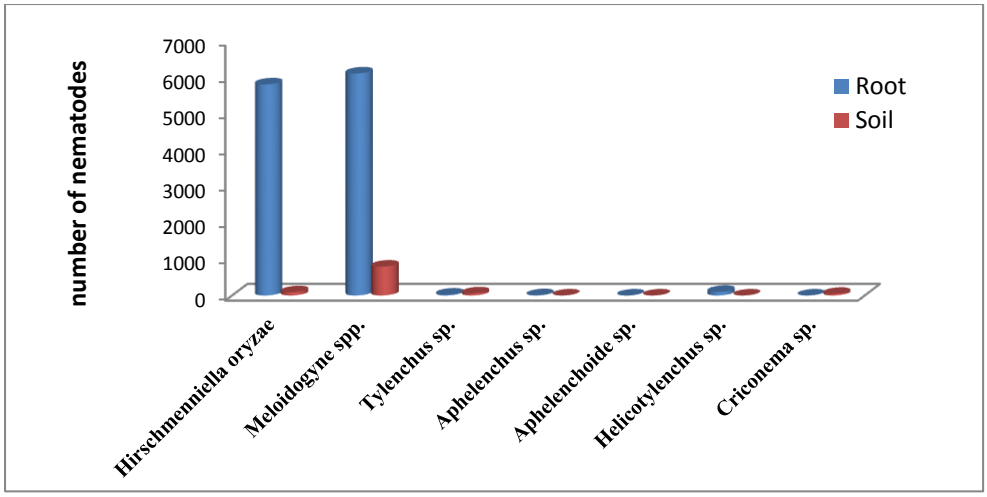


Figure 1 Recorded nematodes population from roots and soil samples of site-1

Table 4 Recorded numbers of plant-parasitic nematodes from root samples of site-2

Site 2 (Root samples)	1st sample	2nd sample	3rd sample	4th sample	5th sample	6th sample	Total	Mean ± SD
Hirschmenniella oryzae	258	930	950	516	901	204	3759	626.50 ± 346.01
Meloidogyne spp.	100	30	275	34	182	141	762	127.00 ± 93.71
Helicotylenchus sp.	0	0	34	0	0	0	34	5.67 ± 13.88
Tylenchus sp.	0	0	0	9	0	0	9	1.5 ± 3.67
Aphelenchoide sp.	0	0	0	0	18	34	52	8.67 ± 14.35
Total	**358**	**960**	**1259**	**559**	**1101**	**379**	**4616**	

Table 5 Recorded numbers of plant-parasitic nematodes from soil samples of Site-2

Site 2 (soil samples)	1st sample	2nd sample	3rd sample	4th sample	5th sample	6th sample	Total	Mean ± SD
Hirschmenniella oryzae	75	34	5	0	7	50	171	28.50 ± 29.94
Meloidogyne spp.	125	50	21	0	18	14	228	38.00 ± 45.66
Helicotylenchus sp.	0	0	34	0	0	0	34	5.67 ± 13.88
Criconema sp.	0	34	5	0	52	14	105	17.50 ± 21.18
Tylenchus sp.	0	25	0	0	1	1	27	4.50 ± 10.05
Total	**200**	**143**	**65**	**0**	**78**	**79**	**565**	

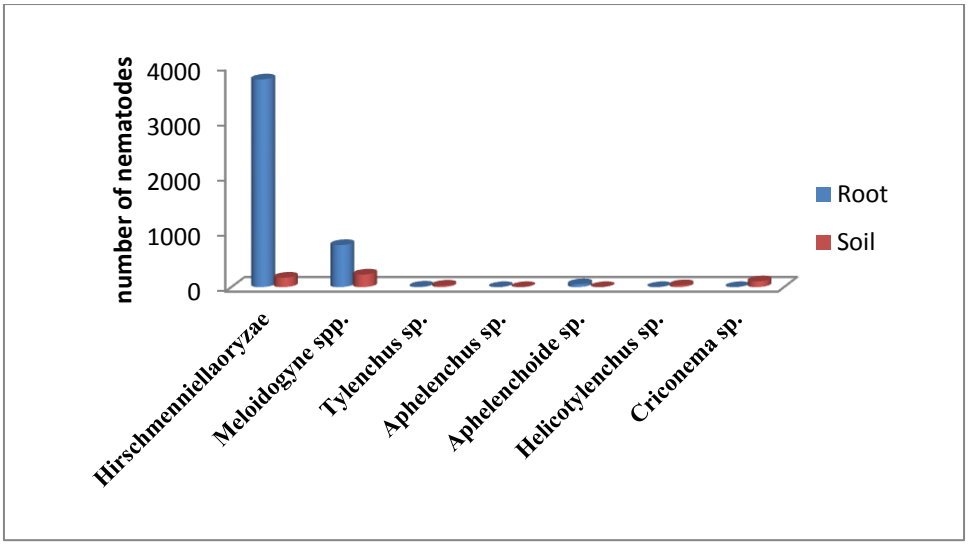


Figure 2 Recorded nematodes population from roots and soil samples of site-2

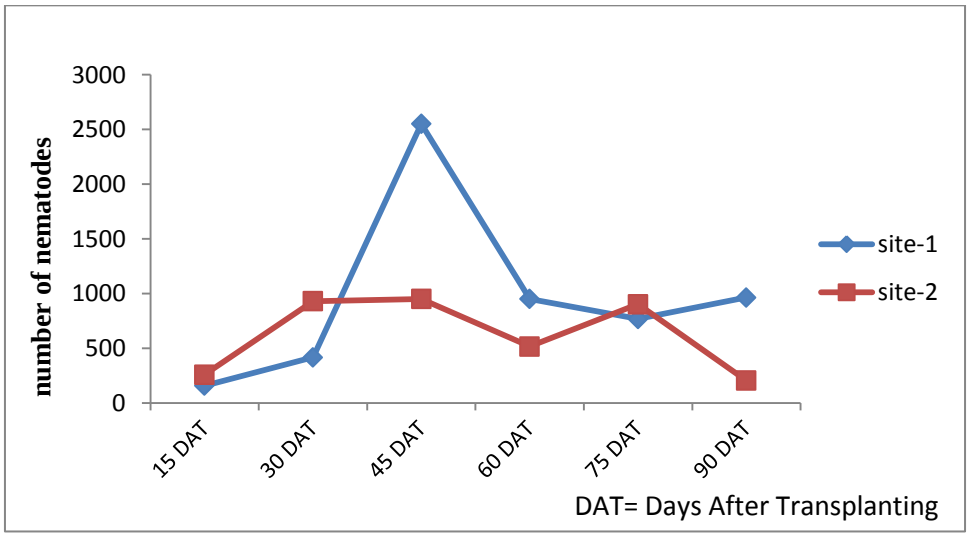


Figure 3 Population fluctuation of *Hirschmanniella oryzae* from rice roots of both study sites

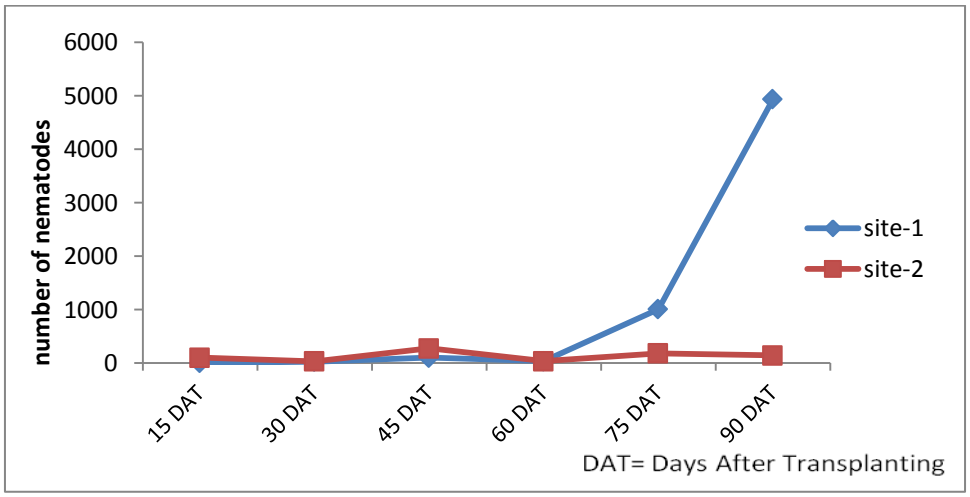


Figure 4 Population fluctuation of *Meloidogyne* spp. from rice roots of both study sites

Discussions

In present study, seven genera of plant-parasitic nematodes were recorded. Among them *Hirschmanniella oryzae* and *Meloidogyne* spp. were abundant in both study sites during the study period. However the total numbers of these two genera were higher in site-1 than in site-2.

It may be assumed that the differences of soil type and field condition were variable the population of nematodes. In site-1, soil type were sandy and flooding condition while in site-2 had muddy and no flooding condition. Therefore, field condition of site-1 was easy to transmit from one to another plant rapidly by swimming or crawling within the rice field.

The present finding agreed with the report of DFID, (2004) it had stated that nematodes can interact with other soil biotic and abiotic factors, and influence rice-weed competition.

H. oryzae are root rot nematodes they particularly infected in the rice root for consume the root sap. In present work, the population of *H. oryzae* rapidly increased until the 3rd sample (45 days after transplanting) in site-1, and then rapidly decreased within next two weeks (4th sample) to harvesting time.

It may be suggested that, the rice roots were highly developed up to 45 days old plants; *H. oryzae* got the fully nutrient from rice roots for multiply their population at that time. The newly hatched juveniles more attacked to root for their food, after that the rice roots became rapidly damage and rot within two weeks. Therefore, their populations in root were decreased until the harvesting time.

The present suggestion was assisted by the report of Yokoo and Su (1966), they found 33% decrease in numbers of *H. oryzae* within 50 days of removal of flooded water. Fortuner and Merny (1979) also stated that, they survive longer in roots than in soil but survival of root populations is shorter in flooded soil due to the more rapid decay of roots

In the present study site-2, the populations of *H. oryzae* were gradually increased along the study period except the harvesting time. Moreover site-2 was reverse situation of mention the previous authors there was no flooding and muddy soil, so population of *H. oryzae* was not significantly differences along the study period.

Similarly *Meloidogyne* spp. is root knot nematodes and they infected on roots of the cultivated crops. In recent work, *Meloidogyne* spp. was gradually increased along the studying time in site-2. However in site-1, the populations of *Meloidogyne* spp. were suddenly increased from the 60 days after transplanting to harvesting time, which was highest in number.

At the same time, the population reduction of *H. oryzae*, and population increasing of *Meloidogyne* spp. were recorded in study site-2. It may be suggested that when the *H. oryzae* infected roots were damage and rot, the rice plants had newly roots developing was occurred at that time because adequate of water supply (flooding). Therefore, it may be favorable condition to *Meloidogyne* spp. for invasion and breeding in the younger roots.

Taylor *et a*l, (1966), assisted to present opinion; they stated that rice root nematodes are well adapted to conditions in marshes and flooded rice paddies. They can infect and reproduce in some sedges and grasses.

According to Mya Mya (1983), *Meloidogyne graminicola* or rice root-knot nematode a sedentary endoparasite, attacks the roots of rice plants and occurs in lowland and upland rice

areas of Myanmar. The present study was agreed with the report of Mya Mya (1983) because the recent study sites were upland area.

Butler,(1913, 1919), who stated that nematode parasites of rice include rice white tip nematode (*Aphelenchoides besseyi*), rice stem nematode (*Ditylenlenchus angustus*), rice root nematode (*Hirschmanniella* spp.), root knot nematode (*Meloidogyne* spp.), rice cyst nematode (*Heterodera oryzae*), stunt nematode (*Tylenchorynchus* spp.), ring nematode (*Criconemoides* spp.) and lance nematode (*Hoplolaimus* spp.)

In recent study, out of the Butler reported rice nematodes, three genera of nematodes *Hirschmanniella oryzae, Meloidogyne* spp. and *Criconemoides* sp. were recorded. However, Criconemiodes sp. was recorded only in soil from both study sites.

The rest of nematodes *Aphelenchus* sp., *Aphelenchoides* sp., *Helicotylenchus* sp. and *Tylenchus* sp. were recorded in both study sites during study period.

According to DFID (2004) report, communities of several potential pest species of nematodes can occur in the same field, which complicates management decisions. In the dynamic and hydrologically heterogeneous conditions of small rice farms, nematode communities may be particularly diverse. Some have a geographically restricted distribution, while others occur throughout the rice-growing regions of the world.

Conclusion

Total seven genera of plant-parasitic nematodes were recorded during study period. Out of them five genera, *Hirschmaniella oryzae, Meloidogyne* spp., *Helicotylenchus* sp., *Tylenchus* sp. and *Aphelenchus* sp. from root samples of site-1, were observed. *H. oryzae*, *Meloidogyne* spp., *Helicotylenchus* sp., *Tylenchus* sp. and *Aphelenchoides* sp. from root samples of site-2 were recorded. Among them *H. oryzae*, and *Meloidogyne* spp. were root damage nematodes and abundantly recorded throughout the studying time. Four genera of nematodes, *H. oryzae*, *Meloidogyne* spp., *Tylenchus* sp. and *Criconema* sp. were recorded from soil samples of site-1 were recorded. Five genera, *H. oryzae*, *Meloidogyne* spp., *Helicotylenchus* sp., *Tylenchus* sp. and *Criconema* sp. were recorded from soil of site-2. All of the recorded nematodes, except the *Criconema* sp. were found in roots and soil samples of both study sites. *Croconema* sp. was recorded only in soil sample of both sites. The present finding may be concluded that the population of root nematodes such as *Hirschmaniella oryzae* and *Meloidogyne* spp. were more infected on flooded area then the non flooded rice fields. The population fluctuation of them was also more rapid in flooded area than the non flooded rice fields.

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