

**SURVEILLANCE OF *EXORISTA BOMBYCIS* L. A POTENTIAL PEST OF FC1
AND FC2 BREEDS OF *BOMBYX MORI* L. WITH REFERENCE TO
KOLHAPUR DISTRICT OF MAHARASHTRA**

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Abstract

The Maharashtra is a non-traditional state with respect to sericulture activity. It has tremendous potential since environmental conditions are favorable for promotion of mulberry sericulture as a profitable activity. Moreover, this is the most economical activity as compared to other agricultural crops in Hatkangale taluka of Kolhapur. Several multivoltine and bivoltine races of B. mori Linn. are reared by the farmers in the district. However, expected yield and quality of cocoons have not been achieved so far because of infestation by tachind fly a major pest of silkworm. In the present study it is noticed that, the Uzi fly Exorista bombycis is a major pest of silkworm. The primary survey of Exorista bombycis as natural enemies of B. mori was conducted in all three seasons at Yalgud village of Kolhapur district of Maharashtra during 2016-2017. In the 3rd stage at weekly interval, 4th stage and 5th stage observation on infestation were made at alternate day. It was found that, Uzi fly is commonly noticed in sericulture crops as compared to other pests. In the present survey also it is noticed that, more damage was observed in bivoltine breeds (FC1 and FC2). The study revealed that, the percent damage was ranged between 9.84 to 22.03 percent in FC1 whereas 13.80 to 28.33 percent was in FC2 breed. Overall infestation and more crop loss were prominently observed during the winter season as compared to summer and rainy seasons. Details are discussed and also suggestions for future course of work to be undertaken on IPM of Uzi fly are being included.

Keywords - Sericulture, pest, Bombyx mori, Exorista bombycis, Infestation

Introduction

The silkworm rearing in India has long history like other states. Sericulture is an agro-based industry, supporting many farmers in India in general and in South India in particular. Sericulture in Maharashtra still has tremendous potential since environmental conditions are very conducive for cultivation and rearing of silkworms. The industry flourished well up to 1980 in India. (Reddy *et al.*, 2015). However, there was a threat from the diseases alone causing a moderate to complete cocoon crop loss. Further, a new threat was encountered during 1980 in the form of a pest which was later recognized as Uzi fly (Anonymous, 1980). Since then, Uzi fly has remained a major silkworm pest (Narayanaswamy *et al.*, 1994a). Several multivoltine and bivoltine races of *Bombyx mori* L. are available for commercial use in sericulture. Mulberry silkworm *B. mori* are parasitized by two species of Uzi flies namely *E. bombycis* and *E. srobillans* Wiedmann. According to (Vender Wulp 1986) *E. bombycis* is primary parasitoid of *B. mori* and distributed in U.K. and India. It is also reported causing damage to sericulture industry from China, Thailand, South Korea and Myanmar (Tashio and Kobayashi, 1978). Indian Uzi fly *Exorista bombycis* L. is very potential parasitoid of silk worm races of *Bombyx mori* L. including multi and bivoltine and their cross breeds and is serious threat to silk production in India and in other sericultural countries of the world.

In India, it is widely reported from Karnataka, Andhra Pradesh, Tamilnadu and West Bengal. (Sathe and Jadhav, 2001) have very first time reported *E. bombycis* parasitizing *B. mori* from Kolhapur region of Maharashtra. Uzi fly, *Exorista bombycis* is an endo-larval parasitoid on silkworm, *B. mori*. causing considerable damage to silkworm rearing in several silk producing countries including India. In spite of adopting several control measures, Uzi infestation recorded to a loss of 20-30 % cocoon production. Maharashtra is in the tropical region, therefore in Maharashtra mainly practices tropical sericulture. Now days, the farmers are actively encouraged to rear pure improved bivoltine breeds like FC1, FC2 and their double hybrids. However, in the present survey while interactions with the farmers on various factors reducing or declining expected yield and quality of cocoons and this have been prominently pointed discussion. It was prominently mentioned by the farmers that due to various diseases and pests particularly infestation of silkworm crops by Uzi fly expected yield is not achieved. Moreover, during the seed crop batches heavy infestation by Uzi fly reduces marketing opportunities, rates and total realization of the income. In the present study it is also perceived that most popular and widely distributed silkworm pest is Uzi fly in the region. (Sathe and Jadhav 2001) have done survey and surveillance of this pest's in various parts of the Maharashtra. But, very little is known about its distribution and economic status in Hatkangale taluka of Kolhapur districts. Hence, detailed

season wise study was undertaken in this region. Survey shows that infestation of Uzi fly is increasing gradually in various parts Maharashtra with changing silkworm cocoon crop patterns without any discontinuity. Hence, it is noted in the survey that, seasonal abundance of Uzi fly is very prominent throughout the year except in few months. This prominence of Uzi flies causes damage to silkworm and reducing cocoon production drastically. The silk worm hybrids such as FC1 x FC2 and Pure Lines like FC1, FC2 are potentially reared in this region with specific intension of commercial as well as seed cocoon production as it fetch good price and income. (Jadhav and Sathe, 2016) reported that it is highly required to have a detailed survey on seasonal abundance of Uzi Fly and to work out suitable strategies for its control particularly in pure line seed crop breeds like FC1 and FC2. Hence, with this intension the present study was undertaken to understand the distribution pattern and damage by the Uzi fly in study area of Yalgud from Kolhapur district as this region is important for seed crop rearing of FC1 and FC2 breeds.

Material and Methods

The survey, surveillance of silkworm *Bombyx mori* L. (FC1, FC2) pest *Exorista bombycis* was carried out at Yalgud village of Kolhapur district of Maharashtra from April 2016 to March 2017. Initial survey on pest distribution record of *E. bombycis* was studied by visiting various rearing houses of 50 farmers from the Yalgud village fortnightly in initial stages of survey. The observation covers 12 rearing crops in randomly selected (30%) of the total 50 farmers initially screened for study of Yalgud village. Later on in 3rd stage visits were made once in a week whereas in 4th and 5th stage of rearing survey was carried out on alternate day by consulting sericulture farmers. During the survey by morphological observations numbers of infested silkworm larvae having black scars on body due to infestation of *E. bombycis* were noted and data was recorded for further analysis. The percent mortality in silkworms by Uzi fly was calculated by taking into consideration no. of dfls provided to farmers and actual mortalities caused by *E. bombycis* in silkworms. 10 dfls of silkworm rearing batch from selected 15 farmers were examined on alternate day during 4th and 5th instars to know infestation by Uzi fly. Usually farmers in study area use 100 dfls batch for brushing consisting about 50000 larvae. However to know the percent infestation by Uzi fly in a particular batch morphological observations were restricted to 10 dfls by defining appropriate rearing area required to rear 10 dfls. By this way 100 percent larvae from 10 dfls rearing can be visualized to know infestation or to get some external symptoms of infestation. The Uzi infested silkworms were separately reared at laboratory condition for the emergence of maggots and adult Uzi fly. Collected data on survey, surveillance of Uzi fly from the study area as well as different stages observed and collected from the laboratory culture noted, tabulated and further analyzed for getting data on percent parasitism by *E. bombycis*.

Results and Discussion

In the present study, survey on *E. bombycis* infestation was carried out at various farmers field as mentioned in materials and methods. The study was carried out during the April 2016-March 2017 for 12 months. The survey study with 50 farmers indicated that the Uzi fly infestation was observed prominently with 30 percent farmers i.e. 15 farmers. Hence these farmers were continued for further survey. The study shows infestation from first week of April to June whereas, a second and third spell was observed from September to November and January to February months respectively. The month wise survey on *E. bombycis* infestation is tabulated in Table No. 1. During the survey it was noticeable that there was no infestation during July, August, December and March months, the detailed data with reference to survey, surveillance, number of larvae parasitized by *E. bombycis*, number of parasitoids emerged, percent parasitism on silkworm observed is tabulated in table No. 1 as well as represented by graphical representation in figures 1 to 3.

Table 1:- Survey on parasitization by *E. bombycis* on *Bombyx mori* L. (FC1 and FC2) breeds at Yalgud village from Kolhapur 2016 to 2017.

Breeds → Months ↓	No. of larvae Brushed <i>B. mori</i> (10 dfls)		No. of larvae Parasitized by <i>E. bombycis</i>		No. of <i>E. bombycis</i> parasitoids emerged from <i>B. mori</i>		Percent parasitism by <i>E. bombycis</i> on <i>B. mori</i>	
	FC1	FC2	FC1	FC2	FC1	FC2	FC1	FC2
Apr.	4505	4675	565	756	406	526	12.54	16.17
May	4350	3346	606	948	806	1033	13.93	28.33

June	4125	4056	406	560	769	852	9.84	13.80
Jul.	4567	4456	0	0	0	0	0	0
Aug.	4556	4268	0	0	0	0	0	0
Sept.	4543	4603	1002	1264	867	914	22.05	27.46
Oct.	4356	4125	960	1045	845	968	22.03	25.33
Nov.	4325	4523	678	1246	878	1053	15.67	27.54
Dec.	3748	3849	0	0	0	0	0	0
Jan.	3789	3745	657	856	568	841	17.33	22.85
Feb.	3298	3587	606	956	536	889	18.37	26.65
Mar.	3569	3669	0	0	0	0	0	0
Average	4146	4075	457	636	519	585	11.44	15.69

The table no. 1 The data on study which was carried out during the year 2016 to 2017 for twelve months April to march shows that, the percent parasitism was gradually increased and found at peak in May month and declined in June and become negligible in the July and August months. However, it was noticed that infestation found increased in the month of September to November (27.46, 25.33 and 27.54 percent respectively). It is also noticed that infestation occurred during January, February and declined in the month of March.

The visual observations on infestation by gravid female of Uzi fly were studied. Random observation in the batch was made on no. of eggs laid on each segment, inter-segmental region and also various regions of dorsal, lateral and ventral regions. These visual observations like eggs, black scar on the silkworm body were counted and expressed in percentage to know the percent infestation. In later phases observations were made on maggots, prepupal, pupal and adult stages observed in the cocoon crop at the time of cocoon harvest and from infested cocoons, left over debris were assessed for knowing the various stages of uzi. These counts were also taken into consideration for calculation of total percent infestation in the lot.

Figure No. 1- Month wise infestation by *E. bombycis* on FC1 breed (*B. mori* L.) 2016-17

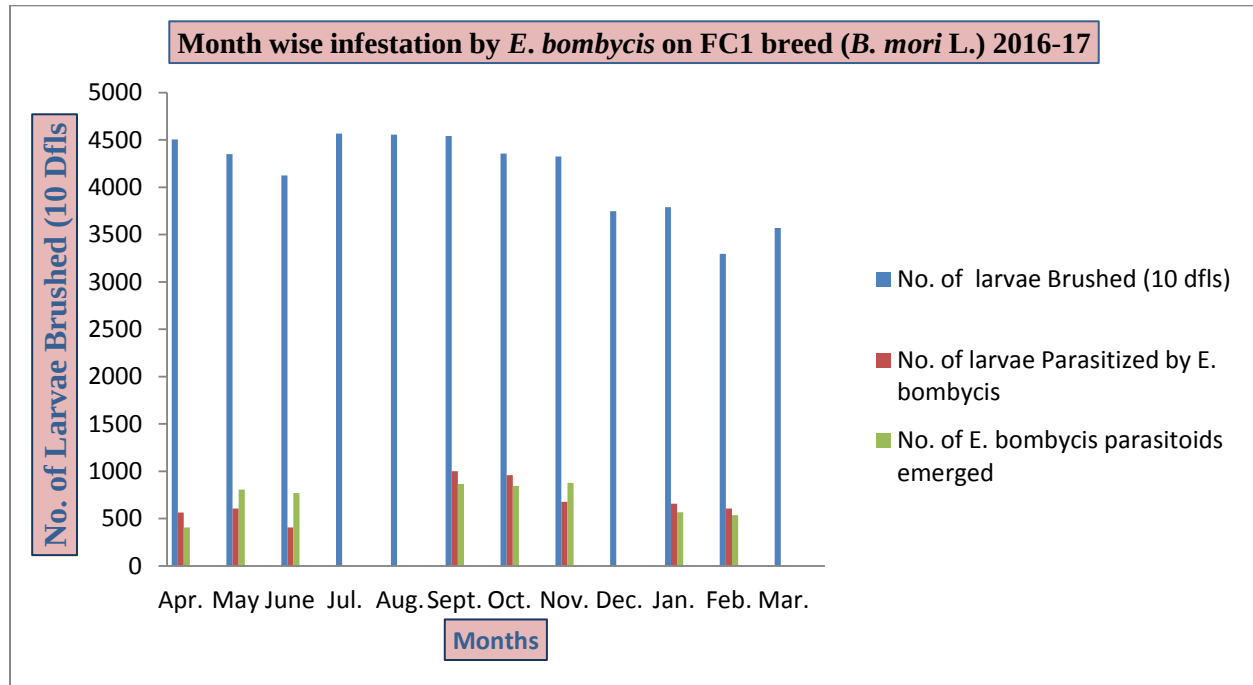


Figure No. 2- Month wise infestation by *E. bombycis* on FC2 breed (*B. mori* L.) 2016-17

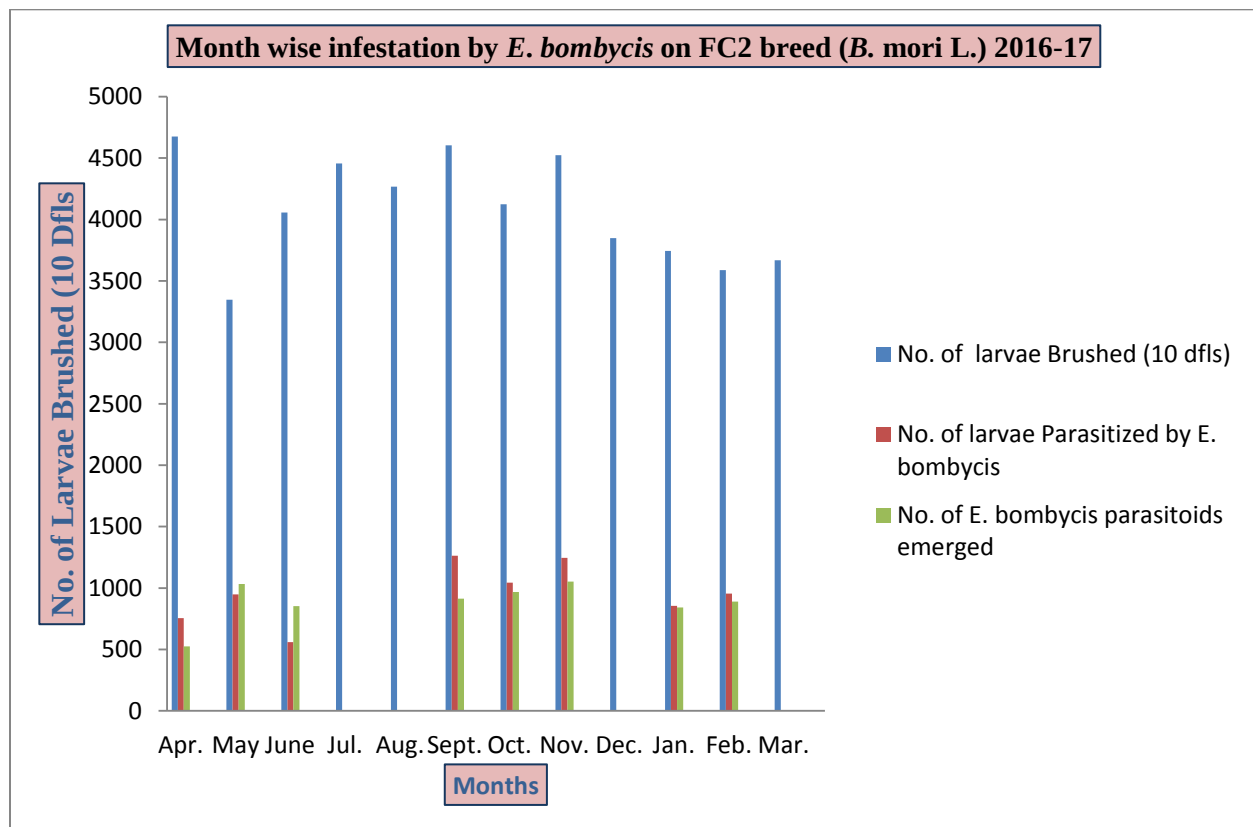
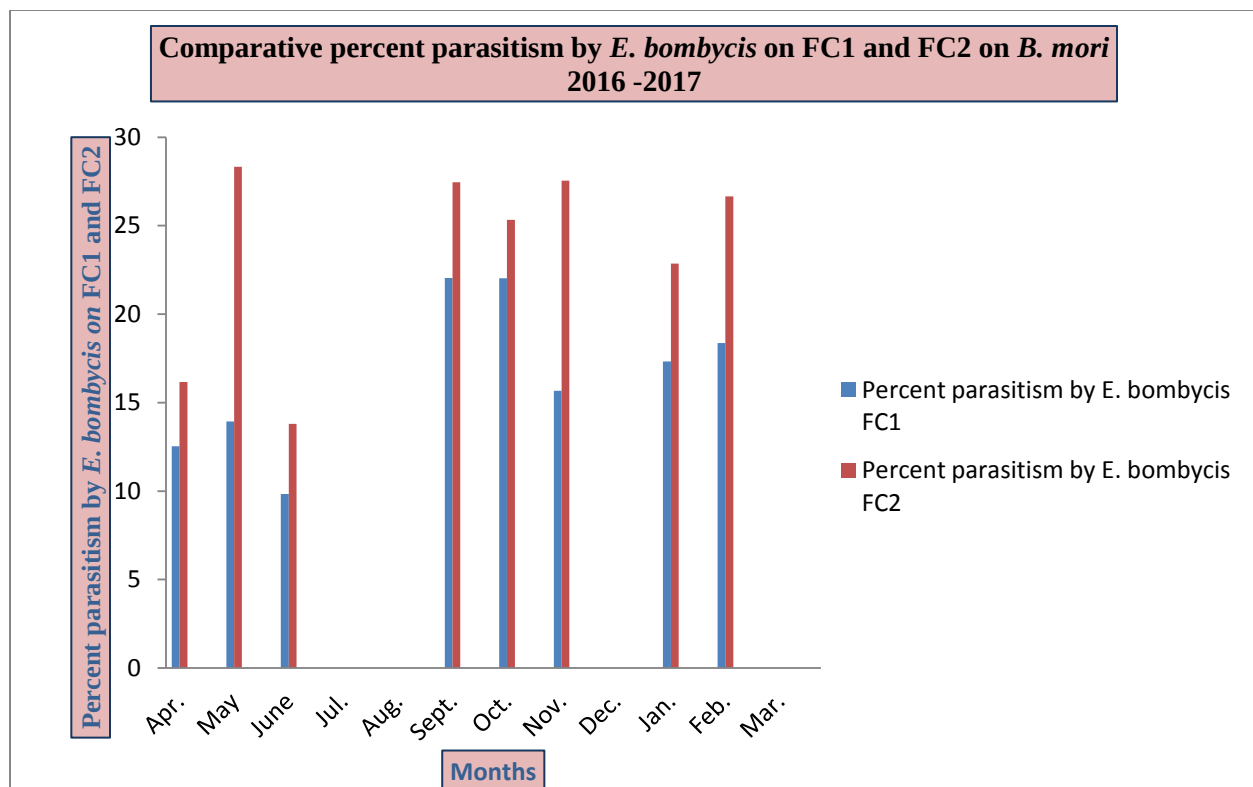


Figure No. 3- Comparative percent parasitism by *E. bombycis* on FC1 and FC2 on *B. mori* 2016 -2017



Host parasitoid plant interactions have been extensively studied by Jadhav & Sathe (2000) and Sathe & Jadhav (2001) in the models *Antheraea mylitta* - *Apanteles angaleti* - *Ain* and *Bombyx mori* - *Cotesia flavipes* mulberry respectively. In both cases they have found that olfactory and visual stimuli were involved in attracting parasitoids towards plant and then towards hosts. In the present study two silkworm breeds namely FC1, FC2, were studied with respect to infestation (parasitism) by Uzi fly *E. bombycis* and it has been noted that the FC1 silkworm breed was found less susceptible as compared to FC2. The order of preference for parasitism to silkworm breeds by *E. bombycis* observed was FC2 > FC1. (Jadhav and Sathe, 2016) have also reported that FC2 breed is more susceptible than FC1 for Uzi parasitism. The present study is in accordance with other authors. According to (Ayuzawa *et al.*, 1972) Uzi fly completed 5 to 6 generations in Japan. The first imago was appeared in the first half of May in Japan. In tropical zones *E. bombycis* completed 7 to 8 generations per year (Krishna swami *et al.*, 1973). Similarly, (Tashio and Kobayashi 1978) reported 5 to 6 generations per year in Japan and more than seven generations in tropics. In Kolhapur, Maharashtra 8 generations has been reported by Sathe and Jadhav 2001. In the present study is observed that, in FC1 and FC2 breeds Uzi fly is able to complete 8 generations except July, August, December and March months where percent infestation was nil.

The *E. bombycis* is well known pest (parasitoid) of *B. mori* in India in traditional states of sericulture namely Karnataka, Andhra Pradesh, Tamilnadu and West Bengal. In the present case intensity and overlapping nature of silkworm rearing combined with the intensive movement of cocoons over long distance Ramnagaram to Bangalore market and negligence of the rearers to destroy the pest in affected crops helped to the spread of the pest all over the region of study village. In Maharashtra *E. bombycis* was noticed during the year 2000, In the process of transport of Uzi fly infested seed cocoons for silkworm seed production purpose in Kolhapur region. In 2001 it was noticed that silkworm rearing of cent per cent farmers were infested by Uzi fly in Kolhapur district (Sathe and Jadhav, 2001). Now days Yalgud village is hub for seed cocoon crops selling of cocoon is usually done in Karnataka markets. Crops are continuously taken this might have lead to sustainable percent parasitization by uzi in this region.

Thite *et al.* 2005 studied the incidence of Uzi fly *E. bombycis* on mulberry silk worm *B. mori* in Solapur district of Maharashtra. Their survey indicates that, Uzi incidence noticed during January in regular stock and to the seasonal crops from 1st week of September. Uzi incidence was noticed throughout the year and they reported two peaks of population on the crop during the year, first in the month of June and second in the August. Now, Uzi fly in Maharashtra was observed abundantly in all sericultural districts which are adjacent to Karnataka and Andhra Pradesh states. However, less intensity of infestation of *E. bombycis* was seen in interior part of Maharashtra and northern region of Maharashtra. However, it was seen that Uzi fly incidence and economic losses to silkworm was higher in Western Maharashtra as compared to Marathwada and Vidarbha region and then *E. bombycis* found spreading gradually in entire Maharashtra. Therefore, this is high time to adopt preventive and curative control measures suggested in the text for avoiding spread of Uzi fly in Maharashtra and in to control

of Uzi fly. In the present investigation it is noticed that Uzi fly found scattered throughout the year except few months of the year as shown in figure 1-3 and table 1. Silkworm rearing for seed and commercial purpose is being carried out by most of the farmers throughout the year. Hence, Uzi fly has well in established with this region. However for calculation brushed larvae, no. of larvae parasitized, no. of parasitoid emerged and percent parasitism by *E. bombycis* 10 dfl *B. mori* larvae (FC1 and FC2) were considered. Maximum no. of larvae FC1 brushed for were 4567 with minimum no. of larvae brushed 3298. Whereas, in FC2 maximum brushed larvae were 4675 with 3346 as a minimum brushed larvae. The observations from 3rd to 5th instar *B. mori* larvae with respect to no. of larvae parasitized by *E. bombycis* were ranged from 406 to 1002 in FC1 whereas in FC2 breeds it was ranged from 560-1264. The no. of larvae parasitoid emerged from FC1 and FC2 during 4th stage to spinning stage is concerned. It was noticed that *E. bombycis* has shown gregarious nature as far as parasitization is concerned. The maximum parasitoids emerged from FC1 was 878 with minimum 406. In FC2 breed maximum parasitoids emergence recorded was 1053 and minimum was 526 in April month.

Conclusion

The present study would be helpful to know the pattern of distribution of Uzi fly in potential belts of sericulture particularly from Kolhapur and surrounding districts. This will also be useful to adopt and to work out specific IPM to control Uzi fly. There will be special reference to use of bio-control *Nesolynx thymus* and to work out its bio-control potential in near future. This work will be useful to minimize silkworm crop losses and increase productivity of seed cocoons on large scale as Yalgud is well known to rear FC1 and FC2 for seed cocoon production as well as commercial crop for better yield. The present survey work will also have importance for assessment of silkworm races to be reared in various parts of Maharashtra and to find suitable strategies for application of IPM.

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