DISEASES OF TROPICAL PINES IN CENTRAL INDIA

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Introduction

With the changing utilization pattern of pines and their increasing demand by pulp and paper industries, tropical pines were raised in Madhya Pradesh at different places like Jagadalpur, Amarkantak, Supkhar and Ambikapur for trial plantations. Koraput District of Orissa was also selected for trial of pine plantation. Madhya Pradesh Forest Department also undertook large scale plantation of *Pinus caribaea* at Jagadalpur under World Bank Project. Tropical pines were found suitable for producing long fibre material for pulp and paper industries.

The exotic pines have faced disease problems from indigenous pathogens as well as exotic pathogens. Most of the exotic pathogens of tropical pines have developed epidemic in plantations and possess invasive disease problems (Bakshi *et al*., 1976; Jamaluddin *et al*., 1984). The objective of study of diseases in tropical pines was fulfilled by conducting extensive surveillance in pine growing nurseries and plantations in Central India. In the present paper, important diseases of tropical pines occurring in nurseries and plantations are discussed.

Damping off

Damping off results in considerable losses in the germination bed before and after seedling emergence. *Pinus* species are found to be more susceptible to damping off as compared to broad-leaved species. The post emergence damping off was noticed in *Pinus caribaea* in nurseries due to *Fusarium* species and *Rhizoctonia solani*. Certain other fungi including *Curvularia lunata* and *Alternaria alternata* also caused both pre- and post-emergence damping off. Pre-emergence damping off is characterized by a wet rot of radical, while post-emergence damping off occurred as a collapse of the stem tissues at soil level causing the seedlings to fall over and lie on the surface of the soil. The experimental findings confirmed that pelleting of seeds with Ceresan (0.1%) or drenching of soil mix with Blitox or Fytolan (Copper oxychloride) at 0.2 % effectively controlled the disease in nursery beds. The conditions favouring damping off include excessive seed bed moisture, alkaline seed bed reaction, presence of a large proportion of organic matter in the seed bed overshading and high sowing density (Gibson, 1979).

Cercospora needle blight of *P. caribaea* and *P. roxburghii*

A severe needle blight caused by *Cercosptoria pinidensiflorae* (Hori et Nambu) Deighton syn. *Cercospora pinidensiflorae* Hori et Nambu in *Pinus caribaea* was detected in tropical pine nursery during 1980 at Amarkantak (MP)

and Jagadalpur (Chhattisgarh). Moderate incidence of needle blight was also recorded in *Pinus oocarpa* and *P. merkusii* at Amarkantak. The seedlings of varying age were susceptible to this infection. The infection could be noticed even in the seedlings of 3-4 months old upto the plantations of varying ages. Mostly the diseases develop after onset of monsoon and become severe from July to September. In Amarkantak nursery disease appeared initially on scattered plant at random in which later spread over the beds and polypots and developed uniform infection. Within the plant, the older foliage got infected first, but in severe attack all the needles can be equally affected. Reddy and Pandey (1973) noticed the incidence of *C. pinidensiflorae* from various pine nurseries of Uttar Pradesh.

The symptoms first appear as pale green bands on the needles, which gradually turned yellow then brown and finally grayish brown. Eventually the whole needle may die and turned grayish with lines of minute sooty spots coincidence with the stromata. The latter are clumps of conidiophores which bear filiform, 3-7 septate, olivaceous and slightly clavate conidia 20-60μ long, 3-4μ wide. These condidia are readily detached and are probably largely dispersed by water splash. It was clearly observed that under severe condition defoliation by *Cercospora* needle blight can cause significant reduction in seedling/sapling growth in nursery and plantation. *C. pinidensiflorae* was cultured in PDA at 28°C. The growth was very slow and produced bunch of mycelial filaments with prominent conidiophores of the pathogen. Laboratory bioassay test was also conducted for controlling successfully this disease in nursery. Out of 6 fungicides tried in laboratory, the fungal growth was significantly reduced in 2% of Bavistin in Petri dishes. In pine nurseries like *P. radiata* and *P. patula,* disease was controlled by foliar spray of Blitox and other copper based fungicides (Bakshi, 1976). However, the experimental trial to control this disease in tropical pine at Jabalpur and Amarkantak clearly indicated about the adaptiveness of copper based fungicides (Fytolan and Blitox) by *C. pinidensiflorae*. To control this disease in nursery 6 fungicides viz., Bavistin 0.2%, Fytolan 0.2%, Dithane M-45, Difolaton, Benlate and Calaxin were applied at monthly intervals. Out of six fungicides, Bavistin 0.2% was found most effective to control attack of *C. pinidensiflorae* in pine nursery (Jamaluddin *et al*., 1980).

During 1981, *Pinus roxburghii* provenances were tried in Amarkantak representing Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh and also of Madhya Pradesh Supkhar origin. Incidence of *Cercospora* needle blight in different provenances of *Pinus roxburghii* at Amarkantak was noticed. The needle blight of *Pinus roxburghii* started in the middle of July and continued upto November. The pathogen *Cercospora pinidensiflorae* becomes very aggressive during rainy season when the humidity is very high. The fungus caused heavy needle cast and the infected needles dried up after the infection. The needles of different age groups were attacked by this fungus (Jamaluddin *et al*, 1990). Due to severity of infection the plants exhibited top bent over. The needle blight disease in different provenances of *P. roxburghii* varied in the plants of different seeds sources (Table 1). It is evident that the mortality percenage was negligible in the provenance of Supkhar (MP) origin and Division Rohri (HP). The number of stromata and average

Table 1

Incidence of Cercospora needle blight of P. roxburghii plantation of different provenances at Amadobh, Amarkantak, M.P.

Provenance		No. of plants examined	No. of plants died	Mortality percentage	Av. no. of stromata per 2mm part of needle	Av. no. of conidia per drop of spore suspension
J&K	Divn. Udhampur, Range Magana, Seed zone JK I, lot No. 2051	25	2	8	44	21
HP	Divn. Nahan, Range Jamta, Seed zone HP I, lot No. 2012	25	12	48	45	69
HP	Divn. Raggarh, Range Fagu, Seed zone HP I, lot No. R 517	25	5	20	39	29
HP	Divn. Palampur, Range Bajnath, Seed zone HP IV, Lot no. 2021	25	5	20	53	40
HP	Divn. Nurpur, Range Broindaban, Seed zone HP IV,, Lot No. 2023	25	4	16	43	20
MP	Supkhar	25	Nil	Nil	23	8
UA	Divn. Chakrata, Seed zone UP XI, Lot No. 2051	25	7	28	62	20
HP	Divn. Solan, Range 1/29 Parag, Seed zone HP I, Lot No. 2010	25	10	40	63	37
HP	Divn. Rohri, Range Kasta 2, Seed zone HP VIII, Lot No. 2017	5	Nil	Nil	20	23
UA	Divn. Pithoragarh, Lot no. 2044	25	6	24	57	33

number of conidia in the infected needles were comparatively less. The provenances from Nahan Division, Solan, (HP), Chakrata, Pithoragarh (Uttaranchal), Rajgarh and Palampur (HP) exhibited high mortality percentge, whereas the provenance from Udhampur Division (J&K) exhibited a low percentage of mortality. The stromata and conidia in the needle also vary from provenance to provenance. Provenance which exhibited a low percentage of mortality indicated less number of stromata and conidia. The morphological characters of conidia of *C. pinidensiflorae* also vary in different provenances. It is clearly evident from the above study that the seeds of MP origin had developed resistance to such exotic pathogen, as the pathogen could not cause the death of plant. Singh *et al*. (1983) also reported a heavy infection in *P. roxburghii* by *Cercoseptoria* (*Cercospora*) needle blight disease in pine nurseries. However, they could minimize the disease by applying the higher dose of copper fungicides.

The infection by this needle blight fungus is mostly dependent upon the conidia. During rainy season there was heavy conidiation by the fungus, which developed a threshold of this disease. Keeping in view this fact the conidia obtained from needles of different provenances were tried for germination in different media and also in the fungicides. The conidia of provenances of Nahan, Nurpur, Brindaban, Solan and Rohri failed to germinate in distilled water, whereas other provenances exhibited a low percentage of germination. The germination of conidia of different provenances was excellent in 2 per cent glucose solution. The conidia failed to germinate when Bavistin 0.2% and Dithane M-45 0.2% were added in the germination media. The germination percentage was minimized by Fytolan application 0.2%. The study indicated that the conidia of *C. pinidensiflorae* obtained from different provenances of *P. roxburghii* vary in their mode of germination in different germination media. The fungicides Bavistin and Dithane M-45 at 02 per cent may be applied during monsoon period to check the spread of disease. Jamaluddin *et al*. (1980) also studied that Dithane M-45 and Bavistin considerably checked the growth of *C. pinidensiflorae*.

***Lophodermium* needle cast**

Survey conducted in pine nurseries and plantations at Amarkantak during September 1980 showed that Chir pine plantation at Birla Institute of Scientific Research was found badly in grip of needle cast caused by *Lophodermium pinastri* (Schrad.) Chev. Needles on ground level turned brown bearing tiny black bodies of the fungus on dead and drying portion. The pathogen was also reported to case needle cast in *P. caribaea, P. kesiya*, *P. roxburghii* and *P. elliotii* from Ararkantak. Other pine species in pinatum and plantations in and around Amarkantak showed no susceptibility to needle cast pathogen. All the *Lophodermium* species considered here colonized live pine foliage by air borne ascospore under wet or humid weather conditions. This species perenated in dead fallen needles. Early symptoms of *Lophodermium* needle cast appeared at first as yellow spots, which later coalesced and turned brown as the needle dies.

Some other pathogens were also recorded causing needle disease in pines. *Pestalotiopsis* sp., *Leptosphaeria* sp. and *Discosia artocreas* (Tode ex Fr.) Fr. *Botryosphaeria abtusa* (Schw) Shoemaker

caused diseases in *P. roxburghii* needles at SFRI nursery, Jabalpur. *Pestalotiopsis versicolor* was found associated with the needles of *P. petula* plantation of SFRI Jabalpur. Although these pathogens were associated with the needles of pines but the damage in affected plants were insignificant as most of them were weak pathogens.

Diplodia die back in *P. caribaea* plantation

During Bastar pines plantation survey, *Diplodia pinea* (Desm.) Kick was recorded sporadically. Some of the ten years old plants of *Pinus caribaea* showed die back symptoms in a small patch. The infected shoots exhibited a blighted appearance and were generally killed and those not killed become invariably deformed. Following death of the top, development of side branches was a normal feature of the infected plants. It was of interest to note that the disease was almost absent in vigorously growing stands whereas in poorly growing ones it was invariably present. *Diplodia pinea* was one of the earliest fungal pathogen found to be the cause of stem and foliage diseases in exotic pine plantation in the southern hemisphere. It was identified as early as 1900 as a pine pathogen (Anon., 1907) and in 1910 was isolated from diseased shoots of *P. radiata* and *P. montana* collected from South Africa. Since that time it has been shown to cause defoliation, die back, canker and seedling diseases of pines in Africa, South America, Australia, U.S.A. It also causes blue stain of conifer timber.

Charcoal root rot in *Pinus caribaea*

Macrophomina phaseolina (Tassi) Goid with its sclerotial stage *Rhizoctonia bataticola* (Taub.) Butler caused a serious charcoal root rot disease of *Pinus caribaea* in nurseries and plantations of Jagadalpur, Amarkantak and Jabalpur. An extensive survey in 1981, 1982 and 1984 was undertaken to assess the disease intensity and its characteristics so as to recommend control measures in the current plantation and to suggest the preventive measures for future plantation programme (Jamaluddin *et al*., 1984). The fungus mainly developed during moisture stress and high temperature condition. The excessive development of black compact sclerotia in the conducting tissues resulted in the formation of ward cavities. The blocking and disintegration in vascular tissues was evident from the sections of diseased portions, which developed root rot and wilt in nurseries and plantations.

Survey and assessment of disease

The survey of charcoal root rot in *Pinus caribaea* caused by *Macrophomina phaseolina* (Tassi) Goid. was conducted by random sampling technique in pine plantations of Bastar. The disease was assessed by laying random sample plots in different compartments of Kurandi, Bhanpuri and Jamgaon plantations. The sample plots were laid out in different areas so as to represent the entire land surface of the plantatins. In each of the substratum three sample plots, with 100 plants in each plot were laid out in each compartment. The disease was assessed on existing healthy, senescent and diseased plants. The data on the observations of disease occurrence has been presented in Table 2.

Development of the disease appeared mainly during the period of moisture stress. It has been observed that the

Table 2

Occurrence and incidence of charcoal root rot in different compartments of Pinus caribaea plantations at Bastar, Chhattisgarh

Comptt./ Section	Year of plantation	Disease percentage			
		Flat area	Slope area	Hill top area	Av. disease percentage
151/A	1977	40	31	55	42
151/B	1978/80	45	42	32	39
152/A	1978	63	71	62	65
152/B	1978 to 81	36	34	50	40
153/1	1979, 80	21	90	17	43
153/2	1979	31	34	73	46
153/3	1979	36	53	83	57
153/4	1979	38	49	98	62
153/5	1979	33	75	84	58
153/6	1980, 81	82	59	75	72
153/7	1979, 80	54	96	100	83
157	1981	73	32	-	53
158/1	1979	78	79	93	83
158/2	1979	72	63	86	73
158/3	1980	68	84	22	58
158/4	1980	38	28	18	28
159/1	1980	87	11	62	53
159/2	1980	44	45	31	40
159/3	1981	62	63	78	68
160/1*	1981	86	62	62	70
Bhanpuri*	1977	96	24	46	55
Jamgaon	1980	65	24	92	63

* All the three sample plot belongs to the flat land facit.

disease infection is more pronounced in hilly areas than on flat surface. The possible reason for the effect of slopes on disease infestation may probably be due to excessive water run-off and consequent moisture stress in hilly areas.

In Bhanpuri area major portion of 32 ha 1977 plantation of *Pinus caribaea* suffers due to water logging, due to which *M. phaseolina* attack was found to be more rampant. Physiologically, the water logging also created conditions of moisture stress and thus facilitated the attack of pathogen.

In Jamgaon flat-salty rocks are present below 15 cm soil depth the seedlings planted in this areas thus faced

with moisture stress when the roots strike this hard layer. During summer months when plants are subjected to excessive moisture stress, attack of *M. phaseolina* becames more pronounced.

The disease percentage was found to vary from compartment to compartment depending upon the land topography. Due to excessive run-off and lack of moisture on steep slopes as also under water logging conditions, the result of moisture stress caused maximum damage to the plants on account of pathogen attack.

Symptoms and mode of infection

M. phaseolina is capable of free mycelial growth through the soil. Infection developed from sclerotia of the fungus in the soil, which germinate in presence of fine growing roots. Initially the fine feeding roots got infected and subsequently infection progressed to the larger roots in due course of time. After root infection is established and water uptake has been impaired, the above ground symptoms appeared as yellowing and wilting of foliage (needles). Eventually the infected plants died. However, in some cases infected plants survived for a considerable time when infection was less severe. Infected roots exhibited dark colour with roughened bark (reflecting the common name of the disease) and in advanced cases the bark turned to slough away. Black pinhead or (smaller) sclerotia were observed throughout the infected root tissues and in the soil (Figs. 1 and 2).

Morphology of pathogen (*M. phaseolina*)

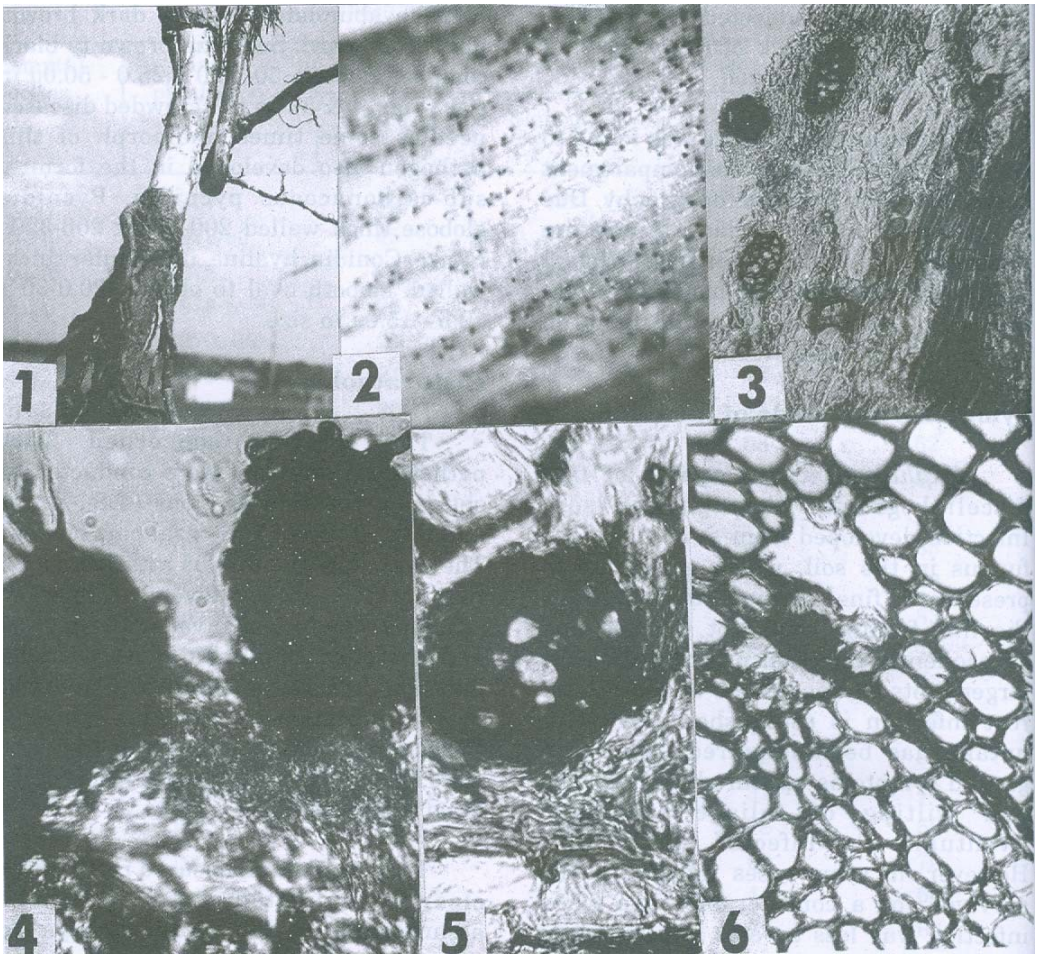
M. phascolina grows fast in PDA medium at 28 2°C. Colony appeared dull cottony, effused turned dark brown. Hyphae abundant, septate dark brown, upto 7.5µ board. Sclerotia brown to black compact globose, 50-75.0 x 25.0 - 50.0µ in size (Figs. 4 & 5). In the crowded diseased needles some times anamorph of this pathogen also developed in the form of sub-carbonaceous pycnidia. Pycnidia globose thick walled 200-400 x 200-320µ in size. Conidia, hyaline, unicellular thick-walled, smooth oval to oblong, 20.0-30 x 12.5 - 15.0µ in size.

Histopathology

The studies concerned with pathological anatomy were conducted by obtaining the thin sections (T.S., T.L.S. and R.L.S.) of root and basal part of stem. The hyphae of the fungus attacked to the root bark sometimes developed infection cushions. The fungus invaded the cavities and bark inter-cellular, later intra-cellular invasion occurred and that was followed by the formation of sclerotia. Primarily the parenchymatous tissues in the wood were affected and after words whole of the wood was involved (Fig. 3).

Thin sections of diseased root regions clearly indicated the sclerotial accumulation in the medulary rays. At some places in the wood compact mass of resistant hyphae accumulated in the form of sclerotia which disorganized the surrounding cells by forming the wards cavities in the wood (Fig. 6). The affected trachieds and the medullary rays exhibited brown colour. The large size of sclerotia, the apparent disruption of host cell walls by sclerotia and appearance of sclerotia in the basal part of the stem suggested that the sclerotia in the tissues were indicative of host cell death.

Figs. 1-6



Charcoal root rot of tropical pines.

Fig. 1 & 2 Infected portion of pine seedlings showing accumulation of Sclerotia (*M. phaseolina*). Fig. 3. V.S. of root bark showing penetration by sclerotia.
Fig. 4. T.S. of diseased root showing sclerotia.
Fig. 5. Detail view of carbonaceous globose sclerotia of *M. phaseolina*.
Fig. 6. T.L.S. of infected root of *P. caribaea* showing formation of ward cavities in stele region.

Management of disease

The intensity of the inoculum can be reduced by modifying the nursery management practices. Soil mix or potting mixture should be thoroughly sterilized before transplanting the seedling in polythene tubes with the formaldehyde

solution (250 ml of solution may be diluted to 4 litres of water). About 1 to 1.5 litres of this dilution may be sprayed on the top 15 cm soil of the seed bed (1m x 1m) or the fumigant should be thoroughly mixed with the soil mix and covered with polythene sheet. Bavistin or 0.1% or Dithane M-45 0.2% may be drenched to the tubes seedlings at monthly intervals.

Leguminous weeds such as *Cassia tora, Cassia auriculiformis, Cassia piñata*, etc. which grow in wild stage should be weeded out if found in the vicinity of *P. careabea* plants in field and in nursery. Similarly intercropping with leguminous plants should be avoided as they are equally susceptible to this infection. Addition of fertilizers should be avoided during nursery stage because *P. caribeaea* does not require much fertilizer during early stages of growth and development. The nutrient requirement of the plants was likely to be fulfilled by available mycorihizal fungi. In plantations, the replacement of causalities should not be done in the same pit in which the seedlings were already affected by the fungus because there were chances for infection to newly planted seedling also. The fresh pit may be prepared for causalty replacement.

SUMMARY

Tropical pines are being increasingly used in pulp and paper industry and to meet their increased demand these are being raised in plantations. Exotic and indigenous plant species are seen to suffer from various diseases. Of these, damping off of *Pinus caribaea* in nursery beds can be controlled by drenching the soil mix with Blitox or Fytolan. *Cercospora* needle blight is seen affecting *P. caribaea* and *P. roxburghiana*. Fungicides Bavistin and Dithane can be applied during monsoon period to check spread of this disease. *Lophodermimam* needle fall is caused by various pathogens but the damaged caused is insignificant as the pathogens are rather weak. *Diplodia* die back in *P. caribaea* plantation was seen to affect poorly growing plants and is almost absent in vigorously growing trees. Charcoal root rot in *P. caribaea* can be managed by modifying nursery practices such as weeding out leguminous weeds, avoiding intercropping, avoiding fertilizers during nursery stage, planting replacements in fresh pits, so that infection does not take place.

मध्यवर्ती भारत में लगे हुए उष्णादेशीय चीड़ों के रोग

जमालुद्दीन व के०के० सोनी

सारांष

उष्णादेशीय चीड़ अब लुगदी व कागज उद्योग में अधिकाधिक उपयोग किए जा रहे हैं और उनकी बढ़ी हुई मांग पूरी करने के लिए उन्हें रोपवनों में उगाया जा रहा है। इनमें लगी परदेशीय और देशी चीड़ जातियों को विभिन्न रोगों से आक्रान्त होते देखा गया है। उन रोगों में *पाइनस कैरिबिया* को रोपणी की क्यारियों में होने वाला आर्द्रगलन मिट्टी–मिश्रण को ब्लाइटॉक्स या फायटोलैन से तर करके नियन्त्रित किया जा सकता है। *सेर्कोस्पोरा* पत्ती महामारी *पा० कैरिबिया* और *पा० रॉक्सबर्घियाना* को कुप्रभावित करते देखी गई है। इस रोग को फैलने न देने के लिए बाविस्टिन और डायथैन जैसे कवकनाशी मानसून काल में अनुप्रयोग किए जा सकते हैं। लोफोडर्मिमम पत्ती पत्तन अनेक रोगजनों के कारण होता है परन्तु उनसे होती हानि नगण्य है, क्योंकि ये रोगजन कमजोर होते हैं। *डायप्लोडिया* से पादपमरण *पा० कैरिबिया* रोपवनों में केवल घटिया बढ़वार वाले पादपों को कुप्रभावित करता है, ओजस्वी पादपों को नहीं। कोयला बन जड़े सड़ना *पा० कैरिबिया* में होते देखा गया, इसकी रोकथाम रोपणी कार्यो में संशोधन करके की जा सकती है जैसे शिम्बिवर्ग की खरपतवार निकलवा देना, पौधों

के बीच में कोई फसल न उगाना, रोपणी अवस्था में उर्वरक उपयोग न करना, मर गए पादपों की जगह नए गड्ढे बनाकर उनमें पौधे रोपना ताकि रोग संक्रमण न हो।

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