Int.J.Curr.Microbiol.App.Sci (2021) *10*(11): 376-386

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 10 Number 11 (2021)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2021.1011.043

Infectious Fish Disease Occurrence in Carp Culture Ponds of West Godavari District, Andhra Pradesh, India

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Keywords

Carps, diseases, causes of occurrence, etiological agents, controlling measures

Article Info

Received:
15 October 2021
Accepted:
02 November 2021
Available Online:
10 November 2021

A B S T R A C T

Aquaculture is one of the fastest growing food producing sector in the world. In India over the last three decades, aquaculture has developed significantly, earning considerable amount of foreign exchange, besides providing employment. India is basically a carp country. Where in the indigenous major carps: Catla (*Catla* catla), rohu (*Labeo rohita*), mrigal (*Cirrhinus mrigal*), exotic carps like common carp (*Cyprinus carpio*) grass carp (*Ctenopharyngodon idella*), silver carp (*Hypophthalmicthys molitrix*) along with air breathing fishes, *Clarias batrachus*, *Heteropneuestes fossils*, *Pangasius* sps. are being widely cultured accounting for bulk of freshwater aquaculture production. In the last few years, the exotic catfish *Pangasianodon hypophthalmus* and pacu *Piaractus branchypomus* culure is also increasing. Tilapia and Pangasius are also offer opportunities for cage culture. The focus on the production of genetically improved tilapia for market as cheep source of proteins is also enhancing (Jelte de Jong, 2017). As the scope for horizontal expansion is limited, the current trend in aquaculture development is focused towards intensification of the culture practices. The frequent occurrence of diseases and epizootics are considered to be major bottlenecks for increasing production. The diseases are mostly bacterial and parasitic origin. The diseases account for 10-5 % towards the production cost (Sahoo, P. K. *et al.*, 2017). India is basically a carp Freshwater aquaculture has been the main stay of Indian aquaculture, in terms of total quantity as well as its share in the domestic fish basket. India is called as carp country as carp production contribute in bulk (over 82%). In Andhra Pradesh fish and shrimp culture is income generating profession. The district West Godavari of Andhra Pradesh, is specifically the fish bowl of India, generating an amount of Rs. 15.00 crores annually. Semi intensive culture practice is common, in an area of more than 2.0 lakh acres. In course of expansion and intensification of this semi extensive culture practice of the Indian major carps, over the last three decades, many economically important problems have been identified which are threatening the sustainability of the culture system. Occurrence of diseases is one of such factor affecting the socio-economic status of aqua farmers. To overcome this, an intensive surveillance was carried to document the prevalence of various diseases, season of occurrence, disease diagnosis, etiological agents, mortality rates and controlling measures, so that the severe risk for sustainability and huge economic loss can be arrested. The frequency in occurrence of septicaemia, bacterial gill disease (bacterial), dactylogyrosis, paradactylogyrosis (parasitic) and argulosis are recorded. The incidence of diseases and mortality rate are high in winter season.

Introduction

Bacterial fish diseases are very common and most difficult health problems to deal. They are generally saprophytic in nature but can become pathogenic when fishes are physiologically unbalanced, deficient in nutrition, over stocking and poor water quality. The microorganisms are essentially opportunistic pathogens which invade the tissues of a fish host and become susceptible to infection by the stress factors (Ahmed, K., Kumar W. A. G. 2005).

Farmers are now in practice of using various probiotic formulations, aqua drugs and chemicals, various antimicrobials, sanitizers, anti-parasitic drugs and even antibiotics in fish culture system, as preventive and control measures to protect the crops (Anon, 2017; Mishra, S. S. *et al.*, 2017; Anon *et al.*, 2017).

Aquaculture in India is a progressively growing food production system which fulfils adequate requirement of protein sources to the society globally. India is the second largest country in fish production. The sector has shown significant growth from traditional culture practices to commercial methods of culture, enhancing fish production from a mere 7.5 lakh tonne in 1950-51 to 107.95 lakhs tonne during 2015-16, earning crores of rupees through export of fish to different countries (Mishra *et al.*, 2017). This aqua sector has bench-marked from a domestic activity to an enterprise in the state, Andhra Pradesh. In Andhra Pradesh, fish and shrimp culture is predominant income generating profession. Further, this state leads first in position in aquaculture production of the nation. In the state, it is estimated that more than 80% of the fish production arise from the fish bowl area i.e. Krishna, East Godavari and West Godavari districts. Of these districts, West Godavari plays a lead role especially in freshwater fish production. Production of IMC i.e. Catla, Rohu and Mrigala contribute 80-85% of total fish production. With a culture area of 2.0 lakh acres the aqua production of the district is 10,51,754 tones (17-18), 10.00 lakh metric tons (18-19) and 11.0 lakh metric tons (19-20) respectively.

Inspite of the unprecedented development of semi intensive culture of Indian major carps, many economically important problems has been identified, that are threatening the sustainability of the culture system. The expansion and intensification of aqua farming practices lead to health problems in culturing fishes, thereby reducing the production rate. The degraded environmental parameters, also influenced the occurrence of infectious diseases. Disease is one of the major constraint to aquaculture and limiting factor for economic and socio-economic development in India and also as in many other countries of the world (Begum, M. *et al.*, 2013, Mohan, C. V. *et al.*, 2002; Sahoo, P. K., 2013). Some disease have caused serious damage, not only the livelihood of fish farmers, but also to the future development of the industry. Many diseases affecting present day aquaculture is resultant of intensification of culture practices without the basic perception of intricate balance between host, pathogen and environment (Bondad – Reantaso, M. G. *et al.*, 2005, Subasingha, R. P. *et al.*, 2013). In Andhra Pradesh the increase in aqua production particularly in expansion into intensive and semi intensive methods of production has been coupled by increase in fish and shell fish resulting from high stocking densities and stress condition that favours the occurrence and spread of infectious diseases (Das, B. K., Mishra, S. S., 2014). The vertical expansion of fish culture with diversified species and high stocking density has resulted in more frequent occurrence of bacterial, parasitic and viral pathogens, often leading to higher morbidity or mass mortalities and lowered production.

Lack of knowledge of fish health management and skill to prevent and control disease outbreak is leading to huge economic loss. This study throws light on various diseases, frequency and seasonal variation in occurrence, etiological agents, mortality rate and also controlling measures.

Materials and Methods

The samples of fish (1073) and water (2118) were collected fortnightly from various ponds of different villages of 242 aqua farmers from 2019 April to 2020 March in West Godavari. The water sample were analysed for various physical and chemical factors by following standard procedures. The fish are disease diagnosed, morphologically and microscopically in our Aquatic Animal Health Referral Laboratory, Fisheries Research Station, Sri Venkateswara Veterinary University, Undi, Bhimavaram, West Godavari district. Anamnesis and parasitological diagnosis were performed and recorded.

The gills and other internal organs were excised and maintained into petri dish with 0.65% saline solution. The slime mount of gill were studied microscopically for diagnosis of internal parasites. A scraping of body surface mucus in skull – tail direction was performed to scratch for parasites microscopically. The severity of disease is recorded by observation of internal organs.

Results and Discussion

Carp culture area of 4964 acres were surveyed in West Godavari district, covering 242 aqua farmers from twenty villages (Table. 1). The size of the culture ponds ranged from 5-25 acres. The incidence of bacterial (2078) and parasitic diseases (1132) and the ethological agents were recorded (Table 2, 3). In bacterial diseases the occurrence of Bacterial Gill Disease (BGD) is higher (1170 cases, 56.3%) than that of septicaemia (908 cases, 43.7%) (Table, 3) (Fig. 1, 2a, 2b). Comparatively winter season is the peak period of bacterial disease occurrence (Fig. 3).

In parasitic diseases, the helminth disease occurrence is higher than that of protozoan and crustacean diseases. In helminth diseases, the dactyologyrosis cases are more (491 – 43.3%) than Paradactylogyrosis cases (484 – 42.7%) (Table 3) (Fig. 4, 5a, 5b). In protozoan, the cases of Myxosporiasis (111 – 9.8%) are higher than that of Trichodiniasis (22 – 2.1%) (Table 3) (Fig. 4 7a, 7b) and in Crustacean diseases the occurrence of Argulus cases 24 – 2.1% are higher than that of Lernaea (10) (Table 3) (Fig. 4, 9a, 9b).

The Aeromonad septicaemia is caused by the etiological agent, *Aeromonas hydrophilla*. Its presence is there more or less throughout the year in Catla and rohu (Table 2). The bacterial gill disease is also caused by another species of bacteria i.e. Flovobacterium branchiophyllum (Table 2). Even though infects both catla and rohu but its occurrence is more severe in rohu which heads to heavy mortality. Comparatively winter season is the peck period of bacterial disease occurrence (Fig. 3).

In parasitic diseases, dactylogyrosis is infected by dactylogyrus, paradactylogyrosis is by paradactylogyrus. The myxosporiasis is caused by myxobolus and trichodiniasis by trichodina. In crustacean diseases, argulosis is caused by argulus sps and lernaeosis is caused by lernae (Table 2). Though the occurrence of parasitic diseases is throughout but their occurrence is more at Rainy and winter season (Fig. 6,8,10).

In general there are four types of bacterial infections (1) fin root – usually resulting from the environmental stress, (2) bacterial body

ulcers – open, shallow to deep, lesions on the fishes body (FAO 2014) (2a) bacterial gill disease – in which the gills are the primary targets (FAO 2014) (2b) systemic bacterial disease, in which bacteria invade and cause damage to internal organs. The details of common bacterial diseases are reported in aquaculture are presented in table (2). Another important bacterial disease often confused with red disease in carp culture is motile aeromonas septicaemia. This is probably the most common bacterial disease causing severe production loss to freshwater fish culture. The disease has been associated with several number of the genus aeromonas, including *A. Hydrophila, A. Sobria, A. Caviae, A. Schuberti* and *A. Veronii*. The clinical signs of motile Aeromonas septicaemia include high mortality often with superficial to deep skin lesions (2a) and sometimes sudden death with or without any clinical symptoms. Skin lesions are often noticed at the base of the fins with variously sized areas of haemorrhage and necrosis. There are red areas on the body, skin ulcers, swollen body, abdomen and eyes and musculature, hence often called as "red disease" (2a). These lesions may progress to reddish to grey ulcerations with necrosis of the underlying. If immediate action is not taken, the mortality rate often reaches to 100%. The *Flexibacter columnaris* affects the skin or gills of fish (2b).

The production from culture system is hampered by infestation of various fish parasites. Compared to other diseases, occurrence of parasitic diseases has been the major cause of concern and caused significant setback to freshwater aquaculture in India (Sahoo, P. K., 2013). Fish parasites multiply rapidly under favourable conditions, there by affecting the health of fishes, often leading to high mortality. Parasites interfere with nutrition of hosts, disrupts metabolism and secretary functions of alimentary canal and damage the nervous system (Das, B. K., Mishra, S. S., 2014, Farhaduzzaman, A. M. *et al.,* 2010). During survey of different carp farms (Table 1) in Andhra Pradesh, fish were observed to be affected by fish parasites (Table 2), mostly, protozoan ciliates (Ichthyophthirius sps, trichodina sps), monogenetic trematodes (Dactylogurus sps, Gyrodactylus sps) and larger crustacean ectoparasites viz lernae spp, argulus sps (freshwater louse), Ergasilus, which cause substantial economic loss in fish culture system in India. Disease and mortality due to monogenian trematodes, gyrodactylus sps (commonly known as skin flukes) and dactylogyrus sps (known as gill flukes) have also been commonly reported in carp culture. These monogenetic trematodes are considered as one of the most prevalent parasitic agents affecting skin and gills, causing irritation and destruction of gill tissues leading to impairment of breathing. The Ichthyopthirius cause "white spot" or Ich in the freshwater fishes. Another parasite Trichodina browse over gills and skin damaging the host tissue and consuming the resulting dead tissues (Fig. 9b). Another important and most prevalent parasitic disease causing severe economic loss in carp culture is "Argulosis" caused by crustacean ectoparasites of the genus Argulus also called "Freshwater fish lice". Acute infestation of Argulus infestations often cause dermal ulceration, osmotic imbalance, physiological stress and immunosuppression, leading to high morbidity and lowered growth rate of carps (Mukharjee, S. C., 2002, Farhaduzzaan, A. M., 2010), but the incidence of mass mortality due to this disease has been very low (Monir, Md. *et al.,* 2015). It is reported that Indian major carps are more susceptible to Argulus parasites (Table 2, 3). The intensity of infestation is greatly influenced by seasonality (Fig. 9a, 10).

Table.1 Location of carp culture ponds in West Godavari district, Andhra Pradesh

Pedapulleru	**Malvanithippa**
Eelampudi	M.M. Puram
Fathepuram	Alapadu
Dirsumarru	Tadinada
Undi	Tummaguppa
Ai. Bhimavaram	Sriparru
Bondada lanka	Kalavapudi
Pedakapavaram	Poola
Akividu	Agadalalanka
Siddapuram	Nidamarru

Table.2 Common diseases recorded from carp farming ponds.

Sl. No.	Disease condition	Symptoms	Etiological agent
	A. Bacterial diseases:		
1.	Columnaris	Haemorrhagic and ulcerative lesions on fins, head, back	*Flexibacter columnaris*
2.	Tail rot and fin rot	Erosions, discoloration and disintegration of fins and tails.	*A. hydrophilla* etc.
3.	Bacterial gill disease or gill rot	Gasping, lethargic, gills look discoloured with trapped materials, secondary fungal infection.	*Flavobacterium* M *brachiophilum* etc.
4.	Vibriosis	Ulcerative abscesses in internal organs, harmorrhagic ulcers on skin, fins and body.	*Vibrio parahaemolyticus etc.*
5.	Pseudomoniasis septicaemia	Haemorrhagic lesions on skin, fins, tail	*Pseudomonas sps.*
	B. Parasitic diseases:		
1.	Ich / white spot	Most fish are susceptible whitish cysts, mostly observed on skin, fins and gills.	*Ichthyophthirius* sps.
2.	Trichodiniasis	Most fish susceptible, whitish cysts on skin, fins, gills disc shaped, spherical cysts can be observed under microscope.	*Trichodina* sps.
3.	Dactylogyrosis (gill fluke)	Mostly affects gills, destroying the gill filaments, gills with clumps of white masses. Parasites can be observed under microscope.	*Dactylogyrus* sps.
4.	Gyrodactyloris (skin fluke)	These grow on and destroy the skin, gills with clumps of white masses, frequently associated with secondary infection.	*Gyrodactylus* sps.
5.	Argulosis (carp lice)	Wide spread on most farmed fish, parasite seen moving on skin surface, causing lesions with secondary bacterial infections, haemorrhagic spots and ulcers.	*Argulus* sps.
6.	Myxosporidiasis	Parasite produce cysts on gill filaments usually, fish becomes weak, falling of scales.	*Myxosporiadium* sps.

Table.3 Incidence of diseases during April 19 to March 20.

Sl. No.	Disease	Cases
I.	Bacterial diseases	2078
	a. Motile aeromonad septicaemia	908 – 43.7%
	b. Bacterial diseases	1170 – 56.3%
II.	Parasitic disease	1132
	a. Helminth	
	- Dactylogyrosis	491 – 43.3%
	- Paradactylogyrosis	484 – 42.7%
	b. Protozoan	
	- Myxosporiasis	111 – 9.8%
	- Trichodiniasis	22 – 2.1%
	c. Crustacean	
	- Argulus	24 – 2.1%
	- Lernaea	10

Table.4 Mortality of fish in culture ponds (month wise)

April 2019	**6.26%**
May 2019	4.78%
June 2019	5.86%
July 2019	5.62%
August 2019	5.24%
September 2019	7.56%
October 2019	9.80%
November 2019	10.30%
December 2019	17.17%
January 2020	13.23%
February 2020	7.60
March 2020	12.39%

Table.5 Water temperature data (range) in ponds during April 04 to March 05.

pH	**7.5 – 8.5**
Salinity	0 – 3.8%
Dissolved oxygen (mg/l)	2.8 – 4.8
Total alkalinity (mg / l)	120 – 450
Total hardness (mg / l)	100 – 500
Total ammonia	0.01 – 2.3

Fig.1 Incidence of bacterial disease

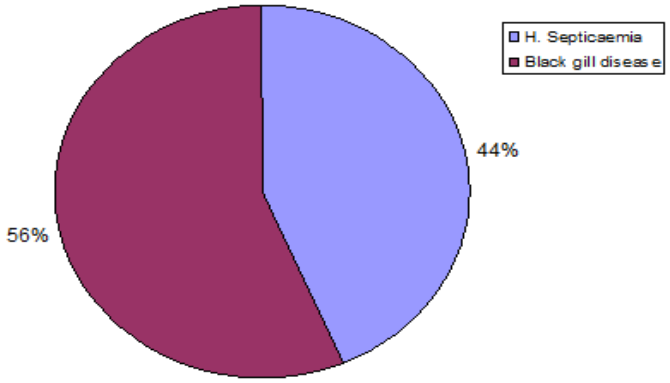


Fig.2a Motile aeromonad septicaemia

Fig.2b Bacterial gill disease

Fig.3 Incidence of bacterial disease

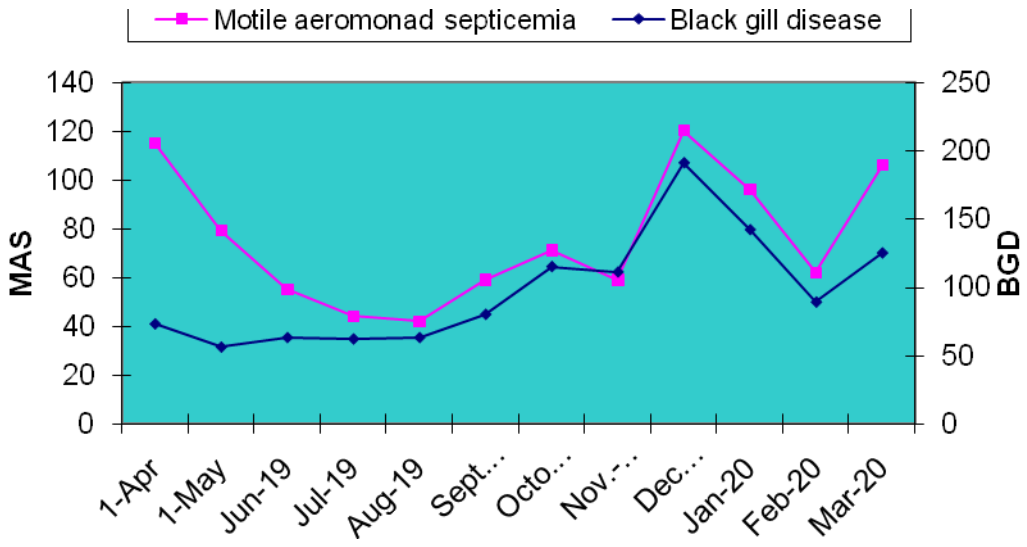


Fig.4 Incidence of parasitic disease

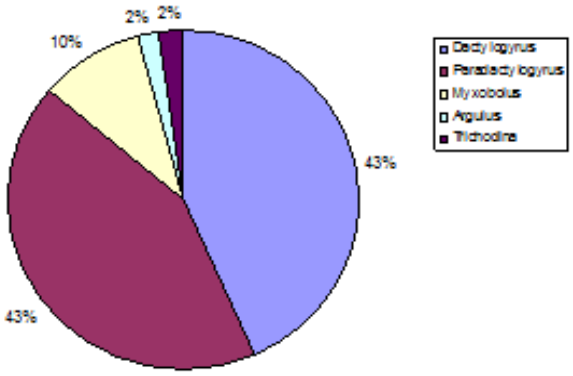


Fig.5a

Fig.5b

Fig.6 Incidence of parasitic disease

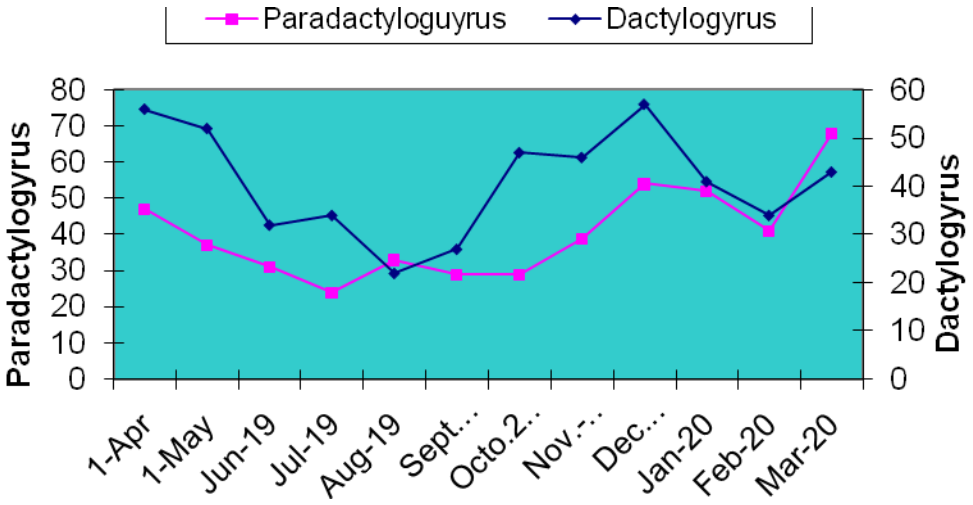


Fig.7a

Fig.7b

Fig.8 Incidence of parasitic disease

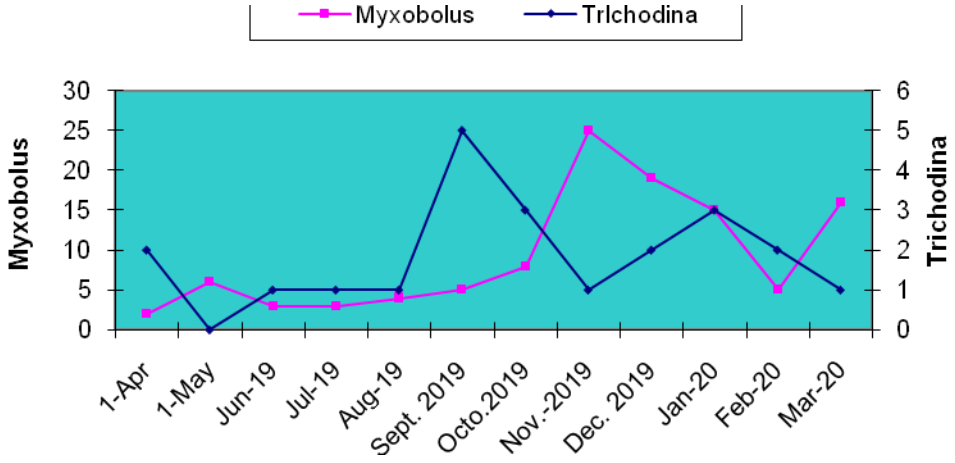
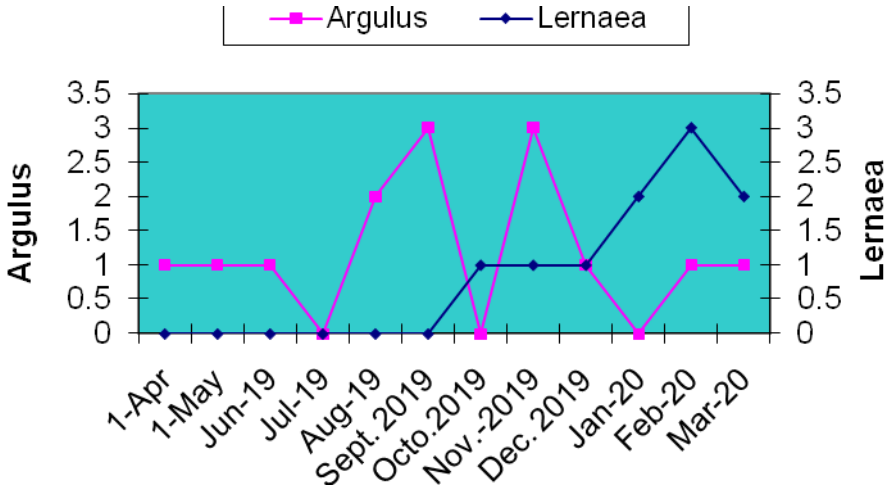


Fig.9a

Fig.9b

Fig.10 Incidence of parasitic disease



Another significant observation in IMC culture is the seasonal variation in occurrence and severity of fish diseases in carp culture (Fig. 3, 6, 8, 10). The incidence of red disease or aeromoniasiss are common during all reasons, whereas the incidences of black gill disease are more during winter periods (Fig. 3). Among parasitic disease, occurrence of Argulosis and gill flukes disease are comparatively more during winter and post rainy seasons (Table 4). The mortality rate is also higher in winter season (Table 4). The water quality of some culture ponds are maintained in optimum level (Table 5). Hence the farmers are advised to take due preventive and control measures during post rain and winter seasons, in grow out culture systems.

The transformation of Aquaculture activity from traditional to commercial scale, has led to drastic increase of production levels, simultaneously earning crores of rupees through export. Due to lucarativeness, the farmers are proceeding from semi intensive to intensive culture practices along with heavy inputs. The heavy inputs of feed, fertilizers, chemicals and probiotics bring in lot of changes in water quality parameters, resulting in negative effects, which lead to stress and finally occurrence of diseases. In the survey study it is observed that the cases of bacterial diseases (2078 cases) are higher than that of the parasitic (1132 cases). In bacterial diseases, the motile aeromonad septicaemia (43.7%), bacterial gill disease (56.3%) and in parasitic diseases, dactylogyrosis (43.3%) and paradactylogyrosis (42.7%) are often being reported in carp culture in India (Mukharjee, S. C., 2002; Mohanty, B. R., Sahoo, P. K., 2007). The aeromonas septicaemia is probably the most common bacterial disease causing severe production loss to freshwater fish culture. The development of suitable preventive and control measures, specific therapy for fish diseases assumes paramount significance, for the farmers to protect their crop against pathogens. The implementation of Better Management Practices (BMP) is most important to prevent frequent occurrence of disease and production loss in aquaculture. Further enhancement in knowledge about the disease process, host – pathogen and the environment interaction leading to disease occurrence, are very much essential for development of scientific methods of disease control (Subasingha, R. P., 2001). This needs due attention by the farmers for attaining of higher yields.

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How to cite this article:

Suguna, T. 2021. Infectious Fish Disease Occurrence in Carp Culture Ponds of West Godavari District, Andhra Pradesh. *Int.J.Curr.Microbiol.App.Sci.* 10(11): 376-386.
doi: https://doi.org/10.20546/ijcmas.2021.1011.043