Pesticides Aquatic ecological risk assessment in China

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CONTENT

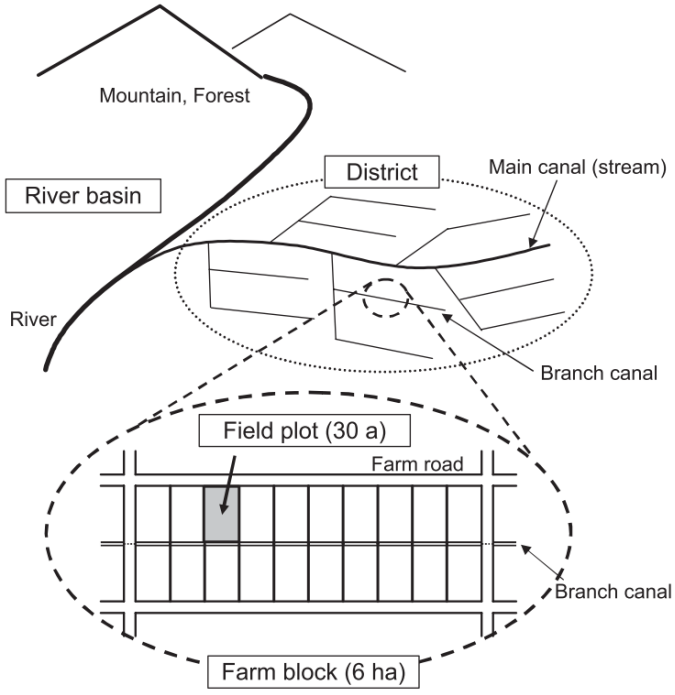
Introduction

Distribution of Rice Paddy in China

In 2014, Rice paddy harvested area 30 million ha, Production 208 million tons (FAOSTAT, 2015)

Rice paddy is one of the most important crops in China

Introduction



Hypothetical drainage system of rice-producing area(K. Inao,2008)

Pesticides might be applied multiple times even a dozen time during the whole rice cultivated period. Pesticide runoff losses from paddy field rages from a few percent to more than 50% .

Pesticides runoff from paddy field is a severe non-point pollution source.

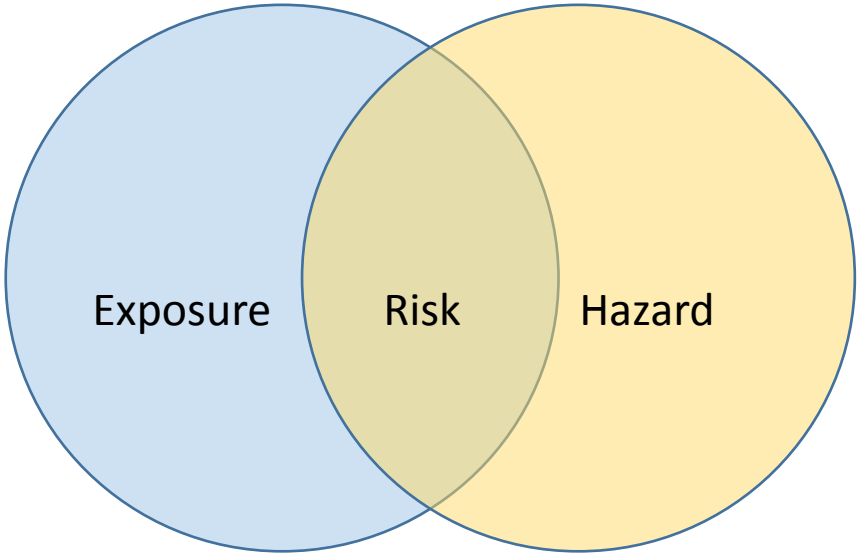
Introduction

Pesticides	Concentration	Location	Reference
Moinate	1.78 μg/L	Alufera Lake, Spain	Papadopoulou-Mourkidou et al,2004
MCPA, Oxadiazon,Pretilachlor	5.8~28.2 μg/L	Rhone River Delta, France	Comoretto et al,2007
Chlorpyrifos, Carbofuran, Carbaryl	1.68 μg/L	Bangladesh	Chowdhurry et al,2012
Fenubocarb	4.32 μg/L	Japan	Anasco et al, 2010
Chlorpyrifos	3.23~26.07 μg/L	Hanjiang River, China	Wu et al, 2011

Introduction

Exposure

- Residue data from registration files;
- Predictive models (China-Pearl, Top-Rice)
- Real scenario monitor data



Hazard

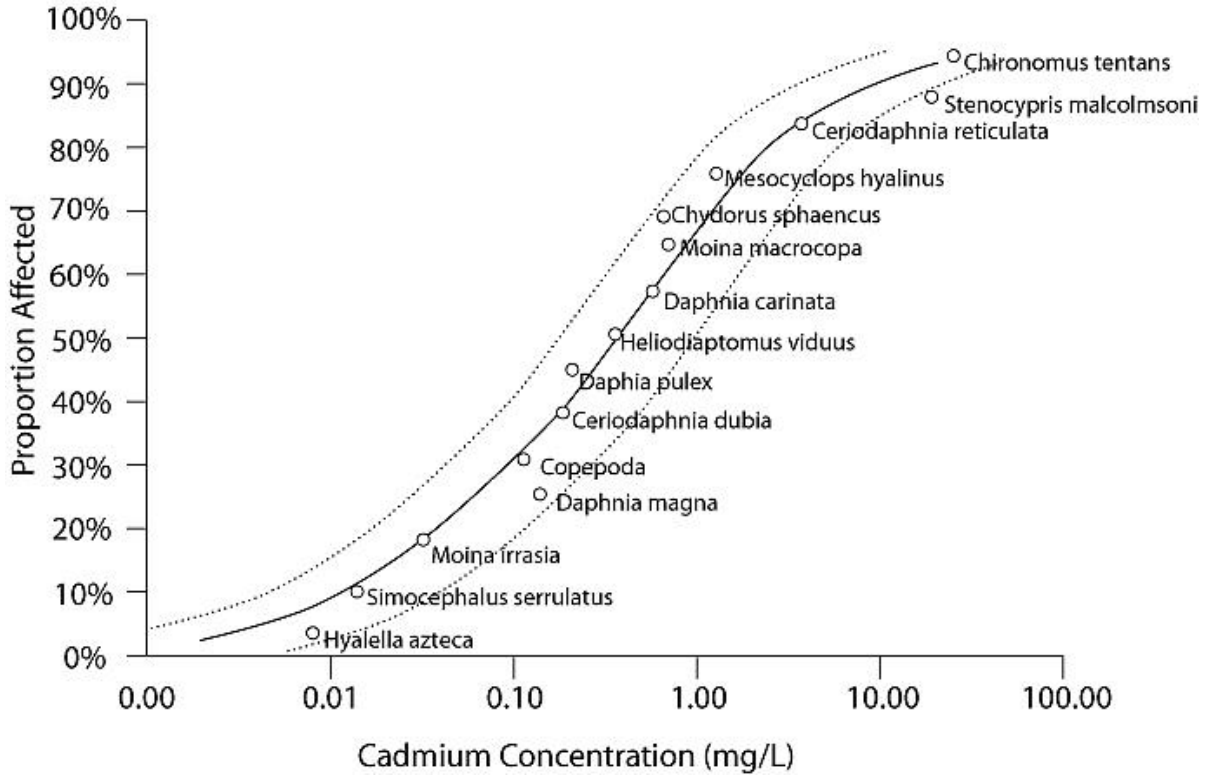
- Toxicology data from registration files;

02

Species Sensitivity Distribution

Species Sensitivity Distribution

- SSD is a statistical distribution describing the variation among a set of species in toxicity of a certain compound or mixture.



Species Sensitivity Distribution

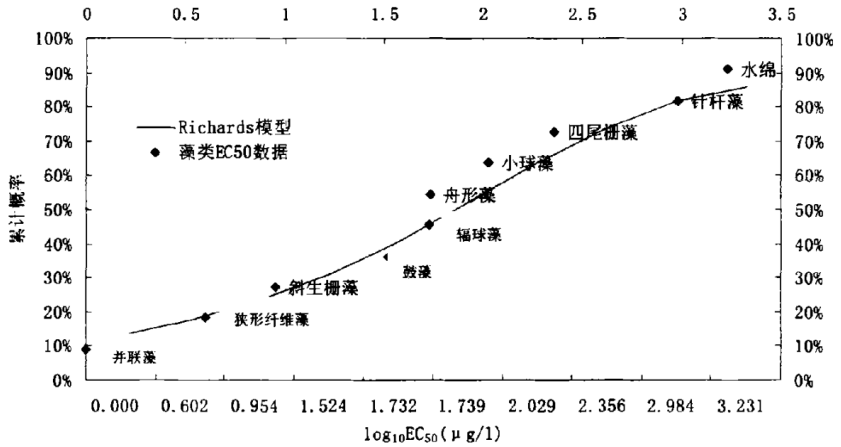


图 3.21 丁草胺对 10 种藻 EC_{50} 的 SSD 曲线

Fig.3.21 The SSD curve of ten pieces of algae under the effect of butachlor

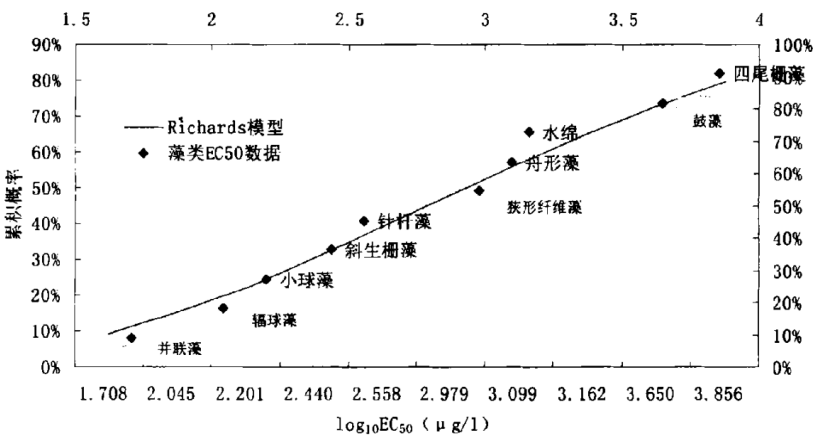


图 3.22 毒死蜱对 10 种藻 EC_{50} 的 SSD 曲线

Fig.3.22 The SSD curve of ten pieces of algae under the effect of chlorpyrifos

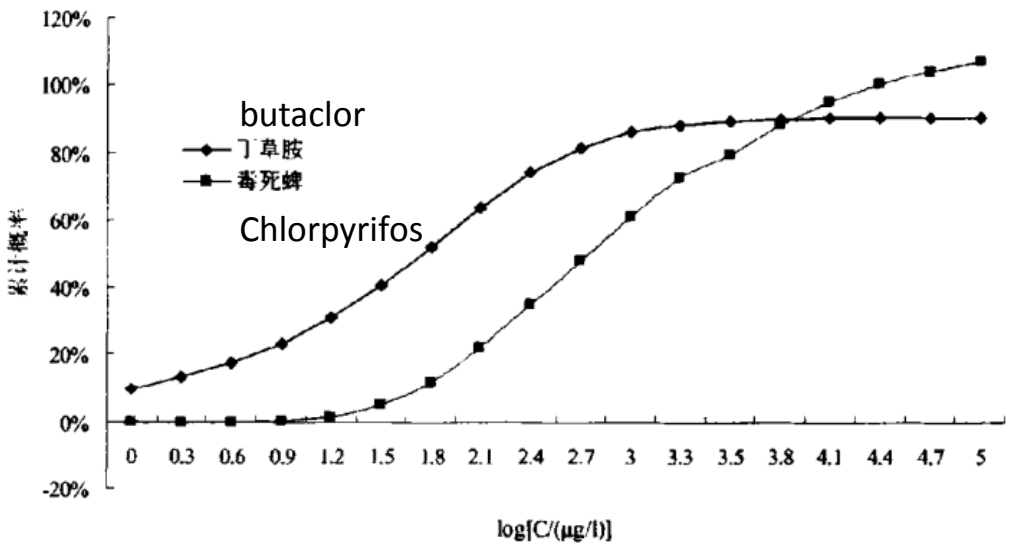
HC5 9.30 μg/L

HC5 27.88 μg/L

SSD curves based on acute EC_{50} for the toxicity of butachlor and chlorpyrifos to ten algae species(C. Gen, 2015)

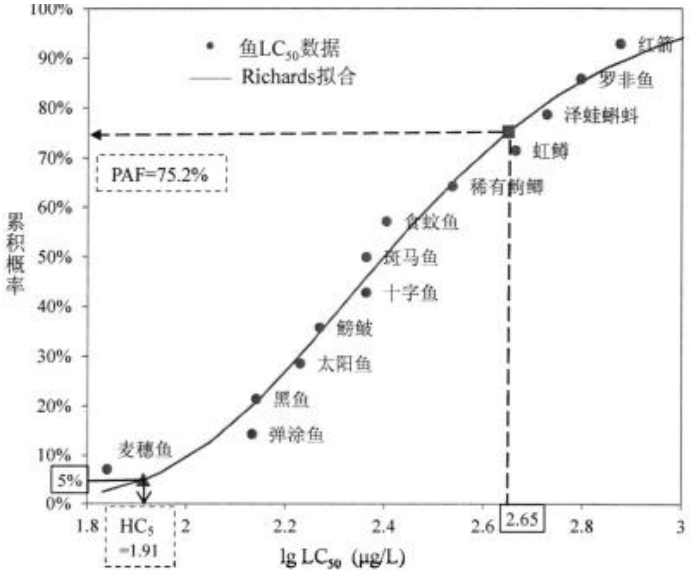
The algae species tested were: *Scenedesmus quadricauda*， *Scenedesmus obfiquus*， *Chlorella vulgam*， *Selenastrum bibraianum,Monoraphiadium sp, Chlamydomonas sp, Asterococcus scherffel, Spirogyra sp., Navicula sp., synedera sp.*

Species Sensitivity Distribution

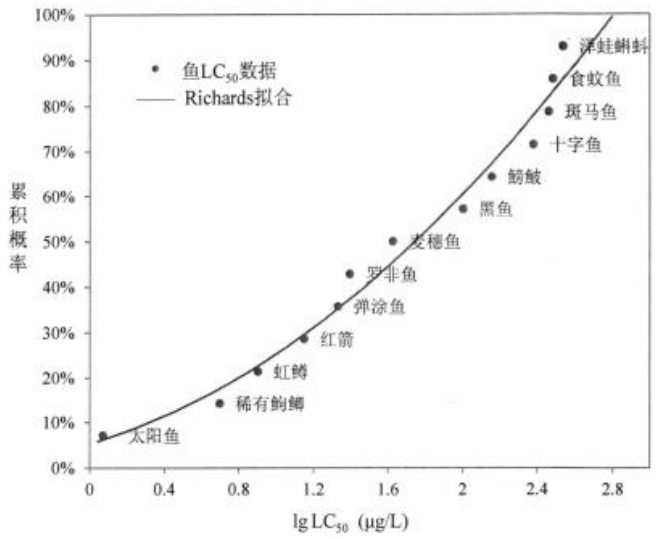


The comparison of the SSD curves based on acute EC50 of butachlor and Chlorpyrifos.

Species Sensitivity Distribution



HC_5 82.065 μg/L



HC_5 0.957 μg/L

SSD curves based on acute EC_{50} for the toxicity of butachlor and chlorpyrifos to 12 fish species(Y . Gen2013)

The fish species tested were:*eudorasbora parva, Rhodeus sinensis, Dario resio, Gobiocypris rarus, Hyphessobrycon anisitsi, Lepomis gibbosus, Tilapia mossambica, Boleophthalmus pectinirostris, Ophicephalu argus, Xiphophorus helleri, Girardinus uniotatus, Oncorhynchus mykiss,*

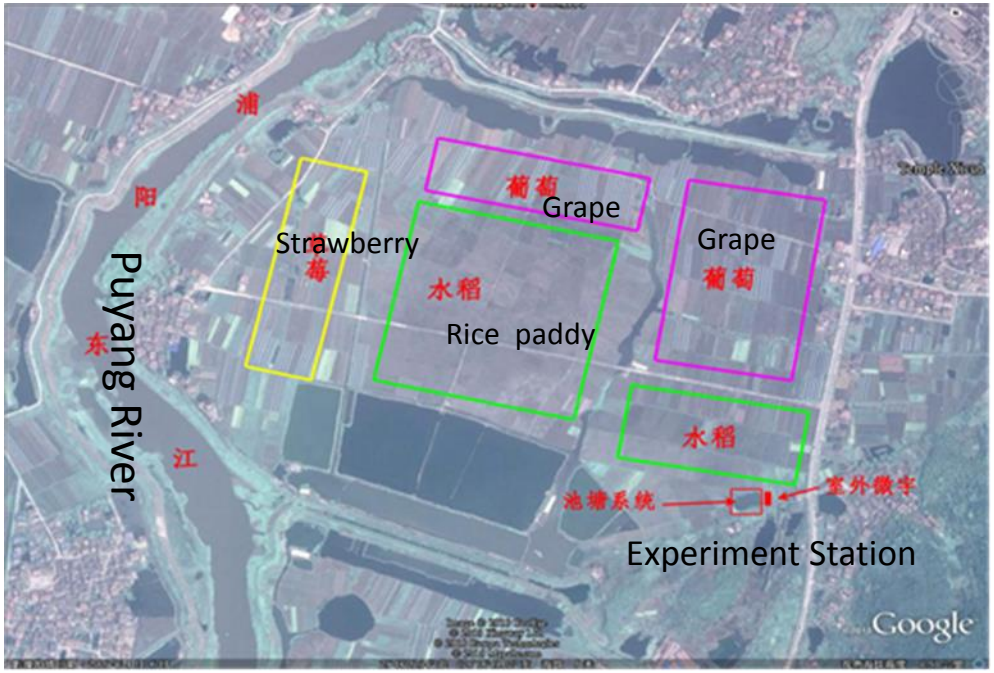
Species Sensitivity Distribution

HC_5 µg/L	Butachlor	Chlorpyrifos
phytoplankton	9.30	27.88
Fishes	82.05	0.957

- SSD curves derived from different data collection can result quite different protective effect.
- Authority has not regulated native species for multiple species pesticide toxicology tests, which may lead to inadequate protection.
- SSD curves is still based on single specie toxicity tests, which can not reflect the complexity of aquatic ecosystem.

03 Aquatic Microcosms Studies

Aquatic Microcosms Studies



Experiment station is located 120° 17′6″E，
29° 47′58″N, at Zhejiang Province, China

Aquatic Microcosms Studies

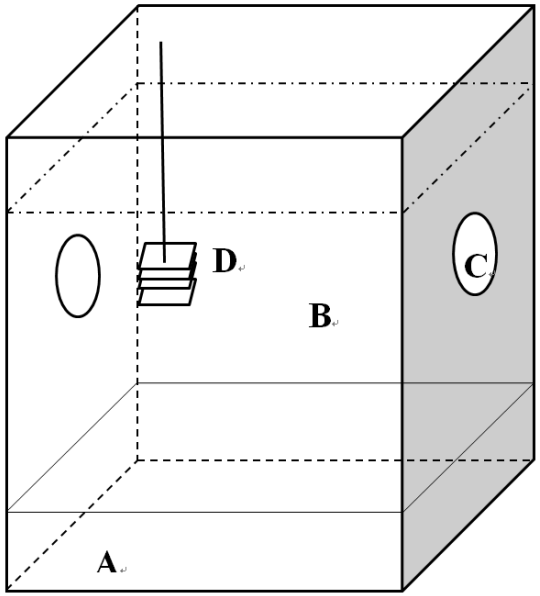
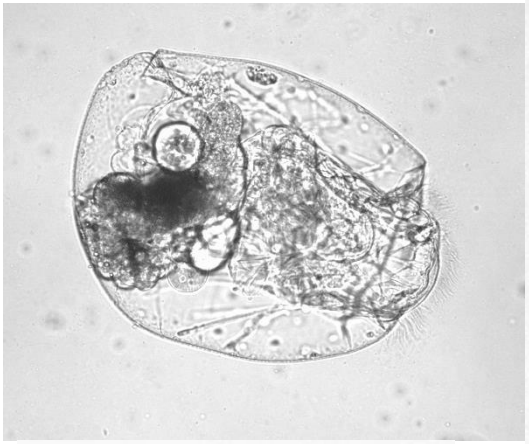
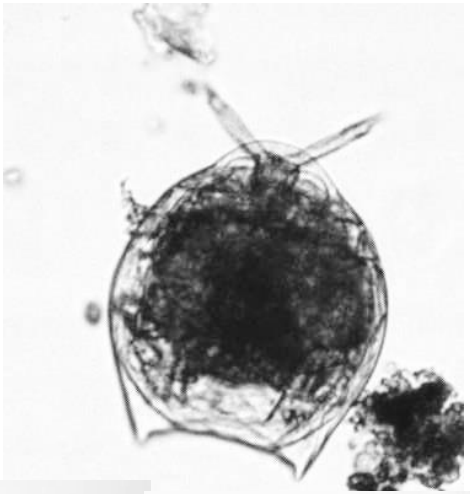
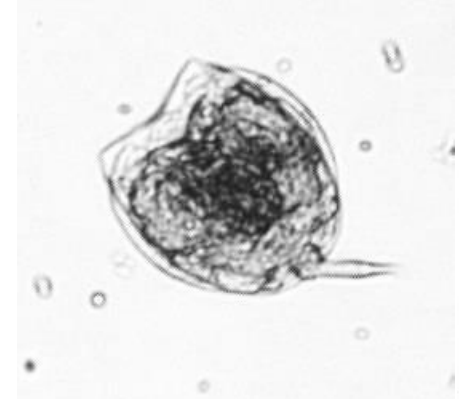
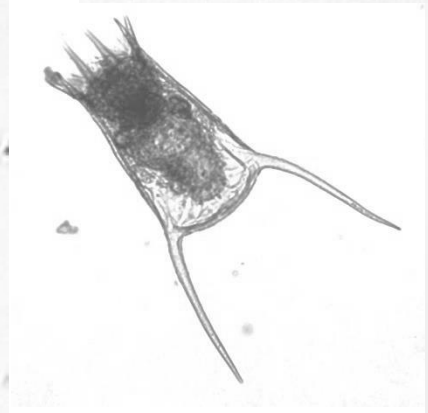


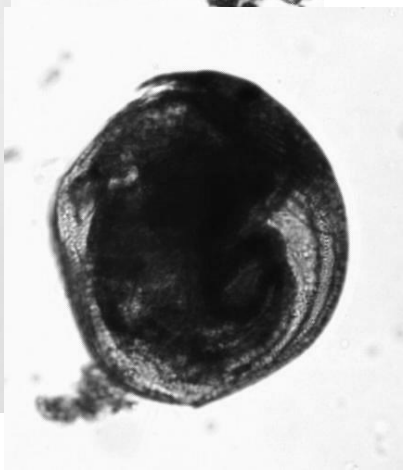
Fig 2.3 Insight of the ourdoor microcosm. (A: sediment layer of 20 cm; B: water phase depth of 60 cm; C: PVC tube connected to adjecent microcosm; D: hanging panels to provide habitats for snails.)

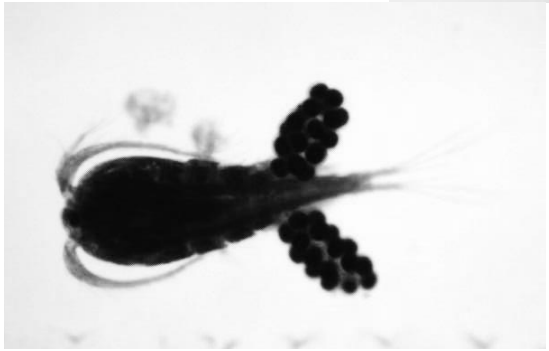
- Four system were used as Control
- Another 12 systems were randomly chosen, eath system was treated with single application of butachlor or chlorpyrifos with initial concentration of 5 or 50 μg/L .
- The experiment was performed for weeks in October to mimic late rice cultivate season

Aquatic Microcosms Studies

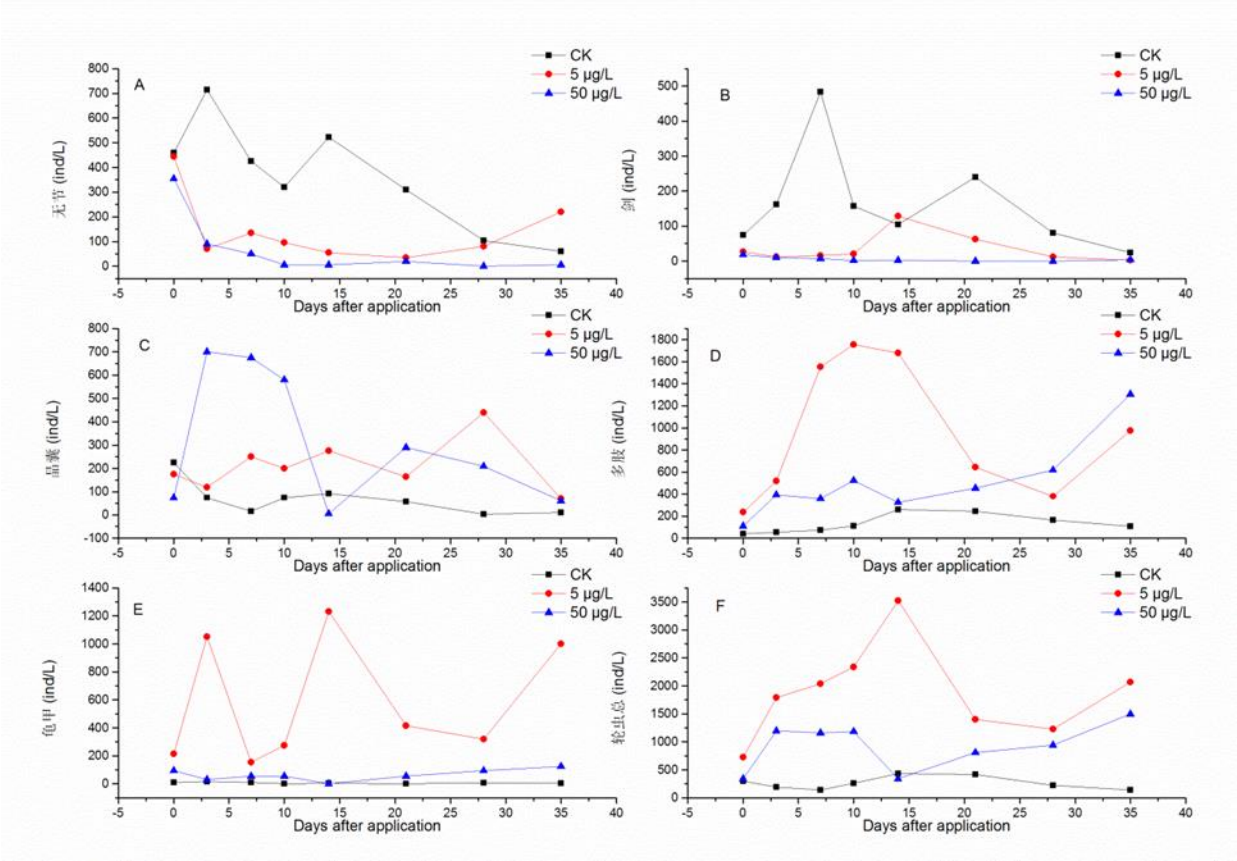




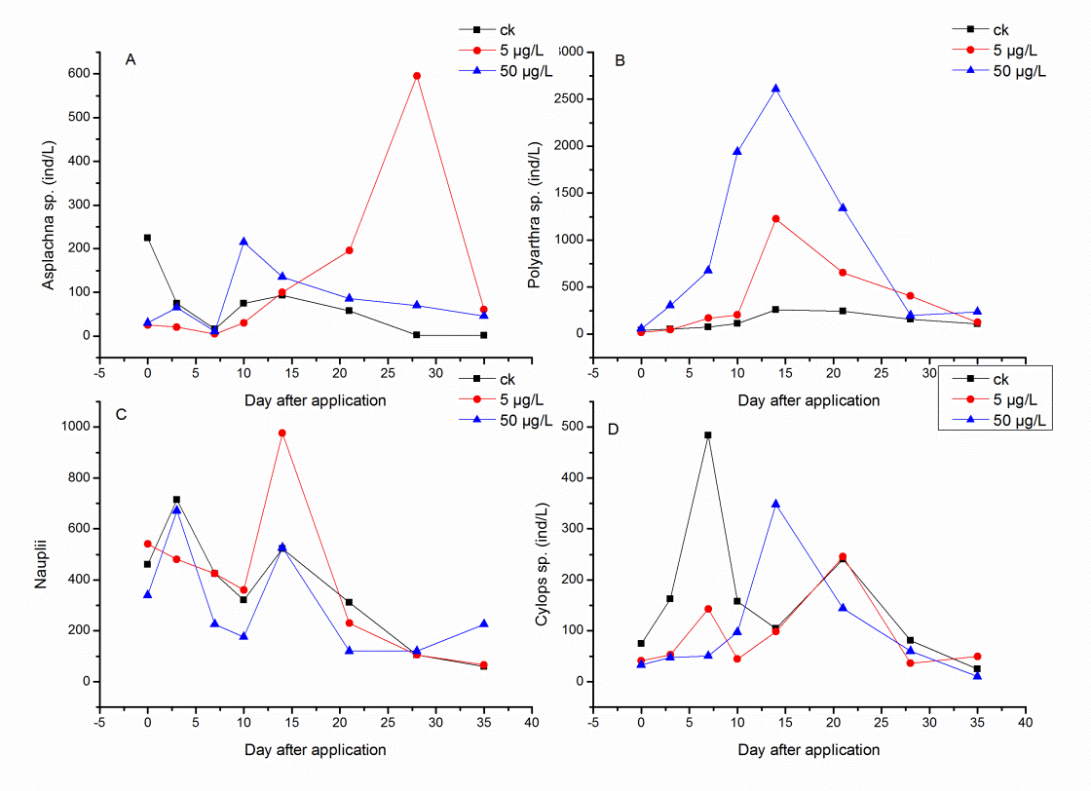


Aquatic Microcosms Studies



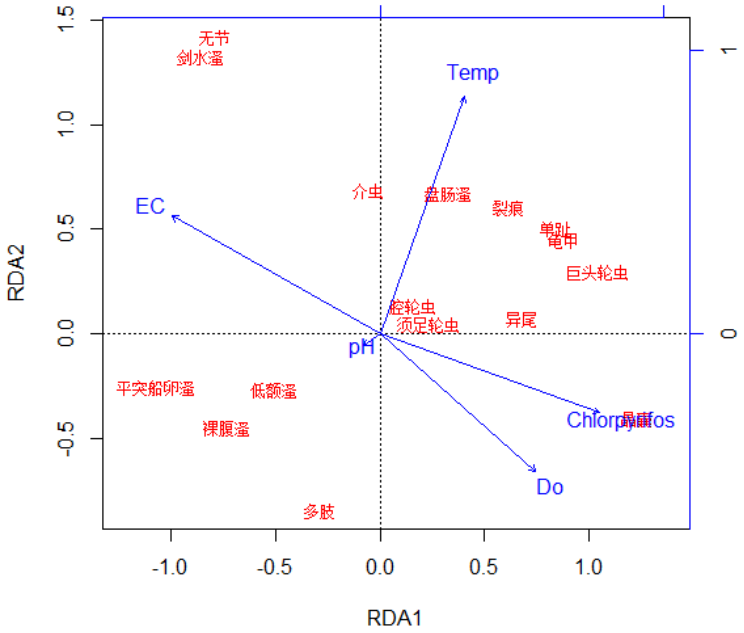
Dynamics of zooplankton community after chlorpyrifos application (A: nauplii; B: *cyclops spp.*; C: *Asplachna spp.*; D: *Polyarthra spp.*; E: *Keratella spp.*; F: total abundance of rotifers)

Aquatic Microcosms Studies

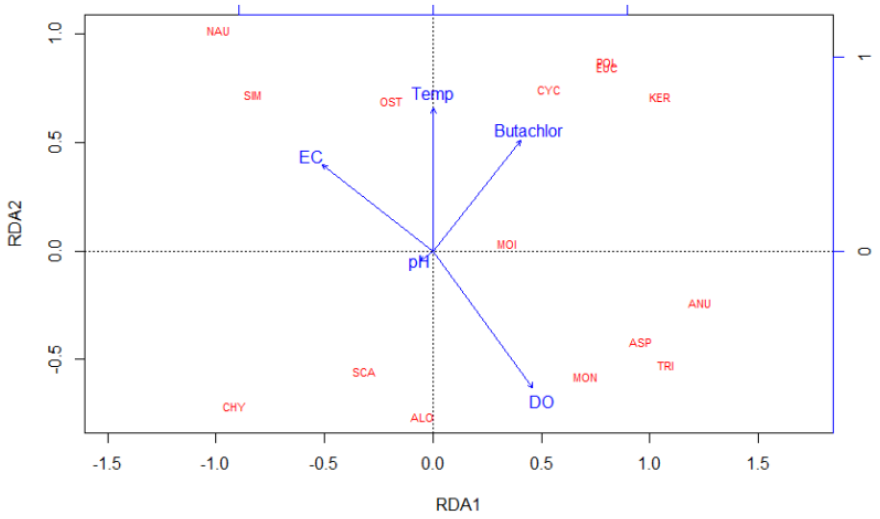


Dynamics of zooplankton community after butachlor application (A: *Asplachna spp.*; B: *Polyarthra spp.*; C Nauplii; D: *Cyclops spp.*)

Aquatic Microcosms Studies



RDA analysis shows the affinity among water parameters and the system (treatment with chlorpyrifos)



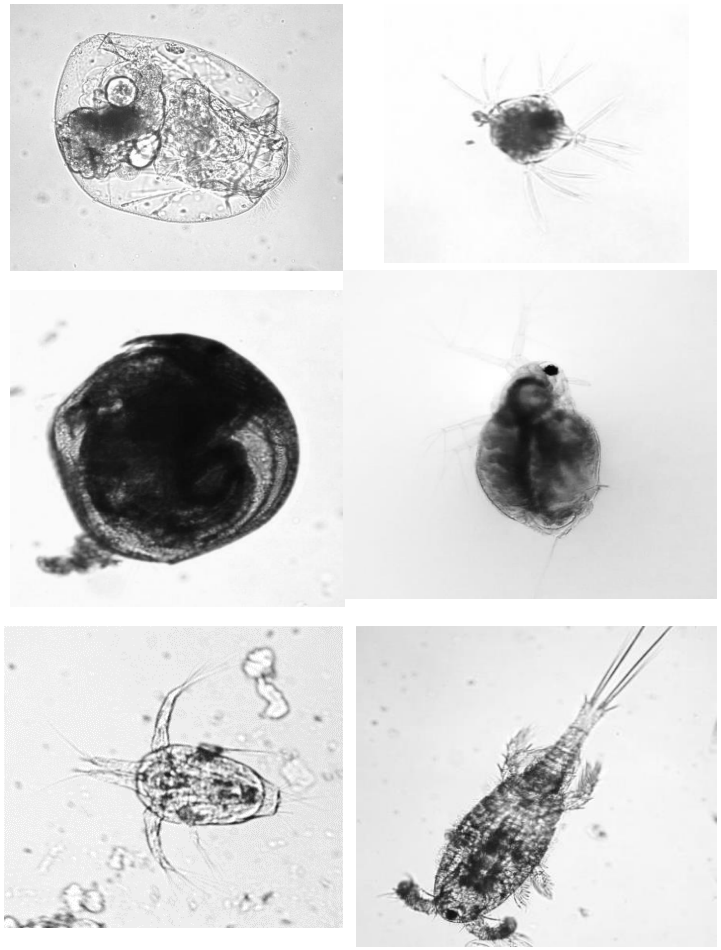
RDA analysis shows the affinity among water parameters and the system (treatment with butachlor)

Aquatic Microcosms Studies

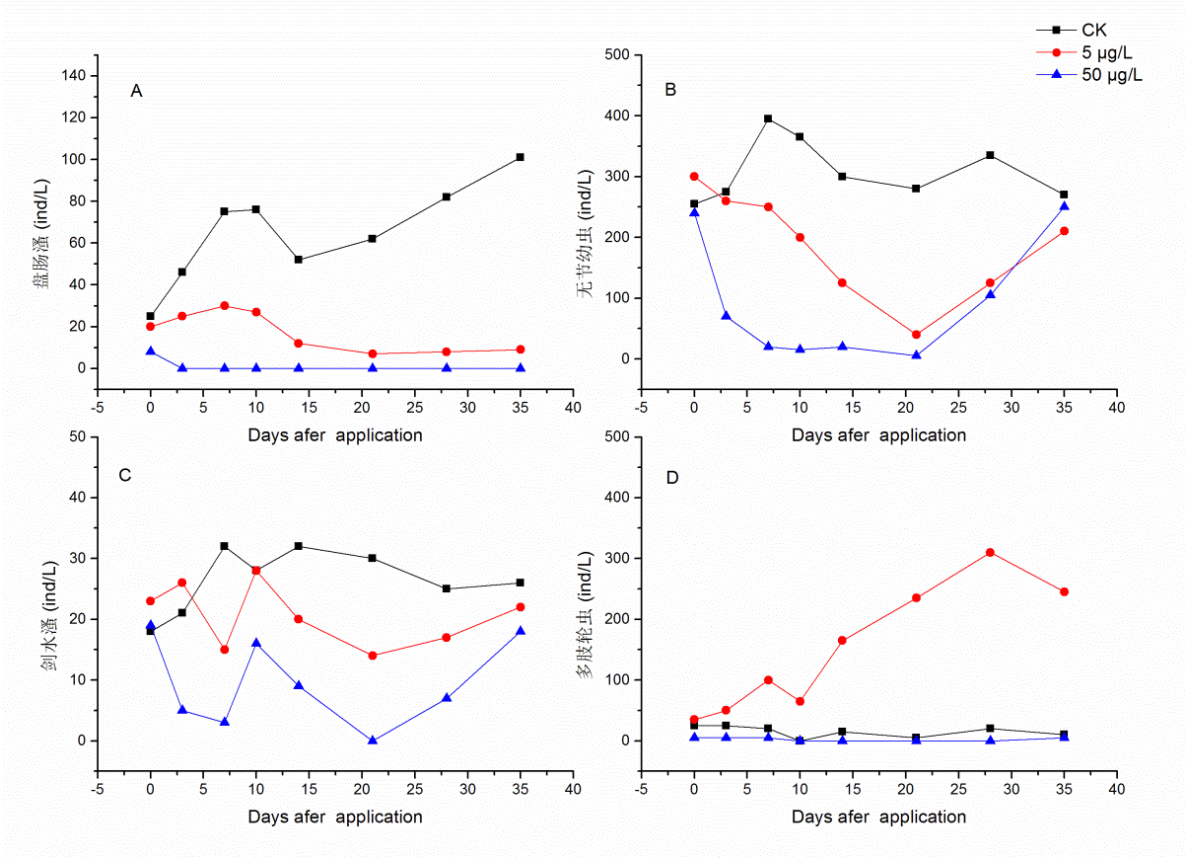
- **Application of chlorpyrifos lead decreasing in population of sensitive Crustacea;**
- **After chlorpyrifos application, zooplankton community showed a clear procedure of break-down, succession and re-balancing**
- **Since no direct toxicity of butachlor to the zooplankton community, the abnormal increasing of Polyarthra spp. may consider as indirect effect.**
- **Because of the season, all system can not resore to initial state.**

Aquatic Microcosms Studies

Facilities of indoor microcosms(100 L) and its illuminations.

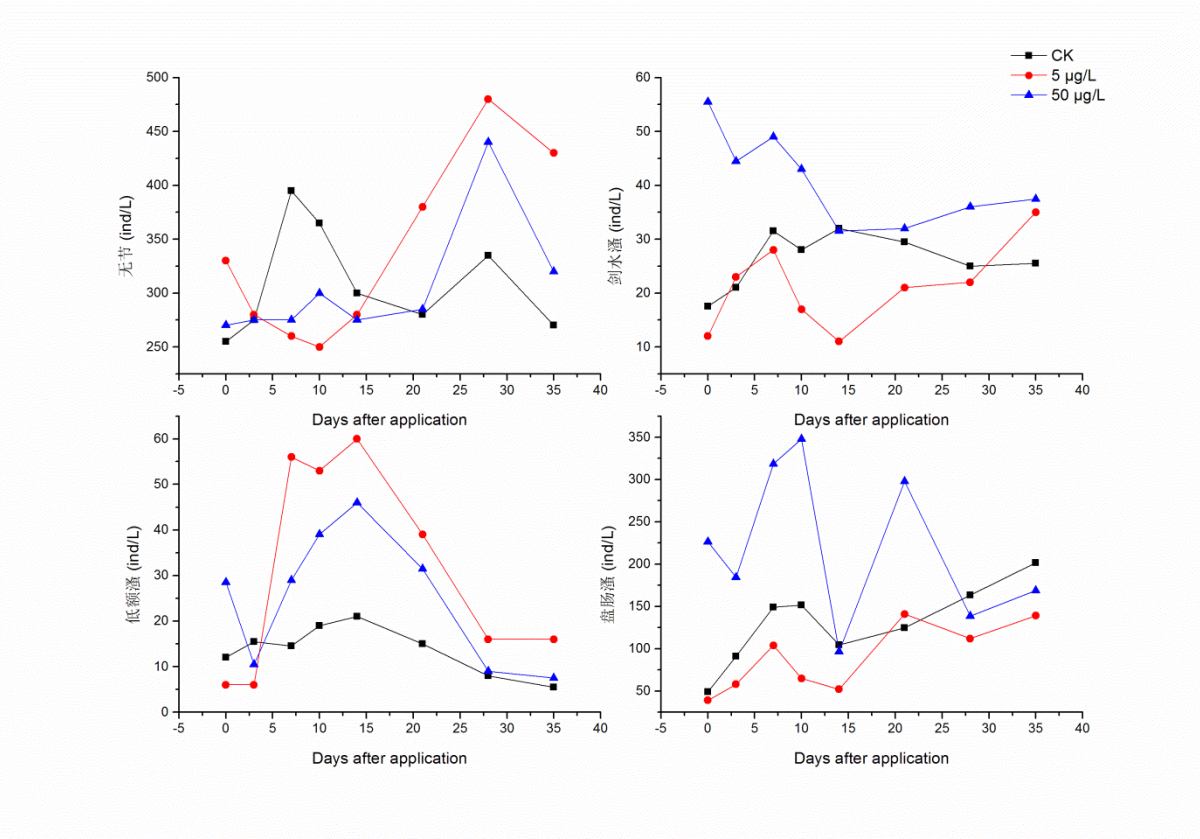


Aquatic Microcosms Studies



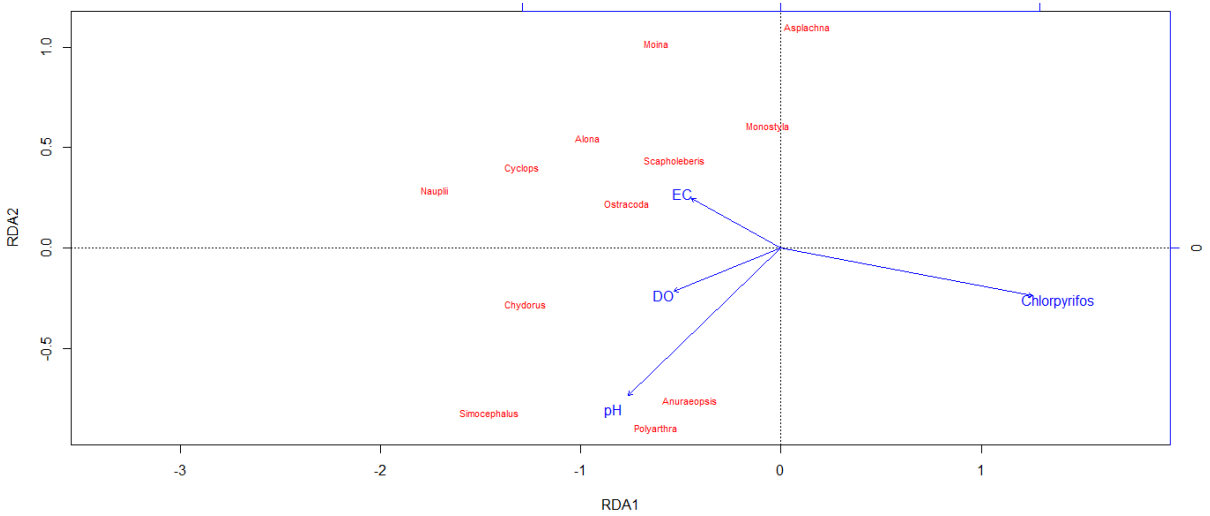
Dynamics of zooplankton population after chlorpyrifos application (A: *Chydorus spp.*; B: nauplii; C:*Cyclops spp.*; D: *Polyarthra spp.*)

Aquatic Microcosms Studies

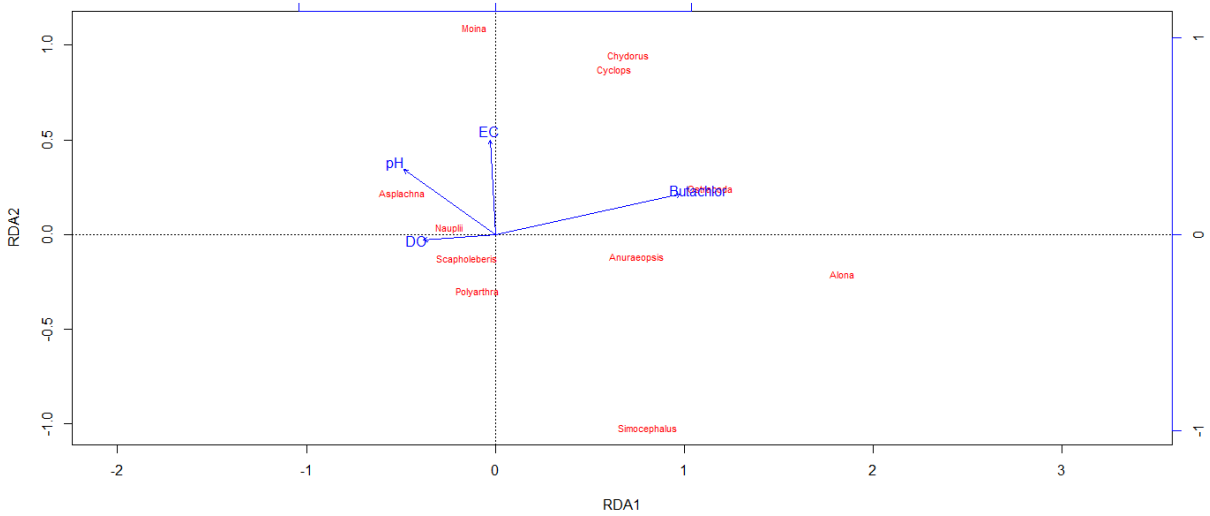


Dynamics of zooplankton population of indoor microcosms after butachlor application(A: nauplii; B: *cyclops spp.*; C: *Simocephalus spp.*; D: *Chydorus spp.*)

Aquatic Microcosms Studies



RDA analysis shows the affinity amaong water parameters and the system (treatment with chlorpyrifos)



RDA analysis shows the affinity amaong water parameters and the system (treatment with butachlor)

Aquatic Microcosms Studies

- After chlorpyrifos application indoor system also showed a procedure of zooplankton community break-down, succession and re-balancing.
- For indoor system, application of chlorpyrifos lead succession of sesentive community (*Chydorus spp*.) and insensitive communities.
- No direct negative effect on zooplankton showed after butachlor application.
- Indoor environment provided a stable water temperature, some of the systems resore to initial state.
- This phenomenon may indicate that the time of pesticide application in paddy field may cause variety damage to aquatic system.

Aquatic Microcosms Studies

Paradox:

To reveal the pattern of pesticides affect aquatic system, the community in the microcosms should be simple.

On the other hand, a ecosystem which is insufficient diversity is vulnerable .

Problem:

Experiment materials were obtained from agricultural area, the organisms in the microcosms may be effected through years pesticide selection.

THANK YOU !