Ecology & biology of nuisance algae in rice fields

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IN A RICE HULL

- Brown slime is due to sticky sugars (polysaccharides) on the surface of bacteria, which cause stubble and a variety of organisms to adhere to it, leading to the formation of mats of slime
- Brown slime is frequently associated with particular conditions on grey soils, which are rich in reduced iron; once nitrogen and water are added, iron-oxidizing bacteria, which lead to slime, multiply and the soil colour changes to orange-brown
- It is impossible to remove either bacteria or iron from rice growing soils but if slime inducing conditions are managed during rice establishment, yield loss can be avoided

Our project began by looking at both green and brown slime, as both types of slime were thought to be due to nuisance algae. We soon found that farmers can control green slime which is caused mainly by green algae such as* Spirogyra *and* Anabaena. *However, we found that for some rice farmers, brown slime is still a problem.

Current methods of sowing pre-germinated rice seed into fertilised and flooded rice bays and more intensive cropping have increased the incidence of brown slime. Farmers are concerned that brown slime which forms large mats in rice bays during rice establishment may lead to a lower yield.

We enlisted the help of farmers to find out when brown slime is a nuisance and what farmers do to prevent it from becoming a nuisance. We also examined samples of brown slime to identify the organisms responsible. We then determined the conditions that cause it to increase so that practical strategies could be devised to prevent it from becoming a problem.

Figure 1 *A mat of brown slime on the water surface of a rice bay near Deniliquin during rice establishment*

Figure 2 *Brown slime at Gogeldrie has lifted off the soil and moved to the surface. After draining some small rice seedlings have been pulled down by the mat of slime.*

When does brown slime become a nuisance?

Brown slime tends to appear during rice establishment, about two to three weeks after flooding and frequently accumulates at the deeper ends of rice bays. It starts by forming a layer on the soil of flooded rice bays, at the soil/water interface. It may then rise to the surface, forming mats, particularly during the period when the water is kept 'locked up' for herbicide application as part of weed control. If the water is then lowered and the rice seedlings are still at the 2- to 3-leaf stage, the seedling may be pulled down by the mats of slime.

Figure 1 shows a mat of brown slime sitting on the water surface of a rice bay at a farm near Deniliquin during rice establishment. Figure 2 is another example of brown slime in a rice bay in the Gogeldrie region. In this case, after brown slime mats lifted off the soil and moved to the surface, the water was drained. It shows that some of the small rice seedlings were pulled down along with the mat of brown slime.

What conditions are related to brown slime?

Several farmers we spoke to have noted that high levels of organic matter (such as stubble left over from a previous crop), broadcasting urea rather than incorporating it below the soil surface, adding urea at more than 125 kg/ha prior to sowing, and still water, can all contribute to an increase in brown slime.

What is brown slime?

Brown slime is caused by iron-oxidising bacteria. The reddish-brown colour is due to iron which has been oxidised by the bacteria. Bacteria are present in all soils but remain in a dormant condition when it is dry. Once water and nitrogen are added, they are able to grow and growth is faster in warm weather. Laboratory experiments using soil samples from rice bays, have shown that when urea is added, the growth of bacteria that break down urea is favoured. Thus, if large amounts of urea are added and water is present in rice bays for several days before rice is sown, bacterial growth will increase and there will be a greater chance of slime forming. The slime is due to sugars (polysaccharides) that bacteria produce on their surface. Because this slime is 'sticky', stubble and a variety of organisms, including filamentous bacteria, small invertebrates, fungi and micro-green algae, adhere to it leading to the formation of mats of slime.

How can farmers tell whether their soils are prone to brown slime?

Past experience of particular paddocks and soil type are good indicators of the likelihood of slime developing. For example, we have noticed that brown slime is often found in association with grey soils. Figure 3 is a photograph of a rice bay at Jerilderie that had been drained. It shows footprints breaking through the surface of brown slime and exposing the dark grey coloured soil underneath. In this case, the seedlings were growing through the thin layer of slime which remained at the soil surface. Grey soils are rich in reduced iron and once nitrogen and water are added, iron-oxidizing bacteria multiply and the surface soil colour changes to orange-brown as iron is oxidized. Figure 4 is another example from a rice bay in Tocumwal.

Suggestions for reducing the incidence of brown slime

It is impossible to remove either bacteria or iron from rice growing soils. In a flooded, fertilised rice bay there will always be competition for nutrients between rice and the many other organisms (bacteria, green algae, invertebrates, weeds) that are present. However, bacteria grow more quickly than plants, especially in warm weather and when large amounts of urea are added. Thus, it is necessary to reduce the conditions that favour the growth of bacteria instead of rice seedlings.

Figure 3 *Footprints breaking through the surface of brown slime in a rice field at Jerilderie and exposing the dark grey coloured soil underneath. Brown slime is often found in association with grey soils, which are rich in reduced iron.*

Figure 4 *Brown slime in a field at Tocumwal. The reddish-brown colour is due to iron which has been oxidised by iron-oxidising bacteria, which become active and multiply when nitrogen and water are added to the soil.*

Summary of suggestions from farmers who successfully manage brown slime

- reduce the amount of organic matter residue on the soil surface before sowing by grazing, burning or incorporating the stubble
- when sowing seed into flooded bays, avoid using urea in excess (no more than 125 kg/ha has been suggested) particularly in soils which are prone to brown slime
- sow rice as soon as possible after flooding - if left for too long (especially in warm weather) then bacteria will have produced slime before rice is sown
- keep the water moving, especially in the corners of bays
- lower the water level, but wait until rice seedlings are at least at the 4-leaf stage to avoid mats pulling down weaker rice seedlings

And the good news is that if brown slime is managed during rice establishment, then there need be no loss in yield. Figure 5 is the same rice bay as that shown in Figure 1, but taken just before harvest. This is one of several instances in which we found that when brown slime is managed, it does not cause a loss in rice yield.

Figure 5 *If brown slime is managed during rice establishment, then there need be no loss in yield. This is the same crop as pictured in Figure 1.*

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