GintongAni

Rice Tungro Virus Disease

Grains Production Enhancement Program IV
Department of Agriculture

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DEPARTMENT OF AGRICULTURE
Office of the Secretary

This bulletin was prepared for agricultural technicians and extensions workers so that they can better understand the nature, spread, management, and control of the rice tungro virus (RTV) disease.

The RTV disease is one of the most important problems in rice production. The disease has no known cure at present, hence, a lot of confusion exists in the field as to its control. Many look for resistance against the virus when there is none, while others resort to massive spraying of insecticides on infected crops that can no longer be saved.

What is known is that small green leafhoppers (GLH) carry the virus from infected plants to healthy plants. By continuous cropping, the disease spreads. This is especially true in Mindanao where asynchronous planting is practiced. In this areas, farmers plant continuously owing to the availability of rainfall. Thus, rice crops of various stages are seen growing side by side, making it easier for GLH to move from older to younger plants. Continuous cropping enables the GLH to complete their life cycles and produce several generations of offsprings, spreading the disease over a wide production area.

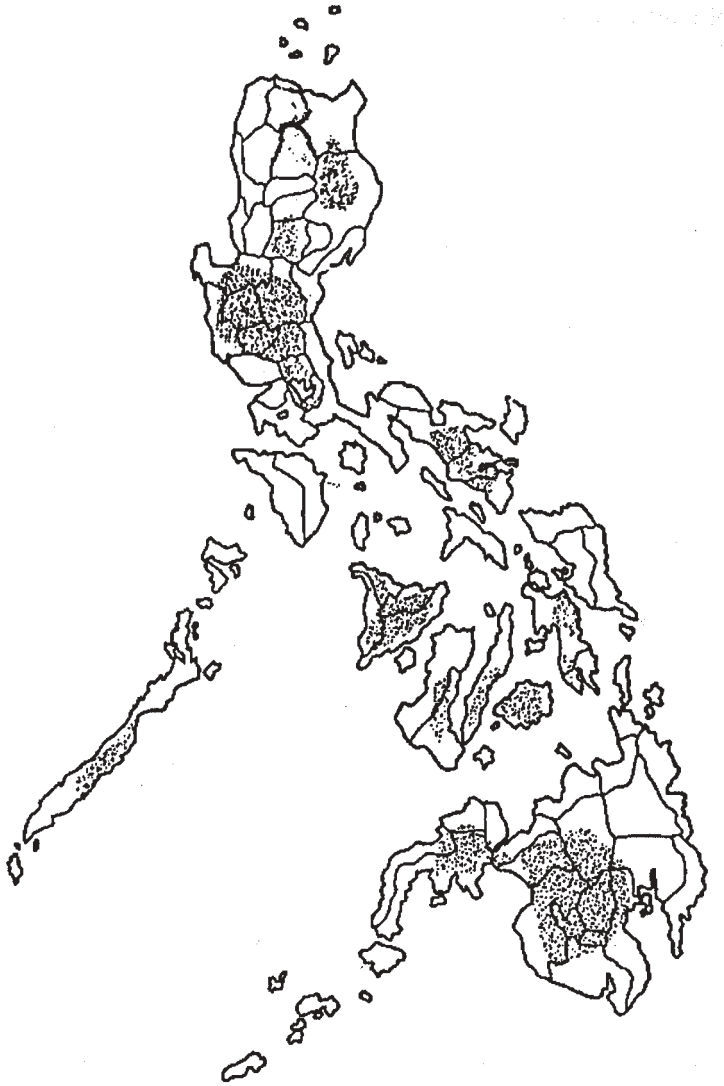
The bulletin details how the virus spreads from a single plant to a whole ricefield. From here, the bulletin presents several preventive measures that farmers can use to manage the effects of the disease in their farm. Measures range from early detection of the disease, synchronous planting, use of resistant varieties against the vector GLH, and chemical sprays when needed against GLH.

The information contained in this bulletin is a synthesis of years of research made by the Philippine Rice Research Institute (PhilRice), the University of the Philippines Los Baños (UPLB), and the International Rice Research Institute (IRRI).

SALVADOR H. ESCUDERO III
Secretary

Importance of Rice Tungro Disease

Tungro is the most important virus disease of rice in the Philippines. Major tungro outbreaks in the last 20 years were reported in principal rice growing areas of the country (shaded).



Symptoms

Tungro affected fields exhibit the following:

- **Discolored and irregularly distributed infected plants**

- **Uneven plant growth**

At closer examination, tungro infected rice plants show:

- **Yellow to orange and mottled leaves**

- **Moderate to severe stunting**

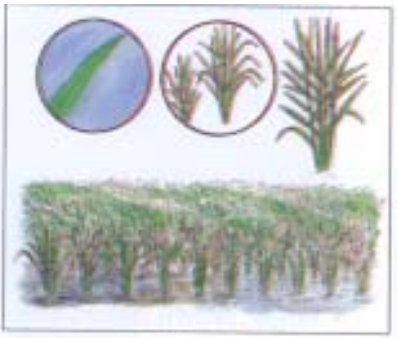
Not all yellow and stunted plants are infected with tungro. The common disorders often mistaken for tungro disease are:

1. **Physiological disorders**

- mostly nutritional deficiency and soil-related

Nitrogen deficiency

- no severe stunting
- no mottled leaves
- plants near levees are greener
- green plants in swath fashion
- plants will recover after appropriate N-fertilization

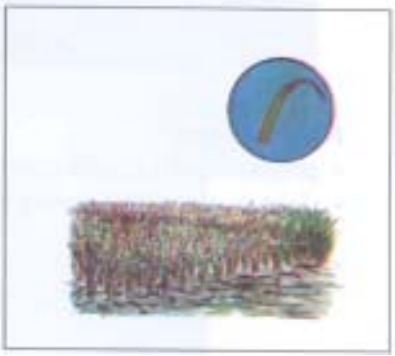


Zinc deficiency

- severely stunted plants
- erect, brittle leaves with rusty spots
- discolored and stunted plants usually present in water-lagged area of the field
- plants recover days after field is drained

Water stress

- old leaves are dry
- tips and margins of leaves drying
- no mottled leaves
- discolored plants usually occur in the higher portion of the field
- plants recover after irrigation



2. Pest infestation

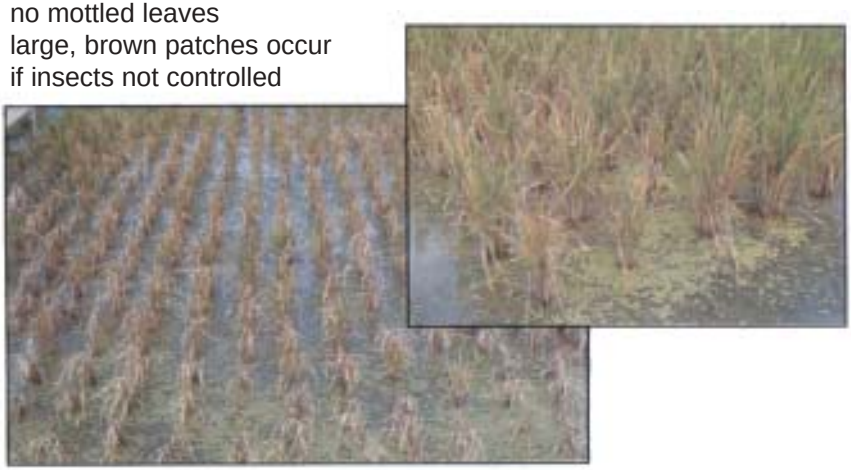
- direct damage to plants by pests due to feeding

Stemborer infestation

- youngest leaf of a tiller is yellow and can be pulled out later
- yellowing does not occur in all leaves of the tiller
- not all tillers in a hill show discoloration

Planthopper infestation

- very high number of planthoppers in lower plant parts
- no mottled leaves
- large, brown patches occur if insects not controlled



Rat Damage

- presence of broken culms
- usually observed during booting and heading stages

3. Other infectious agents

- the disorder is transmissible

Grassy stunt 2 disease

- severe stunting
- many small tillers
- erect, narrow leaves
- high planthopper population

Rice dwarf disease

- yellow leaves with white elongated specks
- mild to severe stunting

Bacterial leaf streak

- pale yellow to orange leaves with narrow, linear streaks
- takes only a few days to infect plants over large area
- no mottled leaves
- no clear stunting

Orange leaf disease
(plant on left)

- no severe stunting
- golden yellow leaves
- discolored leaves roll inward and wilt
- occur sporadically in the field

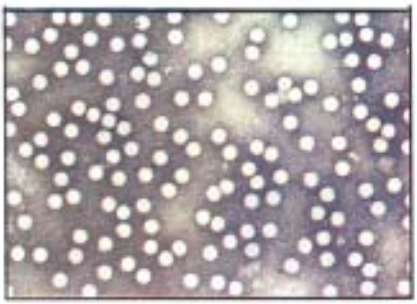
Yellow dwarf disease

- pale yellow leaves
- severe stunting and many tillers
- mostly occurring in ratooned plants

What we know about the tungro virus

Tungro is caused by two different viruses known as:

Rice Tungro Bacilliform Virus (RTBV)



Rice Tungro Spherical Virus (RTSV)

The virus particles are not seen by the naked eyes but by a powerful instrument called electron microscope. Virus particles are measured in nanometer (nm). One nm is 1/1000 of a micron (u) and one u is 1/1000 of a millimeter (mm). The width of RTBV or RTSV is about 30 nm.

The presence of one or both viruses in the plant produce different symptoms (compare diseased plant with healthy one).

RTBV + RTSV

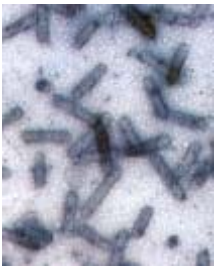
Mottled leaves

Severe stunting

Yellow to orange leaves

Healthy plant

RTBV+RTSV diseased plant



RTBV - alone

Mild stunting

Mild yellowing

Healthy plant

RTBV - diseased plant

RTSV - alone

No clear symptoms

Healthy plant

RTSV - diseased plant

How tungro viruses are transmitted

The ONLY means of transmission is by LEAFHOPPERS; the most important is the Green Leafhopper (GLH) *Nephotettix virescens.*

adult

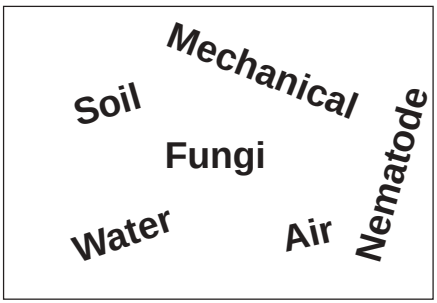
nymph

- local name is “berdeng ngusong kabayo”
- feeds primarily on rice
- prefers to feed on young and susceptible rice plants

The tungro viruses are NOT transmitted by:

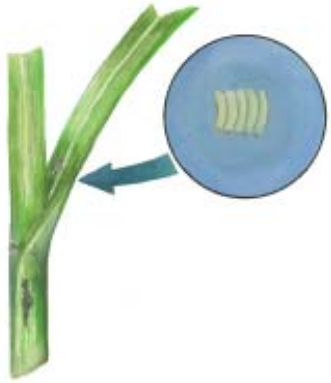
Seeds

Other Means

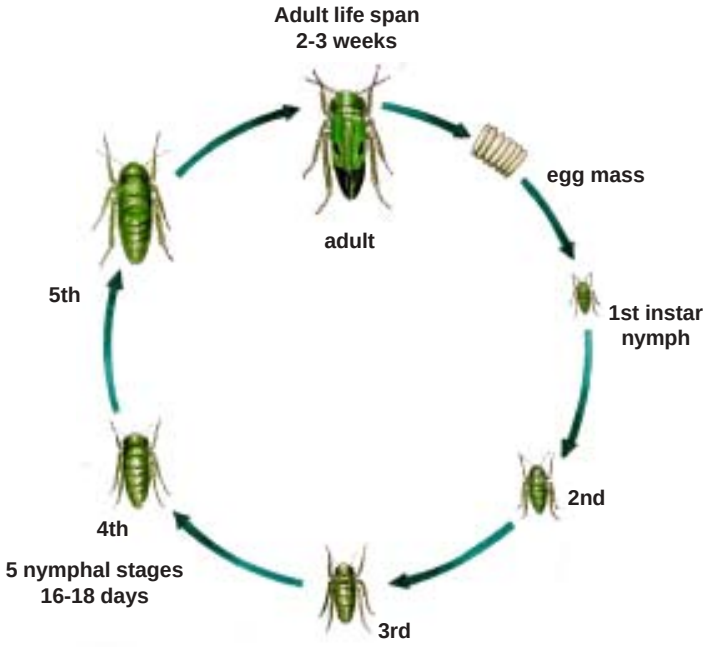


Insect Vector

Egg mass of GLH is found in lacerated leafsheaths.



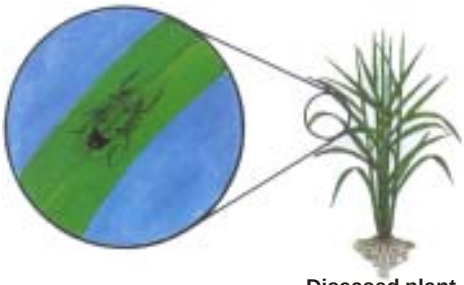
- GLH eggs laid in leafsheaths in rows
- 8-16 eggs per mass
- 200-350 eggs per female
- eggs hatch in 6-10 days
- egg size is about 1x0.3mm



Life cycle of GLH

How GLH transmits tungro to healthy plants

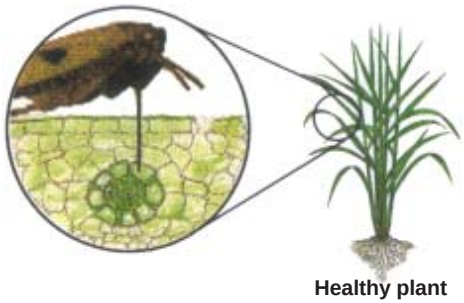
GLH feeds and gets the viruses from tungro-diseased plant.



Diseased plant

- shortest feeding time to get the viruses is 10 min but very few GLH become inefective
- longer feeding time on diseased plant results in higher transmission rate
- more GLH become infective after feeding on diseased susceptible varieties

GLH feeds on healthy plant and transmit the virus.



Healthy plant

- higher infection rate occurs in susceptible varieties
- more plants become diseased when infected at young age
- shortest feeding time to infect healthy plant is 30 min but very few become diseased
- longer feeding time results in higher transmission rate

One to two weeks later, the plant shows tungro symptoms. Once infected, the plant serves as virus source.

- GLH can immediately transmit the virus
- longer feeding time results in higher transmission rate
- nymphs and adults are able to transmit
- nymphs lose the viruses after molting

How GLH transmit tungro viruses

When GLH feeds on RTBV + RTSV diseased plant, it acquires any or both the viruses. As it feeds on healthy plant, it transmits the virus, resulting to any of the three infections.

GLH feeds on:

RTBV + RTSV diseased plant

then on:

Healthy plant

Resulting infection is either:

RTBV + RTSV

mostly infects suseptible varieties

Severe stunting and yellowing

RTBV alone

Mild stunting and yellowing

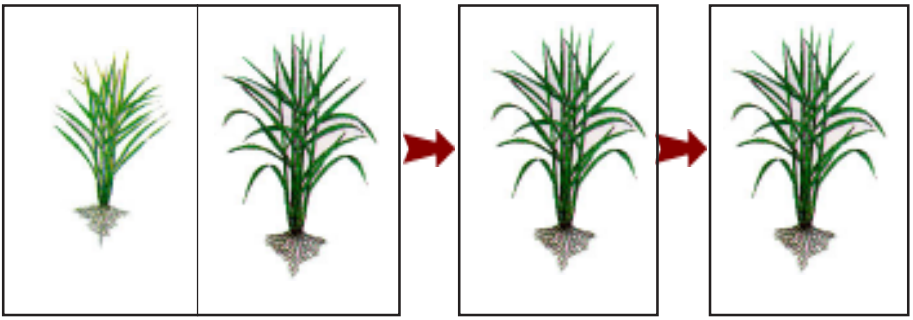
RTSV alone

No clear symptoms

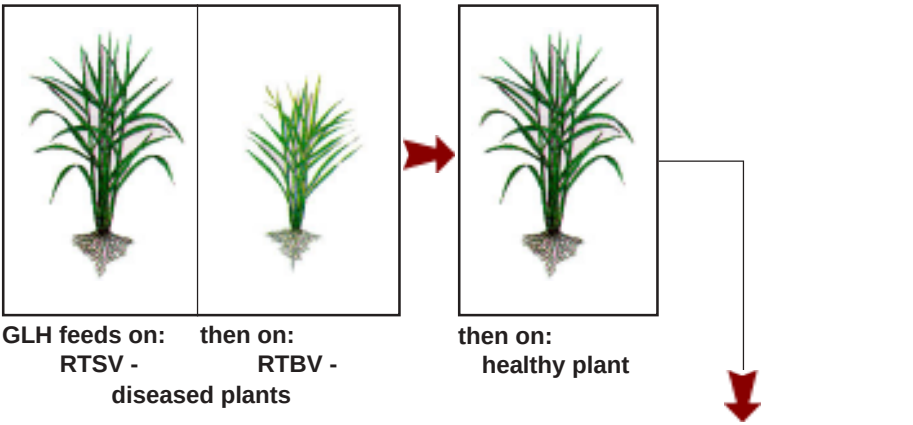
When a plant is infected with RTSV alone, the GLH can get the virus and transmit it to a healthy plant. It cannot, however, transmit the virus when the plant is infected with RTBV alone.

GLH feeds on:	then on:	Result:
RTSV-diseased plant  no clear symptoms	**Healthy plant** 	**RTSV-infected**  High transmission efficiency
RTBV-diseased plant  Mild stunting and yellowing	**Healthy plant** 	**Healthy plant**  NO transmission

The inability to transmit RTBV alone is not understood. However, RTBV is transmissible when GLH feeds first on RTSV-infected plant.



GLH feeds on: RTBV - diseased plants
then on: RTSV -
then on: healthy plant
Result: RTSV - infected plant

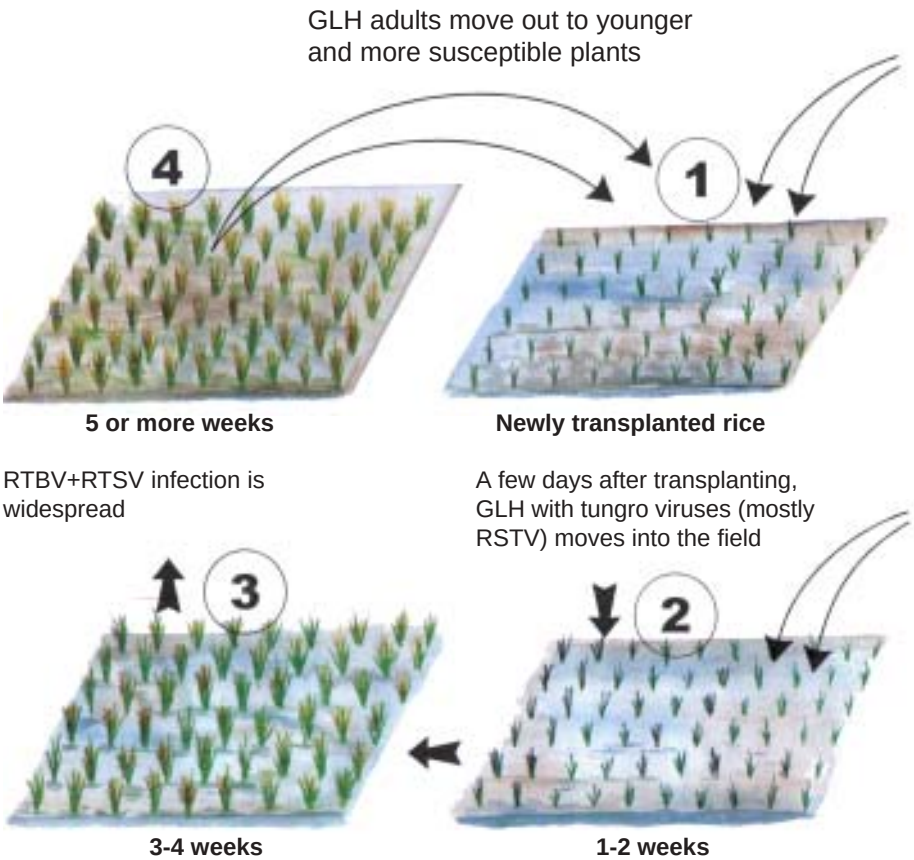


GLH feeds on: RTSV - diseased plants
then on: RTBV -
then on: healthy plant

Plant either infected with:
RTBV + RTSV RTBV RTSV

Development and spread of tungro in a field

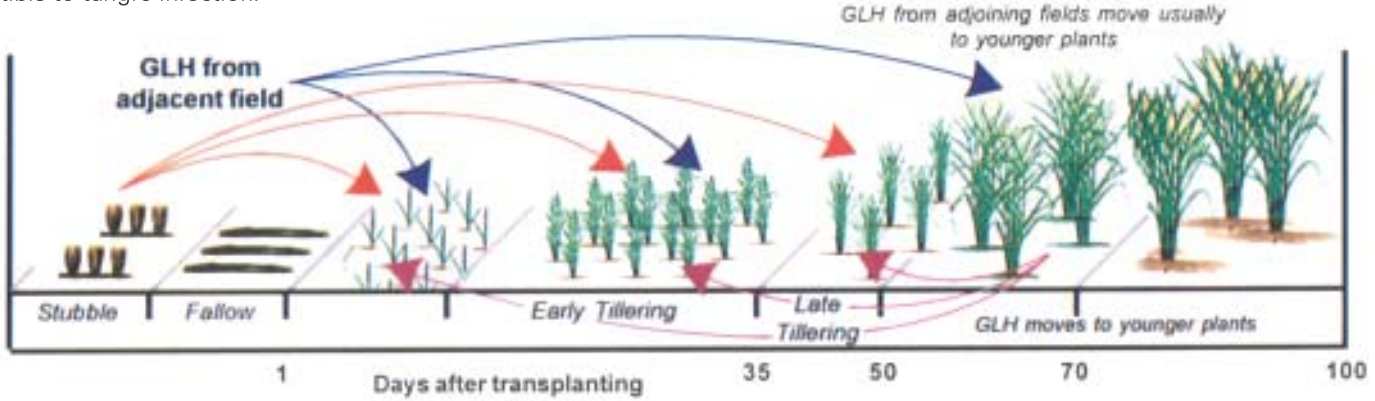
When a susceptible variety is planted and the neighboring field is infected with tungro and there are GLH, the following events may happen:



Possible GLH movement in an asynchronous rice cropping and tungro and GLH status in different growth stages

(estimated plant growth duration based on 120 days maturity)

Most rice growing areas in the Philippines are planted at different times (asynchronous) due to various reasons like unavailability of water, labor, and seeds. Tungro incidences were mostly reported in these areas. When fields are planted at different times, various growth stages are present. GLH tends to move from old to young and susceptible plants making the younger plants more prone to tungro infection. Plants at early tillering stage is most vulnerable to GLH feeding and is most susceptible to tungro infection.



- low GLH number
- poor virus source

- weed hosts of GLH may be present
- weeds are not good virus sources

- likely on 3rd week may serve as host for GLH
- tungro infection very low

- ideal host for GLH
- nymphs present, high rate of GLH increase
- generally, RTSV infection occur at 1-2 wk after transplanting
- usually no symptom is apparent in the first 2 wk after RTSV infection occurred
- most susceptible to tungro and GLH
- good virus source

- GLH number high, adults and nymphs present
- symptoms fully manifested
- good virus source

- GLH number decrease
- if infected at this stage, less yield loss
- poor virus source

- very low GLH number
- poor virus source

Management of tungro virus

Prevention is still the most practical means of control against tungro. Listed are some preventive measures, to be carried out preferrably on community-wide basis:

1. Early detection

It is important to differentiate early tungro symptoms from other disorders. This can be done as follows:

Examine the distribution of diseased plants

- irregular distribution
- generally occurring in the field's inner portion

Look for presence of GLH

- presence of GLH before and during disease development

Observe neighboring fields for the occurrence of tungro

- tungro generally affects not only a field but also nearby fields planted with the same variety and of the same age.

Ratoon suspected plant and monitor symptoms on newly developed leaves

- if symptoms disappear in new growths, the cause is likely not due to tungro

2. Plant resistant variety

This is considered the most economical means of managing tungro. While no variety has been found resistant to tungro, there are varieties resistant to its vector, the GLH. Studies have shown that varieties with R or MR reaction to GLH exhibited lower levels of tungro incidence. Disease spread is slow in R varieties.

Reaction of some Philippine Seedboard (PSB) Varieties to the Green Leafhopper[1]

Variety	Reaction[2]	Variety	Reaction
BPI Ri 10	MR	PSB Rc 4	R
BPI Ri 12	R	PSB Rc 6	MR
IR36	R	PSB Rc 8	MR
IR42	R	PSB Rc 10	R
IR60	R	PSB Rc 12	S
IR62	R	PSB Rc 14	S
IR64	R	PSB Rc 18	MR
IR66	R	Rc 20	MR
IR68	R	Rc 22	MR
IR70	R	Rc 28	MR
IR72	R	Rc 30	MR
IR74	R	Rc 32	MR
PSB Rc 2	R	Rc 34	MR

[1] Most were resistant to GLH when released. IR36, IR42, IR64, and IR66 are now susceptible to tungro while IR72 is now observed to be infected in some rice growing areas in the Philippines

[2] R - Resistant, MR - Moderately Resistant, S - Susceptible

3. **Destroy stubbles right after harvest by plowing and harrowing to eradicate GLH and tungro hosts.**

4. **Plant in synchrony (within a month of the general planting time) to avoid GLH population buildup due to limited time host plants are available.**

5. **Inspect field. The critical time in the development and spread of tungro is within 6 weeks after transplanting. Use insecticides only when needed to save money and the friendly insects. Do not spray in the following growth stages or field conditions:**
   - *in seedbed*
   - *in plants more than 60 days old after transplanting*
   - *when no tungro and few GLH are present*

6. **Observe a fallow period (at least a month), to eliminate hosts of the viruses and vectors.**

Limitations of tungro management

Effective tungro management is limited by:

1. **The absence of symptoms at early stage of disease development.** Farmers often notice the presence of tungro in their fields only when the plants show symptoms of yellowing and stunting. At this stage, another generation of GLH had developed, more GLH eggs were laid, and the disease had already spread making control more difficult.

2. **Lack of resistant varieties to the tungro viruses.** Varieties released to the farmers are resistant only to the vector and not to the viruses. Although insect resistant varieties can slow the progress of the disease spread, the continuous use of the same variety for several seasons is not recommended. Change variety as possible.

3. **Vector "adaptation" on GLH-resistant variety.** Planting the same variety for several sesons results to GLH adaptation. The time when GLH adapts on resistant variety is difficult to know. It is greatly influenced by number and length of time the GLH colonized the variety.

Diagnostic tools for early virus detection

Some serological tools are available in detecting tungro viruses at early stage of infection. They are being tested and modified for field use:

1. Latex agglutination test
2. Simplified Enzyme Linked ImmunoSorbent Assay (ELISA)
3. Rapid ImmunoFilter paper Assay (RIFA)

Acknowledgment

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