

A Review of Rice Tungro Virus in Nepal

Bhusal K¹, Sagar GC² and Bhattarai K³

¹Department of Entomology, Institute of Agriculture and Animal Science, Nepal

²Department of Pathology, Agriculture and Forestry University, Nepal

³Department of Agri-economics, Himalayan College of Agricultural Sciences and Technology, Nepal

*Corresponding author: Bhusal K, Department of Entomology, Institute of Agriculture and Animal Science, Nepal, Tel: +977 9851226246, E-mail: kiranbhusaliaas@gmail.com

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Abstract

Tungro disease is caused by *Rice tungro bacilliform virus* (RTBV) and *Rice tungro spherical virus* (RTSV) firstly reported from Philippines. In Nepal Rice Tungro Virus which is commonly known as rate rog (red disease) or tungro which was firstly reported from Parwanipur of Bara district. Symptom of this disease occurs from early to mid of the tillering stages of rice. Rice tungro virus disease infected plants gave 88.9% of less grain than that of grain from healthy plants. The loss upto 22.9% is obtained due to shorter plant height, 16.3% from smaller panicles, 67% from smaller number of effective tillers and 85.9% from lesser filled grains when plants are infected by tungro virus compared to that of healthy plants. The typical symptoms of rice infected with RTBV and RTSV are stunting, yellow or yellow to orange discoloration of infected leaves, reduced tillering, sterile panicles and often irregular-shaped dark brown specks are visible on the leaves. Active leaf hopper is the primary source of inoculum that transmits disease from the neighboring field and crop residues to the field where new rice seedlings are transplanted. Growing varieties resistant to tungro or vector of this disease will be smarter to manage the virus.

Keywords: Infected; Rice Tungro Virus; *Rice Tungro Bacilliform Virus*; *Rice Tungro Spherical Virus*; Specks

Introduction

There are various constraints for the reduction in production and productivity of rice in world. Diseases are considered one of the most important factors among them viruses is one but very few studies have been done regarding viral diseases. Among them tungro is one of the important viral disease of rice. This disease is caused by *Rice tungro bacilliform virus* (RTBV) and *Rice tungro spherical virus* (RTSV). Rice tungro virus disease was first reported in Philippines and now is one of the most important diseases of South and South East Asia causing considerable economic loss. Tungro virus disease or Rice tungro virus is known as rate rog (red disease) or tungro in Nepal. This disease is not considered as important one in Nepal because of its lower incidence in specific areas. But the presence of vector leafhopper (*Nephotettix spp*), cultivation of susceptible varieties and resemblance of the virus isolated from Nepal with many tungro isolates of Indian sub-continent, this disease is a threat to Nepal [1].

Classification

RTSV	RTBV
Group: Group IV ((+) ssRNA)	Group: Group IV ((+) dsDNA-RT)
Family: Sequiviridae	Family: Caulimoviridae
Genus: <i>Waikavirus</i>	Genus: <i>Tungrovirus</i>
Species: <i>Rice tungro spherical virus</i>	Species: <i>Rice tungro bacilliform virus</i>

Occurrence

John, Freeman & Shahi for the first time reported Rice tungro virus from Parwanipur of Bara district and symptom of this disease was occurred from early to mid of the tillering stages of rice [2]. Symptom of this disease was later observed in IR20 rice cultivar in Dhanusha district of Janakpur [3]. *Rice tungro bacilliform virus* and *Rice Tungro Spherical Virus* were identified from the yellow and stunted symptoms showing infected leave collected [4].

Amatya & Manandhar mentioned the confirmation of rice tungro virus disease by V.T. John at crossing block of Khumaltar of Kathmandu district in his consultancy report [2,5]. Dahal *et al.*, surveyed eighty-one locations of twenty-one districts on main season of rice at Southern terai parts of Nepal and indicated primarily restriction of these diseases to Hardinath of Janakpur and Parwanipur of Bara [1].

Economic Importance

Rice tungro susceptible varieties infected at an early growth stage could have as high as 100% yield loss (Tungro - IRRI Rice Knowledge Bank). Herdt reported estimated annual loss of US \$ 1500000000 in South and Southeast Asia from rice tungro virus disease and again noticed 10% annual loss on total yield of rice in this region [6,7]. Survey report by Dahal, Shrestha, Khatri, Fan & Hull shows that during main season at booting stage of rice crop on 50 hectare of land at Hardinath of Janakpur and Parwanipur of Bara found 10% and 28-30% disease incidence on Sabitri and Makwanpur-1 variety respectively at Hardinath, Janakpur district and 70-80% disease incidence on masuli variety on Parwanipur, Bara district [8]. Plants infected with this disease gave 88.9% of less grain than that of grain from healthy plants. The loss upto 22.9% is obtained due to shorter plant height, 16.3% from smaller panicles, 67% from smaller number of effective tillers and 85.9% from lesser filled grains when plants are infected by tungro virus compared to that of healthy plants [1].

Symptoms

It is difficult to identify tungro disease because of its confusion with various disorders due to biotic and abiotic factors. Symptoms of this disease vary according to age, variety and strains of the plant.

- 1st symptom to appear is yellowing of the young leaves with inter-venal chlorosis and chlorotic mottling.
- Plants when affected at early growth stage show few tillers, poor root development and stunted growth of the crops.
- When the plants are affected severely, flowering delays, panicles become small with deformed seed sett and not viable often with dark brown specks.
- Old leaf shows specks of rust colored of different size.
- *Rice tungro bacillus virus* is localized to the vascular bundles whereas *Rice Tungro Spherical Virus* is found in phloem tissue.
- The typical symptoms of rice infected with RTBV and RTSV are stunting, yellow or yellow to orange discoloration of infected leaves, reduced tillering, sterile panicles and often irregular-shaped dark brown specks visible on the leaves (Figure 1 and 2) [9].



Figure 1: Tungro Infected Plant



Figure 2: Yellowing of Leaves [10]

Disease Assessment

Disease assessment for Rice tungro virus can be done as follows:

Intensity score	% reduction in plant height	Discoloration showing leaves number	Young leaves showing interveinal chlorosis
0	0	0	Absent
1	1-25%	1	Present
2	26-50%	2	-
3	Above 50%	3	-

For each plant disease intensity score (DIS) is sum of scores of intensity for % reduction in plant height, Discoloration showing leaves number, Young leaves showing interveinal chlorosis. Disease intensity Score ranges from 0-7, where 0 is for the uninfected plant and 7 are for the plant which is severely infected [11].

Epidemiology

Number of vectors migrating to rice field are found to be more in rainy season from May-November than that of dry season but population of the vector was also found more in dry season in the field where crop was planted much lately than in nearby fields [12]. In the field with high asynchronous planting, vector emigration may be significant during the maximum tillering stage of the crop [13]. Dry season favors the incidence of leaf hoppers and crop shows senescence in their peak abundance. Rice tungro virus may be harbored more by volunteer rice plants and regenerated stubbles [14]. Irrigated area where the abundance of inoculums is high is highly affected with this disease. Establishment of the population of leaf hoppers in transplanted field occurs later than that of the direct seeded fields whereas in the transplanted fields there is greater movement of vector and potential environment for rapid spread of the disease is created [15]. Suzuki *et al.*, reported that higher will be the tungro disease with higher the densities of fourth and fifth instars of *Nephotettix virescens* during vegetative stage of the plant [16].

Disease Transmission

Disease symptoms start occurring in the irrigated areas where there is no synchronous planting of crop and field is covered with susceptible seedlings. Active leaf hopper is the primary source of inoculum that transmits disease from the neighboring field and crop residues to the field where new rice seedlings are transplanted. When the plants are infected with this virus they show different symptoms like yellowing to orange color of leaves, stunted growth, less number of tillers and sterility of seed grains at severity which may resemble with nutrient deficiencies and physiological disorders. Rice tungro bacilliform virus affects vascular bundle and rice tungro spherical virus affects phloem tissue. When the virus infects the plants there occurs increase in the level of sugar content with the decrease in level of proteins. When the cell is infected, both the virus is found either scattered or aggregated in cytoplasm of the cell. Initial symptoms lead to small patches in the crop field. Within a few weeks of transplanting or in extensive spreading of virus, these small patches increase in size, fuse and the whole field is covered with infection.



Figure 3: Green Leaf hopper

This disease is based on the presence of number of viruliferous vectors rather than their density. *Nephotettix spp* of which *N. virescens* is most efficient [17]. Late planted field shows more incidence of disease than that of field which was early planted. Rice tungro spherical virus is independently transmitted by *Nephotettix spp*. but transmission of rice tungro bacilliform virus depends on the presence of rice tungro spherical virus [18]. Vectors of rice tungro virus *N. virescens*, *N. nigropictus* and *Recilia dorsalis* are prevalent in Nepal [19]. With the increase use of susceptible variety of rice threat of rice tungro virus disease is also increasing which may decrease the production of rice in Nepal (Figure 3).

Management

Once the field is affected by this disease it cannot be controlled. Control measures are found less effective than measure of direct disease control for controlling tungro disease. Insecticide control of this disease is not effective often it is because vectors move continuously to neighboring field and assist in spreading of disease within less time.

- Grow varieties resistant to tungro or vector of this disease. According to Pradhan & Khatri, Pokhareli masino rice variety was found more leaf hopper resistant than the rice cultivars which are grown popularly like Tauli, Taichung, Thapachini and Marsi [20].
- Coincide the date of planting with the other farm nearby. Planting lately than the normal time of transplanting will have to suffer from this disease.
- Planting time of rice seedling should be adjusted in such a way that the populations of vector of this disease are less in number.
- Remove the crop residue from the field as soon as possible and reduce source of inoculum of the disease also remove the eggs and sites where vectors breeds.
- Gyawali, reported the alternative host of tungro disease to be *Cyperus rotundas*, *Digitaria spp*, *Eleusine indica*, *Eleusine coracana*, *Paspalum spp*, *Cynodon dactylon*, *Commelina spp*. These alternative hosts nearby or in the field should be removed [21].
- Carbofuran is taken as one of the effective chemical for the control of rice tungro disease because of its rapid long lasting activity [22].
- Neem is found to work as anti-feedant and an insecticide when direct application of it in soil is done.

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