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Comparative estimation on the growth and yield components of tungro virus infected and healthy rice plants with different levels of resistance to virus and vector

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An estimation of yield loss in six rice cultivars having different susceptibility to rice tungro virus was made at maturity stage. Plants infected by both rice tungro bacilliform virus (RTBV) and rice tungro spherical virus (RTSV) showing typical tungro symptoms (leaf yellowing and stunting) were considered for comparison to yield and yield attributing characters between healthy and infected plants. Infected plants showed reduction in plant height, tiller number, panicle length, total grain number and number of filled grains in each panicle. Reduction of yield components varied with the varieties and no relationship was found among the yield attributing characters and the varieties. The highest reduction in plant height, tiller number, panicle length and total number of grains per panicle was found in IR 26, Balimau Putih & Utri Merah respectively. Cv. Utri Merah recorded the highest reduction of 33.86, 62.08 and 72.12 percent in plant height, total grain number and filled grain number per panicle respectively.

Key words : Rice tungro bacilliform virus (RTBV), Rice tungro spherical virus (RTSV), rice plant, resistance, yield

INTRODUCTION

Rice tungro virus (RTV) disease is one of such virus diseases that is widely prevalent in many states of India (Anjaneyulu *et al.*, 1994). Two viruses namely, Rice Tungro Bacilliform virus (RTBV) and Rice Tungro Spherical Virus (RTSV) are responsible for tungro disease and transmitted only by few species of leafhopper vectors. West Bengal is a major rice producing state of the country where incidence of RTV is becoming predominant, mostly in *kharif* rice (Tarafdar *et al.*, 1997). Severity and incidence of RTV is linked with the presence of susceptible variety, source of inoculum and efficient tungro transmitter.

An extensive research on various aspects of tungro disease have been made including characterization of viruses and biotechnological approaches to obtain virus-vector resistant plants (Jones *et al.*, 1991; Hibino *et al.*, 1987, 1990). Although in literature some information on the crop loss due to RTV are available but in most cases they are based on notional basis to present the countries report (Anjaneyulu, 1994; Chowdhury, 1997) and in few cases based on field experiments (Chowdhury & Mukhopadhyay, 1975; Rao & Anjaneyulu, 1980). Tungro is known to cause differential losses depending on the host resistance, involvement of tungro associated viruses, duration and onset of infection etc. (Teng *et al.*, 1989; Hasanuddin and Hibino, 1989).

A field experiment during *kharif* season was conducted using six rice varieties having different levels of resistance to RTV and its vector, rice green leaf hopper (GLH), *Nephotettix virescene* (Distant) and *N. nigropictus* (Stål) with the object to assess the RTV incidence and to estimate crop loss and yield attributing characters.

MATERIALS AND METHODS

Estimation of yield loss and yield attributing characters due to RTV infection has been made following the procedure followed by Nuque *et al.* (1988) and Teng *et al.* (1989). A field experiment

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was conducted in *kharif* season using six rice cultivars having different levels of susceptibility to RTV and its GLH vector. The varieties were IR26, IR62, IR64, IR68305-18-1, Utri Merah and Balimau Putih. The varieties were received from IRRI (International Rice Research Institute) as material for multilocational collaborative research on RTV. Thirty days old seedlings were transplanted in 8 x 8 m^2 size replicated plots with a plant to plant distance of 20 cm from all the sides. Seedlings were transplanted in third week of August and no plant protection measure was taken to encourage natural infection and spread of RTV by GLH vectors.

Fifteen tungro infected hills in a close proximity to healthy hills in three sites of individual varieties for each of the replication were marked after the appearance of typical tungro disease symptoms. The infected hills considered for evaluation of yield had typical yellow, yellow orange leaf colour with mild to severe stunting. Plant height, tiller number of infected plants as well as healthy plants were recorded and compared. Data on panicle length, number of filled grains and total grains per panicle, thousand grain weight and biomass were recorded for estimation of yield loss.

RESULTS AND DISCUSSION

Tungro virus infected plants showed a reduction in all the parameters related to yield. The variation was significant between the varieties in few of the parameters like, plant height, grain number per panicle, grain weight or volume of the biomass etc. In general tungro infected plants always had reduced number of tillers lower plant height, panicle length, number of grains per panicle and grain weight in relation to the healthy plants in each of the respective varieties (Table 1). The rate of reduction of plant height, tiller number, panicle number or other yield attributing characters were not uniform among the varieties. In respect to plant height cultivar (cv) IR 26 had maximum reduction (52.53%) while a minimum reduction (20.02%) found in cv. IR68305-18-1. Similarly the highest reduction of 67.89 percent in tiller number was observed in cv. Balimau Putih, with a minimum of 22.11 percent as observed in cv. IR62. Such differences among the varieties are due to the varietal characteristics which was also evident through the significant differences between the healthy plants.

Utri Merah and Balimau Putih are two Indonesian rice varieties which have different levels of resistance to RTV and its GLH vectors (Hibino *et al.*, 1990; Daquioag *et al.*, 1986) and are used as donar parents in tungro breeding programme. The advanced breeding line IR68305-18-1 has a parentage of IR64 but the infection of RTV was low. While cv. IR64 was found to be susceptible under the present locality of experimental areas (Chakdaha), a Gangetic new alluvial zone of West Bengal. In many areas IR64 has a greater preference by the farmers of West Bengal for its yield potentiality and tolerance to RTV. This variation on the disease incidence in different locations needs further confirmation to establish the existence of any virus strain. Cultivar IR62 has vector resistance with field resistance to tungro.

Detailed observations on the yield related parameters between healthy and infected plants of each of the varieties were made and in most of the parameters a significant variation was observed. Panicle and its associated characters like, number of total grains and filled grains per panicle or 1000 grain weight are all linked with the yield of the crop. A significant variation on such components have been observed between the cultivars as well as reduction on yield components among the healthy and infected plants. The highest reduction in panicle length, total grains and number of filled grains were respectively 33.86, 62.08 and 72.12 percent found in cv. Utri Merah.

Rice varieties differed in their yield potential as evident from the yield data obtained from the healthy plants. When the yield characters of the infective plants were compared in respective to their healthy plants a general reduction on yield components was recorded in all the test cultivars.

Besides rice varieties and tungro infection, yield of the crops depends on many other factors. Nuque *et al.* (1988) in IRRI and Hasanuddin & Hibino (1989) measured the yield of RTV infested hills and compared with the healthy hills. They also measured the tiller number, percentage of filled grains, 1000 grain weight, grain yield per hill and biomass and indicated that the yield loss due to virus infection varied depending on the symptom severity. Losses may ranged from 1.1 to 99.1% per hill. Besides the susceptibility of the varieties, yield loss also depends on the time of infestation. Usually plants infected within 1-3 week after transplanting showed the highest rate of yield reduction (Hasanuddin,1987).

In India, reports on the estimation of crop loss due to tungro virus infection are available (Chowdhury & Mukhopadhyay, 1975; John & Ghosh, 1981; Rao & Anjaneyulu, 1980; Gangwar *et al.*, 1986) and in most cases yield components such as height, tiller number, number of panicles per hill, number of grain per panicle

Table 1 : Influence of rice tungro virus infection on growth parameters and yield components of six rice varieties

Variety	Plant height (cm)		Tiller No./hill		Panicle length (cm)		No. of grains/ panicle		No. of filled grains/panicle		1000 grains weight (g)		Straw weight (g) (15 hills)	
	H	I	H	I	H	I	H	I	H	I	H	I	H	I
IR 26	74.43	35.33	29.23	10.38	22.50	17.33	146.15	72.0	126.15	44.10	20.19	17.75	679.50	305.75
	(52.53)		(64.48)		(22.97)		(50.73)		(65.04)		(12.08)		(55.0)	
IR 62	80.50	41.42	20.38	16.28	21.80	17.45	144.15	80.80	111.45	47.20	22.42	21.46	705.25	438.0
	(48.55)		(20.11)		(19.95)		(43.94)		(57.64)		(4.28)		(37.89)	
IR 64	85.81	54.28	28.50	11.40	23.36	18.33	121.35	63.10	103.90	36.0	24.63	22.50	891.75	363.50
	(36.74)		(60.0)		(21.53)		(48.0)		(65.35)		(8.64)		(59.23)	
IR 68305 -18-1	78.56	56.54	24.90	15.75	23.33	18.32	131.75	75.75	105.20	45.05	23.47	20.75	951.25	466.25
	(28.03)		(36.74)		(21.47)		(42.50)		(57.17)		(11.58)		(50.98)	
Utri Merah	156.86	105.18	21.38	13.35	30.36	20.08	255.05	96.70	225.15	62.75	19.86	17.72	1070.0	932.50
	(32.94)		(37.55)		(33.86)		(62.08)		(72.12)		(10.77)		(12.85)	
Balimau Putih	134.34	72.44	35.60	11.43	24.02	19.36	167.90	90.90	144.90	49.55	25.78	22.67	1457.50	1097.50
	(46.07)		(67.89)		(19.40)		(45.86)		(65.80)		(12.06)		(24.69)	
SEM	± 2.27	1.71	2.93	NS	1.66	NS	9.01	6.26	NS	3.97	0.85	0.86	93.25	72.16
C.D. at 0.05	6.83	5.14	8.83	-	5.01	-	27.15	18.86	-	11.97	2.55	2.58	281.02	217.46

Figures within the parentheses indicate percentage of reduction over healthy plants
H=Healthy plants; I=Infected plants.

etc. were compared with the infected and healthy plants of most popular, tolerant / resistant and susceptible varieties. In all cases, infested plants had lower yield which may extend up to 98.5 percent of highly susceptible varieties (Srinivasan, 1979).

In the present study, however, no relationship could be drawn on each of the components of growth and yield related characters of the individual varieties but obviously the results indicated to severity and importance of the disease.

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