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CURRENT SCENARIO OF RICE DISEASES IN KARNATAKA

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ABSTRACT
Rice (*Oryza sativa* L.) is the most extensively grown staple food crop in India. India is second leading rice producers in the world. Karnataka is the tenth major rice producing state in India. Production oriented survey was conducted during *Kharif* 2013, 2014 and 2015 in major rice growing areas of Karnataka to study the status of rice diseases and management measures followed. The survey revealed there is no significant increase in incidence of major diseases *viz*., blast, sheath blight, sheath rot, bacterial blight in geographical distribution. The disease severity has become static in endemic areas and increased in some areas due to cultivation of susceptible private varieties and hybrids, heavy application of fertilizers. The neck blast disease has become a menace to the farmers as there are no resistant varieties and also due to unseasonal rains. Minor diseases such as udbatta stem rot and false smut which was restricted to some pockets has spread to new areas. The survey revealed the emerging diseases in the future.

KEYWORDS: Rice, Production, Survey, Diseases, Geographical distribution, Management.

INTRODUCTION

Rice is one of the major staple foods in the world and a pillar for food security in many developing countries. Rice has occupied the central position in Indian agriculture with 24 % of gross cropped area of the country. It contributes 42 % of total food grain production and 45 % of total cereal production of the country. Karnataka is one of the major rice growing states in India. In Karnataka rice is grown under a variety of soils and wide range of rainfall and temperature. Around 44 % of the total acreage is under irrigation while the rest is under the regime of monsoon. In Karnataka rice is cultivated in an area of 13.43 lakh ha with a production of 39.53 lakh tonnes and productivity of 3.098 t/ha (2013-14). Rice production has been challenged by recent changes in crop production technologies that impact disease occurrence. Intensive crop management including heavy chemical fertilization, continuous flooding aggravates the disease problem further continuous monoculture of rice helps in perpetuation of pathogens from crop to crop. Presence of collateral hosts, infected seed and plant debris non adoption of clean cultivation are also important factors for the spread of diseases. Close planting coupled with high N dressing enhance the humidity of microclimate and create favorable environment for the disease spread. The loss in yield due to diseases varied depending on season, weather conditions and variety cultivation. The movement of plant pathogens into new agro ecosystems, pathogen evolution and increasing growing season temperatures has profound effects on expression of disease resistance. However, biotic stresses constantly threaten sustainable production of rice due to their dramatic impact on grain yield and quality. As a prerequisite for efficient and innovative control strategies, it is mandatory to improve the sharing of information among experts in a regional level and increase expertise capacities in epidemiology and disease diagnosis. In this paper the cropping pattern prevailed in the state, pest and disease incidence and management measures followed is discussed.

METHODOLOGY

Production oriented survey (POS) was conducted during Kharif 2013, 2014 and 2015 in rice growing regions of Karnataka to assess the production constraints in paddy production in the state. POS is a combination of eye ball method of survey. The survey was conducted twice in a crop season in major rice growing districs *viz*., Bellary, Davanagere, Hassan, Koppala, Mandya, Mysore and Shivamogga. The incidence/ severity of the diseases are collected from each district and the average incidence was calculated and further classified into different categories based on disease severity as given below (Table 1)

TABLE 1: Classification of disease into different categories based on disease severity

SL.No	Category	Intensity (%)
1	L	< 5
2	L-M	6-15
3	M	16-25
4	M-S	26-50
5	S	>50

L-Low; L-M-Lowto medium; M-Medium; N-S-Medium to Severe; S-Severe

RESULTS & DISCUSSION

The survey carried out during 2013-2015 reviewed the major production constraints in the state. The major cropping pattern of the state was rice-pulses, rice vegetables, rice-rice and rice-maize. The varieties grown in this region were usually local varieties like, Dodiga, Antarsali, and Kumud, Belgaum Basmati Hakkalasali *etc*. besides, high yielding vareties like Abhilash, Jaya, Intan, MTU-1001, MTU-1010, MGD-101 and SIRI-1253.The main varieties grown in these regions were BR-2655, Jaya, Thanu, MTU-1001, MTU-1010, IR-64, IR-30864, BPT 5204, Kaveri Sona ,Nallur Sona and Jyothi *etc*., The weed infestation was medium to low and the common weeds were *Echinochloa colona*, *E. crusgalli*, *Cyprus* sp., *Marsiliaqu adrifolia*, *Cynadon etc*., Zinc deficiency was commonly observed in all the areas of the state especialy in acidic soils. Farmers are using weedicides *viz*., pretilachlor or butachlor or oxyflurofen or benzsulfuron methyl@ 1.5 to 2.0 kg a.i./ha as a pre emergent for management of weeds. One or two hand weedings was common practice of the farmers in most of the surveyed area of the state. The most common insect pests were stem borer, case worm, Gundhi bug, BPH, gall midge and leaf folder. The farmers are using choloropyriphos (2 ml/l of water), monocrotophos (1 ml/l), Rogor (1 ml/l), cypermethrin (2 ml/l), trizophos (2 ml/lt), phorate10G (5-6 kg/ha) or carbofuran 3G (10-15 kg/ha) for management of above pests.

During the last few years, disease has gained considerable importance in rice growing areas due to climate change. The occurrence of rice disease and its severity varied every year. The diseases of rice observed across rice growing areas of Karnataka are blast, bacterial blight, sheath blight, sheath rot, udubatta, false smut and root knot disease. The severity of diseases under irrigated condition in command areas was comparatively higher than that of uplands and varied remarkably among different rice growing areas. The diseases observed across the area surveyed are blast, neck blast, sheath blight, sheath rot, udbatta and false smut. Rice blast caused by the fungus *Magnoporthe oryzae* (*Pyricularia oryzae*) is the most severe and widely distributed disease having significant economic importance in Karnataka (DRR, 1975-2014; Ou,1985) (Fig 1 and 3). The disease is especially more serious in irrigated belt and command areas of Mandya, Mysore, Shivamogga, Chickmaglur, Davangere and Kodagu districts of Karnataka. Blast disease manifests in three main inter-related phases *viz*., leaf blast, node blast and neck and panicle blast. Neck and panicle blast is more detrimental on rice yield. Yield loss upto 70% has been recorded due to neck and panicle blast (Chin 1975).

In 2013 and 2014 the leaf blast disease was severe (>50%) in Kharif season in variety MTU 1001 in cauvery command area where as in summer season Jaya variety was more affected. The disease severity was low to moderate with 5-15% in districts Shivamogga, Davangere, and Hassan while it was < 5% in Koppala and Belllary district (Table 2). In 2015 the leaf blast disease severity was low across all the areas.

There are many reasons for the outbreak and high severity of the disease. Changed Climatic conditions and cultivation practices like frequent and prolonged period of rain shower, large day–night temperature differences resulting in increased dew formation, high humidity, less sunshine hours, heavy application of nitrogenous fertilizer in the form of urea with very less or no application of potash fertilizer and compact planting have made the disease more aggressive and widespread. The neck blast is most destructive phase of the blast diseases which causes heavy yield losses has tremendously increased. Every year few cases of neck blast infection observed in susceptible varieties and hybrids due to rains during panicle initiation and grain filling stage. In the survey period (2013-2015) the varieties and the hybrids which were heavily infected by neck blast are briefly discussed.

In Kharif 2013 heavy neck blast incidence (>50%) was observed in KCP-1 variety in parts of Mandya district. During Kharif 2014 the neck blast incidence was high (>50%) in Jaya shree ram variety in Mysuru, Davanagere and Bellary districts. In summer 2015 Jaya variety showed low to moderate (6-15%) neck blast incidence across all the districts of cauvery command area. In Kharif 2015 heavy incidence of neck blast ranging 50-70% was recorded in hybrid PAC837 in late sown crop in Mysuru and Mandya districts. About 4000 ha in Mysuru and 1000 ha in Mandya district PAC 837 was severely affected with neck blast. The conditions like drizzling rain, continuous spell of cloudy weather, dew, fog, and high relative humidity during flowering and panicle initiation stage favour rapid buildup and heavy incidence of disease.

Sheath blight caused by the fungus *Rhizoctinia solani* Kuhn has become an upcoming major disease affecting production in India and also in Karnataka especially in coastal and humid regions (Fig 3).The yield loss has been reported ranging from negligible to 50% depending on the variety, management methods, environmental conditions and the stage at which the plants are infected and the level of infection (Lee and Rush, 1983). Crop intensification has increased the frequency of sheath blight incidence as it provides the host plants for the pathogen throught out the year. In general high nitrogen application , with very less use of FYM or other organic matter ,moderate temperature, high relative humidity, intermittent rains, close planting and partly shady conditions favour the development and spread of the disease. Above all most of the varieties are highly susceptible to the disease and none of the varieties are resistant to the disease. Across the years surveyed the disease was recorded in low to moderate form with disease severity ranging from 6-15% in all the areas surveyed. In poorly managed fields high intensity (>50%) of the disease was recorded in some private varieties and hybrids. During 2015, disease severity of > 60% was recorded in hybrid PAC 837 and Tata akshay in Mandya and Mysuru district.

The probable reasons may be changes in the unusual rainfall pattern leading to high humidity during maximum tillering to booting stage of the crop which is most susceptible stage to the disease. Brown spot of rice caused by the fungus *Helmithosporium oryzae* is still a more or the neglected disease of rice through it affects the crop in low to moderate form affecting large area of crop (Barwal *et al.,* 2013; Sunder *et al.,* 2014).

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TABLE 2. Prevalence and distribution of Paddy diseases in Karnataka (2013-15)

Districts	Disease	2013		2014		2015	
		Variety affected	Intensity (%)	Variety affected	Intensity	Variety /Hybrid affected	Intensity
Mandya	Blast	MTU1001	20-25	MTU1001	20-25	MTU1001	10-15
						PAC 837	26-50
	Neck Blast	MTU1001	20-25	MTU1001	20-25	MTU1001	20-25
		KCP-1	70-80			PAC 837 (S)	75-80
	Sheath blight	MTU1001	6-15	MTU1001	6-15	MTU1001	6-15
						PAC 837	50-60
	Brown spot	MTU1001	6-15	MTU1001	6-15	MTU1001	6-15
	Sheath rot	BPT 5204	26-50	MTU1001	<5	MTU1001	<5
	Minor disease Udbatta)	BR2655	<5	BR2655	<5%	BR2655	Nil
	Bacterial Blight		Nil		Nil		Nil
	False smut	TU1001	Traces	MTU1001	Traces	PAC 837	5
Mysusru	Blast	MTU1001	26-50	MTU1001	16-25	MTU1001	6-15
		Jyothi	26-50	Jyothi	16-25	Jyothi PAC	6-15
							26-50
	Neck Blast	MTU1001	6-15	MTU1001	6-15	MTU1001	20-25
				Jai shree Ram	60-70%	PAC 837	75-80
				Private variety			
		KCP-1	75-80	Jyothi	6-15	Jyothi	6-15
		Jyothi	6-15				
	Sheath blight	MTU1001	6-15	MTU1001	6-15	MTU1001	6-15
		Jyothi	6-15	Jyothi	6-15	PAC 837	16-25
						Jyothi	6-15
	Brown spot	MTU1001	6-15	MTU1001	6-15	MTU1001	6-15
		Jyothi	6-15	Jyothi	6-15	Jyothi	6-15
	Sheath rot	MTU1001	< 5	MTU1001	< 5	MTU1001	< 5
		Jyothi		Jyothi		Jyothi	
Minor	Udbatta	BR2655	< 5	BR2655	< 5	BR2655	Nil
Diseases		Jyothi	< 5	Jyothi	< 5	Jyothi	< 5
	Bacterial Blight		Nil		Nil		Nil
	False smut	MTU1001	Traces	MTU1001	Traces	PAC 837	< 5
		Jyothi		Jyothi		Jyothi	
Hassan	Blast	MTU1001	5-15	MTU1001	5-15	MTU1001	< 5
		IR-64	5-15	IR-64	<5	IR-64	< 5
		BR2655	Traces	BR2655	Nil	Br2655	Nil

	Neck blast	IR-64 BR2655	5-15 Traces	IR-64 BR2655	5-15 Traces	IR-64 BR2655	5-15 Traces
	Sheath blight	IR-64 BR2655	5-15 Traces	IR-64 BR2655	5-15 Traces	IR-64 BR2655	5-15 Traces
	Brown spot	IR-64 BR2655	Traces	IR-64 BR2655	Traces	IR-64 BR2655	Traces
	Sheath rot	IR-64 BR2655	Traces	IR-64 BR2655	Traces	IR-64 BR2655	Traces
Minor Diseases	Udbatta	IR-64 BR2655 Tunga	Traces 5-15 26-50	IR-64 BR2655	Traces <5	IR-64 BR2655	Traces
	Bacterial Blight		Nil		Nil		Nil
	False smut	IR-64	Traces	IR-64	Traces	IR-64	Traces
Shivamogga	Blast	Jyothi JGL1798 MTU1010	5-10	Jyothi JGL1798 MTU1010	5-10	Jyothi JGL1798 MTU1010	5-10
	Neck Blast	Jyothi JGL1798 MTU1010	5-10	Jyothi JGL1798 MTU1010	5-10	Jyothi JGL1798 MTU1010	5-10
	Sheath blight	Jyothi JGL1798 MTU1010	5-15	Jyothi JGL1798 MTU1010	5-15	Jyothi JGL1798 MTU1010	5-15
	Brown spot	Jyothi JGL1798 MTU1010	Traces	Jyothi JGL1798 MTU1010	Traces	Jyothi JGL1798 MTU1010	Traces
	Sheath rot	Jyothi JGL1798 MTU1010	Traces	Jyothi JGL1798 MTU1010	Traces	Jyothi JGL1798 MTU1010	Traces
Minor disease	Udbatta	Jyothi	5-15	Jyothi	5-15	Jyothi	5-15
	Bacterial Blight	JGL1798	5-15%	JGL1798	5-15	JGL1798	5-15
	False smut	Jyothi JGL1798 MTU1010	Traces	Jyothi JGL1798 MTU1010	Traces	Jyothi JGL1798 MTU1010	Traces
Davangere	Blast	JGL1798 Kaveri sona	5-10	JGL1798 Kaveri sona	5-10	JGL1798 Kaveri sona	5-10
	Neck Blast	JGL1798 Kaveri sona	5-10	JGL1798 Kaveri sona Jayashree Ram	5-10 50-60	JGL1798 Kaveri sona	5-10
	Sheath blight	JGL1798	5-15	JGL1798	5-15	JGL1798	5-15

	Brown spot	Kaveri sona JGL1798	Traces	Kaveri sona JGL1798	Traces	Kaveri sona JGL1798	Traces
	Sheath rot	Kaveri sona JGL1798	Traces	Kaveri sona JGL1798	Traces	Kaveri sona JGL1798	Traces
Minor disease	Udbatta	Kaveri sona JGL1798	Traces	Kaveri sona JGL1798	Traces	Kaveri sona JGL1798	Traces
	Bacterial Blight	Kaveri sona JGL1798	5-15%	Kaveri sona JGL1798	5-15%	Kaveri sona JGL1798	5-15%
	False smut	Kaveri sona JGL1798	Traces	Kaveri sona JGL1798	Traces	Kaveri sona JGL1798	Traces
		Kaveri sona		Kaveri sona Jai shree Ram (Pvt variety)	40-50	Kaveri sona	
Bellary	Blast	BPT5204	5-10	BPT5204	5-10	BPT5204	5-10
	Neck Blast	BPT5204	5-10	BPT5204	5-10	BPT5204	5-10
	Sheath blight	BPT5204	5-15	BPT5204	5-15	BPT5204	5-15
	Brown spot	BPT5204	Traces	BPT5204	Traces	BPT5204	Traces
	Sheath rot	BPT5204	Traces	BPT5204	Traces	BPT5204	Traces
Minor diseases	Udbatta	BPT5204	Traces	BPT5204	Traces	BPT5204	Traces
	Bacterial Blight	BPT5204	5-15%	BPT5204	5-15%	BPT5204	5-15%
	False smut	BPT5204	Traces	BPT5204	Traces	BPT5204	Traces
Koppala	Blast	BPT5204	5-10	BPT5204	5-10	BPT5204	5-10
	Neck Blast	BPT5204	5-10	BPT5204	5-10	BPT5204	5-10
	Sheath blight	BPT5204	5-15	BPT5204	5-15	BPT5204	5-15
	Brown spot	BPT5204	Traces	BPT5204	Traces	BPT5204	Traces
	Sheath rot	BPT5204	Traces	BPT5204	Traces	BPT5204	Traces
Minor diseases	Udbatta	BPT5204	Traces	BPT5204	Traces	BPT5204	Traces
	Bacterial Blight	BPT5204	5-15%	BPT5204	5-15%	BPT5204	5-15%
	False smut	BPT5204	Traces	BPT5204	Traces	BPT5204	Traces

FIGURE 1: Leaf Blast affected field

FIGURE 3: Sheath blight affected plant

FIGURE 2: Neck blast

FIGURE 4: Brown spot

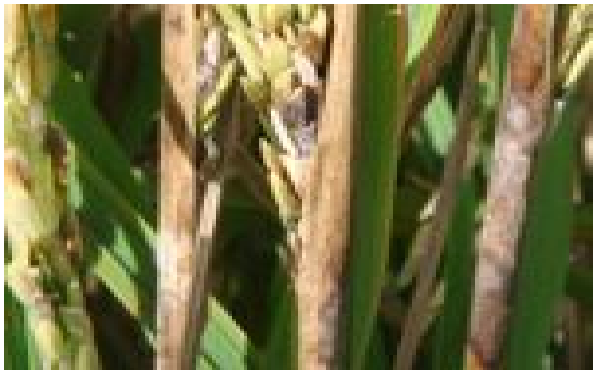

FIGURE 5: Sheath rot

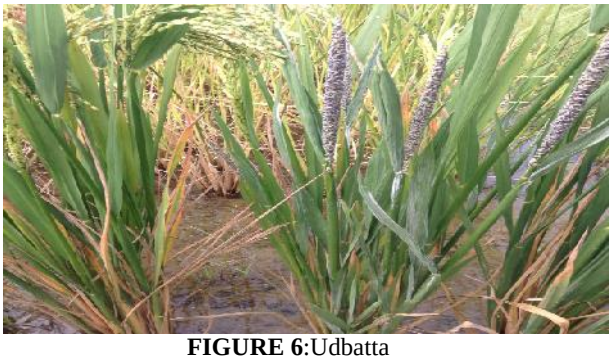

FIGURE 6:Udbatta

FIGURE 7: False smut of Paddy

FIGURE 8: Bacterial blight of paddy

FIGURE 1-8: Rice disease prevailing in Karnataka

The disease is a problem mainly in kharif season in uplands and hill ecosystem (Fig 4). However the disease can assume a serious proportion in irrigated ecosystem especially in ill managed fields. The disease is associated with the nutrition imbalances especially when the nitrogen application is less. In Karnataka the disease severity was low to moderate across all the areas surveyed. The disease has becoming more severe in hilly areas of Madakeri districtand in many villages of Krishna Raja Nagara taluk of Mysuru district of karnataka. Sheath rot disease of rice

caused by *Sarocladium Oryzae* is becoming an important disease in command areas. The main reason is due to growing of varieties which are not recommended as per the package of practices (Fig 5). The other reasons are delay in sowing and prevalence of condusive factors like moderate temperature, high humidity, cloudy days dew deposition, occasional rainfall during booting stage. The disease severity was low to moderate across all the areas surveyed. Heavy incidence of the disease was observed during 2013 in Maddur taluk of Mandya district in variety BPT 5204. In 2015 the disease was ranged from 30-40% in hybrid PAC 837 in Mandya and Mysuru district. Bacterial Blight caused by *Xanthomonas oryzae* pv *oryzae* (Ishiyama) Swings *et al* is one of the major production costraint especially in irrigated and lowland ecosystem(Fig8). In Karnataka the disease severity was low to moderate (6-15%) in Tungabhadra command area covering Shivamogga, Davangere, Koppala, Bellary and Raichur district in BPT 5204 and sona varieties. Yield loss due to the disease has been reported to vary between 2.7-89.8% in India (Manibhushan Rao, 1996) with an average yield loss of 14.5 %(Ou, 1985). False smut of rice caused by *Ustilaionoidea virens* (cooke) takahashi (teleomorph: *Villosiclava virens* (Nakata) Tanaka and Tanaka] once condidered as a minor and sporadic disease of rice has emerged as a serious problem especially on high yielding and hybrid rice varieties in many rice growing areas (Fig7). In India the disease has been reported from all the rice growing states (Ladhalakshmi *et al*., 2012). However, the disease has become a serious problem in different rice ecosystem due to widespread cultivation of high yielding varieties and hybrids, heavy use of chemical fertilizers and changes in the climatic parameters. The yield losses in different states of India have been estimated to vary between 0.2-49% depending on disease intensity and rice varieties (Dodan and Ramsingh, 1996). Late maturing varieties show greater incidence of the disease than the varieties that flower and set grains early. Yield loss is not only due to the occurrence of the smutted balls but also due to increased sterility of kernels neighbouring the smut balls. In Karnataka the disease intensity was low (<5%) across the years and the places surveyed excepting in private hybrids. In 2014 in some private hybrid Jai shree ram with disease severity of 15-20% in many fields of Mysuru (KR Nagar Taluk), Honnali (Davanagere district). In 2015 the disease incidence of 5-10% was observed in PAC 837 Hybrid in H.D Kote taluk of Mysuru district. Across all the areas surveyed the disease was observed mainly in private varieties and hybrids.

Minor Diseases

A few rice diseases are still sporadic in their occurrence and remain minor in their economic importance as the intensity of these diseases has not significantly changed with time. Udbatta disease of rice caused by *Ephelis oryzae* (teleomorph: *Balansia oryzae*) has been reported to occur sporadically in Karnataka and Maharashtra in low to moderate intensities. Udbatta disease was first described by Sydow (1914) from India. Udbatta disease causes significant yield losses in areas where it is endemic, but its occurrence is generally sporadic and of minor importance (Fig6). In recent years the disease has gained importance as many varieties *viz*., MTU 1001, Jyothi, Uma, Tunga and BR2655 have become susceptible to the disease. The disease incidence was recorded upto 50% on Tunga variety in Sakleshpura area of Hassan district. In some fields of Mandya, Mysuru, Hassan and Shivamogga incidence was low to moderate (6-15%) in BR2655 Jyothi and MTU 1001. In a plant if the disease occurs the entire panicle will be infected and infection in even a single panicle results in 100% loss. (Sanengowda and KT Pandurangegowda, 1986). Leaf scald of rice caused by *Microdochium oryzae* (teleomorph: monographella albcens) occurs in low to moderate intensity in hilly region. The disease was recorded in certain pockets of Karnataka especially in Kodagu and Dakshina Kannada during 80s and early 90s. However, the disease is presently not very common in Karnataka. Narrow brown leaf spot caused by C*ercospora janceana* (teleomorph: *Sphaerulina oryzina*) is generally visible on plants approaching grain filling stage. The disease is noticed sporadically present in some fields across all the areas. Stem rot of Rice caused by the fungus *Magnoporthe Salvinii* (Catt) Krause and Webster has been reported in severe form in some places of Tunga bhadra command area covering distrcits Koppala, Raichur and Bellary districts. However 2014 and 2015 low incidence of disease was observed in Mandya district in summer season. Rice Root knot disease caused by *Meloidogyne graminicola* is a serious problem in the nurseries and upland rice but has been recently found to be widespread in the deep water and irrigated rice. Average yield loss due to *M. graminicola* has been estimated to be 20% in upland rice in severe cases the loss may go up to 50%.

Management measures followed varied among the different areas and also the technology adoption. During survey it was noticed in cauvery command area about 11 percent of the farmers have awareness and following seed treatment. In Tungabhadra command area about 50% of the farmers are following seed treatment. The farmers are treating the seed with carbendazim @ 4g/kg of seeds across all the places surveyed. The farmers are applying heavy dose of nitrogenous fertilizer in urea form in command areas. In Tungabhadra command area it is 6-7 times more than the recommended where as in cauvery command area it is 3-4 times. The management practices are being taken in systematic way in Shivamogga and Chickmaglur distrcict using the recommended dose of the pesticides. In Mysuru, Mandya district farmers are now picking up and adopting he management measure but the adoption rate is low especially with respect to neck blast . None of the farmers are taking up prophylactic spray before disease incidence or at the time of 5-50% flowering.

In districts *viz.*, Davangere, Bellary and Koppala districts farmers are using huge quantity of pesticides for management of diseases which increases cost of production and poses environmental problems. The farmers are taking 6-8 sprays using at least 24 pesticides during cropping period. They do tank mix of 3 pesticides at a time. Any new pesticide (with or without approval) will be first tested in these two areas. If the results are good in controlling disease farmers continue to use. In this area rice farmers use chemicals alone for the control of

these diseases which led to deterioration of soil health, besides polluting water and environment.

Farmers are using fungicides *viz.*, Indofil M-45 (0.25%) or Carbendazim (0.1%) or Saaf (0.2%) or Hexaconazole (0.1%), Propiconazole (0.1%), Ibpropenophos (0.1%), Isoprothiolane (0.1%), Tricyclozole (0.06%), Nativo (0.05%) for the management of diseases prevailed in the state. Farmers in cauvery command area are using less pesticides compare to tungabhadra and Krishna command areas

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REFERENCES

Barnwal, M.K., Kotasthane, A., Magculia, N., Mukherjee, P.K., Savary, S., Sharma, A.K., Singh, H.B., Singh, U.S., Sparks, A.H., Variar, M. and Zaidi, N. (2013) A review on crop losses, epidemiology and disease management of rise brown spot to identify research priorities and knowledge gaps. *European journal of Plant Pathology* 136:443-457

Chin, K.M. (1975) Fungicidal control of the rice blast disease. *Malaysian Agricultural journal* 50(2): 221-228.

Dodan, D.S and Ram Singh (1996) False smut of rice: Present Status, *Agriculture Reviews* 17:227-240.

DRR (1975-2014) Annual progress Report, crop protection (Entomology and Pathology) Vol. 2 All India coordinated rice Improvement project (ICAR), directorate of Rice Research, Rajendranagar, hyderabad-500030, Andhra Pradesh, India.

Ladhalakshmi, D., Laha, G.S., Ram Singh, Krishnaveni, D., Srinivas Prasad, M., Mangrauthia, S.K., Prakasam, V., Yugander, A. and Viraktamath, B.C. (2012) False smut –A Threatening Disease of Rice. Technical Bulletin No. 63. Indian institute of Rice Research (ICAR), Rajendranagar, Hyderabad -500030, India, 32 pp.

Lee, F.N. and Rush, M.C. (1983) Rice sheath blight: a major rice disease. Plant disease 67:829-832.

Manibhushan Rao, K. (1996) Sheath rot Disease of Rice Daya Publishing House Delhi, 71pp.

Ou, S.H. (1985) Rice Diseases. 2nd Edition, commonwealth mycological institute, kew, surrey, england, 380 pp.

Sannegowda, S., Pandurangegowda, K.T. (1986) Studies on mode of infection and chemical control of udbatta or agarbatti disease of rice. Pesticides, 20(9):22-23.

Sunder, S., Ram Singh and Agarwal, R. (2014) Brown spot of rice: an overview. Indian phytopathlogy 67: 201-215.

Sydow, H. (1914) Beitrage zur Kenntnis der Pilzflora des Sudlichen Ostindiens. II. Annales mycologici, Berlin, 12:484-490.