Chapter – 5
SUMMARY AND CONCLUSION
Sheath blight disease, caused by the fungus *Rhizoctonia solani* Kuhn [Teleomorph – *Thanatephorus cucumeris* (A.B Frank) Donk] is prevalent on almost all the high yielding varieties of rice (*Oryza sativa* L.) grown in India. The disease is usually more common during rainy season than in the dry season. It is now one of the major fungal diseases occurring in western Odisha. Considering the magnitude of the disease and its resultant losses, investigations were undertaken to know the present status of the disease as well as to find out appropriate management programme against the disease taking account of various aspects of disease management viz. host plant resistance, cultural, biological and chemical control as well as their need based combinations to make it economically and ecologically viable for the farmers of western Odisha.

Summary and conclusion of the investigations are presented as follows:

1. Data on the present status of the disease in different districts of the region are scanty for which a survey was conducted to know the occurrence and severity of the disease in three rice growing districts of western Odisha viz, Sambalpur, Bargarh and Jharsuguda. The survey revealed the presence of sheath blight in all the high yielding rice varieties grown by the farmers. The predominant variety Swarna was found susceptible to the disease. Among the three districts surveyed, maximum disease severity was recorded from Bargarh district with a mean disease severity of 30.19% followed by 25.22% mean disease severity in Sambalpur district. The farmers of Bargarh district used highest dose of nitrogenous fertilizers, far above the recommended level which might led to highest disease severity. The least disease severity percentage was observed in Jharsuguda district recording 21.98% mean disease severity which might be attributed to balanced fertilization especially of nitrogenous fertilizers by the farmers of the district. This study serves as a basis to evaluate location specific management strategy against sheath blight disease, which is still unidentifiable by most of the farmers of the region.

2. Need was felt for thorough understanding on the weather parameters of the region to study the weather relationship of the disease so as to predict, forecast and plan for effective protection measures. Mean weather parameters like maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, total rainfall, daily sunshine hours and daily wind speed were collected at weekly interval and progress of the disease was measured in terms of Cumulative Increase in Percent Disease Index (CIPDI) and Periodical Increment in Percent Disease Index (PIPDI). During both the years of experiment, disease
development and spread was observed from 37th to 45th Standard Meteorological Week (SMW). Out of seven weather parameters considered for studying their influence on the increment of disease severity, three parameters namely rainfall, evening relative humidity and minimum temperature were identified as critical parameters through multiple regression analysis and had their positive or negative contributions towards the PDI increment. Both rainfall and minimum temperature had negative correlations with CIPDI and PIPDI where as evening relative humidity had positive correlation with both of them. A heavy rainfall was found conducive for initiation of the disease followed by low and intermittent rainfall of 13 to 38 mm, which was favourable for progression of the disease. A maximum temperature range of 31°C to 34°C, minimum temperature range of 17°C to 23°C with 70% to 83% evening relative humidity were found favourable for disease development and spread.

3. Host plant resistance is the main basis for eco friendly bio intensive disease management. Resistant cultivars are the most durable, economical and practical means of tackling the disease problems being compatible with all other components of disease control. Till date very few sheath blight resistant varieties are available to the farmers. The main constraint in sheath blight resistance breeding is the lack of good donor lines. In view to this, Thirty four donor entries were screened against sheath blight pathogen, *Rhizoctonia solani* after artificial inoculation under field condition. Among them, three donor entries DRR- BL-257-2, DRR-BL-295-1 and DRR-BL-295-2 showed good results consecutively for two years of screening and were considered to be moderately resistant to the disease. Five donor lines were graded as moderately susceptible, nine lines exhibited susceptible reactions to the disease while 17 donor lines were graded as highly susceptible to the disease. None of the lines screened was found highly resistant or immune to *Rhizoctonia Solani*. The seeds of the three donor lines identified as moderately resistant will be helpful in resistant breeding programme.

4. Twenty one popular varieties of the zone including a number of check varieties were screened against sheath blight both under field and laboratory conditions after artificial inoculation. Out of twenty one varieties screened against sheath blight, three varieties namely Tejaswini, Pratikshya and Mrunalini were categorized as moderately resistant. Six varieties were found moderately susceptible, seven as susceptible and five varieties were designated as highly susceptible to sheath blight. None of the entry was found immune or resistant to the disease. These
twenty one varieties were screened under laboratory conditions also following detached leaf assay (Vijay et al., 2011). The three varieties (Tejaswini, Pratikshya and Mrunalini) graded as moderately resistant in field screening gave good result under *in vitro* conditions also confirming them as moderately resistant to sheath blight. Eight varieties were found highly susceptible to the disease where as majority of the varieties were either moderately susceptible or susceptible to sheath blight. The three varieties which were found moderately resistant to the disease both *in vitro* and *in vivo* conditions will be beneficial to the farmers in sheath blight endemic areas to reduce the extent of crop damage as well as yield loss.

5. Experiment was conducted to find out the effect of sowing dates on sheath blight disease severity. Two most popular varieties of western Odisha, MTU 7029 and MTU 1001 were selected for the study. The Crop was directly sown at 15 days interval as early (30th June), mid (15th July) and late (30th July) crop. Percent disease severity was found highest in case of early sown crop of MTU 7029 (39.85% and 28.05% during 2013 and 2014 respectively) and lowest in mid sown crop of MTU 1001 (12.90 % and 7.80% during 2013 and 2014 respectively). It was clear from the result that both disease severity and rate of spread of the disease were maximum in case of early sown crop and minimum in mid sown crop. The same trend was observed in case of both the varieties. Therefore in areas which are prone to sheath blight infection early sowing of rice crop should be avoided and mid sowing i.e. sowing during mid July (preferably at 15th July) is recommended to escape the disease.

6. Application of nitrogenous fertilizers in higher doses has been intensified in India which has altogether changed the disease scenario on rice and occurrence of sheath blight in severe form is being reported from various rice growing areas. Keeping this in view, field experiment was conducted to assess the effect of nitrogen application, fungicidal sprays and varietal resistance on sheath blight disease severity and yield of rice. The treatment consisted of two varieties, susceptible variety Swarna and moderately resistant variety Pratikshya. Phosphorus and potash were applied as per local recommendations where as nitrogen was applied at 100% of recommended dose and at two-third of recommended dose. There was a progressive increase of sheath blight disease severity with full doses of nitrogen as compared to the application of two-third of the recommended dose in the susceptible variety. The best result was observed in the treatment having susceptible variety with 3 sprays of hexaconazole @ 2ml/l at two-third nitrogen
level during both the years of experiment recording 85.76% disease control over check plots. The same treatment also gave good yield (40 q/ha) which was at par with the highest yield of 40.7 q/ha recorded in the treatment with 100% recommended nitrogen. Though there were significant differences in sheath blight severity at varied nitrogen levels irrespective of fungicidal treatments in the susceptible variety, the resistant variety with 100% recommended nitrogen showed constantly low disease severity throughout the experiment and is a better option in sheath blight endemic areas.

7. Considering the environmental safety, biological control is the most feasible method of disease control. For this, field experiment was conducted to assess the effectiveness of different bio control agents and their application method against sheath blight disease. The bio control agents were applied as seed treatment and in combination of seed treatment and foliar spray and were also compared with standard chemicals. The percent disease index (PDI) as well as the growth parameters of individual treatments were recorded. The yield of the crop in q/ha as well as 1000 grain weight were also worked out. The result revealed that all the treatments reduced the disease significantly as compared to untreated control. Among the treatments with bio control agents, seed treatment + 3 spraying with *Trichoderma viride* @ 1% performed best with a pooled PDI of 10.93% followed by seed treatment + 3 spraying with *Pseudomonas fluorescens* @ 1% recording a pooled PDI of 18.71%. Maximum increase in plant height, panicle length, panicle number as well as 1000 grain weight was also recorded from the same treatment as compared to control. The bio control treatment will be easy to apply in the field by the farmers without any residual toxicity to either soil or plant and further it will promote plant vigour and thus increasing the yield of the rice crop.

8. Till date, chemical control is the only means to combat sheath blight disease to achieve full yield potential of rice crop but continuous use of same chemical year after year may develop resistance in the pathogen. Therefore evaluation of new and effective fungicides should be a continuous process to mitigate the situation of resistance and resurgence in the pathogen. In view to the above facts, a number of new and commercially available fungicides were evaluated against sheath blight disease of rice. The experiment was conducted both under laboratory and field conditions with seven treatments and three replications. Under *in vitro* condition, the fungicides were tested following poisoned food technique and (trifloxystrobin + tebuconazole) was found superior among all the fungicides tested showing 100
% inhibition of mycelial growth of *Rhizoctonia solani* at 200 ppm. It also recorded the lowest ED$_{50}$ value of 3.19 µg/ml. Under field condition, the experiment was laid out in RBD with a susceptible variety Swarna. The pooled data of field trial indicated that, all the fungicides were effective in controlling the disease as compared to control but 3 spraying with (trifloxystrobin + tebuconazole) @ 0.4 g/l at 15 days interval resulted lowest sheath blight disease severity (5.0% PDI) as compared to control plots (41.85% PDI) and was at par with the standard fungicide propiconazole @ 1ml/l (6.11 % PDI). The same treatment also recorded a highest pooled yield of 51.9 q/ha and proved best among all the fungicides tested. No phytotoxicity symptom was recorded within seven days of each spray of the fungicide and therefore the fungicide is considered as safe for use in rice crop.

9. Utilizing the various aspects of sheath blight management in rice, a disease management trial was conducted for its efficacy in the field. The experiment was laid out in split plot design and three rice varieties (Swarna, Pratikshya and Ajay) were considered as main plot treatments and two management levels were maintained in the sub plots. The result indicated that, with proper management practices disease severity differed significantly within all the varieties. After application of management practices, the susceptible variety Swarna recorded highest reduction in disease severity (75% reduction over control) with 29.4% yield increase over control. Among the varieties, moderately resistant variety Pratikshya recorded least disease severity (3.89% PDI) which was at par with hybrid variety Ajay (5.7% PDI) in management plots though highest yield was obtained from hybrid variety Ajay (45.2 q/ha). So, incorporation of different management practices comprising all the available control methods produced less disease as well as better yield. This could be possible because each method compensated the deficiencies of others. Therefore feasible integration and timely application of different methods of disease control will help to ensure successful plant protection.