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Glume Discolouration of Rice: Symptoms, Causes and Integrated Management

*K. M. Patel, A. T. Patel and T. R. Darji
Department of Entomology, NMCA, NAU, Navsari, Gujarat, India
Corresponding Author's email: kapilpatel@nau.in

Glume or grain discolouration is a complex disorder of rice in which the husk, grain, or both develop abnormal brown, black, or other coloured spots and patches. Several fungi and bacteria have been associated with affected seed, while weather, crop nutrition, grain-filling conditions and insect or mite injury may influence symptom development. The disorder can reduce grain appearance, seed weight, germination and market quality; severe losses have been reported in affected situations. Management should therefore combine healthy seed, suitable varieties, balanced fertilizer use, appropriate crop spacing, field sanitation, biological options and need-based plant-protection measures. Correct identification of the causal organism is important because similar symptoms can arise from different causes. The measures described here are drawn from published studies summarized in the seminar material and should be adapted to local recommendations and current pesticide labels.

Introduction

Rice (*Oryza sativa* L.) is a staple food for billions of people, particularly in Asia. It is grown across diverse agro-ecological regions of India. Historical estimates cited in the seminar material reported rice cultivation on 43.19 million hectares in India, with production of 117.47 million tonnes in 2019, while Gujarat was reported to have 0.84 million hectares under rice and production of 1.93 million tonnes in 2017 (Anonymous, 2017, 2019). These are historical figures, not current production estimates. Rice is affected by numerous diseases at different growth stages. Glume or grain discolouration is an important seed- and grain-quality problem associated with several microorganisms. It refers to a change from the normal colour of mature grains and may create difficulties for seed certification and marketing. In severe cases, the disorder has been associated with poor grain filling, reduced grain weight, sterile or unfilled spikelets, lower seed germination and substantial yield loss (Trung et al., 1993; Khamari, 2020). Since multiple organisms and environmental factors may be involved, management begins with careful diagnosis and an integrated approach.

Symptoms and factors associated with discolouration

Symptoms may appear on the outer glumes, within the kernel, or on both. They range from scattered spots to extensive darkening of the spikelets or panicle. Brown or black spots, stripes, rotten glumes, lightweight panicles, poorly filled grains and sterile spikelets are among the symptoms described in the seminar presentation. Grain size, shape, test weight and germination may also be affected. The condition is not always attributable to a single pathogen. Fungi reported in association with discoloured rice include *Sarocladium oryzae*, *Fusarium* spp., *Alternaria* spp., *Curvularia lunata*, *Bipolaris oryzae*, *Aspergillus* spp. and *Penicillium* spp. Bacterial organisms have also been reported, including *Burkholderia glumae* and species of *Pseudomonas* and *Xanthomonas* (Ashfaq et al., 2017; Khamari, 2020). The organisms recovered can differ with location, seed source, harvest conditions and storage. High humidity, excess moisture, high temperature, rainfall around maturity, nutrient imbalance, incomplete pollination or fertilization, and conditions during panicle emergence and grain filling may

influence symptom development. Insect and mite injury can also contribute to grain damage or interact with disease. Therefore, discolouration should be treated as a symptom complex requiring diagnosis rather than automatically assumed to be a single fungal disease.

Evidence-based management options

1. Resistant varieties and suitable crop practices

Host-plant resistance is a useful first line of defence. Studies summarized in the seminar reported lower discolouration in the rice variety Masuri, with 1.94% discoloured grains and 0.58% unfilled grains (Gajre and Chauhan, 2016). Genotypes IET-24486, IET-25654 and IET-25676 were reported as consistently resistant in a screening of rice germplasm (Gangwar et al., 2019). NWGR-11048 and NWGR-12016 were also reported as resistant under natural field conditions in the cited Agresco report. These results should be checked against local varietal recommendations and current performance data before selecting a variety. Appropriate spacing can help create a crop canopy that is less favourable for disease development. A study summarized in the seminar material reported 18.06% disease severity and a yield of 4.648 t/ha at a spacing of 20 × 15 cm in the study summarized in the seminar. The same study reported that a moderate nitrogen dose of 60 kg/ha reduced disease severity to 19.06% and produced 5.17 t/ha. These are study-specific results, not universal fertilizer or spacing prescriptions; farmers should follow soil-test results and region-specific agronomic recommendations. Avoiding excessive nitrogen and maintaining balanced crop nutrition are prudent general practices.

2. Seed health and biological management

Using clean, healthy seed and avoiding seed from heavily affected panicles can help reduce the movement of seed-associated organisms. Seed treatment with thiram 75% wettable powder at 2 g/kg was reported to produce 92.20% germination in a study involving *S. oryzae* (Gajre et al., 2016). Any seed-treatment product should be used only where currently registered and according to its label. Biological control offers a complementary approach. In laboratory studies summarized in the seminar, *Trichoderma harzianum* inhibited mycelial growth of *C. lunata* by 90%, while a strain of *T. viride* inhibited *F. moniliforme* by 65% (Debadatta et al., 2020). Another study reported 80.86% inhibition of *S. oryzae* by *T. viride* after 10 days of incubation (Gajre and Chauhan, 2016). Such laboratory results indicate potential, but field performance may vary with strain, formulation, weather and application method. Neem leaf extract was also reported to inhibit mycelial growth, with 53.10% inhibition in one study (Gajre and Chauhan, 2018a). Botanical and microbial products should be selected from reliable sources and used in accordance with approved recommendations.

3. Need-based fungicide use and integrated management

Published studies summarized in the seminar reported reduced discolouration following fungicide treatments, including combinations of trifloxystrobin and tebuconazole, azoxystrobin, carbendazim, propiconazole, thiophanate-methyl, copper hydroxide, and carbendazim plus mancozeb (Balgude and Gaikwad, 2016a; Surendran et al., 2019; Patil et al., 2020). The results are specific to the studies, organisms, formulations and application conditions reported. They should not be interpreted as a blanket recommendation to apply every listed product. Before choosing a fungicide, confirm the likely cause and consult current local agricultural recommendations. Use only products registered for the crop and target problem, follow the current label for dose, timing, protective equipment and pre-harvest interval, and rotate modes of action where appropriate to help manage resistance. Do not mix products unless compatibility and label directions support it. An integrated programme reported by Balgude and Gaikwad (2016b) combined seed treatment with benomyl and *Pseudomonas fluorescens*, rice-husk ash in raised beds, rice straw application at transplanting and three propiconazole sprays. Because registrations and recommended practices can change, this historical programme should be treated as evidence from a published study rather than a ready-to-use prescription. The general principle is to combine clean seed, resistant varieties, balanced crop management, monitoring and carefully selected biological or chemical measures.

4. Managing the sheath mite and associated disorders

The seminar also highlighted the sheath mite *Steneotarsonemus spinki* Smiley. Feeding in the flag-leaf sheath may cause brown discolouration, while infestation around panicle development can be associated with chaffy, poorly filled or discoloured grains and sterility. The seminar cited studies in which combined management of mites and sheath-rot-associated disease reduced discoloured grains (Gajre, 2012; Shankar et al., 2019). Because mite injury and microbial disease can occur together, inspect the sheath and panicle and seek a diagnosis before selecting a treatment. Older acaricide recommendations in the source material should not be followed unless the product is currently registered and recommended for the specific use.

Practical field checklist

Select locally recommended varieties with documented tolerance or resistance where available. Use healthy seed and avoid retaining seed from severely discoloured panicles. Maintain recommended spacing and balanced fertilizer application based on local advice and soil conditions. Monitor panicles and flag-leaf sheaths, especially around flowering, grain filling and maturity. Separate and examine affected grains; obtain diagnostic support where the cause is uncertain. Use biological products or fungicides only when suitable for the identified problem and permitted by current labels. Harvest at the recommended stage and dry/store grain properly to limit further deterioration.

Future needs

Further work is needed to identify the principal causal organisms in different rice-growing regions, understand how weather and crop practices affect disease development, and validate integrated management under field conditions. Wider screening of rice germplasm, development of stable resistant lines and identification of useful DNA markers were highlighted as research priorities in the seminar. Practical recommendations should be based on recent, location-specific trials and updated registration information.

Conclusion

Glume discolouration is a complex rice grain-quality problem linked with microorganisms and influenced by crop and environmental conditions. Its effects may include darkened glumes, poor grain filling, lower seed weight and reduced germination. No single measure is likely to be equally effective in every situation. The most dependable approach is to use healthy seed and suitable varieties, maintain balanced crop nutrition and recommended spacing, monitor for disease and sheath-mite injury, and use biological or chemical treatments only when diagnosis and current recommendations justify them. Accurate identification of the cause, combined with locally validated integrated management, is essential for protecting both rice yield and grain quality.

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