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## PHYSIOLOGICAL BLOCKS UNDERLYING DORMANCY OF RICE

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THOUGH dormancy in rice had been described earlier[1,2] the underlying mechanism remains elusive. Specifically, the presence of rudimentary and physiologically immature embryo[3], germination inhibitors[4] and supra-optimal level of IAA[5] has been implicated. Removal or puncture of seed covering structures in rice was reported to improve the germination[6–9]. Recently, Lascorz and Drapron[10] demonstrated in dormant oats that the hulls generally considered as dead tissue are enzymatically active. In the present studies, the possible involvement of hulls and embryo in controlling the dormancy of rice has been elucidated.

Freshly harvested seeds of superfine variety (Basmati-370) were collected on 25 November 1986 immediately after harvest from the Ludhiana and Ropar Farms of the University. The seeds were dried to a moisture level of 12% before storing in cloth bags under ambient conditions. The germinability of the two lots was recorded at 15 day interval in the dark at 25±1°C (petri dishes 10 cm in diameter, 25 caryopses per dish) with four replications. Interestingly, after 75 days of harvesting, the seed lot from Ludhiana became non-dormant (88% germination) while the seed lot from Ropar remained dormant (20% germination). These non-dormant and dormant seeds were studied to understand the mechanism of dormancy. The hulls from the seeds were removed using fine tweezers. The peroxidase activity in the hulls was measured[11] and α-amylase activity was estimated[12].

Germination was studied in hulled (with lemma-palea), dehulled (without lemma-palea) dormant and non-dormant caryopses. In the dormant caryopses, a large difference in germination was observed between dehulled (70%) and hulled (20%) grains. Contrary to this, the difference in germination of non-dormant hulled and dehulled caryopses was very little (88% and 100%) respectively. These differences indicate a dormancy block in the hulls, which probably kept the embryo in hypoxic state and prevented germination. This block is perhaps removed during the dry post maturation period or by dormancy breaking treatments[13].

A high hull peroxidase activity was observed in the dormant caryopses whereas in the non-dormant caryopses, the hull peroxidase activity was feeble (table 1). Considering the findings of Lascorz and Drapron[10], the hulls in rice appear to absorb oxygen due to enzymatic activity and devoid of the embryo of oxygen. Kuo[14] reported high peroxidase activity in hulls of dormant rice caryopses and speculated its role in α-oxidation of fatty acids. Sircar[5] speculated that probably the supra-optimal level of IAA is responsible for the dormancy in rice. Due to high oxidative activity in hulls, the high level of IAA in the embryo does not get oxidized due to non-availability of oxygen.

Presoaking of seeds in water for 24 h did not improve germination nor it had any effect on hull peroxidase activity. Contrary to earlier results[15], the dormancy inhibitor in the present studies was not leachable by water. Presoaking of rice caryopses in $GA_3$ (500 μg/ml) and $KNO_3$ (0.2%) for 24 h completely removed dormancy and resulted in significant reduction in peroxidase activity in hulls (table 1).

**Table 1** *Germination, peroxidase and α-amylase activities in dormant and non-dormant rice caryopses*

| Treatment | Germination % | | Peroxidase activity in hulls $10^{-3}$ A units $min^{-1}$ | | α-amylase activity μg starch hydrolysed grain$^{-1}$ 10 min$^{-1}$ | |
|---|---|---|---|---|---|---|
| | ND | D | ND | D | ND | D |
| Hulled caryopses | 88 | 20 | 10 | 40 | 35.83 | 7.17 |
| Dehulled caryopses | 100 | 70 | – | – | – | – |
| Water soaking 24 h | 98 | 35 | 1 | 38 | 27.50 | 7.17 |
| $GA_3$ soaking 24h (500 μg/ml) | 98 | 92 | 1 | 5 | 28.60 | 28.60 |
| $KNO_3$ soaking 24 h (0 2%) | 98 | 82 | 1 | 8 | 30.70 | 26.50 |

ND – Non-dormant; D – Dormant.

In addition to the above mentioned major block of dormancy, a second block appeared to be localized in the embryo. The dehulled dormant and non-dormant caryopses showed difference in speed ot germination (17.0 and 26.6 respectively). The difference was narrow because dehulling itself removed the major block of dormancy[6–9]. The inhibitor and promotor ratio in the seeds is well-documented in many species. As shown in other species[16] and in rice[5], the higher level of IAA in the embryo (responsible for dormancy) gets oxidized with the available oxygen and thus breaking the dormancy.

The $\alpha$-amylase activity substantiated this fact in rice. The amylolytic activity of water-soaked dormant caryopses was very low as compared to the $GA_3$ and $KNO_3$, soaked dormant caryopses. In the non-dormant seeds, the soaking treatments (water, $GA_3$ and $KNO_3$) as well as unsoaked seeds showed high activity of $\alpha$-amylase (table 1). With the reduction in the level of IAA, it is very likely that $GA_3$ promoted germination by enhancing the $\alpha$-amylase activity.

It is likely that endogenous $GA_3$ and IAA levels are responsible for dormancy in rice. With the reduction in IAA level, by high activity of oxidases with available oxygen, $GA_3$ enhanced $\alpha$-amylase activity. Experiments to determine endogenous level of the hormones are in progress.

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## HETEROTROPHIC NITRIFICATION BY *FUSARIUM* SPECIES ISOLATED FROM FIELDS WITH COTTON CROP

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THE autotrophic nitrifying bacteria such as *Nitrosomonas* and *Nitrobacter* are believed to be largely responsible for the formation of nitrite and nitrate, respectively, from ammonium ions in many natural ecosystems[1]. However, in recent years, the involvement of a variety of heterotrophic bacteria, fungi and actinomycetes in nitrification has been established[2,3]. Among fungi, *Aspergillus flavus* was earlier considered to be the only heterotroph that can produce nitrite or large amounts of nitrate from ammonium[4,5]. Another species, *A. carneus*, isolated from benomyl amended soil, has been shown to be involved in nitrogen transformations[6]. Though many heterotrophic micro-organisms have since been reported to oxidize various nitrogen compounds in culture[7], no information is available on the nitrifying ability of fusaria which are quite abundant in soils. The present study deals with the ability of six species of *Fusarium*, isolated from soils with cotton crop, in the oxidation of $NH_4^+$–N, supplemented in mineral salts medium.

Mycelial discs from 7-day-old cultures of fusaria, viz. *Fusarium culmorum*, *F. equiseti*, *F. moniliforme*, *F. oxysporum*, *F. semitectum* and *F. solani* isolated from cotton field soils, were used to inoculate 50 ml aliquots of sterilized mineral salts medium containing sodium acetate and ammonium sulphate[2]. Uninoculated medium served as control. All the flasks were incubated at room temperature (28 ± 4°C) for 30 days. Three replicate flasks of