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STUDIES ON THE MECHANISM OF SEED DORMANCY IN RICE

K. M NARAYANAN NAMBOODIRI,
Agricultural College & Research Institute, Vellayani.

Failure of seeds to germinate immediately after harvest is referred to as seed dormancy. It is a phenomenon of high practical importance in rice cultivation. In the tropics seeds of the nondormant varieties tend to germinate on the panicle itself during the maturity stage of the crop. Too long a rest period is also not a desirable feature, as the seeds of such varieties cannot be utilised for immediate sowing purposes. Hence studies on the induction of dormancy and the breaking of it are of practical importance in rice cultivation.

Though the causes of dormancy vary in different crops, there is a general belief among the workers that germination inhibitors play a vital role here. Not much work has been done on this aspect in rice. Roberts (1961) stated that dormancy in rice seeds could to a large extent be attributed to the inhibitory influence of the husk and that the residual dormancy observed after dehusking could be attributed to the inhibitory influence of other structures like the pericarp or the testa or both; but no water soluble or ether soluble germination inhibitors could be detected in the husk or in the other parts of the dormant seed. The methods found successful in breaking dormancy in rice included soaking the seeds with wet straw or coconut coir (Parija and Chalam 1940), centrifuging soaked seeds (Sumantrai and Dubey 1953) and treating the seeds with N/10 H_2SO_4 for three h urs (Butany and Gangadharan 1958).

In view of the practical importance of these types of studies, the investigations presented in this paper were undertaken at the Kuban Rice Experimental Station, Krasnodar, U. S. S. R,, in order to elucidate further, the mechanisms governing seed dormancy in rice. These studies covered the effect of leaching of seeds on their dormancy, the role of water soluble dormancy inhibitors or stimulators present in the seeds and the breaking of dormancy in rice seeds using different substances.

Material and Methods

Two each of dormant and nondormant strains were used in these studies the salient features of which are indicated below (Smeathanin and Namboodiri 1965).

Variety	Duration in days.	Germination at harvest (%)	Dormancy in days (*).
VIR - 1755	105—110	0·7	35—4
VIR - 487	100—105	15	40—45
KRASNOARMIESKIE313	105—115	86·4	——
VIR - 4573	95—100	98·3	——

(*) Number of days required to give more than 95% germination.

To assess the effect of leaching of seeds on germination, 400 numbers each of husked and unhusked seeds of each variety were bundled in small cloth bags and leached in a continuous stream of water under the tap for 24 hours. The germinability of these treated seeds was then found out under laboratory conditions at 25°C in four replications of 100 seeds each. The unleacted seeds served as control.

The effect of water soluble germination factors of rice seeds, (inhibitors and stimulators,) on dormancy was studied by extracting these factors from the different components of the seeds and determining their effects on the germination of the dormant and nandormant seeds. To prepare the extract, the different components viz., husk (5g),embryo(lg), endosperm with bran (20g) and endosperm without bran (20g) were ground in a mortar, shaken with distilled water (60, 50, 100 and 100 ml respectively) for three hours, allowed to stand for 24 hours at room temperature and filtered- Ten millilitres of the extract were used in petridishes to test the germinability of 100 seeds of both the dormant and nondormant types; two replications were employed for each strain of paddy.

To study the effect of different substances on breaking dormacy of rica seeds, freshly harvested seeds of the two dormant types were treated with them, washed and their germinability tested under laboratory conditions at 25°C with two replications of 100 seeds each, by observing the number of seeds germinating on the tenth day. Table 3 gives details of the substances used, their doses and treatment durations and of the other dornancy breaking treatments employed.

Results and Discussions

Table 1 gives the effect of leaching on the germination of dormant and nondormant verieties. It may be seen that the

Table 1

Mean per rent germination of dormant and nondormant rice seeds after continuous leaching in water for 24 hours

Sice variety	Hulled		Unhulled	
	Leached	Unleached	Leached	Unleached
Dormant				
VIR-1755	125	6·5	6·0	6·5
VIR- 487	56·5	44·0	305	35·5
Nondormant				
Krasnoarmieskie 313	100·0	100·0	100 0	100·0
V1R-4573	100·0	99 5	100·0	99·0

leaching treatments do not affect the germination of the different types of seeds to any significent extent. Hence it is evident that leaching removes no water soluble germination inhibitor from the dormant seeds or no water soluble germination stimulator from the nondormant seeds and that no germination inhibitors or

stimulators that can explain dormancy are present in the seeds.

Table 2 gives the effect of seed extracts on the dormant and nondormant seeds. Since the two dormant types as well as the two nondormant ones give parallel values, the results of only one dormant and one nondormant types are given here. It is seen that the germination rates in the

Table 2

Mean per cent germination of dormant and nondormant rice seeds in water extracts of different parts of the seed.

Fraction of the seed extracted.		VIR-1755 (Dormant)	Krasnoarmieskie 313 (Nondormant)
Husk	Dormant	49·0	99·5
	Nondormant	54·0	99·5
Embryo	Dormant	42·5	98·5
	Nondormant	57·5	99·5
Endosperm with bran	Dormant	58·0	98·0
	Nondormant	49·5	99·0
Endosperm without bran	Dormant	40·0	100·0
	Nondorment	55·5	100·0
Control-Pure water		54·0	100·0

different seed extracts within the limits of acceptable error agree with those in the control (pure water). Thus it is indicated that in the seeds under study no water soluble germination inhibitor or stimulator that can explain dormancy is present. A similar observation was previously reported by Gopinathan (1961).

Results of the experiment on breaking dormancy of rice seeds with different substances are given in Table 3. It is seen

Table 3

Mean per cent germination of seeds of two dormant rice strains after different treatments.

Substance/Treatment.	Concentration of substance (%)	Duration of treatment (hours)	VIR 1755	VIR 487
Copper sulphate	1·5	24	41·5	77·0
	3·0	24	32·0	875
Zine sulphate	1·5	24	12·0	68·0
	3·0	24	16·0	74·5
Mercuric chloride	0·1	5/60	5·5	61·5
	0·1	10/60	6'5	65·0
Hydrobromic acid	1·5	24	2·0	55·0
	3·0	24	1·0	38 5
Sulphuric acid	N/50	3	115	73·0
	N/10	3	16·0	87·6
Glutathione	0·03	24	15·5	76·5
	0·3	24	28·0	93·5
Spirit ethylated	96	5/60	95·5	100·0
	96	10/60	98·5	99·5
Inclole acetic acid	0·001	24	24·5	80·0
	0·01	24	32·0	89·6
2, 4—D	0·003	24	16·5	78·5
	0·03	24	29·0	85·5
Hydrogen peroxide	1·0	3	19·0	71·0
	50	3	83·5	82·0
Boiling water (whole seed)		10 seconds	16·0	75 '5
Boiling water (Endosperm only)		5 seconds	10:0	72·0
Steam		60 seconds	10·0	27·5
Control, No treatment			13'0	47·5

that the different substances tested break the dormancy of the rice seeds to different degrees. Ethylated spirit is the only substance which breaks the dormancy of seeds of both the types completely. This may be due to the removal of substances soluble in spirit from the coat tissues of the seeds facilitating easier water absorption by the steds or gaseous exchange through seed coverings or both; this needs experimental confirmation. Though the per centage of germination in all the treatments is found to be fmore in the type VIR-487 as compared to VIR-1755, the trend is almost the same in both the types. In all the treatments except hydrobromic acid, the higher

the concentration or longer the duration of treatment, the higher is the germination recorded.

Summary

Studies conducted with two dormant varieties of rice, viz., VIR-1755 and VIR-487 and two nondormant varieties, viz., Krasnoarmieskie 313 and VIR-4573 showed that continuous leaching with water of the freshly harvested seeds did not have any effect on their immediate germination. Water extracts of the different fractions of the seeds did not contain any dormancy stimulators or inhibitors. Out of the various substances tested to break the dormancy in rice seeds only ethylated spirit broke the dormancy completely in both the types of seeds tested; others broke the dormancy partially only and to various magnitudes.

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