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The mobile phase was methanol/acetonitrile (LC grade), 35:65 (v/v), at a flow rate of 0.8 mL min⁻¹, and UV detection was at 282 nm. Statistical analysis was done using Duncan's multiple range test.

Ergosterol content was 80.1–512.0 µg g⁻¹ (dry weight, DW) in brown rice koji and 50.9–244.3 µg g⁻¹ DW in milled rice. Brown rice koji had more ergosterol than milled rice koji. Among the *Basidiomycetes*, the highest ergosterol contents were observed in *G. lucidum* of brown rice koji (326.5–512.0 µg g⁻¹ DW) and in *P. ostreatus* of milled rice koji (215.0–244.3 µg g⁻¹ DW). Among the cultivars tested as culture

media, Heughang had the highest ergosterol contents in *G. lucidum* (512.0 µg g⁻¹ DW) and *P. linteus* (247.5 µg g⁻¹ DW), Hyangnambyeo in *C. versicolor* (255.2 µg g⁻¹ DW), and Dongjinbyeo in *P. ostreatus* (278.0 µg g⁻¹ DW) and *L. edodes* (143.4 µg g⁻¹ DW) of the brown rice koji. The ergosterol contents in *Basidiomycetes* of milled rice koji differed as seen in Hyangnambyeo (50.9–244.3 µg g⁻¹ DW) and Dongjinbyeo (110.0–215.0 µg g⁻¹ DW). Ergosterol contents between *Basidiomycetes* and cultivars were statistically different at $P < 0.05$.

These results indicate that rice koji prepared using *Basidiomycetes* can be marketed as a functional

food (vitamin D), that is, a food that has health-promoting effects beyond its nutritive value.

References

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Nitrogen management for direct wet-seeded rice

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Direct seeding is generally practiced under semidry conditions in Tamil Nadu, India. However, the use of direct-seeded rice for lowland areas is gaining importance because of water scarcity, failure of monsoon, paucity of labor, and escalating labor cost. Proper nutrient and irrigation management strategies need to be developed for direct wet-seeded rice. An experiment was carried out to study the effect of time and rate of N application on yield of direct wet-seeded rice under lowland conditions.

Field experiments were conducted during the 2001-02 dry seasons at the central farm of TNAU in Aduthurai. The soil was silty clay (Typic Haplustert) with neutral pH (7.5) and an EC of 0.39 dS m⁻¹. The initial nutri-

ent status of the experimental field indicated low N (216.4 kg ha⁻¹), medium Olsen P (15.7 kg ha⁻¹), and medium K (324.8 kg ha⁻¹) levels. The experiment used five treatments laid out in a randomized block design with four replications. Nitrogen was applied in three and four splits at various stages—basal and 21 and 35 d after sowing (DAS), at panicle initiation (PI), and at first flowering—and at various doses (17%, 25%, 33%, and 50% of the recommended N, i.e., 125 kg ha⁻¹). Recommended doses of 50 kg P₂O₅ ha⁻¹ (full basal) and 50 kg K₂O ha⁻¹ (50% basal and 50% at PI) were applied uniformly to all treatments. At harvest, grain and straw yields were recorded and the corresponding N-use efficiency {NUE (AE*)} and ben-

efit-cost ratios (B:C) calculated. The results of the two-season field experiment revealed that N application in four splits at varying levels (17% at 21 DAS, 33% at 35 DAS, 33% at PI, and 17% at first flowering) gave a significantly higher grain yield (4.18 t ha⁻¹, 21.4% yield increase over four equal splits), high N-use efficiency (14.0), and higher B:C (2.07), whereas N application in four equal splits as per existing recommended practice gave only 3.44 t ha⁻¹, low N-use efficiency (8.1), and a B:C of 1.69 (Table 1). From these results, it could then be inferred that, for direct wet-seeded rice, application of 25% N as basal can be skipped for directly sown rice because it may not be immediately used. It is likely to be nitrified and moved

Treatment	Yield (t ha ⁻¹)		% increase over T ₂	N uptake (kg ha ⁻¹)		NUE-AE ^a	B:C
	Grain	Straw		Grain	Straw		
T ₁ Control (without N)	2.43	4.91	–	21.1	19.4	–	1.35
T ₂ N in four equal splits (25% basal, 25% at 35 DAS, 25% at PI, and 25% at first flowering)	3.44	6.05	–	32.4	20.3	8.1	1.69
T ₃ N in four equal splits (25% at 21 DAS, 25% at 35 DAS, 25% at PI, and 25% at first flowering)	3.82	6.93	10.7	38.4	36.0	11.1	1.89
T ₄ N in three splits (25% at 21 DAS, 50% at 35 DAS, and 25% at PI)	4.11	7.5	19.2	43.5	40.9	13.4	2.03
T ₅ N in four splits (17% at 21 DAS, 33% at 35 DAS, 33% at PI, and 17% at first flowering)	4.18	7.69	21.4	47.6	45.8	14.0	2.07
LSD (0.05)	0.28	0.23	–	3.35	2.16		

^aAE: agronomic efficiency = $\Delta Y/Nr$ (kg grain increase /kg N applied).

beyond the root zone as nitrate under the prevailing aerobic conditions.

Moreover, it was shown that N use as reflected in the higher N-use efficiencies of 11.1%, 13.4%, and 14.0% in treatments that did not receive basal N application (T₃, T₄, and T₅, respectively) has resulted in corresponding significant yield increases of 10.7%, 19.2%, and 21.4% over T₂ (the

existing recommended practice). These results support the findings of Kim (1996). Hence, split application of N (17% N at 21 DAS, 33% at 35 DAS, 33% at PI, and 17% at first flowering) could be recommended for adoption. This will ensure optimum N application in a need-based manner to enhance the productivity of direct wet-seeded rice. It must be noted, however, that similar yield

values were observed with N application in three splits (T₄). This has special significance under the farmers' practice as it saves on the labor needed for an additional application.

Reference

Kim SS. 1996. Effect of nitrogen split application on growth and grain yield at no-tillage machine transplanting of infant rice seedling. *Kor. J. Crop Sci.* 41(6):698-703.

