Turmeric (*Curcuma longa*), an ecofriendly ingredient to control seed-borne rice diseases

Turmeric (*Curcuma longa* L.) is being used in Indian civilization since Vedic age as germicidal ingredient and in all religious functions. It is being used in medical science since long and ultimately the Government of India has patented it in the world market[1]. Turmeric utilization in plant disease control did not advance much till Gangopadhyay reported its use in 1989 (ref. 2). Considering the pollution hazards caused by the broad spectrum pesticides, scanty reports on minimizing plant diseases through use of turmeric powder are available in the literature[3].

The dilemma of using pesticides is that they do so much good and yet threaten so much harm. A complete stop in the use of pesticides might result in 25–30% drop in crop and live stock production[4]. Paul Miller was awarded the Nobel Prize for evolving DDT as a potential pesticide. Gangopadhyay[3,5,7] advocated turmeric as a potent organic product to control plant diseases. With this idea in view, a new organic fungistatic was developed with *Curcuma longa* rhizome powder.

Surface-sterilized 1000 rice seeds of Taichung native-1 were inoculated with fungal and bacterial inoculum in six segments: (i) *Helminthosporium oryzae*, (ii) *Rhizoctonia solani*, (iii) *Acrocylindrium oryzae*, (iv) *Pyricularia grisea*, (v) *Curvularia lunata*, and (vi) *Xanthomonas oryzae* pv. *oryzae* and similar set was kept as non-surface sterilized control. Both the inoculated and non-inoculated seeds were kept in water-soaked cloth bags for 72 h. Then surface-sterilized inoculated seeds were thoroughly mixed with turmeric powder impregnated sodium bicarbonate (100 : 10) @ 1 g/kg rice seeds. One kg turmeric powder (Ruchi) was mixed with 100 g sodium bicarbonate (AR) and mixed thoroughly by hand.

Twenty seeds each of both the turmeric-treated and untreated seed lots were germinated in 19 cm sterilized petri plates for 7 days, followed by planting in nursery and finally transplanting 30-day-old seedlings in micro-plots at the Central Rice Research Institute farm along with untreated control. Fertilizer was applied @ 40 : 20 : 10 N : P : K/ha. Micro-plots were 1×1 m^2 in randomized block design with three replications. One foliar spray with turmeric-impregnated $NaHCO_3$ was applied in water suspension (10 g/10 l H_2O) at maximum tillering stage. The above mentioned fungi and bacterium were tested side by side in laboratory condition using 1, 5 and 10 ppm turmeric suspension keeping untreated control in sterile distilled water.

Of the different concentrations used, only in 1 ppm concentration *H. oryzae* and *R. solani* germinated with 3 and 5 germtubes respectively. In the rest of the treatments, none of the conidia/sclerotia germinated and *X. oryzae* pv. *oryzae* failed to multiply. In concentrations of 5, 10, 20 and 50 ppm, all plants failed to germinate or multiply even up to 96 h, whereas in sterile water, germination and multiplication was 100% and growth of root, shoot was boosted (Table 1). None of the treated seedlings showed any disease symptom either in petri plates, nursery or in the transplanted plots. Whereas in inoculated untreated treatments the seedlings showed disease symptoms of score-5 in SES. In transplanted plots yield data showed much improvement over the control. Probably low yield in control was mainly due to disease besides other components which were similar to all the treatments (Table 2).

The treated plots were free from any insect damage and rice tungro virus symptoms, which was found in untreated plots. Work on every specific component is in progress in multi-disciplinary approach. In pesticidal research, this is the first report of organic systemic seed dresser[8,9] on turmeric sodium bicarbonate powder to control seed-borne fungal and bacterial disease of rice, with difeloloyl methyl carbonate as an active ingredient easily available in commercial form.

C. longa (L.) belonging to the family Zinziberaceae, grows well under diverse agroclimatic conditions, especially in wastelands, drought areas, garden or orchard sheds. Once the rhizomes are planted, it grows year after year. Commercially available turmeric rhizome powder contains essential oil, 5.8%; ester value, 3.2; acetate value, 26.3; d-α-phellundrine,1,d-Sabinene, 0.6; cineol,1,borneol, 0.5; zinziberene, 58%; sequeterpenes, $C_{13}H_2O$; curcumin, 0.6%; difeluroloyl methane, $C_{21}H_{20}O_6$; *para*-torymethyl carbonil, 3.5; carotenoids, 50 l.w/100 g; β-3-1 carotenoids, trace analysed following standard methods[2]. Although separation of different compounds for its antifungal, antibacterial, antiviral properties and active ingredients could not be done, methane might have acted as the primary active ingredient[8]. It works as systemic too as it was detected

Table 1. Germination, root number and length, number of leaves, shoot height and disease score in petri plates inoculated to Taichung native-1 rice seeds followed by *C. longa* + $NaHCO_3$ treatment after 10 days*

	Germination after treatment				
Pathogens	Germination (%)	Root length and nos (cm) (treated control)	No. of layers (treated control)	Shoot height (cm) (treated control)	Disease score (0–5 scale) (treated control)
H. oryzae	100	7.5 (9)	3 (3)	6.8 (5.8)	0 (5)
R. solani	100	7.7 (9)	3 (3)	9.1 (5.6)	0 (5)
A. oryzae	100	9.1 (12)	4 (3)	7.5 (5.3)	0 (5)
P. grisea	100	9.3 (14)	4 (3)	11.2 (5.7)	0 (3)
C. lunata	100	8.5 (14)	4 (3)	11.5 (5.5)	0 (3)
X. oryzae	100	8.2 (15)	5 (3)	12.0 (5.6)	0 (5)

*Untreated control data within parentheses.
S.Em. = ± 1.895.
CD at 0.1% = 0.728.

Table 2. Grain yield of Taichung native-1, 1000 plants seed treated followed by foliar spraying with turmeric and sodium bicarbonate (mean of three replications)

	Grain yield (kg)		Disease symptoms	
Pathogen	Treated	Untreated	Treated	Untreated
H. oryzae	8.75	1.32	0	5
R. solani	9.20	1.58	0	4
A. oryzae	8.99	2.12	0	5
P. grisea	9.95	0.33	0	5
C. lunata	9.37	1.19	0	5
X. oryzae	8.97	0.35	0	5

S.Em. = ± 0.853
CD at 0.1% = 1.113.

from primordia, basipatically and acropetically. After mixing with $NaHCO_3$, the yellow turmeric powder became red just like any organo-mercurials. The reason for adding $NaHCO_3$ was for easy penetration[8] into seed and plant system considering concomitant pH change of seed coat and foliage, which affect fungal population multiplication and check secondary infection. Turmeric may be recommended as a primary step towards the formulation of organic non-hazardous, cheap ecofriendly fungicide and bactericide. Computerized molecular configuration showed sodium difeluroloyl methyl carbonate as strongly germicidal, which acts as plasmolytic and ultimate degeneration of fungal and bacterial cells.

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