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Economics of DNA Finger Printing Assessment

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DNA finger printing is a quick, accurate, low cost, reliable technology that immensely augments genetic purity profile of rice hybrid CORH 3 and its parental lines of TNAU CMS 2A, CB87R and TNAU CMS 2B. The present investigation compared the cultivation cost of Grow Out Test field as well as DNA finger printing at the laboratory and revealed that the cost involved for determining the genetic purity of a genotype was around Rs.717 per sample for GOT method and Rs.4845 for DNA finger printing method respectively. Even though the cost was higher for DNA finger printing it must be judged against the opportunity cost and the cost involved in storing of seeds for few months until GOT results are made available.

Key words: Grow Out Test, DNA fingerprinting, Genetic Purity

Grow Out Test is a statutory requirement for estimation of hybrid seed purity which is based on the assessment of morphological and floral characteristics of varieties and hbyrids grown to maturity. It is time consuming, enervating venture eg. rice plants take several months to reach maturity. Further the seeds have to be stored under appropriate conditions as they cannot be marketed until these results become available which involves labour, time and money. Seed companies have to invest large amount of capital which will be locked up in the form of hybrid seed stock for prolonged period while waiting for GOT results. Another disadvantage is environmental impact on the expression of morphological characteristics when GOT tests are conducted in areas not adapted to the hybrid. Further, there is also the possibility for adverse climatic conditions *viz*., heavy wind or rain that can damage or destroy the crop and make it difficult to collect data thus compounding the misery of seed companies.

Considering the drawbacks of Grow Out Test (GOT), recently new techniques based on DNA finger printing provide novel approach for quick assessment of genetic purity and offer many advantages over traditional morphology based GOT. Molecular marker-based genetic purity assays will be highly useful in rapid and large-scale screening of hybrid seed lots with minimum cost. The present study was aimed at cost comparison of DNA sampling strategy using grow out test matrix developed by Sundaram *et al*. (2008) and conventional GOT for screening hybrid rice.

Materials and Methods

Seeds of the popular rice hybrid CORH 3 and its parents raised at Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India were used (Table 1). Randomly counted four hundred seeds each of rice hybrid CORH 3 and its parents obtained from individual seed lots were sown in raised nursery bed and then transplanted in a 20-row x 20-column of grow-out matrix with an even spacing of 20 x 20 cm_2 during *rabi* 2010 at the Wet Lands of Central farm, Coimbatore. Prescribed agronomic practices are adopted and leaf samples collected from individual plants were used for testing the genetic purity both by GOT and DNA marker studies and cataloged for comparison using 580 samples TNAU CMS 2A- 80 samples; CB87R- 80 samples; TNAU CMS 2B- 20 and hybrid CORH3- 400 samples. The labour and material cost prevailing during 2009-10 were utilized for economic analysis.

Results and Discussion

The economics for the conduct of both tests *i.e*., GOT and DNA finger printing was estimated and presented in (Table 2 and 3). The cost involved for conducting GOT (0.05Ac) from the date of sowing to maturity was Rs.2870.75 for all the four samples (parents and hybrid) and Rs.717.69 per sample. In the case of DNA finger printing technique, it was Rs. 19380.92 for 580 samples and Rs.4845.09 per sample. It is easily inferred that DNA finger printing technique costs more compared to GOT. However, the finger printing technology is more reliable, quick method and once established, the initial investment will reduce with subsequent sampling and assessment compared to GOT which involves an additional cost on storage of the seed lots as it takes longer period (5 months) to complete. Further, quick results obtained from DNA finger printing will allow the producer to dispose of the seed stock early thus availing opportunity of disposing the seed at the right season, while delay of more than five months

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Table 1. Details of hybrid and its parental lines used in the study

Hybrid	Parentage			Year of release
	CMS line	B line	Restorer line	
CORH3	TNAU CMS 2A	TNAUCMS 2B	CB87R	2006

may lead to loss of opportunity thus the producer will be further burdened of storing the seed till next season. Hence, application of DNA finger printing technology helps in marketing the seeds in the current season itself without awaiting for next season. This will result in considerable savings on

Table 2. Cost of cultivation for Grow Out Test in the field (0.05 Ac) at 2009-10 cost estimate

Name of operation	Tractor (hr)	Man power	Women power	Quantity (kg)	Cost (Rs/kg)	Total(Rs/5 cents)
Material cost						
Seed cost for all genotypes					125.00	5.00
Manures – FYM				160	0.5	80.00
Fertilizer N:P:K- 175:60:60						
Urea				6	5	30.00
SSP				6	4	24.00
MOP				1.5	4.5	6.75
Plant protection						
Monocrotophos				15ml		5.00
Labour cost						
Nursery preparation and sowing		1		1	160/labour	160
Main field preparation						
Ploughing and leveling	1/2	1		1	300 + 160	460
Bund forming		2		2	160/labour	320
Transplanting and fertilizer application		4		4	100/labour	640
Irrigation (entire crop period)		1		1	160/labour	160
Two weedings and bund strengthening		2		2	160/labour	320
Observation recorded						
(Assisting technical person)		1		1	160/labour	160
Cost of storage @50 Rs / T / month					5 month x 2 T	500
Opportunity cost	(Return on money invested if sold during season and Immeasurablecost involved in return of money invested due to delay or loss of opportunity)					
						Total cost = Rs. 2870.75

storage, interest on investment and quality loss. Naresh *et al*. (2009) proposed the use of EST-SSR markers for the assessment of genetic purity of safflower hybrids in crop plants to replace GOT while, Sundaram *et al*., 2008; Nandakumar *et al*., 2004; Yashitola *et al*., 2002 and 2004; Tamilkumar

Table 3. Cost of genetic purity assessment of rice hybrid CORH3 and its parental lines by DNA finger printing technology in laboratory @ 2009-10 cost estimate.

S. No	Particulars	Quantity	Cost (Rs)	Total cost (Rs)	Total
I. Buffer preparation cost					
1.	CTAB solution	500 ml	594.00	594.00	
2.	2-Mercapto ethanol	2.5 ml	26.00	26.00	
3.	Chloroform: Isoamylalcohol	500ml	172.22:13.60	185.82	
4.	Sodium acetate	100ml	40.00	40.00	
5.	Ethanol	250ml	135.20/ml	67.60	
6.	Ice cold Isoproponal	500ml	282.00	282.00	
7.	TE buffer	100ml	40.00	40.00	
8.	10X TAE buffer	1l	304.15	304.15	1539.57
II. Agarose gel running cost					
9.	Agarose	160g	28.00/g	4480.00	
10.	Ethidium bromide	1g	1027.52/g	1027.52	5507.52
III. PCR mix cost					
11.	Eppendorf tubes	1200 No	1944.00	1944.00	
12.	1000 ml tips	750 N0	525.00	525.00	
13.	200µl tips	750 No	635.00	635.00	
14.	5 -10 µl tips	1000 No	580.00	580.00	
15.	PCR tubes	700 No	2000 No/ 3484.00	1219.40	
16.	Loading dye			1307.28	
17.	dNTPs			816.00	
18.	Primer			780.00	
19.	Taq buffer, Taq polymerase enzyme			425.15	
20.	100bp ladder			3600.00	11831.83
IV. Consumables					
21.	Disposable gloves	50 No	54/ 25No	108.00	
22.	Tissue paper	3 roll	24/roll	72.00	
23.	Aluminium foil	1		47.00	
24.	Parafilm			25.00	252.0
V.	Labour			250.0	250.0
					19380.92

et al. (2009) suggested the assessment of genetic purity of hybrids using DNA finger printing in conjunction with confirmation through GOT. The current study indicated that costs of storage for a whole season and cost of acquiring land and growing the crop for the GOT can also be avoided. Besides, the DNA finger printing described here would be more accurate for determining genetic purity of hybrid and its parental lines than morphological characteristics as they would be directly assessing the genotype. This will greatly augment the entire process of genetic purity testing of hybrid seeds by saving one full crop season and thus reducing the cost of hybrid seed. Even though the current cost of considering DNA finger printing techniques are higher, they can be cost effective when larger number of samples are tested.

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