

PTB 59 - 'Samyuktha' a high yielding rice variety for kootumundakan system of cultivation in Kerala

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Abstract

PTB 59 'Samyuktha' specifically bred for *kootumundakan* system of cultivation in Kerala, is a pureline, selected from Culture C3-2 developed through hybridization and selection, with M 210 (the dwarf mutant of traditional tall indica rice variety PTB 10) and PTB 28 as parents. Samyuktha is a photo-period insensitive, medium tillering variety of 112 – 117 days duration, growing to an average height of 123 cm with a yield potential of 3600 kg ha⁻¹ under *kootumundakan* system. This short-bold red kernelled rice variety is moderately resistant to major pests of rice crop. It is non-lodging in the *kootumundakan* system of cultivation, with non-shattering grains and moderate dormancy. Considering its qualities, PTB 59 'Samyuktha' was released as a variety for cultivation in *kootumundakan* system during 2010.

Key words: *Kootumundakan* system, PTB 59, Samyuktha, Red kernelled, Non-lodging, Mutant, Non-shattering photo-period insensitive

Introduction

'*Kootumundakan*' is a traditional system of rice cultivation practiced in Palakkad and Malappuram districts of Kerala. This is prevalent in areas where sowing or planting of second crop is not conducive due to excess water in the field. The seeds of a mid-early duration photo-period insensitive variety (*kharif* crop component) are mixed with that of a photo-period sensitive long duration variety (*rabi* crop component) in the ratio 7:3 (w/w), respectively. The mixed seeds are then sown with the onset of South-west monsoon during May - June. The *kharif* crop component being photo-period insensitive and of mid-early duration, will be ready for harvest in August-September. The mature crop is harvested

along with the vegetative growth of the photo-period sensitive *rabi* crop variety. Application of cattle manure and fertilizers further induce profuse vegetative growth from the ratoons of the photo-period sensitive variety (*rabi* crop component) which then reaches flowering by late December. This crop is harvested by mid January. Although the yield realized in this system is less than that from two independent crops, owing to the specific circumstances that prevail, the *kootumundakan* system of cultivation is the only cultivation practice suitable for these areas. The tall, traditional photo-period sensitive varieties used in the combination usually yield much higher straw than grain. This straw is made use of by farmers for hay-making. The only possibility of enhancing grain yield under

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this system is through replacement of poor yielding traditional varieties presently used as the first crop component. The first crop variety suitable for this system should exhibit early vigour, profuse tillering and vigorous early vegetative growth to avoid smothering by the second crop. Considering these, efforts to breed for high yielding photoperiod insensitive rice varieties compatible to this system was initiated at Regional Agricultural Research Station, Pattambi, Kerala.

Materials and Methods

Culture M 210, a promising dwarf mutant of PTB 10 (Thekkencheera) and PTB 28 were hybridized during 1988 - 89 at Regional Agricultural Research Station (RARS), Pattambi, Kerala. Pedigree selection was followed in segregating population during 1989–1993 and superior lines were isolated. Initial yield trials (IYT) for three consecutive years (1993-1995) followed by comparative yield trials (CYT) during 1996 to 1998 resulted in identification of a promising red-kernelled Culture, C3-2. However, as segregation was observed in Culture C3-2, purelines were selected from the population during *kharif* 1999. This resulted in identification of a promising, short-duration, photo-period insensitive, red-kernelled accession, Culture C3-2 KM (Samyuktha).

Mini seed production of Samyuktha was taken up during *rabi* 1999 - 2000. Performance of Samyuktha was evaluated under the *koottumundakan* system in preliminary yield trial (PYT) during 2000. Comparative yield trials (CYT) were conducted for three years (2001, 2003 and 2005). In each trial, the combinations of Samyuktha + Makaram and Swarnaprabha + Makaram were tested against the traditional combination of Chenkayama and Chettadi as check in a randomized complete blocks design with five replications. Standard package of practices were followed to raise a good crop. Based on these trials, Samyuktha in combination with variety Makaram was nominated to multi location trial (MLT) at farmer's field. MLT was conducted

as an unreplicated trial in Palakkad and Malappuram districts of Kerala during 2004 -2006. As in PYT and CYT, at each location, the combination of Samyuktha and Makaram was tested against the traditional combination of Chenkayama and Chettadi as check. The performance of combination Samyuktha with Makaram was evaluated in a total of 17 trials, stretching from station trials to frontline demonstrations.

Characterization of Samyuktha was done as per DUS guidelines (Rani et al., 2004). The culture was also scored for drought tolerance, pest and disease reaction and grain sprouting in panicles as per standard evaluation system of rice (IRRI, 1988). Quality analysis of grain was done as per GEU skill series (IRRI, 1987). Organoleptic quality scoring of cooked par-boiled rice was assessed as per standard procedure (DRR, 2009).

Results and Discussion

In initial evaluation trial conducted at RARS, Pattambi under *koottumundakan* system, the total grain yield realized from varietal combination Samyuktha and Makaram (7539 kg ha^{-1}) was 42.35 per cent more than that obtained from the popular traditional varietal combination of Chenkayama and Chettadi (Table 1). In straw yield, these two combinations were found to be on par. However, the combination of high yielding varieties Swarnaprabha and Makaram out-yielded these combinations in straw yield. Pooled analysis of grain yield obtained over both the seasons (I and II crop) in the CYT revealed that the varietal combinations 'Swarnaprabha + Makaram (7348 kg ha^{-1}) and Samyuktha + Makaram (7539 kg ha^{-1}) were high yielders with respect to grain yield. These combinations out-yielded the popular traditional varietal combination of Chenkayama + Chettadi (6395 kg ha^{-1}) to the tune of 14.9% and 17.9%, respectively.

The performance of varietal combination of Samyuktha and Makaram evaluated under multi location trials at seven locations in Palakkad and

Table 1. Performance of Samyuktha in yield trials

Sl. No.	Trial	Location	Varietal combination		Grain Yield (kg ha ⁻¹)			Straw yield (kg ha ⁻¹)		
			I crop	II crop	I crop	II crop	Total	I crop	II crop	Total
I	Station Trials	RARS, Pattambi	Swarnaprabha	Makaram	2140	6073	8213	15657	6628	22285
	Preliminary Yield		Samyuktha	Makaram	3314	4810	8124	13110	3788	16897
	Trial (2000)		Chenkayama	Chettadi	2304	3402	5707	12310	3787	16097
	CD _(0.05)				167.38	1754.48	1761.51	286.44	1927.37	11878.86
	Per cent increase in total yield of Samyuktha + Makaram over Check (Chenkayama + Chettadi) in Initial Yield Trials						42.35%			4.97%
II	Comparative	RARS, Pattambi	Swarnaprabha	Makaram	2857	4491	7348	15177	7413	22591
	Yield trial		Samyuktha	Makaram	2569	4970	7539	14016	7458	21474
	(2001, 2003		Chenkayama	Chettadi	2524	3871	6395	17761	7611	25373
	and 2005)									
	CD _(0.05)				205.1	1828	343	2723	488	2729
	Per cent increase in total yield of Samyuktha + Makaram over Check (Chenkayama + Chettadi) in Comparative Yield trial (I to III)						17.89%			

Table 2. Mean performance of Samyuktha in Multilocation Trails (2004-06)

Sl. No	Cultures/ Varieties	Grain Yield (kg ha ⁻¹)								% increase in yield over check
		L1	L2	L3	L4	L5	L6	L7	Mean	
1	Swarnaprabha + I crop	2500	3500	2750	3526	5175	3979	4637	3723	23.12
	Makaram II crop	4000	4500	3250	4525	5200	4296	4126	4271	38.4
	Total	6500	8000	6000	8051	10375	8275	8763	7994	30.81
2	Samyuktha + I crop	3000	3250	2025	3679	5200	4153	4526	3690	22.02
	Makaram II crop	3500	4250	3000	4695	5100	4527	4293	4195	35.94
	Total	6500	7500	5025	8371	10300	8680	8819	7885	29.03
3	Local check I crop	1750	2900	2250	2797	4666	3285	3525	3024	
	(Chenkayama + II crop	3500	3250	3500	2346	3150	2369	2590	3086	
	Chettadi) Total	5250	6150	5750	5143	7816	5654	6115	6111	

L1 : C.Govindankutty Nair; Kulukkalloor, L2 : K.Kunju Nair, Malathi mandiram, Vadumthara; L3 : P.P. Chandran, Thripathy, Kulukkalloor; L4 : Sethumadhavan, Choorakode, Vallapuzha; L5 : Vayattu Ali, Valavannur; L6 : Mohammed Kutty Thoppayil, Panniyamkurissy; L7 : Padmanabhan, Panniyamkurissy, Cherpulassery

Malappuram districts (2004 -2006) is given in Table 2. The mean yield of the I crop and II crop components over locations in combinations Samyuktha + Makaram and Swarnaprabha + Makaram were higher than that of the varieties in the check combination. The increase in mean grain yield pooled over seasons (I + II crops) in varietal combinations Swarnaprabha + Makaram (7994 kg ha⁻¹) and Samyuktha + Makaram (7885 kg ha⁻¹) over the check combination (6111 kg ha⁻¹) was 30.81 per cent and 29.03 per cent, respectively.

The mean yield of individual crop components in the combination Swarnaprabha + Makaram (I crop: 3723 kg ha⁻¹; II crop: 4271 kg ha⁻¹) was higher than that in varietal combination Samyuktha and Makaram (I crop: 3690 kg ha⁻¹; II crop: 4195 kg ha⁻¹). However, as the kernels of variety Swarnaprabha is medium slender, white and becomes sticky on cooking, Swarnaprabha is found to be less preferred by the farmers and consumers.

Agronomic characteristics

Samyuktha exhibits robust early seedling vigour on establishment and hence, found to be ideal for

koottumundakan system of cultivation. This trait enables it to outgrow the vegetative growth of the II crop component and also harvest the maximum solar energy for sustained growth. It is photo-period

Table 3a. Varietal descriptor for Samyuktha as per DUS guidelines

No	Characteristics	States	Note
1	Coleoptile	Colour	Colourless
2	Basal leaf	Sheath colour	Green
3	Leaf	Intensity of green colour	Medium
4	Leaf	Anthocyanin colouration	Absent
5	Leaf	Distribution of Anthocyanin colouration	NA
6	Leaf sheath	Anthocyanin colouration	Absent
7	Leaf sheath	Intensity Anthocyanin colouration	NA
8	Leaf	Pubescence of blade surface	Weak
9	Leaf	Auricle	Present
10	Leaf	Anthocyanin colouration of auricle	Colourless
11	Leaf	Collar	Present
12	Leaf	Anthocyanin colouration of collar	Absent
13	Leaf	Ligule	Present
14	Leaf	Shape of ligule	Split
15	Leaf	Colour of ligule	White (Green)
16	Leaf	Length of blade	Long
17	Leaf	Width of blade	Narrow
18	Flag leaf	Attitude of blade (early observation)	Erect
19	Flag leaf	Attitude of blade (late observation)	Semi erect
20	Culm	Attitude (for floating rice only)	NA
21	Culm	Attitude	Semi erect
22	Time of heading	50% of plants with panicle	Early
23	Male sterility		Absent
24	Lemma	Anthocyanin coloration of keel	Absent
25	Lemma	Anthocyanin coloration of area below apex	Absent
26	Lemma	Anthocyanin coloration of apex	Absent
27	Spikelet	Colour of stigma	White
28	Stem	Thickness	Thick
29	Stem	Length (excluding panicle)	Medium
30	Stem	Anthocyanin coloration of nodes	Absent
31	Stem	Intensity of Anthocyanin coloration of nodes	Absent
32	Stem	Anthocyanin coloration of inter nodes	Absent
33	Panicle	Length of main axis	Medium
34	Panicle	Curvature of Main axis	Deflexed
35	Panicle	Number per plant (9 -10)	Few
36	Spikelet	Density of pubescence of lemma	Medium
37	Spikelet	Colour of tip of lemma (at 80-90 days)	Yellowish
38	Lemma and palea colour		Straw
39	Panicle	Awns	Absent
40	Panicle	Colour of awns late observations	NA

Table 3a. contd.....

No	Characteristics	States	Note
41	Length of longest awn	NA	
42	Distribution of awns	NA	
43	Panicle	Presence of secondary branches	Present 9
44	Panicle	Presence of secondary branching	Strong 2
45	Panicle	Attitude of branches	Semi erect to spreading 7
46	Panicle	Exsertion	Well exserted 7
47	Time of maturity	112-117 days	Early 3
48	Leaf	Senescence	Late 7
49	Sterile lemma	Colour	Straw 1
50	Grain	Weight of 1000 fully developed grains	High 7
51	Grain	Length	Short 1
52	Grain	Width	Broad 7
53	Grain	Phenol reaction of lemma	Present 9
54	Decorticated grain	Length	Short 3
55	Decorticated grain	Width	Broad 7
56	Decorticated grain (in lateral view)	L: B Ratio	Short bold 2
57	Decorticated grain	Colour	Red 6
58	Endosperm	Presence of amylose	Present 9
59	Endosperm	Content of amylose	High 7
60	Polished grain	Expression of white core	Small 3
61	Gelatinisation temperature	Through Alkali spreading value	High 7
62	Decorticated	Grain aroma	Absent 1

Table 3b. Varietal features of Samyuktha

Feature	Details	Feature	Details
Plant height	: 123.29 cm	Panicle length	: 22.23cm
<i>Distinguishing morphological characters:</i>		<i>Grain size</i>	
Leaf colour	: Green	Lemma and palea colour	: Straw
Length	: 46.68 cm	Length	: 7.4mm
Width	: 0.985 cm	Width	: 3.2mm
Flag leaf	: Semi erect	L/B ratio	: 2.31
Leaf sheath colour	: Green	Shape	: Short bold
Collar	: Present, Cream	<i>Physiological features</i>	
Ligule	: Split	Photothermic reaction	: Photo insensitive
Ligule Colour	: White	Dormancy	: Moderately dormant
Leaves at maturity	: Yellow, Late senescence	Maturity (Range in days)	: Kharif :-112 -117 days
<i>Inflorescence</i>		Maturity group	: Early
Stigma colour	: White	<i>Agronomic features</i>	
Outer glume colour	: Straw	Lodging (after flowering up to maturity)	: Non lodging (strong)
Lemma & palea	: Light green ripening straw	Shattering (at maturity)	: Low (1 - 5%)
Awn	: Absent	Fertilizer responsiveness	: Responds to 90: 45:45 kg NPK /ha
Fertility	: Fertile		
Panicle	: Well exserted		

insensitive, semi-erect and non-lodging under *koottumundakan* system of cultivation. It had short duration (112 – 117 days) with medium tillering ability, long and narrow erect to semi-erect leaves and flag leaf. It grew to an average height of 123.29 cm and possessed well exerted panicles, short bold

It was found to exhibit moderate resistance to stem borer, leaf folder, whorl maggot and blue beetle, but was highly susceptible to gall-midge (Table 6). Under National screening trial, Samyuktha exhibited moderate resistance reaction to BPH (Table 7).

Table 4. Reaction of Samyuktha to moisture stress and sprouting of grains in panicle

Cultures / Variety	Leaf drying score at vegetative stage	Rating	Survival on receipt of rains (%)	Sprouting of grains in panicle (%)
Samyuktha	3	MR	70	0
Aiswarya	3.7	MR	70	10
Jyothy	-	-	-	25
Swarna prabha	5	MR	70	0
Kanchana	6.3	MS	70	0

R- Resistant; MR- Moderately resistant; S- Susceptible; MS- Moderately Susceptible

awnless non-shattering grains and short bold kernels (Table 3 a & 3b). Samyuktha exhibited moderate resistance to moisture stress at vegetative stage and recorded high survival per cent and recovery of seedlings (70%) on receipt of rains on par with other varieties such as Aiswarya and Swarnaprabha. Samyuktha, Swarnaprabha and Kanchana did not germinate *in-situ* (Table 4).

Grain and Cooking quality

Samyuktha possessed short bold grains with red kernels and recorded good hulling (83%), milling (76%) and head rice recovery (75%). The test weight of grain was 27.9 g. Kernels had high amylose content and gelatinization temperature (Table 3a). On cooking, kernels exhibited moderate elongation

Table 5. Reaction of Samyuktha to major diseases

Cultures / Variety	Blast		BLB		Sheath Blight	
	Score	Rating	Score (%)	Rating	Score (%)	Rating
Swarnaprabha Sel 3-1	6	MS	7	HS	5	MS
Swarna Prabha	5	MS	7	HS	7	S
Aiswarya	2	MR	7	HS	7	S
Kanchana	6	MS	7	HS	7	S
Harsha	6	MS	7	HS	7	S
Samyuktha	5	MS	7	HS	3	MR
Jyothy	7	HS	7	HS	9	HS
Matta triveni	9	HS	7	HS	9	HS

MR- Moderately resistant S- Susceptible MS- Moderately Susceptible HS- Highly Susceptible

Reaction to Pest and Diseases

Samyuktha exhibited moderate susceptibility to blast and moderate resistance to sheath blight. However, it was highly susceptible to bacterial leaf blight under field screening at Pattambi (Table 5).

ratio and volume expansion. (Table 8). The rice is non-aromatic, non-sticky, moderately soft and well-separated on cooking with desirable taste and good consumer acceptance (Table 9).

Considering the yield superiority and quality

Table 6. Reaction of culture Samyuktha to major pests

Culture/ Variety	Stem Borer		Gall midge		Leaf Folder		Whorl maggot		Blue beetle	
	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating
Swarna Prabha	5	MS	3	MR	3	MR	5	MS	5	MS
Kanchana	3	MR	5	MS	3	MR	5	MS	5	MS
Samyuktha	3	MR	9	HS	3	MR	3	MR	5	MS
Jaya	7	S	7	S	1	R	7	S	7	S
Jyothi	9	HS	7	S	9	HS	7	S	5	S

R- Resistant MR- Moderately resistant S- Susceptible MS- Moderately Susceptible HS- Highly Susceptible

Table 7. Reaction of culture Samyuktha to Brown plant hopper

Culture/ Variety	Maruteru	Kota	Pantnagar	Sambalpur	Sakoli
Cul F3-11-3	MR	MR	MR	R	MR
Cul F5-23-2	MR	R	MR	R	MR
Cul C3-2 KM	MR	MR	MR	R	MR

R- Resistant MR- Moderately resistant (Source: DRR, 2005)

Table 8. Grain/ kernel quality characteristics of Samyuktha

Sl. No.	Quality Characteristics	Index		
		Samyuktha	Harsha	Kanchana
1	Kernel length	5.7 mm	6.95 mm	6.0 mm
2	Kernel width	2.7mm	3.30 mm	2.2 mm
3	L/B ratio	2.11	2.11	2.73
4	Classification	Short bold	Long Bold	Long Bold
5	Hulling %			
	a) Laboratory	72	75	80
	b) Commercial Rice Miller	83		
6	Milling %			
	a) Laboratory	70	71.4	74
	b) Commercial Rice Miller	76		
7	Head Rice recovery (%)			
	a) Laboratory	69	69	74
	b) Commercial Rice Miller	75		
8	Kernel Colour	Red	Red	Red
9	Kernel length after cooking	8.2mm	8.4 mm	9.4 mm
10	Elongation ratio	1.43	1.21	1.6
11	Abdominal White	Present	Present	Present
12	Volume Weight	598 g/HL	572 g/HL	580 g/HL
13	Volume Expansion	3.75	5.3	6
14	Test weight of grain	27.9 g	25.9 g	26.0 g

preference by farmers and consumers, Samyuktha was released as PTB 59 “Samyuktha “ by the 24th State Variety Release Committee in 2010. It can

be recommended for direct seeding during the *kharif* season in combination with variety Makaram as the II crop variety under *kootumundakan* system of

Table 9. Organoleptic scoring of cooked rice of samyuktha

Sl. No.	Quality Characteristics*	Culture/Variety			
		Samyuktha		Swarnaprabha 3-1	
		Par-boiled	Raw	Par-boiled	Raw
A	Appearance	2.5	3.7	2.8	4.3
B	Cohesiveness	4.8	2.6	4.9	3
C	Tenderness on touching	2.5	3.6	3.5	3.8
D	Tenderness on chewing	2.6	3.6	3.9	4.2
E	Taste	3.2	2.7	3.7	2.9
F	Aroma	2.3	2.2	2	2.1
G	Elongation	2.6	1.8	3.2	2.3
H	Overall acceptability	2.6	1.8	3.4	2.3

(*Scoring : As per DRR 2009)

cultivation prevalent in Palakkad and Malappuram districts of Kerala.

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