1. RICE (*Oryza sativa* L.)

CLIMATE REQUIREMENT

T_Max°C	T_Min°C	Optimum °C	Rainfall mm	Altitude m MSL
36 - 38	10 - 12	30 - 32	1000 - 4500	up to 2000

Tropical and sub tropical hot and humid climate. Minimum temperature required for germination, flowering and grain formation is 10, 23 and 20°C, respectively. Optimum temperature for growth, flowering and grain formation is (21-36°C, 25-29°C and 20-25°C) respectively. Short day plant.

CROP IMPROVEMENT

I. SEASON AND VARIETIES

Zone District/Season	Month	Varieties
I. Cauvery Delta Zone		
a. Thanjavur/ Thiruvarur		
Kuruvai	(Jun -Jul)	ADT 53, CO 51, ADT 43, ADT (R) 45, TPS 5 , MDU 6, ADT 36, ADT 37, CORH 3, ASD 16, TKM 9
Samba	(Aug)	CR 1009 *Sub*1, ADT 50, ADT 51, CR 1009, TRY 3
Late Samba / Thaladi	(Sep -Oct)	VGD 1, TKM 13, CO 52, CO (R) 50, ADT 39, ADT 38, ADT 49, CO 43, CO 43 sub.1, Imp.White Ponni, ADT (R) 46, TRY 3*, Hybrid CO 4
Navarai	(Dec -Jan)	ADT 53, CO 51, ADT (R) 45, TPS 5 , MDU 6, ADT 36, ADT 37, CORH 3, ASD 16, TKM 9
b. Nagapattinam		
Late Kuruvai	(July)	ADT(R)48, MDU 5, CO 51, ADT 53, ADT(R)45, ADT 37, ADT 36
Samba	(Aug – Sep)	CR 1009 *Sub*1, ADT 50, ADT 51, CR 1009,
		CO(R)50, CO 52, ADT (R)46, TKM 13, TRY 3*, ADT 39, ADT 38, CO 43 sub 1, CO 43
Semi dry cultivation in Thanjavur, Thiruvarur and Nagapattinam	August	CR 1009, CR 1009 sub 1, ADT 51,TRY 3
	September	ADT 38, ADT 39, ADT 46, Co 50, Co 52, TKM 13, TRY 3

c. Tiruchirapalli		
Kuruvai	(Jun -Jul)	ADT 53, CO 51, ADT 43, ADT (R) 45, TPS 5 , MDU 6, ADT 36, ADT 37, CORH 3, ASD 16, TKM 9, TRY 2*
Samba / Thaladi	(Aug -Sep)	CR 1009 *Sub*1, ADT 50, ADT 51, CR 1009
		TRY 3*, TRY 1*, CO 43, TKM 13, VGD 1, CO 52, CO (R) 50, ADT 39, ADT 38, ADT 49, Imp. White Ponni, ADT (R) 46, Hybrid CO 4
Summer	(Dec.)	ADT 53, CO 51, ADT (R) 45, TPS 5, ADT 36, ADT 37, CORH 3, ASD 16,
d. Flood affected areas	(Aug-Sep)	CR 1009 sub1
e. Salt affected areas		TRY 1, TRY 2, TRY 3 and Co 43
II. North Eastern Zone		
a. Kanchipuram/Tiruvallur		
Sornavari	(April -May)	ADT 53, CO 51, ADT 43, ADT (R) 45, TPS 5, ADT 36, ADT 37, CORH 3, ASD 16, TKM 9
Samba/ Late Samba	(Aug- Sep)	VGD 1, TKM 13, CO 52, CO (R) 50, ADT 39, ADT 38, ADT 49, CO 43, Imp.White Ponni, ADT (R) 46, TRY 3*, Hybrid CO 4
Navarai	(Dec -Jan)	ADT 53, CO 51, ADT (R) 45, MDU 6, ADT 36, ADT 37, CORH 3, TKM 9
Rainfed direct seeded and Semi-dry	(July - Aug)	Anna (R) 4, ADT 36, ADT 39, TKM 9, TKM 11
b. Vellore/Tiruvannamalai		
Sornavari	(April-May)	ADT 53, CO 51, ADT 43, ADT (R) 45, TPS 5 , MDU 6, ADT 36, ADT 37, CORH 3, ASD 16, TKM 9
Samba	(Aug)	VGD 1, TKM 13, CO 52, Imp.White Ponni, ASD 19, ADT 49, CO (R) 50, ADT 39, ADT 38, CO 43, ADT (R) 46, Hybrid CO 4
Navarai	(Dec -Jan)	ADT 53, CO 51, ADT (R) 45, TPS 5 , MDU 6, ADT 36, ADT 37, CORH 3, ASD 16, TKM 9
c. Cuddalore/ Villupuram		
Sornavari	(April -May)	ADT 53, CO 51, ADT 43, ADT (R) 45, TPS 5, MDU 6, ADT 36, ADT 37, CORH 3, ASD 16, TKM 9

Samba	(Aug)	CR 1009 *Sub*1, ADT 50, ADT 51, CR 1009,
		VGD 1,TKM 13, CO 52, Imp.White Ponni,, TRY 3*, Hybrid CO 4,CO (R) 50, ADT 49, CO 43, TRY 1, ADT(R) 46, ADT 38
Navarai	(Dec-Jan)	ADT 53, CO 51, ADT (R) 45, TPS 5, MDU 6, ADT 36, ADT 37, CORH 3, ASD 16, TKM 9
Delta regions of Cuddalore		
Samba	(Aug)	CR 1009, CR 1009 Sub 1, ADT 51
Late samba/Thaladi	(Sep-Oct)	ADT 38, ADT 39, ADT 46, Co 50, Co 52, TKM 13, Improved white Ponni, TRY 3
Salt affected areas (Cuddalore)		TRY 1, TRY 2, TRY 3 and Co 43
III. Western zone		
a. Coimbatore/Tiruppur/Erode		
Kar	(May - Jun)	ADT 53, CO 51, ADT 43, ADT (R) 45, TPS 5 , MDU 6, ADT 36, ADT 37, CORH 3, ASD 16
Samba /Late Samba	(Aug - Sep)	CO 52, TKM 13, VGD 1, CO 43, Imp.White Ponni, Hybrid CO 4, CO (R) 50, ADT(R) 46, ADT 49, ADT 39,
Navarai	(Dec -Jan)	ADT 53, CO 51, ADT (R) 45, TPS 5, MDU 6, ADT 36, ADT 37, CORH 3, ASD 16
b. Karur/Perambalur/Ariyalur		
Kuruvai	(Jun -Jul)	ADT 53, CO 51, ADT 43, ADT (R) 45, TPS 5 , MDU 6, ADT 36, ADT 37, CORH 3, ASD 16, TKM 9
Samba	(Aug)	CR 1009 *Sub*1, ADT 50, ADT 51, CR 1009
Late Samba / Thaladi	(Sep -Oct)	VGD 1,TKM 13, CO 52, CO (R) 50, ADT 39, ADT 38, ADT 49, CO 43, Imp. White Ponni, ADT (R) 46, TRY 3*, Hybrid CO 4, TRY 1*
Navarai	(Dec -Jan)	ADT 53, CO 51, ADT (R) 45, TPS 5 , MDU 6, ADT 36, ADT 37, CORH 3, ASD 16, TKM 9
Delta regions of Karur		
Late Samba	(Sep -Oct)	ADT 38, ADT 39, ADT 46, Co 50, Co 52, TKM 13, Improved white Ponni, TRY 3

Delta regions of Ariyalur		
Samba	(Aug)	CR 1009, CR 1009 Sub 1, ADT 51
Late samba/Thaladi	(Sep-Oct)	ADT 38, ADT 39, ADT 46, Co 50, Co 52, TKM 13, Improved white Ponni, TRY 3
IV. North Western Zone		
a. Salem/Namakkal		
Kar	(May - Jun)	ADT 53, CO 51, ADT 43, ADT (R) 45, TPS 5 , MDU 6, ADT 36, ADT 37, CORH 3, ASD 16, TKM 9
Samba	(Aug)	VGD 1,TKM 13, CO 52, Imp.White Ponni, CO 43, TRY 1*, TRY 3*, CO (R) 50, ADT 49, Hybrid CO 4
Navarai	(Dec - Jan)	ADT 53, CO 51, ADT (R) 45, TPS 5 , MDU 6, ADT 36, ADT 37, CORH 3, ASD 16, TKM 9
b. Dharmapuri/ Krishnagiri		
Kar	(May -Jun)	ADT 53, CO 51, ADT 43, ADT (R) 45, TPS 5 , MDU 6, ADT 36, ADT 37, CORH 3, ASD 16, TKM 9
Samba/Late Samba	(Aug - Oct)	VGD 1,TKM 13, CO 52, Paiyur 1, Imp. White Ponni, ADT 49, ADT 39, ASD 19, CO 43
Navarai	(Dec- Jan)	ADT 53, CO 51, ADT (R) 45, TPS 5 , MDU 6, ADT 36, ADT 37, CORH 3, ASD 16, TKM 9
V. High Altitude zone		
a. The Nilgiris		
Samba	(Jul -Aug)	CO(R)50, CO 52, ADT 39
VI. Southern zone		
a. Pudukottai		
Kuruvai	(Jun -Jul)	ADT 53, CO 51, ADT 43, ADT (R) 45, TPS 5 , ADT 36, ADT 37, CORH 3, ASD 16
Samba	(Aug)	CR 1009 *Sub*1, ADT 50, ADT 51, CR 1009
Late Samba/Thaladi	(Sep - Oct)	VGD 1,TKM 13, CO 52, CO (R) 50, ADT 39, ADT 38, ADT 49, CO 43, Imp.White Ponni, ADT (R) 46, TRY 3*, Hybrid CO 4
Rainfed direct seeded/ Semi-dry	(Jul -Aug)	CR 1009 *Sub1,* CR 1009, ADT 39
Delta regions	(Sep -Oct)	ADT 38, ADT 39, ADT 46, Co 50, Co 52, TKM 13, Improved white Ponni, TRY 3
Salt affected areas		TRY 1, TRY 2, TRY 3 and Co 43

b. Madurai/Dindigul/Theni		
Kar	(May -Jun)	MDU 6, CO 51, ADT 53, ASD 16, MDU 5, ADT43, ADT(R)45
Samba/ Late Samba	(Aug- Sep)	VGD 1,TKM 13, CO 52, CO (R) 50, ADT 39, ADT 38, ADT 49, CO 43, Imp.White Ponni, ADT (R) 46, TRY 3*, Hybrid CO 4
Navarai	(Dec -Jan)	MDU 6, CO 51, ADT 53, ADT 36, ADT 37, ADT(R)45, ASD 16
Semi-dry	(Jul -Aug)	Anna (R) 4, MDU 5, PMK (R) 3
c. Ramanathapuram		
Samba	(Aug)	Imp.White Ponni, TRY 3, TRY 1*, VGD 1, TKM 13, CO 52, Hybrid CO 4, CO (R) 50, CO 43, ADT 39
Rainfed direct seeded & Semidry	(Jul -Aug)	Anna (R) 4, MDU 5, MDU 6, PMK (R) 3, ADT 36, ADT 53, CO 51
d. Virudhunagar		
Samba	(Sep-Oct)	VGD 1,TKM 13, CO 52, CO (R) 50, ADT 39, ADT 38, ADT 49, CO 43, Imp.White Ponni, ADT (R) 46, TRY 3*, Hybrid CO 4
Rainfed direct seeded	(Jul -Aug)	Anna (R) 4, ADT 36, MDU 6, PMK (R) 3, ADT (R) 45
e. Sivaganga		
Semi-dry	(Jul –Aug)	ADT 36, MDU 6, PMK (R) 3, Anna (R) 4, ADT 53, CO 51, ADT 39, TKM 13, VGD 1
f. Tirunelveli, Thoothukudi		
Early kar	(Apr - May)	TPS 5 , ASD 16, ASD 18, ADT 53, CO 51, ADT 43, ADT (R) 45, ADT 36, ADT 37, CORH 3, TKM 9
Kar	(May -Jun)	
Pishanam/Late Pishanam	(Sep-Oct.)	TPS 3, ASD 19, VGD 1, TKM 13, CO 52, CO (R) 50, ADT 39, ADT 38, ADT 49, CO 43, Imp.White Ponni, ADT (R) 46, TRY 1, Hybrid CO 4
Semi dry	(July- Aug)	Anna (R) 4, PMK (R) 3
Drought affected areas (Ramanathapuram, Virudhunagar, Tiruvallur& parts of Madurai)		Anna (R) 4, PMK 3

VII. High Rainfall zone		
a. Kanyakumari		
Kar	(May –Jun)	TPS 5, ASD 16, ADT 36, ASD 18, ADT 43, ADT(R) 45, CORH 3, ADT 53, CO 51,
Pishanam / Late samba	(Sep – Oct)	ASD 19, TPS 3, CR 1009 *Sub1*, CR 1009, CO 43, TRY 1*, TRY 3, VGD 1,TKM 13, ADT 39, CO 52, ADT (R) 46, Hybrid CO 4, CO(R) 50, Imp.White Ponni, CO 43
Semi-dry	(Jul – Aug)	ADT 36, TKM 9

* suitable for salt affected soils

***Note of Caution of the varieties**: ADT43 is recommended for Kar, Sornavari and Kuruvai seasons and should not be grown during cold weather period. Improved white Ponni is also susceptible to blast and care should be taken on plant protection measures. All samba/late samba season varieties are likely to get infected with false smut and hence prophylactic spraying has to be adopted.*

Kuruvai/Navarai/Sornavari : Short duration
late samba/thaladi : Medium duration
Samba : long duration

II. PARTICULARS OF RICE VARIETIES

SHORT DURATION VARIETIES

PARTICULARS	CO 51	MDU 6	TPS 5
Year of Release	2013	2015	2014
Year of Notification	SO.268(E)/28.1.2015 (SVRC) SO.1007(E)/30.3.2017 (CVRC)	SO.1379(E)/27.03.2018	SO.1556(E)/11.06. 2015
Parentage	ADT 43 / RR 272-1745	MDU 5 / ACM 96136	ASD 16 / ADT 37
Duration (Days)	105-110	115-120	118
Average Yield (kg/ha)	6641	6118	6301
1000 grain wt (g)	16.0	17.3	22.7
Grain L/B ratio	3.0	3.09	2.3
Grain type	Medium Slender	Long Slender	Short bold
Morphological Characters			
Habit	Semi dwarf, erect	Erect ,good tillering	Erect
Leaf sheath	Green	Green	Green

Septum	-	Green	Green
Ligule	-	Pale green	Light green
Auricle	Pale Green	Pale green	Light green
Panicle	Intermediate, droopy	Intermediate, droopy	Well exserted panicle
Husk colour	Straw	Straw	Straw
Rice colour	White	White	White
Abdominal white	Occasionally present	Occasionally present	Occasionally present
Grain size (mm)			
Length	5.5	6.8	6.1
Breadth	1.8	2.2	2.7

PARTICULARS	**ADT 36**	**ADT 37**	**ADT 43**
Year of Release	1980	1987	1998
Year of Notification	SO 19(E)/ 14.01.1982	SO.280(E)/ 13.04.1989	SO.425(E)/ 8.6.1999
Parentage	Triveni/ IR 20	BG 280-1 2/ PTB 33	IR 50/ Imp. White Ponni
Duration (Days)	110	105	110
Average Yield (kg/ha)	5500	6200	5900
1000 grain wt (g)	20.6	23.4	15.5
Grain L/B ratio	3.1	1.79	2.81
Grain type	Medium	Short bold	Medium slender
Morphological Characters			
Habit	Semi dwarf,Erect	Semi dwarf, Erect	Semi dwarf, slightly open
Leaf sheath	Green	Green	Light green
Septum	Green	White	Cream
Ligule	Colourless	White	White
Auricle	Colourless	White	-
Panicle	Long compact	Compact	Moderately long,

			Intermediate type, drooping
Husk colour	Straw	Straw	Straw
Rice colour	White	White	White
Abdominal white	Absent	White, Present	Very occasionally present
Grain size (mm)			
Length	7.8	5	5.46
Breadth	2.5	2.8	1.94
Thickness	2.0	1.88	1.63

PARTICULARS	**ADT (R) 45**	**ASD 16**	**ASD 18**
Year of Release	2001	1986	1991
Year of Notification	SO.1134(E)/15.11.2001	SO.867(E)/26.11.1986	SO.615(E)/17.8.1993
Parentage	IR50 / ADT 37	ADT 31/CO 39	ADT 31/IR 50
Duration (Days)	110	110 - 115	105 - 110
Average Yield (kg/ha)	5400	5600	5900
1000 grain wt (g)	17.5	24.2	21.8
Grain L/B ratio	2.98	2.6	3.2
Grain type	Medium slender	Short Bold	Medium slender
Morphological Characters			
Habit	Semi dwarf, erect	Semi dwarf, erect	Semi dwarf
Leaf sheath	Green	Green	Pale Green
Septum	Cream	Green	Light green
Ligule	White	White	White clefted
Auricle	-	Colourless	Pale green
Panicle	Compact	Long Compact	Medium, compact exerted
Husk colour	Straw	Straw	Straw
Rice colour	White	White	White
Abdominal white	Absent	Present	Slightly present

Grain size (mm)			
Length	8.00	7.86	8.64
Breadth	2.16	3.02	2.7
Thickness	1.97	1.96	2.2

PARTICULARS	**Anna (R) 4**	**CORH 3 (hybrid)**	**ADT 53**
Year of Release	2009	2006	2019
Year of Notification	SO.2137(E)/ 31.08.2010	SO.1178(E)/ 20.7.2007	SO.3220(E)/ 5.9.2019
Parentage	Pantdhan 10 x IET 9911	TNAU CMS 2A/CB 87R	ADT 43 / JGL 384
Duration (Days)	105-110	110-115	110-115
Average Yield (kg/ha)	3700	7500	6334
1000 grain wt (g)	25.7	22.0	14.5
Grain L/B ratio	3.45	2.95	3.1
Grain type	Long slender	Medium slender	Medium Slender
Morphological Characters			
Habit	Semi dwarf erect	Semi dwarf	Medium tall, erect
Leaf sheath	Green	Green	Green
Septum	-	-	Cream
Ligule	-	-	White, Split shape
Auricle	Pale green	Pale green	Light green
Panicle	Intermediate	Long, compact, drooping	Intermediate Compact
Husk colour	Straw	Straw	Straw
Rice colour	White	White	White
Abdominal white	Absent	Occasionally present	Absent
Grain size (mm)			
Length	6.90	6.2	5.8
Breadth	2.00	2.1	1.9
Thickness	-	1.2	1.02

PARTICULARS	TKM 11	TRY 2
Year of Release	1998	2001
Year of Notification	SO.425(E)/8.6.1999	SO.1134(E)/15.11.2001
Parentage	C 22/BJ 1	IET6238/IR36
Duration (Days)	110-120	115-120
Average Yield (kg/ha)	3000	5362
1000 grain wt (g)	21.4	22.8
Grain L/B ratio	3.2	3.5
Grain type	Long slender	Long slender
Morphological Characters		
Habit	Erect	Semi dwarf, erect
Leaf sheath	Green	Green
Septum	cream	Light green
Ligule	Colourless	Distinct
Auricle	Light green	Hairy light brown
Panicle	Long, compact, drooping	Compact
Husk colour	-	Straw
Rice colour	White	White
Abdominal white	-	Absent
Grain size (mm)		
Length	9.3	9.1
Breadth	2.3	2.6
Thickness	1.6	1.7

PARTICULARS	ADT (R) 48	MDU 5	PMK (R) 3	TKM 9
Year of Release	2005	*1996*	2003	1978
Year of Notification	SO.599(E)/ 25.04.2006	SO.662(E)/ 17.09.1997	SO.1177(E)/ 25.08.2005	SO.19(E)/ 14.01.1982
Parentage	IET 11412/IR 64	*O.glaberrima*/ Pokkali	UPLRI 7/CO 43	TKM 7 / IR 8
Duration(Days)	94-99	95 - 100	110-115	100-105

Average Yield (Kg / ha)	4800	4500	3025	5019
1000 grain wt(g)	22.0	21.1	26.10	25.13
GrainL/B ratio	3.25	3.12	2.64	2.71
Grain type	Long slender	Medium slender	Long bold	Short bold
Morphological characters				
Habit	Semidwarf erect	Erect	Erect	Dwarf
Leaf sheath	Green	Green	Green	-
Septum	Cream	-	-	Light blue
Ligule	Acute, prominent	Colourless	Pale green	-
Auricle	-	Colourless	-	-
Panicle	Intermediate	Intermediate	Intermediate	Compact
Husk colour	Straw	Straw	Gold yellow with brown streaks	Straw
Rice colour	White	White	White	Red
Abdominal white	Occassionally present	-	-	Present
Grain size(mm)				
Length	9.15	8.45	6.75	8.12
Breadth	2.54	2.7	2.38	2.99
Thickness	1.90	-	2.08	2.01

MEDIUM DURATION VARIETIES

PARTICULARS	Rice CO 52	TKM 13	TRY 3	VGD 1
Year of Release	2017	2015	2010	2019
Year of Notification	SO.1379(E)/27.03.2018	SO.3540(E)/ 22.11.2016	SO.1708(E)/26.07.2012	SO.3220(E)/ 5.9.2019
Parentage	BPT 5204 / CO(R) 50	WGL 32100 / Swarna	ADT 43 / *Jeeraga Samba*	ADT 43/ Seeragasamba
Duration (Days)	130-135	130	135	130 - 135
Average Yield kg/ha	6191	5938	5833	5859
1000 grain wt (g)	14.10	13.8	23.0	8.8 to 8.9
Grain L/B ratio	3.0	2.83	2.58	2.1

Grain type	Medium Slender	Medium Slender	Medium	Short bold
Morphological Characters				
Habit	Erect, Medium Tall	Semi dwarf, erect, non-lodging	Intermediate erect	Semi dwarf, erect
Leaf sheath	Green	Green	Green	Green
Septum	--	Cream	--	Cream
Ligule	--	Split, White	Cleft, White	White
Auricle	White	Present, Colourless	Light Green	light green
Panicle	Long, compact, Droopy	Well exerted, Compact	Intermediate, Compact	Compact and drooping at maturity
Husk colour	Straw	Straw	Straw	Straw
Rice colour	White	White	White	White
Abdominal white	Occasionally present	Occasionally present	Occasionally present	Absent
Grain size (mm)				
Length	5.5	5.44	6.2	3.7
Breadth	1.8	1.92	2.4	1.8
Thickness	--	--	1.5	1.25

PARTICULARS	ADT 49	CO (R) 50	ADT 39	ADT 38
Year of Release	2011	2010	1988	1987
Year of Notification	SO.1708(E)/ 26.07.2012	SO.1708(E)/ 26.07.2012	SO.280(E)/ 13.04.1989	SO.280(E)/ 13.04.1989
Parentage	CR1009/ Jeeraga Samba	CO 43 / ADT 38	IR 8/IR 20	IR 1529-680-3-2/ IR 4432-52-6-4/ IR 7963-30-2
Duration (Days)	130- 135	130-135	120 - 125	130 - 135
Average Yield kg/ha	6173	6338	5000	6200
1000 grain wt (g)	14.0	20.5	18	21

Grain L/B ratio	2.77	2.90	2.9	3.2
Grain type	Medium Slender	Medium	Medium slender	Long Slender
Morphological Characters				
Habit	Semi dwarf, Erect	Medium tall with New plant type	Semi dwarf	Semi dwarf, erect
Leaf sheath	Green	Green	Green	Green
Septum	Cream	-	Light Cream	White
Ligule	Split , white	-	Papery white	White Non-prominent
Auricle	Colourless	Pale green	Non-pigmented	White
Panicle	Compact	Long compact droopy	Medium, Moderately dense	Long moderately
Husk colour	Straw	Straw	Straw	dense
Rice colour	White	White	White	Straw
Abdominal white	Occasionally present	Occasionally present	Absent	Absent

Grain size (mm)				
Length	7.36	6.10	7.6	6.9
Breadth	2.24	2.10	2.3	2.4
Thickness	1.69	-	1.9	2

PARTICULARS	**Imp. White Ponni**	**ADT (R) 46**	**CO 43**	**Paiyur 1**
Year of Release	1986	2002	1982	1982
Year of Notification	SO.280(E)/ 13.04.1989	SO.1177(E)/ 25.08.2005	SO.596(E)/ 13.8.1984	SO.596(E)/ 13.8.1984
Parentage	Taichung 65/2 MayangEbos*80	ADT38 / CO 45	Dasal x IR 20	IR 1721-14/IR 1330-3-3-2
Duration (Days)	135 - 140	135	135 - 140	135-140
Average Yield kg/ha	4500	6656	5200	5900
1000 grain wt (g)	16.4	23.8	20	-

Grain L/B ratio	3.22	3.12	3.5	-
Grain type	Medium slender	Long Slender	Medium slender	Medium slender
Morphological Characters				
Habit	Medium tall	Erect, semi-dwarf	Erect	Medium tall
Leaf sheath	Green	Green	Green	-
Septum	Green	Cream	Green	-
Ligule	White	Long white	White, longer	-
Auricle	Colour less	Pale green	Colour less	-
Panicle	Long drooping	Intermediate	Long drooping	-
Husk colour	Straw	Straw	Straw	Straw
Rice colour	White	White	White	White
Abdominal white	Absent	Absent	Absent	Absent
Grain size (mm)				
Length	8	9.58	8.1	-
Breadth	3	2.46	2.3	-
Thickness	2	1.95	1.8	-

PARTICULARS	**TPS 3**	**Hybrid CO 4**	**TRY 1**	**ASD 19**
Year of Release	1993	2011	1995	1995
Year of Notification	SO.360(E)/ 1.5.1997	SO.1708(E)/ 26.07.2012	SO.92(E)/ 2.2.2001	SO.360(E)/ 1.5.1997
Parentage	RP31-492/LMN	TNAU CMS 23 A / CB 174 R	IR578-172-2-2/ BR-1-2-B-1	Lalnakanda/ IR 30
Duration (Days)	135-140	130 - 135	135-140	127 (120-132)

Average Yield (kg/ha)	5253	7348	5255	5800
1000 grain wt (g)	23.2	20.40	24	18.39
Grain L/B ratio	2.06	2.96	2.6	3.06
Grain type	Short bold	Medium slender	Medium	Short, slender
Morphological Characters				
Habit	Semi dwarf/erect	Semi dwarf	Erect	Semi-dwarf, erect
Leaf sheath	Green	Green	Green	Light green
Septum	Cream	-	White	Cream
Ligule	-	-	White	White
Auricle	-	Pale green	White	Palegreen
Panicle	Long	Long compact droopy	Long, moderately compact	Compact, dense drooping & well exerted
Husk colour	Straw	Straw	Straw	Straw
Rice colour	White	White	White	White
Abdominal white	Present	Occasionally present	Absent	Absent
Grain size (mm)				
Length	7.96	5.67	6.2	8.28
Breadth	3.0	1.91	2.4	2.32
Thickness	2.0	-	1.8	1.72

LONG DURATION VARIETIES

PARTICULARS	Rice ADT 51	CR 1009 *Sub* 1	ADT 50	CR 1009
Year of Release	2017	2015	2012	1982
Year of Notification	S.O. 6318(E) /26.12.2018	SO.3540(E)/ 22.11.2016	SO.268(E)/ 28.01.2015	SO.499(E)/ 08.07.1983
Parentage	BPT 5204 / I.W.Ponni	CR 1009 / FR 13 A (MAB)	BPT 5204 / CR 1009	Pankaj/Jagannath
Duration (Days)	154	150-155	149	155 - 160

Average Yield (kg/ha)	6587	5759	5945	5300
1000 grain wt (g)	23.9	23.0	15.9	23.5
Grain L/B ratio	2.74	2.05	2.56	2.2
Grain type	Medium	Short bold	Medium Slender	Short bold
Morphological Characters				
Habit	Erect Semi dwarf	Semi dwarf tolerance to submergence	Medium tall	Erect
Leaf sheath	Green	Green	Green	Green
Septum	Cream	-	Cream	Green
Ligule	White	-	Split , white	White
Auricle	Present, Light green	Pale Green	Absent	Colourless
Panicle	Well exerted, compact panicle	Intermediate	Compact	Medium drooping
Husk colour	Straw	Straw	Straw	Straw
Rice colour	White	White	White	White
Abdominal white	Absent	Occasionally present	Occasionally present	Absent
Grain size (mm)				
Length	6.3	5.06	7.24	6.9
Breadth	2.3	2.46	3.50	3.1
Thickness	1.56	--	1.65	2.1

CROP MANAGEMENT SYSTEMS OF RICE CULTIVATION IN TAMIL NADU

Rice is cultivated under **puddled** and **un-puddled lowland** situations in Tamil Nadu. 'Transplanting' and 'direct wet seeding' are the two environments under puddled lowland. Whereas, un-puddled lowland cultivation is practiced be different environments like, dry seeding exclusively with rainfall, locally called as 'rainfed rice', with supplemental irrigation during peak vegetative and reproductive phases by the rain water collected / harvested in tanks ('semi-dry rice') and also assured irrigation from canal after 30-45 days of dry situation (also called semi-dry rice) . They are grouped as follows:

1. **Transplanted puddled lowland rice**
2. **Direct seeded lowland rice**
    a. Wet seeded rice in puddled soil
    b. Dry seeded rice in un-puddled soil
        i) Rainfed
        ii) Semi dry - supplemental irrigation
        iii) Semi dry - canal irrigation* (contingent crop)

3. **Dry Seeded Upland Rice** – This system of rice cultivation is there in areas with high rainfall (like Assam and NE frontiers of India) where the land is slopy and terraced and there is no possibility for bunding to stagnate the water. Grain yield is poor due to loss of nutrients and soil mainly caused by water erosion. Moisture availability is mostly at saturation or at wet range. There is very limited area in Dharmapuri district, Tamil Nadu.

4. **Deep Water Rice** cultivation exists in certain pockets of Nagapattinam and Thiruvarur districts particularly during NE monsoon with heavy downpour.

1. TRANSPLANTED PUDDLED LOWLAND RICE

TRANSPLANTED RICE

1.1. Nursery Management

1.1.1. Wet Nursery Nursery Area

Select 20 cents (800 m^2) of land area near to water source for raising seedlings for one hectare.

Seed Rate

30 kg for long duration

40 kg for medium duration

60 kg for short duration varieties and 20 kg for hybrids

Seed Treatment

a. Treat the seeds in Carbendazim or Pyroquilon or Tricyclozole solution at 2 g/l of water for 1 kg of seeds. Soak the seeds in water for 10 hrs and drain excess water.

b. This wet seed treatment gives protection to the seedlings up to 40 days from seedling disease such as blast and this method is better than dry seed treatment.

c. If the seeds are required for sowing immediately, keep the soaked seed in

gunny in dark and cover with extra gunnies and leave for 24 hrs for sprouting.

d. **Seed Treatment with *Pseudomonas Fluorescens***: Treat the seeds with talc-based formulation of *Pseudomonas fluorescens* 10g / kg of seed and soak in 1lit of water overnight. Decant the excess water and allow the seeds to sprout for 24 hrs and then sow.

e. **Seed treatment with biofertilizers:** Five packets (1kg/ha) each of *Azospirillum* and Phosphobacteria or five packets (1kg/ha) of Azophos bioinoculants are mixed with sufficient water wherein the seeds are soaked overnight before sowing in the nursery bed (The bacterial suspension after decanting may be poured over the nursery area itself).

Carrier based formulation: Treat the seeds of one hectare with 1 kg each of biofertilizers *viz., Azsopirillum,* Phosphobacteria, (or) Azophos, Silicate solubilizing bacteria (SSB) / Potash bacteria (KRB) using rice gruel, shade dry for 30 minutes before sowing.

Liquid formulation: Treat one hectare of seeds with 125 ml of each biofertilizers *viz., Azsopirillum,* Phosphobacteria (or) Azophos, Silicate solubilizing bacteria (SSB) / Potash bacteria (KRB) shade dry for 30 minutes before sowing.

- Biocontrol agents are compatible with biofertilizers
- Biofertilizers and biocontrol agents can be mixed together for seed soaking
- Fungicides and biocontrol agents are incompatible

Forming Seed Beds

- Mark plots of 2.5m breadth with channels 30 cm wide all around the seedbeds.
- Length of the seed bed may vary from 8 to 10m according to soil and slope of the land.
- Collect the puddled soil from the channel and spread on the seed beds or drag a heavy stone along the channel to lower it, so that the seed bed is at a higher level.
- Level the surface of the seed bed, so that the water drains into the channel.

Sowing

- Sow the sprouted seeds uniformly on the seed bed having thin film of water in the surface.

Water Management

- Drain the water 18 to 24 hrs after sowing
- Care must be taken to avoid stagnation of water on the seed bed.
- Allow enough water to saturate the soil from 3rd to 5th day. From 5th day onwards, increase the water depth to 1.5 cm depending on the height of the seedlings.
- Thereafter maintain 2.5 cm depth of water.

Weed Management

- Apply any one of the pre-emergence herbicides *viz*., Pyrazosulfuron ethyl @ 20 g/ha on 3rd or 4th day after sowing to control weeds in the lowland nursery. Keep a thin film of water and allow it to disappear. Avoid drainage of water. This will control germinating weeds.
- Pre-emergence herbicide Butachlor 1.0 l/ha (or) Pendimethalin 1.0 l/ha. Herbicides should be applied on 8 DAS with thin layer of water in the field.

Nutrient Management

- Apply 1 tonne of fully decomposed FYM or compost to 20 cents nursery and spread the manure uniformly on dry soil.
- Basal application of DAP is recommended when the seedlings are to be pulled out in 20-25 days after sowing in less fertile nursery soils.
- For that situation, before the last puddling, apply 40 kg of DAP and if not readily available, apply straight fertilizers 16 kg of urea and 120 kg of super phosphate.
- If seedlings are to be pulled out after 25 days, application of DAP is to be done 10 days prior to pulling out.
- For clayey soils where root snapping is a problem, 4 kg of Gypsum and 1 kg of DAP/cent can be applied at 10 days after sowing.
- Soil application of 100 g $ZnSO_4$ /cent can be followed.

1.1.2. Dry nursery

- Dry ploughed field with fine tilth is required.
- Nursery area with sand and loamy soil status is more suitable for this type of nursery.
- Area 20 cents.

- Plots of 1 to 1.5 m width of beds and channels may be formed. Length may be according to the slope and soil. Raised beds are more ideal if the soil is clayee in nature.
- Seed rate and seed treatment as that of wet nursery.
- Sowing may be dry seeding. Seeds may be covered with sand and finely powdered well decomposed farm yard manure.
- Irrigation may be done to wet the soil to saturation.
- Optimum age for transplanting – 4th leaf stage
- This type of nursery is handy in times of delayed receipt of canal water.
- During transplanting seedlings may be dipped in 2% $ZnSO_4$ or ZnO for 30 minutes and then transplanted.

1.2. Main Field Management

1.2.1. Land Preparation

- Plough the land during summer to economize the water requirement for initial preparation of land.
- Flood the field 1 or 2 days before ploughing and allow water to soak in. Keep the surface of the field covered with water.
- Keep water to a depth of 2.5 cm at the time of puddling.
- Special technologies for problem soils:

a) For fluffy paddy soils: compact the soil by passing 400kg stone roller or oil-drum with stones inside, eight times at proper moisture level (moisture level at friable condition of soil which is approximately 13 to18%) once in three years, to prevent the sinking of draught animals and workers during puddling.

b) For sodic soils with pH values of more than 8.5, plough at optimum moisture regime, apply Gypsum at 50% gypsum requirement uniformly, impound water, provide drainage for leaching out soluble salts and apply green leaf manure at 5 t/ha, 10 to 15 days before transplanting. Mix 37.5 kg of zinc sulphate per ha with sand to make a total quantity of 75 kg and spread the mixture uniformly on the leveled field. Do not incorporate the mixture in the soil. Rice under sodic soil responds well to these practices.

c) For saline soils with EC values of more than 4 dS/m, provide lateral and main drainage channels (60cm deep and 45cm wide), apply green leaf manure at 5 t/ha at 10 to 15 days before transplanting and 25% extra dose of nitrogen in addition to recommended P and K and $ZnSO_4$

d) For acid soils apply lime based on the soil analysis for obtaining normal rice yields. Lime is applied 2.5 t/ha before last ploughing. Apply lime at this rate to each crop up to the 5th crop.

1.2.2. Stand Establishment

Optimum Age of Seedlings for Quick Establishment

- Optimum age of the seedlings is 18-22 days for short, 25-30 days for medium and 35-40 days for long duration varieties.

Pulling out the seedlings

- Pull out the seedlings at the appropriate time (4th leaf stage).
- Pulling at 3rd leaf stage is also possible. These seedlings can produce more tillers, provided enough care taken during the establishment phase (See section 1.8 Integrated Crop Management (ICM) - Rice-SRI) through thin film of water management and perfect leveling of main field.
- Transplanting after 5th and higher order leaf numbers will affect the performance of the crop and grain yield. Then they are called as 'aged seedlings'. Special package is needed to minimize the grain yield loss while planting those aged seedlings.

Root Dipping

- Prepare the slurry with 5 packets (1 kg/ha) each of *Azospirillum* and Phospho bacteria or 5 packets of (1 kg/ha) Azophos inoculant in 40 lit. of water and dip the root portion of the seedlings for 15 - 30 minutes in bacterial suspension and transplant.

Planting Seedlings in the Main Field

Soil	Medium and low fertility			High fertility		
Duration	Short	Medium	Long	Short	Medium	Long
Spacing (cm)	15x10	20x10	20x15	20x10	20x15	20x20
Hills / m^2	66	50	33	50	33	25

- Transplant 2-3 seedlings/hill for short duration and 2 seedlings/hill for medium and long duration varieties
- Shallow planting (3 cm) ensures quick establishment and more tillers.
- Deeper planting (> 5cm) leads to delayed establishment and reduced tillers.
- Line planting permits rotary weeding and its associated benefits.
- Allow a minimum row spacing of 20 cm to use rotary weeder.
- Fill up the gaps between 7th and 10th DAT.

Management of Aged Seedlings*

* **Which developed tillers / underwent node elongation in the nursery itself and About half of its leaf producing capacity may be already over.**

- Follow the spacing recommended to medium and low fertility soil
- Plant two to three seedlings per hill
- Avoid cluster planting of aged seedlings, which are hindering the formation of new tillers.

- New tillers alone are capable of producing normal harvestable panicle. Weak panicle may appear in the mother culm within three weeks after transplanting and vanishes well before harvest.
- To encourage the tiller production, enhance the basal N application by 50% from the recommended and thereafter follow the normal schedule recommended for other stages.

Gap Filling

- Fill the gaps if any within 7 - 10 days after planting. Nutrient management Application of organic manures
- Apply 12.5 t of FYM or compost or green leaf manure @ 6.25 t/ha.
- If green manure is raised @ 50 kg seeds/ha *in situ,* incorporate it to a depth of 15 cm using a green manure trampler or tractor.
- In the place of green manure, press-mud / composted coir-pith can also be used.

1.2.3. Nutrient Management

Stubble Incorporation

- Apply 10 kg N/ha (22 kg urea) at the time of first puddling while incorporating the stubbles of previous crop to compensate immobilization of N by the stubbles.
- This may be done at least 10 days prior to planting of subsequent crop. This recommendation is more suitable for double crop wetlands, wherein, the second crop is transplanted in succession with short turn around period.

Biofertilizer Application

- Broadcast 10 kg of soil based powdered BGA flakes at 10 DAT for the dry season crop. Maintain a thin film of water for multiplication.

- Raise Azolla as a dual crop by inoculating 250 kg/ha 3 to 5 DAT and then incorporate during weeding for the wet season crop.
- Mix 2 kg each of biofertilizers *viz., Azsopirillum,* Phosphobacteria (or) Azophos, Silicate solubilizing bacteria (SSB) / Potash releasing bacteria (KRB) with 25 kg of FYM and 25 kg of sand and broad cast uniformly before transplanting and
- *Pseudomonas fluorescens* (Pf 1) at 2.5 kg/ha mixed with 50 kg FYM and 25 kg of soil and broadcast the mixture uniformly before transplanting.

Application of inorganic fertilizers

- Apply fertilizer nutrients as per STCR-IPNS recommendations for desired yield target (Appendix I) (or)
- N dose may be through Leaf Color Chart (**LCC**)*
- P & K may be through Site Specific Nutrition Management by Omission plot technique**
- If the above recommendation are not able to be followed, adopt blanket recommendation as follows:

Nutrients	N	P_2O_5	K_2O
	(kg/ha)		
Short duration varieties (**dry season**)			
a) Cauvery delta & Coimbatore tract	150	50	50
b) For other tracts	120	40	40
Medium and long duration varieties (**wet season**)	150	50	50
Hybrid rice	175	60	60
Low N responsive cultivars (like Improved White Ponni)	75*	50	50

* For Ponni, N should be applied in three splits at AT, PI and H stages** in addition to GLM or FYM application.
**Phenological stages of rice (days after sowing)

Stages	Short (105)	Medium (135)	Long (150)
Active Tillering (AT)	35-40	50-55	55-60
Panicle Initiation (PI)	45-50	70-75	85-90
Heading (H)	70-75	100-105	115-120

N Management Through LCC

- Time of application is decided by LCC score
- Take observations from 14 DAT in transplanted rice or 21 DAS in direct seeded rice.
- Repeat the observations at weekly intervals up to heading
- Observe the leaf colour in the fully opened third leaf from the top as index leaf.
- Match the leaf color with the colours in the chart during morning hours (8-10 am).
- Take observation in 10 places.
- LCC critical value is 3.0 in low N response cultures like White Ponni and 4.0 in other cultivars and hybrids
- When 6/10 observations show less than the critical colour value, N can be applied as per the following recommendation : Application of 25 kg N ha^{-1} (1 bag urea) at 7 DAT followed by N @ 40 kg ha^{-1} each time for kuruvai/ short duration rice / 30 kg ha^{-1} each time for medium & long duration rice as and when the leaf colour value falls below the critical value of 4 for varieties and hybrids and critical value of 3 for white Ponni, monitored from 14 DAT.
- For aged seedlings : Basal application of 35 kg N per ha is recommended to avoid yield loss when seedlings aged 35 - 45 days are used for transplanting and the LCC based N management can be followed from 14 DAT.

****Recommendation of P&K fertilizer rates based on SSNM approach for rice growing tracts of Tamil Nadu (other than Cauvery Delta)**

Sl. No.	Location	Calibrated SSNM fertilizer dose (kg/ha)*	
		P_2O_5	K_2O
1	Cauvery delta		
	(i) Old delta	**35**	**50**
	(ii) New delta	**35**	**80**
2	Coimbatore District		
	(i) General	30	40
	(ii) Annamalai block	30	80
3	Killikulam	30	50
4	Trichy	35	50

5	Ambasamudram	40	50
6	Bhavanisagar	20	25
7	Paiyur	25	45
8	Yethapur	30	45
9	Aruppukottai	20	30
10	Cuddalore	30	50

** The above SSNM based fertilizer P and K arrived based on yield response are recommended for specific soil series prevailing in different rice growing areas for adoption by farmers

Split Application of N and K

- Apply N and K in four equal splits viz., basal, tillering, panicle initiation and heading stages.
- Tillering and Panicle initiation periods are crucial and should not be reduced with the recommended quantity.
- N management through **LCC** may be adopted wherever chart is available

Application of P Fertilizer

- P may be applied as basal and incorporated.
- When the green manure is applied, rock phosphate can be used as a cheap source of P fertilizer. If rock phosphate is applied, the succeeding rice crop need not be supplied with P. Application of rock phosphate + single super phosphate or DAP mixed in different proportions (75:25 or 50:50) is equally effective as SSP or DAP alone.

Application of micronutrients

Soil Application

- Soil application of 25 kg Zinc sulphate/ha mixed with 50 kg dry sand or apply 25 kg of TNAU Wetland rice MN mixture/ha enriched in FYM at 1:10 ratio incubated for 30 days at friable moisture, just before transplanting.
- It is enough to apply 12.5 kg zinc sulphate /ha, if green manure (6.25 t/ha) or enriched FYM, is applied.
- For saline and sodic acid 37.5 kg $ZnSO_4$ can be applied.
- Apply 500 kg of gypsum/ha (as source of Ca and S nutrients) at last ploughing. Application of 50 kg $FeSO_4$ + 12.5 t FYM /ha, 40 kg S as gypsum can be followed, if the soils are deficient in respective elements.
- For Cauvery delta zone, application of 5 kg $CuSO_4$ can be recommended.

Foliar Nutrition

- Foliar spray of 1% urea + 2% MAP + 1% KCl at Panicle Initiation (PI) and 10 days after first spray to inprove grain filling rate and yield in all varieties.
- If deficiency symptom appears in the standing crop (15 days after transplanting) foliar application of 0.5% zinc sulphate + 1.0% urea can be given at 7-10 days for short duration and 15 days interval for medium and long duration crop until the Zn deficiency symptoms disappear.
- Biofortification strategies; For biofortification of Zn in rice, the efficient cultivars viz., CO51, CO47, ADT 47, ADT 37 may be grown with the basal soil application of 50 kg $ZnSO_4$ alongwith foliar spraying of 0.50% $ZnSO_4$ thrice at 50% flowering, milky and dough stages to enrich the grain Zn content.

Nutrient Deficiency / Toxicity Symptoms

- **Nitrogen Deficiency**: Plants become stunted and yellow in appearance first on lower leaves. In case of severe deficiency the leaves will turn brown and die. Deficiency symptoms first appear at the leaf-tip and progress along the midrib until the entire leaf is dead.
- **Potassium Deficiency**: Bluish green leaves - when young, older leaves irregular. Chlorotic and necrotic areas - grain formation is poor - weakening of the straw which results in lodging.
- **Magnesium Deficiency:** Leaves are chlorotic with white tips.
- **Zinc Deficiency:** Lower leaves have chlorotic particularly towards the base. Deficient plants give a brown rusty appearance.
- **Copper Deficiency:** Leaves develop chlorotic streaks on either side of the midrib and appearance of dark brown necrotic lesions on leaf tips. Unfolding of the new leaves will also be seen.
- **Iron Toxicity:** Brown spots on the lower leaves starting from tips and proceeding to the leaf base and turns into green or orange purple leaves and spreading to the next above leaves.

Neem Treated Urea and Coal-Tar Treated Urea

Blend the urea with crushed neem seed or neem cake 20% by weight. Powder neem cake to pass through 2mm sieve before mixing with urea. Keep it overnight before use (or) urea can be mixed with gypsum in 1:3 ratios, or urea can be mixed with gypsum and neem cake at 5:4:1 ratio to increase the nitrogen use efficiency. For treating 100 kg urea, take one kg coal-tar and 1.5 litres of kerosene. Melt coal-tar over a low flame and dissolve it in kerosene. Mix urea with the solution thoroughly in a plastic container, using a stick. Allow it to dry in shade on a polythene sheet. This can be stored for a month and applied basally.

N management through LCC for sodic soil

In the case of sodic soils, LCC critical value is 4.0 for varieties and 5.0 for the hybrids.

Other Special Cultural Practices (Contingent Plan)

Application of Pink Pigmented Facultative Methylotroph (*Methylobacterium* sp.) as seed treatment (@ 200 g / 10 kg seeds), soil application (@ 2 kg / ha) and foliar spray (@ 500 ml / ha) at panicle initiation and flag leaf stages for alleviation of water stress effects in both SRI and transplanted system of rice cultivation.

1.2.4. Weed Management

- Use of rotary weeder from 15 DAT at 10 days interval. It saves labour for weeding, aerates the soil and root zone, prolongs the root activity, and improves the grain filling though efficient translocation and ultimately the grain yield.
- Cultural practices like dual cropping of rice-azolla, and rice-green manure (described in wet seeded rice section 2.5 & 2.6 of this chapter) reduces the weed infestation to a greater extent.
- Summer ploughing and cultivation of irrigated dry crops during post-rainy periods reduces the weed infestation.

Pre-Emergence Herbicides

- Use Butachlor 1.25kg/ha or Anilophos 0.4kg/ha as pre-emergence application. Alternatively, pre-emergence application of herbicide mixture viz., Butachlor 0.6kg + 2,4 DEE 0.75kg/ha, or Anilophos + 2, 4 DEE 'ready-mix' at 0.4kg/ha followed by one hand weeding on 30 - 35 DAT will have a broad spectrum of weed control.
- Any herbicide has to be mixed with 50kg of dry sand on the day of application (3 - 4 DAT) and applied uniformly to the field with thin film water on the 3rd DAT. Water should not be drained for next 2 days from the field (or) fresh irrigation should not be given.
- Pre-emergence application of Pretilachor at 1.0 kg ha^{-1} on 3 DAT + weeding with 'Twin-Row' rotary weeder at 40 DAT.
- PE Pyrazosulfuron ethyl @ 20 g ha^{-1} on 3 DAT + hand weeding (HW) on 45 DAT.
- PE butachlor 0.75 kg ha^{-1} + Bensulfuron methyl 50 g ha^{-1} on 3 DAT + HW on 45 DAT
- PE Oxadiazon 87.5 g ha^{-1} followed by Post emergence (POE) 2, 4-D 1 kg / ha^{-1} along with hand weeding on 35 DAT.

- PE Butachlor 0.75 kg per hectare + Bensulfuron methyl 50 g ha^{-1} on 3 DAT followed by mechanical weeding on 45 DAT is effective for broad spectrum weed control.
- Crop growth and yield were enhanced by Butachlor 1.2 + 2,4-DEE 1.5 lit ha^{-1} with 100% inorganic nitrogen.
- Conventional tillage of one dry ploughing and two passes of cage wheel puddling combined with pre-emergence application of butachlor at 1.25 kg ha^{-1} under lowland situation.
- Stale bed preparation by pre-puddling minimum tillage with glyphosate combine with post- plant pre emergence Butachlor 1.25 kg ha^{-1} resulted in increased rice grain yield, net income and B: C ratio in rice-rice cropping.
- If pre-emergence herbicide application is not done, hand weeding has to be done on 15^{th} DAT.
- 2,4-D Sodium salt (Fernoxone 80% WP) 1.25 kg/ha dissolved in 625 litres with a high volume sprayer, three weeks after transplanting or when the weeds are in 3 - 4 leaf stage.
- Early post emergence application of Bispyripac sodium 40 g ha^{-1} (2-3 leaf stage of weeds) + Hand weeding on 45 DAT
- Pre emergence application of Pretilachlor @ 750 g / ha at 3 DAT followed by post emergence application of Chlorimuron methyl + Metsulfuron methyl @ 4 g/ha on 25 DAT had higher weed contol efficiency and net return.
- Pre emergence application of Butachlor @ 1.0 kg / ha on 3 DAT + Finger type single row or double row rotary weeders weeding on 45 DAT. If pre-emergence application is avoided, then finger type single row/double row rotary weeders weeding on 20 and 40 DAT.

1.2.5. Water Management

- Puddling and leveling minimizes the water requirement
- Plough with tractor drawn cage wheel to reduce percolation losses and to save water requirement up to 20%.
- Maintain 2.5cm of water over the puddle and allow the green manure to decompose for a minimum of 7 days in the case of less fibrous plants like sunnhemp and 15 days for more fibrous green manure plants like Kolinchi (*Tephrosia purpurea*).
- At the time of transplanting, a shallow depth of 2cm of water is adequate since high depth of water will lead to deep planting resulting in reduction of tillering.
- Maintain 2 cm of water up to seven days of transplanting.

- After the establishment stage, cyclic submergence of water (as in table) is the best practice for rice crop. This cyclic 5cm submergence has to be continued throughout the crop period.

Days after disappearance of ponded water at which irrigation is to be given

Soil Type	Summer	Winter
Loamy	1 day	3 days
Clay	Just before/immediately after disappearance	1 - 2 days

- Moisture stress due to inadequate water at rooting and tillering stage causes poor root growth leading to reduction in tillering, poor stand and low yield.
- Critical stages of water requirement in rice are a) panicle initiation, b) booting, c) heading and d) flowering. During these stages, the irrigation interval should not exceed the stipulated time so as to cause the depletion of moisture below the saturation level.
- During booting and maturity stages continuous inundation of 5cm and above leads to advancement in root decay and leaf senescence, delay in heading and reduction in the number of filled grains per panicle and poor harvest index.
- Provide adequate drainage facilities to drain excess water or strictly follow irrigation schedule of one day after disappearance of ponded water. Last irrigation may be 15 days ahead of harvest.

Precautions for Irrigation

- The field plot size can be 25 to 50 cents depending on the source of irrigation.
- Field to field irrigation should be avoided. Field should be irrigated individually from a channel.
- Small bund may be formed parallel to the main bund of the field at a distance of 30 to 45 cm within the field to avoid leakages of water through main bund crevices.
- To minimize percolation loss, the depth of stagnated water should be 5 cm or less.
- In water logged condition, form open drains, about 60 cm in depth and 45 cm width across the field.
- Care should be taken not to allow development of cracks.
- In canal command area, conjunctive use of surface and ground water may be resorted to for judicious use of water.

Alternate Wetting and Drying Irrigation (AWDI)

- Safe Alternate Wetting and Drying Irrigation (AWDI) is to monitor the depth of ponded water on the field using 'Field Water Tube' (FWT) which is made of 40 cm long plastic pipe with a diameter of 15 cm so that water table is easily visible.
- Tube is perforated with 0.5 cm diameter holes in the bottom and the top 15 cm portion is non-perforated.
- Above the perforated portion, markings are made for 5 cm so that irrigation at 5 cm depth could be done.
- One Field Water Tube is required for adopting the AWDI in an area of 1 acre. The FWT is installed in the field using mallet and it is inserted upto the perforated portion buried inside the soil. The soil inside the tube is to be removed.
- FWT to be installed near the field levies so that the water level inside the FWT could be monitored easily.
- Safe AWDI of 10 cm depletion in light soils and 15 cm depletion in heavy soils was found to improve the water use efficiency in rice.

Non-Puddled Machine Transplanted Rice (NPTR)

- Traditional transplanted rice cultivation requires 1200-1400 mm of water of which puddling consumes 250 mm of water.
- In NPTR, puddling is replaced with dry ploughing (using cultivator and rotavator) followed by laser leveling and wetting.
- Soil is allowed to settle for 12-24 hrs before transplanting very light irrigation is given again to maintain a uniform depth of 1 cm standing water.
- Machine transplanting is adopted in the wetted soil.
- Alternate Wetting and Drying Irrigation method is followed for water management.
- Though there was a yield reduction, considerable water saving under NPTR from 120 to 245 mm.

1.3. Insect Management: See Crop Protection Chapter

1.4. Disease Management: See Crop Protection Chapter

1.5. Harvesting

- Taking the average duration of the crop as an indication, drain the water from the field 7 to 10 days before the expected harvest date as draining hastens maturity and improves harvesting conditions.
- When 80% of the panicles turn straw colour, the crop is ready for harvest. Even at this stage, the leaves of some of the varieties may remain green.
- Confirm maturity by selecting the most mature tiller and de-husk a few grains. If the rice is clear and firm, it is in hard dough stage.
- When most of the grains at the base of the panicle in the selected tiller are in a

- hard dough stage, the crop is ready for harvest. At this stage harvest the crop, thresh and winnow the grains.
- Dry the grains to 12% moisture level for storage. Grain yield in rice is estimated only at 14% moisture for any comparison.
- Maturity may be hastened by 3-4 days by spraying 20% NaCl a week before harvest to escape monsoon rains.

1.6. SeedlingThrowing Method of Stand Establishment

- 20 days old seedlings of short duration rice varieties
- Requirement of seedlings will be approximately 20% more than the line planting or equal to random planting.
- The seedlings are thrown into the puddled leveled field by labour without using force.
- Suitable for all seasons except *Thaladi* or heavy rain season.
- 50% labour shaving as compared to line planting and 35% to random planting.
- Up to 7-10 days of seedling throwing care should be taken to maintain thin film of water (similar to wet seeded rice).
- Other cultural operations are same as in transplanted rice
- Grain yield will be equal to line planted crop and 10-12% higher than random planted crop.

1.7. Transplanted Hybrid Rice

Seed rate	20 kg per hectare
Nursery	Basal application of DAP at 2 kg/cent of nursery area. Sparse sowing of seeds at one kg/cent of nursery area will give robust seedlings with 1-2 tillers per seedling at the time of planting. If the soil is heavy, apply 4 kg gypsum/cent of nursery area, 10 days before pulling of seedlings.
Age of seedling	20 to 25 days
Spacing (cm)	20 x 10 (50 hills/m^2) or 25 x 10 (40 hills/m^2) according to soil fertility
Seedlings/ hill	One (along with tillers if already produced)
Fertilizer	175:60:60 kg N, P_2O_5 and K_2O/ha

Other package of practices: same as in transplanted rice varieties.

1.8. INTEGRATED CROP MANAGEMENT (ICM) - RICE (SRI - System of Rice Intensification)

1.8.1 Season

- Dry season with assured irrigation is more suitable.
- Difficulty in crop establishment may be seen in areas with heavy downpour (NE Monsoon periods of Tamil Nadu

1.8.2. Varieties

- Hybrids and varieties with heavy tillering feature

1.8.3. Nursery

1.8.3.1. Seed Rate

- 5-7 kg/ha for single seedling per hill
- 12 -15 kg/ha for two seedlings per hill wherever difficulty in establishment of rice is seen
-

1.8.3.2. Mat Nursery Preparation

- *Preparation of nursery area:* Prepare 100 m^2 nursery to plant 1 ha. Select a level area near the water source. Spread a plastic sheet or used polythene gunny bags on the shallow raised bed to prevent roots growing deep into soil.
- *Preparation of soil mixture:* Four (4) m^3 of soil mix is needed for each 100 m^2 of nursery. Mix 70% soil + 20% well-decomposed pressmud / bio-gas slurry / FYM + 10% rice hull. Incorporate 1.5 kg of powdered DAP or 2 kg 17-17-17 NPK fertilizer in the soil mixture.
- *Filling in soil mixture:* Place a wooden frame of 0.5 m long, 1 m wide and 4 cm deep divided into 4 equal segments on the plastic sheet or banana leaves. Fill the frame almost to the top with the soil mixture.
- *Seed Treatment with biofertilizers* : Five packets (1 kg/ha) of *Azospirillum* and five packets (1 kg/ha) of Phosphobacteria or five packets (1 kg/ha) of Azophos. Biofertilizers are mixed with water used for soaking and kept for 4 hrs. The bacterial suspension after draining may be sprinkled in the nursery before sowing the treated seeds
- *Pre-germinating the seeds 2 days before sowing:* Soak the seeds for 24 hr, drain and incubate the soaked seeds for 24 hr, sow when the seeds sprout and radicle (seed root) grows to 2-3 mm long.
- *Soil application of biofertilizers :* Application of *Azospirillum* @ 2 kg and Arbuscular mycorrhizal fungi @ 5 kg for 100 m^2 nursery area
- *Sowing:* Sow the pre-germinated seeds weighing 90 -100 g / m^{-2} (100g dry seed may weigh 130g after sprouting) uniformly and cover them with dry soil to a thickness of 5mm. Sprinkle water immediately using rose can to soak the bed

and remove the wooden frame and continue the process until the required area is completed.

- *Watering:* Water the nursery with rose can as and when needed (twice or thrice a day) to keep the soil moist. Protect the nursery from heavy rains for the first 5 DAS. At 6 DAS, maintain thin film of water all around the seedling mats. Drain the water 2 days before removing the seedling mats for transplanting.
- *Spraying fertilizer solution* (optional): If seedling growth is slow, sprinkle 0.5% urea + 0.5% zinc sulphate solution at 8-10 DAS.
- *Lifting seedling mats:* Seedlings reach sufficient height for planting at 15 days. Lift the seedling mats and transport them to main field.
- For elite seedling production under modified mat nursery: seed fortification with 1.0% KCl mixed with native soil and powdered DAP @ 2.0 kg per cent along with *Pseudomonas* 240 g/ cent followed by drenching with 0.5 % urea solution on 9 DAS

1.8.4. Main Field Preparation

- Puddled lowland prepared as described in transplanted section
- Perfect leveling is a pre-requisite for the water management proposed hereunder

1.8.5. Transplanting

- 1-2 seedlings of 14-15 days old
- Square planting of 25 x 25 cm (10 x 10 inch)
- Fill up the gaps between 7th and 10th DAT.
- Transplant within 30 minutes of pulling out of seedlings.
- There may be difficulty in crop establishment in areas with heavy downpour (North East Monsoon periods of Tamil Nadu)

1.8.6. Irrigation Management

- Irrigation to be done so as to moist the soil during early period upto 10 days
- Restoring irrigation to a maximum depth of 2.5 cm after development of hairline cracks in the soil until panicle initiation (PI)
- Increasing irrigation depth to 5.0 cm after PI one day after disappearance of ponded water till completion of flowering stage.
- Placing of water pipe as safe alternate wetting and drying irrigation (AWDI) reduces the total number of irrigation given to rice crop (Perforated water pipe is placed 10 – 15 cm below the soil surface and the water lever moderation observed for time of irrigation)

1.8.7. Weed Management

- Using rotary weeder / Cono weeder / power operated two row weeder
- Moving the weeder with forward and backward motion to burry the weeds and as well as to aerate the soil at 7-10 days interval from 10-15 days after planting on either direction of the row and column.
- Manual weeding is also essential to remove the weeds closer to rice root zone.

1.8.8. Nutrient Management

- As per transplanted rice.
- Use of LCC has more advantage in N management.
- Green manure and farm yard manure application will enhance the growth and yield of rice in this system approach.
- Under sodic soils, during rotary weeding, apply Azophos @ 2.2 kg/ha and PPFM as foliar spray @ 500 ml/ha

1.8.9. Other package of practices as recommended to transplanted rice

- STCR based fertilizer recommendation for transplanted rice (for some selected districts) is given in the **Appendix I.**

2. WET SEEDED PUDDLED LOWLAND RICE

WET SEEDED RICE

2.1 Area

- Direct wet seeding can be followed in all the areas wherein transplanting is in vogue.

2.2 Season

- As that of transplanted rice

2.3 Field Preparation

- On receipt of showers during the months of May - July repeated ploughing should be carried out so as to conserve the moisture, destroy the weeds and break the clods.
- After inundation puddling is to be done as per transplanting. More care should be taken to level the field to zero level.
- Stagnation of water in patches during germination and early establishment of the crop leads to uneven crop stand.
- Land levelling helps in efficient weed management and water management practices.
- Provision of shallow trenches (15 cm width) at an interval of 3m all along the field will facilitate the draining of excess water at the early growth stage.

2.4. Varieties

All the varieties recommended for transplanting can do well under direct wet seeded conditions also. However, the following varieties are more suited.

Varieties	Duration (days)	Time of sowing
Ponmani	160 to 165	1st to 30th August for *Samba*
CO 43, IR20, ADT 38 ADT 39, Ponni, Improved White Ponni	125 to135	1st to 30th September for *Thaladi*
ADT 36, ADT 37	105 to 110	1st to 10th June for *Kuruvai* 1st to 10th October for late *Thaladi*

2.5. Sowing

- Follow a seed rate of 60 kg / ha
- Pre-germinate the seeds as for wet nursery
- Seed treatments as adopted for transplanted rice
- Sow the seeds by **drum seeder** or broadcast uniformly with thin film of water.
- Dual cropping of rice-green manure is economic for nutrient budget and efficient for grain production. For this method use 'TNAU Rice-Green manure seeder'.

TNAU Rice cum Green Manure Seeder

- Manually drawn seeder developed at TNAU to sow pre-germinated Paddy and green manure Daincha crop (*Sesbania aculeata*) in alternate rows in puddled soil.
- On attaining a height of 40 cm after about one month of sowing the Daincha crop was trampled by using long handled IRRI design Cono weeder.
- Seeder sows four paddy rows and four Daincha rows in a single pass.
- Using one (male) operator and two women labourers half of ha can be sown with the seeder in a day of 8 hours.
- Paddy was sown at 60 kg/ha seed rate and green manure crop at 20 kg/ha seed rate. The distance between the adjacent rows is 12.5 cm. When compared to sole wet seeded rice, weeds are better controlled in the wet seeded rice inter-cropped with green manure.
- Also intercropping of rice with green manure Daincha and incorporation at 7.0 t/ha enhanced the growth and yield of rice and beneficial in terms of N addition (40 kg N /ha).
- There is greater possibility of intercropping green manures during early stage of rice crop with increased grain yield by one ton / ha.

2.6. After Cultivation

- Thinning and gap filling should be done 14 - 21 days after sowing, taking advantage of the immediate rain.
- If dual cropped with green manure, incorporate the green manure when grown to 40 cm height or at 30 days after sowing, whichever is earlier, by using Cono-weeder.
- Green manure incorporated fields may be operated again with rotary weeder a week later in order to aerate the soil and to exploit organic acids formed if any.

2.7. Manures and Fertilizer Application

- For direct wet seeded lowland rice, the recommendation is same as that of transplanted rice.
- Apply N and K as 25% each at 21 DAS, at active tillering, Panicle Initiation and heading stages.
- If N applied through LCC, use the critical value 4 for line sown Panicle Initiate (drill seeded rice).
- Entire P as basal applied in the last plough or at the time of incorporation of green manure/ compost.
- Biofertilizers as recommended to transplanted rice may be followed wherever feasible and moisture available.
- Micro nutrient, foliar application and biofertlizers application as recommended to transplanted rice.

2.8. Weed management

- In wet seeded rice, pre-emergence application of Pretilachlor 0.75 kg/ha on 8 DAS on 3-4 DAS followed by one hand weeding on 40 DAS in direct drum seeded rice
- In wet seeded rice, sowing with drum seeder and Cono weeding (manual / power weeder) is done at 10, 20 and 30 DAS
- In wet seeded rice, hand weeding twice on 15 - 20 DAT and 45 DAT will control the weeds effectively (or) Pendimethalin 1.0 lit/ha at 8 DAT with optimum moisture condition and one hand weeding on 45 DAT.
- In rice -rice -fallow system intercropping of *Sesbania rostrata* control the weeds of rice field along with incorporation of *Sesbania rostrata* in to the field and one hand weeding on 35 DAS.
- Apply PE Pretilachlor 0.45 kg ha^{-1} on 3 DAS + Roto cylindrical weeder + weeding on 45 DAS in wet seeded rice have good control of weeds like

Echinochloa crusgalli, Panicum repens, Eclipta alba and *Monochoria vaginalis.*

- Pre-emergence application of Pendimethalin 1.0 kg/ha at 3 DAS followed by post emergence application of Bispyribac sodium 25 g/ha at 25 DAS along with one hand weeding 45 DAS effectively reduced weed density in wet seeded rice.
- Pre emergence application of Pyrazosulfuron ethyl at 20 g a.i /ha on 3 DAS followed by Cono weeding on 25 DAS had higher weed control efficiency in drum seeded rice.
- Combination of drum seeded rice intercropped with green manure (Daincha) along with pre-emergence herbicide application of Pretilachlor (37 ew) @ 0.45 kg ha^{-1} + safener on 5 DAS is the best weed control method in drum seeded rice.

2.9. Water Management

- During first one week irrigate the soil with thin film of water.
- Depth of irrigation may be increased to 2.5 cm progressively as per the crop age.
- Follow schedule as given in transplanted rice.

2.10. Insect Management: See Crop Protection Chapter

2.11. Disease Management: See Crop Protection Chapter

Other package of practices

- As recommended in transplanted rice

3. DRY SEEDED RAINFED UN-PUDDLED LOWLAND RICE

RAINFED RICE

The crop establishment, growth and maturity depend up on the rainfall received. There will be standing water after crop establishment for a minimum period of few days to a maximum up to grain filling, depending up on the rainfall. This type of cultivation in Tamil Nadu is called as **'rainfed rice'**, with the assumption that the soil moisture will be under unsaturated (dry) condition during establishment or entire growth period, with reference to tropical climate.

3.1. Area

- Coastal districts of Tamil Nadu like Kanchipuram, Tiruvallur, Pudukottai, Ramanathapuram, Virudhunagar, Sivagangai and Kanyakumari.

3.2. Season

- June – July – (Coastal northern districts)
- September – October (Coastal southern districts)

3.3. Field Preparation

- Dry plough to get fine tilth taking advantage of rains and soil moisture availability.
- Apply Gypsum at 1 t/ha basally wherever soil crusting and soil hardening problem exist.
- Perfect land leveling for efficient weed and water management.
- Provide shallow trenches (15 cm width) at an interval of 3m all along the field to facilitate draining excess water at the early growth stage.

3.4. Varieties

- Short duration varieties as mentioned in season and varieties including local land races suitable for those tracts.

3.5. Sowing

- Seed rate: 75kg/ha dry seed for any recommended variety.
- Seed hardening with 1% KCl for 16 hours (seed and KCl solution 1:1) and shade dried to bring to storable moisture. This will enable the crop to withstand early moisture stress.
- On the day of sowing, treat the hardened seeds first with *Pseudomonas fluorescens* 10g/kg of seed and then with *Azophos* 1 kg or *Azospirillum and Phosphobacteria* @ 1 kg each per ha seed, whichever is available.
- Drill sow with 20 cm inter row spacing using seed drill.
- The seeds can also be sown behind the country plough
- Depth of sowing should be 3 - 5 cm and the top soil can be made compact with leveling board.
- Pre-monsoon sowing is advocated for uniform germination.

3.6. After Cultivation

- 10 packets (2 kg/ha) each of *Azospirillum* inoculant and Phosphobacteria or 10 packets (2 kg/ha) of Azophos mixed with 25 kg of FYM may be broadcasted uniformly over the field just after the receipt of rain.
- Thinning and gap filling should be done 14 - 21days after sowing, taking advantage of the immediate rain
- Foliar spray of Cycocel 1000 ppm (1 ml of commercial product in one lit. of water) under water deficit situations to mitigate ill-effects.
- Foliar spray of Kaolin 3% or KCl 1% to overcome moisture stress at different physiological stages of rice.

3.7. Manures and Fertilizer Application

- Blanket recommendation: 50:25:25 N : P_2O_5 : K_2O kg/ha
- Apply a basal dose of 750 kg of FYM enriched with fertilizer phosphorus (P at 25 kg/ha)
- Apply N and K in two equal splits at 20 - 25 and 40 - 45 days after

germination.

- If the moisture availability from the tillering phase is substantial, three splits (25 kg N and 12.5 kg K at 20-25, 40-45 and 60-65 DAG) can be adopted.
- N at PI may be enhanced to 40 kg, if the tiller production is high (may be when the estimated LAI is greater than 5.0) and moisture availability ensured by standing water for 10 days.
- Basal application of $FeSO_4$ at 50 kg/ha + 12.5 t FYM is desirable for iron deficient soil (or) apply TNAU Rainfed rice MN mixture @12.5 kg/ha as EFYM at 1:10 ratio incubated for 30 days at friable moisture.
- Need based foliar application of 0.5% $ZnSO_4$ and 1% $FeSO_4$ + 0.1% citric acid may be taken up at tillering and PI stages.
- Foliar spray of 1% urea + 2% MAP + 1% KCl at PI and 10 days after may be taken up for enhancing the rice yield if sufficient soil moisture is ensured
- Apply 25 kg $ZnSO_4$ if the soil is Zn deficient.

3.8. Weed Management

- First weeding can be done between 15 and 21 days after germination.
- Second weeding may be done 30 - 45 days after first weeding.
- Apply pendimethalin 1.0 kg/ha on 5 days after sowing on the day of receipt of soaking rain followed by one hand weeding on 30 to 35 days after sowing.

3.9. Insect Management: See Crop Protection Chapter

3.10. Disease Management: See Crop Protection Chapter

3.11. Harvesting

Same as that of wet rice cultivation

4. DRY SEEDED RAINFED UN-PUDDLED LOWLAND RICE WITH SUPPLEMENTAL IRRIGATION

Semi dry rice

It is called as **semi-dry rice**. Crop establishment is as that of rainfed rice but the rain water collected in village tank (Kanmai) is supplemented to protect the crop during peak vegetative and reproductive phases. Interaction between applied nutrients and crop is positive here due to better moisture availability than rainfed rice and hence varieties may be improved one and nutrient levels may be higher than the previous system.

4.1. Area

- Kanchipuram, Tiruvallur,Ramanathapuram,Sivaganga, Kanyakumari, Nagapattinam, Tiruvarur and Pudukottai.

4.2. Seasons

- July to August - Kanchipuram/Tiruvallur, Kanyakumari
- August – Nagapattinam / Tiruvarur, Pudukottai
- September to October - Ramanathapuram, Sivaganga

4.3. Field Preparation

- Dry plough to get fine tilth taking advantage of rains and soil moisture availability.
- Apply Gypsum at 1 t/ha basally wherever soil crusting and soil hardening problem exist.
- Perfect land leveling for efficient weed and water management.
- Provide shallow trenches (15 cm width) at an interval of 3m all along the field to facilitate draining excess water at the early growth stage.

4.4. Varieties

- Short duration varieties as mentioned in season and varieties including local land races suitable for those tracts.
- Since there is supplemental irrigation high yielding improved short duration varieties can yield more yield than the land races.

4.5. Sowing

- Seed rate: 75 kg/ha dry seed for any recommended variety.
- Seed hardening with 1% KCl for 16 hours (seed and KCl solution 1:1) and shade dried to bring to storable moisture. This will enable the crop to withstand early moisture stress.
- On the day of sowing, treat the hardened seeds first with *Pseudomonas fluorescens* 10 g/kg of seed and then with *Azophos* 1 kg/ha or *Azospirillum and Phospho-bacteria @ 1 kg/ha* each per ha seed, whichever is available.
- Drill sow with 20 cm inter row spacing using seed drill.
- The seeds can also be sown behind the country plough
- Depth of sowing should be 3 - 5 cm and the top soil can be made compact with

leveling board.

- Pre-monsoon sowing is advocated for uniform germination.
- Sowing of seed by multi crop planter (Happy Seeder) under dry condition @ 40 kg/ha

4.6. After Cultivation

- 10 packets (2kg/ha) each of *Azospirillum* inoculants and Phosphobacteria or 10 packets (2 kg/ha) of Azophos mixed with 25 kg of FYM may be broadcasted uniformly over the field just after the receipt soaking rain / moisture.
- Thinning and gap filling should be done 14-21 days after sowing, taking advantage of the immediate rain
- Foliar spray of Cycocel 1000 ppm (1 ml of commercial product in one lit. of water) under water deficit situations to mitigate ill-effects.
- Foliar spray of Kaolin 3% or KCl 1% to overcome moisture stress at different physiological stages of rice.

4.7. Manures and Fertilizer Application

- Blanket recommendation: 75:25:37.5 kg N : P_2O_5 : K_2O /ha
- Apply a basal dose of 750 kg of FYM enriched with fertilizer phosphorus (P at 25 kg/ha)
- Apply N & K in three splits at 20-25, 40-45 and 60-65 days after germination.
- Each split may follow 25kg N and 12.5 kg K_2O.
- If the moisture availability is substantial, the split at 40-45 DAS (panicle initiation) may be applied up to 40kg N and 12.5kg K_2O to enhance the growth and the grain yield.
- Basal application of $ZnSO_4$ at 25kg/ha and $FeSO_4$ at 50 kg/ha + 12.5 t FYM is desirable wherever zinc and iron deficiency were noted (or) apply TNAU Rainfed rice MN mixture @12.5 kg/ha as EFYM at 1:10 ratio incubated for 30 days at friable moisture.
- Need based foliar application of 0.5% $ZnSO_4$ and 1% $FeSO_4$ + 0.1% citric acid at tillering and PI stages.
- Foliar spray of 1% urea + 2% MAP + 1% KCl at PI and 10 days after may be taken up for enhancing the rice yield if sufficient soil moisture is ensured

4.8. Weed Management

- First weeding should be done between 15 and 21 days after germination.
- Second weeding may be done 30 - 45 days after first weeding.
- Apply Pendimethalin 1.0 kg/ha on 5 days after sowing followed by one hand weeding on 30 to 35 days after sowing.
- Application of butachlor 1.0 kg ha^{-1} followed by weeding using finger type single row and double row rotary weeders resulted in higher grain yield and net profit.
- Application of Pretilachlor@0.45 l/ha on 5 DAS and two machine weeding (Power weeder) on 30 and 45 DAS, if sowing is done by using Happy seeder.

4.9. Water Management

- The crop to be irrigated from 30-35 days onwards, utilizing water impounded in the tanks.
- Irrigation to be given to a depth of 2.5 - 5.0 cm only. The schedule of irrigating one day after disappearance of ponded water to be followed in order to save water and to bring additional area under rice cultivation.

4.10. Insect Management: See Crop Protection Chapter

4.11. Disease Management: See Crop Protection Chapter

4.12. Harvest

- It is same as that of transplanted rice.
- These areas are more suitable for combine-harvester

5. DRY SEEDED IRRIGATED UN-PUDDLED LOWLAND RICE

Also be called 'semi-dry rice'

It is a contingent plan to command areas, anticipating the release of water; rice crop can be established under rainfed condition up to a maximum of 45 days as that of previous two situations. Field is converted to wet condition on receipt of canal water. Conversion depends up on receipt of canal water and nutrient management is decided according to the period of irrigation.

5.1. Area

- Tiruvarur and Nagapattinam districts

5.2. Season

- Samba / Thaladi seasons command areas.

5.3. Field Preparation

- Dry plough to get fine tilth taking advantage of rains and soil moisture availability.
- Apply gypsum at 1 t/ha basally wherever soil crusting and soil hardening problem exist.
- Perfect land leveling for efficient weed and water management.
- Provide shallow trenches (15 cm width) at an interval of 3m all along the field to facilitate draining excess water at the early growth stage.

5.4. Varieties

- Medium duration varieties, if sown in August and short duration varieties beyond September, as mentioned in season and vanities.
- Since there is assured irrigation from canal, high yielding improved short or medium duration varieties can be cultivated depending up on the situation (month of sowing, nearness to canal, depth of standing water during NEM etc).

5.5. Sowing

- Seed rate: 75kg/ha dry seed for any recommended variety.
- Seed hardening with 1% KCl for 16 hours (seed and KCl solution 1:1) and shade dried to bring to storable moisture. This will enable the crop to withstand early moisture stress.
- On the day of sowing, treat the hardened seeds first with *Pseudomonas fluorescens* 10g/kg of seed and then with *Azophos* 1 kg/ha or *Azospirillum and Phospho bacteria* @ 1 kg/ha each per ha seed, whichever is available.
- Drill sow with 20 cm inter row spacing using seed drill.
- The seeds can also be sown behind the country plough
- Depth of sowing should be 3 - 5 cm and the top soil can be made compact with leveling board.
- Pre-monsoon sowing is advocated for uniform germination.
- Pre-monsoon sowing with medium duration variety is an advantage for higher grain yield and as well to manage the heavy rainy season.

5.6. After Cultivation

- 10 packets (2 kg/ha) each of *Azospirillum* inoculant and Phosphobacteria or 10 packets (2 kg/ha) of Azophos mixed with 25 kg of FYM may be broadcasted uniformly over the field just after the receipt soaking rain / moisture.
- Thinning and gap filling should be done 14 - 21 days after sowing, taking advantage of the immediate rain.

5.7. Manures and Fertilizer Application

- Apply FYM/compost at 12.5 t/ha or 750 kg of FYM enriched with 50 kg P_2O_5 as basal dose in clay soils of Nagapattinam / Tiruvarur district.
- Blanket recommendation : 75:50:37.5 kg N:P_2O_5:K_2O /ha
- N and K in three splits at around 20-25, 40-45 and 60-65 days for short duration varieties or four splits for medium duration varieties at around 20-25, 40-45, 60-65 and 80-85 days after germination is suitable.
- Each split may follow 25kg N and 12.5 kg K_2O.
- If the moisture availability is substantial and canal water received from tillering phases itself, the split at panicle initiation (40-45 DAS in short duration and 60-65 DAS in medium duration) may be applied up to 40kg N and 12.5kg K_2O to enhance the growth and the grain yield.
- To induce tolerance under short and prolonged drought situation in Kuruvai season, apart from seed treatment, foliar spray with 1% KCl + CCC at 500ppm during vegetative stage is effective in mitigating the drought and in increasing the yield.
- Basal application of $ZnSO_4$ at 25 kg/ha and $FeSO_4$ at 50 kg/ha + 12.5t FYM is desirable wherever Zinc and iron deficiency were noted (or) apply TNAU Rainfed rice MN mixture @12.5 kg/ha as EFYM at 1:10 ratio incubated for 30 days at friable moisture.
- Need based foliar application of 0.5% $ZnSO_4$ and 1% $FeSO_4$ + 0.1% Citiric acid at tillering and Panicle Initiation stages
- Foliar spray of 1% urea + 2% MAP + 1% KCl at Panicle Initiation and 10 days later may be taken up for enhancing the rice yield if sufficient soil moisture is ensured

5.8. Weed Management

- First weeding should be done between 15 and 21 days after germination.
- Second weeding may be done 30 - 45 days after first weeding.
- Apply Pendimethalin 1.0 kg/ha on 5 days after sowing followed by one hand weeding on 30 to 35 days after sowing.

- Application of Pretilachlor@0.45 l/ha on 5 DAS and two machine weeding (Power weeder) on 30 and 45 DAS, if sowing is done by using Happy seeder.

5.9. Other Special Cultural Practices

- Foliar spray of Cycocel 1000 ppm (1 ml of commercial product in one lit. of water) under water deficit situations to mitigate ill-effects.
- Foliar spray of Kaolin 3% or KCl 1% to overcome moisture stress at different physiological stages of rice.
- For delayed water release in LBP area, irrigating rice to 5cm depth three days after disappearance of pounded water and growing ADT 38 rice can be resorted to if the release of water is delayed up to September.
- First top dressing should be applied immediately after the receipt of sufficient rain or canal water.
- Hand weeding, thinning and gap filling should be done before N-fertilizer application.
- Subsequent top dressings in two or three splits should be done before heading.

5.10. Water Management

- As that of irrigated rice when canal water is used for irrigation
- Possibility of subsequent conversion to deep water situation as seen in this tract, specfic variety should be chosen.

5.11. Insect Management: See Crop Protection Chapter

5.12. Disease Management: See Crop Protection Chapter

5.13. Harvest

As that of transplanted rice. This area is more suitable to combined harvester.

DEEP WATER RICE

5.14.1. Cultivation is like the methods described in this section except the harvest. Harvest may some times restricted only to panicle because of the standing water even after maturity.

DRY SEEDED UPLAND RICE

Establishment

5.14.2. As that of section 3 to 5.

Area

5.14.3. There are small batches in and around Dharmapuri district. Rainfall availability in these tract is better than the rainfed rice cultivated in other parts of Tamil Nadu. There is no bund to stagnate the water. Moisture availability is there but crop growth depends on the nutrient status.

Other Cultural Practices

5.14.4. As recommended to semi-dry rice (sec. 4)

5.14.5. Nutrient may be split applied depending upon the growth.

5.14.6. LCC based N application is more suitable for this tract.

5.14.7. Use of PPFM-Pink Pigmented Facultative Microbes (seed treatment @ 0.2 kg / 5 kg seeds, soil application basal @ 2.0 kg/ha and foliar spray @ 500 ml/ha at PI & flag leaf stages)for mitigation of terminal drought is recommended.

Intercropping

5.14.8. Blackgram for every four rows of rice.

Grain Yield

5.14.9. Grain yield depends up on the moisture availability and nutrient status.

AEROBIC RICE

5.14.10. Suitable variety PMK (R) 3

5.14.11. Optimum plant population: 50 hills per m^2 (20 x 10 cm)

5.14.12. Green manure intercrop in aerobic rice: Daincha intercropping and incorporation at 25 DAS

5.14.13. Ridges and furrows

5.14.14. Weed management: Pre emergence application of Pendimethalin at 0.75 kg/ha followed by two hand weeding or mechanical weeding on 25 and 45 DAS

5.14.15. PE Pendimethalin 1.0 kg ha^{-1} along with single tyne sweep weeding on 45 DAS which was comparable with PE along with hand weeding.

5.14.16. Fertilizer dose: 150 : 50 : 50 kg NPK/ha.

5.14.17. N in four splits: 20 % at 15 DAS, 30 % at tillering and PI and 20% at flowering or Nitrogen management at LCC value of 4

5.14.18. Basal application of $ZnSO_4$ at 25 kg/ha and $FeSO_4$ + 12.5t FYM at 50 kg/ha

is desirable wherever Zinc and Iron deficiency were noted (or) apply TNAU Rainfed rice MN mixture @12.5 kg/ha as EFYM at 1:10 ratio incubated for 30 days at friable moisture.

5.14.19. Need based foliar application of 0.5% $ZnSO_4$ and 1% $FeSO_4$ + 0.1% Citric acid may be taken up at tillering and PI stages

5.14.20. Irrigation : IW/CPE ratio of 1.0 with 3 cm depth of water – total water requirement of 650 mm.

5.14.21. **Surface drip fertigation:** Under aerobic rice conditions, schedule surface drip irrigation (with the lateral distance of 80 cm) at 125 % Open Pan Evaporation (PE) for clay soil / 150 % PE for sandy soil along with fertigation of 500 ml / ha of *Azophosmet* (composite biofertilizer) as seed treatment (@ 200 g / 10 kg seeds) and fertigation through drip system @ 500 ml / ha to be given during panicle initiation and flag leaf stages

5.14.22. **Sub-surface drip biogation:** Under aerobic rice conditions, schedule sub-surface drip fertigation (laterals concealed at 10 cm soil depth at a distance of 80 cm) scheduled at 125 % Open Pan Evaporation (PE) for clay soil / 150 % PE for sandy soil along with fertigation of *Azophosmet* as seed treatment @ 200 g 10 kg / seeds and fertigation @ 500 ml / ha and along with biogation of seaweed extract @ 500 ml / ha to be given during panicle initiation and flag leaf stages

POST HARVEST TECHNOLOGY OF RICE

PROCESSING OF RICE

Parboiling

5.14.23. Parboiling is a hydrothermal treatment followed by drying before milling for the production of milled parboiled grain. Parboiling of paddy has been known in the orient for centuries. Nearly 50 per cent of the paddy produced in India at present is parboiled.

5.14.24. In general, the three major steps in parboiling, i.e. soaking, steaming and drying and have a great influence on the final characteristics and quality of parboiled rice.

5.14.25. Parboiling is the latest premilling treatment which improves the quality of rice. The traditional parboiling process in India is carried out in different ways in paddy.

- Cleaning
- Soaking in water (8 h)
- Draining
- Steaming (20 minutes)
- Aerating (3h) and heaping (3h)

- Tempering (1h)
- Sun drying (2-4 h)
- Dried paddy (14% moisture)

Improved Parboiling Method of CFTRI, Mysore, India (Batch)

- Cleaning
- Soaking in hot water for 3 h (70 ^{0} C)
- Draining the water
- Steaming
- Shade drying (2-4 h)
- Dried paddy (15 % moisture)

MILLING OF PADDY

- Milling of dried paddy (raw and parboiled) Destoner (remove dust, dirt, chaff and stones)
- Sheller
- Husk Brown rice and unshelled paddy (aspirated through fan box)
- Huller (primary polishing)
- Bran Polished rice
- Cone polishing
- Bran Head rice
- Packaging

PROCESSED PRODUCTS

Parched Rice *

It is prepared by throwing rice in sand heated to a high temperature in an iron or mud pan. On stirring, rice begins to crackle and swell. Then the content of the pan are removed and sieved to separate the parched rice from sand. Parboiled rice is used for making grayish to brilliant white colour parched rice and sold either salted or unsalted. It is eaten as such or mixed with butter milk or milk.

Expanded cereals Expanded rice (Pori) *

5.14.26. Expanded rice (murmura, pori, muri) is a traditional convenience food widely consumed in India either as such or with Jaggery, roasted Bengal gram and shredded vegetables and spices. The product is mostly produced in home or cottage sector by skilled artisans.

5.14.27. In the traditional process, the paddy is soaked in water preferably over night until saturation, drained and then either steamed or dry roasted in sand for parboiling. The parboiled paddy is milled, salted and again roasted in sand for expansion.

Flow chart

Paddy
↓
Soaking in water (30% m.c)
↓
Parboiled rice (14% m.c)
↓
Milling (15% m.c)
↓
Dry heat parboiled rice in pans (110°C)
↓
Salting (Sodium chloride 10g/100ml water per kg of rice)
↓
Roasting in hot sand (250°C)
↓
Expanded rice (0.5% m.c)

Puffing / Popping * Puffed Rice: (using rice)

This popular ready-to-eat snack product is obtained by puffing milled parboiled rice. In the traditional process rice is gently heated on the furnace without sand to reduce the moisture content slightly. It is then mixed with salt solution and again roasted on furnace in small batches with sand on a strong fire for a few seconds to produce the expanded rice. Rice expands about 8 times retaining the grain shape and is highly porous and crisp.

Parched paddy or Puffed Rice: (using paddy)

Sun dried paddy is filled in mud jars and is moistened with hot water. After 2-3 min. the water is decanted and the jars are kept in an inverted position for 8-10 hours. Next the paddy is exposed to the sun for a short time and then parched in hot sand s in the preparation of parched rice. Puffed rice is prepared by throwing pretreated paddy into sand heated to a high temperature in an iron pan. During parching the grain swell and burst into a soft white product. The parched grains are sieved to remove sand and winnowed to separate the husk.

Puffed Rice from Parboiled Rice

The rice is soaked in salt water to increase the moisture to about 20%. The moist rice is introduced into a hot vessel at about 250-275°C for 30-40 seconds. The rice puffs suddenly.

Popped Rice

This is yet another traditional value added product prepared from raw paddy. The paddy at a moisture content of 12-14% is directly roasted in iron pans using sand as a medium at a temperature of 150-200^{o}C. The production of popped rice is comparatively less and the product is mainly used in religious functions and ceremonies.

Flaking *

Flaked Rice is another important value added product prepared from paddy. Traditionally, it is prepared from soaked paddy, after heat treatment and immediate flattening using a flaking machine (an edge runner)

Paddy
↓
Soaking (12-18 hours)
↓
Roasting (200 – 250^{0}C for 20-30 sec)
↓
Tempering (5 min)
↓
Flaking (using an edge runner) Flaking machine
↓
Flaked rice

Flaked rice is made from parboiled rice. Paddy is soaked in water for 2 -3 days to soften the kernel followed by boiling water for a few minutes and the water is drainedf. The paddy is heated in a shallow earthen vessel or sand in iron pan till the husks break open. It is pounded by a wooden pestle which flattens the kernel and removes the husk. The husk is separated by winnowing. Flaked rice is thin and papery and of white colour.

Quick cooking rice is made by steeping polished rice in water to a moisture content of 35 per cent, cooking under pressure and drying. Alternatively the rice may be subjected to freezing, thawing and dehydration.

Derived products

Polished rice may be precooked and canned as rice pudding and also used to make dry breakfast cereals.

RICE AND RICE PRODUCTS

Modernization of rice milling Industry also results in production of quality by-products viz., broken rice, husk and rice bran. Technology is now available for the production of value- added products from these by-products.

Byproducts of Rice

Broken Rice

The broken rice is widely used in the food preparations and in the industries for making flour and in the manufacture of baby foods. The starch extracted from broken rice finds wider application in the pharmaceutical, textile and other industries.

Rice Husk

Rice husk that contains about 38% cellulose and 32% lignin and is one of the most abundant renewable agriculture based fuel materials. The production of rice husk is about 80 million tonnes per year, equivalent in energy to about 170 million barrels of oil. Paddy husk contains about 22 per cent ash of which 95 per cent is silica. Because of its high silica content, it is used as an abrasive. Large quantities of husk are used in India as fuel for boilers, kilns and household purposes.

Rice Bran

Commercially rice bran is the most valuable by-product, which is characterized by its high fat (15 to 20%) and protein content. It also contains vitamins, minerals and many other useful chemicals. It is a potential source of edible oil. Because of its nutritional value, it is being used as feed for poultry and livestock. More stable defatted bran containing higher percentage of protein, vitamins and minerals is an excellent ingredient for both food and feed. The bran is the most nutritious by product of rice milling and is used almost exclusively as a feed stuff. It is generally contaminated with husk, which lowers its nutritive value. Rice bran contains about 12 per cent protein and 15 per cent fat.

Rice Bran Oil

Bran oil is obtained by the extraction of rice bran with solvents. Bran oil is also obtained in the solvent extraction milling of rice. The oil contains a high percentage of unsaturated fatty acids, yet it is quite stable because of the presence of natural antioxidants. When refined, bleached and deodorized, it is used for salad dressing and as cooking oil. Bran after solvent extraction has a higher percentage of protein that the original material. With its low fat content it keeps well.

Importance

Rice bran oil is the oil extracted from the germ and inner husk of rice. Rice bran oil is rich in vitamin E, γ-oryzanol (an antioxidant that may help prevent heart attacks) and phyto-sterols (compounds believed to help lower cholesterol absorption) which may provide associated health benefits. It has a mild taste and is popular in Asian cuisine because of its suitability for high - temperature cooking methods such as deep-frying and stir-frying. Rice bran oil is mostly monounsaturated - a table spoon contains 7 grams of monounsaturated fat, three of saturated fat and five of polyunsaturated fat.

Rice bran oil also contains components of Vitamin E that may benefit health. The unique components, such as oryzanol or tocotrienol, have been drawing people's

attention. Numerous studies show rice bran oil reduces the harmful cholesterol (LDL) without reducing good cholesterol (HDL). In those studies, Oryzanol is reported as the key element responsible for that function. Tocotrienol, on the other hand, is highlighted as the most precious and powerful Vitamin E existing in nature and is said to have an anti-cancer effect, too. As a Vitamin-E source, rice bran oil is rich not only in alpha Tocopherol but also has the highest amount of Tocotrienol in liquid form vegetable oils.

Uses

Rice bran oil is ideal oil for margarine and shortening. The flavor gives the good palatability and the desired prime form crystal provides smooth plasticity and spreading qualities. When processed to retain high levels of tocols, rice bran oil may be used as a natural antioxidant source for topically coating a wide range of products such as crackers, nuts, and similar snacks to extend shelf life.

Rice Polishing

Rice polishing is also rich in nutrients. They are not recovered in sizeable quantity in India.

They are mostly used as animal feed.

Uses of Defatted Bran and Bran

Defatted bran can be successfully used as an ingredient in the bakery products such as bread, cake, biscuits etc. After finer grinding, it can be incorporated into maida flour up to 20 per cent for the preparation of bakery products.

Appendix – I

1. Cereals
Rice (1)

Soil : River alluvium (Noyyal series)
Season : Kharif
Target : 7 t ha^{-1}

FN = 4.39 T – 0.52 SN – 0.80 ON
FP_2O_5 = 2.22 T – 3.63 SP–0.98 OP
FK_2O = 2.44 T – 0.39 SK– 0.72 OK

Initial soil test values (kg ha^{-1})			NPK (kg ha^{-1}) + GM @ 6.25 t ha^{-1} + *Azospirillum* @ 2 kg ha^{-1} + PSB @ 2 kg ha^{-1}			NPK (kg ha^{-1}) + FYM @ 12.5 t ha^{-1} + *Azospirillum* @ 2 kg ha^{-1} + PSB @ 2 kg ha^{-1}		
SN	**SP**	**SK**	**FN**	**FP_2O_5**	**FK_2O**	**FN**	**FP_2O_5**	**FK_2O**
200	18	300	150	67	25*	148	65	25*
220	20	350	140	60	25*	138	58	25*
240	22	400	130	53	25*	128	51	25*
260	24	450	119	45	25*	117	43	25*
280	26	500	109	38	25*	107	36	25*

* Maintenance dose

Note: FN, FP_2O_5 and K_2O are fertilizer N, P_2O_5 and K_2O in kg ha^{-1}, respectively; T is the yield target in q ha^{-1}; SN, SP and SK respectively are available N, P and K in kg ha^{-1} and ON, OP and OK are the quantities of N, P and K supplied through organic manure in kg ha^{-1}.

Rice (2)

Soil : River alluvium (Noyyal series)
Season: Rabi
Target : 7 t ha^{-1}

FN = 4.63 T – 0.56 SN – 0.90 ON
FP_2O_5 = 1.98 T – 3.18 SP– 0.99 OP
FK_2O = 2.57 T – 0.42 SK – 0.67 OK

Initial soil test values (kg ha^{-1})			**NPK (kg ha^{-1}) + GM @ 6.25 t ha^{-1} + *Azospirillum* @ 2 kg ha^{-1} + PSB @ 2 kg ha^{-1}**			**NPK (kg ha^{-1}) + FYM @ 12.5 t ha^{-1} + *Azospirillum* @ 2 kg ha^{-1} + PSB @ 2 kg ha^{-1}**		
SN	**SP**	**SK**	**FN**	**FP_2O_5**	**FK_2O**	**FN**	**FP_2O_5**	**FK_2O**
200	18	300	159	58	25*	157	56	25*
220	20	350	148	52	25*	146	50	25*
240	22	400	137	46	25*	135	44	25*
260	24	450	126	39	25*	124	37	25*
280	26	500	114	33	25*	112	31	25*

*Maintenance dose

Rice - SRI (3)

Soil : River alluvium (Noyyal series)
Season: Kharif
Target : 8 t ha^{-1}

FN = 4.33 T – 0.53 SN – 0.68 ON
FP_2O_5 = 2.08 T – 3.18 SP – 0.70 OP
FK_2O = 2.78 T – 0.30 SK – 0.63 OK

Initial soil test values (kg ha^{-1})			**NPK (kg ha^{-1}) + GM @ 6.25 t ha^{-1} + *Azospirillum* @ 2 kg ha^{-1} + PSB @ 2 kg ha^{-1}**			**NPK (kg ha^{-1}) + FYM @ 12.5 t ha^{-1} + *Azospirillum* @ 2 kg ha^{-1} + PSB @ 2 kg ha^{-1}**		
SN	**SP**	**SK**	**FN**	**FP_2O_5**	**FK_2O**	**FN**	**FP_2O_5**	**FK_2O**
200	18	300	187	75**	75**	183	75**	75**
220	20	350	177	75**	75**	173	71	75**
240	22	400	166	73	69	162	64	68
260	24	450	156	67	54	152	58	53
280	26	500	145	61	39	141	52	38

** Maximum dose

Rice - SRI (4)

Soil : River alluvium (Noyyal series)
Season: Rabi
Target: 8 t ha^{-1}

FN = 4.20 T – 0.45 SN – 0.68 ON
FP_2O_5 = 2.05 T – 2.65 SP – 0.66 OP
FK_2O = 2.85 T – 0.29 SK – 0.59 OK

Initial soil test values (kg ha^{-1})			NPK (kg ha^{-1}) + GM @ 6.25 t ha^{-1} + *Azospirillum* @ 2 kg ha^{-1} + PSB @ 2 kg ha^{-1}			NPK (kg ha^{-1}) + FYM @ 12.5 t ha^{-1} + *Azospirillum* @ 2 kg ha^{-1} + PSB @ 2 kg ha^{-1}		
SN	**SP**	**SK**	**FN**	**FP_2O_5**	**FK_2O**	**FN**	**FP_2O_5**	**FK_2O**
200	18	300	193	75**	75**	191	75**	75**
220	20	350	184	75**	75**	182	75**	75**
240	22	400	175	75**	75**	173	76	75**
260	24	450	166	75**	65	164	70	66
280	26	500	157	72	50	155	65	51

** Maximum dose

Rice - SRI – White Ponni (5)

Soil : River alluvium (Noyyal series)
Season: Rabi
Target: 6 t ha^{-1}

FN = 3.43 T – 0.34 SN – 0.64 ON
FP_2O_5 = 1.83 T – 3.24 SP – 0.61 OP
FK_2O = 1.98 T – 0.18 SK – 0.37 OK

Initial soil test values (kg ha^{-1})			NPK (kg ha^{-1}) + GM @ 6.25 t ha^{-1} + *Azospirillum* @ 2 kg ha^{-1} + PSB @ 2 kg ha^{-1}			NPK (kg ha^{-1}) + FYM @ 12.5 t ha^{-1} + *Azospirillum* @ 2 kg ha^{-1} + PSB @ 2 kg ha^{-1}		
SN	**SP**	**SK**	**FN**	**FP_2O_5**	**FK_2O**	**FN**	**FP_2O_5**	**FK_2O**
200	18	300	85	25*	32	86	25*	35
220	20	350	78	25*	25*	79	25*	26
240	22	400	71	25*	25*	72	25*	25*
260	24	450	64	25*	25*	65	25*	25*
280	26	500	58	25*	25*	59	25*	25*

* Maintenance dose

Rice - SRI (6)

Soil : River alluvium (Ambasamudram series)
Season: Rabi
Target : 7 t ha^{-1}

FN = 3.54T– 0.30 SN – 0.94 ON
FP_2O_5 = 1.37T– 0.41 SP – 0.80 OP
FK_2O = 2.61T – 0.64 SK –0.61 OK

Initial soil test values (kg ha^{-1})			NPK (kg ha^{-1}) + GM @ 6.25 t ha^{-1} + *Azospirillum* @ 2 kg ha^{-1} + PSB @ 2 kg ha^{-1}			NPK (kg ha^{-1}) + FYM @ 12.5 t ha^{-1} + *Azospirillum* @ 2 kg ha^{-1} + PSB @ 2 kg ha^{-1}		
SN	**SP[a]**	**SK**	**FN**	**FP_2O_5**	**FK_2O**	**FN**	**FP_2O_5**	**FK_2O**
200	20	150	135	65	54	135	60	57
225	30	175	127	61	38	127	56	41
250	40	200	120	57	25*	120	52	25*
275	50	225	112	52	25*	112	47	25*
300	60	250	105	48	25*	105	43	25*

* Maintenance dose; SP[a]- Bray P

Rice - SRI (7)

Soil : Red non calcareous (Vannapatti series)
Seaso : Rabi
Target : 7 t ha^{-1}

FN = 3.49 T - 0.36 SN - 0.74 ON
FP_2O_5 = 1.66 T - 2.76 SP - 0.69 OP
FK_2O = 2.19 T - 0.66 SK - 0.52 OK

Initial soil test values (kg ha^{-1})			NPK (kg ha^{-1}) + GM @ 6.25 t ha^{-1} + *Azospirillum* @ 2 kg ha^{-1} + PSB @ 2 kg ha^{-1}			NPK (kg ha^{-1}) + FYM @ 12.5 t ha^{-1} + *Azospirillum* @ 2 kg ha^{-1} + PSB @ 2 kg ha^{-1}		
SN	**SP**	**SK**	**FN**	**FP_2O_5**	**FK_2O**	**FN**	**FP_2O_5**	**FK_2O**
200	12	100	119	60**	54**	115	51**	57**
220	14	120	112	55**	41**	108	46	44**
240	16	140	105	49**	28**	101	40	31**
260	18	160	98	44	25	94	35	25*
280	20	180	91	38	25	87	29	25*

** Maintenance dose

Rice (8)

Soil : Red sandy loam (Irugur series)
Season : Kharif
Target : 7 t ha^{-1}

FN = 5.19 T - 0.89 SN - 0.98 ON
FP_2O_5 = 2.27 T - 4.50 SP - 1.09 OP
FK_2O = 3.11 T - 0.59 SK - 1.02 OK

Initial soil test values (kg ha^{-1})			NPK (kg ha^{-1}) + GM @ 6.25 t ha^{-1} + *Azospirillum* @ 2 kg ha^{-1} + PSB @ 2 kg ha^{-1}			NPK (kg ha^{-1}) + FYM @ 12.5 t ha^{-1} + *Azospirillum* @ 2 kg ha^{-1} + PSB @ 2 kg ha^{-1}		
SN	**SP**	**SK**	**FN**	**FP_2O_5**	**FK_2O**	**FN**	**FP_2O_5**	**FK_2O**
160	12	160	168	60**	60**	166	60**	60**
180	14	180	150	60**	60**	148	60**	60**
200	16	200	132	60**	60**	130	57	60**
220	18	220	115	55	55	113	48	58
240	20	240	97	46	43	95	39	46

** Maximum dose

Rice (9)

Soil : Red -Sandy loam (Irugur series)
Season : Rabi
Target : 7 t ha^{-1}

FN = 4.88 T - 0.68 SN - 0.72 ON
FP_2O_5 = 2.06 T - 2.91 SP - 2.27 OP
FK_2O = 2.89 T - 0.47 SK - 0.59 OK

Initial soil test values (kg ha^{-1})			NPK (kg ha^{-1}) + GM @ 6.25 t ha^{-1} + *Azospirillum* @ 2 kg ha^{-1} + PSB @ 2 kg ha^{-1}			NPK (kg ha^{-1}) + FYM @ 12.5 t ha^{-1} + *Azospirillum* @ 2 kg ha^{-1} + PSB @ 2 kg ha^{-1}		
SN	**SP**	**SK**	**FN**	**FP_2O_5**	**FK_2O**	**FN**	**FP_2O_5**	**FK_2O**
180	12	200	166	75**	75	164	75**	75**
200	14	220	153	75**	66	151	73	69
220	16	240	139	75**	57	137	68	60
240	18	260	125	69	47	123	62	50
260	20	280	112	63	38	110	56	41

** Maximum dose

Rice (10)

Soil : Black alluvium (Adanur series)
Season: Rabi
Target: 8 t ha^{-1}

FN = 2.80 T - 0.29 SN - 0.89 ON
FP_2O_5 = 1.35 T - 1.28 SP - 1.78 OP
FK_2O = 2.50 T - 0.42 SK - 1.14 OK

Initial soil test values (kg ha^{-1})			NPK (kg ha^{-1}) + GM @ 6.25 t ha^{-1} + *Azospirillum* @ 2 kg ha^{-1} + PSB @ 2 kg ha^{-1}			NPK (kg ha^{-1}) + FYM @ 12.5 t ha^{-1} + *Azospirillum* @ 2 kg ha^{-1} + PSB @ 2 kg ha^{-1}		
SN	**SP**	**SK**	**FN**	**FP_2O_5**	**FK_2O**	**FN**	**FP_2O_5**	**FK_2O**
180	16	240	119	65	66	117	58	69
200	18	260	113	62	58	111	55	61
220	20	280	107	59	49	105	52	52
240	22	300	101	57	41	99	50	44
260	24	320	96	54	33	94	47	36

Rice (11)

Soil : Black alluvium (Kalathur series)
Season: Kharif (Kuruvai)
Target: 7t ha^{-1}

FN = 5.29 T - 0.75 SN - 0.89 ON
FP_2O_5 = 1.65 T - 1.76 SP - 0.78 OP
FK_2O = 2.73 T - 0.37 SK- 0.82 OK

Initial soil test values (kg ha^{-1})			NPK (kg ha^{-1}) + GM @ 6.25 t ha^{-1} + *Azospirillum* @ 2 kg ha^{-1} + PSB @ 2 kg ha^{-1}			NPK (kg ha^{-1}) + FYM @ 12.5 t ha^{-1} + *Azospirillum* @ 2 kg ha^{-1} + PSB @ 2 kg ha^{-1}		
SN	**SP**	**SK**	**FN**	**FP_2O_5**	**FK_2O**	**FN**	**FP_2O_5**	**FK_2O**
200	18	260	167	61	62	165	54	65
220	20	280	152	57	55	150	50	58
240	22	300	137	54	47	135	47	50
260	24	320	122	50	40	120	43	43
280	26	340	107	47	32	105	40	35

Rice(12)

Soil : Black alluvium (Kalathur series)
Season: Rabi
Target: 7 t ha^{-1}

FN = 5.34 T - 0.67 SN - 0.73 ON
FP_2O_5 = 1.90 T - 1.86 SP - 0.70 OP
FK_2O = 2.81 T - 0.33 SK - 0.80 OK

Initial soil test values (kg ha^{-1})			NPK (kg ha^{-1}) + GM @ 6.25 t ha^{-1} + *Azospirillum* @ 2 kg ha^{-1} + PSB @ 2 kg ha^{-1}			NPK (kg ha^{-1}) + FYM @ 12.5 t ha^{-1} + *Azospirillum* @ 2 kg ha^{-1} + PSB @ 2 kg ha^{-1}		
SN	**SP**	**SK**	**FN**	**FP_2O_5**	**FK_2O**	**FN**	**FP_2O_5**	**FK_2O**
200	18	260	187	75**	75**	185	70	75**
220	20	280	173	73	71	171	66	74
240	22	300	160	69	65	158	62	68
260	24	320	147	65	58	145	58	61
280	26	340	133	62	52	131	55	55

** Maximum dose

Rice (13)

Soil : River alluvium (Manakkarai series)
Season: Kharif (Kuruvai)
Target: 7 t ha^{-1}

FN = 4.25 T - 0.60 SN - 0.79 ON
FP_2O_5 = 2.71 T - 4.39 SP - 0.89 OP
FK_2O = 3.83 T - 0.60 SK - 0.82 OK

Initial soil test values (kg ha^{-1})			NPK (kg ha^{-1}) + GM @ 6.25 t ha^{-1} + *Azospirillum* @ 2 kg ha^{-1} + PSB @ 2 kg ha^{-1}			NPK (kg ha^{-1}) + FYM @ 12.5 t ha^{-1} + *Azospirillum* @ 2 kg ha^{-1} + PSB @ 2 kg ha^{-1}		
SN	**SP**	**SK**	**FN**	**FP_2O_5**	**FK_2O**	**FN**	**FP_2O_5**	**FK_2O**
180	14	240	137	75**	75**	135	75**	75**
200	16	260	125	75**	75**	123	75**	75**
220	18	280	113	75**	67	111	75**	70
240	20	300	101	75**	55	99	72	58
260	22	320	89	70	43	87	63	46

** Maximum dose

Rice (14)

Soil : River alluvium (Manakkarai series)
Season: Rabi (Pishanam)
Target: 7 t ha^{-1}

FN = 4.47 T - 0.58 SN - 0.79 ON
FP_2O_5 = 2.66 T - 3.68 SP - 0.89 OP
FK_2O = 4.08 T - 0.65 SK - 0.82 OK

Initial soil test values (kg ha^{-1})			**NPK (kg ha^{-1}) + GM @ 6.25 t ha^{-1} + *Azospirillum* @ 2 kg ha^{-1} + PSB @ 2 kg ha^{-1}**			**NPK (kg ha^{-1}) + FYM @ 12.5 t ha^{-1} + *Azospirillum* @ 2 kg ha^{-1} + PSB @ 2 kg ha^{-1}**		
SN	**SP**	**SK**	**FN**	**FP_2O_5**	**FK_2O**	**FN**	**FP_2O_5**	**FK_2O**
180	14	240	156	75**	75**	154	75**	75**
200	16	260	144	75**	75**	142	75**	75**
220	18	280	132	75**	71	130	75**	74
240	20	300	121	75**	58	119	75**	61
260	22	320	109	75**	45	107	75**	48

** Maximum dose

12 Points for SRI

- Use of quality certified / hybrid seed
- Seed rate 2 kg per acre
- 40 m^2 nursery for one acre Raised bed
- nursery / Tray nursery
- 14 days old seedling (3-4 leaf stage)
- Levelling with lazer leveller
- Marker for square planting
- Square planting with 25 cm x 25 cm
- Single seedling per hill
- Alternate wetting and drying method of irrigation
- Cono weeding four times from 10 DAT at an interval of 10-15 days
- Use of leaf colour chart (LCC) for N management

CROP PROTECTION

A) Pest Management

Nursery

Seed treatment with Imidacloprid 48% FS @ 2.5 g/kg of seed.
An area of 800 sq m (20 cents) nursery is required for planting one ha of main field.
Forty litre of spray fluid is required for spraying the nursery area.

Pests	Management strategies
Thrips *Stenchaetothrips biformis*	• Sampling: Wet your palm with water and pass over the foliage in 12 places at random in the nursery and count the number of thrips • ETL: If thrips population exceeds 60 numbers in 12 passes or if rolling of half of leaf area of first and 2nd leaves in 10% of seedlings is noticed. • Spray any one of the following insecticides: Monocrotophos 36% SL 40 ml Thiamethoxam 25% WG 4 g
Green leafhopper *Nephotettix nigropictus* *N. cincticeps* *N. virescens*	• Sampling: Take 25 net sweepings in the nursery area. If the population exceeds 60 for 25 sweepings or 20/m^2 by actual counting, • Maintain 2.5 cm of water in the nursery and broadcast Carbofuran 3% CG 3.5 kg in 20 cents
Caseworm *Parapoynx stagnalis*	• Mix 250 ml of Kerosene with sand and apply to the standing water • Dislodge the cases by passing a rope and drain water • Collect the cases and destroy • Spray any one of the following insecticides: Monocrotophos 36% SL 40 ml Quinalphos 25% EC 80 ml
Army worm *Spodoptera mauritia*	• Drain water from the nursery • Spray Chlorpyriphos 20% EC 80 ml during evening hours.

ii) Main Field

- Remove/destroy stubbles after harvest
- Keep the fields free from weeds
- Trim field bunds
- Provide effective drainage
- Avoid use of excessive 'N' fertilizers.
- Avoid close planting, especially in BPH and leaf folder prone areas/seasons
- Leave 30 cm space at every 2.5 m
- Use irrigation water judiciously
- Use light traps (1/ha) to monitor pest incidence
- Use pheromone traps (12/ha) to monitor stem borer and leaf folder incidence

- Remove and destroy egg masses of stem borer
- In BPH prone areas/seasons, avoid use of resurgence causing chemicals like synthetic pyrethroids and quinalphos
- Use suggested insecticides at recommended doses based on ETL
- Avoid repeated use of same insecticide
- Dose recommended are per ha, unless otherwise specified

Economic Threshold Level (ETL) for Important Pests

Pest	ETL
Stem borer	2 egg masses/m^2 or 10% dead hearts or 2% white ear
Leaf folder	10% leaf damage at vegetative phase and 5% of flag leaf damage at flowering
Gall midge	10% silver shoots
Whorl maggot	25% damaged leaves
Thrips	60 numbers in 12 passes or rolling of the first and second leaves in 10% of seedlings.
Brown plant hopper	1 hopper/ tiller in the absence of predatory spider and 2 hoppers / tiller when spider is present at 1/hill.
Green leaf hopper	60/25 net sweeps or 5/hill at vegetative stage or 10/hill at flowering or 2/hill in tungro endemic area
Ear head bug	5 bugs/100 ear heads at flowering and 16 bugs/100 ear heads from milky stage to grain maturity

Pests	Management Strategies
Stem borer *Scirpophaga incertulas*	• Release of the egg parasitoid, *Trichogramma japonicum* thrice (at weekly interval from 37 DAT) @ 1,00,000/ha each release (when moth activity is noticed) • *Bacillus thuringiensis* var. *kurstaki* @ 1.50 kg/ha • Spray any one of the following insecticides: (per ha) Acephate 75 % SP 670-1000 g Acephate 95 % SG 590 g Azadirachtin 0.03% 1000 ml Carbofuran 3% CG 25 kg

	Carbosulfan 6% G 16.7 kg Carbosulfan 25% EC 800-1000 ml Cartap hydrochloride 50 % SP 1000 g Chlorantraniliprole 18.5% SC 150 ml Chlorantraniliprole 0.4% G 10 kg Chlorpyriphos 20% EC 1250 ml Fipronil 5% SC 1000-1500 g Fipronil 80%WG 50- 62.5 kg Flubendiamide 20% WG 125 g Flubendiamide 39.35% M/M SC 50 g Thiacloprid 21.7% SC 500 g Thiamethoxam 25% WG 100 g
Leaf folder *Cnaphalocrocis medinalis*	• Release *Trichogramma chilonis* thrice (at weekly interval from 30 DAT) @ 1,00,000/ha each (when moth activity is noticed) • Spray *Bacillus thuringiensis* var*. kurstaki* 1.50 kg/ha • Apply *Beauveria bassiana* 1.15 WP 2.5 kg/ha • Spray any one of the following insecticides per ha: Acephate 75 % SP 666-1000 ml Acephate 95 % SG 590 g Azadirachtin 0.03% 1000 ml Chlorpyriphos 20% EC 1250 ml Carbosulfan 6% G 16.7 kg Cartaphydrochloride 50 % SP 1000 g Chlorantraniliprole 18.5% SC 150 g Chlorantraniliprole 0.4% G 10 kg Fipronil 80%WG 50-62.5 g Flubendiamide 20% WG 125-250 g Flubendiamide 39.35% M/M SC 50 g Indoxacarb 15.8% EC 200 g Thiamethoxam 25% WG 100 g

Gall midge *Orseolia oryzae*	• Distribute *Platygaster oryzae* parasitised galls at 1 per 10 m^2 on 10 days after transplanting (DAT), when natural parasitisation is noticed in abundance. • Spray any one of the following insecticides per ha: Carbosulfan 25% EC 800-1000 ml Chlorpyriphos 20% EC 1250 ml Fipronil 5% SC 1000-1500 g Fipronil 0.3% G 16.67 - 25 kg Quinalphos 5% G 5 kg Thiamethoxam 25% WG 100 g
Whorl maggot *Hydrellia sasakii*	• Spray any one of the following insecticides per ha: Cartap hydrochloride 4% G 18.75 – 25 kg Chlorpyriphos 20% EC 1250 ml Fipronil 5% SC 1000-1500 g Fipronil 0.3% GR 16.67- 25 kg
Case worm *Parapoynx stagnalis*	Spray Phenthoate 50% EC 1000 ml
Hispa/ spiny beetle *Dicladispa armigera*	• Spray any one of the following insecticides per ha: Carbofuran 3% CG 25 kg Chlorpyriphos 20% EC 1250 ml Malathion 5% DP 25 kg Malathion 50%EC 1150 ml
Grass hopper	Dust Chlorpyriphos 1.5% DP 25 kg/ha
Thrips *Stenchaetothrips biformis*	• Spray any one of the following insecticides per ha: Azadirachtin 0.15% W/W 1.5 – 2.5 kg Thiamethoxam 25% WG 100 g
Brown plant hopper *Nilaparvata lugens*	• Avoid excessive use of nitrogen • Control irrigation by intermittent draining • Set up light traps during night or yellow pan traps during day time • Drain water before use of insecticides • Direct spray towards the base of the plants. • Spray any one of the following insecticides per ha: Acephate 75 % SP 666-1000 g Acephate 95 % SG 590 g Acetamiprid 20% SP 50-100 g

	Azadirachtin 0.03% 1000 ml Neem oil 3% 15 lit Buprofezin 25% SC 800 ml Carbosulfan 25% EC 800-1000 ml Clothianidin 50% WG 20-24 g Chlorantraniliprole 18.5% SC 150 g Chlorantraniliprole 0.4% G 10 kg Chlorpyriphos 1.5% DP 25 kg Chlorpyriphos 20% EC 1250 ml Dinotefuran 20% SG 150-200g Fenobucarb 50% EC 500-1500 ml Fipronil 5% SC 1000-1500 ml Fipronil 0.3% GR 16.67-25 kg Imidacloprid 70% WG 30-35 kg Imidacloprid 17.8 SL 100-125 ml Pymetrozine 50% WG 300g
White backed Plant hopper *Sogatella furcifera*	• Spray any one of the following insecticides per ha: Phosphamidon 40% SL 1000 ml Azadirachtin 0.03% 1000 ml Buprofezin 25% SC 800 ml Carbosulfan 25% EC 800-1000 ml Chlorantraniliprole 18.5% SC 150 g Chlorantraniliprole 0.4% G 10 kg Fipronil 5% SC 1000-1500 ml Fipronil 0.3% GR 16.67-25 kg Imidacloprid 70% WG 30-35 kg Imidacloprid 17.8% SL 100-125 ml
Green leaf hopper *Nephotettix nigropictus* *N. cincticeps* *N. virescens*	• Spray any one of the following insecticides twice, 15 and 30 days after transplanting per ha: Phosphamidon 40% SL 1000 ml Carbofuran 3% CG 25 kg Buprofezin 25% SC 800 g Carbosulfan 25% EC 800-1000 ml Fipronil 5% SC 1000-1500 g Fipronil 0.3% G 16.67-25 kg Imidacloprid 17.8% SL 100 -125 ml Thiamethoxam 25% WG 100 g

	• The vegetation on the bunds should also be sprayed with the insecticides • Set up light traps to attract and control the leafhoppers as well as to monitor the vector population. • Destroy/ kill the leaf hoppers attracted to light trap
Mealy bug *Brevennia rehi*	• Spray methyl demeton 25% EC 1000 ml/ha
Blue leaf hopper/ white leaf hopper	• Spray methyl demeton 25% EC 500-1000 ml/ha
Black bug *Scotinophara lurida*	• Spray neem seed kernel extract 5% (25 kg kernel/ha)
Earhead bug *Leptocorisa acuta and L. oratorius*	• Dust/ spray any one of the following, the first during flowering and second a week later (per ha): Quinalphos 1.5% D 25 kg Malathion 50% EC 500 ml Neem seed kernel extract 5% (25 kg kernel/ha) Notchi or *Ipomoea* or *Prosopis* leaf extract 10% KKM 10% D 25 kg
Termite *Anacanthotermus viarum*	• Apply chopped paddy straw treated with Chlorpyriphos 1.5% DP 25 kg/ha
Mite *Oligonychus oryzae*	Spray any one of the following insecticides per ha: • Dicofol 18.5% EC 1250 ml Azadirachtin 0.03% 1000 ml
Rat *Rattus rattus rufuscens,* *Rattus meltada*	• Poison bait at 1 part Zinc phosphide with 49 parts popped corn/rice/dry fish or warfarin 0.5% 1 part with 19 parts of popped corn/rice/dry fish or Bromodialone 0.25% w/w (1:49) at 0.005%. Mix one part of bromodialone + 49 parts of bait and keep inside the field. • Mechanical collection and destruction • Narrow bund maintenance (45 x 30 cm) • Setting up of owl perches • Setting up of Thanjavur bow trap @ 100/ha

IPM Module

- Seed treatment with Imidacloprid 48%FS @ 2.5 g/kg
- *Pseudomonas fluorescens* – Seed treatment (10 g/kg), seedling dip (2.5 kg/ha), main field application (2.5 kg/ha)
- Pest and disease management in nursery (preferably neem seed kernel extract 5% or Neem oil 2%)
- Integrated Nutrient Management
- Use of neem cake coated urea (5 : 1)
- Incorporation of green manures / biofertilizers
- 'N' management by Leaf Colour Chart (LCC)
- 'K' application – basal (50%) + one top dressing (50%)
- Adoption of cultural practices
- Variety selection
- Spacing based on season, variety and location (endemic / hot spot)
- Rogueing space (1' for every 8')
- Water management – alternate wetting and drying and submergence of recommended level during critical periods only
- Release of biocontrol agents (*Trichogramma japonicum* for stem borer and *Trichogramma chilonis* for leaf folder*)*, when the moth activity is noticed
- Set up bird (owl) perches at 40 to 50 /ha
- Application of botanicals especially Neem seed kernel extract 5% and Neem oil 2%
- ETL based insecticide / fungicide application (No synthetic pyrethroids)
- Integrated rodent management
  Narrow bund maintenance (45 x 30 cm)
  Zinc phosphide baiting (49: 1)
  Trapping with Thanjavur bow trap (100 nos./ha)
  Baiting with Bromodialone

Resurgence

Repeated application of the following insecticides can cause resurgence of insect pests Avoid spraying of synthetic pyrethroids and the following insecticides

- BPH, *Nilaparvata lugens* **:** Acephate, Carbofuran, Chlorpyriphos, Deltamethrin, Ethopenprox, Fenthion, Fenvalerate, Methomyl, Methylparathion, Monocrotophos, Permethrin, Perthane, Phosalone, Quinalphos, Thiometon, Vamidothion
- GLH, *Nephotettix virescens :* Deltamethrin, Phorate
- WBPH, *Sogatella furcifera :* Cypermethrin, Deltamethrin, Fenvalerate
- Leaf folder, *Cnaphalocrocis Medinalis :* Carbofuran

B. Disease Management

I. Disease management in nursery

Dry seed treatment	• Treat the seeds with thiram or Captan or Carboxin or Carbendazim @ 2 g/kg of seeds • Treat the seeds at least 24 hours prior to soaking for sprouting • The treated seeds can be stored for 30 days without any loss in viability
Wet seed treatment	• Treat the seeds with Carbendazim or Tricyclazole @ 2 g/l/kg of seeds • Soak the seeds in the solution for 2 hours • Drain the solution, sprout the seeds and sow in the nursery bed • This wet seed treatment gives protection to the seedlings up to 40 days from seedling diseases such as blast and this method is better than dry seed treatment or • Treat the seeds with talc-based formulation of *Pseudomonas fluorescens* @ 10g/kg of seed and soak in 1lit of water overnight • Decant the excess water and allow to sprout the seeds for 24 hrs and then sow **CIB Recommendation** • Treat the seeds with Carbendazim 25% + Mancozeb 50% WS @ 3-3.5 g/kg of seeds
Seedling dip with *Pseudomonas fluorescens*	• Stagnate water to a depth of 2.5cm over an area of 25m^2 in the main field • Sprinkle 2.5 kg of the talc-based formulation of *P. fluorescens* and mix with stagnated water • The seedlings pulled out from the nursery are to be soaked for 30 min. in the stagnated water and then transplanted
❖ Biocontrol agents are compatible with biofertilizers ❖ Biofertilizers and biocontrol agents can be mixed together for seed soaking ❖ Fungicides and biocontrol agents are incompatible	

II. Disease management in main field

Name of the Disease	Recommendations
Blast : ***Pyricularia grisea* (*Magnaporthe grisea)***	**1. Cultural methods** • Remove collateral weed hosts from bunds and channels • Use only disease free seedlings • Avoid excess nitrogen • Apply N in three split doses (50% as basal, 25% at tillering phase and 25% at panicle initiation stage) • Use resistant varieties like CO 47, CO 52 and hybrid CO 4 and moderately resistant varieties like CO 50 and CO 51 in endemic areas **2. Chemical method** • Spray Carbendazim 50WP @ 500 g/ha or Tricyclozole 75 WP @ 500 g/ha or Metominostrobin 20 SC @ 500 ml/ha or Azoxystrobin 25 SC @ 500 ml/ha after observing initial infection of the disease **CIB Recommendation** • Spray Isoprothiolane 40 % EC @ 750 ml/ha or Kasugamycin 3% S.L @ 1000 -1500 ml/ha or Kasugamycin 5% + Copper oxychloride 45% WP @ 700gm/ha or Picoxystrobin 22.52% SC @ 600 ml/ha or Tebuconazole 25% WG @ 750 gm/ha or Mancozeb 75 % WP @ 1.5 -2.0 kg/ha or Aureofungin 46.15% SP @ 1% after observing initial infection of the disease and repeat after 15 days, if required. **3. Biological control** • Treat the seeds with *Pseudomonas fluorescens* TNAU liquid formulation @ 10 ml/kg of seeds • Seedling root dipping with *P. fluorescens* TNAU liquid formulation @ 500 ml for one hectare seedlings • Soil application with *P. fluorescens* TNAU liquid formulation @ 500 ml/ha • Foliar spray with *P. fluorescens* TNAU liquid formulation @ 5 ml/l
Brown spot: *Drechslera oryzae* (*Cochliobolus miyabeanus*)	• Spray Metominostrobin @ 500 ml/ha after observing initial infection of the disease **CIB Recommendation** • Spray Propineb 70% WP @ 1500 – 2000 gm/ha or Propineb 54.2% + Tricyclazole15 % WP @ 1250 gm/ha or carbendazim 5% GR @ 12.5 kg/ha

	For combined infection of blast and brown spot • Spray Propineb 54.2% +Tricyclazole 15 % WP @ 1250 gm/ha after observing initial infection of the disease. **For combined infection of blast, sheath blight and brown spot** • Spray azoxystrobin 16.7 % + Tricyclazole 33.3% SC @ 500 ml/ha after observing initial infection of the disease
Sheath rot: *Sarocladium oryzae*	**Botanicals** • Spray neem oil 3% or *Ipomoea* leaf powder extract @ 25 kg/ha or *Prosopis* leaf powder extract @ 25 kg/ha. First spray at boot leaf stage and second at 15 days later **Chemical method** • Spray Carbendazim @ 500 g/ha or Metominostrobin @ 500 ml/ha or Hexaconazole 75% WG @ 100 mg/ lit. First spray at the time of disease appearance and second spray at 15 days later **Biological control** • Treat the seeds with *Pseudomonas fluorescens* TNAU liquid formulation @ 10 ml/kg of seeds • Seedling root dipping with *P. fluorescens* TNAU liquid formulation @ 500 ml for one hectare seedlings • Soil application with *P. fluorescens* TNAU liquid formulation @ 500ml/ha • Foliar spray with *P. fluorescens* TNAU liquid formulation @ 5ml/l
Sheath blight: *Rhizoctonia solani* (*Thanate phorus cucumeris*)	**Cultural method** • Apply neem cake @ 150 kg/ha to soil **Using botanical** • Foliar spray with neem oil 3% @ 15 l/ha starting from disease appearance **Chemical method** • Spray Carbendazim 50 WP @ 500 g/ha or Azoxystrobin @ 500 ml/ha or Hexaconazole 75% WG @ 100 mg/l. First spray at the time of disease appearance and second spray at 15 days later. **CIB Recommendation** • Spray Azoxystrobin 11% + Tebuconazole 18.3% w/w SC @ 750 ml/ha or Azoxystrobin 7.1% + Propiconazole 11.9 % W/W SE @ 500 ml/ha or Flusilazole 40% EC @ 300 ml/ha or iprodione 50 % W.P @ 2.25 kg/ha or Pencycuron 22.9 % SC @ 600-750 ml/ha or Propiconazole 25% E.C @ 500 ml/ha or Thifluzamide 24 % SC @ 375 ml/ha or

	Carbendazim 25 % + Flusilazole 12.5% SE @ 800-960 ml/ha after observing initial infection of the disease **For combined infection of blast and sheath blight** • Spray Hexaconazole 4% + Carbendazim 16% SC @ 750 gm/ha or Hexaconazole 5% EC @ 1000 ml/ha or Iprodione 25% + Carbendazim 25% WP@ 500 gm/ha or Carpropamid 27.8% SC @ 100 ml/ha or Iprobenphos 48 % EC @ 200 ml/ha or Kresoxim-methyl 44.3% SC @ 500 gm/ha or Tebuconazole 25.9% E.C. @ 750 ml/ha or Tricyclazole 45% + Hexaconazole 10% WG @ 500 gm/ha or Carbendazim 1.92% + Mancozeb 10.08% GR @ 12.5 kg/ha after observing initial infection of the disease. Repeat the applications as per severity of diseases. Broadcast the granules under standing water condition **Biological control** • Treat the seeds with *Pseudomonas fluorescens* TNAU liquid formulation @ 10 ml/kg of seeds • Seedling root dipping with *P. fluorescens* TNAU liquid formulation @ 500 ml for one hectare seedlings • Soil application with *P. fluorescens* TNAU liquid formulation @ 500 ml/ha • Foliar spray with *P. fluorescens* TNAU liquid formulation @ 5 ml/l
Rice grain discoloration: *Helminthosporium oryzae, Alternaria tenuis, Fusarium Moniliforme, Sarocladium oryzae*	• Spray Carbendazim + Thiram + Mancozeb (1:1:1) @ 0.2% at 50% flowering stage **CIB Recommendation** • Spray Tebuconazole 50% + Trifloxystrobin 25% WG @ 200 gm/ha at 50% flowering stage **For combined infection of sheath blight, leaf blast and neck blast and grain dis-colouration** • Spray Tebuconazole 50% + Trifloxystrobin 25% @ 200 gm/ha For combined infection of blast, brown spot and grain dis-colouration, spray Tricyclazole 18% + Mancozeb 62% WP @ 1000 – 1250 g/ha
Bacterial leaf blight: *Xanthomonas oryzae* pv. *oryzae* and **Bacterial leaf**	• Spray 20% fresh cow dung extract twice (starting from initial appearance of the disease and another at fortnightly interval) or spray twice Copper hydroxide 77 WP @1.25 kg/ha 30 and 45 days after planting or spray Streptomycin sulphate + Tetracycline combination @ 300 g + Copper oxychloride @ 1.25 kg/ha. If necessary repeat 15 days later

streak: *Xanthomonas oryzae* pv. *oryzicola*	• Application of bleaching powder @ 5 kg/ha in the irrigation water is recommended at the kresek stage • Spray neem oil 60 EC @ 3% or NSKE @ 5% for the control of sheath rot, sheath blight, grain dis-colouration and bacterial blight
False smut: *Ustiloginoidea virens*	• Two sprays with Propiconazole 25 EC @ 500 ml/ha or Copper hydroxide 77 WP @ 1.25 kg/ha at boot leaf and 50% flowering stages **CIB Recommendation** Two sprays with Copper hydroxide 77 WP @ 2.0 kg/ha at boot leaf and 50% flowering stages
Rice tungro disease: *Rice tungro Bacilliform virus* and *Rice tungro Spherical virus* (Vectors: *Nephotettix virescens* *N. nigropictus* *N. parvus* *N. malayanus* *Recilia dorsalis*)	**Physical methods** • Set up light traps to attract and control the leaf hopper vectors as well as to monitor the population. • In the early morning, the population of leafhopper alighting near the light trap should be killed by spraying / dusting the insecticides. This should be practiced every day **Chemical method** • Spray Phosphamidon 40% SL 1000 ml/ha or Carbofuran 3% CG 25 kg/ha or Buprofezin 25% SC 800 g/ha or Carbosulfan 25% EC 800-1000 ml/ha or Fipronil 5% SC 1000-1500 g/ha or Fipronil 0.3% G 16.67-25 kg/ha or Imidacloprid 17.8% SL 100 -125 ml/ha or Thiamethoxam 25% WG 100 g/ha twice at 15 and 30 days after transplanting • The vegetation on the bunds should also be sprayed with the insecticides
Rice Orange leaf: ***Candidatus Phytoplasma*** (Vector: *Nephotettix virescens, N. nigropictus*)	**Cultural method** • Plough the stubbles as soon as the crop is harvested to prevent the survival of orange leaf pathogen during offseason **Chemical method** • Spray Phosphamidon 40% SL 1000 ml/ha or Carbofuran 3% CG 25 kg/ha or Buprofezin 25% SC 800 g/ha or Carbosulfan 25% EC 800-1000 ml/ha or Fipronil 5% SC 1000-1500 g/ha or Fipronil 0.3% G 16.67-25 kg/ha or Imidacloprid 17.8% SL 100 -125 ml/ha or Thiamethoxam 25% WG 100 g/ha twice at 15 and 30 days after transplanting • The vegetation on the bunds should also be sprayed with the insecticides

C) Nematode management

❖ Application of Carbofuran 3G @ 1 kg a.i./ha both in nursery and in main field at 45days after planting reduces of rice root-knot nematode, *Meloidogyne graminicola*.

RICE - VARIETAL SEED PRODUCTION

Land requirement

- Land should be free of volunteer plants. The previous crop should not be the same variety or other varieties of the same crop. It can be the same variety, if it is certified as per the procedures of certification agency.

Isolation

- For certified / quality seed production, a distance of 3 m all around the field from the same and other varieties of the crop.

Pre-sowing seed management

- In dormant cultivars, break the dormancy by soaking the seeds in equal volume of 0.1 N conc. HNO_3 or 0.5 % KNO_3 for 12 - 16 h.
- Upgrade the seeds adapting specific gravity grading with salt solution prepared by dissolving 1.5 kg of common salt in 10 lit of water. Remove the floaters and sinkers should be used for sowing after repeated washing with water.
- Harden the seeds for rainfed or direct sowing by soaking in equal volume of 1% KCl solution for 16 h and dry back the seeds to original moisture content.
- Soak the seed in 4% *Pseudomonas fluorescens* for 12 h at the ratio of 1 : 1 and dry back the seeds to original seed moisture content under shade.
- Soak the seeds in equal volume of 80 µM concentration of Sodium nitroprusside for 16 hrs to raise the nursery in saline / sodic soils.

Method of Planting

- SRI method can be adapted.

Recommendation for planting under saline soil condition

- Incorporation of green manure like Daincha in soil.
- Shallow planting at 3 - 4 seedlings / hill.
- Basal application of Gypsum @ 500 kg / ha.
- Foliar spray with 0.5 % $FeSO_4$ and $ZnSO_4$ at tillering stage.

Recommendation for Zinc deficient soils

- Apply $ZnSO_4$ @ 25 kg / ha.

Fertilizer recommendation for different duration varieties

- Short duration : NPK @ 120:40:40 kg / ha
- Medium duration : NPK @ 150:50:60 kg / ha
- Long duration : NPK @ 150:50:80 kg / ha

Roguing Space

- Leave a roguing space of 30 cm for every 150 cm.

Foliar Application

- Foliar spray of 2 % DAP at boot leaf stage and at 5 - 10% flowering.

Harvesting

- When 90 % of the panicle are in golden yellow colour with the moisture content of 20% for short and medium duration varieties and 17% moisture for long duration varieties.

Threshing

- Thresh either manually or using mechanical threshers at a seed moisture content of 16 - 17%.

Drying

- Dry the seeds to 12 - 13 % moisture content for short term storage and 8-9 % moisture for long term storage.

Pre-storage seed treatment

- Treat the seeds with Carbendazim @ 2 g / kg of seed.
- Treat the seeds with Halogen mixture @ 3 g / kg ($CaOCl_2$ + $CaCO_3$ + arappu (*Albizzia amara*) leaf powder mixed in the ratio of 5:4:1) as eco-friendly treatment.
- Seeds of poor storable paddy varieties (ADT 38, ADT 46) at 10 per cent moisture content are to be treated with Halopolymer @ 4 g / kg + Bavistin @ 2 g / kg + Imidacloprid @ 1 ml / kg and stored in super grain bag for extending the storability.

Storage

- Store the seeds in gunny or cloth bags for short term storage (8-9 months) with a seed moisture content of 12 - 13 %.
- Store the seeds in poly-lined gunny bag for medium term storage (12- 15 months) with a seed moisture content of 8 - 9 %.
- Store the seeds in 700 gauge polythene bag for long term storage (more than 15 months) with a seed moisture content less than 8 %.

RICE - HYBRID SEED PRODUCTION TECHNIQUES

Land Requirement

- Select fertile land with good drainage and irrigation facilities.
- Previous crop should not be different varieties / hybrids of paddy

Isolation

- Space isolation : 100 m
- Time isolation : 25 days (later)
- Barrier isolation : Either a distance of 30 m with vegetative barrier or plastic sheet with 2 m height.

Staggered Sowing

- Male parent should be sown in three to four staggered sowings based on the duration of parental lines for continuous availability of pollen till the completion of flowering in the female parent.

Main Field Management

Spacing

- Between 'A' lines 10 cm; between 'R' lines 30 cm; between A and 'R' line 20 cm : within rows 15 cm.

Planting design

- Two paired row @ 2 - 3 seedlings / hill.

Fertilizer application

- Apply NPK @ 150 : 60 : 60 kg / ha.
- Apply N and K in 3 split doses during the basal, active tillering and panicle initiation stages.

Foliar Application

- Foliar spray of 2 % DAP at boot leaf stage and another at 5 - 10 % flowering stage.

Special operations

Foliar spray of GA_3 @ 75 g/ha for Panicle Exertion

- First foliar spray of 40 g of GA_3 at 5-10 % panicle emergence stage followed by 35 g of GA_3 at 24 h after first spray.

Note: GA_3 should be dissolved in 70 % ethyl alcohol.

Supplementary pollination

- Rope pulling or shaking the pollen parent (R line) with the help of two bamboo sticks at 30 - 40% of spikelets opening stage is followed as supplementary pollination technique. This process is repeated for 3 to 4 times during the day time (10 am to 1 pm) at an interval of 30 min and continued for 7 to 10 days during flowering period.

Harvesting

- Harvest the male parent (R line) first and remove completely from the field.
- Then harvest the seed parent (A line).

Grading

- For getting better seed quality, size grade the seeds using 1.3 mm x 19 mm oblong sieve.
- Size graded seeds may be upgraded by density grading using specific gravity separator. Heavy and medium fractions with 90 - 92% recovery are selected for seed purpose.

Drying

- Sundry the seeds to reduce the moisture content to 12 - 13 %.

Pre-storage seed treatment

- Treat the seeds with Carbendazim @ 2 g / kg.
- Treat the seeds with Halogen mixture @ 3 g / kg ($CaOCl_2$ + $CaCO_3$ + *arappu* (*Albizzia amara*) leaf powder mixed in the ratio of 5:4:1 as eco-friendly treatment.