Hybrid Rice Research in Sri Lanka

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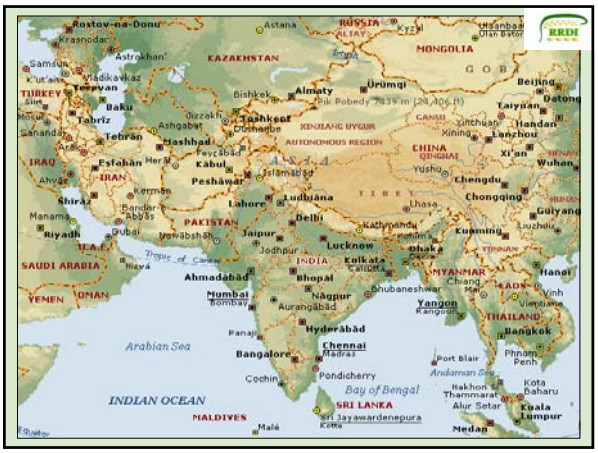
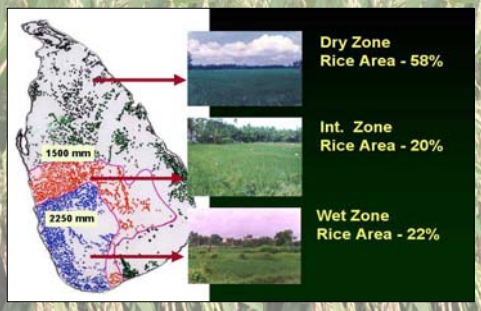


Rice growing areas of Sri Lanka



Importance of paddy sector to the economy

- Farm families engaged - 1.5 million
- Directly or indirectly depend on rice - 6.75 million
- Total paddy extent (ha) - 0.87 million
- Average labor requirement - 90 man days/ha
- Total annual labor requirement - 0.3 million persons

Rice cultivation can provide direct employment for 0.3 million people Produce annually R.s60 billion worth of paddy

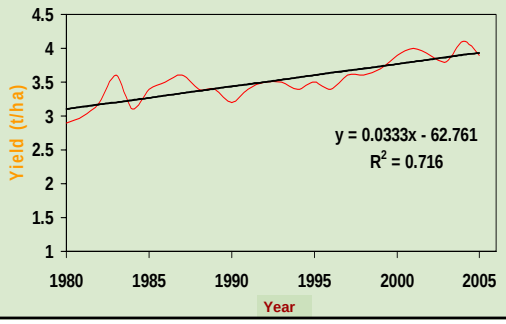
Why do we need hybrid rice ?

1. **Present national yield 4.1t/ha need to be increased to 5.1 t/ha in 2013**
   (yield level need to increase by 0.2t/ha/ year)

2. **However, it has taken 25 years to increase national rice yield by 1 t/ha (yield increase 0.03t/ha /year).**

3. Yield level of semi-dwarf varieties of green revolution era have plateaued.

Trends in Rice Yield in Sri Lanka



4. More & more rice has to be produced on less land & with less inputs with degrading environment.

5. Demand for rice is rapidly increasing with increase in population.

6. This cannot be achieved through the inbred rice technology.

7. One of the major options is to increase yield potential of varieties

8. Hybrid rice have shown 15-20% yield potential than inbred rice varieties under farmer's field conditions (Yield potential is 12t/ha).

9. Hybrid have shown their ability to perform under adverse conditions such as salinity and iron toxicity

Hybrid Rice Research in Sri Lanka

Objectives:

Sustaining food security in Sri Lanka through increased national paddy production at a reasonable cost and improve income of rice farmers through extensive use of hybrid rice

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1. Development of hybrid rice varieties adaptable to Sri Lanka
2. Development suitable technologies for hybrid rice seed Production
3. Develop management practices suitable for hybrid rice cultivation

…Hybrid Rice Research

- Initiated as early as in late 1970 s
- Tested several rice hybrids introduced from China
- No progress due to poor adaptability
- Started to develop own hybrids using CMS lines introduced from China
- No progress was made
  - Poor adaptability of CMS lines

Hybrid Rice Research…..

- Importance of a HR R & D program was felt with the observation of yield plateauing of inbred varieties
- Breeding materials such as CMS lines adaptable to tropical environment available at IRRI and accessible
- Successfully developed hybrid rice technology
  - Hybrid Varieties
  - Agronomic package for hybrid cultivation
  - F_1 Seed production technology
  - Awareness

Improvement of Parental lines

- Three line system most feasible system in Sri Lanka
- To increase the frequency of B and R among elite lines
- To broaden the genetic base of parental lines

Improvement of Restors (R) and maintainers (B)

- Cross breeding
- Sterility facilitated population improvement

Table 1: Performance of IRRI and Sri Lankan CMS lines at RRDI during the minor seasons -2007

CMS Line	Panicle Length (cm)	Spikelets Panicle $^{-1}$	Duration of floret opening (min)	Stigma Exsertion (%)	Pollen Sterility (%)	Outcrossing rate (%)
IR 69616 A	21.00	180.0	325	22.35	100	30
IR 68275 A	24.20	196.2	290	14.31	100	7
IR 68897 A	25.50	162.6	270	12.84	98	14
IR 58025 A	19.16	180.0	265	12.87	100	37
IR 77289 A	23.40	170.0	255	20.32	100	32
IR 80156 A	24.20	165.3	270	22.12	100	28
IR 77298 A	21.20	182.6	272	18.32	100	30
Bg CMS 1A	26.30	170.2	280	70.00	100	30
Bg CMS 2A	25.20	185.3	325	71.00	100	23
Bg CMS 3A	25.80	195.2	350	75.00	100	24
Bg CMS 4A	26.80	175.5	270	76.00	100	34

RRDI Develop CMS lines

Evaluation of Hybrids

Table 2. Performance of selected hybrids in preliminary yield trails at RRDI, wet season 2006-07

Hybrid	Plant height (cm)	Number of Tillers/Plant	Maturity (days)	Yield (t/ha^{-1})	Std. Hetorosis(%)
IR 69616A/BR1356-13-2-IR	105	18	105	6.0	-1.6
Bg CMS 1A/IR55838-32-2-3-2-2R	100	22	107	7.1	16.4
IR 68275A/Bg 95-454	98	18	110	5.9	-3.3
IR 68897A/Bg 95-276	90	17	103	6.2	1.6
IR 58025A/ P 2087-194-12-2R	97	16	102	5.8	-4.9
Bg CMS 2A/Bg 95388	98	17	104	6.3	3.3
IR 77289 A/HRSP 923	100	18	102	6.1	0.0
Bg CMS 1A/Bg 98-445	100	17	102	6.2	1.6
Bg CMS 4A/IR 62030-97-3-2-2	98	18	104	6.3	3.3
Bg CMS 4A/R 49735-4-13-1	100	17	105	6.0	-1.6
Bg 407H (Std.)	115	23	108	6.1	0

Promising Hybrid Combinations (Standard Heterrosis 20% or above)

Hybrid	Plant height (cm)	Number of Tillers/Plant	Maturity (days)	Yield (t/ha^{-1})	Std. Hetorosis(%)
Bg CMS 2A/IR 33380-7-2-1-3	100	21	100	7.4	21.3
Bg CMS 1A/BN 6986-108-2R	102	20	103	7.5	23.0
IR 69616/IR 69702-32-1-3	102	22	105	8.1	32.8
IR 80156A/IR 68077-37-2-3R	98	20	100	7.9	29.5
IR 77289A/HRSP 948	96	23	102	7.8	27.9
IR 76768A/IR 73012-2-2-2	98	21	105	7.5	23.0
Bg CMS 4A/At 95-10-4	99	24	102	8.2	34.4

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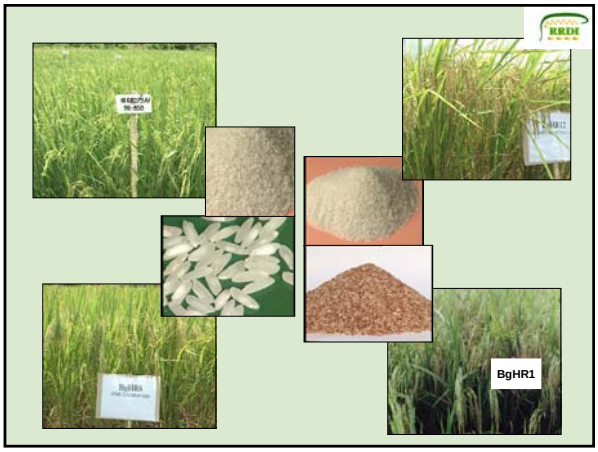
Promising rice hybrids

Locally developed hybrids

1. BgHR1 (Red)
2. BgHR12

Standard hetaerists for grain yield of above hybrids were 30 - 40% at yield trial level



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Hybrid Rice Seed Production

Small Scale Seed Production

CMS Seed Production

Large Scale CMS Seed Production at RRDI

Agronomic studies on HR cultivation and F1 Seed Production

Developing locally adopted management practices for HR cultivation

1. "Parachute method" – Seedling broadcasting is being popularizing among Sri Lankan farmers as a method of Hybrid Rice establishment – Introduced from P.R. China

Table 3: Effect of different seed rates on the grain yield and yield components of 407H Wet season 2007

Treatment	Panicles M^{-2}	Yield t/ha^{-1}	Filled Grains/panicle	Unfilled grains/panicle	Total grains/ panicle	Filling %	1000 Grain Weight (g)
Direct seeding 25Kg/h	305	4.57	115	6	141	81.6	28.58
Direct seeding 50Kg/h	339	4.33	110	25	135	81.4	28.73
Direct seeding 75Kg/h	382	4.13	104	23	127	81.7	28.10
Direct seeding 100Kg/ha	342	3.85	95	24	119	80.1	28.65
Line sowing (15 x 20cm)	370	4.54	105	30	135	77.9	28.38
Seedling Brodcasting	344	4.82	113	20	133	85.0	28.60
Row seeding	347	4.46	91	20	111	82.3	27.95
Transplanting (20 x 15)	326	4.66	117	30	174	79.5	27.93

Effect of different establishment methods on hybrid rice yield

Table 4: Effect of row arrangement and N fertilizer application on CMS yield (wet season 2007)

N fertilizer management	CMS seed yield (Kg/ha)			
	Border Between CMS Lines (new mtd)	Border Between B and CMS lines (IRRI mtd)	Average Yield (Kg/ha)	Yield Increase over
T1. 05,25,30 & 40% N at 0,2,5 & 7 WAT (Present practice)	506	586	546	15.8
T2. 20,20,20 & 40% N at 0,1,3,7 WAT	524	604	544	15.2
T3. 40,20,20 & 20 at 0,2,4 & 7 WAT	514	596	554	15.9
T4. 30,30 & 40 at 0,3 & 7 WAT	290	330	310	13.7
Average	458	529	488	15.5

WAT- Weeks After Transplanting Total N 100 Kg /ha


22/11/2007


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Constraints & suggested remedies

- **Majority of the farmers practiced direct seeding. High cost of hybrid rice seed paddy prevents the direct seeding of hybrid rice. Therefore, alternative cost effective establishment method for seed savings needed.**
- **Difficult in finding isolated large scale fields for seed production**
- **High cost of GA3 used for hybrid rice seed production. Finding alternative chemicals/ other means for GA3 is essential**
- **Limited yield heterosis in developed hybrids. Due to low level of genetic diversity used for hybrid rice development.**
- **Poor and inconsistence of seed yield of F1. Need to develop stable & highly adoptable hybrids.**

Future outlook

To overcome these constraints, HR, R & D programme reoriented to…

- Develop hybrids with acceptable grain quality
- Enhance the magnitude of heterosis to20% and above by developing two line and intersubspecific hybrids
- Develop hybrids resistant to the major pest and disease
- Enhance seed yields beyond 1.5t/ha^{-1} to bring down the F1 seed cost
- Promoting seedling broadcasting / " Parachute method".

- Technology dissemination has to be intensified through the conduct on-farm demonstrations and training programmes to increase awareness about the benefits of hybrids rice among the farmers and consumers
- Policy intervention by the government to increase support for HR technology
- Aggressive efforts to popularize hybrid rice technology and the assured procurement of hybrid rice seeds (F_1) at a subsidize price

If the above constraints are solved effectively,

Hybrid rice is likely to be cultivated in area of around 10000ha in high potential area in future to help sustain food security in Sri Lanka

Conclusion

During the past few years HRDC program in Sri Lanka has shown a remarkable progress under the numerous constraints. There are many activities to carryout to achieve the goals. The current activities of the Hybrid Rice R & D program in the country would make good success with the collaboration of IRRI, and INHRRDC of P.R. China and with the financial support from FAO/TCP.

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