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Study of Hybrid Rice in India –Current Status, Economics and Future Prospects

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Introduction:

Rice is staple food of more than 60 % of Indian population. It accounts for about 43 % of total food grain production and 46 % of total cereal production in the country. In order to meet the domestic demand of the increasing population the present day production of 99 million tons (2008) of milled rice has to be increased to 125 million tons by the year 2030. Since the yield of high yielding varieties (HYVs) of rice is plateauing, it is rather difficult to achieve this target with the present day inbred varieties. Therefore, to sustain the self sufficiency in rice, additional production of 1.5 million tons is needed every year. Among the limited options, hybrid technology is the only proven technology currently available for stepping up rice production significantly. The rice hybrids, recently introduced in cultivation, on an average, give 10 to 15 q/ha additional yield over the conventional varieties (about 20 % increase). Therefore, the introduction of hybrids and popularization of their production technology are feasible and readily adoptable to achieve targeted production.

What is hybrid rice?

Like in other crops, the first generation progeny (F1) obtained by crossing two genetically different varieties (parents) of rice is called 'Hybrid'. Since rice is self-pollinated, cytoplasmic male sterile (CMS) parent is used as female parent, which is normally called 'A' line. The fertility restoring line which is called 'pollinator' to the female parent is known as male parent. It is generally referred to as 'R' line, and is used for hybrid seed production. The hybrid combines the desirable characters from CMS line and R line. They exhibit vigour for several quantitative characters including yield. They exhibit buffering capacity to counteract several biotic and abiotic factors that limit productivity. While developing/evaluating hybrids, the combinations of varieties that exhibit vigour or heterotic

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effect for yield are selected. The hybrid seed is purchased or procured afresh every year/ season for raising the commercial crop. The harvested grains from hybrid crop should not be used for planting the next crop.

Chinese experience of hybrid rice:

The Chinese scientists were the first in the world to develop commercial hybrids in rice and the first hybrid was released in 1976. Now, China covers 53% of its rice area and about 58% of production under hybrid rice. So far on account of cultivation of hybrids, about 350 million tons of additional rice has been produced in China. Now China is developing 'Super Hybrid' rice targeting yield level of 15 t/ha. This kind of effort is needed in India where rice productivity is still below 3 t/ha.

Hybrid rice in India:

Taking cue from the success of hybrid rice technology in China, systematic research efforts on hybrid rice in India were initiated in 1989, when Indian Council of Agricultural Research (ICAR) launched a special goal oriented and time bound project on 'Promotion of Research and Development Efforts on Hybrids in Selected Crops'. For rice, National Network Project involving 12 centres was initiated. The technical support was received from the International Rice Research Institute (IRRI), Philippines and Food and Agriculture Organization (FAO), Rome and financial support from United Nations Development Programme (UNDP), Mahyco Research Foundation, World Bank funded National Agricultural Technology Project (NATP) and IRRI/ADB projects on hybrid rice.

Generous support of policy makers, liberal funding from donors and creation of research infrastructure enabled India to become second country in the world after China to develop and commercialize hybrid rice. In India, in 2008, hybrid rice occupied 1.4 million hectares of area and contributed additional rice production of about 1.5 to 2.5 million tons. Besides China and India, the hybrid rice technology has also been adopted in other countries of the world (Table 1).

Table 1: Area under hybrid rice in different countries (2006)

Country	Area (ha)
India (2008)	14,00,000
Vietnam	8,00,000

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Philippines	2,00,000
Mynmar	50,000
Indonesia	40,000
U.S.A	20,000
Others (Egypt, Sri Lanka, etc)	50,000

Development of rice hybrids:

Initially, the experimental hybrids are developed by the centres included in the Hybrid Rice Research Network. The hybrids developed by the network and some others developed by IRRI and private sector are categorized into three maturity groups i.e., early (<120 days), mid-early (121 to 130 days) and medium (131-140 days). The hybrids of these three maturity groups are then evaluated in Initial Hybrid Rice Trial (IHRT) at 25-30 locations across the country. Such hybrids which exhibit yield advantage of 15 % over the National check varieties are promoted to Advanced Varietal Trial-I (AVT- I) and evaluated at multi-locations. The promising hybrids are further evaluated in Advanced Varietal Trial-II for yield, quality, resistance to insect pests and diseases and response to agronomic practices. The hybrids found superior to National check varieties are identified for release by the Varietal Identification Committee (VIC) convened by Deputy Director General (Crop Sciences), I.C.A.R during All India Coordinated Rice Improvement Project workshops every year. Finally, the hybrids are released by the Central Sub-Committee on Crop Standards, Notification and Release of Varieties.

So far (between1994 to 2009) 43 hybrids (Table 2) have officially been released for commercial cultivation in different parts of the country.

Table 2: List of rice hybrids released in India since 1994.

Sl. No	Hybrid	Duration	Year of	Developed by
1.	**APHR – 1****	130-135	1994	APRRI, Maruteru (ANGRAU), Hyderabad
2.	**APHR – 2****	120	1994	APRRI, Maruteru (ANGRAU), Hyderabad
3.	**MGR – 1 (CORH-1)****	110-	1994	TNAU, Coimbatore
4.	**KRH – 1****	120-125	1994	VC Farm, Mandya, UAS, Bangalore

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5.	**CNRH – 3****	120-	1995	RRS, Chinsurah, West
6.	**DRRH – 1****	130	1996	Directorate of Rice Research, Hyderabad
7.	**KRH – 2***	125-130	1996	VC Farm, Mandya, UAS, Bangalore
8.	**Pant SankarDhan–1****	120	1997	GBPUA &T, Pantnagar
9.	**PHB –71***	130-135	1997	Pioneer Overseas Corporation, Hyderabad
10.	**CORH – 2****	125-	1998	TNAU, Coimbatore
11.	**ADTRH – 1****	115	1998	TNRRI, Aduthurai (TNAU)
12.	**Sahyadri–1****	125-	1998	RARS, Karjat (BSKKV)
13.	**Narendra Sankar Dhan–2****	125-	1998	NDUA & T, Faizabad
14.	**PA–6201***	125-	2000	Bayer Bio-Science,
15.	**PA–6444***	135	2001	Bayer Bio-Science,
16.	**PRH–10***	110-	2001	IARI, New Delhi
17.	**PRH–122 R (Ganga)***	130	2001	Paras Extra Growth Seeds Ltd, Hyderabad
18.	**RH–204***	120-125	2003	Parry Monsanto Seeds Ltd, Bangalore
19.	**Suruchi***	130	2004	Mahyco Ltd, Aurangabad
20.	**Pant SankarDhan–3****	125-	2004	GBPUA & T, Pantnagar
21.	**Narendra Usar Sankar**	130-	2004	NDUA & T, Faizabad
22.	**DRRH–2***	115	2005	Directorate of Rice Research, Hyderabad
23.	**Rajlaxmi****	130-135	2005	Central Rice Research Institute, Cuttack
24.	**Ajaya****	130-135	2005	Central Rice Research
25.	**Sahyadri–2****	115-120	2006	RARS, Karjat (BSKKV)
26.	**Sahyadri–3****	125-130	2006	RARS, Karjat (BSKKV)
27.	**HKRH–1****	139	2006	RARS, Karnal (CCSHAU)
28.	**CORH–3****	115	2006	TNAU, Coimbatore
29.	**Indira Sona***	125-130	2006	IGKKV, Raipur
30.	**JKRH–401***	140	2007	JK Agriculture Genetics Ltd, Hyderabad
31.	**JRH–4****	116	2007	JNKVV, Jabalpur
32.	**JRH–5****	115	2007	JNKVV, Jabalpur
33.	**PA–6129***	120	2007	Bayer Bio-Science,

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34.	**GK–5003***	128	2008	Ganga Kaveri Seeds Pvt. Ltd. Hyderabad
35.	**Sahyadri–4***	115-120	2008	RARS, Karjat (BSKKV)
36.	**JRH–8****	-	2008	JNKVV, Jabalpur
37.	**DRH–775***	97	2009	Methahelix Life Sciences, Pvt.Ltd,
38.	**HRI–157***	130-135	2009	Bayer Bio-Science,
39.	**PAC–835***	102	2009	Advanta India Ltd,
40.	**PAC–837***	97-103	2009	Advanta India Ltd,
41.	**NK–5251***	128	2009	Syngenta India Ltd.,
42.	**DRRH–3***	131	2009	Directorate of Rice Research, Hyderabad
43.	**US–312***	125-130	2009	Seed Works International,

Source :

- Viraktamath et al (2010) "Hybrid Rice in India", Bulletin No.47, Directorate of Rice Research, Rajendra Nagar, Hyderabad-500030., *Hybrids released by State Variety Release Committee., **Hybrids released by Central Variety Release Committee.

Economics of hybrid seed production

The hybrid rice seed production is fast becoming a lucrative proposition for entrepreneurial farmers. With the average seed yield of 1.5 to 2.5 t/ha and at average procurement price of Rs. 30 – 40 per kg, the gross returns are Rs. 60,000 – 80,000 per hectare. The cost of seed production is around Rs. 25,000 – 30,000 per hectare. Hence the net profit by undertaking hybrid rice seed production works out to be Rs. 35,000 – 50,000 per hectare and hybrid rice growers are benefited substantially. Besides, hybrid rice seed production generates additional employment for 60 – 80 person days/per hectare, particularly for rural women in activities like supplementary pollination, rouging, etc

Future Outlook

A good beginning has been made by ushering in to an era of hybrid rice in the country. Development of heterotic hybrids by the researchers, large scale production of hybrid seeds by various seed agencies and transfer of this technology to the end users by the extension agencies must go hand in hand to have the real impact of this technology in the Indian agriculture. Though

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the hybrid rice technology has been introduced to Indian agriculture, the successful large scale adoption of this innovative technology, in future, primarily depends upon the economic attractiveness of this technology. Rice hybrids with still higher magnitude of heterosis coupled with better grain, cooking and eating quality and possessing resistance to major pests and diseases are being developed.

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