Rice Research: Open Access
ISSN: 2375-4338

Short Communication Open Access

Fulfillment of Rice Products for Mankind

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Introduction

Special rices such as waxy rice, organic rice and natural rice have recently drawn rice growers particular attention to some rice-producing countries. Milling yield and cooking quality and processing characteristics need further studies. Harmonization of analytical methods for grain quality at national and international laboratories should be encouraged. Rice consumption has increased in Europe, America and Africa as a result of food diversification and immigration. Recently, the demand for long grain and aromatic rice has been increasing in North America and EU, resulting in a significant change in rice-planted areas. Many long grain varieties have been developed for temperate conditions, particularly under frequent low night temperature, where grain quality still needs to be improved [1]. The Basmati rice types, which have high grain quality with relatively-long grain and aromatic characters and long extruded cook grains, still needs to be developed, with yield improvement. Water control was the main factor necessary to increase the rice production and productivity in Asia during the Green Revolution, but a decline in investment for the development of irrigation infrastructures in many developing countries has taken place, thereby affecting the growth of rice production as well as productivity. High labour costs, mechanization, the use of chemical inputs and the slow increase in grain yield contributed to the high cost of rice production in irrigated rice, especially in developed countries [2]. It is known that an increase in rice yield can substantially compensate for the high cost of production, but it increases slowly and cannot catch up with the latter. In addition, the yield potential has reached the plateau and the price of rice is not sufficiently high to provide farmers with an incentive for increased production. The world's price of rice declined during the 1980s, however recently it has again increased and levelled off, due to the increased import of rice from China, Indonesia, Philippines, etc. and the occurrence of flooding and drought in these countries. One of the most effective means to promote the flow of agricultural information over the world is the modern computerized communication facilities, which allow gathering, disseminating, and facilitating interaction and exchange of such information among a large number of people and institutions working in the same field. Obviously, it still needs to have initiatives, coordination and leadership in this regard. The More collaborative efforts among member countries and institutions, universities, NARCs, etc., working on rice in the temperate regions should be encouraged in the participation in the flow of rice information in various disciplines [3]. At the initial step, e-mail and other electronic mail forum for short-term conferences on relevant topics could be explored to promote the flow of rice information among those interested. Recently, hybrid rice is the only emergent technology available for raising the ceiling of rice yield potential. Hybrid rice, which is grown on million ha and accounts for more than the total rice area in China, has helped this country to produce additional million tonnes of rice since 1976 and has saved more than 2 million ha for agricultural diversification. This was achieved due to the fact that the yield of hybrid rice is higher than that of conventional varieties [4]. This technology is very essential for highly populated areas, where arable lands are limited. Furthermore, this practice to increase rice production involves less investment than land and irrigation development; however, the present method of hybrid seed production is still labour-intensive and costly. The new method of deploying two-line hybrid rice by using environment-sensitive genetic male sterile lines seems promising for the future wide adoption of hybrid rice in other countries besides China, India and Vietnam.

Discussion

The one-way method or apomixis of rice is under intensive research in China, the USA and at IRRI in the Philippines, but no success in this field has yet been reported. At CIMMYT in Mexico, Savidan and his team are working on the development of apomictic maize, exploring combined conventional breeding techniques, DNA markers and other advanced science [5]. Once a maize apomictic gene is identified it could be transferred into other crops including rice. As apomictic seed reproduces asexuality, farmers do not need to renew their seeds, especially in hybrid rice seeds. FAO has assisted several countries in Asia and Latin America in strengthening their national capacity for the development and use of hybrid rice, through the FAO Regular Programme, TCP funding, and UNDP project. Under the present demographic pressure and limited arable land, an increase in rice productivity through the hybrid rice method, will contribute to the world's food security. It is also noted that FAO and IRRI have jointly established the International Task-Force on Hybrid Rice in 1995, with the participation of countries, aimed at expediting the development and use of hybrid rice outside China. Its Coordinating centre is located at IRRI in the Philippines. The yield of rice has increased during the last two decades and has now reached plateau. The variety IR 8 which was released by IRRI, still has the highest yield potential against the other improved varieties, recently introduced to farmers in Asia. Rice scientists have been working towards raising the present yield level or more by making carbohydrate partitioning more efficient for increasing grain yield or harvest index [6]. The work on super rice initiated in 1988 by IRRI, with studies on improvement of physiological aspects of modern rice for increasing yield potential. The potential yield of this rice could reach under tropical conditions, compared to the present potential yield. According to a forecast made by IRRI's rice breeders, seeds of super rice will be available to farmers within 5-6 years. At present, several promising lines with high yield have been developed, but they are susceptible to brown plant hoppers, and have low percentage of filled grains and low grain quality. Some scientists, however, are still sceptical about the productivity, sustainability and environmental impact of super rice. Super rice is the continuation of the modern rice generation, which was widely adopted by farmers

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Received: 23-Aug-2022, Manuscript No. rroa-22-74614; **Editor assigned:** 25-Aug-2022, PreQC No rroa-22-74614 (PQ); **Reviewed:** 08-Sep-2022, QC No. rroa-22-74614; **Revised:** 14-Sep-2022, Manuscript No rroa-22-74614 (R); **Published:** 21-Sep-2022, DOI: 10.4172/2375-4338.1000324

Citation: Ghonemy DE (2022) Fulfillment of Rice Products for Mankind. J Rice Res 10: 324.

during the Green Revolution. Genetically, to achieve the goal of 15 t/ha, IRRI has exploited two strategies of breeding. The first strategy would increase the present yield potential, while the second strategy would further increase the yield. Rice scientists are now hoping to raise HI of HYV, through a new plant type concept including reduced tillering, large panicles, high grain density, longer grain filling period and resistance to major pests. Physiologically, high-density grains were conceptualized and designed by IRRI [7]. After six years of work in the Philippines, it proposed a new approach to increase grain yield by increasing weight per grain within a variety through a change in plant type. High density grains have higher grain volume, weight, milling yield and head rice recovery. A new plant type, that was proposed by IRRI to have HD grains is Low tillering, to produce vigorous and large tillers that result in more HD grains, Panicle weight type, to produce large panicles with mostly primary branches, Panicles composed mainly of primary branches as they have mostly HD grains and fewer empty and half-filled spikelets, Large pedicellar vascular bundle for better transport of assimilates, Thick culm for more vascular bundle, less tendency to lodge, better support of panicle, and probably a larger area for carbohydrate accumulation, Medium-size grains, since large grains have low density and are not usually completely filled, Erect and thick leaves, for better light distribution and higher photosynthetic rate per unit leaf area, Dark green sheath for the flag leaf to increase assimilate production, Slow senescence for increased assimilate production and a longer grain-filling period, High photosynthetic rates and low photo-synthetically-active radiation, so that carbohydrate supply will be less limiting during the wet season, Medium growth duration for carbohydrate accumulation before heading and Intermediate plant height with an HI of 0.55, because semi-dwarf plants tend to be high tillering [8]. A similar concept has been adopted for rice production under direct seeding in the temperate zone and others related. Most improved varieties grown in these countries have medium growth duration, less tillering, panicle-weight type, medium-size grains, less grain number per panicle, etc. Besides the work done by IRRI's scientists, Chinese and Japanese scientists have worked on super rice in the last several years. Chinese scientists have developed New HYV or super HYV. Japan started a project to increase the yield. The yield of the variety Oochikara with large grains, which has been developed, is higher than the control [9]. This variety is not suitable for human's daily diet, but for animal feeding or others. Japanese scientists proposed a new model of V-type leaf plant, in which half of the leaf's angle from the horizontal plane should vary in degrees. The photosynthetic rate of unfolded V-type single leaves was the same with a reference cultivar and parents, but their leaf thickness and nitrogen content were higher and leaf area was less [10]. The high yield of cultivars is attributed by five features, Mutual shading decreased as a result of leaf blade's inclination, Lower leaves received more irradiation, The photosynthetic rate unchanged although leaf inclination, Higher leaf thickness and nitrogen content, and High root activities. The character of V-type leaf is controlled by a recessive gene. As grain quality is poor, V-type rice plants were evaluated for feed and fodder use.

Conclusion

As the rice area worldwide has remained more or less stable since the early 1900s and a trend to increase it is unlikely in the future, it is believed that the hybrid rice technology and the new plant type rice, which are aimed to increase rice yield, will play an important role to meet the world's rice demands in the coming century.

Acknowledgement

None

Conflict of Interest

None

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