TRAINING COURSE ON HYBRID RICE TECHNOLOGY IN PAKISTAN & HYBRID RICE SEMINAR IN PAKISTAN & CHINA 2017

REPORT

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INTRODUCTION

Rice is an important food and cash crop of Pakistan - the second largest staple food crop after wheat and the second major exportable commodity after cotton. It attains this position for having export of over two billion dollars. This export has a significant share of coarse rice.

Rice accounts for 3.0 percent of value added in agriculture and 0.6 percent in GDP. During 2016-17, rice crop was cultivated on an area of 2724 thousand hectares showing a decrease of 0.6 percent over last year’s area of 2793 thousand hectares. Rice production stood at 6849 thousand tons achieving its targeted production of 6838 thousand tons and showing an average increase of 0.7 % over corresponding period of last year’s production of 6801 thousand tons. Rice area decreased due to decline in domestic prices of rice which reduced the area under the crop and growers shifted to sugarcane and maize crop.

The export figures in rice also contemplate that the coarse varieties are dominant in overall rice business and any further expansion is possible through the increase in production and productivity of rice as a whole with specific reference to coarse rice and replacement of traditional coarse varieties with high yielding rice hybrids, that can double the production to make sizeable surpluses.

A) MEETING WITH CHINESE COMPANY:

Ministry of National Food Security and Research Islamabad requested vide letter No.F.1-1/2016 – Sec, NFS & R dated January 5, 2016 to Chinese Embassy for Training of hybrid Seed Production. Afterwards, another request was made by the Ministry to Economic Affairs Division Government of the Pakistan (No.F.8-8/2016 (China) IC-II Dated 18 March, 2016 – Sec, NFS & R) for support of this idea for sponsorship and arrangements of experts for trainings to be arranged in China and in Pakistan.
Government of China has graciously accepted this request and approved a world renowned Rice hybrid institute from China “Yuan Longping High-Tech Agriculture Co., Ltd China” to undertake this activity. Consequently, a delegation from Longping High Tech Agriculture visited Pakistan and have a meeting at the Ministry of National Food Security and Research (MNFS&R) with Additional Secretary on 27th April, 2017 in the presence of representatives of Chinese Embassy in Pakistan, Economic Affairs Division Islamabad and Provincial Rice Research institutes of Punjab and Sindh. It was decided that a month long training will be arranged at National Agricultural Research Centre (NARC) Islamabad for Pakistani scientists, extension agents, private sector and farmers followed by field visits and trainings at all rice regions of Pakistan for training on hybrid seed production and promotion for productivity enhancement.

B) FINALIZATION OF ACTION PLAN:

Action plan to finalize the details of curricula of training, boarding and lodging arrangements, faculty required, budget needed and propionate share of Pakistan and China was finalized in a joint meeting of both countries at Pakistan Agricultural Research Council (PARC) Islamabad. Dr Muhammad Anjum Ali Member Plant Sciences Division (PSD) was notified by MNFS&R. Provincial Governments, Private Sector Seed companies and other stakeholders were requested for nominations. Nominations received were scrutinized and invitations were accordingly issued and training was organized from 12th September to 11th October 2017. Thirty participants including scientists, extension workers, farmers and persons from private sector participated. Out of these, three were from PARC, four from Punjab, two from Sindh, three from KP, one from Baluchistan, five farmers from different provinces and twelve were from private sector. A team of high skilled teachers/trainers from Longping institute China joined this national program. 12 faculty members from China joined this program and 2 elite members travelled with the participants in all the four ecological zones i.e. Punjab, Sindh, Baluchistan and KP. Member PSD was also invited for lectures on Pakistani Agriculture and potential of hybrid rice in Pakistan. A comprehensive report on this training was prepared and is attached as appendix A. However, the main contents of the training are given as below:

✓ Rice research and production in Pakistan
Hybrid rice technology including hybrid rice breeding.
Parents breeding and F1 breeding.
Hybrid rice seed production.
Field management skills for high-yield hybrid cultivation, including theoretical lectures and field practice from Chinese side.
Cooperation in agriculture between China and Pakistan, and hybrid rice promotion by federal and provincial public and private sector in Pakistan.

C) RECOMMENDATIONS:

Travelling was done from 16th September to 3rd October, 2017. It provided an effective platform to interact among different stakeholders of public and private sectors in real life situation.

The following recommendations were made:

- This type of training should remain continue in future however, the training duration should not be more than 3 weeks.
- Scientists of Pakistan should be provided training opportunities in China on practical aspects of hybrid rice development. The nature of training should be more practical / applied rather than theoretical.
- Specific trainings on hybrid rice seed production may be arranged both in Pakistan and China for officers and field staff.
- There should be agreement regarding exchange of rice germplasm between Pakistan and China for breeding the best suited hybrids for Pakistan.
- Region specific testing, approval and promotion of hybrid rice should be carried out instead of making generalized recommendations.
- Efforts should be carried out to develop Basmati rice hybrids with technical assistance from China in public sector organizations of Punjab province.
- Training and internship facilities should be provided to Pakistani professionals on transfer of hybrid rice technology at R & D centers of LPHT located in Pakistan.
- There should be market players / plan for the purchase / sale of hybrid rice produce both in local and International markets, so that grower may get better price. As a result of good price for hybrid rice in market, the area under hybrid rice in Pakistan will increase and farmers take interest in its cultivation.
- Formulate public-private partnership for the development of parental lines with clear cut propriety rights.
Approval of new hybrids should be made on strict merit including yield and quality parameters for specific area.

More emphasis may be given for technical assistance from China to develop thermo-sensitive genetic male sterile lines to develop two line hybrids.

Rice R&D at Usta Muhammad, Balochistan (public sector organization) may be started as there is no independent Rice Research station in the province.

Farmer training programs may be initiated regarding the hybrid rice production technology.

Hybrid rice R&D may be initiated through collaborative / joint project by China & Pakistan preferably in Sindh & Balochistan province.

Lack of seed outlets in Balochistan. Branded seed outlets of companies are in Upper Sindh from where the rice seed is marketed. Segregation population are observed that means either some mixture in seed or F₂ population is sold to the farmers sometimes. Hybrid claimed to get more than 10 t/ha, could not achieve that in the field.

There must be a monitoring system on the approved hybrids feedback. In this system, the company will provide least list of 20 farmers to whom the seed was sold. This team will get feedback directly from the farmers to evaluate both hybrid performance and company credibility. In case of any loss due to ill performance of hybrid seed, the company will be bound to compensate the farmer’s loss.

D) BUDGET AND EXPENDITURE:

Regarding the expenditures of the Training Course, the expenses of opening and closing ceremony, meals of the participants were borne by the Chinese Side. The expenditure on boarding/accommodation of the participants and travelling were borne by Pakistan side by arranging funds from AIP/CIMMYT Pakistan.
A REPORT ON SEMINAR ENTITLED

“Hybrid Rice for Pakistan”
21-07-2017 to 10-08-2017 in Changsha, Hunan, China”

Organized By

“Yuan Longping High-Tech Agriculture Co., Ltd China”

Promoting the Development of Seed Industry, Benefiting People All Over the World

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HYBRID RICE SEMINAR IN PAKISTAN AND CHINA 2017

INTRODUCTION

This seminar was organized by the Longping Hi Tech Co., Ltd. on Hybrid Rice for Pakistan in the Kaichen Hotel, Changsha Hunan, China with financial support of China AID.

LPHT is known as the “China-Aid Hybrid Rice Technology Training Center” awarded by Ministry of Commerce of P.R. China. The company was established in June 1999 and was listed in Shenzhen Stock Exchange in 2000. The company regards the “promoting the progress of seed industry for the welfare of people of all over the world” as its mission and “to be the excellent seed enterprise in the world” as its vision. At present LPHT rank the first among the Credit Star Enterprises in the seed industry of China. Along with the hybrid seed industry as a main business, also focusing on the business of hybrid pepper, hybrid maize, hybrid cotton and hybrid rape seed, covering the field agriculture technology. LPTH is agriculture company group with more than XXX subsidiaries and branches integrated by R&D, production, sale and import & export trade.

With the materialization of the request for the training of Pakistani Professionals at the Longping Agriculture High-Tech Co., Ltd. Changsha, China, twenty seven scientists participated in the training in China. Out of these, Two were from PARC, one from FSCRD, one from PAEC, eleven from Sindh, five from Balochistan, three from KP and four from Punjab. The purpose of the seminar was to bring together scholars from Pakistani research institutes and universities to learn about the hybrid rice breeding, seed production technology and marketing along with sharing of information regarding hybrid rice successes of China.

A) HUNAN PROVINCE:

Hunan Province is located at central China, and boarders on Guangdong, Guangxi, Chongqing, Jiangxi, Hubei and Guizhou. Since it lies in the south of Dongting
Lake, it is called Hunan for its geographical position. An abbreviation of it is Xiang because Xiang River runs through the whole boundary. It has long been reputed as Fu Rong Kingdom (hibiscus kingdom) for the massive planting of hibiscus flowers within its boarder. Its total population is 68.452 million and covers 211,800 square kilometers. Changsha is the provincial capital.

i) History & Cultural Background:

The earliest primitive cultivated rice of mankind 12,000 years ago and the earliest archaeological site of primitive society in China are both find here. Qin’s bamboo slips, ancient tomb of Western Han Dynasty and Wu’s bamboo slips unearthed are the civilization deposits of long history in Hunan. Hunan is known to be the home-town of Mao Zedong, the great leader of China. Many other great talents who changed China’s fate as well as the frame-work of world were also born here in Hunan. From time immemorial it is the most productive farm land in China and the quantity of rough rice occupies the first position in China year to year ”when rice in Hunan is ripe, it is sufficient for the whole China” and “a land flowing with milk and honey” are vivid depiction of Hunan. The economic and social development of Hunan is full of energy. It is also a province with rich culture with distinct location advantages and transportation superiority.

ii) Changsha City:

Changsha is rich in tourist resources because of its unique geographical location. Surrounding the city are the beautiful Yuelu Mountain and Weishan Mountain, and the Xiangjiang river and Liuyang River Flow across it. The Juzizhou scenic spot in the city is regarded as one of the eight most charming places in Hunan attracting both domestic and overseas visitors.

Being the political, economic scientific and technological educational cultural and transportation center in Hunan, Changsha is quite a large place occupying land of 11,800sq km. with a population of 5.63 million. Changsha is among the First group of Chinese cities which are selected as famous historical and cultural cities in the country and allowed to open-up to the outside world. Thus it has become an important city in central china enjoying the fastest economic growth and immense vitality.
### Yuan Longping: Father of Hybrid Rice:

YUAN LONGPING, born in Beijing in 1930, now lives in Changsha of Hunan Province, an Academician of Chinese Academy of Engineering, and the founder of hybrid rice, known as the “father of hybrid rice”. Academician Yuan took the lead to carry out rice heterosis application research in our country, published the famous paper Male Sterility in Rice in 1966, achieved the matching “three lines” of sterile lines, maintainer lines and restorer lines of hybrid rice in 1973, cultivated the world’s first hybrid rice variety “Nan You No.2”, obtained success in “two-line method” hybrid rice research under the charge of him in 1995, launched and led the research of “super hybrid rice” in 1999, and realized the research goal with yield per mu exceeding 1,000 kg in 2015.

Develop hybrid rice to benefit people of the world is a lifelong pursuit dream of Academician Yuan. Since the hybrid rice of China went abroad for the first time in 1979, it has been studied and promoted in more than 80 countries and regions in the world, and it has made a significant contribution to food security of the world.

Arising from the great dream of Academician Yuan Longping, Yuan Long Ping High-Tech Agriculture Co., Ltd. (referred to as “Long Ping High-Tech”) was officially established in Changsha, Hunan Province in 1999, and Academician Yuan undertook honorary chairman of the company. Under the guidance of the spirit of Academician Yuan, Long Ping High-Tech has inherited dream, adhered to innovation and developed rapidly, and it has been ranked the first in “Chinese seed industry credit star enterprises” for many years, known as “the first brand in Chinese seed industry”.

Agricultural services are based on the concept of making profit for cultivator and bringing benefit to eater. The company has continued to expand agricultural service value chain, its business covers precision planting technology, new professional peasant training, quality grain trading platform, cultivated land rehabilitation and development, brand agriculture and agricultural finance etc., and it creates an agricultural integrated service platform by including peasants, dealers and other means of agricultural production, finance and other partners into the integrated service ecological circle.

As a high-tech modern seed industry group, the development direction of Long Ping High-Tech highly accords with the national development strategy of “emphasize
agriculture and consolidate foundation”; the company takes “promote the progress of seed industry to benefit people of the world” as the mission, takes “an excellent seed industry company in the world, which devotes to providing clients with comprehensive agricultural service solutions” as the corporate vision, and is committed to making

iv) **Yuan Agriculture Hightech Institute:**

The establishment of Yuan Longping Talents Training Center for Worldwide Top Agricultural Professionals aims to give play to the advantages of sponsors and brand effects of "Yuan Longping", enhance international high-end agriculture talent cultivation, promote industry-university-research cooperation, offer services to national economic construction and the building of the "Belt and Road", achieve win-win cooperation among three parties, and contribute to China's efforts to promote advancement and popularization of agriculture technology, develop modern agriculture, and safeguard global food security.

Vice director-general of Hunan Province Agricultural Commission Huang Qiping, vice supervisor of Department of Commerce of Hunan Province Mao Qixing, party member of the Education Department of Hunan Province Xu Wei and other leaders offered their congratulations to the establishment of the cultivation center, and said that they would actively support the construction and development of the cultivation center with high quality, high standard, and high efficiency.

Under the organization of leaders such as Zhou Dan from Longping High-tech, personnel of General Affairs Office of Longping University, backbone staff of International Training Center of Longping University and relevant leaders of Hunan Agricultural University had discussions regarding the cultivation of international agriculture talents for several times. They pushed forward the preparation for building Yuan Longping Talents Training Center for Worldwide Top Agricultural Professionals, and eventually, this signing ceremony was held successfully. After the signing ceremony, International Training Institute of Longping High-tech held the Opening Ceremony of the 2017

B) **INAUGURATION CEREMONY:**

Inauguration ceremony was held at Hunan Hybrid Rice Research Center, Changsha. The ceremony was chaired by the *Father of Hybrid Rice* Yuan Longping in
China. The other eminent scientists, officials and representatives were Dr. Muhammad Anjum Ali, Member Plant Sciences Division PARC/Head of Pakistan Delegation, Dr. Wang Xiusong Director LPHT, Ms Zhou Dan, Vice President LPHT and Mr. Huang Dahui Director LPHT. During the inaugural ceremony, following aspects were highlighted:

i) **The importance, objective and the purpose of training** with regard to the promotion of hybrid rice technology in Pakistan and to strengthen the bilateral relations between China and Pakistan.

ii) **The problems and opportunities of hybrid rice** in Agriculture sector of Pakistan - the most important sector in Pakistani economy. Almost 20% of national income and 44% of the total employment is generated through this sector. However, a wide range of factors also restrict the output of rice in Pakistan, such as the uses of poor quality seeds, low yielding rice varieties, declined soil fertility and imbalance use of fertilizers, water scarcity or drought, insect pests and so on. In order to solve these problems, a series of public rice institutes have been established in Pakistan. Also, Pakistan has been actively building international cooperation with the global community. In 1990, GUARD Agricultural and Services Pvt. made an agreement with Yuan Long Ping High-Tech Agriculture Company in 1999 and released 7 hybrids. In 2004, GUARD, PARC and Long Ping signed a trilateral agreement to establish a hybrid rice research and development center in Pakistan.

iii) **The prospect for the development of hybrid rice** looks quite promising. Since 2009, seed import and area under cultivation of hybrid rice have been increasing. Hybrid rice is cultivated on 25% of rice growing area of Sindh and Baluchistan, approximately 5, 20,000 acres, which is about one-fifth (1/5) of the total area under rice cultivation in Pakistan. On an average, farmers achieving around 8-10 t/ha paddy yield and maximum up to 15 -20 t/ha.

From this seminar, the participants expected to have a better understanding of the development history of hybrid rice and the development trend of hybrid rice generic breeding, be well equipped with the knowledge and skills on hybrid rice seed production system, rice cultivation system as well as hybrid rice scientific research system. Besides, we do hope to open more channels with Chinese Institutions in this filed and create a comprehensive bounding which flourishes the bilateral relations as well, and enhance the professional skills of both country regarding agriculture development. Hopefully, a **Memorandum of Understanding (MoU) could be developed** in this regard, thus achieving expected increases in cooperative activities. Ultimately, agriculture sector will thrive in true sense, which is a real reward of this Seminar.
C) LEARNING, VISITS & SITE SEEING:

During the training at Changsha, some of the best sites were also visited by the participants to have knowledge about the history and development of China. The following:

i) **Guanghan City, Sichuan Province:**
Guanghan is a county-level city in Deyang, Sichuan province, China, and only 23 Kilometers (14 miles) from Chengdu. The predominant industries are tourism, pharmaceuticals and the supply of building material. Guanghan has an area of 538 square kilometers (208 square miles), a population of 590,000 with urban population of 170,000. A major part of tourism is nearby Sanxingdui ruins. The striking exhibits at the Sanxingdui Museum highlight archaeological finds that some Chinese archaeologists regard as even more important than Xian’s Terracotta Warriors. The region is steadily becoming more industrialized and that is helping with the progression of agriculture and enhances the region’s advantage on tourism etc.

ii) **Chengdu City, Sichuan Province:**
Chengdu is sub-provincial city which has served as capital of China’s Sichuan province. It is one of three most populous cities in Western China (the other two are Chongqing and Xi’an). As of 2014 the administrative areas houses 14,427,500 inhabitants, with an urban population of 10,152,632. At the time of the 2010 census, Chengdu was the 5th-most populous agglomeration in China, with 10,484,996 inhabitants in the built-up area including Xinjing County and Deyang’s Guanghan City.

iii) **Shaoshan City:**
Hometown of the late Chairman Mao Zedong, Hunan Province. Shaoshan, one of the four major revolutionary memorial lands of China.

iv) **Changsha City:**
The city tour of Changsha was arranged on July 22, 2017 by the host company for sightseeing of Orange Island and Hybrid Rice Museum in HHRRC at Changsha. All the developments were made by the Longping and his team in hybrid rice were preserved in the form of documentation and pamphlets and picture gallery in the hybrid rice museum.

v) **Professor Dr. Mao Changxiang Lecture:**
In the morning and evening session on July 23rd Dr. Mao Changxiang presented about hybrid rice development in China. He emphasized on history of hybrid rice development in China and role of Yuan Longping (Father of Hybrid Rice) in the discovery of this technology to increase rice production for alleviation of hunger in China.
vi) **Travelling to Sichuan:**

Preparation meeting was held on July 24, 2017 to visit the other province Sichuan where the Longping Hi Tech has there Hybrid seed production fields and marketing offices. The participants and host managers were set off to Sichuan.

vii) **Visit to Longping Seed Company Sichuan:**

The visit of trainees in Sichuan was from July 25 to 28, 2017 and this visit was started with welcome meeting at Sichuan Longping Hi tech Meeting Hall, the research efforts and technology of hybrid rice was presented by the Tian Ye (Deputy Director). The general principles of three line hybrids breeding and as well as two line hybrids breeding were also discussed in the meeting. The process of hybrid rice seed production was also presented. The seed production site was also visited.

viii) **Visit to Sanxingdui Museum:**

Sanxingdui museum was visited where the archaeological finds of Chinese archaeologists were seen by the visitors. The Panda is the national animal of China which have now limited in numbers so the Chinese also focusing on breeding of this animal. Chengdu Panda Breeding was also visited by the participants.

ix) **Lectures: Mr Xin Yeyun And Mr Huang Dahui:**

Introduction to Yuan Longping academician was presented from July 29th to 31st 2017 for two days. Mr Xin Yeyun, Yuan Long highlighted on agriculture in China efforts to discover the hybrid rice technology to improve income & alleviate hunger from China. In the evening session the development of hybrid rice and global food security was discussed by Huang Dahui where he elaborated about the current status of food the key points are:

- Every second there are 4.1 new born babies, and 140 million new born people.
- Every 6 second there is an infant died of food shortage. 57 million people died.
- 1 billion people are suffering lack of food.
- So there is dire need to produce the more food to feed this much population pressure as well as to combat the starvation from the Globe.
- Different countries adopted the hybrid rice technology for the food security including India, Bangladesh, Indonesia, Vietnam, USA, Liberia, Sri Lanka. Breeding methods principle and technology also discussed along with ideal plant type with higher yield.
Lectures: Mr Zhao Dan and Mr Huang Dahui:

In house lectures program through the elite facility of LPHT was arranged again from August 1st to 5th 2017 to acquaint the participants with rice hybrid developments. A lecture on Chinese national reality and reforms and opening up was delivered by the Ms.Zhou Dan. Chinese history and culture was elaborated with special emphasis on agriculture sector.

- Huang Dahui presented on the hybrid seed production, the hybrid seed production model was elaborated as
  - A/S line \((♀) \times R \text{ line } (♂) \rightarrow F_1\)
  - Planting A/S line and R line at a certain row ratio in the same field.
  - Make sure to have two parental lines heading & flower at the same time (synchronization).

Technical approaches were also discussed for more yield in hybrid seed production which are following;

- Choice of the proper locations for hybrid seed production
- Optimum date for parental lines interval sowing
- Optimum season for heading and flowering
- Land preparation, seed treatment, soaking & germination
- Raising healthy seedlings with more tillers
- Suitable time for transplanting
- Row ratio, row orientation and planting patterns
- Zou Yingbin/Doctoral Advisor delivered lecture on the hybrid rice cultivation systems that how to adjust yield components.
- Shaoshan city was visited and which is called the city of Chinese late leader Mao Zedong. That place was a scenic spot. These visits and subsequent lectures continued from August 6th to 9th 2017
- Chinese Culture was introduced by the Tan Yanping, about the style of living of Chinese people.
- Dr. Wang Xiusong discussed about the possibilities and realities of the LPHT international cooperation regarding hybrid rice. The PR China interaction with others countries for the promotion and introduction of hybrid rice was also mentioned.
- The dean named Yang Yuanzhu delivered lecture on the introduction to hybrid scientific and research systems. Heterosis is rice was discussed along with CMS line breeding and breeding for the parental line. Etc.
Chinese Calligraphy was practiced by the Prof. Chen Kern, the concept of scraping along with types was learned in the lecture. The calligraphic work was also done by the participants. Following topics were covered during the training program:

- Seed production and field cultivation of hybrid rice
- Promoting the development of seed industry
- Hybrid rice breeding system
- Hybrid rice globalization
- Hybrid Rice and World Food Security
- Development of Hybrid Rice in China
- Introduction of Longping High-tech Hybrid Rice Scientific Research System
- Hybrid Rice Genetic and Breeding System
- Technical System of Hybrid Rice Seed Production and Hybrid Rice High-yield Cultivation System

D) CLOSING CEREMONY:

The closing ceremony was held at HHRCC, Changsha China. In the ceremony, seminar completion certificates were distributed among the participants by the Chief Guest Father of Hybrid Rice Yuan Longping the inventor of hybrid rice technology of China.

E) COMMENTS AND SUGGESTIONS BY THE PARTICIPANTS:

- This type of seminar should be a continue process for the transfer of hybrid rice technology innovations.
- There should be an agreement regarding exchange of rice germplasm between Pakistan and China.
- It provided an effective platform to interact the Pakistani and Chinese researchers/scientists on hybrid rice.
- Efforts should be carried out to develop Basmati Hybrids with the technical assistance from China in public sector organization of Punjab province.
- The training and internship facilities to researchers/students of hybrid rice in the LPHT R&D center of Pakistan.
- Approval of new hybrids should be on strict merit basis including yield and quality parameter for specific area.
- A specific training on seed production of hybrid rice should be arranged for Pakistan officials in the Sindh Province of Pakistan.
Farmers training programs should also be conducted in the country by the Govt of Pakistan.

There should be market players/plan for purchase/sale of hybrid produce both in local and international markets of Pakistan.

Instead of making mess generally region specific hybrids should be approved by the country.

**F) SALIENT FEATURES OF HYBRID SEED PROGRAM:**

Rice is an important staple food of almost half of the world population. Rice (Oryza sativa L.) belongs to family Poaceae having chromosome number 2n = 24. It originated in south east Asia and having 24 species out of which 22 are wild species and 2 are cultivated. Hybrid rice was released for commercial production in 1976. Rice hybrid seed production involves effective male sterility system to produce hybrids on commercial scale.

**i. Ideotype of Hybrid Rice:**— Cytoplasmic genetic male sterility and environment sensitive genetic male sterility system have been used extensively to develop commercial rice hybrids. Ideotype of hybrid rice consists of Moderate tillering capacity, Heavy and drooping panicles at maturity, Plant height of at least 100 cm and long panicle height at maturity, Flag-leaf length of 50 and 55 cm, All leaves should remain erect until maturity. Narrow and V-shape leaves. Harvest index of about 0.55

**ii. Ideotype of Super Rice:**— High yield potential of 13,000 – 15,000 kg/ha. 3 to 4 tillers per plant. 200 to 250 grains per panicle. Plant height of 90 to 100 cm. Thick and sturdy stems, dark green, thick and erect leaves, vigorous root system. 100 to 130 days growth duration, and high harvest index.

*Heterosis Indica × Japonica crosses show maximum heterosis but frequency of fertility restoral is low. Crosses showing heterosis in descending order are indica × japonica > indica × javanica > japonica × javanica > indica × indica > japonica × japonica > javanica × javanica.*

**iii. Male Sterility Used in Hybrid Rice:**—

- Cytoplasmic genetic male sterility.
- Environment sensitive genetic male sterility
- Chemically induced male sterility and
- Transgenic male sterility

**iv. Cytoplasmic Genetic Male Sterility:**—

- Male sterility is controlled by the interaction of mitochondrial and
nuclear gene. (A) line is male sterile when the male sterility controlling factor S in the cytoplasm and recessive alleles present in the nucleus. (B) line is isogenic to the A, but it differs in cytoplasm which makes it self-fertile. The restorer gene in the form of dominant homozygous or heterozygous restore the fertility in the F1 hybrid Hybrid seed production involves two steps: Multiplication of A, B and R lines • Production of hybrid seeds.

✓ Multiplication of the A, B and R line. For successful production of the A line, it is grown in six or eight rows interspersed by two rows of a maintainer line in an alternating manner. B and R lines are maintained by selfing. There is a small difference between the growth duration of A and B lines, their sowing dates are adjusted for synchronization of their flowering. Techniques such as flag-leaf clipping, GA3 application, and supplementary pollination by rope pulling or the bamboo pole method are used to improve the out crossing rate and seed yield of the A line.

✓ Production of hybrid seeds. This involves the use of A line with R line by growing them in a specific female: male ratio in the field under isolation by space or time. The A line is usually grown in eight or ten rows interspersed with two rows of restorer lines in an alternating manner (8-10:2). The sowing dates of A and R lines are staggered to achieve synchronization of their flowering;

○ Environment sensitive genetic male sterility. This male sterility system is controlled by nuclear gene expression, which is influenced by environmental factors • First observed in pepper by Martin and Crawford in 1951.

✓ ADVANTAGES There is no need for a maintainer line for seed multiplication, thus making seed production simpler and more cost-effective. Any fertile line can be used as a pollen parent therefore, the frequency of heterotic hybrids is higher among two-line hybrids than among three line hybrids. Negative effects of sterility inducing cytoplasm are not encountered.

✓ The EGMS trait is governed by major genes, thus enabling their easy transfer to any genetic background, help to increase diversity among the female parents, which helps in reducing potential genetic vulnerability among the hybrids. • Since there is no need for restorer genes in the male parents of two-line hybrids, this system is ideal for developing indica / japonica hybrids because most japonica lines do not possess restorer genes.

✓ Disadvantages of the EGMS system • Environmental factors influence the sterility of EGMS lines • The multiplication of EGMS lines and hybrid seed production are restricted by space and season • This means that an EGMS line is used in a given region and season.
Characteristic features of ideal EGMS lines • The proportion of male sterility during the critical sterility period should be 100%. • EGMS lines should have clearly defined sterility-fertility alteration regimes. • Seed setting during the fertile phase should be more than 30%.

Classification of the EGMS system TGMS lines • Most TGMS lines remain male sterile at high temperature and they revert back to partial fertility at a lower temperature. Reverse TGMS • It is reverse of the TGMS system, for example, JP 38, Dianxin 1A, and IVA.

PGMS lines • PGMS lines remain male sterile under longday (>13.75 h) conditions and revert back to fertility under short-day (<13h). Male sterility expression in EGMS lines is governed by a single nuclear recessive gene or pair of nuclear recessive genes that are sensitive to environmental conditions:

- **Chemically Induced Male Sterility.** This system is not being used at commercial scale due to environmental concerns • This involves the use of chemicals called CHAs or Gametocides, makes plant male sterile • Chemicals which have been evaluated in rice are arsenics, GA3, Ethrel, FW450, MH etc. 21 • Only zinc methyl arsenate and sodium methyl arsenate have been reported to be effective for producing commercial hybrids in China (Zhao et al.1988) • Hybrids produced by chemically induced male sterility are also called two-line hybrids in rice • Chemically induced male sterility is used sporadically because the effective and safe chemicals for inducing male sterility are not available **Transgenic male sterility.** • Nuclear gene named Oryza sativa No Pollen 1 (OsNP1), responsible for tapetum degeneration and pollen exine formation • Expressed in the tapetum and microspores • Gene OsNP1 with another α-amylase gene to devitalize transgenic pollen • Red colour protein (DsRed) gene to mark transgenic seed. Self-pollination of the transgenic plant carrying a single hemizygous transgene produced non transgenic male sterile and transgenic fertile seeds in 1:1 ratio • Seeds can be sorted out based on the red colour. Cross-pollination of the fertile transgenic plants to the non transgenic male sterile plants provide male sterile seeds of high purity (Chang et al. 2016)**Transgenic male sterility II** • Unique male sterility and fertility restoration system developed in rice by combining Brassica napus cysteine-protease gene (BnCysP1) • With P12 promoter of rice for facilitating production of hybrid varieties • Transgenic rice plants obtained with P12- BnCysP1 failed to produce
functional pollen grains. For male fertility restoration, transgenic rice plants carrying BnCysP1Si silencing system were developed • Pollination of BnCysP1 male sterile x female fertile plants with BnCysP1Si pollen resulted in normal grain filling (Rao et al. 2017).

✓ Rouging at maximum tillering, Roguing at flowering & Roguing just before harvest.

✓ Promotion of exertion of panicle GA3 has following favorable effects:
  o A dose of 45-60 g/ha of GA3 is optimum
  o Increases stigma exertion and receptivity
  o Promotes plant height
  o Influences flowering and hence flowering in parental lines can be adjusted
  o Widens the flag leaf angle
  o Promotes exertion and growth rate of secondary and tertiary tillers

✓ Flag leaf clipping • The clipping of flag leaf helps in free movement and wide dispersal of pollen grains to give higher seed production • However, flag leaf cutting is not advisable in the plots infested with diseases as this operation may spread the disease further.

✓ Supplementary pollination • Supplementary pollination can be done either by rope pulling or by shaking the pollen parent with the help of two bamboo sticks • This process is repeated 3 – 4 times during the day at an interval of 30 minutes. • Supplementary pollination has to be done for 7-10 days during the flowering period.

✓ Harvesting: Harvest all R lines rows first. Remove the R line harvest and keep it in a safe place separately. Carefully remove the left over R line panicles in the field. • Threshing: During threshing, the ‘A’ line parent and ‘R’ line parent harvests must be kept separate from each other. The A and R lines should be threshed separately. Before starting threshing, all the threshing equipment, threshing floor and tarpaulin to be thoroughly cleaned.

✓ Seed drying • Seeds can be safely stored when they have been dried to a moisture content of less than 13 % • Seed Processing: Seed Processing has to be done to remove impurities, cleaning, grading • Gunny bags for storing the seeds.

✓ Future prospects (1) High price of rice, (2) Expansion of boro
rice area due to shallow tubewell development, (3) Continued technological progress, (4) Expanded possibilities for public-private partnerships and (5) Rising demand for rice from other countries.

Hybrid Rice Seed Production Issues & Strategies • Higher hybrid seed cost - Lower hybrid seed yield • Synchronization problem • Ideal location / season not identified • Higher production input cost • Parental line susceptibility to biotic stress. Genetic Purity of Hybrid seed • Hybrids by State/Central Government departments • Inadequate training and technology transfer Problem of non-availability of N/s and B/s of parental lines on sustainable basis • Purity of foundation seed stock of parental lines. Poor integration of research, seed production and technology transfer-poor technical dissemination • Inadequate sensitization of administrators / policy makers.
Training Report

“2017 Training Course on Hybrid Rice Technology In Pakistan”

September 12 To October 11 2017,
NARC, Islamabad Pakistan

Organizers:
Pakistan Agriculture Research Council, Islamabad
Yuan Longping Hi-Tech Agriculture Company Ltd., China
Agricultural Innovation Program, Pakistan
Inauguration ceremony:

Inauguration ceremony was held at National Agriculture Research Center, Islamabad on 12.09.2017. The ceremony was chaired by Mr. Nasir Bosal, Special Assistant to Prime Minister (National Food Security & Research), Pakistan. The other eminent scientists, officials and representatives of private sector were:

- Dr. Muhammad Yousaf Zafar, Chairman PARC
- Dr Muhammad Anjum Ali, Member Plant Sciences PARC
- Mr. Shahzad Malik, CEO Guard Agri Services private Ltd.
- Dr. Wang Xiusong
- Ms. Zhou Dan, Vice President LPHT

The Importance, objectives and the purpose of this training was highlighted by the speakers for the promotion of hybrid rice technology in Pakistan and to strengthen bilateral relations between China and Pakistan.

Ms. Zhou Dan, Vice President LPHT gave a presentation regarding Chinese history and culture with special emphasis on agriculture sector. Current status of hybrid rice technology and future strategies were discussed to promote innovative R&D approaches and seed business sector.

13-09-2017

In the morning session Mr. Wang Xiusong presented about hybrid rice development in China. He emphasized on history of hybrid rice development in china and the role of Professor Yuan Longping (Father of Hybrid Rice) in the discovery this technology to increase rice production for alleviation of hunger in China.

In the afternoon session Mr. Zhenhua Yi, Assistant General Manager YLHT presented about Hybrid Rice F1 Seed Production (HRFSP). He focused on following key points for HRFSP for higher seed production per unit area:
- Optimum season for heading and flowering.
- Flowering synchronization.
- Improvement of the outcrossing posture.

He also highlighted HRFSP outside China.

**September 14th, 2017**

Mr. Wang Xiusong delivered a lecture on hybrid rice genetics and breeding. In his presentation he elaborated the basic concepts and terminology used in hybrid rice. He highlighted the procedures and practices for three line and two line hybrid systems. A detailed discussion on male sterile line (CMS and PTGMS) characters was done. The pros and cons of both systems were discussed for exploitation of the most suitable system in different ecological zones. Question answer session was carried out for further understanding of the technology.

**September 15th, 2017**

Dr. Anjum Ali, Member Plant Sciences, PARC presented rice situation in Pakistan including scope and prospects for hybrid rice technology. He elaborates rice zones of the country;

Zone I: Swat and Kaghan vallies of Khyber Pakhtunkhwa

Zone II: Kallar tract of Punjab

Zone III: Upper Sindh and Baluchistan

Zone IV: Lower Sindh

The introduction of hybrid rice varieties imported from China and other countries for general cultivation in Pakistan was elaborated. The initial response of the growers was also discussed to highlight the issues faced during the cultivation and marketing of these hybrids. It was highlighted that we need to focus on proper selection of suitable hybrid varieties for different environments,
to eliminate malpractices in seed business and to ensure the good grain quality hybrids.

He shared the major challenges faced in early hybrids i.e;

- High seed cost
- Short grain length
- Poor grain quality
- Poor seed setting / Sterility due to high temperature
- Inconsistency in field performance
- Low price of hybrid produce in the local markets

The procedures and technical points for hybrid rice seed production were discussed in details by Mr. Huang Dahui, Deputy Director, Longping Hi-Tech. He shared some success stories of hybrid rice seed production in other countries. He pushed the participants to be specific for heterosis keeping in view the following points:

- Superiority in morphological characters
- Superiority in physiological characters
- Superiority of grain yield

Hybrid rice seed production techniques and practices with emphasis on row ratio of A:R lines to harvest maximum seed yield. Post-harvest seed handling and proper storage were also discussed.

16-09-2017

All the participant and Chinese experts travelled by bus from NARC Islamabad to Rice Research Institute KSK Lahore.

**Rice Research Institute Kala Shah Kaku:** This institute was established in 1926 for scientific work on rice crop of the Punjab Province. The first ever world famous Basmati rice variety “Basmati-370” was released in 1933 for general cultivation. This institute is the prime organization for Basmati rice research in Pakistan. So far institute has developed 26 rice varieties since inception. More
than 90% rice area in Punjab is covered by the rice varieties developed at this institute.

Dr. Muhammad Akhtar, Director, RRI KSK gave a brief presentation on achievements and ongoing R&D activities for development of new rice varieties.

A meeting was held with scientists of RRI KSK and Agri Extension workers of agriculture department. Mr. Wang Xiusong explained the purpose of the visit and elaborated the potential of hybrid rice technology to meet the food requirement in increasing population scenario. He focused that the extension workers are the major players in the promotion of this technology as they have direct links with the rice growers. He extended his cooperation in hybrid rice technology dissemination on behalf of Longping Hi-tech China.

In question answer session the extension workers highlighted the reservations in growing hybrid rice as shared by the rice growers. Grain length, quality, milling recovery and marketing were found to be the major hurdles in propagation of hybrid rice varieties. It was also pointed out that industry for value addition might play an important role in promotion of hybrid rice varieties for higher yields per unit area.

All the participants were allowed to visit hybrid rice research and seed multiplication trials planted at the research area of institute. The local participants from public and private sector showed a high interest in hybrid rice breeding program of the institute. In addition conventional breeding trials were also visited by the participants of this training course.
Meeting of Hybrid Rice Training Delegation with extension workers of Agriculture Department and scientists of RRI KSK

September 17, 2017:

On request from Tara Seed Company, all the participants visited their research farm located nearby Kala Shah kaku, Lahore. Different research and seed multiplication activates were briefed by Dr. Wang Xiusong explained the purpose of this training for the promotion of hybrid rice seed business in Pakistan. While evaluation of exotic hybrids, some key points regarding the field management were also discussed. Tara Seed Company showed a great interest in mutual cooperation for the promotion of hybrid rice technology.

September 18, 2017:

Recreational tour to historical places at Lahore.

September 19, 2017:

Farmers’ field visit: In order to explore the typical Basmati rice area, rice farmers of different villages of Tehsil Muridke, District Sheikhupura were visited and exchanged the rice farming experiences. One of the farmers Ch. Zulfiquar Sehol admitted the role of Rice Research by KSK not only in variety development but also technology transfer. He showed the participants his rice field area comprising of 300 acres planted with direct seeded rice. He acknowledged the
technical support of the scientists from RRI KSK in propagation of modern rice production technologies keeping in view the climate change scenario with declined availability of irrigation water. He welcomed the scientists from china and extended his full cooperation in the field of modern technologies including hybrid rice. Another farmer from the same village Hardo Sehol Muslim welcomed the visitors and showed his keen interest in the use of certified seed from private seed companies.

*Training Participants Visited Basmati Field Area of Ch. Zulfiqar Sehol, Rice Grower, Hardo Sehol Muslim Village, Tehsil Muridke, District Sheikhupura.*

**September 20, 2017:**

All the participant and Chinese experts visited Guard Agriculture services private Ltd. located at Raiwind road Lahore. Mr. Abdul Rasheed, Quality manager gave brief presentation about his company. It was presented that the Guard Agri. was established in 1989, as the first private sector company with its own rice research and development facility & is the pioneer in introducing the hybrid rice variety from China in Pakistan. So far this company has introduced more than five rice hybrids for general cultivation in Sindh Province. In addition hybrid seed production is being done in collaboration with Longping Hi-tech china.
September 21, 2017:

Field Visit of Guard Agri. Farm: On guard agri. farm candidate hybrids and hybrid rice F1 rice seed production plots were visited by all participants. Practical demonstration of hot water treatment for the emasculation of male parent was given by Chinese experts. All the participants appreciated the management team of guard agri. farm for their excellent farm management. Mr. Wang explained the flowering synchronization phenomenon for successful and good seed yield. Growth stages of the rice plant were discussed and practically demonstrated. All the participants appreciated the hospitality of Guard agri. services.
Participants of 2017 Training On Hybrid Rice Technology In Pakistan Visited Guard Agriculture Services Private Ltd Hybrid Seed Production Farm, Lahore

**September 22, 2017:**

Travelled from Lahore to Multan

Farmer field visit at Sahiwal: In the way to Multan, a preplanned farmer visit was arranged by the extension workers of Sahiwal region. Briefing was given by the extension staff regarding the area and important crops of the region at the field area of local farmer. A gathering of more than 15 extension staff workers was indicating their interest in the promotion of hybrid rice cultivation. Mr. Wang highlighted the importance of hybrid rice technology. The owner of the farm showed his interest in adoption of rice hybrids with the condition that it must have Basmati grain qualities with an advantage of higher yield.

**Participants of Hybrid Rice Training Visited Farmer field at Sahiwal**

Reached Multan and made overnight stay.

**September 23, 2017:**

Travelled from Multan to Rahim Yar Khan.
Meeting with extension workers: A meeting was arranged at In-service Agricultural Training Institute, Rahim Yar Khan. The incharge of the training institute explained training activities of the institute. Chinese experts briefed about the purpose of this travelling seminar regarding the importance and promotion of hybrid rice technology to increase rice production. About 30 extension workers were present in the meeting. Most of the extension workers highlighted the issues of poor adoption of rice hybrids in the area. Sterility due to heat, poor quality and low market price were pointed out as the major discouraging factors. They were of the view that rice hybrids can be adopted by the rice growers of the region if the above mentioned problems were solved. The Chinese experts ensured to address the discussed problems in future hybrids.

Visit and Meeting at In-service Agricultural Training Institute, Rahim Yar Khan by The Participants

September 24, 2017:
Travelled from Rahim Yar Khan (Punjab Province) to Larkana (Sindh Province) and halted.

September 25, 2017:
Rice Research Institute, Dokri: Rice Research Institute, Dokri was primarily established as Agriculture Research Station at Larkana, Sindh in 1912. As Sindh province is the major growing area of coarse rice cultivation both inbred and
hybrid rice varieties. Out of total 750529 hectares rice area, rice hybrids are being planted on 46% (343727 ha) of the area. The Institute has released 9 rice varieties for general cultivation in the province. Coarse grain rice variety 'IR6' (released by RRI Dokri) is the most popular among the rice farmers due to high yield and good grain quality. Provision of pre-basic & basic seed of approved rice varieties to public and private seed companies is the part of Institute responsibilities.

The Director, Rice Research Institute, Dokri welcomed all the participants of the travelling seminar and gave briefing about the institute and presented the background, objectives, varieties released, NUYT Trials, adoptability trials of different rice hybrids. A meeting with agriculture extension officers, growers and scientists was held to discuss issues of hybrid rice production and to produce hybrid rice seed. During the farm research area visit, Director and other rice experts of various disciplines gave briefings to the visitors including Chinese experts at their respective field trials.

All the participants and Director RRI Dokri visited the field of grower Qazi Shah Jahan Junejo. He shared the field experiences of growing rice hybrids ‘Komal’ and ‘Tahafuz-121’. The crop was in good condition and in flowering stage with long panicle. In a meeting with growers and exporters in the office of Director Dokri was arranged. The growers shared their problems being faced in hybrids cultivation as below;

- Seed mixing by some seed companies
- High seed cost of hybrid varieties
- Poor seed setting / Sterility due to high temperature
- Inconsistency in field performance
- Un-acceptable / poor grain quality
- Low price of hybrid produce in the local markets

The exporters were of the view that due to short grain length, poor grain quality and low milling recovery were the main issues of low prices in
International market. Mr. Wang, Chinese expert gave a detailed briefing about the rice hybrids advantage in yield over OP varieties. He highlighted that worldwide hybrid rice technology adoption had proved the success of this technology. However, it was pointed out that all the issues can be resolved by mutual cooperation and understanding while developing new hybrids. He said that we on behalf of Longping Hi-Tech China are here to promote this technology so that Pakistani growers can increase rice production and can earn more income with less cost of production. All the stakeholders agreed for mutual cooperation.

September 26, 2017:

Visited Jafarabad area, Balochistan province.
**Rice cultivation in Balochistan Province**

Balochistan province is blessed with four Agro-ecological zones and consists of 43.5% land area of Pakistan. Upland zone is called fruit basket while plain zone is popular for field crop where major canal system exists. Total rice area in Balochistan is 196000 ha.

Course Rice IRRI-type is grown on large scale whereas Basmati area is very limited. With the introduction of course rice hybrids in Balochistan, paddy yield increased from about 5 t/ha to 7 t/ha (>50%). Therefore, some 20 to 25% land area of rice in Balochistan shifted towards hybrid rice due to late sowing and availability of canal water. But the farmers of the area are experiencing great difficulty not only in marketing of hybrid rice produce but also in getting good seed of hybrids.

**Points of concern for rice hybrids seed business in Balochistan**

Farmers of the area are facing issues in hybrid rice cultivation. Following are the point of concerns regarding rice hybrids;

- Grain size is very small which is not competing in export/ marketing
- Must be tolerant to water stress as scarcity of irrigation water limits rice cultivation
- Heat resistant as the temperature may rise to 53°C
- Hybrid claimed to get more than 10 t/ha, not achieved in the field.
- Quality of seed is not guaranteed
- Germination percentage claimed to have more than 80% but the farmers are observing 30-60% germination.
- Lack of seed outlets in Balochistan. Branded seed outlets of companies are in Upper Sindh from where the rice seed is marketed
- Segregation population are observed that means either some mixture in seed or F2 population is sold to the farmers sometimes.
- Very low market price of hybrid varieties as compared to inbred varieties
It is direly needed to bred rice hybrid suitable for local conditions with the help of Chinese experts and local breeders jointly to reduce cost of hybrid seed and to increase yield per unit area.

One day rice travelling seminar under the joint venture of PARC & China was arranged in plains of Balochistan on 26th September 2017. The team of national scientists arrived in Jafarabad district. Local scientists from four rice growing districts i.e., Jafarabad, Naseerabad, Jhalmagssi and Sohbatpur gathered there. There were extension, research and progressive growers, seed companies and local rice hybrid dealers. Director Agriculture Research Cereal Crops, ARI Quetta briefed about the hybrid rice situation in Balochistan. Discussion was carried out in depth among all the stake holders regarding future strategies for the region.

The team visited Bhand Sharif and Hayat Village of District Sohbatpur where Hybrid-HF-98 (from Rogi company) and Almas Hybrid (from Auriga Company) were growing on large area.

For field day, all the team gathered at Zahoor Ahmed Khosso House who is one of the landlords with 5000 acres of agricultural land. Sardar Ali Khan was a farmer and also rice hybrid dealer of the area. He was of the view that he is getting 80 munds per acre yield from his field while other farmers claimed that hybrids are giving yield of 6.0 to 6.5 t/ha.

After consultation and field visit, now Chinese experts hoped that they will introduce some new hybrids with heat tolerance and export quality. In long term strategy, they are planning to develop climate resistant and locally adapted rice hybrids.
Visit to Farmer Field in Sohbatpur and Jafarabad, and Visit to Dept. Director Office (Extension) Jafarabad.

September 27, 2017:

Travelled from Larkana to Hyderabad and halted.

**Agriculture Research Institute Tandojam:** All the participants and Chinese experts visited all sections of ARI Tandojam. Dr. Nehal Uddin Mari, Deputy Director gave briefing on hybrid rice status and also demanded that they need hybrid rice but those hybrids which are long grain, heat tolerant, no bursting in grain, and resistant to insect pest & diseases. He said that in Sindh hybrid rice yield is 40-50 % more as compared to inbred varieties. Mr. Wang invited the scientists and growers to visit China and their fields.
September 28, 2017:

Visited farmers field and Guard Agri Seed multiplication plot, Tando Muhammad Khan.

**Farmer Field visit:** All the participants and Chinese experts visited the field of Abdullah Cheepa and Haji Abdul Kareem Baloch where rice hybrids Guard 403 and Guard 53 were planted. Crop stand was good and near to maturity. Meeting with agriculture officers and growers was held for the discussion of hybrid rice problems. All the participants and Chinese experts also visited Mir Pur Bathoro village where 30 acres for seed production of Guard hybrid rice were planted. Various technical points in hybrid seed production like row ratio, flowering synchronization, fertilization and GA₃ application were discussed.
Glimpses of trainee Participants Visit to Farmers Field and Guard Agri Seed Multiplication Plot, Tando Muhammad Khan

**Rice Research Station, Thatta (Lower Sindh):** The delegation also visited Rice Research Station, Thatha. Dr. Allah Ditta Jarwar, Deputy Director, RRS gave briefing about the activities being conducted at the station. It was presented that Rice Research Station was established during 1984 and was engaged to conduct experiments on different technologies, adaptability of different hybrid and inbred varieties received from PARC and RRI Dokri. He informed about the ideal climate to conduct research on hybrid rice. In meeting with scientists, agriculture extension officers and growers, the problems related to hybrid rice production
were discussed. The delegates also visited the experimental fields. Mr. Wang, Chinese expert discussed about the hybrid seed production due to its suitable environments.

During discussions with farmers and scientists of various institutes in Sindh, it was highlighted that the following issues / criteria must be considered while introducing new rice hybrids for the region;

- Long slender grain (clean rice more than 6.5 mm)
- Heat tolerant
- Low bursting % on cooking (less than 10%)
- Having medium maturity (below 100 days from transplanting)
- Tolerant to prevailing diseases
- Printed literature about production technology in local language
- Seed germination must be > 80%
- Low market price

Dr. Wang presenting sovinier from China to Director RRS Thatha, Sindh  
Field visit at RRS Thatha by the participants
October 02, 2017

Travelled from NARC Islamabad to Peshawar

Rice cultivation in Khyber Pakhtunkhwa province

Rice is the third most important crop after wheat and maize in the province of Khyber Pakhtunkhwa. It is cultivated on an area of 53000 hectares. Rice in Khyber Pakhtunkhwa is sown in two different environmental zones:

1. Upper Mountainous cooler areas: (Malakand division, Hazara division and attached tribal areas)

In Khyber Pakhtunkhwa, 74% of the rice acreage lies in the high altitude, cold and mountainous areas, where cold damage to rice has been the problem to growers. The cooler climatic conditions of this zone include categorical low air and water temperature. Water temperature remains 18 °C during the main
growing season. Owing to this reason, the direct use of existing course hybrid rice and fine basmati rice varieties has not been successful.

**Problems and breeding objectives at upper zone:**

In Malakand division, Hazara division and attached tribal areas, cold stresses cause;

- poor germination,
- slow seedling establishment,
- yellowing of leaves,
- stunting in early vegetative stages,
- incomplete panicle exertion,
- delayed heading,
- irregular maturity and
- spikelet sterility

To overcome these problems, research activities for the improvement of rice for this zone are being executed to develop cold tolerant and early maturing varieties with acceptable grain quality, insect pests resistant, disease resistant and high yielding. The main dominating rice varieties of the cooler regions are Fakhre Malakand, Swatai-2014, Dil Rosh-97, Swat-1, Swat-2 and JP5.

2. **Lower hot Plain areas:**

The main areas are Dera Ismail Khan, Charsadda, Mardan, Parts of Swabi. There is great scope of hybrid and Basmati rice cultivation in lower hot zone of the province, if the canal system of the province is developed.

**Problems and breeding objective of rice in lower areas**

The main problem of this area mainly in DI Khan rice belt is the heat stress. The focus of rice breeders of DI khan is to develop water and heat stress
tolerant varieties to alleviate poverty among their farming community. Rice varieties i.e. IR6, PS2 (Kainat) and KS282 are sown in major area of DI Khan.

Hybrid rice didn’t get popularity among farmers of Khyber Pakhtunkhwa due to water shortage, unavailability of heat and cold stress tolerant rice hybrids. Existing hybrids have poor grain quality and market acceptability. Tolerance to low temperature remains an essential character needed at seedling and reproductive stage in Malakand and Hazara division.

**Agriculture Research Institute (ARI), Tarnab, Peshawar:** Trainees of the group with Chinese experts visited Agriculture Research Institute (ARI), Tarnab, Peshawar. The delegation visited different sections, laboratories and greenhouses. Dr. Zaheer Ullah, Senior Director of the Institute delivered a very comprehensive presentation about the achievements and ongoing research activities of the institute. Dr. Muhammad Anjum Ali, Member Plant Sciences PARC delivered a speech regarding the purpose of this delegation visit and stressed to strengthen the mutual coordination between the provincial organizations. He also ensured to rehabilitate the role of PARC in this regard. Mr. Wang Xiusong, Chinese expert showed interest in breeding program of Pak China in citrus varieties in addition to hybrid rice technology.

On the same day, a meeting was arranged in the office of Director General Extension. Mr. Muhammad Nasim, DG Extension gave presentation to highlight the role of extension staff in transfer of various technologies through seminars, farmer days and farmer field visits. Dr Muhammad Anjum Ali, Member Plant Sciences also shared some experiences of extension services being offered by Agriculture department of Punjab province.
October 03, 2017:

Travelled from Peshawar to Mingora, Swat.

The group visited Agricultural Research Institute, Swat and observed the ongoing activities of rice program. The Chinese delegate appreciated rice variety ‘Fakhre Malakand’ for its phenotypic appearance and yield potential in high altitude of Malakand division. Dr. Muhammad Abdul Rauf, Director ARI Mingora Swat gave a presentation about the research achievements and ongoing activities of the institute. It was highlighted that poor adaptability, acceptance and quality are the major hurdles in the adoption of rice hybrids in Khyber Pakhtunkhwa.
October 04, 2017 to October 11, 2017:

Travelled from Mingora, Swat to NARC Islamabad.

During the said periods participants stay at NARC, Islamabad and attended the different sessions of lecturers;

- Lecture on ‘Technology for Hybrid Rice Cultivation’ by Prof. Zou Yingbin, Hunan Agriculture University, China.
- Lecture on ‘Commercial Breeding progress of Hybrid Rice of LPHT China’ by Prof. Yang Yuanzhu, Vice President, LPHT, China.

Closing Ceremony:

Closing ceremony was held on October 11th, 2017 at NARC, Islamabad. In the ceremony, training completion certificates were distributed among the participants by the chief guest Mr. Sikandar Hayat Khan Bosan, Federal Minister for National Food Security and Research, Islamabad, Pakistan.
Comments and Suggestions by participants

- Training duration should not be more than 3 weeks. This type of training should remain continue in future.
- It provided an effective platform to interact among different stakeholders of public and private sectors in real life situation.
- Scientists of Pakistan should be provided training opportunities in China on practical aspects of hybrid rice development. The nature of training should be more practical / applied rather than theoretical.
- There should be agreement regarding exchange of rice germplasm between Pakistan and China for breeding the best suited hybrids for Pakistan.
- Region specific testing, approval and promotion of hybrid rice should be carried out instead of making mess generally.
- Efforts should be carried out to develop Basmati rice hybrids with technical assistance from China in public sector organizations of Punjab province.
- Training and internship facilities should be provided to Pakistani professional on transfer of hybrid rice technology at R & D centers of LPHT located in Pakistan.
- There should be market players / plan for the purchase / sale of hybrid rice produce both in local and International markets, so that grower may get better price. As a result of good price for hybrid rice in market, the area under hybrid rice in Pakistan will increase and farmers take interest in its cultivation.
- Formulate public-private partnership for the development of parental lines with clear cut propriety rights.
- Approval of new hybrids should be made on strict merit including yield and quality parameters for specific area.
- More emphasis may be given for technical assistance from China to develop thermo-sensitive genetic male sterile lines to develop two line hybrids.
- Specific trainings on hybrid rice seed production may be arranged both in Pakistan and China for officers and field staff.
- Rice R&D at Usta Muhammad, Balochistan (public sector organization) may be started as there is no independent Rice Research station in the province.
• Farmer training programs may be initiated regarding the hybrid rice production technology.

• Hybrid rice R&D may be initiated through collaborative / joint project by China & Pakistan preferably in Sindh & Balochistan province.

• Lack of seed outlets in Balochistan. Branded seed outlets of companies are in Upper Sindh from where the rice seed is marketed. Segregation population are observed that means either some mixture in seed or F₂ population is sold to the farmers sometimes. Hybrid claimed to get more than 10 t/ha, not achieved in the field.

• There must be a monitoring system on the approved hybrids feedback. In this system, the company will provide at least list of 20 farmers to whom the seed was sold. This team will get feedback directly from the farmers to evaluate both hybrid performance and company credibility. In case of any loss due to ill performance of hybrid seed, the company will be bound to compensate the farmer’s loss.