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Objectives:

- Development of high yielding guar varieties suitable for planting under rainfed ecologies of Pakistan.
- Guar production technology development for higher yield in rainfed areas of country.
- Seed multiplication, introduction and adaptability studies of the most desirable guar varieties.

Summary:

Guar or cluster bean [*Cyamopsis tetagonoloba* (L) Tuab] ($2n = 14$) is an important commercial, industrial and a valued export commodity. It is cultivated for grain as well as fodder purpose. Being a palatable and nutritious commodity, guar dry fodder is exported to Middle East for feeding desert animal like Camels. Guar plant is extremely drought resistant, being able to absorb soil moisture efficiently for its growth and development. Guar is the main source of galactomannans for industrial use. Galactomannans is a polysaccharide composed of 1-4 mannanose backbone with varying degree of 1-6 galactose substitution. Galactomannan extracted from guar seed is called guar gum. Guar seed is made up of hull (13% - 18%), endosperm (34% - 43%), and germ (41% - 46%). In USA guar gum is mostly use in Oilfield industry for fracturing the rocks and drilling oil well.

During first year of project, country-wide Guar Germ Plasm was collected on **Seed Basis** from various guar growing areas, grain dealers and PGRI, NARC, Islamabad during May 2016. The performance of all the germ plasm accessions collected from various source was not encouraging, therefore, another campaign was launched to select the most desirable plants on **Field Performance Basis**. About 200 desirable (single and multiple sticks) plants were selected and screened at various locations. Some of the most desirable lines with high yield potential and resistance against disease were selected in 2017. During 2018, 15 single sticks and 12 multiple stick lines were planted at AZRC, D.I.Khan and AZRI, Bhakkar along with check varieties. Finally seven single sticks lines and five multiple sticks lines were selected on the basis of yield performance. The single stick line AZRC-G-12 and multiple stick line AZRC-G-192 has been sent to NARC for inclusion in Guar National Uniform Yield Trial-2019. Both the line have been included in GNUYT-2019 which have been plant at various locations in country.

Besides germ plasm screening, the seed of high yielding guar varieties (BR-99 and BR-2017) was also multiplied and more than one tone seed was produce which is being sold among farmers. More than 15 demonstration plots of guar (using BR-99 and BR-2017 varieties) were conducted under diversified ecologies at farmers' fields. Workshop on "Profitable Cultivation of Guar in Pakistan" was also conducted at AZRC, D.I.Khan during the year under report.

Statement of Problem:

Guar or cluster bean [*Cyamopsis tetagonoloba* (L) Tuab] ($2n = 14$) is an important commercial, industrial and a valued export commodity. It is cultivated for grain as well as fodder purpose. Being a palatable and nutritious commodity guar dry fodder is exported to Middle East for feeding desert animal like Camels. Guar has worldwide uses for food stabilization, fiber source, food, and industry. Pakistan stands second in area and production after India. Total area of guar in Pakistan is about 1,98,544 hectare with production of 1,24,566 tone (Anonymous, 2016). Guar plant is extremely drought resistant, being able to absorb soil moisture efficiently for its growth and development. It is really a crop of rainfed region also cultivated in arid and

semi-arid area where other crop could not successfully grow. Guar seeds are mainly used for extraction of endospermic gum having good binding properties and high demand in food, petroleum, varnish, textile, explosive, pharmaceutical, telephone, electricity, juice, paper, dairy and coal industries.(Girish et al; 2013). Along with carob (*Ceratonia siliqua*), guar is the main source of galactomannans for industrial use (Jakson et al 1982). Galactomannans is a polysaccharide composed of 1- 4 mannanose backbone with varying degree of 1 - 6 galactose substitution (Marten and Brunstedt 2001). Galactomannan extracted from guar seed is called guar gum (Miyazawa and Funazukuri 2006). Guar seed is made up of hull (13% - 18%), endosperm (34% - 43%), and germ (41% - 46%).

Guar a coarse-growing summer annual legume is famous for its drought resistance. Most of the improved varieties of guar have glabrous (smooth, not hairy) leaves, stems and pods. Plants have tap root system, single stems, fine branching or basal branching (depending on the variety) and grow 50 to 200 cm tall. It is a photosensitive crop and grows in specific climatic conditions, i.e. soil temperature around 25°C for proper germination, long photoperiod, with humid air during its growth period and finally short photo-period with cool dry air at flowering and pod formation. Guar being a drought tolerant crop can be successfully grown on marginal lands with reasonable production. India is the major producer of guar and contributes about 80% of world's total guar seed production followed by Pakistan contributing about 15% in world's guar seed production. India is the one and only competitor of Pakistan in international guar market. Keeping in view the farmers' interest, it becomes the liability of plant scientists to identify high yielding guar varieties/lines and develop the profitable production technology to increase the livelihood of resource poor farmers and export as well.

In present research project different guar germ plasm accessions were acquired and evaluated for yield, drought tolerance and some other desirable traits in various part of country with rainfed background including; D.I.Khan, Lakki Marwat, Bhakkar and Pind Dadan Khan. Moreover, various agronomic practices including time of planting, seed rate, and plant density were also studied to work-out the most appropriate input factors for higher yield. The seed of high yielding guar varieties has been multiplied and distributed among farmers.

Germ Plasm Collection

Country-wide visits were conducted to collect the Guar Germ Plasm from various districts. Utmost try was made to collect the seed from every part of the country especially ecologically diversified areas. Guar germ plasm was collected either through personal visit or with the help of scientists working at research institutions in far-flung areas. Consequently, a total of 223 guar germ plasm accessions/lines collected from various part of country including: PGRI, NARC 100 accessions; RARI, Bahawalpur 70 lines and farmers fields etc, 53 line.



(A) Single Stick Guar Candidate line (AZRC-G-12) Developed at PARC AZRC, D.I.Khan

(B) Guar Experiment at PARC, AZRC, D.I.Khan during 2018.

CONCLUSION:

1. In Pakistan guar crop is cultivated on an area of about 0.20 million acres.
2. About 95% area of guar is covered with local land races having mixture of various plant types.
3. Grain yield at farmers' field is lower due to:
 - i) **Non-availability of approved variety seed**
 - ii) **Poor plant population**
 - iii) **Higher infestation of various types of weeds.**
 - iv) **Insect pest (specially sucking pest like, black aphid).**
4. The most appropriate time of guar planting in Thal Area, Bhakkar is Mid-June while in D.I.Khan and Lakki Marwat best time is Mid-July.
5. Seed rate for single stick guar varieties is recommended as 15 kg/acre while 10 kg for multiple sticks varieties.
6. Row spacing for single stick varieties is recommended as 30 cm while 40 cm for multiple stick varieties.
7. Among two guar types single stick varieties are recommended for grain production while multiple stick varieties are recommended for fodder production.
8. The varieties released by Guar Research Station RARI, Bahawalpur namely BR-99 and BR-2017 are recommended for cultivation with higher preference to BR-2017.
9. Project has identified two guar diseases viz. Cercospora leaf Spot and Guar Leave Curl Virus which were not reported by any guar scientist earlier.
10. More than 10 guar demonstration plot (using BR-99 and BR-2017) were conducted at various locations during project time where farmers had obtained more than double yield of guar varieties as compared to their own land race yield.
11. In ALP Guar Project; two high yielding lines one each single stick (AZRC-G-12) and Multiple stick (AZRC-G-192) have been developed which have been included in Guar National Uniform Yield trial-2019 planted at various location of countries including AZRC, D.I.Khan.
12. More than one tone seed of high yielding guar varieties has been produced under the project.
13. It has been observed that higher production is obtained when crop is cultivated on light soils. The hard soil never recommended for guar grain production. Such soil are however suitable for guar fodder production.
14. Organized one workshop on "Profitable Cultivation of Guar in Pakistan" at PARC, AZRC, D.I.Khan.
15. Produced on M.Phil student department of Agronomy, Gomal University, D.I.Khan.

Visit to Guar Gum Industry and Trade Development Authority of Pakistan (TDAP)

The principal use of guar seed is the production of Guar Gum or Guar powder. About 95% guar gum produced in Pakistan is exported for foreign exchequer. Keeping in view the importance of guar gum and its export, we needed to have a visit to Guar Gum industry and Trade Development Authority of Pakistan (TDAP). This visit was conducted during February, 2019. The TDAP had also helped in arranging this visit. Both the P.Is of Guar Projects Dr. Muhammad Yaqoob PARC, AZRC, D.I.Khan and Dr. Lal Hussain Akhtar, RARI, Bahawalpur jointly visited Guar industries at Karachi and TDAP office at Hyderabad and Karachi.

We also visited Supreme Agro Industry, Karachi and hold meeting with Mr. Shaikh Abdul Waheed the General Manager of the Firm. We discussed several issues relating to Guar seed quality, farmers problems and guar gum production and export. We also met the Pakistan Agro-Chemical Industry, Karachi and hold discussion with General Manager and his team.

Trade Development Authority of Pakistan is playing vital role in export of Guar split and guar gum. We also visited the Office of Director General (Trade and Marketing) TDAP, Karachi and Deputy Director TDAP, Hyderabad and discussed many issues relating to guar quality and its production enhancement in country.

Seminar/Workshop

One day workshop entitled “**Profitable Cultivation of Guar in Pakistan**” was organized to disseminate Guar production technology and Educate the farmers. More than 60 participants from multidisciplinary Departments and farmers had participated:

Director PARC, AZRC, D.I.Khan Dr. Noman Latif Addressing the Guar workshop

