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Breeder Seed Production and Supply Scenario of Jute and Allied Fiber Crops from 2012–13 to 2022–23 of Bangladesh Jute Research Institute

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A b s t r a c t

Breeder seed is seed directly controlled by the originating or sponsoring plant breeding institution, or by plant breeder. Breeders seed is the source for the production of certified seed. Breeder seed is genetically pure which is subsicuent seed class of foundation seed. From foundation seed certified seed is proudeced for the growers.Breeder seed department of Bangladesh Jute Research Institute (BJRI) produces breeder seed and nucleus seed by special management for ensuring the genetic purity and improve the quality of different varieties of jute seed to meet up the demand of Bangladesh Agricultural Development Corporation (BADC) and private jute seed production companies. Every year BJRI produces breeder seed of jute and allied fibre crops at five regional and two sub stations at different geological locations of Bangladesh. Proper isolation distances, intercultural operations, fertilizer management, close monitoring are maintained and different jute seed production techniques are followed stricktly. Breeder seed department of BJRI has produced a total 16.75 tons breeder seed among them 4.91 tons of deshi jute varieties, 8.15 tons of tossa varieties and 3.67 tons of kenaf varieties at previous 11 years. Breeder seed department of BJRI, has suppled these seeds in different GO (BADC) and NGO (private seed company & farms). Last 11 years breeder seed department has supplied 2.24 tons of deshi varieties, 4.30 tons of tossa varieties, 0.25 ton of kenaf varieties to BADC and 2.78 tons of deshi, tossa and kenaf varieties at different private seed producing farms or companies for the production of foundation and certified seed.

Keywords: Jute, Kenaf, Breeder Seed, Isolation distance and Roguing.

Introduction

Out of the six classified crops in Bangladesh, jute, kenaf and mesta are significant ones. They are all self-pollinating crops, although each one undergoes a single outcrossing due to insect visitation during pollination. The two principal species of jute, *C. capsularis* L. (white jute) and *C. olitorius* L. (tossa jute) belong to the genus Corchorus. The scientific names of kenaf and mesta are *H. cannabinus* L. and *H. sabdariffa* L., respectively and they belong to the genus *Hibiscus*. The variants of these species ought to be entirely homogeneous, according to theory. However, in actuality, there may still be a sizable degree of variance during the seed production cycle, particularly in recently introduced kinds (Talukder and Ali, 1977). Therefore, purification of such kinds during nucleus/ breeder seed care may be required. When a breeder releases a variety and gives some beginning seed (parental seed material) to a seed-multiplication organization, their obligations are not over. As long as the variety is cultivated, the breeder is often obliged to have a steady supply of modest amounts of the variety's genetically pure seed for future multiplications. To prevent unintentional changes to the genetic characteristics of the variety's seeds, this must be done precisely (Talukder and Rahman,1989). A crop variety's ability to produce high-quality seeds will be guaranteed by using a genetically pure variety and keeping the nucleus and breeder seed well maintained (Thompson, 1979).

There are four kinds of seeds of any sort or variety, according to the seed rules, 1998, section 9 (kinds and sources of seeds). These are: - Breeder Seed (BS), Foundation Seed (FS), Certified Seed (CS) and Truthfully Labelled Seed (TLS). The foundation seed's initial and ongoing growth is sourced from breeder seed. The BS is the purest because it is created, developed, managed, and given to the breeder of the variety directly for additional multiplication, (Molla *et al*.,2002). The certification badge for BS must be green in color. Breeder seed must be sold to privately licensed seed dealers for the purpose of seed multiplication; nevertheless, no farmer will get breeder seed.

Every year for cultivation of jute and allied fibre crops Bangladesh requires 6000.00 Metric tons of jute seeds approximately.

Bangladesh Agricultural Development Corporation (BADC) and few private seed companies produces jute seed by receiving breeder seed from BJRI according to country demands. To ensure varietal purity and meet up jute seed demands Bangladesh Jute Research Institute produces and supplying breeder seed of jute and allied fibre crops. Based on the above-mentioned facts the study was undertaken to assess the breeder seed production and supply scenario as well as to ensure genetic purity and genetic information of breeder seeds.

of Bangladesh Jute Research Institutes by standard experimental design and layout accordingly. More over for the production of breeder seed breeder seed department of BJRI has produced and maintained nucleus seeds regularly with standard breeding methods.

Nucleus seed production procedure: Nucleus seed is the initial number of pure seeds of an improved cultivar or hybrid parental line produced under the close supervision of a plant breeder. It is

Table 1. Year wise breeder seed production (kg) of different jute, kenaf and mesta varieties by BJRI from 2012-13 to 2022-23

Variety	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	Total
Deshi jute												
CVL-1	510.0	260.0	245.0	530.0	385.0	545.0	430.0	300.0	100.0	180.0	120.0	3605
CVE-3	70.0	8.0	12.0	0	0	0	0	0	0	0	0	90
CC-45	0	0	30.0	0	0	0	0	0	0	0	0	30
BJRI Deshi Pat 5	108.0	30.0	0	50.0	95.0	85.0	65.0	60.0	53.0	60.0	25.0	631
BJRI Deshi Pat 6	45.0	20.0	0	0	0	0	0	0	0	0	0	65
BJRI Deshi Pat 7	0	8.0	0	0	0	0	0	0	0	0	0	8
BJRI Deshi Pat 8	0	0	0	5.0	25.0	12.0	20.0	40.0	30.0	50.0	50.0	232
BJRI Deshi Pat 9	0	0	0	0	0	0	0	0	50.0	40.0	30.0	120
BJRI Deshi Pat 10	0	0	0	0	0	0	0	0	0	0	10.0	10
BJRI Deshi Pat Sak 1	0	0	0	0	13.0	6.0	14.0	20.0	17.0	35.0	15.0	120
Sub Total	**733.0**	**326.0**	**287.0**	**585.0**	**518.0**	**648.0**	**529.0**	**420.0**	**250.0**	**365.0**	**250.0**	**4911**
Tossa Jute												
O-9897	592.0	540.0	500.0	670.0	761.0	618.0	660.0	290.0	20.0	48.0	25.00	4724
OM-1	34.0	3.0	0	0	0	0	0	0	0	0	0	37
BJRI Tossa Pat 4	284.0	51.0	30.0	55.0	60.0	26.0	40.0	34.0	0	0	0	580
BJRI Tossa Pat 5	67.0	46.0	90.0	40.0	99.0	75.0	36.0	25.0	0	0	0	478
BJRI Tossa Pat 6	0	0	0	20.0	20.0	10.0	15.0	18.0	0	0	0	83
BJRI Tossa Pat 7	0	0	0	0	0	0	0	0	0	20.0	10.0	30
BJRI Tossa Pat 8	0	0	0	0	0	0	0	320.0	720.0	555.0	640.0	2235
Sub Total	**977.0**	**640.0**	**620.0**	**785.0**	**940.0**	**729.0**	**751.0**	**687.0**	**740.0**	**623.0**	**675.0**	**8157**
Kenaf & Mesta												
HC-95	126.0	250.0	110.0	115.0	339.0	280.0	363.0	330.0	420.0	500.0	575.0	3408
BJRI Kenaf 3	0	0	0	0	18.0	15.0	25.0	15.0	50.0	0	0	123
BJRI Kenaf 4	0	0	0	0	0	0	32.0	50.0	43.0	12.0	0	137
BJRI Mesta 2	0	0	0	0	0	0	0	0	0	0	10	10
Sub Total	**126.0**	**250.0**	**110.0**	**115.0**	**357.0**	**295.0**	**420.0**	**395.0**	**513.0**	**512.0**	**585.0**	**3678**
Total	**1836**	**1216**	**1017**	**1485**	**1815**	**1672**	**1700**	**1502**	**1503**	**1500**	**1510**	**16756**

Materials and methods

10 popular and high yielding deshi jute varieties such as CVL-1, CVE-3, CC-45, BJRI Deshi Pat 5, BJRI Deshi Pat 6, BJRI Deshi Pat 7, BJRI Deshi Pat 8, BJRI Deshi Pat 9, BJRI Deshi Pat 10, BJRI Deshi Pat Shak 1; 7 tossa jute varieties such as O-9897, OM-1, BJRI Tossa Pat 4, BJRI Tossa Pat 5, BJRI Tossa Pat 6, BJRI Tossa Pat 7, BJRI Tossa Pat 8 and 4 kenaf and mesta varieties were HC-95, BJRI Kenaf 3, BJRI Kenaf 4, BJRI Mesta 2 has produced for breeder seeds during last ten years. Breeder seeds of these varieties has produced in one central research station, four different regional research stations and two different sub stations

genetically cent percent genetically pure and free of other physical impurities. Nucleus seeds are produced in strict isolation to avoid both genetic and physical contamination (Baskin, undated). Nucleus seed should retain original vigor of the variety or parental line.

Before flowering starts about 500-1000 individual plant selection (IPS) which are healthy and have vigorous growth are selected from the nucleus bulk-plot. Observations are recorded on each IPS for important and easily observable morphological characters like plant height, stem color, leaf shape, branching, pods per plant, seeds per pod etc. The IPS which are off-types or affected from

Table 2. Year and variety wise breeder seed supplied (kg) to BADC by BJRI from 2012-13 to 2022-23

Variety	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	Total
Deshi Jute												
CVL-1	75.0	180.0	219	219	232.5	232.5	225	120	99	97.5	97.5	1797
BJRI Deshi Pat 5	15.0	12.0	21	21	27	12	27	15	45	22.5	22.5	240
BJRI Deshi Pat 8	0	0	0	0	0	0	7.5	6	21	30	15.0	79.5
BJRI Deshi Pat 9	0	0	0	0	0	0	0	0	36	30	15.0	81
BJRI Deshi Pat 10	0	0	0	0	0	0	0	0	0	0	8.0	8
BJRI Deshi Pat Sak 1	0	0	0	0	3	3	3	3	9	9	9.0	39
Sub-Total	**90.0**	**192.0**	**240.0**	**240.0**	**262.5**	**247.5**	**262.5**	**144**	**210**	**189.0**	**167.0**	**2244.5**
Tossa Jute												
O-9897	300.0	350.0	365.0	381.0	359.3	166.25	243.0	66.0	13.0	12.92	24.0	2280.47
MG-1	0	0	0	0	0	0	0	0	0	0	2.58	2.58
BJRI Tossa Pat 4	20.0	12.0	23.3	28.0	25.83	13.18	19.38	0	0	0	0	141.69
BJRI Tossa Pat 5	5.0	12.0	18.6	14	12.92	0	0	0	0	0	0	62.52
BJRI Tossa Pat 6	0	0	0	0	2.33	2.33	2.33	0	0	0	0	6.99
BJRI Tossa Pat 7	0	0	0	0	0	0	0	0	0	2.58	0	2.58
BJRI Tossa Pat 8	0	0	0	0	0	0	0	319	490.0	430.13	620.0	1859.13
Sub-Total	**325.0**	**374.0**	**406.9**	**423.0**	**400.4**	**131.75**	**264.71**	**385.0**	**503.0**	**445.63**	**646.58**	**4305.97**
Kenaf												
HC-95	100.0	5.0	25.0	25.0	25.0	00	0	5.0	5.0	20.0	20.0	230
BJRI Kenaf 4	0	0	0	0	0	0	0	0	0	10.0	0	10
Sub-Total	**100.0**	**5.0**	**25.0**	**25.0**	**25.0**	**0**	**0**	**5.0**	**5.0**	**30.0**	**20.0**	**240**
Total	**512**	**571**	**671.9**	**688**	**688.4**	**379.25**	**527.21**	**534**	**718**	**664.63**	**833.58**	**6787.97**

diseases are removed. Separate harvesting and standard post harvesting activity of the IPS is carried out. Seeds are stored in separate brown paper bags with proper labeling in desiccator with silica gel. In s year, seeds of selected individual plants are sown in individual rows to assess critically several times during the growing season. The progeny rows that deviate in one or other characteristics are discarded and entire progeny rows are rejected. The plant progenies that are uniform and true to type are selected and bulk together as nucleus seed. This nucleus seed used for breeder seed production in the next year. Thus, nucleus seed stock is produced and maintained properly.

Breeder seed production procedure

Land selection

Should choose high and mid-highland areas that are free of rain and floods. The soil should be loamy to sandy loamy. Areas used for breeder seed production must be free of volunteer plants. A high percentage of organic matter and soil moisture available prior to harvest favor the production of high-quality breeder seed. In addition, the soil should be fertile, well-drained, and neither too acidic nor too alkaline. Must be free of pesky weeds and soil-borne diseases

Land preparation and fertilization

The land needs to be plowed deeply, leveled with 5-6 ladders. Fine tilth requires for seed germination. Urea, TSP and MoP fertilizers are applied at rates of 60 kg, 50 kg and 20 kg per hectare during final land preparation. 15-20 days after seed germination, a first top dressing of 60 kg urea/ha and a second top dressing of 60 kg urea/ha 15 days later. If sulfur and zinc are deficient, 50 kg and 5 kg of gypsum and zinc sulfate should be applied per hectare. Sufficient soil moisture is required when applying nitrogen fertilizers.

Methods of seeding/plantation

Jute, kenaf, and mesta breeder seed production typically use two techniques. These two techniques are stem or top cutting and direct seeding. The seeds of less photosensitive tossa jute cultivars are generated through stem and top cuttings, as opposed to the normal practice of producing deshi jute, kenaf, and mesta seeds directly from the mother plant. It should be noted that breeder seed for tossa jute can also be produce in the late season by direct seeding. For direct seeding, mid-July to late-August is the best period for seed sowing ((Hossain *et al.,* 1994b). To increase seed yield, tossa jute seeds are sown by August 30 whereas deshi jute can be sown from last week of May to Mid June and kenaf/mesta can be sown from mid-July to first week of August. Between the north and south of the country, the sowing period varies by 15 days. 15 days earlier than in the southern districts (Jessore, Faridpur, Rajbari, Kustia) are the northern districts (Dinajpur, Rangpur, Rajshahi, Bogra). Even as late as September 15th, sowing is possible (Hossain *et al.,* 1999).

First mother plants should be cultivated for the stem and top cutting technique. To do this, seed should be placed in a line in early March, with a 30 cm spacing between each line. Healthy and disease-free plants should be chosen for top and stem cutting when plants are between 100 and 120 days old (before to the start of flowering). Cut the chosen top and stem into 20–30 cm-long, slanting segments. Larger leaves should be carefully removed before cutting the top and stem (Salim and Hossain, 2003). The planting should be done as soon as feasible after the harvest of the tops and stems. Cloudy days and evenings are favorable for plantations. Cuttings should be planted in rows with a 30 cm

Table 3. Year and variety wise breeder seed supplied (kg) to private seed company by BJRI from 2012-13 to 2022-23

Variety	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	Total
Deshi Pat												
BJRI Deshi Pat Shak 1	0	0	0	0	0	0	0	0	3.00	0	0	0
Sub-Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3.00**	**0**	**0**	**3.0**
Tossa Pat												
O-9897	0	0	0	99.0	150.0	150.0	0	30.0	0	0	0	429
BJRI Tossa Pat 5	0	0	0	0	30.0	0	0	0	0	0	0	30
BJRI Tossa Pat 8	0	0	0	0	0	0	0	0	75.0	20.0	10.0	105
Sub-Total	**0**	**0**	**0**	**99.0**	**180.0**	**150.0**	**0**	**30.0**	**75.0**	**20.0**	**10.0**	**564**
Kenaf												
HC-95	0	0	0	0	300.0	140.0	115.0	320.0	280.0	450.0	555.0	2160
BJRI Kenaf 3	0	0	0	0	0	0	0	0	20.00	0	0	20
BJRI Kenaf 4	0	0	0	0	0	0	0	25.00	10.00	0	0	35
Sub-Total	**0**	**0**	**0**	**0**	**300.0**	**140.0**	**115.0**	**345.0**	**310.0**	**450.0**	**555.0**	**2215**
Total	**0**	**0**	**0**	**99.0**	**480.0**	**290.0**	**115.0**	**375.0**	**388.0**	**470.0**	**570.0**	**2787**

between-lines and 15 cm between-cuttings interval. The line should run north to south. Plantations should have 45^0 angles and a 5 cm depth. The ideal time for top and stem plantation is from the latter week of June to the first week of July. This technique is typically used to produce *C. olitorius* breeder seeds (Islam *et al*.,2005). The following two factors are crucial no matter what methods are used to produce breeder seeds.

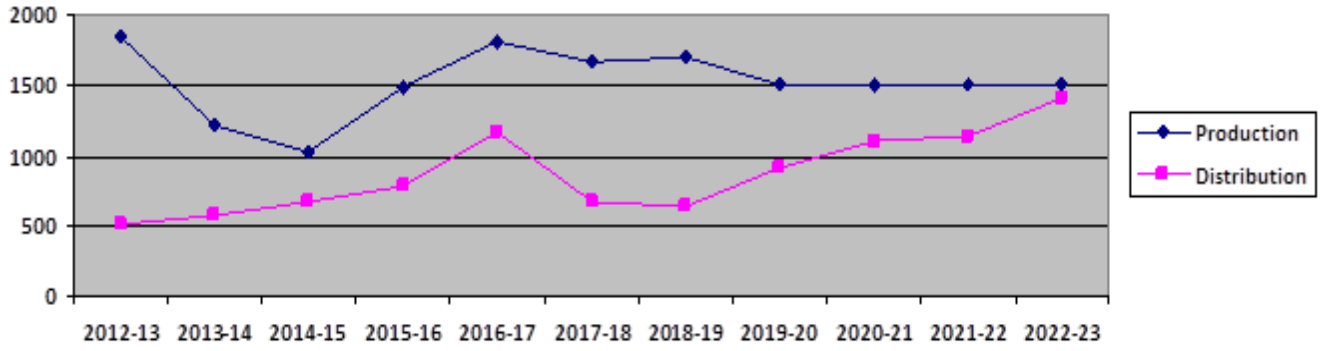

Fig.1. Year wise breeder seed Production and Distribution by BJRI from 2012-13 to 2022-23

a) Isolation distance: It is the separation between a variety's seed crop and crops of other varieties or crops of other species in the same family. It should be kept up for the purpose of producing breeder seeds in order to prevent cross-pollination, maintain genetic integrity, and reduce physical mixing. Although Jute, Kenaf, and Mesta are typically self-pollinated plants, some cross-pollination does take place. Natural crossover has been observed in *C. capsularis* at 2-3%, *C. olitorius* at 10-12%, *H. cannabinus* at 3-10%, and *H. sabdariffa* at 1.46%. Therefore, a minimum isolation distance of 50 meters from fields of other varieties of the same species, and a minimum isolation distance of 5 meters from fields of other species, should be given for the generation of breeder seeds of these crops (ISTA,1985).

b) Roguing: It entails removing undesired plants from the seed field, such as other crop plants, different varieties, off-types, diseased plants, obnoxious weeds, etc. Roguing is required to guarantee the genetic purity of a seed lot and the absence of illnesses transmitted through the seed. Three stages of the plant's growth should be checked for off-types, diseases, and insect infestations. Plants should be rogued for the first time between 30 and 40 days after planting. The second roguing should be carried out at the bud or flowering stage, and the third roguing at the period of capsule or fruit production (Talukder and Hossain, 1989).

Intercultural operations

When the crop is 3–4 weeks old and before the first top dressing, the first-hand weeding and thinning should be performed. Therefore, the second weeding should be done by hand or cultivator two days before to the second top dressing. Usually, irrigation is applied as and when it is required. Ordinarily, 2-3 irrigations spaced 20 days apart are needed prior to the start of the monsoon. As and when necessary, additional actions like as roguing, controlling insects and illnesses, etc., should be taken.

Harvesting, threshing and drying

Harvesting time varies from mid-October to mid-December depends on variety or species, when 60–70% of the fruits turn brown, the crops are ready for harvest. Shattering occurs by over maturity, especially in *C. olitorius* and *H. sabdariffa*. Harvesting should be avoided from wet plants caused by rain. For optimal threshing, the harvested plant needs to be dried in the sun for two to three days (Talukder and Akanda, 1994). By pounding the material with a stick or hammer, threshing is accomplished. Seed

needs to be dried for 4-6 days on a gunny bag or sacking after threshing (Islam *et al*.,2002a). When it comes to drying seeds, gunny bags or sacking are better options than polythene sheets, cow dung flooring, and cement floors. Proper drying is the major factor determining seed quality. Seed should be properly preserved after drying. The initial moisture level of the seed is crucial for preserving the quality of the seed during storage. For *C. capsularis*, storing moisture should be 10%, for C. olitorius, 8%, and for H. cannabinus and H. sabdariffa, roughly 10% (Khandakar and Bradbeer, 1983 and ISTA).

Breeder seed lots are given to the Seed Certification Agency (SCA) for certification following the completion of all seed production stages. The produced seeds are sent to BADC and other NGOs in accordance with their specifications for foundation seed production after receiving certification and a tag label.

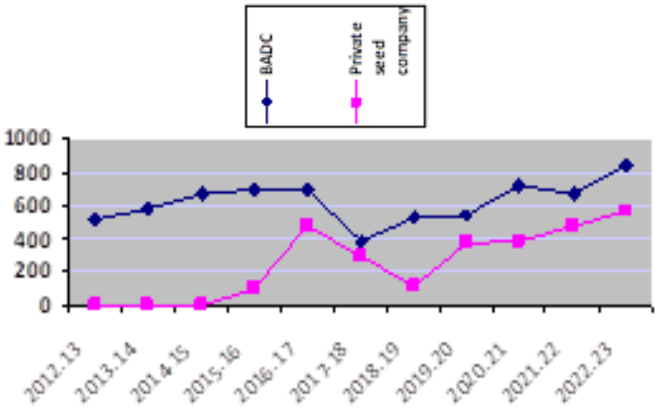

Fig.2. Year wise breeder seed supplied (kg) to BADC & private seed company by BJRI from 2012-13 to 2022-23

Maintenance of breeder seed of released varieties

The creation of breeder seeds is a very pricey operation that carries a danger of contamination due to repetitive multiplication. The upkeep of breeder seed does, however, require the subsequent measures.

- Breeder stock seed from the nucleus ought to be sown on open, fertile ground that didn't produce a crop of the same sort the year before.
- The field needs to be well segregated.
- Breeder's stock should be planted, raised, and harvested using the greatest agricultural techniques.
- The stock ought to be created at the research facility in the region where the new variety was bred.
- Sowing should be done in a manner that maximizes the limited number of seed available and facilitates rouging.
- The spacing between rows should be sufficient to allow inspection of the plants within the rows for possible mixtures or heterogeneity.
- All non-variety plants should be picked and removed. If the parent seeds of previous breeders were well protected from natural outcrossing, few plants should be replaced.
- Rouging should be done before flowering. It should be done relatively early in the day.
- When harvesting and threshing of breeder seed, equipment used should be cleaned and free of seed from other breeds.

Results

During 2012-13 to 2022-23, BJRI has produced a total of 16.75-tons breeder seeds of jute and allied fibre crops among that 4.91 tons of deshi jute varieties, 8.15 tons of tossa jute varieties and 3.67 tons of kenaf and Mesta varieties were supplied as per BADC and various private seed companies demand (table1). Bangladesh Agricultural Development Corporation (BADC) has received 6.79 tons of breeder seed from Bangladesh Jute Research Institute (BJRI) among that 2.24 tons of six popular deshi varieties, 4.30 tons of seven popular tossa varities and only 240 kg of two kenaf varieties for the production of foundation and certified seed (table 2). BADC has taken more deshi jute seeds of CVL-1 (1.79 tons) variety, tossa jute seeds of O-9897 (2.28 tons), BJRI Tossa pat-8 (1.85 tons) variety and Kenaf seeds of HC-95 (230 kg) (table 2). On the other hand, different private seed production farms have received 2.78 tons breeder seed of various popular deshi, tossa and Kenaf variety from last eleven years (table 3).

Table shows that amount of breeder seed production ranges from 1.01- 1.83 tons and trends of breeder seed production was highest (1.83 ton) at 2012-13 and lowest (1.01 ton) at 2014-15 (Table 1). Heighst breeder seed supplied to BADC 0.833 ton and private seed company 0.570 ton by 2022-23 respectively (Table 2 and 3). Breeder seed production and distribution difference was higher by 2012-13, lower by 2014-15 and the lowest by 2022-23 respectively (Figure 1). Bangladesh Agricultural Development Corporation (BADC) always received more breeder seeds of jute and allied fibre crops than the private seed companies or farms from 2012-13 to 2022-23 (Figure 2).

Conclusion

To increase agricultural output, seed potential is regarded as the most crucial input in all agricultural nations, whether they are developed or underdeveloped. Even if all other variables are favorable, a crop's productivity cannot significantly increase if the seed does not have a high yielding potential. Any crop's quality seed alone can enhance yields by 15% to 20%. Breeder seed production is a normal and essential task performed by BJRI. In accordance with this policy, BJRI produces breeder seed of various high yielding varieties of jute and allied fibre crops to meet the BADC and other NGOs demands. Farmers profit from employing this upgraded jute and kenaf seeds to cultivate these plants as a result of receiving better jute and kenaf seeds.

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