

STARTING POINT OF BUCKWHEAT BREEDING IN BANGLADESH

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ABSTRACT

Buckwheat is not commonly cultivated in Bangladesh because it is an ancient minor crop. Common buckwheat is familiar as a rabi season crop and is rarely cultivated in some areas of northern part in Bangladesh. Henceforth, organized research improvement has not been established yet on buckwheat and so research information about buckwheat breeding is very limited. Again no developed variety available in Bangladesh. The varieties which are being cultivated in farmer's level are actually local cultivar. Bangladesh Agricultural Research Institute (BARI) started working on buckwheat with five genotype, since 2018 and collected from PGRC, BARI. Characterization, different yield trial in different regions of Bangladesh have been conducted for selection of promising genotype.

Keywords: Buckwheat, characterization, breeding, selection, minor crop

1. INTRODUCTION

Buckwheat is a versatile crop used for both grain and green parts and known to have several medicinal and nutritional properties. Due to its nutritional and medicinal value it is gaining popularity and appreciable attentiveness in the global scientific community. In all over the world it is widely planted and used. It belongs to the genus *Fagopyrum* and family Polygynoaceae [2]. China is one of the crop origination centers in the world and buckwheat originated in China [12]. Common buckwheat (*Fagopyrum esculentum*) and Tartary buckwheat (*Fagopyrum tartaricum*), are commonly grown for food and medicinal purpose. Buckwheat grains and other plant parts are prominently used in the food, pharmaceutical, cosmetic and feed industry. Buckwheat is an excellent source of protein and amino acid composition which have biological value. It grain contains thiamine (vitamin B1), riboflavin (vitamin B2) and pyridoxine (vitamin B6) [5]. Buckwheat grains have remarkable quantity of microelements namely Zn, Cu, Mn, Se as well as of macro elements, including: K, Na, Ca, and Mg [15]. Compare to other cereals grain buckwheat is nutritionally admirable in fatty acid composition [14]. In a human body proteins are the dominant structural compound of tissues and of biologically-active compounds such as enzymes, hormones and antibodies. Buckwheat flour contains higher level of protein compare to other cereals such as rice, wheat, millet, sorghum and maize [15]. Its protein is liberal in lysine and arginine, which are generally limiting in other cereals. Dietary fibre is an important element of buckwheat grains because it helps patients suffering from obesity or type II diabetes. Again seeds are rich in high antioxidative properties likely α -, β - and γ -tocopherols, rutin and quercetin, catechins and polyphenols. Among them rutin has cardioprotective, vasoprotective, anti-hypertensive, anti-inflammation, cytoprotective and anti-diabetic properties [15]. Also their potential antioxidant activity plays a vital role to the dietary value [16]. Buckwheat flour is gluten free so it is blessings for celiac disease patient. As a nutritious healthy food, demand is being increased globally in buckwheat made products as an alternative of wheat flour for gluten-allergic person. Just like wheat, buckwheat also can be grounded into flour and can be used either as food (usually in bread, pancakes, and noodles) or as medicine. Roasted and unroasted form of buckwheat is available in the world. Kasha is widely used in traditional European dishes which is the roasted form of buckwheat. It is used in United States to make porridges and pancakes. And people of Bangladesh use it in various ways such as chapati, halua, khai (puffed), etc. It is a good source of grains, leafy vegetable and fodder. The whole grains (achenes), middling or flour is fed to the livestock and poultry and young and green buckwheat seedlings with soft leaf have been used as vegetable in northern region people in Bangladesh [4].

As a minor crop the local name of buckwheat in Bangladesh is dhemsia [10]. The farmers of Northern region particularly, in the greater Dinajpur, Rangpur and Rajshahi District are cultivated buckwheat [9]. There is minimum fertilizer need to cultivate this minor crop and maturity comes within 2-3 months in Bangladesh. Buckwheat needs poor and marginal soils with minimum care and inputs for cultivation. As a short duration crop it is also less susceptible to pest and diseases. Cool and moist climate particularly rabi season is suitable for buckwheat cultivation in Bangladesh. But in flowering stage it is sensitive to high temperature and dry weather [9]. And changing climate is a common issue in Bangladesh agriculture. So sustainable utilization of our limited resources to ensure food and nutritional security is the main challenge. In this case buckwheat is a nutrition rich and low input crop and help to deal with this challenge. But this crop showing low yield due to shattering of seed because of breaking of pedicel and self incompatibility. This dimorphic heterostylism self incompatibility occurs as a major problem for large scale production in agriculture system [3].

Due to low yield because of shattering tendency, lack of proper knowledge about its benefit, uses among farmers and people this underutilized crop cannot gain popularity. But owing to its higher price of seed, farmers of Rajshahi district in Bangladesh started cultivation of buckwheat. Farmers of the district cultivated buckwheat on five hectares of land while it was cultivated on two and a half hectares of land last year [7]. And health concerned people showing interest on buckwheat as a result demand is increasing. Combination of buckwheat and marsh pepper residues showed potentiality to suppress weed growth [1]. [4] The genetic diversity studies exposed that presence of variation in the material and suggested some selected promising genotypes for future hybridization program. Importance and genetic resources of buckwheat in Bangladesh agriculture reported [9]. Definitely the above information is very much important for buckwheat research and this paper provides some particulars about buckwheat breeding, problems, challenges and future prospective.

For expanding the crop it is important to develop high yielding variety with desired characteristics. Also it is necessary to take action for popularizing buckwheat in policy level. But in Bangladesh organized research improvement has not been established yet. So research information about buckwheat breeding is very limited and no developed variety in Bangladesh. The varieties which are being cultivated in farmer's level are actually local varieties. In this aspect development of buckwheat varieties is badly needed for Bangladesh agriculture. Plant Breeding Division, Bangladesh Agricultural Research Institute (BARI) started working on buckwheat with few germplasm, since 2018. Characterization, different yield trial in different regions of Bangladesh have been conducted for selection.

2. BUCKWHEAT IN BANGLADESH AND NUTRITIONAL IMPORTANCE

As a origin, north-west area of Bangladesh is very adjacent and have a scope to find out genetic variability. Genarally the rabi (October to March) season and north-west region namely Thakurgaon, Panchagar, Nilphamari and parts of Dinajpur and Rangpur districts showed favourable climatic condition for buckwheat cultivation because these area are located near the Himalayan mountains [4]. But cultivation area is rapidly decreasing due to increasing population, development of major cereals varieties, economic changes, shattering tendency and lack of knowledge about crop nutrition. Genetic diversity of buckwheat is now acute warning of disappearance. In literature there is many proof for eradication of genetic diversity. In this case Bangladesh agriculture is in great threat for buckwheat germplasm. Diverse germplasm or genetic resources is the basic requirement of any crop improvement or breeding program. Research success mainly depends on availability of germplasm. For plant breeding research wider genetic base is an important factor for development of new varieties as well as successful crop production. Available germplasm helps to find out desired traits which can be incorporated in the newly developed varieties and can fill out the nutritional deficiency. In Bangladesh agriculture as well as for nutrition security buckwheat is important crop and now it is time to realize for improvement of this crop through modern agricultural method to increase their yield. Compared to cereals pseudocereals are rich in fatty acids especially unsaturated fatty acids (linolenic acid) [13]. Pseudocereals have higher mineral content than other cereals which can minimize hidden hunger problem (Table 1) [11]. As a pseudocereals bucwheat is highly nutritious because of containing biological proteins, essential vitamins, antioxidants and minerals. Also buckwheat is abundant in dietary fiber, antioxidant namely rutin, vasoprotective, antihypertensive, and ardioprotective properties (Table 1) [3]. To prevent various chronic disease intake of buckwheat should be increased in daily consumption.

Table 1: Nutritional composition of buckwheat in comparison to three major cereals.

| Nutrients | Buckwheat | Rice | Wheat | Maize |
|---|-----------|------|-------|-------|
| Proximate composition (per 100 g grain) | | | | |
| Energy (Kcal) | 355 | 345 | 346 | 365 |
| Crude protein (%) | 12.0 | 6.8 | 11.8 | 9.4 |
| Total carbohydrate (g) | 72.9 | 78.2 | 71.2 | 74.3 |
| Total fiber (%) | 17.8 | 4.5 | 12.5 | 7.5 |
| Fat (g) | 7.4 | 1.5 | 2.5 | 4.7 |
| Moisture (%) | 11.0 | 13.7 | 12.8 | 10.4 |
| Minerals and trace elements | | | | |
| Calcium | 11.0 | 10 | 30 | 7 |

| | | | | |
|-----------------------------|------|------|-----|------|
| Iron | 4.0 | 0.7 | 3.5 | 2.7 |
| Magnesium | 390 | 65 | 138 | 127 |
| Phosphorous | 330 | 160 | 298 | 210 |
| Manganese | 3.4 | 0.5 | 2.3 | 1.9 |
| Zinc | 0.8 | 1.3 | 2.7 | 2.3 |
| Potassium | 450 | 268 | 284 | 287 |
| Essential amino acid | | | | |
| Lysine | 5.9 | 3.8 | 2.6 | 1.9 |
| Methionine | 3.7 | 3.0 | 3.5 | 3.2 |
| Tryptophan | 1.4 | 1.0 | 1.2 | 0.6 |
| Leucine | 6.7 | 8.2 | 6.3 | 13.0 |
| Vitamin | | | | |
| Thiamine | 3.3 | 0.06 | 0.5 | 0.4 |
| Riboflavin | 10.6 | 0.06 | 0.2 | 0.2 |
| Niacin | 18.0 | 1.9 | 5.5 | 3.6 |
| Tocopherol | 40.0 | - | - | - |
| Pantothenic acid | 11.0 | - | - | - |
| Choline | 440 | - | - | - |

Source: Pirzadah et al., 2020

3. OVERVIEW OF RESEARCH

3.1 Germplasm Collection and Evaluation

Dhemshi has been cultivated since ancient times in northern region of Bangladesh but breeding has not advanced. After realization the importance and nutritional status of buckwheat, research is being started in Bangladesh with few germplasm. As an exotic crop, availability of germplasm is very limited. Ten underutilized nutritious crop are being dealt in plant breeding division of Bangladesh Agricultural Research Institute (BARI). Among them buckwheat is one of the crop. But in Bangladesh there is no released variety of buckwheat. Since 2001, the Plant Genetic Resources Centre (PGRC) of Bangladesh Agricultural Research Institute has under taken the programme of collection and conservation of buckwheat germplasm. In PGRC, rejuvenate the buckwheat seed in alternate year maintaining open pollination but no breeding program was not done. But now days as a medicinal short day and high nutritious crop, demand of buckwheat is increasing to the health conscious people. So some research activities on breeding are being started on buckwheat in Plant Breeding Division, BARI since 2018. Now Plant Breeding Division deals with a total of 5 germplasm of buckwheat collected from PGRC, BARI. Morphological characters of five germplasm are fully described in table 2.

3.2 Population Development

Five genotypes have been bulked to develop broad genetic base population. Bulking method will be done to select individual plant for next generation. Thus four cycle should be completed to develop broad genetic base population and then selected lines of this population will be performed under multilocation trial. And finally best performed stable line will be selected and will be maintained for developing new variety.

3.3 Varietal Improvement

Organized breeding activities have not been started yet for improvement of variety. Because it is one of the neglected underutilized minor cereal in Bangladesh. Major crop i.e rice, wheat, maize etc occupied the cultivated area and most of the scientist working on major crops and vegetables and also they are well trained on this crop researching activities. Nevertheless, BARI is continuing following activities as initiation for buckwheat varietal improvement

3.4 Characterization of Buckwheat germplasm

Six lines of common buckwheat were collected in 2018 from PGRC and were characterized following IPGRI descriptors (table 2) in the field of Plant Breeding Division, Bangladesh Agricultural Research Institute. Morphologically little variation observed in qualitative characters. Variation was observed on color characteristics of different plant parts such as stem color (StC), leaf color (LC), petiole color (PC), leaf vein color (LVC) and flower color (FC) (Table 3). And quantitative characters showed variation more than qualitative characters (Table 4). All the germplasm were germinated within 3 to 4 days and early flowering and maturity were observed in BD-4273 (30 days and 80 days, respectively). After characterization all the germplasm were evaluated under different trial to observe their performance. Recently three exotic germplasm of common buckwheat have been collected from china and was not characterized. These three germplasm have been received by plant breeding division of BARI.

3.5 Preliminary yield trial (PYT)

In PYT, all the germplasm collected from local sources were sown in 2019 and 2020 at Gazipur location just to observe their performances and select desired trait genotype for advanced yield trial. Among the five entries BD-4273 showed early maturity compare to other entries which is one of criteria in selection genotype (table 3). Highest yield performance observed in BD-4272 followed by BD-4273 among the tested entries. Better performing desired characteristics genotype (BD-4273) was selected for multilocation trial.

3.6 Regional Yield Trial (RYT)

In 2021, mean data of three locations was given in table 6 and observed that no significant variation in yield data and for days to maturity significant variation were observed in Jamalpur and Debiganj location. Debiganj location appeared lowest time (76 days) for days to maturity than other two locations. In all location BD-4273 showed early maturity (77 days) among the tested entries. In 2021, Gazipur location showed highest plant height (110.3cm) than other location followed by Debiganj and Jamalpur, respectively. Highest plant height (107.3 cm) was observed in BD-4272 followed by BD-7274 (100.9cm). In case of yield there is no significant variation among the entries. Regarding yield, Jamalpur and Debiganj location showed highest yield (0.6 t/ha) compare to Gazipur location. Compare to local check (Bog-1), BD-4272 and BD-4273 showed highest yield (0.6t/h). As a indeterminate crop, buckwheat yield is low due to seed shattering and high lodging tendency. In this year BD-4273 was selected based on its early maturity and yield performance and another multilocation trial was conducted for its confirmation in next year of 2022 (table 4).

In 2022, mean data of three location was given in table 7 and observed that no significant variation in yield data. Compare to local check (85 days) BD-4273 took lowest time (79 days) for days to maturity and desirable character for selection. In all location BD-4274 (87 days) showed maximum days to maturity. All of the genotypes were matured earlier in Jamalpur location (82 days) than other location. In case of plant height, Gazipur location showed lowest plant height (90.8cm) than other location. Because urea fertilizer were applied only in land preparation. Lowest plant height observed in genotype BD-4272 (85.5cm) followed by BD-7274 (91.5cm), respectively. Variation of yield among the genotypes was not significant in all the location. However, compare to local check BD-4272 showed (1.1t/ha) highest yield in three locations. Finally genotype BD-4273 was selected based on its early maturity (table 5).

Table 2: List of buckwheat lines and their morphological characteristics

| Name | Source of collection and year | Germination% | Qualitative Characteristics |
|---------|-------------------------------|--------------|--|
| BD-4272 | PGRC, BARI,2018 | 100% | Growth and branch shoot habit is Semi erect shorter; Stem, petiole and leaf vein color is green; hastate leaf blade shape; white flower; Compactness of inflorescence is loose; seed shape is ovate and grey in color. |
| BD-4273 | PGRC, BARI,2018 | 80% | Growth and branch shoot habit is semi erect shorter; stem color is initially pink, petiole and leaf vein color is red; sagittate leaf blade shape; pink flower; compactness |

| | | | |
|---------|-----------------|----------------|---|
| | | | of inflorescence is loose; seed shape is triangular and grey in color. |
| BD-7274 | PGRC, BARI,2018 | 100% | Growth and branch shoot habit is semi erect shorter; stem color is initially red, petiole and leaf vein color is red; sagittate leaf blade shape; pink flower; compactness of inflorescence is loose; seed shape is triangular and grey in color. |
| BD-4275 | PGRC, BARI,2018 | 100% | Growth and branch shoot habit is semi erect shorter; stem color is initially red, petiole and leaf vein color is red; sagittate leaf blade shape; pink flower; compactness of inflorescence is loose; seed shape is triangular and grey in color. |
| BD-4276 | PGRC, BARI,2018 | Not germinated | - |
| Bog-1 | Bogura,2019 | 100% | Growth and branch shoot habit is semi erect shorter; stem color is initially red, petiole and leaf vein color is red; sagittate leaf blade shape; pink flower; compactness of inflorescence is loose; seed shape is triangular and grey in color. |

Table 3: Quantitative characteristics of five buckwheat lines

| Entry | Days to first germination | Days to 50% flowering | Days to maturity | Plant height (cm) | No. of flower cluster/plant | Thousand seed weight (gm) |
|---------|---------------------------|-----------------------|------------------|-------------------|-----------------------------|---------------------------|
| BD-4272 | 3 | 37 | 80 | 120 | 148 | 18.0 |
| BD-4273 | 4 | 30 | 81 | 109 | 135 | 20.2 |
| BD-7274 | 4 | 36 | 86 | 95 | 145 | 18.2 |
| BD-4275 | 4 | 37 | 85 | 104 | 139 | 14.0 |
| Bog-1 | 4 | 35 | 85 | 108 | 144 | 15.1 |
| Mean | 3.8 | 34.4 | 83.4 | 107.2 | 142.2 | 17.1 |
| Min | 3 | 30 | 80 | 95 | 135 | 14.0 |
| Max | 4 | 37 | 86 | 120 | 148 | 20.2 |

Table 4: Preliminary yield trial (PYT) of Growth and seed yield in different buckwheat genotypes evaluated at Gazipur during 2019 and 2020

| Entry | Days to 50% flowering | | Days to maturity | | Plant height (cm) | | Thousand seed weight (gm) | | Seed yield (kg/h) | |
|-----------|-----------------------|------|------------------|------|-------------------|-------|---------------------------|------|-------------------|--------|
| | 2019 | 2020 | 2019 | 2020 | 2019 | 2020 | 2019 | 2020 | 2019 | 2020 |
| BD-4272 | 44 | 40 | 80 | 75 | 106 | 128.0 | 17.9 | 18.0 | 749.7 | 734.0 |
| BD-4273 | 35 | 34 | 79 | 73 | 109 | 115.3 | 19.7 | 20.2 | 821.6 | 647.7 |
| BD-7274 | 37 | 38 | 84 | 79 | 95 | 104.3 | 15.7 | 18.2 | 500.9 | 450.0 |
| BD-4275 | 37 | 38 | 85 | 80 | 105 | 105.7 | 16.9 | 14.0 | 557.7 | 426.7 |
| Bog-1 | 39 | 40 | 84 | 80 | 104 | 106.7 | 17.9 | 15.1 | 628.0 | 448.2 |
| Mean | 38.4 | 38 | 82.4 | 77.4 | 103.8 | 112 | 17.62 | 17.1 | 651.58 | 541.32 |
| CV (%) | 4.0 | 2.9 | 1.5 | 1.9 | 2.3 | 4.0 | 3.7 | 6.6 | 9.1 | 11.6 |
| LSD(0.05) | 4.3 | 3.0 | 3.4 | 4.0 | 6.5 | 12.3 | 1.8 | 3.1 | 165.0 | 174.0 |

Table 5: Genotypic mean of different location in 2021

| Entry | Days to maturity | | | | Plant height (cm) | | | | Yield (t/ha) | | | |
|--------------|------------------|-----|-----|------|-------------------|------|-------|-------|--------------|------|------|------|
| | Gaz | Jam | Deb | Mean | Gaz | Jam | Deb | Mean | Gaz | Jam | Deb | Mean |
| BD-4272 | 83 | 83 | 75 | 80 | 104 | 113 | 105 | 107.3 | 0.6 | 0.6 | 0.7 | 0.6 |
| BD-4273 | 79 | 81 | 70 | 77 | 106 | 85 | 101 | 96.9 | 0.6 | 0.7 | 0.6 | 0.6 |
| BD-7274 | 87 | 86 | 77 | 83 | 114 | 87 | 102 | 100.9 | 0.4 | 0.6 | 0.5 | 0.5 |
| BD-4275 | 84 | 83 | 78 | 82 | 117 | 78 | 111 | 101.8 | 0.4 | 0.5 | 0.6 | 0.5 |
| Bog-1(check) | 83 | 87 | 78 | 83 | 112 | 87 | 100 | 99.3 | 0.3 | 0.5 | 0.6 | 0.5 |
| Mean | 83 | 84 | 76 | | 110.6 | 90 | 103.5 | | 0.4 | 0.6 | 0.6 | |
| cv% | 2.8 | 1.7 | 2.1 | | 4.5 | 5.6 | 5.7 | | 22.3 | 10.1 | 12.1 | |
| Lsd | 6.4 | 3.5 | 4.9 | | 13.6 | 13.9 | 16.4 | | 0.3 | 0.2 | 0.2 | |

Table 6: Genotypic mean of different location in 2022

| Entry | Days to maturity | | | | Plant height (cm) | | | | Yield (t/ha) | | | |
|--------------|------------------|------|------|------|-------------------|-------|-------|-------|--------------|------|-------|------|
| | Gaz | Jam | Deb | Mean | Gaz | Jam | Deb | Mean | Gaz | Jam | Deb | Mean |
| BD-4272 | 83 | 79 | 82 | 81 | 85.5 | 96.4 | 105.1 | 95.7 | 1.1 | 1.1 | 1.0 | 1.1 |
| BD-4273 | 81 | 77 | 79 | 79 | 92.0 | 101.5 | 100.5 | 98.0 | 1.0 | 0.8 | 0.6 | 0.8 |
| BD-7274 | 85 | 87 | 88 | 87 | 91.5 | 97.6 | 102.1 | 97.1 | 0.8 | 0.9 | 0.6 | 0.8 |
| BD-4275 | 87 | 85 | 84 | 85 | 92.0 | 103.4 | 109.2 | 101.5 | 0.5 | 1.0 | 0.6 | 0.7 |
| Bog-1(check) | 86 | 84 | 85 | 85 | 93.0 | 97.4 | 102.6 | 97.7 | 0.6 | 0.8 | 0.9 | 0.8 |
| Mean | 84 | 82 | 84 | | 90.8 | 99.26 | 103.9 | | 0.8 | 0.92 | 0.74 | |
| CV% | 2.01 | 1.12 | 2.80 | | 9.09 | 5.73 | 3.74 | | 20.93 | 5.54 | 11.86 | |
| Lsd | 4.7 | 2.56 | 6.44 | | 3.61 | 15.75 | 10.77 | | 0.45 | 0.14 | 0.24 | |

4. EFFORTS TO ACHIEVE STABLE AND HIGH YIELD IN BANGLADESH

In Bangladesh, cultivation of buckwheat as a crop is very less and it is the minor cereals crop. So research of buckwheat is not advanced properly. BARI is working on buckwheat keeping in front of some breeding objectives i.e short plant height, early maturity, lodging resistance, low shattering, high yield and quality seed. But still now there is no developed variety on buckwheat. Nevertheless, recently, little advance has been assembled in the improvement of variety development based on desirable characters of multilocation trial (table 4 and 5). And now mutation breeding activities on buckwheat have been started recently to create variation. Buckwheat yield is very low due to shattering and lodging tendency. So short plant height is the desirable character for achieving high yield. In this context available germplasm and variation among the germplasm is prerequisite for selection. In this case mutation breeding helps to select diverse population of desirable characters. For better yield of buckwheat, it may be sown on November 15 with 19 kg seed rate in the north-west region of Bangladesh [10]. If buckwheat is planted after December 30, its yield is reduced even though the seed rate is increased [10]. Anyway identification of a superior breeding program is foremost because there is shortage of information about genomic breeding in buckwheat. In concise, for development of superior varieties strengthened efforts on breeding activities namely self incompatibility, seed shattering, stable yield, determinate maturity, lodging resistance and increase familiarity showing its

nutritive value and good marketing channel for its availability could bring popularity among the people of Bangladesh.

5. PROBLEMS OF BUCKWHEAT GROWING AND BREEDING IN BANGLADESH

Buckwheat is not only produces grain and fodder but also be used as a succulent green leafy vegetable. It is a economic source of rutin (glucoside) and medicine which is used to control blood pressure and arrest the frostile gangrene (Mondal et al., 1992). The fertility of soil is increased if it is used as a organic matter or green manure in the time of land preparation [4]. As a smart crop, buckwheat can be intercropped with crops such as potato, soybean, sunn hemp, millet, safflower, sunflower etc [7]. Generally buckwheat is grown by the north-west region of farmers after harvesting of wet land rice. But there is a shortage of information about buckwheat cultivation and management practices. So there is immediate need of a variety with production technology. In Bangladesh, Buckwheat expansion, popularity and demand are low even in the presence of high nutrient rich crops. Different factors such as agronomic, technological and ecological factors hamper the cultivation of buckwheat. Moreover as rice based country, farmers are more interested in rice and vegetable cultivation. But some farmers of northern region are cultivated local buckwheat for medicinal purpose but not used in food processing. Besides no developed variety has not yet released in Bangladesh, so farmer are not aware of their cultivation practice. Buckwheat has very poor agronomic traits when compared to the country's major crops and even minor crops. Because of indeterminate crop and high shattering tendency results in low yield. And this is the major problem to survive with other crops. Besides agronomic traits some genetic character i.e self incompatibility hampers buckwheat breeding and other improvement program. Due to crossing problem, conservative knowledge and lack of collaborative program expansion, cultivation and production of underutilized crop is limited in good agronomic farming system [12].

6. FUTURE PERSPECTIVES

Minor cereals cannot completely replaced by staple foods but can provide nutritional security alongside major crops. Due to low yield of buckwheat and less use in food processing, the farmer cannot get the expected price. So they are not interest to grow this crop. Effect of salinity and drought increasing day by day due to climate change impact. As a result most of the land remains fallow in some of areas in Bangladesh. Being a short durated crop buckwheat can be easily cultivated in those fallow lands and also it can be included in Jhum cultivation [8]. As a result the crop will be expanded and the nutritional requirements will be met for the general people. Simultaneously, if we can include them in our daily food habit, our nutrition needs will be guaranteed. Again it is a good source of honey because of its fragrance. A lot of bees are seen at the flowering stage and helps in the pollination. Buckwheat flour can be used in food processing

industry and having a good quality export potentiality. So needs a proper marketing channel and a policy which can change the context of agricultural economy. On the other hand research sector of buckwheat should be emphasized. Therefore, research on molecular breeding of buckwheat should be started in context of Bangladesh. In future, the challenge of food security cannot be ruled out in any way. A well-developed agricultural system needs to deal with population growth and climate change impacts on agricultural production. As a result, it can play an important role in food and nutrition security for the growing population in the future. In that case there is no alternative to food diversification. In this context, nutrient rich underutilized crops should be strengthened. Integrating underutilized crops alongside staple crops will help to address food and nutrition security challenges. With that a strong linkage with national and international institution will be needed to improve or advance the buckwheat research in Bangladesh.

7. FUTURE RESEARCH DIRECTIONS

In context of Bangladesh, buckwheat is a minor cereals and just used in medicinal purpose not as food. But now a days in elite society is very conscious about health, so demand of nutriceals is also increasing day by day. Again three major cereals namely rice, maize and wheat contribute 50% of global dietary supply and 12 crops contribute 75% of world food supplies (FAO 2005). Therefore research on diversified nutrient rich crops should be emphasized in addition to major crops to ensure food security as well as nutritional security. So attempt have been made to start buckwheat research activities. Development of base population, mutation breeding research for creating variation, nutrition analysis research, evaluation of buckwheat in multilocation for stability, screening of buckwheat genotypes for biotic and abiotic stresses under managed stresses are being done for buckwheat research advancement and also germplasm collection should be continuously strengthened. Better varieties and technology are needed to increase awareness at farmer's level. Therefore existing problems of buckwheat cultivation should be minimized and expansion should be increased through development of improved technologies. As a short durated crop buckwheat can be produced easily and can easily fit in the cropping pattern in Bangladesh. Again, molecular biology techniques should be applied for strengthening of buckwheat research advancement in future. Therefore, capacity of human and infrastructure, better marketing channel should be increased and breeding activities in Bangladesh should blurred on certain problems in different climatic condition through conventional and molecular breeding [12].

8. CONCLUSION

As a underutilized crop buckwheat is not popular crop in our country but familiarity is gaining day by day to health conscious people because of its nutritional and medicinal value. Within

these five years, I first explore the possibility of buckwheat breeding and one variety would have been released. Since it is considered as a minor crop and very low number of researchers involved, so the progress of buckwheat research have not been advanced yet in Bangladesh. So, availability and the use of buckwheat crop is not very common. But in near future the expansion of buckwheat is expected because of its nutritional and medicinal value. Therefore, research directing on stable and high yielding variety are necessary which could be achieved through accretion of fundamental knowledge of buckwheat and development of molecular breeding method.

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