Buckwheat (*Fagopyrum esculentum*)– a Potential Coarse Grain Crop for Food and Nutritional Security

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Abstract

Buckwheat (*Fagopyrum esculentum*), one of the traditional, underexploited crop having food value, can be grown in harsh climatic condition. Tender shoots, flowers, green leaves, seed and flour of buckwheat is consumed in many ways. The crop can be grown in varied soil and climatic conditions. Buckwheat is a rich source of protein and carbohydrate while crude fat, fiber and minerals content in buckwheat is comparatively higher than common cereal crops. Buckwheat has excellent protein quality in terms of amino acid composition. It contains the high value for lysine (300 mg g^{-1} N) followed by other cereal grains. It contains considerable amounts of vitamins B_1 and B_2. It is virtually fat free and total lipids in seed ranged from 1.5-3.7%.

1. Introduction

Buckwheat is one of the traditional under exploited crop which has highfood value, can be grown in harsh climatic condition. It has its origin in temperate central Asia. The range of distribution of buckwheat extends from the mountainous regions of Pakistan to India, Nepal, Bhutan and Myanmar. It is also grown in China, Japan, Korea, Iran and Afghanistan. In India, the crop is grown on commercial scale in about 1500 ha in the Himalayan region from Jammu and Kashmir in the West to Arunachal Pradesh in the East.

Buckwheat is a broad leafed herbaceous annual plant. It belongs to the family Polygonaceae, which is generally referred to as the buckwheat. However, as its seeds structurally and chemically resemble the cereal grains, buckwheat is usually handled and classed with cereals and is often referred to as *pseudocereals* due to its ways of cultivation and utilization. It is a multipurpose crop.

2. Species

Only two species, viz. *Fagopyrum esculentum* (common/sweet buckwheat) and *F. tataricum* (tartary/bitter buckwheat) are largely cultivated and consumed as food. The vernacular name for common buckwheat is *ogal, ogla, kathu* and *kuttu* and for tartary buckwheat *phaphra, phaphar* and *chabri*. However, both types are collectively known as *bhresh* or *bhresha.*

3. Forms of Consumption

The tender shoots are used as leafy vegetables (Saag) and in pakoras. The flowers and green leaves are Buckwheat flour used for extraction of rutin (glycosides) used in medicine. The flower of common buckwheat produces very good quality honey. The seed is used in a number of culinary preparations and alcoholic drinks. In Western countries, the flour is mixed with wheat, rice or maize flour to form pancakes, biscuits, noodles, cereals etc. In case of Kathu, the grains are heated in boiling water to remove bitterness before making food products. In the hill regions of India, flour is mixed with wheat and barley flour for making *chapati,* stuffed *parathas* and sweet preparations (*halwa*). Flour is popularly known as *kuttu ka atta* and sold at premium prices during religious fasts. The brew locally called *pechuwi, chang, ghanti* made of buckwheat have medicinal properties and popular among hill people. The tartary buckwheat flour and groat must be used fresh because it becomes rancid very soon due to relatively high fat content. The crop help in soil binding and check soil erosion during rainy seasons and is a good green manure crop as well as smother crop.

4. Soil and Climatic Condition

Buckwheat requires moist and cool temperature climate and is widely grown between 500-4200 m above sea level. Tartary buckwheat (*Fagopyrum tartaricum*), a wild species is better

Buckwheat Seed

Buckwheat flower

Buckwheat flour

adapted to higher altitudes compared to common buckwheat. It thrives best on well drained sandy soils, but can also grow on very poor soils, under cold arid and variable climatic conditions. It has a capacity to thrive in infertile, poorly tilled land under favourable climatic conditions. It is tolerant to acid soils. However, it is sensitive to high temperature and hot dry winds, particularly when moisture is scarce.

5. Cultivation Practices

5.1. Sowing time: Optimum time of sowing of crop plays an important role in determining the performance of crop. The sowing time of buckwheat varies from October to November.

5.2. Seed rate: The seed rate depends on the method of sowing, genotype, soil fertility and moisture status of soil. A seed rate of 40-50 kg ha^{-1} is enough for optimum plant density.

5.3. Seed treatment: Seed treatment with Thiram/ Captan @ 2.5 g kg^{-1} seed protects the crop against seed borne diseases.

5.4. Sowing method: Buckwheat is sown either by drilling or by broadcasting. A row spacing of 30-40 cm with a plant spacing of 6-8 cm has been found to be optimum for achieving higher production.

5.5. Varieties: Himpriya, VL Ugal-7, PRB-1, Himgiri.

5.6. Fertilizer Management: Since barley is grown on soils low in fertility and moisture stress conditions, application of manures viz. FYM, organic manures, crop residues etc. improves the water holding capacity and fertility status of the soil. Application of well decomposed compost or FYM @ 10-15 t ha^{-1} at the time of land preparation and mixing in the soil improves the soil condition. In addition to organic manure, NPK @ 40-50 kg N ha^{-1}, 30-40 kg P_2O_5 ha^{-1} and 20-30 kg K_2O ha^{-1} as basal application has been found better.

5.7. Thinning: At 20 Days After Sowing (DAS) the extra plants should be removed to maintained the desired plant population and spacing.

5.8. Water Management: Basically buckwheat is a drought-tolerant crop having limited water requirement. However, providing irrigation is quite useful in increasing yield. The quantity and frequency of irrigation to buckwheat depends on the soils and climatic conditions. Flowering and fruit setting stages are considered as critical for irrigation.

5.9. Weed Management: Since it is a fast growing crop, it can cover the ground very soon suppress weed growth. Weed should be removed 20-30 DAS.

5.10. Earthing-up: It is done to provide support to the crop and to protect it from lodging. Due to heavy vegetative growth, stem of crop become unable to keep in standing position.

5.11. Disease management: Leaf spot, Smut, Stem rot, Brown

Table 1: Comparative food value of buckwheat and cereals

Crops	Protein (%)	Carbohydrates (%)	Crude fat (%)	Crude fiber (%)	Minerals (%)
Buckwheat	10.3	65.1	2.4	8.6	2.3
Wheat	11.8	71.2	1.5	1.0	1.5
Rice	6.8	78.2	0.5	0.2	0.6
Maize	11.1	66.2	3.6	2.7	1.5
Barley	11.5	69.6	1.3	3.9	1.2

Table 2: Essential amino acid profile of buckwheat and important cereals (mg g N^{-1})

Amino Acids	Buckwheat	Wheat	Rice	Maize	Barley
Arginine	570	290	480	290	300
Histidine	130	130	130	160	180
Lysine	300	170	230	200	230
Tryptophan	080	070	080	040	100
Phenylalanine	240	280	280	290	310
Methionine	100	090	150	120	100
Theonine	220	180	230	280	200
Leucine	380	410	500	720	420
Icoleucine	240	220	300	240	240
Valine	370	280	380	300	310

leaf spot, Powdery mildew, Color rot, Downey mildew, Rust etc are major diseases. For *control, s*eed treatment with Thiram/ Captan/ Baviston @ 2.5 g kg^{-1} seed as well as spraying of Mancozeb or Ridomil @ 2 kg ha^{-1} in 500 litre of water are advisable.

5.12. Pest and their management: Major insects' are- bruchids, cut worm, grain moth, aphids, storage beetle etc. Spraying of Rogor 35 EC @ 250 ml in 600 litre water or dimecron 85 EC @ 100 ml in 600 litre water can be effective.

5.13. Harvesting: The crop matures in 75 to 90 days, depending upon environmental conditions. Time and methods of harvesting depends on the nature of maturity. Generally, harvesting is done when 75% of the seeds are ripe, this is important to minimize shatter loss and maximize crop yield (Edwardson, 1996.). Periodic harvesting is also practiced because crop does not have synchronous maturity.

5.14. Yield: Yield varies from 10-15 q ha^{-1} depending on the plant type, fertility status, environmental conditions and crop management practices.

5.15. Storage: Traditional methods are practiced for storage after sun drying. It can be store safely at 14 to 16 % moisture content.

Table 3: Variation in vitamin B-complex content (mg 100 g^{-1}) in buckwheat and major cereal grains

Crops	Thiamine	Riboflavin	Niacin
Buckwheat	0.90	0.34	4.4
Wheat	0.45	0.17	5.5
Rice	0.06	0.06	1.9
Maize	0.42	0.10	1.8
Barley	0.47	0.20	5.4

6. Nutritional Value of Buckwheat

Buckwheat grains are highly nutritious in terms of mineral, protein and amino acids (Dogra and Awasthi, 2009). Potassium, magnesium, calcium, phosphate, zinc and iron are abundant in buckwheat flour (Gopalan et al., 1989a and 1989b). Buckwheat has excellent protein quality in terms of amino acid composition. Buckwheat contained the high value for lysine (300 mg g^{-1} N) followed by other cereal grains. The biological value of buckwheat grain protein is also superior to many other food stuffs/ grains and is almost comparable to milk (casein) protein and egg protein. As such grains can serve as a rich source of good quality protein to be useful for supplementing with pulses/ lysine deficient diets. It contains considerable amounts of vitamins B_1 and B_2 (Table 3). It is virtually fat free and total lipids in seed ranged from 1.5 to 3.7% (Gopalan et al*.,* 1989c).

7. Medicinal Features or Nutraceutical Utility

Besides being staple food of various tribal and ethnic communities residing in the high lands of India, Bhutan and Nepal, buckwheat has many other uses such as medicinal, industrial, animal feed, green manure, and smoother crop. Buckwheat as important nutraceutical crop worldwide is enumerated below:

- Rutin, a flavanoid which occurs in concentrations of 3-6% on dry weight basis, is the most important ingredient of buckwheat. It keep capillaries and arteries strong and flexible resulting in a decreased incidence of vascular complications such as retinal haemorrhage, apoplexy and coronary obstructions, Sterols in buckwheat prevent cholesterol from increasing in the blood serum. It has also been found preventative against high blood pressure or hypertension. Regular consumption of 30 g of buckwheat has been shown to lower blood pressure regardless of other factors such as age and weight.
- It has also shown effect in lowering level of blood sugar. Its noodles finding great market in China and Japan for treating diabetes. Buckwheat grain is digested more slowly than other carbohydrates, thus people feel full for longer times and reduces the urge to snack. The slow

uptake also prevents adult-onset of diabetes, as well as improves glucose tolerance in those who have developed the disease.

- Buckwheat contains choline, which facilitates the working of the liver. It contains considerable amount of vitamin B_1 and B_2. B_1 is important in rekindling energy by facilitating the working of the nerves.
- Antioxidant activity is a functional property of a living organism important for sustainable life. Many of the biological functions such as antimutagenity, anticarcinogenity and antiageing, among others, originate from this property. Potential antioxidants such as tocopherols and phenolic substances namely 3-flavanols, rutin, phenolic acids and the derivatives are present in adequate amounts in buckwheat.

8. Conclusion

It is clear that in spite of amazing nutraceutical potential, the grains/ edible plant parts of this underutilized crop still need to be promoted for large scale cultivation. Sincere efforts are thus solicited to create awareness to popularize buckwheat as one of the enriched coarse grain crops for food and nutritional security of human beings, livestock and poultry industry.

9. References

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