

BUCKWHEAT (*Fagopyrum* spp.)

Buckwheat a Nutri-cereal

Buckwheat is an important crop of the mountain regions at elevations above 1400 m amsl for grain and green leaves. In the higher Himalayas, up to 4500 m, this is the only crop which can be grown successfully. There are two species of buckwheat cultivated in the Himalayas hills (*F. esculentum* and *F. tataricum*). Buckwheat belongs to the family Polygonaceae which are distinct from the monocot cereals (Family, Poaceae) and belong to the category of dicot pseudo-cereals. Buckwheat is also grown as a cover crop to smother weeds and improve the soil fertility. The crop seems to improve soil tilth, and is reported to make more available phosphorus, possibly through root-associated mycorrhizae. Buckwheat flowers profusely, making it popular with bee keepers and an attractive crop in the landscape. Buckwheat is cultivated primarily to obtain grains for human consumption. It is also grown for livestock and poultry feeds. The hulls are often used for stuffing pillows. The protein is high quality due to its high lysine content, which is normally deficient in cereal products. Buckwheat is a health food because it is rich in essential nutrients including protein and mineral. It is known to contain various anti-oxidative compounds such vitamins B₁, B₂, and E, and phenolic compounds, such as rutin, quercetin, and proanthocyanidines (condensed tannins).

Climate

Buckwheat is normally a plant of cool, moist, temperate region. It is sensitive to high temperatures and hot dry winds especially when moisture is scarce. Flowering at temperatures above 30°C is accompanied by desiccation of fruit and lowering of yield. Low soil moisture levels during the periods of high temperatures can aggravate the situation. Adequate soil moisture level seems essential throughout the growing season. Buckwheat can be severely damaged by late spring or early fall frost. Buckwheat grows well under a wide range of conditions but tends to lodge when subjected to high winds or heavy rains and when grown on very fertile soils. Tartary buckwheat is a hard plant and useful in short season climates and poor soils. It stands well both in heat and cold better than common buckwheat.

Soil

Buckwheat grows on a wide range of soil and fertility levels. Buckwheat has higher tolerance to soil acidity than any other grain crop. It is best suited to light to medium textured, well-drained soils such as sandy loams, loams and silt loams. It does not grow well in heavy, wet soils or in soils that contain high levels of limestone. It produces a better crop than other grains on infertile, poorly drained soils if the climate is moist and cool. It is an efficient crop in extracting phosphorus of low availability from the soil. In addition, soils high in nitrogen, lodging may occur and cause a reduction in yield. Once

lodged, a buckwheat plant does not return upright. Crusting on clay soils may result in an unsatisfactory stand because of poor seedling emergence.



Photo – Buckwheat field in Sikkim



Photo – Buckwheat flowers

Field preparation

Buckwheat can grow well only after one ploughing and on land that has recently been cleared for cultivation. Field is prepared by one deep ploughing followed by two harrowing/tilling and planking results in good germination and uniform stand of the crop. It may also help the crop to achieve higher rate of establishment and early growth. Being a cover crop, it does not require extensive land preparation and can grow well on poorly tilled soil.

Recommended varieties: Local cultivars Mithey, Tithey, PRB-1, VL-Ugal and Sangla B-1

Seed rate and sowing

Healthy and disease-free quality seed should be selected for sowing purposes. The growing season in the State varies due to varied altitudes and rainfall pattern. The sowing time of buckwheat mainly depends on agro-climatic conditions and altitude in Sikkim. Generally, the seed should be sown in mid altitude after harvesting of *Kharif* crops particularly in the month of October to November. However, it may be grown in any

season in Sikkim in view of its natural ability to grow well throughout the year. For leafy vegetable purpose it can be grown from February to October under controlled conditions.

The seeding rate varies from 35-40 kg/ha for a grain crop. It is about 50 kg/ha when buckwheat is grown as a cover crop/fodder crop/vegetable crop. In buckwheat, higher seed rate is generally used to promote faster canopy development and higher population for better weed control. Buckwheat should be placed at 3 to 5 cm deep in line and kept 30-45 cm row to row spacing and 10-15 cm from plant to plant spacing depending upon varieties. Thinning may start at 15-20 days after sowing to kept proper space. The crop emerges usually within 4-5 days.

Organic nutrient management

Farmers of the state generally grow buckwheat on residual fertility without adding other nutrient input. However, it removes 47 kg nitrogen, 22 kg phosphorus and 40 kg potassium from the soil for each hectare planted and gives a yield of 1600 kg/ha. Buckwheat does not well respond to the nitrogen fertilization hence, nitrogen should be applied on soil test value. High application of nitrogen can create weed pressure, encourages excessive vegetative growth, causes lodging, and decreases grain yield. ICAR-NOFRI (earlier ICAR Sikkim Centre) recommends application of Azophos seed treatment + mixed compost @ 5 t/ha+ neem cake @ 0.5 t/ha for obtaining good crop yield. *Azospirillum* spp. and *Azotobacter* spp. thrives well in acidic soils of Sikkim and their combined application resulted in better buckwheat productivity and positively influenced the soil biological properties (Singh *et al.*, 2015)

Water management

Generally, buckwheat is grown as rainfed crop in Sikkim. However, the most critical stages are pre-flowering and pod formation stage for buckwheat.

Weed management

Very limited options are available for weed control in buckwheat under organic farming situation, hence, it may limit to certain cultural and mechanical practices. Although buckwheat plants are very good competitor for weeds and generally fast growing capacity makes them a smother crop. Under such conditions, one weeding and hoeing at 20-25 DAS is helpful for raising a good crop. Firstly, the crop should be seeded into a fine, firm and weed-free seedbed. Secondly, the seed should be placed into moist soil to ensure quick germination and emergence. These practices help the crop compete with any emerging weeds. ICAR-NOFRI (earlier ICAR Sikkim Centre) standardized the use of bio mulches in buckwheat crop. Maize stover + weed biomass mulch not only reduces the weed population but also enhances the water use efficiency in buckwheat.

Hilling

Buckwheat tends very heavy branching capacity and weak stems, which makes them susceptible to lodging. The plants lodge easily and thus hilling at 30-35 DAS stage is required. Lodging is dependent on the plant population and on gaps between the plants. Therefore, in buckwheat it is recommended that plant population should be kept at optimum so that yield should not be reduced due to lodging.

Insects and diseases

Buckwheat is normally a cold tolerant crop and is not attacked by many diseases or pests. However, a number of diseases and pests have been reported on this crop. The major diseases and pests have been recently reported by Joshi and Paroda (1991). The diseases are leaf spot (*Septoria polygonicola*), smut (*Sphacelotheca jagopyri*), root and stem rot (*Phytophthora jagopyri*), brown leaf spot (*Ascochyta italica*), powdery mildew (*Erysiphe polygoni*), rust (*Puccinia jagopyri*), root and collar rot (*Sclerotinia libertianai*), root rot (*Fusarium* spp.), stem rot (*Botrytis cinerea*), chlorotic leaf spot (*Alternaria alternata*), downy mildew (*Peronospora ducumeti*) and major pests bruchids (*Acanthecelids obtectus*), grain moth (*Cephitinea* spp.), cut worm (*Cirphis* spp.), storage beetles (*Mycetophagus* spp.) and aphids. Attacks of several viruses also cause reduction in plant height and losses in grain yield. Bird damage, particularly by doves has been observed in this crop.

Insects

1. Aphids

There is no major insect pest in field but sometimes aphids may cause considerable loss. Aphids are small, soft bodied insects on underside of leaves and/or stems of plant; usually green or yellow in colour. Heavy aphid infestation causes leaves to yellow and/or distorted, necrotic spots on leaves and/or stunted shoots; aphids secrete a sticky, sugary substance called honeydew which encourages the growth of sooty mold on the plants.

Management

If aphid population is limited to just a few leaves or shoots then the infestation can be reduced by pruning out. In case of heavy infestation petroleum oil-based spray @ 7 ml/l or neem oil (1500 ppm) @ 3 ml/l can be sprayed for effective management of aphids. In Sikkim, the population of Syrphid fly and lady bird beetle is abundantly available in buckwheat crop to control aphid population to some extent.

2. Stored grain pests

Buckwheat is damaged by a complex of weevils, the rice (*Sitophilus oryza*), granary (*Sitophilus granarius*), and maize (*Sitophilus zeamais*) weevils during storage.

Management

Prevention is the best strategy to avoid insect problems in storage of buckwheat grains. Proper drying of grains is necessary to reduce infestation. Before introduction of new grain the old storage bin should be cleaned properly. Good sanitation involves the removal of old grain from corners, floors, and walls of the grain bin. After the bin is cleaned, and all needed repairs have been made, the floor and wall surfaces both inside and outside the bin should be treated with neem oil (1500 ppm) @ 5 ml/l and grains should be stored after proper drying of bin.

Diseases

1. Downey mildew (*Peronospora ducometi*)

Symptoms - It occurs during February to April. This fungus mainly affects the leaves of younger plants. Under moist conditions, sparse, hyaline to light gray sporulation developed on the abaxial leaf surface followed by defoliation. The pathogen overwinters in seed and plant debris left on the field. Oospores surviving on the infected plant debris serve as primary source of infection. The secondary infection through windborne sporangia and splashing rain.

Management

Allow good air circulation by maintaining optimum plant population and by removal of weeds. Removal of infected plant debris. Selection of seeds from disease-free plants. Plant buckwheat seed when soil temperature is 15°C or above. Treat the seeds using *Trichoderma viride* @ 4 gm/kg of seeds. Soil application of *Trichoderma viride* @ 2.5 kg mixed with 25 kg well-decomposed FYM.

2. Powdery mildew (*Erysiphe oligony*)

Symptoms - It occurs during December to March. Disease starts as white blotches on the leaf. The blotches become more apparent during seed fill resulting in necrotic areas. The affected portion of the leaves show necrosis and finally dry and fall off. White powdery growth on the leaves, flower and stem. Primary source of infection the mycelium surviving under the hull of the buckwheat kernel after having grown in the flower of preceding generation.

Management

Selection of seeds from disease-free plants. Application of wettable sulphur @ 0.25 per cent.



Photo – Downy mildew (left) Powdery mildew (right)

3. Aster Yellows (Aster yellows phytoplasma)

Symptoms - Phytoplasma disease where flowers become small, sterile and green. It affects very few plants in a field. Aster leaf hopper serves as the vector for the disease

Management - There is no preventive treatment and the disease does not affect the buckwheat yield. Buckwheat should not be rotated with Aster yellows susceptible hosts like carrot, lettuce. The vector can be managed by using petroleum oil-based spray @ 7 ml/l or neem oil (1500 ppm) @ 3 ml/l.

4. Stem rot (*Sclerotinia sclerotiorum*)

Symptoms - The disease initiates as small brown spots on leaves. Stem turn pale in colour and become dehydrated. Seeds fall off easily and stem eventually collapses. The pathogen survives as sclerotia in soil up to five years.

Management - Avoidance of soils which are shaded, moist and cool. Canopy and plant population management especially during flowering time. A minimum of 2-3 years crop rotation with non-host or non-susceptible crops such as maize, barley, and oats will reduce the pathogen population. Avoidance of excessive irrigation. Spray of copper oxychloride @ 0.25-0.3% in the initial stage of disease to prevent spread. The fungus *Coniothyrium minitans* has been identified as bio-control pathogen of *Sclerotinia sclerotiorum* and is to be incorporated in soil up to depth of 2 inches and minimum three months before the expected time of infection.

Harvesting and threshing

Timely harvesting of buckwheat is essential to prevent shattering of grains. Generally late harvesting was observed in high altitude while early harvesting was done in the mid and low altitude areas. Yield of 12-14 q/ha is expected from well managed crop. The plant shows irregular time of maturity because of indeterminate growth habit. If the harvesting

is delayed, shattering will start which may cause huge loss. Careful handling of the crop is very important because grain shattering results in losses up to 25 per cent. Due to its gradual formation and maturity, harvesting is done periodically and finally the crop is cut and then threshed when the rest of the seeds are fully matured. The harvesting period is not limited in Tartary (*Tithey*) buckwheat (*F. tataricum*) as compared to common (*Mithey*) buckwheat (*F. esculentum*). The '*Mithey*' type matures earlier than '*Tithey*' type. After harvesting the seeds must be well-dried and kept at about 14 per cent or less moisture for the safe storage of buckwheat grains. Over-matured seeds when in contact with high moisture, germinate very quickly as the seeds have vivipary characteristics.