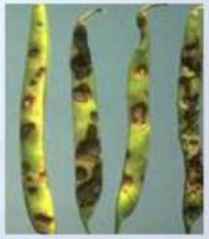
leaves and grown up larva may feed on pods also. Adult moth is brown in colour. Spraying of *neem* formulation @ 3ml/L is done to avoid egg laying of moths and killing of young larva.

Pod borer (*Helicoverpa armigera*): Larva is usually greenish or brown and found feeding by making circular bore holes on fruits. The larva remains partly out of the fruit hole while feeding. Adult moths are brownish and lay eggs singly in the growing tips. Planting marigold at the sides of the french bean field attracts the adult female moths to lay eggs on marigold flower, thus act as a trap crop. Release of *Trichogramma* sp. (1 card/200 m^2) is recommended (3-4 releases at 7-10 days interval). Installation of pheromone traps (Helilure®) @ 12 per ha attracts and capture adult male moths leading to pest management. Placement of bird perches 15-20 per ha should be done to invite insectivorous birds. Spray of 5% *neem* seed kernel extract against early instar larvae. Spray of Bt 2g/ L for the larval management.

Disease management

Rust (*Uromyces appendiculatus*): Rust-coloured pustules form on the lower leaf surfaces. Severely infected leaves turn yellow, wilt, and then drop off of the plant. The french bean crop should be grown in sequence with non-host crops. Plough under infected crop residues. Date of sowing and irrigation schedule should be adjusted to avoid long period of leaf wetness, when temperatures are warm. The level of organic manure should be adjusted to avoid over application of nitrogen and to ensure adequate potassium fertilization. Foliar spray of *Trichoderma viride* @ 5.0 g/litre of water is found effective.

Anthracnose (*Colletotrichum lindemuthianum*): Symptoms of anthracnose can appear on any plant part. Lesions on leaves are dark brown. On stems, lesions are elongated and sunken. On the pods, the fungus produces black, sunken lesions. These lesions penetrate deep into the pods and may cause shrivelling of the young pods. Infected seed become discoloured changing to yellow through brown to black and sometimes entire plant dies. Healthy seed should be used to control anthracnose in french bean. Seed treatment with *T. viride* @ 5g/kg seed and *Pseudomonas fluorescens* @ 10g/kg seed showed promising results in the control of anthracnose in french bean.



Angular leaf spot (*Phaeoisariopsis griseola*): The symptoms appear on all aerial parts of plant including leaf, stem, petiole and pods. It consists of small dark brown spots with angular edges and are often numerous to give the foliage a checker-board appearance. The spots may increase in size, join together, and cause yellowing and necrosis of the affected leaves. This may lead to premature defoliation. Use healthy seeds and follow crop rotation in affected areas. Treat the seeds with bioagent *Trichoderma viride* @ 4g/kg seed.

Dashparni extract is useful to manage all kind of insect-pests. 5-6 litres of *dashparni* extract is diluted in 250 litres of water for spraying one ha crop area.

Harvesting, threshing and storage

French bean is harvested in pod stage for vegetable purpose. Crop will be normally ready for picking by 40 to 50 days after sowing depending on the variety and season of cultivation. The pods are harvested in immature and tender stage, which are ready for harvest within 7–12 days after flowering. Pods are harvested when they attain full size and are crisp. A yield of 18-20 tons/ha can be obtained from a good crop. The pod yield was influenced the most by the number of pods/plant. In bush varieties, 2 or 3 harvests are made and in case of pole type variety, 3 to 5 harvests are made. Marketable pods should be carefully removed, so that the pods are not damaged and there should not be injury to small pods. Harvesting should be done during cool periods, such as late afternoon or early morning. Immediately after harvesting, shift the harvested produce to shade.

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Organic Management of French Bean in Hills

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French bean is one of the most popular and widely grown leguminous vegetables cultivated in north-western Himalayas (NWH). It is also called snap bean, kidney bean, navy bean, field bean, bush bean, etc. The green immature pods are cooked and eaten as a vegetable. It is very rich in protein, vitamins, minerals and crude fibre. The mineral matter and crude fibre are concentrated in seed while crude protein and energy are stored in the cotyledons. It contains about 1.0-2.5% protein in the green pods, 3.2-5.0% mineral matter, 4.2-6.3% crude fibre, 1.2-2.0% crude fat and 340-450 kcal energy besides about 61.4% carbohydrates, 3.8 g ash, 425 mg phosphorus, 13.7 mg calcium, 16.7 mg iron per 100 g of edible parts. It also provides carotenoids like beta–carotene, neoxanthin, lutein and violaxanthin. It also contains antioxidant and hence helps our body to rid away of harmful radicals and also benefits our cardio-vascular system. They are rich source of dietary fiber, which protects the mucosa in the colon by reducing exposure to toxins. It is rich source of zea-xanthin, a dietary carotenoid which gives protective UV filtering function. It has humongous health benefits and should be an important supplement of our diet.

It is a short duration crop and farmers get more profit in a short period. Tender pods of french bean for vegetable purpose can be harvested at about 55-60 days after sowing. In this region, it is cultivated during spring-summer and autumn season. It is traditionally a crop of temperate region. It is cultivated in hilly tract of Jammu & Kashmir, Himachal Pradesh and Uttarakhand.

People throughout the world as well as in NWH are more interested for organic products because of the perceived health benefits. Organic production of french bean can provide sustainable higher yield compared to chemical.

Types of french bean

The french bean is grouped into two according to the growth habit – pole or climbing type and bush type, which are dwarf in nature. Generally, bush type is cultivated in the NWH.

Climate

French bean is a day neutral, warm season vegetable that cannot tolerate frost. Its seed do not germinate below 15°C and plants drop blossoms in hot or rainy weather. A mean air temperature of 20-25°C is optimum for its growth and high pod yield. Extreme high temperatures interfere with pod filling, while low temperatures are for vegetative growth. A favourable soil temperature is 18-24°C. The organic management of crop moderates the soil temperature up to 3-5°C during the peak summer. It helps the french bean crop for better growth and higher pod yield by providing optimum temperature.

Soil

French bean is grown over a wide range of well-drained, alluvial friable soils, but it cannot withstand extreme acidic and alkaline soils. Clay soils impede the emergence of seed leading to uneven or poor stand. The optimum soil pH is 5.5-6.8. For optimum nitrogen fixation, good soil aeration is required.

Field preparation and level of organic manure

French bean requires fine seedbed with least clods. One deep ploughing or disking, followed by cross ploughing and 2 harrowings are sufficient. For preparation of field without the availability of deep ploughing or disking equipment, soil is ploughed 2-3 times with power tiller or with spade or bullock-drawn plough. Planking is done during the last ploughing to make friable seedbed for sowing. For better seedling establishment, there should be sufficient moisture in the field. Land is ploughed to a fine tilth and divided into plots of convenient size. Well decomposed FYM @ 25-30 t/ha should be applied during final ploughing.

High yielding variety suitable for organic farming

There are number of high yielding varieties suitable for organic farming in the NWH. Generally, the short duration varieties, which are ready for picking within 45-60 days, are suitable for cultivation in the NWH. Farmers prefer bush type of bean for cultivation.

Types of french bean	Variety
Bush type	VL Bean 2, VL *Bauni* Bean 1, Contender, Pusa Parvati, Pant Anupama
Pole type	Pusa Himalatha

Sowing Time

It is generally cultivated during spring-summer and autumn season in the NWH. The second fortnight of March to first fortnight of April is the optimum time for sowing spring-summer sown crop. If the sowing is delayed beyond mid-April, then fruiting will coincide with monsoon rainfall and there will be heavy loss in pod yield. For autumn crop, the sowing must be completed by August 10. If the sowing is delayed beyond August 10, then the pod yield drastically decreases due to prevalent low temperature during pod development. Generally, farmers prefer for spring-summer sowing in the NWH, because of suitable temperature for better growth and pod yield. The vegetative and early reproductive stages of autumn sown crop coincide with monsoon rain. Hence, the yield is drastically reduced, as the crop is highly susceptible to waterlogging.

Seed rate and spacing

A seed rate of 75-80 kg per hectare (1.5-1.6 kg per *nali*) is sufficient for french bean cultivation. The crop should be sown with a spacing of 30-45 cm (row to row) × 8-10 cm (intra-row) for higher yield.

Seed treatment

The seed inoculation with *Rhizobium*, phosphate solubilizing bacteria (PSB) (*Pseudomonas fragii*) and plant growth promoting rhizo-bacteria (PGPR) (PGERS17); and soil application of arbuscular mycorrhiza (*Glomus fasciculatum*) enhance the grain yield. The *beejamrit* (prepared from indigenous cow dung, lime, undisturbed soils from forest and indigenous cow urine) can also be used as seed treatment. The seeds (1.5-1.6 kg per *nali*) should be made wet by sprinkling water 2-3 hours before sowing. Then, seeds are inoculated with 15-20 g each of *Rhizobium*, PSB and PGPR and kept on newspaper for drying in shadow. It is better to sow seeds of inoculated french bean during evening hours. The inoculated seed should neither be dried nor sown during bright sunshine.

Depth of sowing

French bean should be sown at a depth of 4-5 cm. The cotyledons cannot emerge properly, if seeds are placed more than 5 cm deep in the soil. If seed is placed deeper than 5 cm or there is crust formation just after sowing, the seed germination may be delayed and may result in a poor crop stand. Shallower depth may not get sufficient moisture for germination and hence poor plant density of crop.

Method of sowing

Ridges and furrows are prepared by ploughing after a basal dose application of farmyard manure. Field is irrigated once and seeds are sown under optimum moisture condition on side of ridges 2-3 days after irrigation. About 2 quintal of FYM (4 kg FYM/*nali*) mixed with 50 g *Trichoderma harzianum* and 200 g *Bacillus cereus* strain WGPSB-2 powder should be incorporated into the soil during field preparation to avoid fungal disease and white grub infestation, respectively. Sow the seeds (2 seeds/hill) in lines or in beds at a spacing of 30-45 cm × 8-10 cm.

Crop management

Spraying of *jeevamrit* @ 500 litres per ha twice a month enhances the yield. Spraying of 3% *panchagavya* and vermiwash enhances the soil health and pod yield. One earthing must be provided at 30-35 days after sowing to avoid lodging.

Water management

The crop is most sensitive to water deficit during flowering and fruit development. For the good crop growth, well timed furrow irrigation is effective. Wilting in the late morning indicates that the crop should be irrigated. The crop is sown with pre-sowing irrigation. As a general rule during the dry season, irrigate at an interval of 5-6 days for the first month after sowing, and then every 9-10 days interval until crop completion.

Weed control

Since french bean is grown under assured moisture conditions frequent irrigations provide congenial condition for luxuriant growth of weeds. As a result, seasonal weeds offer severe competition to the crop particularly during initial stages of growth. Weeds can be effectively controlled by hand weeding twice at 20 and 35 days after sowing. It will help in loosening the soil and provide aeration to root also.

Insect management

French bean semilooper (*Trichoplusia* sp.) : The larva is green in colour and makes loops while moving. It feeds extensively on