

BERSEEM:

Berseem (*Trifolium alexandrinum L.*) is *rabi* season leguminous fodder crop and also called king of the fodders. It is one of the most suitable fodder crops with irrigation facilities. It remains soft, nutritive, palatable and succulent at all stages of growth. The significance of this forage species lies in the development of milk industry. It appeared to behave as a most potent milk multiplier in the lactating cattle as compared to other forage crops alone or in combination. Of the two Egyptian biotypes of Berseem 'Mescavi and Fahli' introduced in India during 1903. Most of the present day cultivars are derivative of Mescavi. The merit of these cultivars lies in their multicut nature (4-8 cuts), long duration of fodder availability

(November to April) and very high green fodder yield (85 t/ha), better quality, high digestibility and palatability. The phenomenal success of Berseem in India is also due to its

high nitrogen fixing ability resulting in substantial improvement in soil fertility. *T. alexandrinum*, possesses moderate tolerance for salinity and can be used for the reclamation of saline soils. The fodder is rich in crude protein 20-24%, calcium 3%, phosphorus 0.4%, and digestible dry matter 65-70 percent. It can be mixed with wheat bran to increase its palatability and contents. Paddy-Berseem crop rotation is used in reclaiming saline soils. The last cut of the berseem is generally not taken as fodder, but is ploughed into the soil, which acts as green manure to the soil and adds approximately 224 kg of nitrogen to the soil. Berseem can be converted into good hay during March and April and is used after 2- 3 months when no other fodder is available for animals. Powdered berseem hay is mixed with concentrates and is used as feed to poultry birds. Berseem clover's greatest potential is probably as green-chopped forage or pasture.

Origin: Berseem is believed to be indigenous to Egypt. It is being cultivated in Egypt, Israel, Syria, Persia, Cyprus, Italy, South Africa, South America, Australia, Pakistan and many other European countries. It was introduced into India from Egypt probably in 1904. It has now been established as one of the best *rabi* fodder crops in irrigated areas of Punjab, Rajasthan, Uttar Pradesh and other parts of western and northern India.

Climatic requirement: Berseem requires a dry and cool climate for its normal growth. It needs temperature around 13 to 15.5 °C temperature for germination and establishment. The crop growth is very fast at 18-21 °C. Frost period during winter checks the crop. Frost period during winter makes the crop dormant and no regeneration is recorded. Similarly when temperature goes around 32-35°C re-growth after cut may not be possible. It can not be grown in damp and heavy rainfall areas.

Soil requirement: Berseem can grow in all types of soils except very light sandy soil. The soil should be well drained, rich in phosphorus, calcium and potash. It does not grow well in acid soils but grows successfully in alkaline soils having good water retaining capacity. The land should be well leveled. It does not tolerate water logging. It grows successfully in soil with pH 7 to 8.

Crop rotation: Sometime berseem crop is grown with Chinese cabbage, oats, or mustard. The intercrops grow faster than berseem and add to the first cutting in quantity of fodder produced, subsequently berseem gives sufficient fodder to meet the requirements. Berseem grows in rotation with many cereal and forage crops. The most common rotations are:

(1) Maize - Berseem - Cowpea, (2) Paddy – Berseem - Cowpea, (3) Cotton - Berseem, (4) Bajra – Berseem - Cowpea + Maize, (5) Sorghum - Berseem.

Field preparation: Prepare fine compact seed bed. Remove the grass, stubbles particularly doob grass root, as they cause difficulty later on and level the land uniformly. Small sized beds (1/10 or 1/20 of an acre) are finally prepared with bunds before sowing for easy irrigation.

Sowing time: Sowing is to be done in the end of September to end of October by broadcasting. Care should be taken for proper sowing time as late sowing often hampers the fodder yield because the onset of severe and harsh winter interferes with the crop growth in early stages.

Seed rate: Seed rate of 20 -25 kg/ha is recommended. Mix 1 kg of *Japani sarson* / *Chinese cabbage* or 25 kg of oat seed for harvesting higher quantity of fodder at first cut.

Seed treatment: Berseem seeds are sometimes mixed with weed seed i.e. Kasani seed (*Cichorium intybus*). These have to be removed before sowing by putting the seeds in a bucket containing common salt 5% solution. This makes the light kasani seeds to float on the surface and can be removed by skimming. Farmers who grow this crop first time in their fields, which have never been cultivated by the berseem crop before. Such fields do not contain bacteria *Rhizobium trifolli* which live in nodules of berseem crop roots. To inoculate field with the bacteria any of the two methods described here can be adopted.

1. Soak the seed in water for 12 hours (overnight) and spread the seed on the floor to drain the excessive water. Meanwhile prepare the berseem-culture. This is done by mixing the culture to 10% sterilized jaggery solution, at room temperature. Mixed the wet seed with berseem-culture-solution thoroughly and let it dry under shade for atleast one hour before sowing.

2. In case the berseem-culture is not available in the market the farmer can spread 50 kg of soil from the field in which berseem has been successfully cultivated during previous year, in his own field before sowing.

Method of sowing: Berseem seed can be sown in anyone of the two methods described below:

1. Seed is broadcasted uniformly over the field with good moisture content and is mixed with soil over the field. Irrigation is applied only after proper germination has been observed.

2. Field is watered and seed is broadcasted in the standing puddled water. The soil particles suspended in water cover the seeds on settling. This method generally gives good germination and requires delayed irrigation. The broadcasting of FYM or ash after seeding also gives good germination.

Varieties:

Varieties released	Area of adaptation	GFY (t/ha)
Mescavi	Northern and Central India	80-90
Wardan	All India	90-120
BL-1	Punjab and H.P.	100-120
BL-10	Punjab, Haryana and H.P.	110-115
BL-22	Temperate zone of India	90-100
JB-2	Northern and Central India	90-100
Bundel Berseem –2 (JHB 146)	North West and Central zone	58-85
UPB-110	Southern zone	50-65
BL-2	Northern India	65-90
Bundel Berseem –3	North eastern Zone	60-70
UPB-103	Northern, Central and part of South India	100-115

1. **Mescavi:** Tillering is fast and provides 5-6 cuttings. The leaves of this variety are medium in size and no cuts on the margins. Green fodder yield is 750 – 850 q/ha. The seeds of this variety are medium in size and having yellowish appearance and are shining. It gives an additional seed yield of 4.5 – 5.5 q/ha.

2. **Hisar Berseem 1:** It is a new variety and recommended for cultivation in Haryana state. It is fast growing, have more number of leaves, better quality and remains 8-10 days more green than Mescavi. Green fodder yield is 700 – 750 q/ha. It is resistant to stem and root rot.

3. **Hisar Berseem 2:** It is recommended for cultivation in Haryana state. It is fast growing, have more number of leaves, better quality and remains 8-10 days more green than Hisar Berseem 1. Green fodder yield is 700 – 750 q/ha. It is resistant to stem and root rot.

Fertilizer management:

The crop must be fertilized with 20 kg N + 70 kg P₂O₅ /ha before sowing of crop. If the crop is new to the field seed treatment be done with *Rhizobium* culture. If oat seed is mixed with berseem, then an additional dose of nitrogen @ 40 kg/ha should also be added. For obtaining good yield 15-20 tonnes of FYM or compost should be added 20-30 days before sowing & mixed well in the field.

Irrigation management: The first irrigation is very crucial and it must be applied after 3-5 days of sowing in light soils whereas in heavy soils it can be delayed to 8-10 days. Later on irrigate the crop at 15-20 days interval depending upon the climatic conditions. During cold season it requires less irrigation, while in hot seasons it requires more irrigation. Irrigation after each cutting is also beneficial for re-growth.

Weed Management: The crop is infested by a number of weeds like *Asphodelus*, *Chenopodium*, *Convolvulus* and *Chichorium*. The berseem crop is thickly populated crop so weeding is a very difficult process. The weeds also serve as fodder and do not make it necessary to pull them /out, but some weeds like *Cichorium* has low content of protein, silica and crude fibre. as per requirement. The crop usually matures in third week of April.

Diseases management:

Diseases	Causal organism	Symptom	Control
Stem rot	<i>Sclerectonia trifoliorum</i>	Collar region becomes necrotic with depressed lesions. Stems are girdled at the collar region	Avoid excessive irrigation. Spray 0.1% solution of Bavistine twice during January and February at 15-20 days interval. Select disease resistant variety HB 1
Root rot	<i>Rhizoctonia solani</i> , <i>Fusarium semitactatum</i>	Sudden complete wilting of plant within a day. The affected plant can easily be pulled out	Crop sanitation Resistant varieties Seed treatment with Thiram, Bavistine and Carbofuran @ 2.5g/kg

Insect management

Black ants	-	They remove the germinating seeds	Apply Methyl Parathian 2% dust
White grass hopper		It damages the crop in the month of April. During this time more than 90% insect comes from the other crops and damages the crop.	Spray malathion @1 lt/ha in 750 lts of water. If the crop is sown for seed purpose then apply 2% Methyl Parathian dust @ 25 kg/ha.

Cutting management: The crop can be harvested in 55-60 days after sowing and subsequent cuts can be taken after every 30 – 40 days. In all 4-6 cuts are taken with a production of about 750-825 q/ha of green forage .

Seed production: For seed production the last cut is to taken in the first week of March in low moist areas whereas in moist areas in the last week of March. If weeds are present then remove these to avoid contamination specially the kasni weeds. Irrigate the field after 1st cut and given irrigation at 15 days interval. Seeds will mature in the month of May and 4.5 – 5.5 q /ha seed can be harvested. Irrigation should be given to the crop as per requirement depending on soil and climatic conditions. The cutting schedule can also be adjusted in such a way so as to harvest green fodder everyday.

Toxicity: A substance known as 'astrogenons' is present in berseem, the excess of which makes the animal sick and causes bloat disease. The bad effect of this substance is reduced if the fodder is sprayed with linseed or mustard oil. Mixing of dry fodder which contains more fiber like wheat straw also reduces the problem of bloating.

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OAT:

Oat (*Avena sativa* L.) which is also known as *jai*, is a most important cereal fodder crop of winter season. The green plant is good forage and makes good hay and silage. The straw is useful roughage. Grains are used as concentrate for poultry, cattle, sheep and other animals. The grain is an important livestock feed and the unhulled, crushed fruit is the usual form in which it is fed to ruminants and horses. Oat forage, hay, straw and grain are renowned horse fodder. Green fodder contains about 10-12% protein and 30-35% dry matter. It is fed to animals mixed with berseem or lucerne green fodder. Oats grain is used widely for human consumption. The oat grain contains 66% Carbohydrate, 11% dietary fiber, 7% fat and 17% protein. While oats are still widely used for breakfast cereals. Oats have numerous uses in food; most commonly, they are rolled or crushed into oatmeal, or ground into fine oat flour. The cholesterol-lowering properties has led to wider appreciation of oats as human food.

Origin: Oats are a crop of Mediterranean origin, the domestication dates back to ancient times. Oat seeds are reportedly found in 4000 year old remains in Egypt.

Area and Production: Oat rank around sixth in world cereal production statistics following wheat, maize, rice, barley and sorghum. In India it is grown in Punjab, Haryana, Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh, Madhya Pradesh, Rajasthan, Maharastra and Bengal. Oats crop is a heavy yielder and the average yield varies from 45 to 55 ton of green fodder per hectare.

Climatic requirement: Oat can be grown successfully for fodder purpose during rabi season under both irrigated and rainfed conditions. It requires a cool temperature during germination, tillering and booting. High temperature at blooming increases the proportion of empty spikelets. The crop can be grown at temperatures varying between 5^o to 30^oC. However optimum temperature required is 25^oC. Oats can be grown in areas where the annual rainfall ranges from 40-110 cm. Oats flourish in cool and moist climates. At low temperature its germination is delayed, while grain production is hampered by hot and dry weather, especially from heading to grain filling period.

Soil requirement: Oats can be grown on variety of soils. Almost any reasonable fertile, well-drained soil is suited if temperature and moisture conditions are favorable. Oat has been shown to tolerate acid soils with a pH of 4.5 but soil pH up to 5.3-5.7 range for higher yields and is also fairly tolerant to salt conditions. It can be grown on all types of soils except the alkaline and water logged ones. Oats generally make their best growth on loam soils, but produce satisfactory yield on heavy or light soil.

Method of sowing, Seed rate and Time of sowing: It is recommended to take 75 kg/ha seed for small seeded varieties, while for bold seeded varieties the seed rate is 100 kg/ha. It can be planted with kera or pora method depending upon the moisture availability. It is always better to sow the crop with seed cum fertilizer drill by maintaining row to row distance of 25 cm. The optimum sowing time is mid October to mid November.

Varieties:

Variety	Optimum sowing Time	Time of harvest	Recommendation and characteristics	Forage yield (Qt/ha)
Haryana Jai (HFO-114)	Multi cut- October Single cut- November	Feb.-March	It is erect and tall growing. It has good regeneration and is specially suited for multi-cut. Its seed size is very bold.	550
OS-6	November	Feb.-March	It is suitable for all the oat growing regions of the country. It grows erect with more early vigour. Leaves are relatively broad and green in colour. Flag leaf remains erect at the time of emergence of panicle.	575
OS-7	November	Feb.-March	It is suitable for all districts of Haryana. It grows erect with more early vigour. Leaves are relatively broad and light green in colour. Flag leaf remains erect at the time of emergence of panicle.	590
Haryana Jai 8	Multi cut- Mid.October Single cut- November	Ist cut 60-65 DAS and 2 nd cut in Feb.March	Recommended for whole Haryana. Regenerates fast after Ist cut. Its leaves are green and broad. Grains are medium bold.	650

In addition to these the recommended varieties at national level are as follows:

Varieties released	Area of adaptation	GFY (t/ha)
Kent	Whole of India	45-50
OS-6, OS-7	Whole of India	40-50
UPO-212, UPO-222	Whole of India	37-52
OL-125, OL-9	Whole of India	35-48
UPO-94	Whole of India (Multicut)	45-50
OL-9	Northern and North-Western India	45-55
JHO-810	Kashmir valley	50-60
JHO-822	Central India (Multicut)	45-55
JHO-851, JHO 885	Whole of India (Multicut)	50-55

JHO 99-2	NE and NW India	50-55
Pusa oat-1, 3, 5 & Haryana oat-8 etc		

Fertilizer requirement: Seeds must be treated with *azotobacter*. Apply 40 kg N/ha at sowing and 40 kg N/ha at first irrigation. For multicut varieties 40 kg N/ha should also be applied after each cut.

Irrigation management: In general 3-4 irrigations are required. Irrigation should be applied at one month interval. Irrigation is essential after each cutting in order to promote the regeneration of the plants.

Weed management: The vigorous growth habit of oats smothers the most of weeds. A few tall broadleaf weeds, such as ragweed, goosegrass, wild mustard and buttonweed (velvetleaf) can occasionally be a problem, as they complicate harvest and reduce yields. These can be controlled with a modest application of a broadleaf herbicide, such as 2,4-D sodium salt @ 1 kg/ha spray in 500 liter water at 35 DAS.

Disease and pest management:

Diseases/ Insects pests	Causal organism	Symptoms	Control
Covered smut	<i>Ustilago kollerii</i>	Grains in ear of affected plants replaced by black mass of smut spores.	Seed treatment with Emissan @ 2.5g/kg seed
Loose smut	<i>Ustilago avenae</i>	Grains transformed into black powdery mass of smut sori.	Seed treatment with Vitavax or bavistin @ 2g/kg seed
Aphid	<i>Rhopalosiphum maidis</i>	Leaves, leaf sheath and inflorescence are covered with dark green aphid colonies with a slight white covering. Mottling and distortion of leaf may occur.	Spray of plain water @ 400 l/ha Application of malathion or endosulfan @ 0.05% in the patches of aphid colony.

Harvesting: First cutting should be taken when the plants are 60 cm tall and about 50-55 days old and 2nd cutting at the dough stage. Only two cuts should be taken for high yield and quality forage. For satisfactory seed production, the crop should be left for seed after the first cutting which should be taken 50-55 DAS. First cut should be taken 8-10cm above the soil surface for re-growth.

Yield:In case of only forage, the green forage yield obtain about 500-600 Qt/ha. If crop is grown for seed purpose 1st cut forage yield is about 250 Qt/ha and 30-35 Qt/ha seed and 25-30 Qt/ha straw yield is obtained.

LUCERNE: (Rijika or Alfa-Alfa)

Lucerne (*Medicago sativa* L.), known as 'rijika' in northern India, is a perennial leguminous crop and belongs to Fabaceae family, which provide green fodder continuously for 3-4 years from the same sowing. It is generally raised in areas where water supply is inadequate for berseem. Being a deep rooted crop, it extracts water from the deeper zone of the soil. It can be raised both as rainfed or irrigated crop. Generally grown in areas where water supply is inadequate for berseem. Lucerne is relished by all kinds of livestock, because it yields nutritious and palatable green fodder. It is very much liked by the draft animals like horses, which possesses about 20% crude protein with 72% digestibility and 25% fibre. It's green fodder contains 1.5% calcium, 0.2% phosphorous and a considerable amount of vitamin A, B and D. It can also be easily converted into silage and hay. Lucerne supplies green fodder for a longer period (November-June) in comparison to berseem (December-April). Excessive feeding causes "bloat" in cattle. (Excessive volume of gas in the rumen of the animals)

Origin: Lucerne is one of the oldest cultivated fodder crops in the world. It was known to Greeks and Romans in about 470 BC. It is generally believed that lucerne originated in south-west Asia. It was first cultivated in Persia (Iran), the name alfalfa being an Arabic word. From Iran it was taken to Greece in about 500 BC and from there it spread to Italy. Lucerne was introduced in India from north-west sometime in 1900.

Area and production: Lucerne is grown world-wide on 35 mha out of which 8.8 m ha is in USA alone. Besides USA, India, Australia, New Zealand, France, Italy and Russia are other important countries producing Lucerne. In India, lucerne is cultivated in about 1 m ha mostly in irrigated areas of Punjab, Haryana, Uttar Pradesh, Gujarat, Maharashtra and Tamil Nadu.

Climatic requirement: Lucerne is a widely adopted crop. It is cultivated in temperate to tropical regions of world. It thrives best under warm, dry and sunny conditions. High temperature with high humidity is not good for crop. Its plants can withstand fairly low temperature.

Soil requirement: Lucerne can be raised on a wide range of soils. However, well drained fertile soils with neutral pH are ideal. It is very susceptible to acidic soil, therefore, it cannot be grown in soil with pH below 6.5 unless lime is applied

Crop rotation: It is usually raised after harvest of kharif crops, such as sorghum, paddy, soybean, maize, cowpea, clusterbean etc. It can be raised in rotation with almost every grain or forage crop. The most common crop rotations adopted in north India are: Maize – lucerne, Pearl millet – lucerne, Paddy-lucerne, Soyabean-lucerne, Sorghum-lucerne, Cowpea+ maize (fodder)-lucerne, Sorghum (grain)-lucerne-maize (fodder). It can be intercropped with Napier grass also.

Field preparation: Lucerne requires a fine seed bed. There should not be left over residue of the previous crop. The field must be ploughed 2-3 times with harrow before pre sowing irrigation. A leveled field is required.

Sowing time: Best sowing time is last week of October to the first week of November.

Seed rate: A seed rate of 10-12 kg/ha is required for line sowing and 20-25 kg/ha for broadcasting.

Method of sowing: Seeding should be done in rows 30 cm apart at a depth of 4-5 cm in well moist soil. Because of their hard seed coat, seed should be soaked overnight in water before seeding. Like berseem, it must be inoculated with rhizobium culture (*Rhizobium meliloti*), if the seeding is going to be done for the first time in any field. Care should be taken that seed should not go more than 5 cm deep as seed size of lucerne is very small.

Varieties: Type-9, Anand 2, Anand 3, NDRI selection No.1, IGFRI-S-54, IGFRI-S-244, Sirsa No.8, 9, Co-1, Moopa & Rambler etc. recommended for different areas.

Fertilizer requirement: Basal dressing of 25 kg N and 100 kg P₂O₅/ha is required at sowing. The fertilizer must be drilled at a depth of 10 cm. Later on 125 kg P₂O₅/ha must be applied in the month of November in the succeeding years. Being a perennial crop, it is important to apply every year 25-30 qtls FYM/ha/year. The leaves of Lucerne plants develop numerous pale yellow spots leading to disorder known as LUCERN YELLOW spraying of 0.2% Borex could be done to remove this deficiency.

Irrigation management: First irrigation should be applied about a month after sowing. The subsequent irrigations may be given at an interval of 10-15 days during summer, 15-20 days during autumn and 20-25 days interval during winter season. During rainy season water should not be allowed to stagnate.

Weed management: Lucerne takes a long time to establish itself and gives ample scope for weed infestation up to the first cutting. It is very difficult to control weeds in broadcast crop. If crop is sown in lines, weeding and hoeing become easier. First weeding should be done 20-25 days after sowing. Pendimethalin 1-2 kg/ha (pre-emergence) or diquat @ 6-10 kg/ha 5-10 days after sowing effectively controls *Cuscuta*. 'T 9' cultivar is found highly susceptible to this weed. Pre-sowing application of diuron @ 2.0 kg/ha or fluchloralin @ 1 kg/ha controls the weeds in lucerne crop.

Diseases management:

Downey mildew: It appears generally in the month of January. Leaves become light green with light brown growth of fungus on the lower side. Stem becomes short and rolling of leaves may take place. Continue cutting and it will be removed in the next cutting with the increase in temperature.

Rust: The disease appears on small brown spots that are toothed at the outer margins with a black/brown colour at the centre. Rust pustules cause severe yield reduction. It is more prevalent in the 2nd fortnight of March with the increase in temperature to 30°C temperature. Small, round or oval shaped raised lesions which rupture with the touch give rise to brown powder. In severe conditions falling of leaves takes place. For control, spray Dithane M 45 @ 0.25% and repeat after 20 days if required.

Leaf spot (*Pseudopezia medicagenis*): It is an air borne common disease of lucerne severe in north and central India. Diseased plant turns yellow and leaves drop off. Early cut can cure the crop to some extent. Dithane M-45 @ 0.2% or 0.1% Chlorothalonil is effective for its control.

Seed production: Good quality seed can be obtained from 1-2 year old crop. If the crop is sown for taking seed than last cut must be taken in the 1st week of March. For seed, crop must be planted at 45-60 cm row spacing. The harvesting of seed crop is generally done in the end of May or early June. On an average 200-250 kg/ha seed can be harvested. The crop must be irrigated at the time of flowering.

Harvesting: 1st cut at 50-60DAS, subsequent at 20-30 days intervals.

Yield: About 800-1000 qtls of green fodder and 1.75 to 2 qtls of seed /ha

Forage crops are crops on which animals graze independently, or crops that have purposes other than animal feed. Grasses and legumes make up the two broad sources of **forage** livestock feed. Grazing livestock like cows and horses do well with **forage** crops.

FODDER CROPS are **crops** that are cultivated primarily for animal feed. By extension, natural grasslands and pastures are included whether they are cultivated or not. **Fodder crops** may be classified as either temporary or permanent **crops**. The former are cultivated and harvested like any other **crop**.

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