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Linseed: Important Diseases, Epidemiology and their Management: A Review

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Abstract:
Linseed *(Linumusitatissimum* L.), commonly known as flaxseed, is an important crop in India due to its high industrial, nutritive, and medicinal value. However, the productivity of linseed in India is relatively low despite ranking second in terms of cultivation area. One of the major factors contributing to low productivity is the incidence of various diseases. Fungal diseases are particularly damaging to the crop, often causing significant losses ranging from 80 to 100 percent during epidemics. Rust (*Melampsora lini*Erenb), wilt (*Fusariumoxysporum*f.sp. *lini*), powdery mildew [*Oidiumlini*, *Leviellulataurica* (Lev.)] are the major ones. The minor diseases are macrophomina/rhizoctonia wilt/collar rot, sclerotium stem rot, Pythium damping-off, Botrytis rot, Anthracnose and dreschlera blight. The number of seed borne mycoflora are more. Bacterial disease has been reported was aster yellow and among virus *Oat blue dwarf virus* has been reported. Among the pests associated with linseed, nematodes such as *Rotylenchusreniformis*, *Tylenchorhynchusbrevidens*, *Meloidogyne incognita*, *M. hapla*, and*Pratylenchus* species have been reported to cause damage to the roots. Additionally, the phanerogamic parasite Cuscuta, commonly known as dodder, can become a serious problem in certain areas where it infests linseed crops.

Keywords: Linseed diseases, management, symptoms, yield losses

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Introduction

Linseed (*Linumusitatissimum*L.) is a commercially important oilseed crop grown in several countries for its oil and fiber. It is second most important *rabi*(winter) oilseed crop in India. It has various industrial, edible and medicinal uses. Linseed contains around 40 % oil, making it a rich source of dietary fat. The fat content consists mainly of polyunsaturated fatty acids (PUFAs), monounsaturated fatty acids (MUFAs), and a smaller amount of saturated fatty acid(SFAs). Linseed is particularly notable for its high content of omega-3 fatty acids, specifically alpha-linolenic acid (ALA). It contains about 73 % PUFA, 18 % MUFA, and 9% SFA. ALA constitutes about 55 % of total fatty acids in linseed oil. Linseed is a good source of protein, containing approximately 20 % protein. Linseed contains around 30 % dietary fiber. The fibre is two types: soluble and insoluble. Soluble fibersare around 24 % of total fiber content while insoluble is around 75 %. Both type of fiberis beneficial for digestive health and can contribute to a well-rounded diet. Linseed is also a source of various minerals and vitamins, including magnesium, potassium, zinc, and Vitamin-B. It is particularly known for its phytoestrogen content, specifically lignans. Lignans are a type of plant compound that exhibit estrogen-like properties and have been studied for their potential use in breast cancer prevention. India ranked in the linseed area is 2nd (around 15% of the world area) after the China and Canada. Both countries nearly equal in total area. In productions (6-7% of world production) India ranks 3rd after Canada and China. However, the area under linseed cultivation is declining due to its low productivity. Among several abiotic and biotic stresses, diseases are the major one affecting its productivity. Sometimes, they cause 80- 100 per cent losses. Some of the diseases of linseed have been the cause of temporary elimination of the crop in certain parts of the world. The crop suffers from several diseases. Among them rust in hilly and cooler part of the country, Alternaria blight in Northern Indo-Gangetic plains and wilt and powdery mildew in central and peninsular regions cause appreciable yield losses if they appear in epidemic form. Rust, wilt and powdery mildew were the major disease problems in early and middle of the 20th century; therefore, the major research work during that period was focused on these diseases. However, in later part of the century Alternaria blight has been a major challenge, causing significant yield losses (Chauhan and Srivastava, 1975). Apart from this another major linseed diseases are pasmo disease which is caused by fungus, asteryellow caused by phytoplasma and crinkle oat blue dwarf disease cause by virus while minor diseases are Macrophomina stem rot and Cercospora leaf spot, both are caused by fungi. This review includes the major diseases and research work related to these diseases in India.

In India, the crop is mainly cultivated in the states like Madhya Pradesh, Chhattisgarh, Uttar Pradesh, Maharashtra, Bihar, Odisha, Jharkhand, Karnataka and Assam accounting for more than 97 % of the total area.

1. Rust

Rust is a major disease and caused by *Melampsora lini*, which belongs to division *Basidiomycota*, class *Pucciniomycetes*, order *Puccinales* and family*Melamosporaceae*. It has been reported almost from all linseed growing countries. *M. lini*was first described by Persoon (1801) under the name *Uredo minuta*. Its occurrence was reported by Butler (1914) for the first time from the country. It was of common occurrence in Madhya Pradesh and Uttar Pradesh (Prasada, 1940). The disease was in epiphytotic form in Indo-Gangetic Plains in Northern India during 1961 (Hora *et al*., 1962). Rust is now a serious problem in northern part of India like Jammu & Kashmir, Northern hills of Himachal Pradesh and Uttar Pradesh, adjacent part of Punjab, Bihar, West Bengal, Odisha and certain parts of Uttar Pradesh (Gill, 1987). One of the major diseases of linseed. It reduces quality as well as quantity of fibres or we can say that flax. Around 40% linseed crop is affected worldwide by this rust. Flor gives Gene for gene hypothesis on basis of linseed rust disease which is now helpful for breeder as well as pathologist.

Some common symptoms shown by the affected plants are, all the parts above the ground are infected with this disease. In the early stage affected parts are yellow to light orange colour, due to the uredospore and in the later stage these parts appear brown or dark black because of teliospores. Pycniospore form on upper surface and aeciospore on lower surface. On the leaves uredia are small because of veins, nearly round, and reddish brown in colour and surrounded by chlorotic region, while

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on stem uredia are long, irregular. Telia form commonly on stem, because after the formation of uredia much of leaves fallen off. On the stem it appears dark black surrounded uredia. Fungus obtains nourishment from leaves and leaves become chlorotic and reduce photosynthetic area, so directly or indirectly effect on photosynthate product and ultimately it reduces the yield. If stem is affected, mainly it retards the quality and quantity of fibres.

M. lini is autocieous macrocyclic rust. So, all types of spores form on linseed. Pycnia is generally, flask shaped, yellow to light orange colour and form on upper surface of the leaves. Pycniospore are the spores which form in pycinal fruiting body. Pycniospores are small oval to globose in shape. Aecia forms under the leaves. Many aecia group together and form circular ring like shape while aeciospores developed in aecia. Thin wall aeciospore formed in chain. Uredia formed on both surface of leaves, which is reddish yellow in colour. On leaves minute circular in shape while on stem irregular in shape and elongated. Uredospore is spores form in uredia which is stalked, 25x15 micro meters in size, ovoid with spiny surface. On germination it forms germ tube. While telia are rarely found on leaves and it is single celled. On germination teliospores form basidium and basidiospores (Lawrence, 1988).

Linseed rust is macrocyclic and autoecious, surviving only on *Linum* species. In India the uredospores and teleutospores do not survive in plains due to unfavorable weather conditions because these spores require low temperature and free water for germination (Vasudeva, 1962). However, they may survive in hills throughout the year (Mathur*et al*., 1961). Misra and Sethi (1962) and Prasada (1967) have shown actual role of teleutospores in initiating the disease in hilly areas of Northern India. The disease is initiated from pieces of linseed straws, bearing viable teleutospores in stored seeds, which is common in the hills, hence, clean seeds preferably after seed dressing were recommended. Even highly susceptible wild species like *Linummysporense*has not been found to harbour rust in nature. Prasada (1967) however, surmised the possibility of survival of self-sown plants of linseed to harbor rust in the hills during off season. So Primary inoculation or infection by wind-blown uredospores and teliospores from hilly region while secondary inoculation by uredospores which is known as repeating spores are main cause of secondary infection.

As we know that rust causes major damage to the linseed crops, so it is utmost important that we manage by the best way such that diseases is controlled as well as less effect on environmental conditions.As in economical point of view, disease resistant varieties are the best measure to control the disease. Here, some common practices by which rust is controlled before the economic damage like balanced use of fertilisers is recommended by local agricultural institutes. Generally higher dose of nitrogen causes more susceptible to disease while higher dose of potassium reduces the severity of disease, provide sufficient spacing because optimum row to row and plant to plant spacing provide proper air circulation, optimum plant densities etc. These all are causes minor effects but this practices are helpful for local control of diseases, avoid solo cropping because growing of same crop year after year increasesthe severity of disease due to last year crop residues contain spores of rust which is germinated in next year or next season crop when favourable conditions are available. Practicelike multiple cropping or intercropping pattern it reduces the severity of rust, also grow resistant varieties like NP (RR) 9, 10, 56, 95, 218, 279B, 279K3, 368, 381, 389, 415, 501 (Mishra and Prasad, 1966). Apart from this rust is also managed by Hexaconazole 5% EC at the rate of 0.005 %(5g/100 lit) or 0.1 % (100ml/100 lit). Dusting of sulphur at 25kg/ha is also helpful in disease reduction. The use of plantavax or oxycarboxin at optimum dose is also an effective measure to manage rust.

2. Wilt

After rust, wilt is a major disease of linseed caused by many fusarium fungi but main causal agent is *Fusariumoxysporum*f.sp.*lini*. This fungus belongs to division Ascomycota, class Sordariomycetes, order Hypoceralesand family Nectriaceae.The disease was first reported by Luggar (1890) from Minnesota, USA. He found that the disease wastransmitted by water or infected plant debris to thenoninfested fields. Bolley (1901) isolated the pathogen andproved pathogenicity by Koch postulate. In India it was first reported fromCentral Province (Pearl, 1924; Mc Rae, 1926), Maharashtra(Verma, 1945) and Rajasthan (Sharma *et al*., 1971). Thedisease is now reported from all linseed growing areas of thecountry.Crop losses around 20 to 25%, but in disease favourable condition it is 70 to 80% yield loss. Light soils which contain high proportion of sand particles are more favourable for wilt. The temperature around 24°C is most favourable. Below 13 °C and above 35 °C *Fusarium* are not more severe. Low moisture (25 %) is also favourable for wilt, so it issevere in dry area like Rajasthan and Gujarat etc. Acidic to neutral pH are also factor which causes higher severity of wilt.

Common symptoms of wilt are that it affects vascular tissue and block the mineral and water etc. translocation through xylem. Yellowing and wilting followed by browning appearance and in severe case plant ultimately die. Disease plant also shows Shepherd's crook symptoms (Mehrotra & Agarwal, 2010) in which top part turn downward (Due to excessive growth).Fusaric acid is a toxin released by pathogen is also major cause of symptoms.Wilt affect plants on all stage, from seedling stage to maturity. In following way, it affects plants in different stages, like seedling stag, in this stage if wilt attack than plant not show further growth, small newly emerged leaves shrivelled, necrotic and die; if plant infected during young stage, cotyledon is affected. Cotyledon rolled and dies. In older stage plants showseveral brownish spots appear upon leaves. After sometime whole leave affected and drooping of the plant. After pod development plants show premature ripening of pod so seed not develops in better way (Singh R. S. 2018).

Fusarium produces macroconidia, microconidia and chlamydospores. Macroconidia are generally one to two septate or two to three cells while microconidia are non-septate. Chlamydospore produces on hyphae as well as macroconidia. Chlamydopsore is resting spores which continue *Fusarium spp.* during unfavourable conditions. Perithecium isfruiting body of *Fusarium spp*.

*F. oxysporum*f.sp. *lini*is both seed and soil borne. Due to competitive saprophytic ability, it may persistent in the soil for several year even in the absence of host (Arora, 1980). In seeds the mycelium may persists on or inside seed coat. It may penetrate the soil up to 10 inches but more abundantly found at a depth not exceeding 5 inches. The chlamydospores of the fungus present in soil/debris germinate in response to root exudates and the germ tubes penetrate the plants through root hairs. It can also enter the young seedlings through epidermal cells or stomata. In seeds it enters through macrophyle or wounds. Chlamydospores and infected plant debris is source of primary infection while conidia are sources of secondary infection.

Management of this disease by various practices like cultural practices, chemical practices and biological practices. Crop rotation at least for 3 to 4 years, because mycelia survive in soil for long periods. Deep summer ploughing also reduces the secondary source of inoculation which is present at depth in soil. Use heavy soil which contains high proportion of clay which suppresses this disease. Amendment in soil and make the soil basic also reduces the wilt disease. Grow resistant varieties like

NP12, PR82, PR80, NP1, NP124; etc. (Kulkarani*et al*. 1996 and Sharma *et al* 1972) Use of FYM also reduces infection, its show effect similar to heavy soil. Increase potassium content as fertiliser show few effects of disease. Seed treatment with Carboxyl 37.5% + Thiram 37.5% WS at the rate of 3gm/Kg. In seed treatment wetting not required. Tebuconazole 5.4% w/w FS at the rate of 0.24 g/10 Kg of seed as seed dresser. Treat the acid-delinted seeds with Carboxin or Chlorothalonil at 4 g/kg or Carbendazim at 2g/kg seed. Dastur and Bhatt (1964) found that the wilt resistant plants contained more potassium content than susceptible ones. Zinc also reduced the leaf symptoms caused by *F. oxysporum*f.sp.*lini*, which was attributed to the inhibition of fusaric acid production in the pathogen. *Fusarium* is controlled by *Trichoderma* spp. (*Trichoderma viride and Trichoderma hazrianum), Bacillus*. Multiply *Trichodermaviride* (2 kg) in 50 kg of Farm yard manure for 15 days and then apply to the soil.

3. Powdery mildew – *Oidiumlini*

Occurrence of powdery mildew (*Oidiumlini*) of linseed was reported for the first time from Yugoslavia (Skoric, 1926). Around four powdery mildew fungi *viz.,Oidiumlini,Erisiphecichoracearum*DC, *E. polygoni*, *Spherothecalini*have been reported from world, and the first two reported from India (Sandhu and Chandwani, 1965; Pavgi and Singh, 1965; Shukla and Pathak, 1967). Powdery mildew belongs to division Ascomycota, class *Dothideomycetes*, order *Capnodiales*, family *Mycosphaerellaceae*.Powdery mildew of linseed is a disease of wide occurrence, but it is more serious in Central and Penincular regions of the country. Hot and dry conditions are favourable because conidia are already containing high amount of water.A temperature range between 20-25ºC, humidity less than 65 % and less rainfall are the predisposing factors (Saharan, 1988). Saharan and Saharan (1994a) found that powdery mildew severity was negatively correlated with temperature and relative humidity.

In the early stages, the upper side of leaves covered with effuse, thin, white mycelium. The mycelium then developed to both sides, which often results in covering the entire surface of the leaves, stems and pods, along with quick covering the whole areal, especially the upper part of the plants. There were two types of mycelia. Primary mycelium was tender, hyaline, and thin-walled, while secondary mycelium was persistent, slightly thick-walled, white to yellowish, straight to sometimesflexuous, septate and branches. If plants affected during early-stage leaves are small and plat become stunted.

Oidiumlini is an ectoparasite and septate hyphae. Obtain nutrition through intracellular hyphae. Powdery mildew fungus has the longest conidia and contains a very high content of water around 70-72%. Other fungus conidia are dry. Therefore, powdery mildew fungus does not require free water for the germination of conidia. The fruiting body is cleistothecia in which produce ascospores (sexual spores). Ascospores are thick-walled sexual spore which produced during the unfavourable condition and continues the disease cycle during the unfavourable condition and germinate during sexual condition.

The pathogen survives through the formation of cleistothecia in diseased plant debris present in the soil. The primary source of infection is infected plant debris, infected seeds, and alternate hosts. The aeciospore which is germinated during favorable conditions also is the source of primary infection. On plant the conidial germination of *O. lini*was initiated after 2 hours at 30ºC and 40 or 80 % RH and appresoria formation was highest (16.8%) after 14 hours at 70 percent RH (Saharan and Saharan, 1994b).The secondary source of infection is airborne conidia.

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Management at appropriate stage are important to prevent from economical damage. Proper and optimum doses of fertiliser at proper time are a major factor which reduces the disease. Generally,nitrogen increase severity of powdery mildew while potassium reduces the disease incidence. Provide sufficient space between row to row and plant-to-plant so maintain optimum moisture level, air circulation and plant density. Avoid solo cropping, because same crop year after year causes higher chance of disease outbreak. Grow-resistant varieties are most economical measures to control the diseases. Some resistant varieties are likeSurbhi (Kl-1), and germplasms are GS-61, GS-64, LC-2279-4, GS-100, PCL-57, EC-22596, EC 41595, EC 99006 and EC 41636 found resistant to powdery mildew. Seed treatment with Thiram or Carbendazim at the rate of2.5g/kg seed. Two spray/application of hexaconazole 5% EC at 1ml/L and wettable sulphur 80%WP at 4g/ml at 45 & 60 DAS reduced the disease severity. Soil drenching with Carbendazim at the rate of 0.1% or Copper oxychloride at the rate of 0.25% is also effective against disease reduction.

4. Pasmo disease/Septoria leaf spot

Pasmo disease also called septoria leaf spot caused by *Septorialinicola*. This fungus belongs to division *Ascommycota*, class *Dothideomycetes*, order *Capnodiales* and family*Mycospharellaceae*.Temperature around 20 to 21 °C and high rainfall are the major favourable condition for germination and spread of this disease. Irrigation during the susceptible stage also promotes this disease and increases the disease severity.

All above ground parts are affected withthis disease, but generally or more severely on leaves and form spots of different colour like brown to dark brown in color and it surrounded by healthy green circular ring. At last, this spotted region tissue become necrotic and die.

Septorialinicola is anamorph and teleomorph*Mycospaerella*. It is ascomycetes fungi produce pycnidia as asexual fruiting body in which conidia (pycnidiospore) produces which is hyaline and needle shape. Sexual fruiting body is pseudotheca, in which aeciospore is form. It is bipolar heterothallism fungi.Pseudotheca generally formed under side of epidermis. Pseudotheca is globular shape and brown in colour. Ascospore is hyaline like conidia and elliptical in shape. After some time when ascospores become mature it ejaculates with force.

Source of infection is infected plant debris in soil, alternate host, while secondary infection caused by wind borne conidia. These conidia also spread through insects.

For the management of the pasmo disease eliminate the initial source of infection by removing infected plant debris and weeds, and use disease free seeds. Use drip irrigation or a soaker hose at the base of the plant instead of watering with a method that gets foliage wet. No resistant variety developed. Wider spacing helps in reduction of disease. Application of benomyl was shown to reduce pasmo severity. Seed treatment with zineb at 2g/kg seed. 3 or 4 Spray zineb at the rate 0.2% at 10 days interval also helpful in management of disease.

Other minor fungal disease

1. Macrophominastem rot

The stem rot caused by *Macrophominaphaseolina*was reported from India for the first time by Sunderaman (1931) and Uppal (1935). The sclerotial stage i.e., *Rhizoctoniabataticola*was reported by

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Asthana (1957) and laterby Bedi*et al.* (1961), causing seed and seedling rot. *R.bataticola*(*M. phaseolina*) was found associated with linseedroots (Misra and Shukla, 1981). It causes 50 % to 80% losses depend upon moisture and temperature.

The disease symptoms are observed at different stages of plant. If symptoms appear at early growth stage, leaves become yellow and loss turgidity, stunting and partial or entire discolouration of root system. If plant affected at later stage, dark brown discolouration of basal part of stem and roots is observed. The bark of the roots peels off and the small sclerotia are present on the bark, wood of the root and basal part of the stem. Chandwani and Srivastava (1968) reported that Rhizoctonia does not attack the linseed plant directly as does *Fusariumlini*but makes its entry where root system has been damaged by either soil borne insect or physical injury.

Misra and Sinha (1982) identified that the survival of the pathogen on six collateral hosts *viz.,Sorghum halepense*, *Cynodondactylin*, cowpea, pigeonpea, *Cyprus rotundus*and *Panicumatrosanguineum*, which were cross pathogenic. The primary source of infection is collateral hos as well as sclerotia and infected plant debris, while secondary infection is caused by transfer of sclerotia from infected field to healthy field by irrigation, rainfall etc.

For the cultural control grow NP-5. This variety was found to be moderately resistant to macrophomina stem rot (Mishra and Sinha, 1982). Seed treatment with organomercurials reduced disease incidence (Kadian and Suryanarayana, 1971), seedling mortality was reduced by 0.25% by Captan (Mishra and Sinha, 1982).

2. Cercospora leaf spot

The disease was reported for the first time from India occurring in severe form in Varanasi area of the Uttar Pradesh (Rathaiah and Pavgi, 1971). The disease appears as small circular leaf spots on upper surface of leaves. The pathogen survives through mycelium in crop debris (Rathaiah and Pavgi, 1973a). The resistance of 24 linseed varieties to *C. linicola*was assessed but none was found resistant. However, BS 12-9 and KB 96/10 were found moderately resistant (Rathaiah and Pavgi, 1973b). Rathaiahand Pavgi (1970) evaluated some fungicides against some leaf spot diseases of oilseed crops including Cercospora leaf spot of linseed.

Bacterial Disease

1. Aster yellow disease

Aster yellow disease is caused byphytoplasmaand it is transfer through vector which is leafhopper. Generally found in temperate region of the world. Mainly favourable condition for leafhopper also favourable condition for phytoplasma diseases. For leafhopper favourable season is rainy season. In this season plant show luxuriant growth and plants is succulent and Leafhopper easily feed upon this.

It is systematic disease. Severity of disease depends upon stage of plant, temperature, humidity, etc. Phytoplasma infected plants are stunted. Leaves become smaller and yellowing of leaves while vein remain green. Flower colour change to green. It also affects the reproductive part and produces sterile plant. Sometime bushy growth also appears.

Phytoplasma present in infected plants and alternate host are transfer through vector in healthy plants. Leafhopper is vector of this disease. Leafhopper injects stylet into phloem of the plant and feed. During this period Phytoplasma acquired by the leafhopper and after that *Phytoplasma* multiply in the vector and then transfer to salivary gland. Now, when insect feed on healthy plants they transfer this Phytoplasma from salivary gland into the healthy plant. In whole this process total time is around 10-15 days. After injection, around one week plant show symptoms or one week is incubation period.

Actually, no cure available against this disease, but we use insecticides for control of leaf hopper. Diatomaceous Earth and Surround WP (kaolin clay) can be applied to leaf and fruit surfaces to deter leafhopper feeding. Both provide a physical barrier as well as insecticidal properties once leafhoppers come in contact with them. Treat seed with imidacloprid 70 WS at 7 g/kg. Spray Imidacloprid 70% WS 490 ml/ha or Imidacloprid 17.8% SL 100 ml/ha. Remove alternate host and infected plants which is major factor for disease spread.

Viral Disease

1. Crinkle – Oat blue dwarf virus

This disease is caused by*Crinkle Oat blue dwarf virus*and transfer through the vector (Leaf hopper: *Macrostelesfascifrons*). This disease is more severe intemperate regions. High rainfall, irrigation, N doses etc. increases the severity of the disease.

Plants affected by this disease show symptoms like leaves become shorts, crinkled and loss turgidity. Plant height is less as compared to healthy one. In severe case seed pod not develops. If pod develops, seed is shrivelled and not completely developed.

Primary source of infection of the viral disease is, through the wild type plants or alternate host which contains viruses and these viruses transfer through leaf hopper.

Virus easily not controlled so control of leaf hopper population control this disease. Disease management practices are same as pasmo disease. So, in following way we control the disease, Diatomaceous Earth and Surround WP (kaolin clay) can be applied to leaf and fruit surfaces to deter leafhopper feeding. Both provide a physical barrier as well as insecticidal properties once leafhoppers come in contact with them. Treat seed with imidacloprid 70 WS at 7 g/kg. Spray Imidacloprid 70% WS 490 ml/ha or Imidacloprid 17.8% SL 100 ml/ha. Remove alternate host and infected plants which is major factor for disease spread.

Phanerogamic parasites

1.Doddar / Cuscuta

The dodder, represented by species such as *Cuscutaepilinum* and *Cuscutahylina*, is a flowering stem parasite that primarily infests flax plants. This parasitic plant grows rapidly and causes significant damage, to the extent that it has become a quarantine concern. The dodder initially appears as a slender, pale vine with yellowish, leafless stems. It obtains its nutrients from the flax plant by forming haustoria, specialized structures that penetrate the host plant's tissues. Infected plants exhibit a decline in vigor and gradually turn yellow, resembling the color of the parasite. Furthermore, these plants produce fewer seeds.

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To control and manage dodder infestation, several cultural practices can be employed. It is important to ensure that the seeds used for planting are free from dodder seeds. Before sowing, the linseed seeds should be carefully examined and any dodder seeds present should be removed using a sieve. Regularly harrowing the soil between crop rows can disrupt the growth and attachment of dodder to the host plants. This mechanical disturbance can help prevent or reduce parasitism. It is crucial to avoid the flow of irrigation water from infested fields to non-infested ones. This can prevent the spread of dodder seeds through water movement. Grazing cattle can inadvertently transfer dodder seeds from infested areas to non-infested areas. Therefore, it is important to prevent the movement of grazing cattle from infested fields to other areas. Practices such as tillage, crop rotation, and intercropping can help reduce dodder infestation. Tillage can disturb the soil and disrupt the parasite's seed bank, while rotation and intercropping with non-host plants can interrupt the life cycle of the dodder. By implementing these cultural practices, it is possible to reduce the infestation of dodder and minimize the damage caused to flax crops. Use of herbicides *viz.*, Pronamide (as pre-emergence or post emergence after 15-20 days of sowing at 1.25-2 kg/ha); Pendimethalin (pre-emergence at 1.0 kg/ha); Fluchlorin (presowingat 1.0-1.25 kg/ha) or Paraquat (spot treatment, spray of 1.0% solution) have been recommended against cuscuta/dodder (Mishra and Raghuwanshi, 2002).

Conclusion

Linseed(*Linumusittatissimum*) is a significant crop with great economic potential, both as an industrial as well health condition. The Indian soil and climatic conditions are highly favourable for the cultivation of linseed. However, the productivity and production of linseed are limited by various abiotic as well as biotic factors, including diseases and deficiency of nutrients. In this paper, we highlight some important, major as well as minor diseases caused by fungus, bacteria, and viruses. For the management point of view, primarily focus on integrated disease managements which include cultural practices, chemical practices and biological practices. So, it is very precious crop but we need to focus on diseases and management in such a way that farmer not face economical losses and lesser impact on environmental conditions.

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