

## Survey and surveillance of Powdery Mildew in linseed growing areas of northern Karnataka

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Linseed powdery mildew survey conducted in northern Karnataka districts during *rabi* of 2009-10, 2010-11 and 2011-12 revealed that during *rabi* of 2009-10 mean disease incidence was maximum in Raichur district (57.5%) followed by Bidar (56%) and Gulbarga (52%). During *rabi* of 2010-2011 mean disease incidence was maximum in Raichur district (46.25%) followed by Bidar (42%) and Bijapur (41%). During *rabi* of 2011-12 mean disease incidence was maximum in Raichur district (93.5%) followed by Bidar (25%) and Bijapur (16.33%). During the survey it was observed that in all the three years incidence of the disease was maximum in Raichur district this may be due to the fact that crop coincides with the favourable weather factors such as temperature, relative humidity, distribution and amount of rainfall followed by cultural practices like intercropping, date of sowing, sanitation and other suitable management practices.

**Key words:** Linseed, Powdery Mildew, survey

### INTRODUCTION

Linseed (*Linum usitatissimum* L.) is an important oilseed crop grown for both seed and fibre. Almost every part of the plant is commercially utilized either direct or after processing. It is next in importance to rapeseed-mustard grown during *rabi* season. In India it is grown on 3.592 lakh hectares contributing 1.465 lakh tons in production in the oilseed scenario of the country with a productivity level of 408 kg/ha. (2010-II) (Anon., 2012). On small scale, the seed and its oil are directly used for human consumption as flax seeds and other baked and fried foods stuffs by a small segment of population. In north Karnataka linseed Chutney is very famous edible item made out of linseed. Linseed is highly nutritious and a good source of complete protein (all 8 essential amino acids), high order linolenic acid (an essential polyunsaturated Omega-3 fatty acid), complex carbohydrates, vitamins and minerals. Recent advances in medical research have found linseed as best herbal source

of Omega-3 and Omega-6 fatty acids which have immense nutritional / medicinal effect on human body system.

Linseed occupies an important position in India for its technical grade oil producing ability. Fiber yielding property from the linseed stalk is an added advantage of this crop. Karnataka is eighth largest grower of linseed only after Madhya Pradesh, Chhattisgarh, Maharashtra, Uttar Pradesh, Jharkhand, Bihar and Orissa with an area of 11,000 ha. mainly as sole crop as well as intercrop with other *rabi* crops like sorghum, bengalgram, safflower and wheat producing about 4000 tones of seed with a productivity of 364 kg/ha (2010-II) (Anon., 2012). However, production wise also Karnataka stands eighth position. As majority of farmers are growing their own local types only, a mere replacement of their material with elite varieties and management of biotic factor losses can boost the productivity to a considerable extent.

Survey of the powdery mildew disease over a period

of time gives the intensity with which it affects the yield and quality. Presently disease is very severe in northern Karnataka and Raichur has identified as hot spot for powdery mildew. even though there is no systematic yield loss estimation of the disease. The yield loss due to powdery mildew is proportionate to the disease intensity and varies considerably depending on the stage of the plant at which disease occurs.

## MATERIALS AND METHODS

An intensive roving survey was carried out using GPS (Global Positioning System) tools during *rabi* season of 2009-10; 2010-11 and 2011-12 to know the incidence and severity of linseed powdery mildew in farmers' field of Bidar, Gulbarga, Yadgir, Raichur, Bellary, Koppal and Main Agricultural research station, Raichur. In total 20 locations were surveyed from all the districts, in each location 10 samples were drawn randomly for determining the extent of incidence of powdery mildew by following methods; visual observation; and microscopic observation. The disease severity was scored by using 0-5 scales and described as follows (Saharan and Saugan, 2005).

Grade	Disease Severity	Reaction
0	Free from infection	Highly Resistance (HR)
1	0.1 to 10 per cent plants/ plant parts infected	Resistance (R)
2	10.1 to 25 per cent plants/ plant parts infected	Moderately Resistance (MR)
3	25.1 to 50 per cent plants/ plant parts infected	Moderately Resistance (MS)
4	50.1 to 75 per cent plants/ plant parts infected	Susceptible (S)
5	>75 per cent plants/ plant parts infected	Highly Susceptible (HS)

Further, the per cent disease index was calculated by using the formula given by Wheeler (1969).

$$\text{Per cent disease severity} = \frac{\text{Sum of all observation grades}}{\text{Total number of plants observed}} \times \frac{100}{\text{Maximum grade}}$$

In addition 11 isolates of powdery mildew pathogen were also collected during 2011-12 survey from different geographical regions to study the molecular variability of the pathogens.

## RESULTS AND DISCUSSIONS

During *rabi* season of 2009-10, survey for powdery

mildew disease was conducted in six districts (Table 1) and the maximum mean per cent disease severity (PDI) was observed in Raichur district (57.5%) which coincided with the maximum temperature of 34.4°C and minimum temperature of 17.5°C and relative humidity of 91 per cent followed by Bidar district (56%). Whereas, minimum PDI was noticed in Koppal district (18 %) followed by Bellary district (35.89%).

In Koppal district five villages comes under Koppal taluk were surveyed, among them maximum disease incidence of 22 per cent was recorded in Agoli village followed by Abbigere (20%). However, least disease was observed in Achalapur (12%).

In Bellary district survey was carried out in two taluks comprised of eight villages. Survey revealed that maximum per cent disease incidence (51%) of powdery mildew was observed in Badanahalli village of Bellary taluk which was followed by Asundi village (48 %) of Bellary taluk, whereas minimum powdery mildew incidence was observed in Amalapur village (18 %) of Kudligi taluk. Among the two taluks surveyed in Bellary, maximum mean per cent disease severity was observed in Bellary taluk (43 %). Whereas the mean disease severity in Kudligi taluk was 27 per cent.

Survey conducted in Raichur district revealed that maximum linseed powdery mildew disease severity of 91% was observed in Main Agril Research Station (MARS) followed by Dirni (36%) village of Raichur talu. Atkur village (52%) of Raichur taluk. However, minimum disease incidence was recorded in Raichur village (28%). Apart from this, survey was also conducted in Bidar, Gulbarga and Bifapur districts. and among these three districts maximum disease incidence (42 %) of powdery mildew was observed in Bidar followed by Bijapur (41%) and Gulbarga(39%).

During *rabi* season of 2010-11, survey for powdery mildew disease was conducted in six districts (Table 2). The maximum mean per cent disease severity was observed in Raichur district (46.25 %) which coincided with the maximum temperature of 32.9 °C and minimum temperature of 15.2 °C and relative humidity of 81 per cent followed by Bidar district (42%). Whereas. minimum PDI was noticed in Koppal district (19%) followed by Bellary district (32%).

In Koppal district four villages of Koppal taluk were

surveyed, among them maximum disease incidence (28 %) was recorded in Agoli village followed by Advihal (20 %). However, least disease was observed in Achalapur (12%).

**Table 1 :** Survey on severity of linseed powdery mildew in districts of Northern Karnataka during 2009-10.

Districts Surveyed	Taluk	Village	Powdery mildew disease incidence (%)	Mean disease incidence (%)
Koppal	Koppal	Abbigere	20	18.00
		Advihal	18	
		Agoli	22	
		Achalapur	12	
Bellary	Bellary	Alipur	44	35.89
		Asundi	48	
		Badanahalli	51	
		Bandihatti	32	
		Basarkodu	40	
		Challagurki	20	
		Kudlgi	18	
		Bellighatta	32	
		Ambli	38	
Raichur	Raichur	Main Agril Research Station (MARS)	96	57.50
		Atkur	52	
		Dinni	44	
		Kalmala	38	
Bidar	Bidar	Bidar	56	56.00
Gulbarga	Gulbarga	Gulbarga	52	52.00
Bijapur	Bijapur	Bijapur	46	46.00

In Bellary district survey was carried out in two taluks comprised of nine villages. Among the taluks surveyed, maximum mean disease severity was observed in Bellary taluk (34.33 %), whereas the mean disease severity in Kudlgi taluk was 27.33 per cent. However, maximum disease incidence (52 %) of powdery mildew was observed in Badanahalli village of Bellary taluk which was followed by Asundi village (42 %) of Bellary taluk, whereas minimum powdery mildew incidence was observed in Amalapur village (16 %) of Kudlgi taluk.

Survey conducted in Raichur district revealed that maximum linseed powdery mildew disease severity of 91 per cent was observed in Main Agril Research Station (MARS) followed by Dinni (36 %) village of Raichur taluk. However, minimum disease incidence was recorded in Atkur village (28 %). Survey was also conducted in Bidar.

**Table 2 :** Survey on severity of linseed powdery mildew in districts of Northern Karnataka during 2010-11.

Districts Surveyed	Taluk	Village	Powdery mildew disease incidence (%)	Mean disease incidence (%)
Koppal	Koppal	Abbigere	16	19.00
		Advihal	20	
		Agoli	28	
		Achalapur	12	
Bellary	Bellary	Alipur	34	32.00
		Asundi	42	
		Badanahalli	52	
		Bandihatti	28	
		Basarkodu	32	
		Challagurki	18	
		Kudlgi	16	
		Bellighatta	32	
		Ambli	34	
Raichur	Raichur	Main Agril Research Station (MARS)	91	46.25
		Atkur	28	
		Dinni	36	
		Kalmala	30	
Bidar	Bidar	Bidar	42	42.00
Gulbarga	Gulbarga	Gulbarga	39	39.00
Bijapur	Bijapur	Bijapur	41	41.00

Gulbarga and Bijapur districts. Among three districts maximum disease incidence (42%) of powdery mildew was observed in Bidar followed by Bijapur (41%) and Gulbarga (39%).

During *rabi* season of 2011-12 survey for powdery mildew disease was conducted in six districts (Table 3) and the maximum mean per cent disease severity (PDI) was observed in research stations of Raichur district (93.50 %) which coincided with the maximum temperature of 32.9 °C and minimum temperature of 15.2 °C and relative humidity of 81 per cent followed by Bidar district (25 %). Whereas, minimum PDI was noticed in Yadgiri district (2 %) followed by Bellary district (13.25 %).

In Raichur district survey was conducted in Main Agril Research Station where the maximum incidence of 95 per cent was recorded in breeding trial plots (plot #169) followed by 92 per cent incidence in pathological experimental plots (plot # 87). In Bidar district four villages of Bidar taluk were surveyed for disease incidence where the maximum incidence was observed in Bhimanakheda village (28 %) followed by Rajagira (26 %) and mini-

**Table 3 :** Survey on severity of linseed powdery mildew in districts of Northern Karnataka during 2011-12.

Districts Surveyed	Taluk	Village	Powdery mildew disease incidence (%)	Mean disease incidence (%)
Raichur	Raichur	Plot #87 MARS	92	93.50
		Plot # 169 MARS	95	
Yadgiri	Shahpur	B'gudi	02	02.00
Gulbarga	Gulbarga	Ankalagere	11	15.00
		Agril Research Station (ARS)	19	
Bidar	Bidar	Krishi Vigyan Kendra (KVK)	21	25.00
		Bhimanakheda	28	
		Bhimanakheda	25	
		Rajagira	26	
Bellary	Hagari-bommanahalli	Basarakod	10	13.25
		Nymathahalli	15	
	Hadagali	N.M. Wadi	12	
		Hirevadagali	9	
	Hadagali	Hirevadagali	6	
		Challagurki	18	
	Hagari	Byalachintha	21	
		Kadekallu	15	
Bijapur	Bijapur	Regional Research Station (RRS)	15	16.33
		Honnalli	18	
		Sathihak	16	

mum of 21 per cent incidence was recorded in Krishi Vigyan Kendra (KVK), Bidar.

Among the three taluk's surveyed in Bellary district, maximum mean disease incidence was recorded in Hagari taluk with 18 per cent incidence followed by Hagaribommanahalli taluk (12.5 %) and minimum was recorded in Hadagali taluk (9 %). Among the eight villages surveyed maximum incidence was observed in Byalachinta (21%) followed by Challagurki (18 %) village of Hagari taluk, however minimum incidence was noticed in Hirevadagali (6 %) village of Hadagali taluk.

In Bijapur district three villages were surveyed for linseed powdery mildew incidence. Among them maximum incidence was recorded in Honnalli village (18 %) followed by Sathihak (16 %) and Regional Research Station (RRS) (15 %). In addition, survey was conducted in Bheemarayanagudi vil-

lage of Yadgiri district with the incidence of 2 per cent and two villages of Gulbarga whereas the incidence of 19 and 11 per cent were recorded in Agricultural Research Station (ARS) and Ankalagere respectively. In general it was observed that disease severity was more during full flowering and it indicated that pre-flowering stage was more prone for infection (Dinesh *et al.*, 2010).

The variation of disease incidence in various localities is mainly attributed to the climatic factors like temperature, relative humidity and distribution and amount of rainfall followed by cultural practices like intercropping, date of sowing, sanitation and other suitable management practices. The age of the crop and cool nights and dry weather situation are more favourable for the powdery mildew disease to attain severity (Aust and Jurgan, 1986). When the age of the crop coincides with favourable weather parameters and water management aggravates the disease and causes a severe incidence. When there was less rain, cooler nights and high day temperatures, which were enough for dew formation and wide variation (13 - 15°C) in the maximum and minimum temperature and day and night relative humidity (39.9 - 51.7 %) increased powdery mildew intensity in black gram (Singh and Sirohi, 2003).

The microclimate builds up due to close spacing and heavy crop canopy also helps in pathogen multiplication (Akhileshwari *et al.*, 2012). Less disease severity depends on factors such as location, cultural practices, followed by susceptibility of the cultivars grown, microclimate congenial for disease progress, and meteorological factors such as temperature, relative humidity and rain. The higher incidence of powdery mildew was attributed to the temperature and relative humidity prevailing during the crop period, which were favourable for the disease development and spread (Ashtaputre *et al.*, 2007 and Patil *et al.*, 2012).

With reference to Raichur district, in all the three years maximum incidence was recorded during January- February. This may be due to susceptibility of the cultivar and favourable environmental condition like temperature and less amount of rainfall experienced during the period under study. The climatic conditions prevailed during the crop growth favours the build up of inoculum level. Cool temperature and low relative humidity are reported to cause severe epidemics

of powdery mildew of sunflower (Kolte, 1985).

Thus, the survey also supplemented the information about intensity with which it affects the yield and quality and existence of variability or variable potency of fungi in these varied zones as evidenced in eleven isolates in the investigation conducted during *rabi* season of 2011-12. In addition, it will be a source of information on severity of disease in relation to environmental conditions.

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