**Original Research Article**

**Epidemiology and Varietal Screening of *Alternaria* Blight of Linseed**

**ABSTRACT**

Linseed (*Linum usitatissimum* L.) is a crucial oilseed crop with significant economic and health implications. The study investigated the impact of sowing dates and environmental factors on Alternaria blight disease development and grain yield. Field trials were conducted during the *Rabi* season 2022-23 at Birsa Agricultural University, Ranchi, using the linseed variety ‘T 397’. Sowing dates were staggered at seven days interval from 4th November to 16th December, and subsequently disease severity and environmental parameters recorded. Early sowing on 4th November resulted in the lowest disease severity of 13.2% and highest grain yield of 1052.31 Kg/ha, while late sowing on 16th December recorded the highest disease severity of 36.5% and lowest yield of 817.99 Kg/ha. Environmental conditions (temperature: 7.7-26.0°C, relative humidity: 69.5-86.3%, sunshine: 8.0-8.2 hrs) significantly influenced disease development. Statistical analysis revealed significant correlations between percent disease index (PDI) and minimum temperature, evening relative humidity, morning relative humidity, and sunshine hours. Varietal screening of 118 linseed entries showed that 52 entries were resistance to Alternaria blight. The study highlighted the importance of early sowing and varietal selection in managing Alternaria blight in linseed cultivation**.**

**Key words:** Linseed, *Alternaria* blight, *Alternaria lini,* weather parameters*,* varietal screening, management

1.INTRODUCTION

Linseed (*Linum usitatissimum* L.) is an important oil seed crop grown for dual purposes, seed and fiber in India. It is also popularly known as *Alsi, Tisi, Jawas, Aksebija* in Indian languages. Linseed oil is used as edible oil when it is blended with mustard. The oilcake is good feed for milch cattle and also used as manure. Linseed has roughly 40 percent oil by weight, about 55 percent of which is alpha linolenic acid (omega-3 fatty acid) which has anti-inflammatory action in the treatment of arthritis. It also has the quality in lowering down the cholesterol level in mammals. Overall Linseed play role in the treatment of cancer, arthritis and cardiological diseases. It is used for the manufacture of paints, varnish, linoleum, oil cloth, currency paper, patent leather, printer ink, enamels, plastics, stickers, tarpaulins, soaps and very small fraction of it is used for edible purposes. India is the second largest producer of linseed, next to Canada in the world. The area of linseed in India was 294 X 103 ha, production of 154.3 X 103 tons and productivity of 525 Kg/ha during 2016-17 (Anon., 2018). In India, the major growing states are Madhya Pradesh (121.0 thousand ha), Jharkhand (38.5 thousand ha), Uttar Pradesh (32.0 thousand ha), Chhattisgarh (29.9 thousand ha), Bihar (16.7 thousand ha), Maharashtra (14.0 thousand ha). In Jharkhand, the total area of linseed is 38.5 X 103 ha, annual production is 23.7 103 tons with productivity of 615 Kg/ha (Anon., 2018). However, in terms of productivity, India (525 Kg/ha) is far below than Switzerland (2647 Kg/ha), Tunisia (2633 Kg/ha), U.K. (2600 Kg/ha), France (2121 Kg/ha) and New Zealand (1853 Kg/ha) *etc*. (Naik, 2016). Seeding date and its influence on flax performance is linked to weather, with early or later seeded flax having a higher chance of encountering frost or drought and disease development (Casa *et. al*., 1999). Sowing date plays a key role in development of disease, yield of crops and the knowledge of this factor is imperative in working out a strategy for enhancing the yield of oil and fiber. Higher growing season temperatures can have dramatic impacts on agricultural productivity, farm income and food security. Delay in sowing leads to an increase in environmental temperature during reproductive growth of crop resulting in poor seed quality. The adjustment of sowing date plays an important role in improving the quality and quantity of seeds and *Alternaria* blight disease management. *Alternaria* blight in linseed is highly influenced by environmental factors (Pandey *et. al.,* 2019). Host resistance is also one of the cheapest and eco-friendly management strategies to manage any pathogen. Since, linseed is grown generally by marginal farmers and unable to use costly chemicals for economical management, very little information is available on the management of this economically important disease on the aspects of use of resistant varieties and alteration in sowing dates. Hence, an investigation was undertaken to fill the existing gap, to evaluate different dates of sowing and screening of available linseed entries/germplasm to find out the most suitable one for economical management of the disease.

2. MATERIAL AND METHODS

Field trial was conducted during *Rabi*, 2022-23 with the most susceptible variety of *Alternaria* blight of linseed (T 397) at Research Farm, Birsa Agricultural University, Ranchi (Latitude- 23o44’ N, Longitude- 85032’ E, Altitude- 625.4 m above msl, soil type was sandy loam and pH of 6.4) in RBD with…..replications. Linseed seed (Var. - T 397) was sown at seven days interval *viz*., 4, 11, 18, 25 November, 2, 9, 16 December, 2022 in field with a spacing (R-R) of 30 cm. The plot size was 3.0 m X 3.6 m each with three replications. The crop was fertilized with 30: 20: 20 Kg NPK/ha. Plants were inoculated after sixty days of last date of sowing by using eight days old mycelia-cum-spore suspension of the pathogen (2 x 106 spores/ml) in evening under humid condition for early establishment of the pathogen. The disease severity was recorded after fifteen days of inoculation by taking fifty leaves randomly from each plot. All the recommended package of practices were followed to raise linseed crop. After harvest, the grain yield of linseed was also calculated (Kg/ha) and increase in grain yield over control (%) was also worked out. The per cent disease index (PDI) or Disease severity was calculated by using 0-5 rating scale as given by Singh and Singh (2006) *i.e.,* PDI = [Sum of numerical rating/total number of observations taken x maximum disease score] x 100.

Weekly meteorological data like temperature (maximum, minimum and mean), relative humidity (morning, evening and mean), wind speed (Km/hr.), sunshine (hour) were taken from meteorological observatory, Department of Agriculture Physics and Meteorology, Birsa Agricultural University, Ranchi, during *Rabi*, 2022-23.

PDI was correlated with weather parameters and grain yield. Coefficient of determination (R2) and simple regression equation amongst weather parameters and grain yield with PDI were also worked out. Multiple regression equation were also worked out by adopting statistical analysis procedures (Gomez and Gomez, 1984).

**Screening of linseed varieties against the *Alternaria* blight disease**

A field trial of one hundred eighteen entries/ germplasms of linseed were screened against *Alternaria* blight disease at Research Farm of Birsa Agricultural University (BAU), Kanke, Ranchi during *Rabi* season, 2022. One line of each entry was sown in three meter length each in augmented design with two replications. One row of resistant (Rashmi) and susceptible check (Chambal) of *Alternaria* blight of linseed was sown after every 10 entries of linseed. The spacing (Row- Row) of the crop was 30 cm. Fertilizers (NPK) were applied at the rate of 30:20:20 Kg/ ha and FYM @ 200 q/ ha. The pathogen (*Alternaria lini-* Spore load – 1 x 107 spore /ml*)* was inoculated in evening time in linseed field two days after irrigation when crop was at the age of 80 days old. Disease observation was recorded twice *i.e.,* 100 and 120 DAS by using 0-5 rating scale given by Anonymous, 2018 are as follows

**Table 1. Rating Scale of *Alternaria* blight of linseed (0-5 Scale)**

|  |  |  |
| --- | --- | --- |
| **Scale** | **Disease Intensity** | **Disease Reaction** |
| 0 | Free from disease | Free (F) |
| 1 | 1 to 10% infection | Resistant (R) |
| 2 | 10.1 to 25% infection | Moderately Resistant (MR) |
| 3 | 25.1 to 50% infection | Moderately Susceptible (MS) |
| 4 | 50.1 to 75% infection | Susceptible (S) |
| 5 | 75.1 to 100% infection | Highly Susceptible (HS) |

The per cent disease index (PDI) or disease severity was calculated by randomly taking fifty leaves of twenty tagged plants from each entry by using 0-5 rating scale as given by Singh and Singh (2006) *i.e.,* PDI = [Sum of numerical rating/total number of observations taken x maximum disease score] x 100.

3. RESULTS AND DISCUSSION

Linseed sown on 4th November recorded lowest disease severity of 13.2 per cent and highest grain yield of 1052.31 Kg/ha. A relative lower disease severity (16.5%) was recorded in the crop sown on 11th November, whereas, highest disease severity of 36.5% was recorded in the crop sown on 16th December. This treatment also gave lowest grain yield of 817.99 Kg/ha. As evident from the data, late sowing favoured disease development whereas early sowing recorded lower disease severity of *Alternaria* blight. The temperature ranged from 7.7 to 26.0oC, relative humidity ranged from 69.5 to 86.3 per cent, sunshine ranged from 8.0 to 8.2 hr and wind speed ranged from 2.4 to 2.5 Km/hr favoured *Alternaria* blight disease development (Table 2).

Per cent disease index (PDI) were significantly positively correlated with minimum temperature and evening relative humidity whereas, maximum temperature, mean temperature and wind speed showed non-significantly positive correlation with PDI. PDI was significantly negative correlation with morning relative humidity, mean relative humidity and sunshine hours and grain yield. Co-efficient of determination between PDI x minimum temperature (0.413), PDI x morning relative humidity (0.423), PDI x evening relative humidity (0.502), PDI x sunshine hour (0.654), PDI x grain yield (0.459) showed significant value, whereas, co-efficient of determination between PDI and maximum temperature, PDI x mean temperature, PDI x mean relative humidity, and PDI x wind speed were recorded as non-significant value. Minimum temperature significantly influenced the PDI of *Alternaria* blight of linseed. Regression equation between PDI x minimum temperature showed that one unit change of minimum temperature changes the PDI by 32.32 units. There is also significant relationship between PDI x morning relative humidity in which regression equation showed that a unit change of morning relative humidity changes the PDI by 67.14 units. Regression equation between PDI x evening relative humidity showed that one unit change of evening relative humidity changes the PDI by 142.667 units. Regression equation between PDI x sunshine hours showed that one unit change of sunshine hour changes the PDI by 100.97 units. Grain yield significantly influenced the PDI of *Alternaria* blight of linseed. Regression equation between PDI x grain yield showed that one unit change of grain yield (independent variable) changes the PDI by 8.211 units. (Table 3).

**Table 2. Effect of dates of sowing and weather parameters on incidence of *Alternaria* blight and yield of linseed during *Rabi,*2022**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Dateof****Sowing** | **Days** | **Temperature(oC)** | **RH(%)** | **Sunshine****( Hr.)** | **Wind speed****(Km/hr.)** | **PDI\*****(%)** | **GrainYield\*****( Kg/ha )** |
| **Maximum** | **Minimum** | **Mean** | **Morning** | **Evening** | **Mean** |
| **04.11.2022** | 122 | 26.0 | 7.9 | 17.0 | 86.2 | 69.5 | 77.9 | 8.2 | 2.5 | 13.2(21.2) | 1052.31 |
| **11.11.2022** | 115 | 25.8 | 7.7 | 16.8 | 86.2 | 69.5 | 77.9 | 8.1 | 2.5 | 16.5(23.9) | 1011.64 |
| **18.11.2022** | 108 | 25.8 | 7.7 | 16.8 | 86.3 | 69.5 | 77.9 | 8.1 | 2.4 | 20.4(26.7) | 986.94 |
| **25.11.2022** | 101 | 25.9 | 7.8 | 16.9 | 86.2 | 69.5 | 77.9 | 8.0 | 2.5 | 25.1(30.1) | 962.62 |
| **02.12.2022** | 94 | 25.8 | 7.8 | 16.8 | 86.2 | 69.5 | 77.9 | 8.0 | 2.5 | 30.4(33.5) | 947.62 |
| **09.12.2022** | 87 | 25.9 | 8.1 | 17.0 | 86.1 | 69.6 | 77.9 | 8.0 | 2.5 | 34.3(35.8) | 904.32 |
| **16.12.2022** | 80 | 26.0 | 8.2 | 17.1 | 86.0 | 69.6 | 77.8 | 8.0 | 2.5 | 36.5(37.1) | 817.99 |
|  **CDat5%** **CV (%)** | 5.9711.27 | 67.3411.62 |
| **\*Mean of three replications Figures in parentheses are transformed arc sine values** |

**Table 3.Correlation co-efficientandsimpleregression equationsbetweenweather parametersandPDI**

|  |  |  |  |
| --- | --- | --- | --- |
| **Correlation pairs** | **Correlationcoefficient value (r)** | **Coefficient ofdetermination (R2)** | **Regressionequations** |
| **Temperature(OC)** |
| PDI X Maximum(X1) | 0.142 NS | 0.20NS | Y=- 376.780 + 15.529X1 |
| PDI X Minimum(X2) | 0.642\* | 0.413\* | Y=- 229.663 + 32.321X2 |
| PDI X Mean(X3) | 0.390 NS | 0.152NS | Y=-508.045 + 31.527X3 |
| **Relativehumidity(%)** |
| PDI X Morning(X4) | - 0.650\* | 0.423\* | Y=5810.789 – 67.140X4 |
| PDI X Evening(X5) | 0.709\* | 0.502\* | Y=-9894.200 + 142.667X5 |
| PDI X Mean(X6) | - 0.505\* | 0.255NS | Y= 10254.200 - 131.333X6 |
| PDI X Wind speed(X7) | 0.216NS | 0.047NS | Y=-114.267 + 56.111X7 |
| PDIXSunshine hour (X8) | - 0.809\* | 0.654\* | Y= 838.774 – 100.974X8 |
| PDI X Grain yield (X9) | - 0.678\* | 0.459\* | Y = 1161.772 – 8.211X9 |

###### \*Significantat5%levelofsignificanceNS –Non significance

###### Table 4.MultiplelinearregressionofPDIof*Alternaria*blightinrelation to

###### weatherparameters

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Particulars** | **MaximumTemp.(ºC)****(X1)** | **MinimumTemp.(ºC)****(X2)** | **Morning****RH(%)****(X3)** | **Evening** **RH(%)****(X4)** | **Wind speed (Km/hr.)****(X5)** | **Sunshine****(Hr.)** **(X6)** |
| **β–Value(RC)** | - 52.67 | 70.22 | - 3.78 | - 122.44 | - 42.44 | - 68.44 |
| **Intercept(α)** | 10330.667 |
| **R2Value** | 0.829 |
|  MultiplelinearregressionequationY=α+β1X1+β2X2+β3X3+β4X4+β5X5+β6X6 |
| Y=10330.667 - 52.667 X1 + 70.222 X2 - 3.778 X3 - 122.444 X4 - 42.444 X5 - 68.444 X6 |

Where, Y =Percent disease index (PDI) (%)

 X1 = Maximum temperature (0C) X4=Evening RH (%)

X2=Minimumtemperature(0C)X5 = Wind speed (Km/hr.)

 X3= Morningrelativehumidity(%) X6 = Sunshine(Hr.)

 Thedataareagainsubjectedtosimpleandmultiplelinearregressionanalysis.Themultipleregressionfit wasfoundhighlysignificantforthedatawithR2 = 0.829forthe PDI. The significance of the coefficients is presented in Table 4. Out of six weatherparameters selected for the study, maximum temperature, morning relative humidity (RH), evening RH, wind speed and sun shine was found to be contributing significantlynegativeimpact onPDI. Whereas, minimum temperature was contributing significantly positive impact on PDI. The multiple regression equation derived from the data revealed that a unit change of maximum temperature could influence the disease severity up to an extent of 52.67 units, followed by minimum temperature which revealed that a unit change of minimum temperature could influence the disease severity up to an extent of 70.22, morning relative humidity (3.78), evening relative humidity (122.44), wind speed (42.44) and sunshine hour (68.44). The multiple linear regression was conducted to assess the relationship between the per cent disease index (PDI) (dependent variable) and independent variables like maximum temperature, minimum temperature, morning relative humidity, wind speed and sunshine. The model with an R2 of 0.829 indicates that about 82.9% of the variability in the PDI can be explained by these weather parameters, suggesting robust explanatory power. In the multiple linear regression analysis, out of six weather parameters selected for the study *i.e*., maximum temperature, morning relative humidity, evening relative humidity, wind speed and sunshine were found to be significant contributors to the PDI, as indicated by their significant coefficients (Table 4).

It can be seen from the regression equation that PDI is influenced negatively by maximum temperature, evening relative humidity, wind speed and sunshine. Conversely, it is positively influenced by minimum temperature and morning relative humidity.

Early sowing causes minimum damage of linseed crop from *Alternaria* blight disease and increased seed yield (Gupta et al., 2003; Chauhan et al., 2008; Singh et al., 2008; Shaikh et al., 2009; Khatun et al., 2011; Dhaliwal et al., 2020). Mahapatra and Das (2015) reported that *Alternaria* leaf blight severity gradually increased with delay in sowing irrespective of three different varieties of linseed (Binoy, Seeta and Bhagirathi). The crop sowing from 20th October to 5th November recorded significantly less disease severity with the highest seed yield and enhanced in subsequent sowing dates. Minimum temperature (9.7 to 12.0°C) had significant negative correlation, while minimum relative humidity (44.9 to 60.2% RH), wind velocity (during morning) (0.55 to 1.04 Km/hr.) and total rainfall (5.74 mm) had positive significant correlation with disease progression up to 59 per cent whereas, in 20th November sowing minimum temperature (9.69 to 15.74 °C), minimum relative humidity (39.0 to 88.0%) and maximum relative humidity (96.0 to 99.0%), wind velocity (during morning) (0.4 to 1.29 Km/hr.), bright sunshine hours (3.8 to 9.0 hr.) and total rainfall (69.6 mm) had positive significant correlation, wind velocity (evening) (0.4 to 1.3 Km/hr.) had negative significant correlation on disease progression up to 62.0 per cent. Bright sunshine hours (3.8 to 9.2 hr.), total rainfall (73.7 mm) and minimum temperature (9.7-18.2 °C) had positive significant correlation on disease progression up to 73 per cent.

Pandey et al. (2019) observed that the lowest disease incidence of *Alternaria* blight (41.30%) was recorded in crop sown on 17th Dec. with the maximum yield and lowest disease incidence in 2015-16 and 2016-17 crop seasos. Punia et al. (2021) observed that *Alternaria* blight disease severity was positively correlated with maximum and minimum temperature, wind speed, sunshine hours and evaporation, while relative humidity and rainfall negatively correlated with *Alternaria* blight on RH 30 and RH 0749 varieties of mustard.

**Evaluation of different varieties/ entries of linseed against the *Alternaria* blight of linseed under artificial epiphytotics:**

One hundred eighteen linseed entries were screened against *Alternaria* blight of linseed under artificial condition of inoculation of the pathogen. Lowest disease severity of 3.0 per cent was recorded in RLC164 followed by Janki X SLS 76 (3.2%),Nagarkota (4.0%), RLC 116 (4.2%), RL 2209 (4.8%), SLS 73 (5.2%), KLS-D-3 (5.8%), RLC 155 (5.8%). None of the entries were recorded as disease free. whereas, only 52 entries *viz.*, BAU 13-08, Mukta X Rashmi, Subra X Laxmi-7, BAU 13-09, JRF 4, DL-98-15-17, Chambal X RLC 92, Himalsi, JRF -5, KLS –D-3, BAU 15-02, TL 99, Neelam X Sweta, Sweta X Padmini, BAU 833-11, BAU-15-06**,** Divya, BAU 14-04, BAU 15-03, RL 1007, Kiran X OLC-10, RL 177, H 40, BAU-15-05, BAU-16-08, RLC-92, RLC 164, SLS 73, T-397 X Shekhar, Sweta X Subra,Janki X SLS-76, JRF 2, RLC-1-1009, SLS 68,LCK 9320, RLC 85, RLC 143, RLC 155, RL 2209, Subra X LMS 427, NDL 2005-29, Janki, PCL 34, RLC 109, Nagarkota, Birsa Tisi-1, TL 99, NL 260, Meera X J23, RLC 156, OL 98-13-1 and Rashmi showed resistant reaction against the *Alternaria*blight of linseed. Thirty twoentries *viz*., Kiran X LCK-4036, NDL165 X NDL 2004-5, NDL 2005, Himalsi X Meera, BAU

**Table 5.Evaluation of linseed entries/germplasm against *Alternaria* blight disease during *Rabi* season, 2022**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S. No.** | **Entries** | **Disease Severity (%)** | ***Alternaria* Blight (Disease Score)** | **Disease Reaction** |
| **1** | Kiran X LCK-4036 | 18.2 | 2 | MR |
| **2** | RLC 116 | 38.4 | 4 | S |
| **3** | RLC 191 | 58.6 | 4 | **S** |
| **4** | BAU 13-08 | 9.8 | 1 | R |
| **5** | Mukta X Rashmi | 6.8 | 1 | R |
| **6** | NDL165 X NDL 2004-5 | 24.5 | 2 | MR |
| **7** | Mukta X Chambal | 34.2 | 3 | MS |
| **8** | NDL 2005 | 15.4 | 2 | MR |
| **9** | Subra X Laxmi-7 | 9.0 | 1 | R |
| **10** | Shekhar X NDL 2004-5 | 12.0 | 2 | MR |
| **11** | JRF 4 | 9.2 | 1 | R |
| **12** | NDL 2005-17 | 32.0 | 3 | MS |
| **13** | BAU 13-09 | 8.4 | 1 | R |
| **14** | DL-98-15-17 | 9.0 | 1 | R |
| **15** | Chambal X RLC 92 | 8.4 | 1 | R |
| **16** | Himalsi | 6.8 | 1 | R |
| **17** | Himalsi X Meera | 18.7 | 2 | MR |
| **18** | JRF -5 | 7.4 | 1 | R |
| **19** | KLS –D-3 | 5.8 | 1 | R |
| **20** | Shekhar | 34.4 | 3 | MS |
| **21** | BAU 13-09 | 36.4 | 3 | S |
| **22** | BAU 15-03 | 11.2 | 2 | MR |
| **23** | BAU15-02 | 8.3 | 1 | R |
| **24** | TL 99 | 9.0 | 1 | R |
| **25** | BAU 14-03 | 18.8 | 2 | MR |
| **26** | Neelam X Sweta | 7.0 | 1 | R |
| **27** | BAU 10-11 | 16.2 | 2 | MR |
| **28** | Sweta X Padmini | 8.8 | 1 | R |
| **29** | BAU 15-06 | 9.0 | 1 | R |
| **30** | BAU 833-11 | 7.5 | 1 | R |
| **31** | RL 2600 | 36.2 | 3 | MS |
| **32** | R 552X Pusa -2 | 28.4 | 3 | MS |
| **33** | Meera X J- 23 | 7.0 | 1 | R |
| **34** | Laxmi X Garima | 18.2 | 2 | MR |
| **35** | T-397 X Shekhar | 7.2 | 1 | R |
| **36** | Subra X Meera | 12.6 | 2 | MR |
| **37** | SLS 73 | 5.2 | 1 | R |
| **38** | Sweta X Subra | 7.5 | 1 | R |
| **39** | LMS149-4 X LMS 153-3 | 15.6 | 2 | MR |
| **S. No.** | **Entries** | **Disease Severity (%)** | ***Alternaria* Blight (Disease Score)** | **Disease Reaction** |
| **40** | L-98-07-03 | 29.2 | 3 | MS |
| **41** | Jeevan X Shekhar | 19.1 | 2 | MR |
| **42** | BAU 06-07 | 14.1 | 2 | MR |
| **43** | RLC 164 | 3.0 | 1 | R |
| **44** | NL 124 | 19.2 | 2 | MR |
| **45** | Shekhar X SLS 61 | 18.1 | 2 | MR |
| **46** | BAU 17-08 | 56.8 | 4 | S |
| **47** | RLU-6 X Jeevan | 19.4 | 2 | MR |
| **48** | RLC 92 | 5.8 | 1 | R |
| **49** | Janki X SLS-76 | 3.2 | 1 | R |
| **50** | Padmini X Pusa-361 | 35.2 | 3 | MS |
| **51** | Subra X Laxmi-27 | 25.6 | 3 | MS |
| **52** | JRF 2 | 9.8 | 1 | R |
| **53** | BAU 13-06 | 31.2 | 3 | MS |
| **54** | Divya | 9.2 | 1 | R |
| **55** | BAU 14-04 | 7.8 | 1 | R |
| **56** | BAU 14-07 | 16.6 | 2 | MR |
| **57** | BAU 14-09 | 29.2 | 3 | MS |
| **58** | BAU 15-03 | 8.5 | 1 | R |
| **59** | Chambal X BAU13-01 | 36.3 | 3 | MS |
| **60** | JLT-98X Shekhar X PKDL-112 | 36.9 | 3 | MS |
| **61** | RL 1007 | 5.8 | 1 | R |
| **62** | Kiran X OLC-10 | 8.1 | 1 | R |
| **63** | LMS 23-06 | 29.4 | 3 | MS |
| **64** | Padmini X Pusa-2 | 16.8 | 2 | MR |
| **65** |  SLS-142 | 36.4 | 3 | MS |
| **66** | LCK 1-1009 | 19.2 | 2 | MR |
| **67** | RLC-1-1009 | 7.8 | 1 | R |
| **68** | SLS 68 | 7.2 | 1 | R |
| **69** | LCK 9320 | 9.4 | 1 | R |
| **70** | Sheela | 32.4 | 3 | MS |
| **71** | Pusa-2 X R 552 | 18.4 | 2 | MR |
| **72** | RLC 157 | 28.0 | 3 | MS |
| **73** | NDL 2015-03 | 27.0 | 3 | MS |
| **74** | RLC 153 | 38.0 | 3 | MS |
| **75** | TL 114 | 15.4 | 2 | MR |
| **76** | Rashmi X Meera | 39.0 | 3 | MS |
| **77** | RLC 85 | 6.2 | 1 | R |
| **78** | PKDL 18 | 23.1 | 2 | MR |
| **79** | J23X RLC 100 | 57.2 | 4 | S |
| **80** | RL 260-18 | 52.0 | 4 | S |
| **81** | RLC 143 | 8.0 | 1 | R |
| **82** | RLC 155 | 5.8 | 1 | R |
| **S. No.** | **Entries** | **Disease Severity (%)** | ***Alternaria* Blight (Disease Score)** | **Disease Reaction** |
| **83** | PKDL 65 | 19.2 | 2 | MR |
| **84** | Garima X Laxmi 27 | 17.5 | 2 | MR |
| **85** | RL 2206 | 13.4 | 2 | MR |
| **86** | Hira X J 27 | 38.1 | 3 | MS |
| **87** | RL 2209 | 4.8 | 1 | R |
| **88** | Subra X LMS 427 | 9.2 | 1 | R |
| **89** | Nagarkota X Pusa 2 | 14.0 | 2 | MR |
| **90** | OL 122 | 28.2 | 3 | MS |
| **91** | NDL 2005-29 | 7.0 | 1 | R |
| **92** | Janki | 8.8 | 1 | R |
| **93** | PCL 34 | 7.0 | 1 | R |
| **94** | EL 52047 | 16.2 | 2 | MR |
| **95** | RLC 109 | 8.0 | 1 | R |
| **96** | Laxmi 27 X Garima | 15.4 | 2 | MR |
| **97** | Priyam | 18.4 | 2 | MR |
| **98** | Nagarkota | 4.0 | 1 | R |
| **99** | Meera | 34.0 | 3 | MS |
| **100** | Birsa Tisi-1 | 9.0 | 1 | R |
| **101** | TL 99 | 6.2 | 1 | R |
| **102** | K. Brani Alsi-4 | 18.2 | 2 | MR |
| **103** | NL 260 | 5.2 | 1 | R |
| **104** | Binwa | 36.2 | 3 | MS |
| **105** | WTS 149 | 58.0 | 4 | S |
| **106** | RLC 156 | 7.0 | 1 | R |
| **107** | RLC 161 | 34.2 | 3 | MS |
| **108** | LMS 149-4 | 13.8 | 2 | MR |
| **109** | RL 177 | 5.0 | 1 | R |
| **110** | BAU 13-01 | 50.6 | 4 | S |
| **111** | H 40 | 7.8 | 1 | R |
| **112** | BAU-15-05 | 9.6 | 1 | R |
| **113** | BAU-16-08 | 8.0 | 1 | R |
| **114** | LC 54 | 19.4 | 2 | MR |
| **115** | OL 98-13-1 | 7.2 | 1 | R |
| **116** | T 397 | 38.2 | 3 | MS |
| **117** | Chambal | 51.0 | 4 | S |
| **118** | Rashmi | 5.4 | 1 | R |

15-03, BAU 10-11, BAU-14-03, PKDL 65, Shekhar X NDL 2004-5, Subra X Meera, Laxmi X Garima, LMS149-4 X LMS 153-3, Jeevan X Shekhar, BAU 06-07, RLU-6 X Jeevan, NL 124,Shekhar X SLS 61, BAU 14-07, Padmini X Pusa-2, LCK 1-1009, Pusa-2 X R 552, TL 114, PKDL 18, Garima X Laxmi 27, RL 2206, Nagarkota X Pusa 2, EL 52047, Laxmi 27 X Garima, Priyam, K. Brani Alsi-4, LMS 149-4 and LC-54 showed moderately resistant reaction against the disease and rest of the entries showed moderately susceptible to susceptible disease reaction against the disease(Table 5).

Kumar et al. (2012) observed that out of fourteen parents evaluated against *Alternaria* blight under field conditions, one line, NP-72 was found to be resistant reaction. Whereas, seven lines *i.e*. RLC-33, RLC-24522, RL 2450, C-429, NPRR-137 Acc.no. 2901 and RL-24109 and three testers *viz.,* Padmini, Jawahar- 23 and Jeevan were found to be moderately resistant. Singh *et al*. (2015) reported that out of fortysix varieties evaluated against *Alternaria* blight of linseed *(Alternaria lini)*, only two *viz.*Ayogi and ES-44 cultivars were found resistant reaction and twenty cultivars were moderately resistant. Singh *et al*. (2017) reported that out of 95 genotypes of linseed, none was found disease free (Immune). However, 15 genotypes (KL-31, KL-229, Polf-2, LCK-11, H-22, KL-168, KL-225, KL-221, KL-220, SJKO-17, H-12, H-15, H-43, H-5, Ayogi) showed resistant reaction against *Alternaria* blight.

**Conclusion**

Linseed crop sown on 4th November recorded lowest diseaseseverity(13.2 %) and highest grain yield of linseed (1052.31 Kg/ha). Late sowing favoureddisease development whereas early sowing recorded lower disease severity of *Alternaria* blight. The temperature ranged from 7.7 to 26.0 oC, relative humidity rangedfrom69.5to86.3 per cent,sunshine ranged from 8.0to8.2hr.andwind speedrangedfrom2.4to 2.5Km/hrfavoured*Alternaria* blightdiseasedevelopment. Disease severity weresignificantlypositivecorrelatedwithminimum temperature and evening relative humidity Whereas Maximumtemperature, mean temperature and wind speed showed non-significantly positive correlated with disease severity or per cent disease Index (PDI). PDI was showed significantly negative correlationwith morning relative humidity, mean relative humidity and sunshine hours and grain yield. Co-efficient of determination between PDI X minimum temperature (0.413), PDI X morning relative humidity (0.423), PDI X evening relative humidity (0.502), PDI X sunshine hour (0.654), PDI X grain yield (0.459) showed significant value. Themultipleregressionfit wasfoundhighlysignificantforthedatawithR2 = 0.829forthe PDI. Among one hundred eighteen linseed entries, none of the entries were recorded as disease free. whereas, fifty two entries *viz.*, BAU 13-08, Mukta X Rashmi, Subra X Laxmi-7, BAU 13-09, JRF 4, DL-98-15-17, Chambal X RLC 92, Himalsi, JRF -5, KLS –D-3, BAU 15-02, TL 99, Neelam X Sweta, Sweta X Padmini, BAU 833-11, BAU-15-06**,** Divya, BAU 14-04, BAU 15-03, RL 1007, Kiran X OLC-10, RL 177, H 40, BAU-15-05, BAU-16-08, RLC-92, RLC 164, SLS 73, T-397 X Shekhar, Sweta X Subra, Janki X SLS-76, JRF 2, RLC-1-1009, SLS 68, LCK 9320, RLC 85, RLC 143, RLC 155, RL 2209, Subra X LMS 427, NDL 2005-29, Janki, PCL 34, RLC 109, Nagarkota, Birsa Tisi-1, TL 99, NL 260, Meera X J23, RLC 156, OL 98-13-1 and Rashmi showed resistant reaction against the *Alternaria* blight of linseed.

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