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# Effects of temperature on incidence of flax wilt caused by *Fusarium oxysporum* f.sp. *lini*

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Fusarium wilt of flax caused by soilborne fungus *Fusarium oxysporum* f.sp. *lini* is the most important disease causing severe losses in fibre as well as seed yield all over the world under warm and humid conditions (Temperature ~25-30$^0$C). Flax crop (cv. JRF 2) was sown in three dates at 15 days interval starting at 30$^{th}$ October at ICAR- CRIJAF Research Farm, Barrackpore during 2017-2020.The result revealed that sowing of flax in 15 November reduces the disease by 35-47% in comparison to 30 October sown crop. Disease incidence was further reduced by 60-74% if the crop is sown in 30 November. Significant positive co-relation coefficient between incidence of disease and temperature (r=0.995 for maximum temperature and r=0.923 for minimum temperature) was observed.Under laboratory condition also different growth parameters of the pathogen like conidia germination, pathogen growth and germ tube emergence are adversely affected at lower temperature. Therefore, sowing of flax in November 15-30 may escape the disease.

**Keywords :** *Fusarium oxysporum* f.sp. *lini, Linum usitatissimum,* temperature, wilt

## INTRODUCTION

Flax (*Linum usitatissimum)* is one of the oldest and important fibre crop of the world. 'Linen' obtained from flax is one of the World's best raw materials for textile purposes. It is non-lignified, soft, flexible, lustrous, shining, pale yellow fibre and possesses high water absorbency quality. Furthermore, it is the second stronger fibre after ramie. Flax fibre has low elasticity and is resistant to high temperature, moisture and mildew. It contains 80-90% cellulose and is valued for strength and durability as it is stronger than cotton, rayon or wool. The best grades are used for linen fabrics such as damasks, lace and sheeting (Chaudhary *et al.* 2016, Gupta *etal.* 2006).

At present, India spends more than 1000 crores of rupees annually for import of flax fibre from China, Canada, Belgium, Holland and France to meet indigenous demand, particularly to defense sector. There is an urgent need to increase production and productivity of flax (as fiber and seed) in India to meet the needs of industry and to save foreign exchange. Fusarium wilt is considered as one of the major flax diseases limiting the flax production in India. The fungus is a cosmopolitan soilborne pathogen; hence, the disease occurs extensively both in seed and fiber crop in all flax-growing regions of the world. However, the economic significance of the disease varies with region, depending on the availability of resistant cultivars and the prevailing environmental conditions. The disease is most destructive in warm, dry seasons. In India also it is one of importance diseases of flax (Tripathi, 2016). Losses by vascular wilt disease in linseed crop goes up to 80 % under favourable conditions. Management of the disease is very difficult and single method is not sufficient for management of the disease. Presently there is no resistant variety of flax is available. In view the importance of the crop and seriousness of the disease the

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present investigation was undertaken to know the effect of atmospheric temperature on disease incidence so that manipulation of sowing date can reduce the effect of disease incidence.

## MATERIALS AND METHODS

Flax seeds(cv. JRF 2) collected from ICAR-CRIJAF, Barrackpore was sown in three dates at 15 days interval starting at 30th October at ICAR-CRIJAF Research Farm (88.43$^0$E and 22.75$^0$N, soil pH-6.8, soil texture- sandy loam, organic carbon- 1.21%, soil nitrogen-254 kg/ha, soil phosphorus-72.3 kg/ha and soil potassium-351 kg/ha) till November 15 during 2017-2020. The crop was raised with standard agronomic practices (seed rate 40/ha, one hand weeding at 20-25 DAS, irrigation as and when required and spacing 30cm x 5cm). Field data on incidence of wilt were collected at 10 days interval starting from 30days after sowing (DAS). Records on temperature (both maximum and minimum temperature) of crop season (Standard meteorological week 48-6) during three years (2017-2020) were collected from the meteorological observatory of the institute at Barrackpore and mean value of respective observation was presented (Fig.1). Statistical analysis of data were done using SAS programme. Under laboratory condition germination, growth and germtube emergence of the pathogen (*Fusarium oxysporium* f.sp. *lini)* was studied at different temperature starting from 15$^O$C to 35$^O$C at 5$^O$C interval.

## RESULTS AND DISCUSSION

### *Progress of vascular wilt of flax in different dates of sowing*

Occurrence of the disease and its symptoms have been shown in Fig.2. Symptoms of disease The result showed the cumulative progress of the disease gradually increased with crop age in all dates of sowing. However, the disease incidence gradually decreases in delay sown crops and least incidence was recorded in 30th November sown crop (Table1). Sowing of flax in 15 November reduce the disease by 35-47% in comparison to 30 October sown crop. Disease incidence was further reduced by 60-74% if the crop is sown in

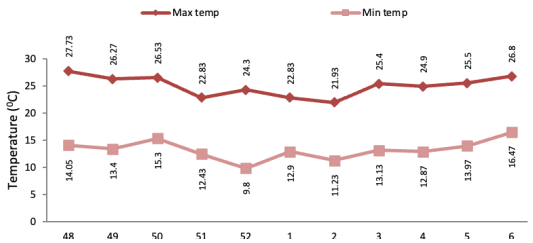


**Fig 1:** Maximum and minimum temperature during the growing season of flax at Barrackpore, West Bengal (mean of 2017-2019)


**Fig. 2** : Healthy and wilt affected flax crop along with symptoms.

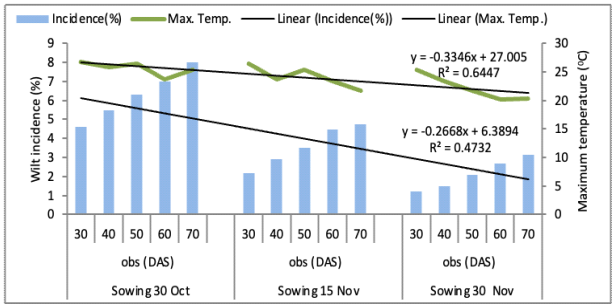


**Fig 3** :Effect of maximum temperature on the incidence of flax wilt under field condition

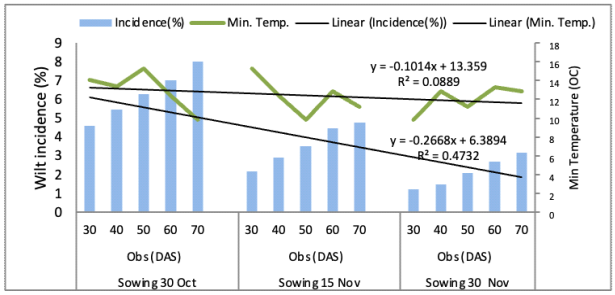


**Fig 4** : Effect of minimum temperature on the incidence of flax wilt under field condition

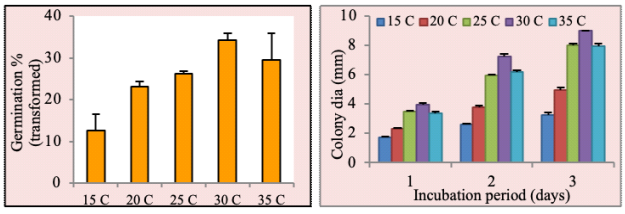


**Fig. 5 :** Effect of temperature on germination of conidia and growth of *F. oxysporium* f. sp *lini*

**Table 1 :** Progress of vascular wilt of flax in different dates of sowing (mean data of three years)

| Observation on disease incidence | Incidence of vascular wilt of flax (%) | | | C.D: P= 0.05 | Percent reduction of wilt in $D_2$ over | Percent reduction of wilt in $D_3$ over |
|---|---|---|---|---|---|---|
| | DoS 30 October | DoS 15 November | DoS 30 November | | | |
| | ($D_1$) | ($D_2$) | ($D_3$) | | $D_1$ | $D_1$ |
| 30 DAS | 4.6 | 2.6 | 1.2 | 0.61 | 43 | 74 |
| 40 DAS | 5.5 | 2.9 | 1.5 | 0.71 | 47 | 73 |
| 50 DAS | 6.3 | 3.5 | 2.1 | 0.80 | 44 | 67 |
| 60 DAS | 7.0 | 4.5 | 2.7 | 0.83 | 35 | 61 |
| 70 DAS | 8.0 | 4.8 | 3.2 | 0.97 | 40 | 60 |

DoS= Date of sowing, DAS= Days after sowing

**Table 2:**Correlation coefficient (r) between flax wilt and weather temperature at ICAR-CRIJAF,Barracpore

| Weather parameters | Correlation coefficient (r) |
|---|---|
| Maximum atmospheric temperature (°C) | 0.995* |
| Minimum atmospheric temperature (°C) | 0.923* |

*Correlation significant at 5 %

30 November (Table1). This may be due to lowering of atmospheric temperature. The result is corroborated with the findings of earlier workers (Kishor *et. al.* 2008; Singh and Singh, 2011; Singh and Kumar 2019).

***Effect of temperature on disease incidence under field condition***

The result revealed that with lowering of atmospheric temperature, wilt incidence decreases (Fig 3 &4). The decrease of disease ($R^2$=0.47) with lowering of maximum temperature (26.8$^O$C to 20.2$^O$C) ($R^2$=0.64) is more pronounced than decrease in minimum temperature (15.3$^O$C to 9.8$^O$C). Significant positive co-relation coefficient between incidence of disease and temperature (r=0.995 for maximum temperature and r=0.923 for minimum temperature) was observed. Kishor *et. al. (*2008) also reported the maximum incidence of wilt in early sown (October 10) crop. Aly (1988) had also reported that temperature has a pronounced effect on the development of the flax wilt pathogen. With lowering of atmospheric temperature, the rate of infection decreased. In both greenhouse and field tests, resistant cultivars of flax have been attacked severely at the relatively high temperatures of 25 - 30$^0$C, whereas even susceptible cultivars have escaped infection at temperatures below 20$^0$C.

***Effect of temperature on growth of pathogen under laboratory condition***

Different parameters like conidial germination, pathogen growth and germ tube emergence greatly increased upto 30$^O$C temperature and thereafter decrease. At lower temperature the above growth parameters are negatively affected (Fig.5). Pal *et al.* (2019) also observed that at lower temperature (24°C) the growth and sporulation of *F. oxysporum* f. sp. *lini* was more than high temperature.These laboratory findings support the lowering of disease incidence under field conditions.

## CONCLUSION

It is clear from the investigation that incidence of flax wilt reduced significantly with sowing of crop in cooler month. Another important inference of the study is the screening of germplasm which should be done not only under sick plot but also in relatively warmer season so that stable resistant lines can be identified.

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## DECLARATION

Conflict of Interest. Authors declare no conflict of interest.

## REFERENCES

Aly, A. A. 1988. Incidence of Fusarium wilt of flaxes influenced by biotic and abiotic factors. PhD Thesis, South Dakota State University. Brookings SD, USA.

Chaudhary, Babita.,Tripathi, M. K., Pandey, S. K., Bhandari, H.R., Meena, D. R. Prajapati, S. P. 2016.Uses of Flax (*Linum usitatisimum*) After harvest. *Inter. J. Trop. Agric*.**34:** 159-64.

Chaudhary, B., Tripathi, M.K., Bhandari, H.R., Pandey, S.K., Meena, D.R. ,Prajapati, S.P. 2015. Prospects of flax cultivation. *Indian Farming***65**: 17-19.

Chaudhary, B., Tripathi, M.K., Pandey, S.K., Bandana. 2016.Flax: The fibre of linen *Curr.Biotica***10**:1-4.

Gupta, D., Hazra, S.K., Saha, A., Mahapatra, A.K. 2006. Flax the fibre of Linum. Bulletin No. 2/2006. ICAR-CRIJAF, Barrackpore, 1-34.

Kishor, K., Singh, J., Pandey, M. 2008. Management of wilt disease caused by *Fusarium oxysporum f. sp. lini* in linseed through cultural practices. *Ann. Plant Protect. Sci.***16**: 245-247.

Kishore, R., Singh, S. 2008. Evaluation of fungicides against *Fusarium oxysporum f. sp. lini* of linseed. .*Ann. Plant Protect. Sci.* 16:165-167.

Pal, N., Kumar, A., Malannava, A.B. 2019. Effect of temperature and pH levels on the growth and sporulation of *Fusarium oxysporum*f.sp. *lini*causing linseed. *Inter. J. Chem. Stud.***7**: 4494-4497.

Singh, R. B., Singh, R. N.2011. Date of sowing and varieties for the management of root-rot wilt complex of linseed (*Linum usitatissimum*L.). *Ind. J.Agricult. Sci.***81**: 287-289.

Somesh, S.,N., Kumar S. 2019. Evaluation of Suitable Sowing Dates and Varieties for the Management of Linseed (*Linum usitatissimum* L.) wilt Under Wilt-Sick Field Condition incited by *Fusarium oxysporum*f.sp. *lini*(Bolley) Synder and Hansen. *Int. J. Curr. Microbiol. App. Sci.***8**: 1717-1727

Tripathi, A. N. 2016. Occurrence of vascular wilt incidence in fibre crop of flax caused by *F.oxysporum* f. sp. *lini* Schlecht. *J. Mycopathol. Res*.**54***:* 41-44