Occurrence of vascular wilt incidence in fibre crop of flax caused by *F. oxysporum* f. sp. *lini* Schlecht

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Occurrence of vascular wilt incidence in fibre crop of flax caused by *F. oxysporum* f. sp. *lini* Schlecht

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Flax (*Linum usitatissimum* L.) is an important bast fibre producing cash crop grown in temperate as well as tropical countries including India. Flax has been introduced as allied fiber crops at CRIJAF, Barrackpore for germplasm evaluation, conservation and varietal development during the year 2009-2010. So far, flax wilt (*F. oxysporum* f. sp. *lini* (Schlecht) was rarely noticed at Research Farm of CRIJAF. But due to continuous monoculture of flax during last five years, localized outbreak of the disease was noticed at research plot during December 2012-January 2013. Three types of wilt symptoms were observed; early wilt averaged up to 90%, late wilt up to 80% and partial wilt up to 10%. Out of seven genotypes, JRF2 was the most susceptible (80%) by JRF-1 (60%) and JRF-3 (40%). However, wilt incidence was least on genotypes viz. JRF-4, FT-850, FT-896 and FT 897. The incidence was drastically increased with the age of the crop and varietal response to moisture as well as to temperature. The pathogen was isolated from the stem section of the infected plant but not from root, pure culture was established and the pathogen was identified as *Fusarium oxysporum* f. sp. *lini*. This documentation may play an important role aiming for detail investigation of the disease, breeding/developing resistance varieties and development of disease management strategies under field condition.

Key words: Disease Incidence, Fusarial wilt, Genotype, *Linum usitatissimum*

INTRODUCTION

Flax (*Linum usitatissimum*) is a commercial bast fibre crop belonging to the family Linaceae (Barozai, 2012). It is cultivated as a cash crop of industrial importance in temperate as well as tropical regions of the world viz. Argentina, Canada, China, Ethiopia, India, Pakistan, Poland, Russia and USA (Muir and Westcot, 2003). Reports pertaining to flax wilt occurrence in Australia dates back from 1913 (Millikan, 1951), in India from 1923 (Gill, 1987), in Northern Ireland from 1926 (McKay, 1947). In Eastern Europe the incidence of disease was first published in 1973 (Dudin and Sysoenko, 1973). Flax wilt is a seed/soil borne fungal disease (Nair, 1956, Kommedahl *et al*, 1970) caused by *F. oxysporum* f. sp. *lini* (Schlecht) which belongs to the Deuteromycetes (mitosporic fungi Imperfecti), section Elegans (Snyder and Hansen, 1940). The pathogen has very limited host range and restricted only to species of the genus Linum (Armstrong and Armstrong, 1968; Snyder and Hansen, 1940). This

crop has been introduced as allied fibre crops at CRIJAF, Barrackpore for germplasm evaluation, conservation and varietal development of flax during the year 2009 -2010. It was observed in epidemic form on flax varieties in the research farm during the month of December to January 2011-2012 and 2012-2013. Wilt disease symptoms appeared from any growth stage i.e. cotyledon (GS-1) to flowering (GS-9). Disease incidence is gradually increasing year after year due to development of heavy inoculum load of the pathogen in the soil which makes experimental field as a sick plot and threatens cultivation of flax in such fields. Therefore, this study will help in the better understanding of flax wilt pathosystem as well as development of resistant varieties which is best alternative to manage the disease.

MATERIALS AND METHODS

Seven flax varieties namely JRF-1, JRF2, JRF-3, JRF-4, FT-850, FT-896 and FT 897 were grown in 2011-2012 and 2012-2013 with followed of recommended agronomic package of practice and crop was planted in Ist week of November. The soil of experimental field is alluvial with 6.5-7.0 pH and organic carbon content up to 1.0%. However the conducive parameter viz. temperature (23.9 – 24.8 ^{O}C) and soil (15.4-16.8 ^{O}C) were recorded during the month of December and January 2011-12 and 2012-2013, respectively. Wilted plants were collected from the experimental field and presence of the wilt pathogen in infected plants can be ascertained in the laboratory by using light microscopy. The stem of each plant was cut into four parts (between root and in- florescence) a cut section of infected stem placed on agar media to identify the causal fungus on January 20 when seeds were just forming. A stem section about 1 cm. long is surface disinfected in 0.1% Hgcl2 for 1 minute , rinsed with sterile water and plated on Potato Dextrose Agar. The wilt pathogen was isolated only from the discoloured part of the stem. The pathogen causing wilt was grown from the stem section after 2-3 days of incubation at 25° C as illustrated in figure 4. Subsequently pure culture was established on PDA and fungal growth was used for mount preparation for confirmation of the wilt pathogen by using of light microscope (Figure 5 and 6).

RESULTS AND DISCUSSION

Three types of wilt symptoms were observed: early (wilt occurs prior to flowering from stage of cotyledon (GS1) to bud formation (GS 6), late (wilt after flowering from first flowering (GS 7) to late flowering (GS 9)) and partial. Early wilt is potentially the most destructive and usually predominates, since 100 per cent of the plants in a stand may be dying from the cotyledon stage to floral bud formation stage. At first, infected plants appear sickly yellow, begin to wilt at the top, then slowly die and eventually become dry and brown (Figure 1). Late wilt has been observed up to 80 per cent of the plants and occurred from flowering through boll set in the form of stem browning and discoloration.(Figure 2 and 3) Partial wilt was of less important and averaged 10 per cent in prevalence during a 2 year observation period from 2011-12 to 2012-2013 of flax varieties in experimental field. When the weather is more favourable for flax than for wilt, the new lateral shoots remain free from infection while hot weather, which favours wilt, the lateral shoots may subsequently wilted and the whole plant die (Table 2). Why only some of the vascular elements are invaded by the pathogen is not well established; perhaps it is a matter of chance.

Table 1 : Incidence of flax wilt in different genotypes/varieties

Varieties	* Wilt incidence (%)				
	Dec 10	Dec 25	Jan 10	Jan 25	Feb 10
JRF-1	10	24	40	60	70
JRF-2	20	38	70	80	85
JRF-3	12	16	20	40	60
JRF-4	4	6	10	30	52
FT-850	2	4	6	8	10
FT-896	3	5	5	8	12
FT-897	3	5	6	7	10

* Based on averages for two seasons (2012-13) with the 100 plants of the same varieties of flax; the flax stems having wilt proved to be infected with the pathogen (as determined by isolation and microscopic studies).

Infected fields were observed at fort night intervals and data were recorded by counting the number of infected plants and total population to calculate wilt incidence. As shown in Table 1, the percentages of wilt incidence on flax varieties were; JRF-2 (80%), JRF-1 (60%) and JRF-3 (40%). JRF-2 appeared to be most susceptible to wilt than other varieties. Disease incidence graph for flax varieties were presented in Figure 4. Wilt percentages are based on averages of 100 plants; from five locations with 20 plants per lines. Scoring for wilt reaction is based on scale of 0 to 9. This is the ûrst report of flax wilt outbreak in the research farm located at CRIJAF. This documentation will play

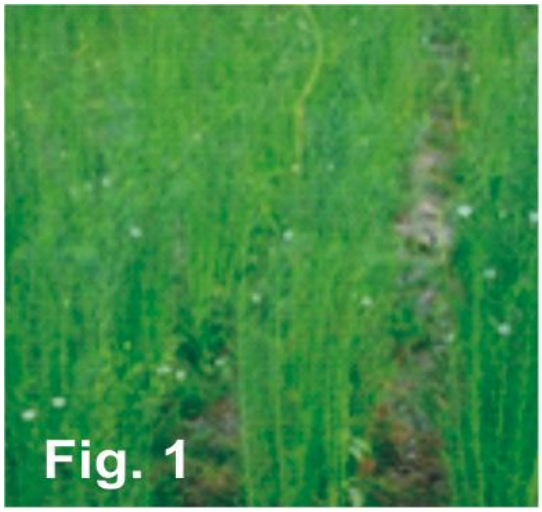

Fig. 1: Healthy crop

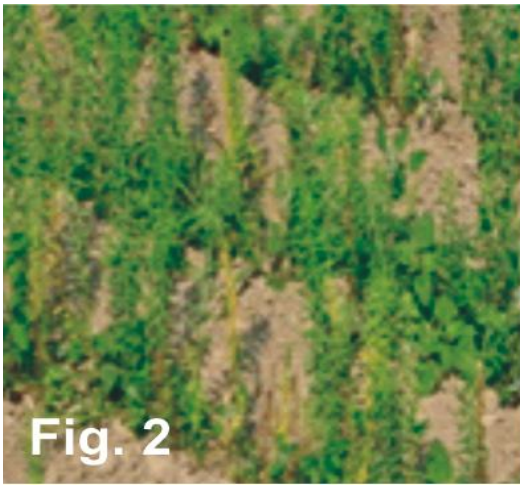

Fig. 2: Wilted crop

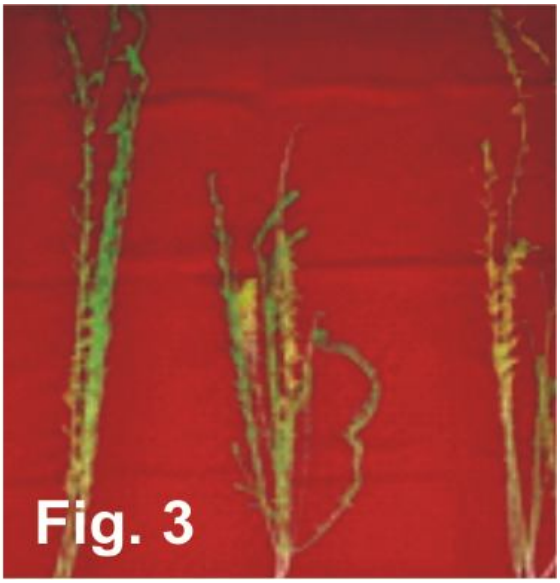

Fig.3: Wilted plant

Table 2 : Environmental parameter during December 2012-January, 2013

	Temperature (°C)		Soil Temperature (°C)	
Month	Maximum	Minimum	5cm	15 cm
December 2012	24.8	12.2	14.7	16.8
January 2013	23.9	10.5	13.3	15.4

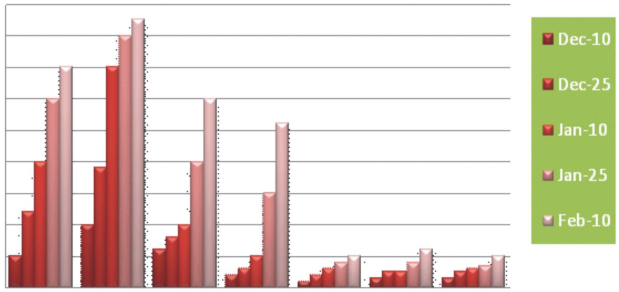

Fig. 4 : Percent of wilt incidence on flax genotypes

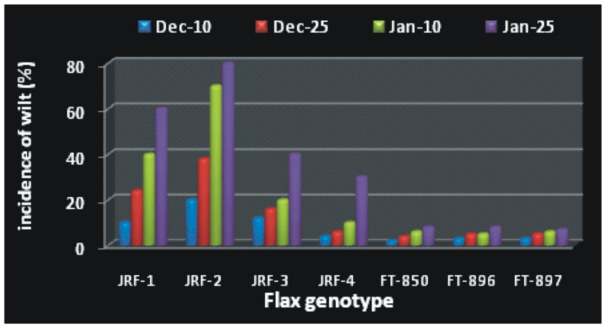

Fig. 5 : Dynamics of wilt in different flax genotypes

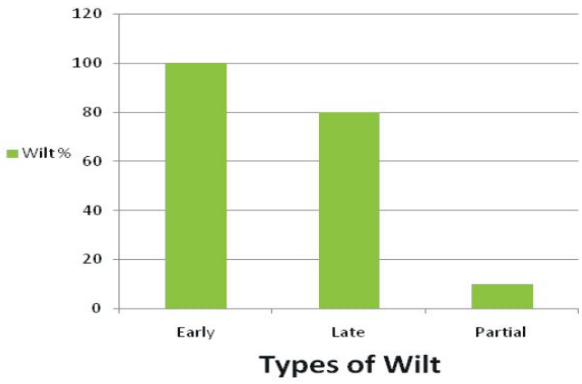

Fig. 6 : Percentage of wilted plants with the type of wilt symptom

important role for strategies aimed to developing resistance varieties, disease free germplasm conservation and suitable management modules for flax wilt. Wilt incidence was more abundant in 2012-13 than 2011-12.Wilt symptoms may appear at any stage of flax growth and may vary greatly with the age and variety of plant, cultural practices,

environmental conditions, and the physiological race of the pathogen. There was a direct relationship was observed between the soil temperature and soil moisture for the wilt incidence (percentage of wilted plants). Diseased plants occur at random throughout the field. However, in 2011-12 wilt appeared in low intensity than 2012-2013 due to varietal response to moisture as well as to temperature. (Table 2). Disease incidence is gradually increasing year after year due to development of heavy inoculum load of the pathogen in the soil which makes sick plot and threatens cultivation of flax in such fields. Being a complex nature of disease, there is limited scope of fungicidal application. Wilt disease appear from any growth stage from cotyledon to flowering when the application of control measure become ineffective. Therefore breeding of wilt resistant flax varieties is best alternative to manage the disease under field condition.

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