Survey for the incidence of Fusarium wilt in Sunhemp in the regions of Dharwad and Haveri districts of Karnataka

Abstract

Fusarium wilt, caused by the fungal pathogen,*Fusarium oxysporum*, is a major disease affecting a wide range of crops, leading to significant yield losses globally. This study was conducted to assess the incidence of Fusarium wilt across three distinct locations: College of Agriculture (CoA), University of Agricultural Sciences (UAS), Dharwad, Agricultural Research Station (ARS), Mugad and College of Agriculture, Hanumanamatti. A systematic survey was carried out during the cropping season, where the prevalence and severity of the disease were recorded in various fields at each location. The data collected included soil type, percentage of infected plants, the extent of wilting symptoms, and occurrence of other diseases.The survey results indicated that, the highest incidence of disease was recorded in G and F block (43.67 %) followed by B block (9.71 %) at UAS Campus, in Dharwad district and lowest incidence was recorded from COA, Hanumanamatti (7.33 %) in Haveri district. The differences in disease incidence were attributed to variations in environmental conditions, crop management practices, and soil health. Understanding the distribution and factors influencing Fusarium wilt can aid in developing effective management strategies to mitigate its impact on crop production. Further research is needed to explore resistant varieties and improved agronomic practices to control Fusarium wilt in these regions.

Key words: Fusarium wilt , Disease incidence , Resistant varieties

1. Introduction

Sunhemp (*Crotalaria juncea* L, 2n=16) which is known by different names as Indian hemp, Brown hemp, Madras hemp, is a tropical Asian plant belonging to the Fabaceae.The crop is also grown for green manure as well as fibre. It holds promising account in fixing atmospheric nitrogen, reducing soil erosion, suppressing weeds, adding organic matter and could diminish the build-up of nematodes population.India is the largest producer of sunhemp fibre followed by

Bangladesh and Brazil.However, its area and production gradually stepped down with the advent of green revolution. The reason was expansion of irrigation facilities and intensive cropping system with more profitable crops like paddy, pulses, oilseeds and vegetables (Sarkar *et al*., 2015).Due to more incidence of disease and pest complex under a varying climatic scenario and fluctuating economic return when evaluated with other competitive crops area, productivity and production of sunhemp began declining over the years and also the main reason is lack of quality seed, as seed is fundamental in agricultural system and the high yield of quality seed can only be achieved with improved agro-techniques (Chittapur and Kulkarni, 2003). Among biotic stresses *viz.*, fusarium wilt, sclerotium rot, anthracnose and mosaic on sunhemp which are infected to the crop starting from the seedling stage to harvesting stage. Sarkar *et al*. (2015) described that the wilt disease is caused by *Fusariumudum* (Bult.) f. sp.*crotalariae* (Kulkarni) prior named as *Fusarium lateritium* f. sp. *crotalariae, F. vasinfectum*Atk. *v. crotalariae* (Padwick). Mainly the pathogen survives in the crop stubbles as it is a facultative parasite. The pathogen produce sporodochia which is pink coloured and on which enormous macro and micro-conidia are produced. Fungal spores and hyphae block the xylem vessels of the infected part leading to death of the plant. Microconidia is single celled, mostly curved, hyaline and are scattered. Macroconidia is falcate, subulate, pedicellate with 1-3 septa and rarely having 4-7 septations. Conidia are borne on verticillate branched conidiophores forming slimy groups at the tips of the phialides. Chlamydospores measures 4 to 10 µm in diameter, ochre yellow coloured and typically intercalary.Sarkar and Gawande (2016) described symptoms of disease as the affected plant gradually withers, droops and hang down later turns brown leading to death of plant. The fungus also produced sporodochium on the dead portion of the stem where the infection is confined with pinkish tinge on which enormous macro and micro conidia are produced.Mosaic and wilt in sunhempreduce the fibre yield to the tune of 10 to12 per cent and 40 per cent respectively. But 60 per cent of yield loss can be caused by wilt alone under favourable conditions (Mitra, 1934).Uppal (1937) reported that the wilt incidence was 88 per cent under green house conditions and was about more than 60 per cent in seedling condition.Bandopadhyay *et al.*(1982) stated that incidence of sunhemp wilt caused by pathogen *F. udum*f. sp.*crotalariae* is about of 10 to12 per cent but it may be 60 to 70 per cent under favourable condition and the average loss due to this disease is about 11 to 15 per cent. Li *et al.* (2012) reported that sunhemp grown in wet soil is susceptible to *Fusarium* spp. and causes significant yield losses.The survey on wilt of sunhemp is not carried out till now. Hence it is important to conduct survey to know about disease severity in different regions and to formulate effective management strategies.

2. Materials and methods

2.1.Study area

The present investigations on wilt of sunhemp caused by *Fusarium udum* f. sp. *crotalariae* (Kulkarni) Subram. was carried out during the year 2019-2020. The studies were conducted at College of Agriculture, University of Agricultural Sciences and ARS Mugod, Dharwad and also in Haveri. Dharwad is located at geographical co-ordinate of 15^{o}12' N and 75^{o} 07' E with an altitude of 670 m above mean sea level. The average annual rainfall of the location is 835 mm distributed from May to November in bimodal way. The temperature ranges 12-36^{o}C and relative humidity varies between 34-87 per cent.

2.2.Methodology forSurvey for the incidence of wilt in sunhemp

A fixed plot survey was conducted during 2019-2020 to record the incidence and severity of wilt in sunhemp seed production plots in northern parts of Karnataka UAS Main Campus (B, F and G Block) in Dharwad, ARS Mugad and College of Agriculture, Hanumanamatti. The plants showing typical symptoms of wilting in the field plots were selected randomly in 5 - 10 rows in each field and number of affected plants as well as total number of plants in selected rows were counted. During survey, information was collected as described in the following survey format and per cent disease incidence was calculated to know the severity of the disease by using the formula given by Wheeler (1969).

$$\text{Per cent Incidence} = \frac{\text{No. of plants showing wilting symptoms}}{\text{Total number of plants observed in a field}} \times 100$$

During the survey information was collected as described in the following survey format.

Sl No.	Particulars
1	District, taluk, village
2	Area (in acre)
3	Soil type
4	Rainfed/ Irrigated
5	Variety
6	Other diseases noticed
7	Plant protection measures
8	Percent disease incidence
9	Stage of crop

Results and discussion

3.1. Survey for the incidence of fusarium wilt in sunhemp

3.1.1.Dharwad district

In Dharwad district, sunhemp seed production plots at UAS main campus near *krishimela* site (F block and G block), near organic farm (B block) and in ARS, Mugadwere surveyed for recording the wilt incidence and the per cent disease incidence in all the surveyed plots ranged from zero to 81.60 per cent (Table 1a and 1b).In UAS main campus, near *krishimela* site nine seed production plots at G block and F block were surveyed and observed that the wilt incidence varied from 14.80 to 81.60 per cent. Among the surveyed plots in G block, plot 169 recorded the maximum disease incidence (81.60 %) followed by plot 171 (76.00 %) and the least incidence of the disease was recorded in plot 173 (14.80 %).Further, in UAS main campus, near organic farm (B block) seven seed production plots were surveyed for recording the wilt incidence. The incidence of wilt ranged from 2.80 per cent to 36.80 per cent. The maximum wilt incidence was recorded in plot 34 showing 36. 80 per cent incidence and plot 29 recorded least wilt incidence of 2.80 per cent. Whereas, plot number 25, 30, 33, 28 and 32 recorded 3.20, 4.00, 5.20, 7.20 and 8.80 per cent incidence respectively.In ARS Mugad, four plots were surveyed and the disease incidence was recorded in the surveyed plots. The wilt incidence ranged from 0.00 to 16.80 per cent among the plots surveyed. It was observed that maximum incidence of wilt was recorded in plot number

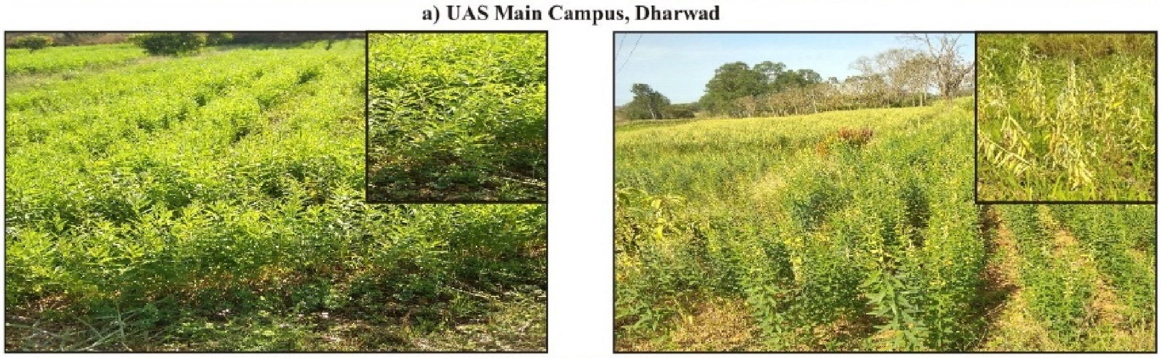
76 (16.80 %) and plot number 72 recorded the least incidence with zero per cent incidence whereas, plot 78 and 75 recorded incidence of 7.20 and 8.80 per cent respectively.

3.1.2. Haveri district

In Haveri district, three seed production plots at COA, Hanumanamatti were surveyed for recording the per cent wilt incidence and observed that the wilt incidence ranged from 1.00 per cent to 13.80 per cent in all the surveyed plots (Table 2). Among the three surveyed plots in the Hanumanamatti campus the maximum incidence of wilt was recorded in the plot 25 (13.80 %) followed by plot 24 (8.40 %) and plot 5 recorded the lowest disease incidence of 1.00 per cent.The incidence of wilt in sunhemp among all the surveyed areas were ranged from zero per cent to 81.60 per cent. Among the two districts surveyed, the meanincidence of 20.53 per cent was recorded in Dharwad district and lowest mean incidence of wilt was observed in Haveri district recording of 7.33 per cent

The survey results indicated that, the highest incidence of disease was recorded in G and F block (43.67 %) followed by B block (9.71 %) at UAS Campus, in Dharwad district and lowest incidence was recorded from COA, Hanumanamatti (7.33 %) in Haveri district.

a) UAS Main Campus, Dharwad



b) ARS, Mugad

Plate 1a, b and c. Survey carried out for Fusarium wilt in Sunhemp at UAS Main campus, ARS Mugadand at CoA, Hanumanamatti

Table 1a. Survey for the incidence of fusarium wilt in sunhempduring *kharif/rabi* 2019-2020 at UAS Campus , Dharwad

District	Place	Plot	Area (acre)	Soil type	Crop grown condition	Variety	Stage of crop	Per cent disease incidence	Other disease recorded	Plant Protection measures
Dharwad	Near *krishimela* site (G Block)	G-169	0.25	Black	Rainfed	Local	Flowering	81.60	No	No
		G-170	0.25	Black	Rainfed	Local	Flowering	76.00	No	No
		G-171	0.25	Black	Rainfed	Local	Pod formation	68.00	No	No
		G-173	0.50	Black	Rainfed	Local	Flowering	14.80	Powerdy mildew	No
		G-174	0.25	Black	Rainfed	Local	Flowering	30.00	No	No
		G-175	0.50	Black	Rainfed	Local	Flowering	49.60	No	No
		G-176	0.50	Black	Rainfed	Local	Flowering	39.20	No	No
		G-178	0.50	Black	Rainfed	Local	Flowering	28.40	No	No
	(F Block)	F-140	0.50	Black	Rainfed	Local	Pod formation	32.40	No	No
							Mean PDI	**43.67**		
	Near organic Farm (B Block)	B-25	1.00	Black	Rainfed	Local	Pod formation	3.20	Powdery mildew	No
		B-28	0.50	Black	Rainfed	Local	Pod formation	7.20	No	No
		B-29	0.50	Black	Rainfed	Local	Pod formation	2.80	No	No
		B-30	0.50	Black	Rainfed	Local	Pod formation	4.00	Powdery mildew	No
		B-32	0.50	Black	Rainfed	Local	Pod formation	8.80	Powdery mildew	No
		B-33	0.50	Black	Rainfed	Local	Pod formation	5.20	No	No
		B-34	0.50	Black	Rainfed	Local	Pod formation	36.80	No	No
							Mean PDI	**9.71**		

Table 1b. Survey for the incidence of fusarium wilt in sunhempduring *kharif/rabi* 2019-2020 at ARS, Mugod , Dharwad

District	Place	Plot	Area (acre)	Soil type	Crop grown condition	Variety	Stage of crop	Per cent disease incidence	Other disease recorded	Plant protection measures
Dharwad	ARS, Mugad	72	0.25	Red	Rainfed	Local	Vegetative stage	0.00	No	No
		75	0.50	Red	Rainfed	Local	Vegetative	8.80	No	No
		76	0.25	Red	Rainfed	Local	Flowering	16.80	No	No
		78	0.50	Red	Rainfed	Local	Flowering	7.20	No	No
Mean PDI								**8.20**		
District mean								**20.53**		

Table 2. Survey for the incidence of fusarium wilt in sunhempduring *kharif/rabi* 2019-2020 at COA, Hanumanamatti, Haveri

		Plot	Area (Acre)	Soil Type	Grown Condition	Variety	Stage of crop	Percent Disease Incidence	Other disease recorded	Plant protection measures
Haveri	COA, Hanumanamatti	5	4.00	Red	Rainfed	Local	Pod formation	1.00	Powdery mildew	No
		23	3.00	Black	Rainfed	Local	Pod maturity	8.40	Powdery mildew	No
		25	4.00	Black	Rainfed	Local	Pod maturity	13.80	Powdery mildew	No
Mean PDI								**7.33**		
District mean								**7.33**		

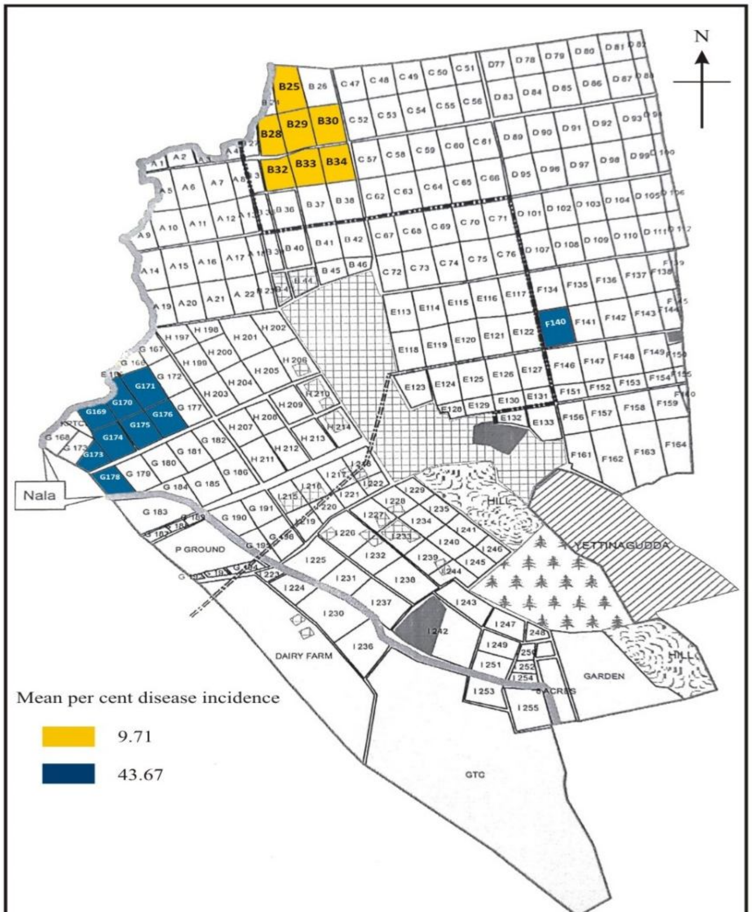


Fig. 1: Map showing incidence of fusarium wilt in sunhemp during *kharif/rabi* 2019-20 at Main Agricultural Research Station, Dharwad

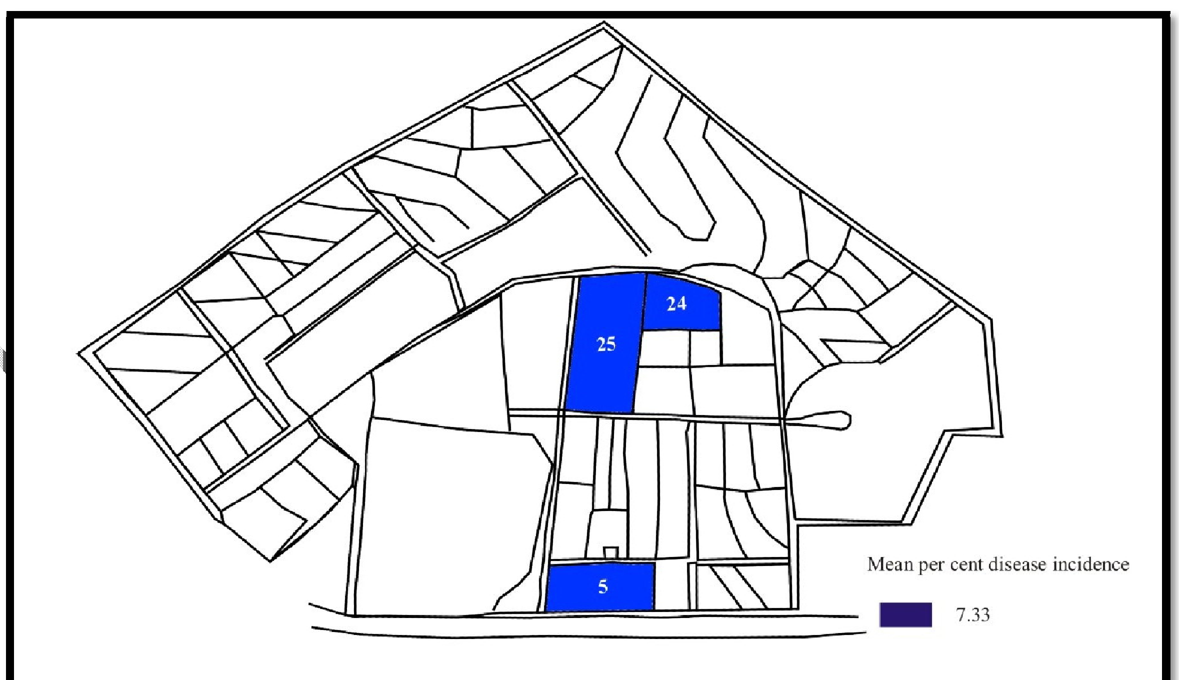


Fig. 2: Map showing incidence of fusarium wilt in Sunhemp during kharif/rabi 2019-20 at CoA, Hanumanamatti

3.2. Factors responsible for variation in disease incidence in different location

The variation in occurrence of the disease in different location is mainly due to environmental conditions and cultivation practices followed *viz.,* seed material used, amount and frequency of irrigation, fertilizer application, plant protection measures, stage of crop, edaphic factors and prevalent race of pathogen.The incidence of wilt in sunhemp varied from zero to 81.60 per cent in the surveyed plots. Maximum mean incidence of wilt was noticed in the plots surveyed near *krishimela* site at G and F block (43.67 %) followed by plots near organic farm (B block) (9.71 %), ARS, Mugad (8.20 %) and the minimum incidence of 7.33 per cent was noticed in the plots surveyed at COA, Hanumanamatti campus. It was evident from the literature on wilt of pigeon pea, that disease incidence of wilt varied from year to year and place to place and also soil moisture play major role in the incidence (Bidari, 1995; Saifulla and Mahesh, 2009 and Mahesh, *et al.,* 2010).The incidence was high in the UAS main campus because the plots were located in the low lying area where water percolation is less and the soil moisture is maintained for most of the time favouring for the survival of the pathogen.

It was observed that the disease noticed mainly during flowering,pod formation and pod maturity stages. The wilt incidence was prevalent more in reproductive phase of the crop as the nutrients drain to the reproductive part of the plant and due to imbalance supply of nutrients in the stem and root region. Such observations have also been recorded by different researchers having 30 to 90 per cent disease incidence at flowering and crop maturity stages in pigeonpea (Kannaiyan and Nene, 1981).

Continuous cultivation of the same crop year after year could be the reason for high incidence of this disease as *Fusarium* is soil borne pathogen. Further, it may be due to the formation of resting structure chlamydospore in the unfavourable condition as it can overcome adverse climatic condition and survive in soil for more than six years even in the absence of host plant. Its ubiquity in soil worldwide and its ecological activities indicate a much more diverse role in nature (Haware *et al*., 1996).

References

Bandopadhyay, A. K., Prakash, G. and Som, D., 1982, Screening of germplasm of sunnhemp against fusarium wilt disease. *Bangladesh J. Bot.*, 11(1): 14-16.

Bidari, V. B., 1995, Incidence and distribution of Pigeon pea wilt in Karnataka. *Indian J. Pulses Res.*,8: 166-168.

Chittapur, B. M. and Kulkarni S. S., 2003, Effect of sowing dates on the performance of sunnhemp. *J. Maharashtra Agric. Univ.*, 28(3):331-331.

Haware, M. P., Nene, Y. L. and Natarajan, M., 1996, Survival of *Fusarium oxysporum*f. sp. *ciceris*in soil in absence of chickpea. *Phytopath. Medit*., 35:9-12.

Kannaiyan, J. and Nene, Y. L., 1981, Influence of wilt at different growth stages on yield loss in pigeon pea. *Trop. Pest Mgt*., 27(1): 141.

Li, Y., Wang, Q., Klassen, W. and Hanlon, E. A., 2012, *Crotalaria Juncea.* Soil and Water Science Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. USA, pp. 2-4.

Mahesh, M., Muhammad, S., Prasad, P. S. and Sreenivasa, S., 2010, Studies on cultural variability of *Fusarium udum* isolates in India. *Int. J. Sci. Nat*., 1(2): 219-225.

Mitra, M., 1934, Wilt disease of *Crotalaria juncea* L. (Sun-hemp). *Indian J. Agr. Sci*.,4: 701-704.

Saifulla, M. and Mahesh., 2009, Status of *Fusarium* wilt and sterility mosaic disease of pigeon pea in southern Karnataka. *TrendsBiosci*., 2(1): 6-9.

Sarkar, S.K. and Gawande, S.P., 2016, Diseases of jute and allied fibre crops and their management (Book), p. 330.

Sarkar, S. K., Hazra, S. K., Sen, H. S., Karmakar, P. G. and Tripathi, M. K., 2015, Sunnhemp in India. ICAR-Central Research Institute for Jute and Allied Fibres (ICAR), Barrackpore, West Bengal, pp. 1-139.

Uppal, B. N. and Kulkarni, N. T. 1937, Studies in Fusarium wilt of sunnhemp. The physiology and biology of *Fusarium vasinfectum*Atk. *Indian J. Agric. Sci*., 7(3): 413- 442

Wheeler, B. E. J., 1969, *An Introduction to Plant Disease*, John Wiley and Sons Ltd., London, p. 301.