SCREENING OF LENTIL GENOTYPES AGAINST WILT OF LENTIL (*LENS CULINARIS* MEDIK L.) CAUSED BY *FUSARIUM OXYSPORUM* F. SP. *LENTIS* IN GLASSHOUSE CONDITION.

Abstract. Wilt of lentil is most damaging disease of lentil caused by the fungus *Fusariumoxysporumf. sp.lentis*. It causes severe crop damage from vegetative to reproducing stage which results in yield reduction. *Fol* isolates shows high variability and aggressiveness according to the climatic condition. So to overcome from this disease there are many ways of management like by cultural, mechanical, biological and chemical practices. Resistant variety selection is one of the best ecofriendly cultural management of the disease. So for this purpose one hundred genotypes were taken and screened through pot screening technique under glasshouse was carried out at the Student Instructional Farm (SIF), in the department of Plant Pathology, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, which is situated in the IndoGangatic plains of eastern Uttar Pradesh at a latitude of 26.470 and an altitude of 113 meters above sea level during Rabi 2020-21.One hundred genotypes of lentil were obtained from the Department of Genetics and Plant breeding, N.D. University of Agriculture and Technology, Kumarganj, Ayodhya and IIPR, Kalyanpur, Kanpur (U.P.).Out of 100 genotypes, 41 genotypes were found highly resistant, 30 genotypes resistant, 8 genotypes moderately resistant, 10 genotypes susceptible and 11 genotypes highly susceptible to Fusarium wilt.

Keywords:*Lentil, Fusariumoxysporum f. sp. Lentis, genotype, screening.*

Comment [LL1]: Why does it add the "L." of Linnaeus if the author is Medik?

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Introduction

Lentil (*Lens culinaris*Medik~~L.~~),also known as Masur, was also known as one of the first crop to be domesticated, may be as early as 8,500 years ago since then, it has become a key food legume crop in the food system of many countries [1].Lentil is thought to have originated in Near East and expanded quickly to Egypt, Central and Southern Europe, the Mediterranian basin, India, Pakistan, China and later Latin America[2,3,4].Lentil is grown throughout the world as rainfed crop in winter season. It is herbaceous, annual, self - pollinated pulse crop of *Fabaceae* family with erect / sub-erect growth habit. It is diploid (2x=2n=14) with genome size 4063 Mbp [5,6]. There are some names of lentil in different languages Lentil (English), Mercimek (Turkey), Masur (India), Heramame (Japanese). Lentil seeds are rich in protein, the mean level is at about 28.5% [7]. Dehulled lentil contains 24-26% protein, 3.7% fibre and 57% carbohydrate. It is a good source of minerals. It is also rich in 10-15 mg Vitamin C, (450IU) vitamin A and 9% Vitamin B_2[8]. Lentil is second most widely grown *Rabi* pulse crop in India after chickpea, and is most grown in North East Plains Zone and Central India, covering 1.51 million hectares (mha) with an annual production of 1.61 mts [9]. India was first in terms of area and second in terms of output, accounting for 39.79 per cent of global area and 22.79 per cent global production respectively. Croatia has the highest productivity (2862 kg/ha) followed by New Zealand (2469 kg/ha). With a productivity of 1633 kg/ha, Canada ranks first in production (41.16%) which is higher than

India's productivity[10].It is mostly grown in M.P. on 5.57 lakh ha with 6.67 lakh tones produced, followed by U.P. on 4.78 lakh ha with 4.47 lakh tones produced with a productivity of 936.0 kg/ha[11].Lentil is primarily grown for its seed and is used as dal. Lentil flour is used in soups, purees, and mix with cereals to produce bread and cakes; also as a meal forinfants [12].It may be cultivated in different type of soils, ranging from light loam to black cotton soil, although it thrives in clay soil and can even withstand less fertile moderately alkaline soils.Lentil is a high yielding, long day- plant with certain varieties that are day-neutral and grow best in environments with annual precipitation range from 2.8-24.3^0 C, and pH of 4.5-8.2. [13,14]. The maturation period of lentil crop is between 90 to 128 days .

Production of lentil crop is constrained by a number of abiotic and biotic stresses. Abiotic factors including drought, terminal heat, and salt susceptibility cause considerable yield loss. Among biotic stresses fungal diseases are most common which greatly reduces the crop production and productivity. Among fungal diseases, ascochyta blight and fusarium wilt are major diseases which reduces its yield remarkably [15,16,17]. Wilt in lentil, caused by *Fusariumoxysporum*f.sp*lentis* (Fol), is a one of the major cause of crop loss on every continent except Australia where lentils are produced [18, 19, 20]. It is the most destructive disease as it causes significant annual yield losses. The wilt pathogen reduces crop yield and leads to deterioration of seed quality [21]. It is a soil borne pathogen of lentil that can live in plant materials in the field and the pathogen has medium entry potential.It infects its host by entering through the root and blocking the vascular system (xylemand phloem), preventing water and nutrient transfer to the plant, causing wilting, discoloration, and eventually causing death. Wilt disease occurs at both pre- emergence as well as post emergence stages. This shows that it is highly adapted to withstand variety of adversities [22]. The disease was first discovered from Hungary;however it is discovered in India in 1941 from Delhi and Karnal. Depending on the cultivars studied infection rates ranges from 25 to 95 per cent. The annual yield loss owing to this illness in lentil is estimated to be 10-15%, worth around Rs. 2000-2500 Crores. There is availability of resistant sources against wilt pathogen of lentil. So to overcome from this disease there are many ways of management like by cultural, mechanical, biological and chemical practices. Resistant variety selection is one of the best ecofriendly cultural management of the disease. So for this purpose one hundred genotypes were taken and screened through pot screening technique underglasshouse.The released varieties exhibit variation for resistance, there hasn't been any evidence of a high level of wilt resistance. Therefore, stable sources are essential for breeding wilt resistant varieties. Keeping that in view, the present experiment was carried out to identify lentil genotypes resistant against this highly aggressive strain of *Fol* under greenhouse screening. One hundred genotypes of lentil were obtained from the Department of Genetics and Plant breeding, N.D. University of Agriculture and Technology, Kumarganj, Ayodhya and IIPR, Kalyanpur, Kanpur (U.P.).

Comment [LL4]: This part seems to mix things up a bit. The introduction usually ends with the aim of the work. It would be advisable to end in this way, without mentioning part of the results and conclusions.

MATERIALSAND METHODS

One hundred genotypes of lentil were obtained from the Department of Genetics and Plant breeding, N.D. University of Agriculture and Technology, Kumarganj, Ayodhya and IIPR, Kalyanpur, Kanpur (U.P.). The genotypes will be screened through pot screening techniques in a glasshouse.

Table 1. List of lentil genotypes used for screening:

Name of genotypes

IPL 213, KLS 2003-3, DPL 15, SL 73-3, KLS 218, WBL 77, SL 94-08, JL30, JL31, DPL62, IPL 525, KLS224, KLS227, IPL81, LL1049, L4679, SLC38, L4580, L4076, JL3, L4689, NDL 6-1-8, LL 985, LL 968, LY 688, NDL 6-1-5, LH 3-11, L 4687, PL 01, LH 3-12, VL 133, RLG 62, LH 4-4, LY 4685, L 4581, LH 84-8, PL 024, PL 063, LL931, VL 132, VL 515, L 4682, L4147, VL 514, LH 3-38, LL 1054, LL 921, L 4678, L 4686, NDL 5-5, Sehore 74-3, VL 148, LL 1370, VL 151, IPL 333, PL4, LL1375, RLG 195, L4727, PL 213, RVL 14-4, L 4737, RKL 607-1, L 4769, L 4147, LL 1320, LL 1397, L 4751, VL 525, LL 1374, PL 194, DL 14-2, LL 1373, VL 526,L 4717, RVL 14-5, L 4771, K 75, VL 126, L 4076, PL 024, RLG 191, VL 150, TRCL-1, RKL 14-20, , L 4726, PL 220, L 4764, L 4735, IPL 534, KLS 14-23, PL 406, DPL 15, L 4755, BPL 15, RL 3-5, IPL 334, RVL 13-5, LL1404, L4762, KLB 1442, KLS 14-1.

After germination, observations were recorded regularly for 24 days for the appearance of wilt symptoms and severity. The disease was recorded using a 1-9 scale for the wilt disease of lentil as described in (Table-2).

Table 2. Disease rating scale for *Fusarium oxysporum* f.sp. *lentis* (Iqbal et al., 2005):

Rating scale	Description	Reaction
1	0-10% wilted plant	Highly resistance
3	11-20% mortality	Resistance
5	21-30% mortality	Moderate resistance
7	31-50% mortality	Susceptible
9	51% ormore mortality	Highly susceptible

Screening of lentil genotypes against Fusarium wilt depends majorly on two factors that is time of occurring disease in different isolates as well as intensity of disease on the basis of appearance of patchy like symptoms on each genotype.

COLLECTION AND ISOLATION OF Fol.

The sample of diseased plant of lentil was collected from Student Instructional Farm (SIF), from the department of Plant Pathology, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, which is situated in the Indo-Gangatic plains of eastern Uttar Pradesh at latitude of 26.470 and an altitude of 113 meters above sea level. Now the collected sample of lentil were surface sterilised and placed on Potato Dextrose Agar (PDA) plate. After the small visible growth of the pathogen it is pure cultured by single spore method on another PDA plate as shown in plate 1. The proper growth of fungus is observed in plate and then mass multiplication has been done. The fungal culture was sprayed on the lentil field that shown the result as highly resistance, resistance, moderately resistance, susceptible and highly susceptible genotypes.

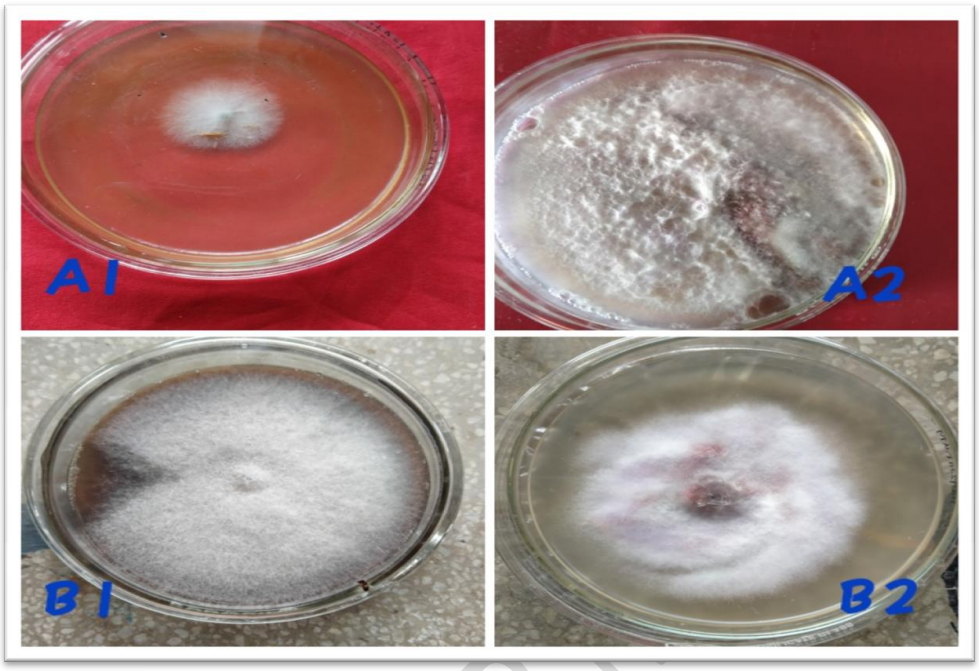

Plate 1: Culture plate of the pathogen (A1) Initial growth of the Fol. (A2) Complete growth of the Fol. (B1) Growth of the *Fol* in pure culture. (B2) pure culture.

RESULT AND DISCUSSION

Use of resistance genotypes is the best method of avoiding the disease occurrence on the crop.One hundred genotypes of lentil were screened for their reaction to *Fusarium oxysporum* f.sp. *lentis* by following the sick pot technique. The genotypes were grouped in various categories of resistant and susceptible based on per cent wilting in sick pots asdescribed by Iqbal *et al.* (2005) and the result are summarized in Table 3.Out of 100 genotypes, 41 genotypes were found highly resistant, 30 genotypes resistant, 8 genotypes moderately resistant, 10 genotypes susceptible and 11 genotypes highly susceptible to Fusarium wilt (Table 4).**Chaudhary *et al.* (2008)** [23]reported that theflip 2006- 11L was highly resistant, seven lines (flip 2005-51, flip 2005-12L, flip 2008-sl, flip 2008-81, flip 2007- 10L, flip 2007- 63L and flip- 2007- 85L) were resistant to Fusarium wilt. **Arya and Kushwaha (2019)**[24] ninety two germplasms were screened along with the local check (Sehore) under field condition during the two consecutive years 2016-2017 and 2017-18. Line ILL6037 and ILL7531 were selected as the highly resistant. **Chandra *et al.* (2019)** tested 150 germplasm and cultivars for *in vivo* and reported sixty six genotypes were found resistant and thirty seven were reported moderately resistant.

Comment [LL5]: Perhaps the CONCLUSION needed to be developed a little more. Something like what the benefits of these highly resistant genotypes would be in Indian cultivation, if they plan to delve a little deeper into studies of this type and if these crops could already be put into practice.

Table 3. Performance of Lentil genotypes against *Fusarium oxysporum* f. sp. *lentis* under natural field condition during *rabi* crop season 2020:

Rating Scale	Reaction	No. of Genotypes	Name of genotypes
1	Highly resistance	41	L4762, KLB1442, KLS14-1, JL3, LY688, LH3-11, L4687, PL-01, VL133, LY4685, PL-024, LL1370, IPL333, LL1375, RLG195, RVL14-4, L4737, RKL607-1, WBL77, LL1320, LL1397, VL525, LL1373, VL526, RVL14-5, L4717, VL126, L4076, RLG191, VL150, RKL14-20, L4726, PL220, L4764, L4735, IPL534, DPL15, BPL15, RL3-5, IPL334, RVL13-5.
3	Resistance	30	IPL213, DPL15, SLC38, LH3-12, VL132, VL515, L4682, VL514, L4678, L4686, Sehore74-3, VL148, VL151, PL4, PL213, LL1404, L4769, L4147, L4751, L4755, LL1374, PL194, DL14-2, L4771, LH84-8, K75, PL024, TRCL-1, KLS 14-23, PL406,
5	Moderately resistance	8	KLS2003-3, SL73-3, DPL62, LL985, LL968, LL931, LL1054, LL4727
7	Susceptible	10	KLS218, SL94-08, JL30, JL31, IPL525, KLS227, IPL81, LL1049, NDL6-1-5, NDL5-5.
9	Highly susceptible	11	L4679, L4580, L4076, L4689, NDL6-1-8, RLG62, LH4-4, L4581, PL063, LH3-38, LL921

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