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# Field evaluation of lentil germplasms for their resistance to Ascochyta blight (*Ascochyta lentis*) under field conditions

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**Ascochyta blight caused by Ascochyta lentis is a fungal disease with a major importance in Ethiopia. It has the potential to cause appreciable reduction in yield. The present study was conducted to identify the sources of resistance in lentil to ascochyta blight in 2018 main cropping season in hot spot area in AlemTena research station. The total of 148 accessions were received from Ethiopian Biodiversity Institute were grown in augmented design without replications that only checks were replicated. The spacing was 20 cm between rows with 4m row length. The disease severity was recorded three times at different growth stage every seven to ten days intervals using (1-9) point disease ratings scale. There were high variations in resistance among the tested lines ranged from resistant to highly susceptible. It compares that about 22 were resistant, 58 were moderately resistant and other become susceptible to highly susceptible which is 56 and 11 lines, respectively. In comparison, there are promising lines to use as source of parental materials in which most of the released cultivars lacking the resistance. A wide range of variation to ascochyta blight disease reaction was observed among lentil genotypes. More resistance resources need to be identified to back up breeding programs.**

**Key words:** Ascochyta blight, *Ascochyta lentis*, genotypes, resistance.

## INTRODUCTION

Ascochyta blight, caused by *Ascochyta lentis*, is one of the most globally important foliar disease of lentil. It has been reported to be a major lentil disease in many lentil-producing countries, including Argentina, Australia, Canada, Ethiopia, India, New Zealand, Pakistan and the Russian Federation (Sheikh et al., 2010). The disease has a potential to cause appreciable reduction in yield foliar infection up to 40% yield losses (Gossen and Morall, 1984). The disease has considerable effects on both seed quality and yields (Cromey et al., 1987). *A. lentis* is specific to cultivated and wild species of lentil (Hernandez et al., 2006; Tullu et al., 2010). It is morphologically indistinct from *Ascochyta fabae* but the latter is unable to infect lentil species. *A. lentis* populations are highly variable in terms of aggressiveness on different lentil cultivars and wild accessions (Davidson et al., 2016). Movement of the host germplasm has disseminated the pathogen worldwide where it is primarily introduced to new sites through infected seed (Kaiser and Hannan, 1986; Nasir and Bretag, 1997b; Khan et al., 1983; Hawthorne et al., 2012). Despite extensive agronomic and chemical control

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studies, no efficient method has been devised to control ascochyta blight in lentil. The use of resistant varieties is an environmentally sound and a feasible option for resource poor farmers (Erskine et al., 1994). Many resistant cultivars/lines have been identified in both cultivated and wild lentil. The genetics of resistance to Ascochyta blight coming from Lens orientalis was first reported by Ahmad et al. (1997). Resistance to Ascochyta blight in lentil is mainly under the control of major genes, but minor genes also play a role (Ye et al. 2002). However, none of the varieties that have been released, for production in low potential areas, are not having good level of ascochyta blight resistance. Resistances identified so far in lentil crops against the ascochyta blights provide only incomplete protection (Ford et al., 2011). Resistance breeding in lentil crops has been slow due to the complex nature of resistance and the relatively low investment on genetics, genomics, and biotechnology of legume crops. However, continuous cultivation of relatively few resistant cultivars with narrow genetic base has likely led to episodes of resistance breakdown through selection of adapted and aggressive isolates (Davidson et al., 2016; Sambasivam et al., 2017). Breeding for resistance has been suggested as an efficient means to reduce the economic loss caused by ascochyta blight in lentil (Erskine et al., 1994; Ye, 2000). These resistances are mostly polygenic traits controlled by quantitative trait loci (QTLs) (Rubiales and Fonde Villa, 2012). Quick shifts in aggressiveness of the population of the causal agent *A. lentis* mandates developing germplasm with novel and durable resistance (Sari et al., 2018). Moreover, the efficiency of resistant in lentil cultivars in Ascochyta blight is limited by pathogenic variability in the natural populations, location-specific occurrence of races which causes resistant cultivar to lose resistance over a period of time, breakdown of resistance, which is a consequence of directional selection for better-adapted mutants, recombinants or immigrants and also by widespread and intense deployment of R genes favored by monoculture practices (Suhas et al., 2006). Also, available information on levels of resistance and on the responsible mechanisms is often incomplete. The disease appears regularly in alarming epidemic form in main season especially in early planting season. The present study was to evaluate the lentil lines for resistance to ascochyta blight.

## MATERIALS AND METHODS

Field experiments were conducted during 2018 main cropping seasons at AlemTena (8°18'24.4"N, 38°57'05.3"E and 1610 m.a.s.l) and the average annual rainfall is about 728 mm and the maximum and minimum annual mean temperatures are 29.8 and 12.9°C, respectively, and the relative humidity ranges between 67 and 83% which is the sub centers of Debre Zeit Agricultural Research Center under natural infested field in hot spot area (DZARC, 2018). The number of entries was 148 lentil accession were obtained from Ethiopian Biodiversity and evaluated for their reaction to ascochyta blight disease that had grown in augmented design without replications that only checks were replicated. Ten test entries after one cultivar of susceptible check (Teshale) is sown. The spacing was 20 cm between rows with 4m row length. After germination, observation was recorded regularly for the appearance of ascochyta blight and severity. The disease severity was recorded three times at different growth stage every seven to ten days intervals using (1-9) point disease ratings scale. Evaluation of resistance has generally been performed at the seedling stage, 11 to 28 days after infection, although Gupta et al. (2012) co-assessed resistance in both the seedling and mature pod-bearing plant. Final disease assessment was made on whole plants when discrimination of disease reaction between susceptible and resistant plants was distinct (Ford et al., 1999). One observation was made from each seedling. The subjective 1 to 9 disease index used by previous researchers (Nasir and Bretag, 1997a; Ford et al., 1999; Sambasivam, 2011) was modified by specifying a size limit of small lesions and percentage leaf drop.

The scores were: 1 = no visible disease symptoms; 3 = leaf lesions only, chlorosis of affected leaves, < 10% leaf drop; 5 = leaf lesions, up to 25% leaf drop, stem flecks or lesions < 2 mm; 7 = leaf lesions, up to 50% leaf drop, stem lesions > 2 mm; 9 = leaf lesions, potential defoliation, stem girdling, potential plant death.

Test genotypes were further categorized for their reaction to AB infection on the basis of Gowen et al. (1989) scale, according to this scale; 1-<2 = Highly resistant (HR); 2<4 = resistant (R); 4-<6=moderately resistant (MR); 6<7= moderately susceptible (MS); 7-<9= susceptible (S); and 9-10=highly susceptible (HS).

## RESULTS AND DISCUSSION

It was provided that 22 lines were resistant, 58 were moderately resistant, 56 were susceptible while 11 were highly susceptible to the ascochyta blight in the field (Figure 1). The 22 accessions (36144, 242603, 244614, 27879, 221720, 36044, 36048, 23754, 23971, 28747, 235015, 244603, 242604, 24175, 241132, 237987, 23898, 36124, 23970, 244628, 36159, 244635) were resistant to *Ascochyta lentils* (Table 1). None of the lines was found immune against the disease. Erskine and Bayaa (1991) found 30 accessions of lentils with strong resistance reaction. Similar finding was reported by Iqbal et al (1990). Of 152 cultivar those genotypes tested, 17 were highly resistant, 40 were resistant, 34 had an average level of resistance and the rest were susceptible which is in concurrent with (Singh et al., 1982). This supports similar findings in the Canadian study (Ahmed and Morrall, 1996) and is in broad agreement with the theory that the resistance that plants deploy against ascochyta blight is polygenic. Moreover, many valuable resistant resources have been identified by germ plasm screening in cultivated and wild lentil species (Morrall and Sheppard, 1981; Singh et al., 1982; Kapoor et al., 1990; Erskine and Bayaa,1993; Bayaa et al., 1994). Ye et al. (2001a) found that the gene conferring high resistance in “ILL 5588 is allelic to that in ILL 5684. Of the 139 entries tested, none was categorized in highly resistant, 35 were in resistant and 22 were in moderately resistant (Seid and Beniwal, 1991). There was a varied reaction to the disease among the test entries, ranging from resistant to susceptible. High disease pressure and better disease resistant selection intensity was observed in the cropping

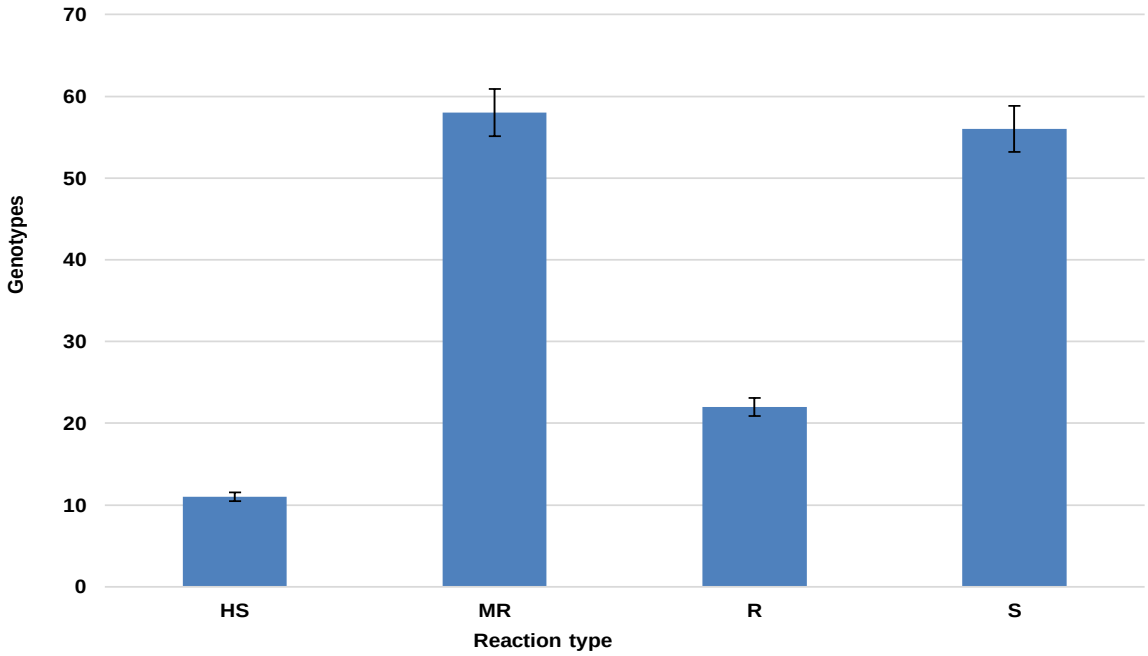


**Figure 1.** Reaction type of genotypes to ascochyta blight disease R= Resistant, MR= Moderately resistant, S= susceptible, HS= Highly susceptible).

**Table 1.** Reaction of Ascochyta blight diseases on lentil accessions.

| Disease reactions | Accessions |
|---|---|
| Resistant | 36144,242603,244614,27879,221720,36044, 36048, 23754, 238971,28747,235015,244603, 242604,241785, 241132, 237987,238988,36124, 238970,244628,36159,244635 |
| Moderately resistant | 36156,243434,36090,244607,244611,28747,230837,244617, 243444,204621,233973,36139,242605,243440,236456,28745, 245447,235384,237024,244615,243436,15345,243432,244629, 36007,28747,36087,220120,236889,19066,244606,243435, 244616,244623,244612,244605,244610,36089,244624,238991, 36086,36087,244631,243438,15317,237502,36013,236484,238987, 235016,36016,36092,36120,243441,223221,36027,238977,237502 |
| Susceptible | 36033,243449,243443,36003,36014,36072,237503,238987,235013,244625, 235014,36007,235011,243445,244627,36008,235382,244608,36032,36018,18007, 36058,238980,244618,244609,36007,244626,241784,236487,238974,235385,36091, 244620,24178,36012,243437,236890,243439,238990,36015,243446,244608,22918, 239184,243437,15346,243433,208758,238989,36045,28745,230015,244604, 238979,36005,244622, |
| Highly susceptible | 22322,244627,244803,230656,28748,235012,36043,230016,243448,36046,244613 |

season.

The pathogens require most effort to be achieved durable resistance and so breeding effort should concentrate on quantitative resistance which is renewed regularly to stay ahead of the pathogen (Cowger and Mundt, 2002; Pariaud et al., 2009). So far, released cultivars were becoming susceptible to ascochyta blight. The rapid loss of resistance in released cultivars

indicates there may be one or more major genes for resistance that have been rendered ineffective by changes in the pathogen population. Wild species have the potential to be an important source of resistance to ascochyta blight in lentil, compensating for the comparatively low intraspecific variability that is the characteristic of domesticated lentil species (Abo-elwafa et al., 1995; Tullu et al., 2010).

However, in addition to changes on specific hosts there is an apparent continuum of aggressiveness among the *A. lentis* isolates when assessing the mean reaction across the entire host set. Screening in controlled conditions with field observations indicates that isolates aggressive to cultivar have become more frequent and widespread in the *A. lentis* population, possibly as a selective response to the widespread presence of this cultivar in the farming system (Banniza and Vandenberg, 2006). The resistant lines of the germplasm evaluated could further be tested for their yield potential or these may be used as source resistant parents to transfer their resistance into commercial cultivars lacking resistance.

Detailed understanding of the genetics resistance to *A. lentis* is essential for the successful future deployment of ascochyta blight resistance in lentil lines.

The identification of highly significant differences in disease reactions between specific isolates against specific cultivars in the phenotyping experiments provides opportunity for further study into the genetic differences involved. The use of resistant varieties against this pathogen is the most practical and cost-efficient individual disease control measure for management of Ascochyta blight of lentil. Intensive cropping of single cultivars can lead to loss of resistance by selection for aggressive isolates that are already present in the naturally variable population.

## Conclusion

Ascochyta blight, caused by *A. lentis*, is an important disease of lentil in Ethiopia. Due to the continuous accumulation of new pathotypes there is constant need to evaluate new varieties using different methods against virulent ascochyta blight for sustainable agricultural practices. Therefore, under present study identified new sources of ascochyta blight resistance in some genotypes. The use of resistant cultivars was the most efficient and economical for controlling the disease. A wide range of variation to disease reaction was observed among lentil accessions in field evaluation. The local germplasm has the adaptability genes and carries the advantage over exotic genetic material for use in the breeding program to develop varieties for high yield potential with wider adaptability and disease resistance against ascochyta blight pathogens. Intensive cropping of single cultivars can lead to loss of resistance by selection for aggressive isolates that are already present in the naturally variable population. The identification of highly significant differences in disease reactions between specific isolates against specific cultivars in the phenotyping experiments provides opportunity for further study into the genetic differences involved. For this reason, resistance to ascochyta blight has been considered a priority with a significant amount of research and breeding effort put into accessing and introgression sources of resistance to *A. lentis*. Large-scale screening of germplasm for resistance is required. It is necessary to evaluate the resistance several times and to test against different isolates. More resistance resources need to be identified to back up breeding programs. Moreover, use of resistant cultivars would enhance the efficacy of other disease control measures in an integrated management strategy. It is suggested that breeding programs should be used on crossing the identified resistant lines with high yield cultivars, multi-location testing and genotypes may be used directly as potential lentil varieties in area having low severity of disease. For this reason, resistance to ascochyta blight has been considered a priority with a significant amount of research and breeding e ort put into accessing and introgression sources of resistance to Ascochyta lentis. Large-scale screening of germplasm for resistance is required.

## CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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