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Assessment of the Occurrence and Prevalence of Faba Bean Gall (Olpidium viciae) in Western Highlands of Oromiya,Ethiopia

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Abstract
Faba bean gall disease has become a serious threat to faba bean production and productivity in some parts of Ethiopia causing a yield loss as high as 100%. The assessment was carried out during 2015 main cropping season in Western Oromiya, at which faba bean is mainly grown: West Shewa, Horo Guduru Wellega and East Wellega zones to confirm the temporal and spatial occurrence and distribution of faba bean gall diseases with the objective to find out distribution, status and the prevalence. The assessment was made along the main roads and accessible routes in each targeted district at every 5-10 km intervals as per faba bean fields available. Five samples were taken from each sampling points by moving "W" fashion. The mean prevalence of faba bean gall was 17%. However, the overall mean severity of faba bean gall was (7%). Faba bean gall disease was more severe in West Shewa zone with mean severity of 15% followed by East Wellega (4%) and Horo Guduru Wellega (4%), respectively. Its prevalence was more prevalent in Mida Kegn district (80%) and followed by f 50%, 20%, and 17% at Horo, Jardaga Jarte and Gida Ayana, district, respectively. However, the least disease prevalence was observed in Gida Ayana district prevalence value of 17%. Faba bean gall disease observed in Western Oromiya was the most devastating and widely disseminated in the area within a few years since its occurrence, specifically in Mida kegn district. Farmers and woreda experts in Meda kegn witnessed that the occurrence of the disease was first observed in 2012. However, the disease was found in 2015 at Horo Guduru Wellega, East Wellega zones .They observed fast dissemination and increasing coverage of the pathogen in time and space. In fact the disease was epidemic and more serious from the recorded data in the surveyed areas. Based on the result of quick survey, it is very mandatory to give attentions in order to find immediate solutions to enhance the production and productivity of the crop. Therefore, Joint work, and collaboration of plant pathologist with Agricultural experts are crucial to develop different management options for newly emerged faba bean gall disease.
Keywords: Faba bean, Faba bean gall, Incidence, Prevalence, and Severity

INTRODUCTION

Faba bean (*Vicia faba* L.) is believed to be originated in the near East and is one of the earliest domesticated legumes after chickpea and pea (Hawitin and Hebblewaite, 1993). China has been the main producing country, followed by Ethiopia, Egypt, Italy and Morocco (Salunkhe,1989). It is the first among pulse crops cultivated in Ethiopia and leading protein source for the rural people and used to make various traditional dishes.

According to Central Statistics Agency of Ethiopia (CSA, 2012), Faba bean takes over 30% (nearly half a million hectares) of cultivated land. The crop has been considered as a meat extender due to its high protein content (20-41%) (Crepona *et al*; 2010). Faba bean is a source of cash crop to farmers and foreign currency to the country (Desta, 1988)). The Average yield of faba bean under small holder farmers is not more than 1.8t/ha (CSA; 2014), and its productivity increased to 1.9t/ha (CSA, 2015). However, its national productivity is still below its potential (3.8t/ha) the recently release variety) Variety registration, June, 2016).

The low productivity of the crop is attributed to susceptibility to biotic and abiotic stresses (Sahile *et al;* 2008 and Mussa *et al*., 2008), of which diseases are important factors limiting the production of the crop specifically in Ethiopia, (Berhanu *et al*; 2003). Many diseases are affecting faba bean, but only a few of them have either major or intermediate economic significance. Diseases such as chocolate spot (*Botrytis fabae* Sard.), rust (*Uromyces Vicia fabae*), black root rot (*Fusarium solani*), and foot rot (*Fusarium avenaceum*) are among fungal groups that contributes to the low productivity of the crop (Nigussie *et al*; 2008 and Berhanu *et al;* 2003). Furthermore, a new emerging disease known as "faba bean Gall" incited by the pathogen *Olpidium viciae* Kusano causing up to complete crop failure over wide areas within short period of time and aggravates the diminution of yield to maximum nationwide (Dereje *et al;* 2012).

Faba bean gall infection starts at seedling stage and continues through the flowering stage.Its symptoms mainly appear on leaves and stem (Dereje G,*et al*.,2012; Teklay *et al*.,2014).The disease forms small tumor like puckered galls on reverse side and under side leaf and extends to stem. Finally the whole plant become shrunk, shortened or stunted or totally dead (Lang Li-juan *et al*., (1993).The causative pathogen of faba bean gall survives on crop debris of diseased plants in the soil and spores can survive up to 2years in the soil (Lang Li-juan *et al*., (1993).Its primary source of inoculums is infected plant debris from previous crop in the field.

Recently, faba bean gall disease has become a serious threat to faba bean production and productivity in some parts of the country causing a yield loss as high as 100% (Beyene and Wulita, 2012). In Ethiopia, the

disease was first reported as a faba bean "gall" in North Shoa (Degem, Bash Area of Menz Mama and Mojana Wedera district) in 2011 (Beyene and Wulita, 2012; Dereje *et al*.; 2012). This disease also causes up to 100% severity in Tigray region (Teklay *et al*.; 2014). Moreover, according to the survey conducted in 2013, the disease has spread to the highland faba bean-growing areas of Amhara, Tigray, and Oromia regions (Endale *et al*.; 2014), where 89.4% of total faba bean production of the country has been grown. (CSA, 2014). Faba bean gall disease prevalence was observed in West Shewa zone with prevalence value of 36% (Endale *et al*.;2014). This shows that the spread of the disease has been very fast and expanding from year to year in all faba bean growing areas of the country.

Therefore, periodical disease monitoring and surveillance are of paramount important for sustainable faba bean production and tackle food insecurity. Therefore, the assessment of diseases/ pathometery involves the measurement and quantification of plant diseases that help to give basic information for further researchers in order to generate possible options to tackle the problem. Hence, the paper mainly focuses on the distribution, prevalence and severity of major faba bean diseases with special focus on the newly emerging "faba bean gall.

Materials and Methods

Study Area Description

The assessment was in eleven districts of three zones of Western Oromiya ; West Shewa, Horo Guduru Wellega and East Wellega zones at stage of flowering to pod setting stages to determine the temporal and spatial occurrence and distribution of faba bean gall disease. The targated districts in three zones were, Chalia, Mida Kegn, Jima Rare, Guduru, Hababo Guduru, Abay Choman, Horo, Jardaga Jarte, Amuru, Gida Ayana and Jima Arjo (fig 1). All districts are the major faba bean growing areas of the zones and the region as a whole.

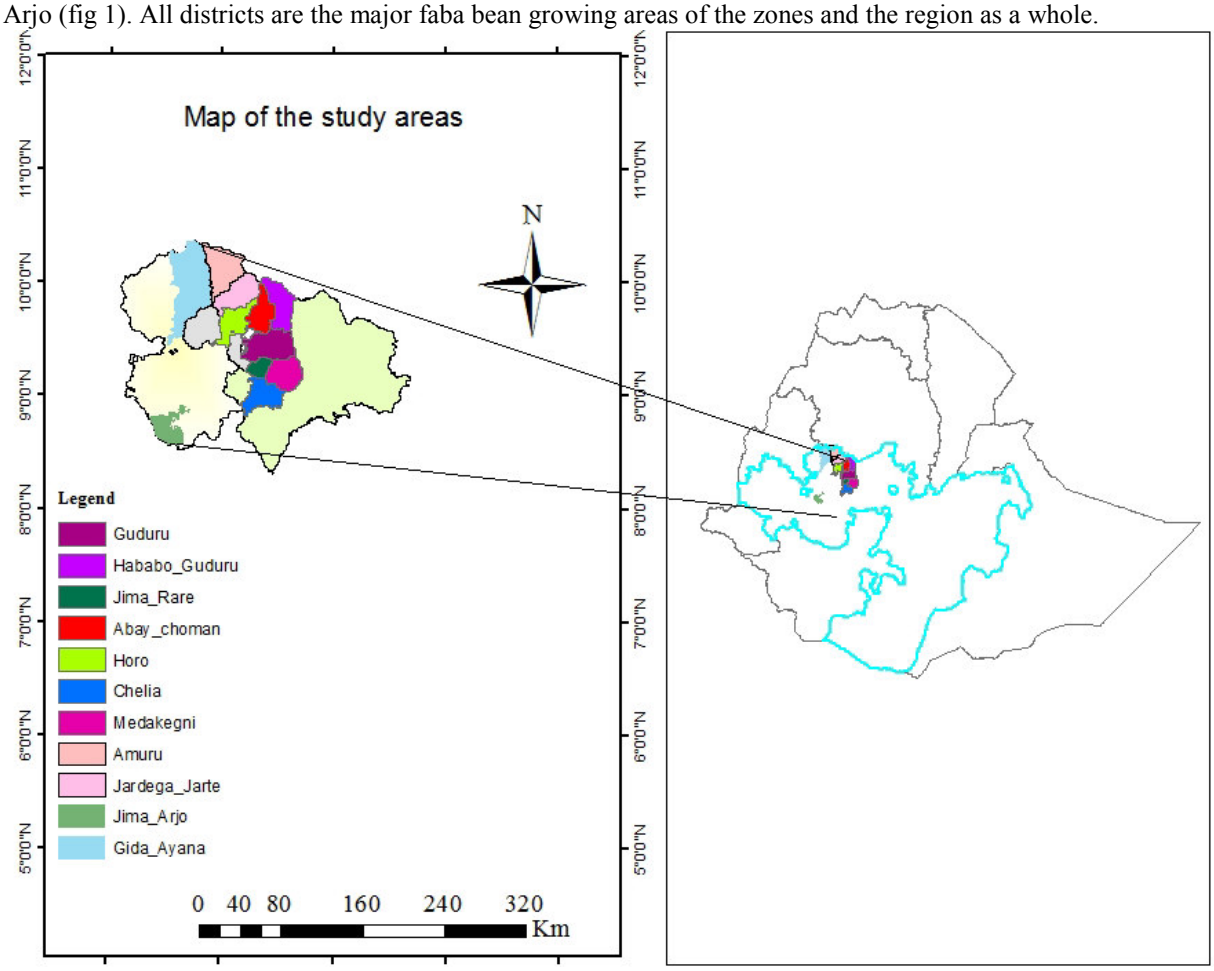

Figure 1 Eleven districts included for faba bean gall disease assessment

The survey trips was made following the main roads and accessible routes in each surveyed districts, and stops were made randomly at every 5-10 km intervals based on vehicles odometer as per faba bean field available. A total of 58 faba bean fields were surveyed at flowering to pod setting growth stage of the crop. Five sampling points were made in each faba bean fields by moving in 'W' fashion of the fields using $1m^2$ quadrates and data were collected from individual quadrates and the average of five sample were used as one field. The collected data from each quadrate of sampling points were number of affected and non affected plants per

quadrates, the percent severity of each disease, GPS, information from witness (farmers) about the disease history and history of the field(previous crop).

The assessment of faba bean gall disease was based on the disease prevalence, incidence and disease severity. The severity of the disease was examined visually on the whole plants within the quadrates and recorded as the percentage of plant part (tissue) affected, using (1-9scale) scoring. Faba bean gall disease severity was recorded based on both the percentage of infected leaves/leaf and/or stem (for gall) area damage.

Data Analysis

Disease incidence was calculated by using the number of infected plants and expressed as percentage of total plant assessed. Disease severity changed to percent severity index while prevalence was calculated by number affected field and expressed as percentage of total number of assessed fields in each surveyed areas. Finally Pearson correlation coefficient was done using SPSS software to identify the relationship between faba bean gall disease and altitude.

Results and Discussions

Faba bean gall Disease Distribution, Status and Prevalence across Districts

Faba bean gall disease was observed in Mida Kegn, Horo, Jardaga Jarte and Gida Ayana districts. The prevalence of the disease was in the range of 0 and 80% in these districts (fig 2). The overall average percent of prevalence was about 17% in the surveyed areas. It was more prevalent in Mida Kegn district with prevalence value of 80%. This result indicated that the disease was very epidemic and distributed from year to year based on the prevalence reported by Endale (Hailu *et al.,* 2014) who reported that the diseases prevalence recorded from West Shewa was 36%.It is for the first time that the disease was identified in Horo Guduru Wellega and East Wellega. However, the prevalence percentage of 50%, 20%, and 17% were recorded in Horo, Jardaga Jarte, Gida Ayana, districts of Horo Guduru Wellega and East Wellega respectively (fig. 2). The Least disease prevalence was observed in Gida Ayana district of East Wellega zone with prevalence value of 17% than the other districts in where the disease was observed. On the other hand, faba bean gall disease was not observed in Chalia, Jima Rare, Guduru, Hababo Guduru, Abay Choman, Amuru and Jima Arjo districts (fig. 2).

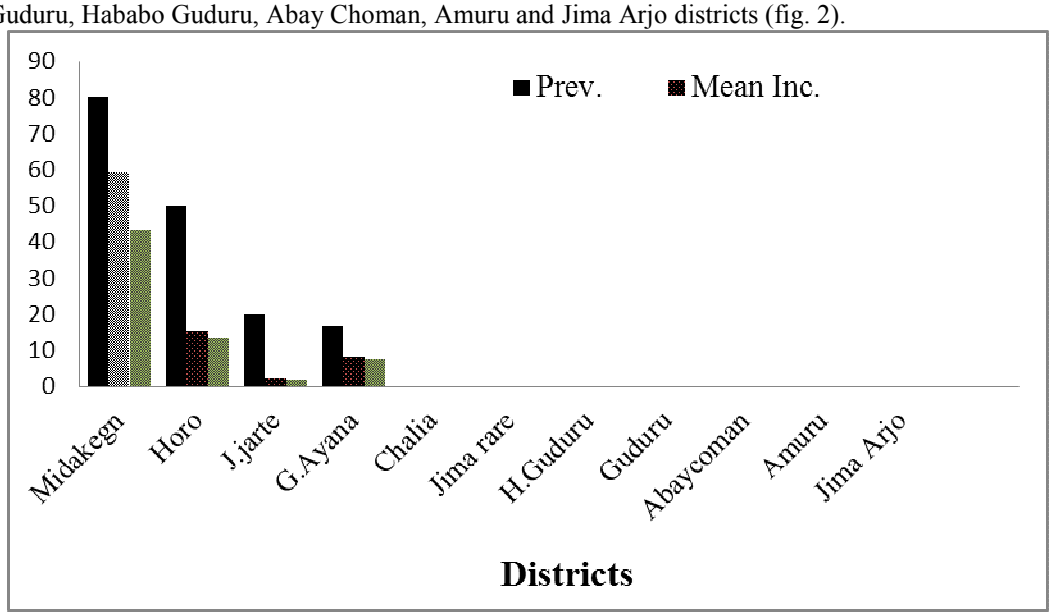

Figure 2.The status of Faba bean gall disease prevalence percentage, Mean incidence and Severity across eleven Districts of Western Oromiya.

The overall mean incidence of faba bean gall disease in Western part of Oromiya was 8% in which the disease incidence ranged from 0 to 100%. The maximum mean incidence of 59%, 15%, 8%, and 2% were recorded in Mida Kegn, Horo,Gida Ayana, and Jardaga Jarte districts respectively.The disease was widely disseminated and caused epidemic in short period of time in surveyed areas. According to (Dereje G (2012); Hailu *et al*., (2014) faba bean gall disease is very serious and becoming epidemic in Oromiya Amhara and Tigray; in the country as whole.

Faba bean gall Disease Distribution, Status and Prevalence across Zones

Among the three zones, the highest mean incidence of 21% was recorded in West Shewa. The mean disease severity was also ranges from 0 to 84%. The maximum mean severity of 43% was observed in Mida Kegn district followed by Horo district with mean severity of 14%. The overall mean faba bean gall severity of 7%

was observed in three targeted zones (fig 3). In West Shewa zone, 15% mean severity was recorded and the disease was more severe in this zone as compared to other zones, specifically Mida Kegn district (fig 3). The distribution status, prevalence, incidence and severity of faba bean gall disease were not similar across the districts, and zones. The same resulted were reported in different Tigray and Amhara regions districts (Beyene and Wulita 2012; Abebe *et al*., 2014)

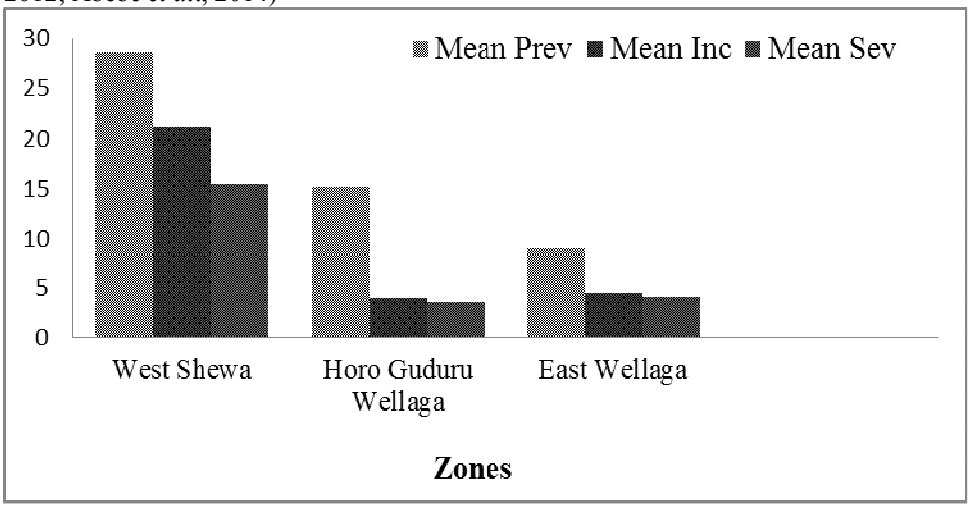

Figure. 3. The status of Faba bean gall disease prevalence percentage, Mean incidence and Severity across three Zones of Western Oromiya

Correlation of faba bean gall disease severity and altitude.

Pearson correlation coefficients(r) run to assess the relationship between faba bean gall disease severities with altitude. There was a moderate positive and significant correlation with altitude(r=0.42). Starting from the altitude above 2189 m.a.s.l the disease became more severe at where the disease was observed. The positive Pearson correlation coefficient indicated that the direct relationship between disease severity and altitude while the number value of (r) which was 0.42 indicated strength of their relation (Evans (1996). The seriousness of the disease was linearly associated with the increases of elevation (Li-juan *et al;* 1979; Hailu *et al.* (2014);B.Nigir Hailemariam *et al.,* 2016). This showed that faba bean gall disease severity has direct relation with altitude in line with the results reported before. The distribution and severity of the disease was high at higher altitude (Table 1). As altitude increases the relative humidity, cloud increases and this favors the development of pathogens spore within short time.

Table.1 Pearson Correlation Coefficient of faba bean gall disease severity with, other diseases and Altitude in western Oromiya

	Altitude	FBGS
Altitude	1	
FBGS	0.42**	1

**=highly significant, ns= non-significant, FBGS= Faba bean gall severity,

Conclusion

The prevalence of the fab bean gall disease was in the range of 0 and 80% in these districts while the mean disease severity was also ranged from 0 to 84%. The quick assessment results indicated that, the newly emerged faba bean gall pest was found and become a serious pest in Western parts of Oromiya within short period of time. The epidemic conditions of faba bean gall diseases have significant implication on the production of faba bean in Western highlands of Oromiya. Based on the result of quick survey, it is very mandatory to give attentions in order to find immediate solutions to enhance the production and productivity of the crop. Therefore, Joint work, and collaboration of plant pathologist with Agricultural experts are very essential to develop different management options for newly emerged faba bean gall disease.

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