

# Severity of Chocolate Spot (*Botrytis fabae*) Disease on Yield and Yield Components of Faba Bean (*Vicia Faba* L.) Varieties at Guduru District, Horro Guduru Wollega Zone, Western Ethiopia

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## Abstract

Chocolate spot (*Botrytis fabae* Sard.) is one of the major diseases threatening faba bean (*Vicia faba* L.) production and limiting its productivity in Ethiopia. The yield losses reach up to 100% on susceptible cultivars. Although a number of faba bean varieties with good yield potential have been released, their reaction to this major disease and yield performance are little understood in western Ethiopia. Thus, chocolate spot severity on 14 improved faba bean varieties and one local cultivar were tested under natural infections at Guduru district in Horro Guduru Wollega zone of western Ethiopia. The experimental site was located at longitude 36°39'28.8"-37°40'11.2"E and latitude 9°9'24.6"-10°20'59.9"N with altitudes range from of 1500-2450m and annual range of rainfall 900mm-2000mm with temperature range of 15°C -25°C as well as 262km distance from Addis Ababa capital city of Ethiopia. The field experiments consisted of 15 treatments (14 varieties and a local cultivar) are laid out in a randomized complete block design (RCBD) with three replications during the 2017/18 crop season. The data were analyzed by SAS computer software version 9.1.3. The onset and progress of chocolate spot severity was assessed (with a 1-9 scale) and yield and yield components were recorded and statistically analysed. The varieties varied significantly ( $P < 0.05$ ) in disease severity, grain yield, pod per plant, plant height and hundred seed weight. Degaga, Gora, Bulga-70 and Holeta-02 varieties were exhibited moderate to lower resistance to chocolate spot disease, whereas, Mesay, local cultivar and Kasa varieties were highly susceptible to chocolate spot disease. The yield performance of Gora and Degaga were also superior at the study area 993.33kg/ha and 941.83kg/ha, respectively and thus, are recommended for faba bean production in western Ethiopia. The effect of chocolate spot disease on yield and yield components from coefficient determination of linear regression show that grain yield was more stressed by disease than other yield components. Generally, the study indicated that improved faba bean varieties reacted differently to chocolate spot disease.

**Keywords:** *Botrytis fabae*, yield, disease severity, *Vicia faba*.

## INTRODUCTION

Faba bean (*Vicia faba* L.) has been grown in the highlands of Ethiopia between 1800 and 3000 m above sea level (a.s.l.) for many decades and the country is now considered as one of the centers of secondary diversity for the crop (Agegnehu et al., 2006). Faba bean (*Vicia faba* L.) also referred to as broad bean, horse bean and sometimes field bean occupies nearly 3.2 million hectare worldwide (Torres et al., 2006). Faba bean production in the world is concentrated in nine major agro-ecological regions: The Mediterranean Basin, the Nile Valley, Ethiopia, Central Asia, East Asia, Oceania, Latin America, Northern Europe and North America (Bond et al., 1985). The crop occupies the largest areas among legumes and the total area under cultivation is estimated to be about 512,067 ha from which 200,000 metric tons of grain yield is harvested (FAOSTAT, 2010). In Europe, faba bean is the second legume crop in area and production, after pea. Europe accounts for 14% of the world area (0.37 million ha) and about 25% of world production (1.2 Mt) (Torres et al., 2006).

In Ethiopia, faba bean is grown in the highlands (1800-3000 m.a.s.l) where the need for cold temperature is met (Yohannes, 2000). It is believed that the crop was introduced to Ethiopia from the Middle East via Egypt around 5000 B.C., immediately after domestication (Asfaw et al., 1994). Ethiopia is now considered as one of the centers of secondary diversity for faba bean (Asfaw et al., 1994; Yohannes, 2000 Torres et al., 2006). Currently the crop is grown in several regions of the country receiving annual rainfall of 700-1000 mm (ICARDA, 2006). Production in Ethiopia is totally rain-fed on nitosols and cambisol type of soils (Gemetchu et al., 2002). The Amhara Region has the largest pulse area (43.7%) and contributes to the highest production (47%) in the country followed by Oromiya Region that has 38% of the area and contributes 39% to national production (CSA, 2007).

Chocolate spot (*Botrytis fabae* Sard.) is the major fungal disease hampering faba bean production in Ethiopia (Dereje and Yaynu, 2001; Sahile et al., 2010). It is a highly prevalent and destructive disease, causing yield loss up to 61% on a susceptible and 34% on tolerant faba bean genotypes in the central highlands (Dereje and Yaynu, 2001). Sahile et al. (2010) reported even higher losses of 67.5% in the unsprayed faba bean plots in northwest Ethiopia.

Faba bean is an important legume crop and pre-dominantly grown by every individual farmers in the study

area. However, there are different faba bean production constraints that limit the production and productivity of the crop. Chocolate spot disease caused by *Botrytis fabae* Sard. is the major and the most widespread and destructive disease wherever faba bean is grown. In Ethiopia the yield reducing capacity of the disease exceeds up to 61% on susceptible cultivars (Samuel, *et al.*, 2008a). The relative importance of aerial fungal diseases and their effect on yield varies among years and cropping area. However, some of them affect large areas in all the countries where faba bean is cultivated and cause considerable losses in quality and quantity of the products. While informal observation have been done in some there where found that the whole faba bean crops grown in the area infected by the disease and show necrotic symptoms. Hence, this needs more attention in all surveyed areas and finds solution for farmers to sustain their life with producing faba bean crops (Personnel communication and observation).

In Ethiopia, there is no research evidence on the control of chocolate spot by cultural practices, crop rotation may help in reducing the initial inoculum and thus the disease incidence (Habtu and Dereje, 1985). Despite a general recommendation on crop rotation and field hygiene for control of chocolate spot, no supporting evidence for these has been produced yet (Harrison, 1988). Farmers commonly used local varieties which is highly susceptible by the disease. Variety transmission is most promising methods of disease management strategies which is environmentally sound, cost effective and pesticide free. Therefore, searching efficient means for controlling the foliar diseases is so urgent for improving faba bean yield and its components. Due to this reason selection of more promising varieties to foliar diseases is the appropriate means to increase the yield of the crop. Thus, this work in line with selection and adaptation of released varieties against chocolate spot disease having with the objectives of assess yield and yield components of faba bean varieties to chocolate spot diseases and select the capable varieties of faba bean for the study area

## MATERIAL AND METHODS

The experiment was conducted at Guduru district of Horro Guduru zone, western Ethiopia during the main cropping season of 2017/18. The site represents wona dega climatic region with high rainfall extends, from half of April to end of September. The experimental site was located at longitude 36°39'28.8" to 37°40'11.2"E and latitude 9°9'24.6" to 10°20'59.9"N with altitude range of 1500-2450m and annual rainfall range of 900mm-2000mm with temperature range of 15°C -25°C. The site was found 262km distance from Addis Ababa capital city of Ethiopia to western part of the country.

### Treatments and experimental design

The treatments were arranged in randomized complete block design (RCBD) with three replications and plot size 2m x 2m and to reduce the inter plot effect, the space between plots and blocks were adjusted at 0.5 and 1 m, respectively. Fourteen improved varieties (CS20DK, Hachalu, FB-Didia'a, Kasa, Bulga-70, Mesay, Tesfa, Holeta-02, Degaga, Moti, Obse, Dosha, Tumsa and Gora) and one local cultivar were assessed with chocolate spot disease (SARC, 2013). The seed and fertilizer rate were based on standard seed rate (30kg/ha or 160lb/acre) and DAP 75-90kg/ha and UREA 30kg/ha, respectively.

### Data Collection

The data of plant height, pods per plant, hundred seed weight and grain yield were collected randomly from each plot. Disease severity was assessed as a visual estimation of the percentage of the total plant surface covered with chocolate spot lesions. Assessments were started as soon as the first chocolate spot symptoms occurred in every one fifteen day's interval. Disease severity on leaves was rated using 1-9 rating scale (Bernier *et al.*, 1993), where 1= no disease symptoms or very small specks; 3= few small discrete lesions; 5= some coalesced lesions with some defoliation; 7= large coalesced sporulating lesions, 50% defoliation and some dead plant; and 9= Extensive lesions on leaves, stems and pods, severe defoliation, heavy sporulation, stem girdling, blackening and death of more than 80% of plants (Bernier *et al.*, 1984). Disease severity was computed with the formula:

$$\text{Disease severity} = \frac{nxv}{9N} * 100$$

Where:

n = Number of plants in each category.

v = Numerical values of symptoms category.

N = Total number of plants.

9 = Maximum numerical value of symptom category

### Data analysis

The collected data from experimental site was subjected to analysis of variance with SAS computer software version 9.1.3 (SAS, 2003). Means were compared with Least Significance Difference (LSD) at 5% probability level.

## RESULT AND DISCUSSION

In this experiment, fourteen improved faba bean varieties and local cultivar were evaluated for their reactions to chocolate spot epidemics under natural conditions at Guduru district of local area where the crop is predominantly grown by small-scale farmers in Horro Guduru Wollega zone, western Ethiopia. The performances of these varieties were critically assessed for disease severity levels at varying growth stages of faba bean plants and finally for grain yield and yield components.

### Yield and Yield Components

The result confirmed that considerably higher grain yield was harvested from Gora variety 993.33kg/ha followed by Degaga variety 941.33kg/ha and the minimum yield from local cultivar 390.12kg/ha followed by Mesay and CS20DK varieties 521.67kg/ha and 541.67kg/ha, respectively. The mean maximum pod per plant was recorded from Holeta-02 and Tesfa varieties 10pod/plant both followed by Hachalu variety 9.33pod/plant and the minimum from Kasa variety 4pod/plant followed by Dosha variety 4.33pod/plant. Maximum plant height was recorded from Hachalu variety 130cm followed by Tumsa variety 125.67cm and the minimum value was recorded from local cultivar 74.67cm followed by Bulga-70 variety 88.33cm. Again maximum hundred seed weight was recorded from Hachalu variety 58.33gm followed by Degaga and Tesfa varieties 56.33gm both and Bulga-70 and Gora varieties both 56gm. There were highly significant differences ( $P < 0.05$ ) among the tested faba bean varieties of Grain yield and pod per plant and there was no significance among treatment on hundred seed weight and moderately significance on plant height (Table 1). Generally, in all parameters Degaga, Hachalu, Gora and Tesfa varieties are significantly higher in value than local cultivar, Kasa, Dosha and Mesay varieties, respectively in the experimental site of main cropping season that in lined with Mesele et al (2016) reports.

Table 1. Performance of faba bean varieties in yield and yield components at Guduru district experimental sites, western Ethiopia during 2017/18 main cropping season.

Varieties	Number of Pod per			
	plant	Plant height(cm)	Grain yield(kg/ha)	100seed weight(gm)
Fb didia'a	8.00ba	117.67bac	796.83bdc	53.67ba
Hachalu	9.33ba	130.00a	711.83edc	58.33a
Degaga	7.33bc	91.67bdc	941.83ba	56.333ba
Tumsa	8.67ba	125.67a	653.33edf	50.33bc
Dosha	5.00dc	105.67bac	560egf	46.33c
CS20DK	8.33ba	124.00a	541.67egf	52.67bac
Bulga-70	8.33ba	88.33dc	703.50edc	56.00ba
Kasa	4.00d	93.67bdc	645.00edf	49.67bc
Holeta-02	10.00a	120.00ba	863.33bac	52.33bac
Gora	8.67ba	110.67bac	993.33a	56.00ba
Mesay	4.33d	118.33bac	521.67gf	53.00bac
Obse	8.00ba	105.67bac	550.00egf	53.67ba
Moti	5.00dc	110.67bac	898.33ba	53.00bac
Tesfa	10.00a	110.33bac	640.4edf	56.33ba
Local cultivar	5.00dc	74.67d	390.12g	46.33c
CV (%)	20.34	16.40	15.17	8.15
LSD (5%)	2.49	30.21	176.11	7.22
P-value	<.0001**	0.0321*	<.0001**	NS

Means in a column with the same letter(s) are not significantly difference ( $P < 0.05$ ) and \* and \*\* indicate levels of significance at  $P < 0.05$  and  $P < 0.01$  levels, respectively, ns stands for non significant

### Disease severity

The result demonstrated that the tested faba bean varieties showed remarkable differences and percent of disease severity from Degaga variety (28.33%) was significantly lower than other followed by Holeta-02, Bulga-70 and Gora varieties 30% and FB Didia'a variety 31.67%, respectively and there was significantly higher value recorded from Mesay variety 50% followed by local cultivar(43.83%) and varieties of Dosha(43.33%), Kasa(42.33%), CS20DK(41.67%) and Tumsa(41.67%), respectively. Statistical analysis showed that there was significant difference ( $p < 0.05$ ) among the treatments of faba bean varieties (Figure 1). The response of the varieties against chocolate spot were revealed individually similar with reports of Mekuria et al (2015), however, all varieties are influenced by chocolate spot disease because the severities were recorded above 28.33% in the main growing season. This study show that Degaga, Holeta-02 and Bulga-70 varieties are relatively resistance to the disease that in lined with Melese et al. (2016) report but Mekuria et al (2015) report states that Degaga and

Hachalu varieties are highly significantly susceptible in specific location which not in lined with this study.

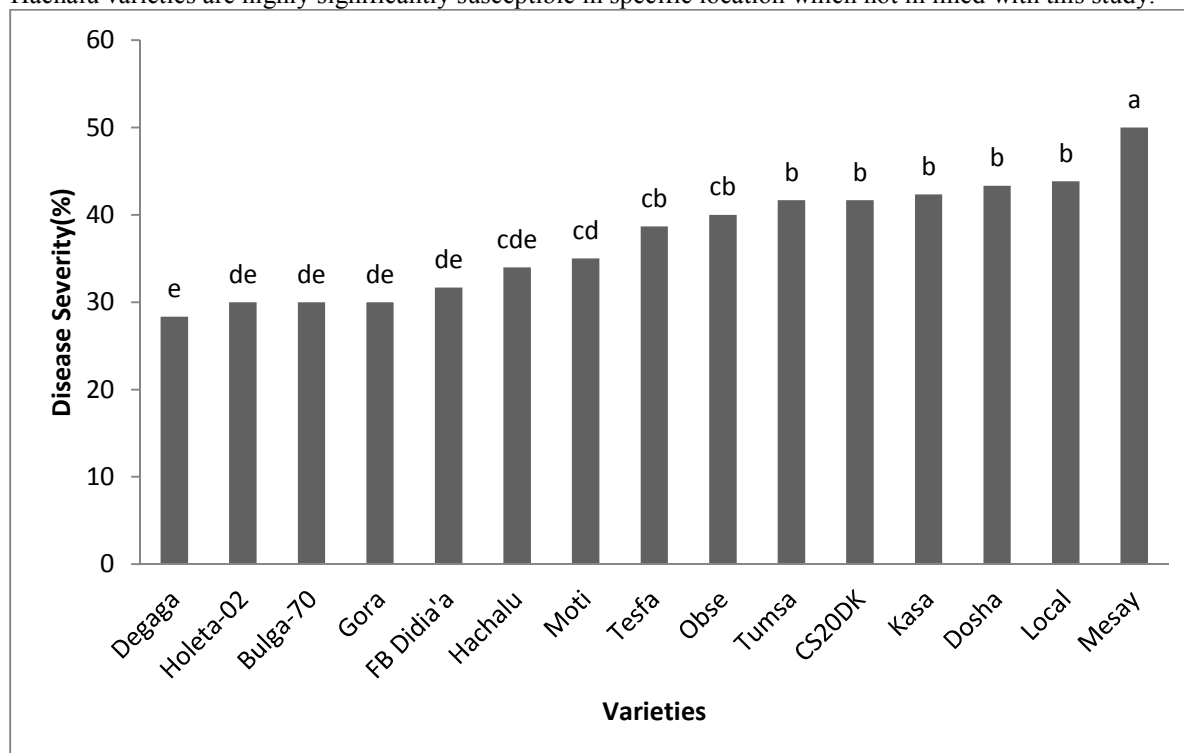
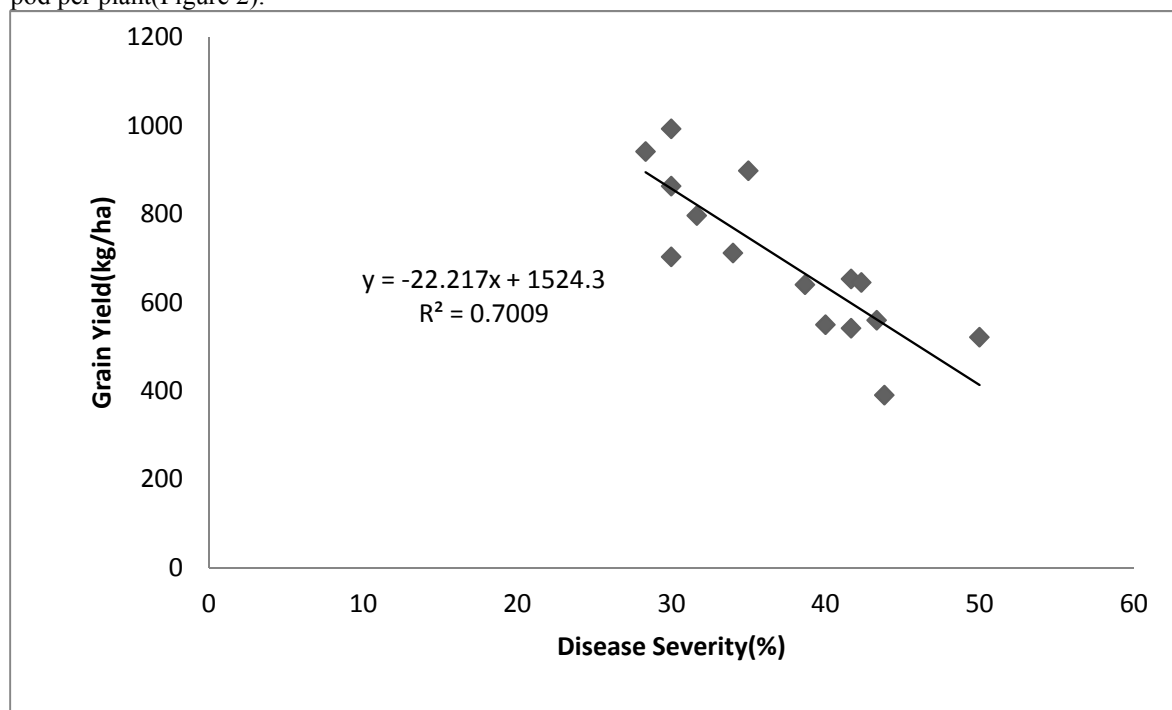
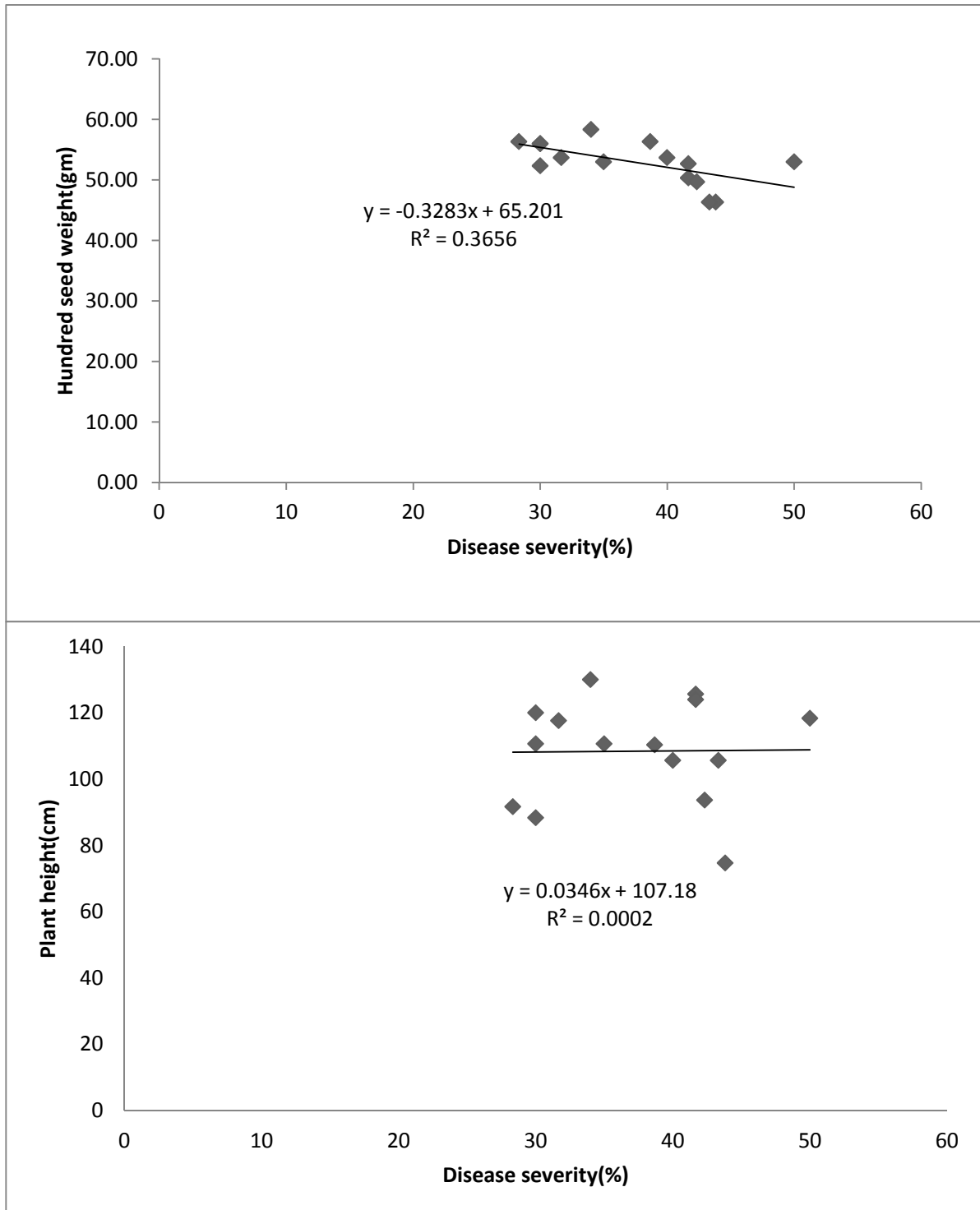


Figure 1. Chocolate spot disease severity on tested varieties and local cultivar at Guduru district in 2017/18 main cropping season. Bars with the same letter(s) are not significantly different ( $P < 0.05$ ) from each other

In addition, from the linear regression model relating chocolate spot disease severity against yield and yield components there was better impact on grain yield, pod per plant and hundred seed weight and the linear regression coefficient were estimated of -22.21, -0.183 and -0.328 respectively, whereas nothing impact on plant height and slope of regression lines was 0.034 by coefficient of determination 0.70, 0.32, 0.365 and 0.00 respectively. In general the results revealed that except plant the associations were negative but not strong and disease severity have highly impact on grain yield than yield components followed by hundred seed weight and pod per plant (Figure 2).





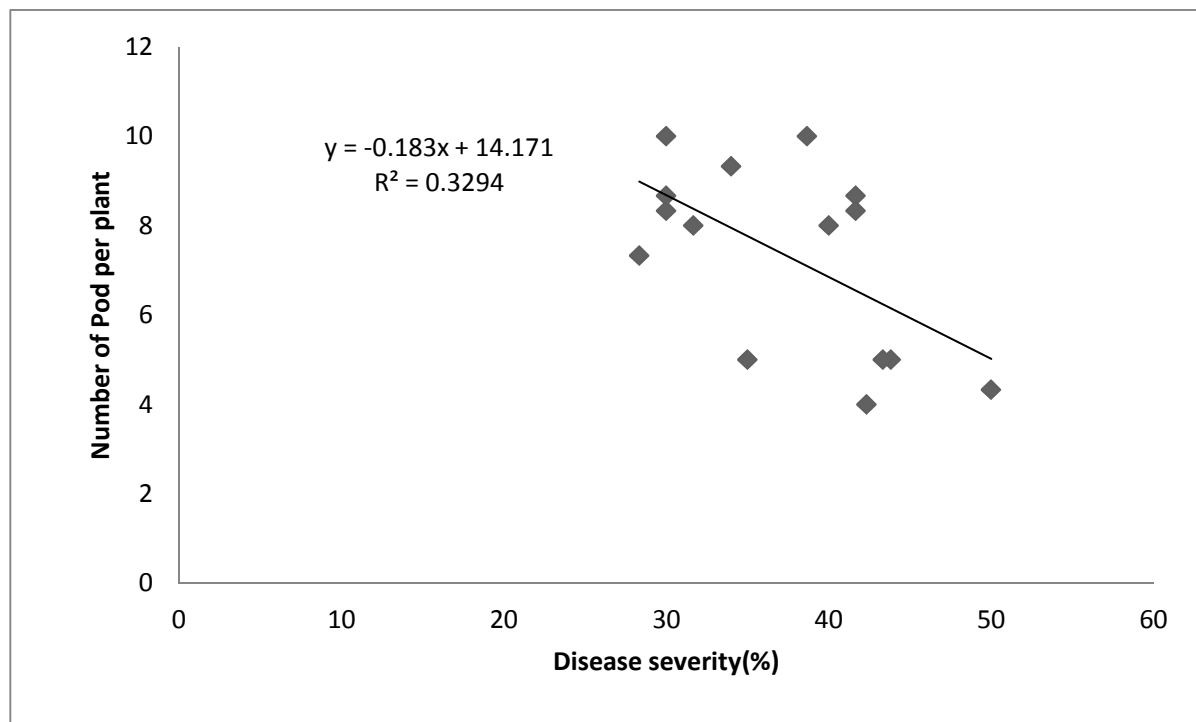


Figure 2. Linear regression model relating chocolate spot disease severity against yield and yield components at Guduru district of experimental sites during 2017/18 cropping season.

#### CONCLUSION AND RECOMMENDATION

Chocolate spot disease is the major biotic problem that affects the productivity of faba bean varieties at Horro Guduru Wollega Zone. This finding revealed that chocolate spot disease is the most important disease affecting faba bean in Ethiopia causing considerable reduction in yield. Even if chocolate spot severity was affected all varieties at experimental site the disease was more severe on Mesay variety followed by local cultivar, Dosh and kasa varieties, respectively while minimum chocolate spot severity were recorded from Degaga followed by Holeta-02, Bulga-70 and Gora varieties, respectively. From the linear regression model the chocolate spot disease has more percent stress on grain yield than yield components. The result revealed that high grain yield was harvested from Gora and Degaga varieties and again they were indirect proportional with chocolate spot disease severity thus, these varieties are recommended for the farmers in the study area. Even though, this study was indicated some clues the severity of and the impact of the disease on faba bean varieties are vary from location to location. This variation may be due to environmental variation between the locations, including high rainfall during the cropping season. Prolonged rainfall is conducive for chocolate spot development leading to complete crop loss (Dereje et al., 1994). Chocolate spot incidence is strongly influenced by climatic conditions (Villegas-Fernández et al., 2010).

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