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# Effect of fungicide Frequencies and Sowing date for management of Chocolate spot (Botrytisfabae Sard.) of Faba bean Sodo Zuria District Southern Ethiopia

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## Abstract

Faba bean (*Vicia faba L.*) is a cool legume crop grown in the highlands of Ethiopia, and chocolate spot disease (*Botrytis fabae Sard.*) occurs in wide areas. Chocolate spot is a serious disease that cause yield reduction on faba bean crop, thus, effective management is essential. Thus the objectives of this study were to assess the influence of sowing dates and the frequency of foliar fungicide (mancozeb) application for the management of chocolate spots and determine the association of sowing dates with chocolate spot disease occurrence. Field experiments were conducted at Sodo Zuria district of kokate research sites during 2014 and 2015 cropping seasons. Treatments were designed in RCBD factorial with three replications. The mean disease severity, AUDPC, and grain yield were found to be statistically significant differences (P<0.05) among the treatments. A high disease severity, AUDPC and low grain yield were recorded from the unsprayed treatment. Four times applications of mancozeb spray on the first July sowing date have effectively reduced disease severity and significantly increased yield. However, cost-effective of these chemical and other faba diseases like rust are becoming economically important diseases is an issue that has to be further investigated.

**Keywords:** Sowing data; Fungicide frequencies Faba bean; Grain yield

## Introduction

Faba bean *(Vicia faba L.)* is a cool legume crop grown in the highlands of Ethiopia at an altitude range of 1800-3000 meter above sea level. Grain legumes play an important role in improving livelihood, nutritional security of farmers and populations in less developed countries as well as sustainability of agriculture in dry areas worldwide. In Ethiopia, faba bean is grown in highlands (1780-3000 m.a.s.l.) with 700-1000 mm annual rainfall. The area of faba bean production in Ethiopia has increased by 18.21% from 2010 cropping season to 2016. Ethiopia is the second producer with 519,000 hectares of area harvested and 0.92 million tons of production. Chocolate spot disease, caused by Botrytis fabae, is the most prevalent and substantial disease in faba bean production globally. The disease can also cause complete crop failure in extreme situations, and in Ethiopia, the disease is also the main yield-limiting biotic constraint. Many methods of control are possible such as the use of resistant genotypes, chemicals (fungicides), and biological, induced resistant and modified cultural practices. In fact, the amount of losses in seed yield due to a disease determines the importance of that disease [1,2]. A chemical is recommended for use when the cost of its application equals to or is less than the returns gained. Management options for chocolate spot disease in Ethiopia include the use of resistant cultivars, chemical control (Mancozeb) and late planting, but these options were neither widely disseminated nor adopted by end users (farmers). Sahile reported that the cereal mixed cropping and fungicide application consistently reduced chocolate spot severity and increased the yield correspondingly. Generally, faba bean chocolate spot is serious problems in our country including Wolaita Zone, therefore, integrating compatible disease control measures was needed to complement one another and minimize yield losses. Farmers are no longer familiar with fungicide application on faba bean crops, yet the times of fungicide application have not significantly reduced the infection of diseases. The objectives of this study were to assess the influence of sowing dates and the frequency of fungicide (Mancozeb) application for the management of chocolate spot disease and determine the association of sowing dates with chocolate spot disease occurrence [3,4].

## Materials and Methods

### Descriptions of the study areas

The experiment was conducted during 2014 and 2015 main cropping season in an open environment to convince the objectives of the trial around Sodo Zuria distict Kokate Kebele Southern Ethiopia. The experimental site is geographically located at 06O 85' 28" N and 037O 76' 10" E and at an elevation of 2156 meters above sea level. Bimodal rainfall pattern is the major characteristics of the study area, short rainy season (April and May), and the main rainy season (early June to mid-November). Thus, the areas receive average annual rainfall is 1200-1300 mm and mean monthly temperatures varies from 11-26 OC. The soils are sandy-loam with a PH of 5.2 [5].

### Experimental design and treatments

The experiment was conducted for two consecutive cropping seasons (2014 and 2015). The plot size was 2 m × 2 m with 6-seedling rows, 1 m spacing between blocks, 0.5 m between plots, and 0.4 m to 0.1 m inter row and intra-row spacing, respectively. Mancozeb 80% WP spray frequencies designed for treatments were unsprayed as control, one-time spray (which was applied at the first appearance of disease symptom(F1), two-times spray (F2), three-times spray (F3) and four-

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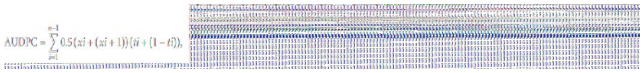
times spray (F4), were applied at three-week intervals at a rate of 2.5 kg/ha. There were three times of sowing (S): June 24 (S1), July 1 (S2), and July 8 (S3). A local faba bean cultivar from surrounding farmers was used for the experiment, and the seed and fertilizer rates were used based on standards (275 kg•ha-1) and P2O5 (46 kg•ha-1) and UREA (18 kg•ha-1), respectively. The experiments were arranged in a randomized complete block design (RCBD) in a factorial combination [6].

### Diseases assessment

Severity of faba bean chocolate spot was assessed six times at weekly intervals starting from the first appearance of the disease symptoms in the experimental plots. Disease severity was recorded from 10 randomly selected and pre-tagged plants in the central rows of each plot separately, for the three layers of the canopy (top, middle and bottom). Severity was rated using a 1-9 scale, where 1 indicates no visible symptom and 9 represents disease covering greater than 80% of leaf area. Disease severity scores were converted into percentage severity index (PSI) for analysis [7].



The effects of fungicides on the disease severity were calculated as AUDPC values (%-day) and that is obtained from the PSI data recorded at involved dates of assessment as described by.

$$\mathrm{AUDPC} = \sum_{i=1}^{n-1} 0.5\,(xi + (xi+1))\,(ti + (1-ti)),$$

Where n is the total number of assessments, ti is the time of the ith assessment in days from the first assessment date, and xi is the percentage of disease severity at ith assessment.

### Data analysis

Disease progression of chocolate spot from each treatment was calculated by transforming the percent disease severity values to the Gompertz model ln[-ln (Y)], where 'y' is disease severity scores in proportion. AUDPC values were used in the analysis of variance to compare amount of disease among plots with different treatments. When treatment effect was significant means were separated using Fisher's protected least significance difference (LSD) test at 0.05 level of probability. The data were analyzed using Statistical Analysis System (SAS) software version 9.0 [8].

## Results and Discussion

Chocolate spot disease severity was significantly different (P<0.05) among the treatments in years. In 2014, the highest disease severity was recorded at the time of sowing on June 24 (S1) in the unsprayed treatment (39.2%), while the minimum disease severity was recorded at the time of sowing on July 1 (S2) in the four-time spray treatment (S2F4) (5.4%). In 2015, the highest disease severity was recorded at the time of sowing on July 8 (S3) in unsprayed/control treatment (S3F0) (34.87%), while the minimum disease severity was recorded at the time of sowing on July 1 (S2) in the four-time spray treatment (S2F4) (4.38%). The results show that spraying mancozeb four times significantly (P<0.05) reduced the yield losses in both season over years. Application of mancozeb also increased the mean grain yield of faba bean both seasons over years [9,10]. In 2014, the highest mean grain yield was recorded at the time of sowing on July 1 (S2) in the four-time spray treatment (S2F4) (3002 kg/ha), while the minimum mean grain yield was recorded at the time of sowing on July 8 (S3) in the unsprayed/control treatment (1422 kg/ha). In 2015, the highest mean grain yield was recorded at the time of sowing on July 1 (S2) in the four-time spray treatment (S2F4) (2815.3 kg/ha), while the minimum grain yield was recorded at the time of sowing on July 8 (S3) in the unsprayed/control treatment (1450.42 kg/ha). Area under the Disease Progress Curve (AUDPC). The mean AUDPC % days was found to be statistically significantly different (P<0.05) among the treatments at both seasons over years. In 2014, the highest mean AUDPC was recorded at the time of sowing on July 8 (S3) in the unsprayed/control treatment (1612.3 0%-days), while the minimum mean AUDPC was obtained at the time of sowing on July 8 (S3) in the four-time spray treatment (S3F4) (213.5 % days). In 2015, the highest mean AUDPC was recorded at the time of sowing on June 24 (S1) in the unsprayed/control treatment (1528.6 %days), while the minimum AUDPC was recorded at the time of sowing on July 1 (S2) in the four-time spray treatment (S2F4) (285 %-days) [11,12] (Table 1).

## Conclusion and Recommendation

A chocolate spot disease of the faba bean causes serious problems

**Table 1:** Chocolate spot disease severity, grain yield, and area under diseases progress curve of faba bean at Kokate location.

| | 2014 | | | 2015 | | |
|---|---|---|---|---|---|---|
| **Treatment** | **PDI** | **AUDPC** | **GY** | **PDI** | **AUDPC** | **GY** |
| S10 | 39.2 a | 1606a | 1646.3d | 33.4a | 1528.6a | 1567c |
| S1F1 | 28.4 b | 1496b | 1876.9c | 23.5b | 1439.7a | 1743.8b |
| S1F2 | 29.5b | 1434.8b | 2175.4b | 22.8b | 1398.2a | 1893.2a |
| S1F3 | 30.3b | 1323.2c | 2920a | 21.9b | 1402.1a | 1734.2b |
| S1F4 | 30b | 1398.6cd | 2932.4a | 20.3b | 1325.8b | 1801b |
| S20 | 27.3a | 1532.6a | 1634.3d | 28.9a | 1324.8a | 1601.4d |
| S2F1 | 15.7b | 1114.5bc | 2365.2c | 19.4b | 540.3b | 2454c |
| S2F2 | 15bc | 1165b | 2845.7b | 18.4b | 495.8b | 2619.5b |
| S2F3 | 11.3bc | 1043.5c | 2920ab | 18.7b | 308.4c | 2598.3b |
| S2F4 | 5.4c | 235.3d | 3002a | 4.38c | 285c | 2815.3a |
| S30 | 39.1a | 1612.3a | 1422d | 34.87a | 1456.5a | 1450.42d |
| S3F1 | 18.5b | 1269.4b | 2013.4c | 22.5b | 1349b | 1657.9bc |
| S3F2 | 12.7bc | 454.9c | 2243.8b | 27.6b | 1299.54bc | 1954.76a |
| S3F3 | 11.5bc | 432.3c | 2245.8b | 27.9b | 1201.32c | 1727b |
| S3F4 | 9.8c | 213.5d | 2502.4a | 18.1c | 1132.76c | 1599.6c |
| LSD (0.05%) | 8.5 | 85 | 95 | 9.4 | 111.3 | 89.6 |
| CV (%) | 18.5 | 15.8 | 26.3 | 15.7 | 17.3 | 32.6 |

Means in the same column followed by the same letters are not significantly different at 5% level of significance. PSI: Percentage Severity Index; AUDPC: Area Under Disease Progress Curve (% days); GY: Grain Yield (kg/ha); CV: Coefficients of variation (%); and LSD: Least Significant Difference at $p < 0.05$ probability level

in the study areas during the production season. This study showed that combining foliar application of fungicide mancozeb on later sowing dates can decrease the severity of chocolate spot compared to no foliar fungicide or earlier sowing dates. As the frequency of foliar mancozeb application increased, the severity of the disease decreased. Chocolate spot disease development was lowest in the experiments receiving four-time spray (S2F4) fungicide mancozeb application at the time of sowing on July 1 (S2F4) experiments. Disease development was highest and increased the fastest where no fungicide was applied to control pathogens. Different reports state that fungicide applications have been shown to cause a significant reduction in disease severity between sprayed and no sprayed treatments. The grain yield increased as a result of an increase in fungicide application with disease intensity. In this study, S2F4 (four-time spray) in one growing season would control chocolate spot disease and increase the grain yield. This shows that the chocolate spot causes grain yield loss. Thus, mostly, the fungicide frequency showed differences, and therefore, the occurrence of the disease has been affected more by mancozeb application frequency than by the time of sowing. Of the treatments, one time of foliar application of mancozeb has not been recommended for the management of chocolate spots. To improve disease control, foliar application of mancozeb fungicides in combination with cultural practices such as appropriate sowing dates would be very important. Four times applications of mancozeb spray on the first July sowing date have effectively reduced disease severity and significantly increased yield. However, cost-effective of these chemical and other faba diseases like rust are becoming economically important diseases is an issue that has to be further investigated.

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## Competing Interests

The authors declare that they have no competing interests.

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