



## Evaluation of Damu 45% SC Fungicide against Chocolate Spot (*Botrytis fabae* Sardina), Ascochyta Blight (*Ascochyta fabae* f.sp.fabae) and Rust (*Olpidium viciae* Kusano) on Faba Bean (*Vicia faba* L)

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### Abstract

In Ethiopia, the average yield of Faba bean crop is about 2.53 t ha<sup>-1</sup> which is less than yield potential (8 t ha<sup>-1</sup>). Some diseases on faba bean have significant and/or intermediate importance in terms of yield reduction and aggressiveness. The crop is severely attacked by seven major fungal diseases, of which the three most economically important foliar diseases are chocolate spot (*Botrytis fabae*), Ascochyta blight (*Ascochyta fabae* S), and Rust (*Uromyces viciae fabae*). Field experiment was conducted to verify the effectiveness of the Damu 45% S C Fungicide (Carbendazim 400 g/lit+ Hexaconazole 50 g/lit) against Chocolate Spot (*Botrytis fabae* Sardina), Ascochyta Blight (*Ascochyta fabae* f.sp.fabae) and Rust (*Olpidium viciae* Kusano) on Faba Bean (*Vicia faba* L) on Faba bean were tested at Kokate, Dalibo Wogane and Bossa Qacha on farmers' field in a Randomized Complete Block Design (RCBD) with five replications during 2022. The experiment result showed that, fungicide treated plots were showed significant difference compared to the control treatments in all variables. Evidence obtained from the verification trial showed that even if there is no statistically significant difference observed between candidate (test) fungicide (Damu 45% SC) and standard fungicide (Tilt 250 EC) in all diseases parameters measured at five locations, the candidate (test) fungicide (Damu 45% SC) with active ingredient Carbendazim 400 g/lit+ Hexaconazole 50 g/lit at the rate of 0.5 lit/ha with 250 liter of water acted better in reducing diseases incidence, percentage Severity index, area under disease progress curve and increased grain yield (kg/ha) of the faba bean as compared to the standard fungicide (Tilt 250 EC) and unsprayed checks in tested locations. In nut shell, it is concluded that Damu 45% SC at the rate of 0.5 lit/ha with 250 liter of water was found the best by minimizing Chocolate spot, Ascochyta blight and Rust diseases in all experimental locations as compared to the standard check (Tilt 250 EC) and unsprayed checks in both locations. However, it needs further investigation for the interval and frequency.

**Keywords:** Faba bean; Chocolate spot; Ascochyta blight; Rust; Fungicides

### Introduction

Faba bean is a major grain legume widely cultivated around the globe for food and feed purposes. 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 [1]. In Ethiopia, faba bean is grown in highlands (1780–3000 m.a.s.l.) with 700–1000 mm annual rainfall [2]. The area of faba bean production in Ethiopia has increased by 18.21% from 2010 cropping season to 2016. China has been the main producing country, followed by Ethiopia, Egypt, Italy, and Morocco [3]. Ethiopia is considered as; the secondary center of diversity and also one of the nine major agro geographical production regions of Faba bean [4]. The primary producers of pulses are small scale farmers with small and dispersed plots under rained conditions, with substantially lower yields compared to the improved Faba bean varieties and international yields [5]. In Ethiopia, the average yield of Faba bean crop is about 2.53 t ha<sup>-1</sup> which is less than yield potential (8 t ha<sup>-1</sup>) of Faba bean [5]. The low productivity of the crop is attributed to susceptibility to biotic and abiotic stresses [6, 7] of which diseases are important factors limiting the production of the crop specifically in Ethiopia. Some diseases on faba bean have significant and/or intermediate importance in terms of yield reduction and aggressiveness. Chocolate spot (*Botrytis fabae* Sard.), ascochyta blight, rust (*Uromyces vicia fabae*) and foot rot (*Fusarium avenaceum*) are among fungal diseases that contribute to the low productivity of the crop [8]. Earlier study with regard to the distribution of faba bean diseases in Ethiopia stated that numerous pathogens infect the crop in different parts of the country. Diseases caused by chocolate spot,

ascochyta blight and rust reported to have economic significance [9]. The crop is severely attacked by seven major fungal diseases, of which the three most economically important foliar diseases are chocolate spot (*Botrytis fabae*), Ascochyta blight (*Ascochyta fabae* S), and Rust (*Uromyces viciae fabae*) [10].

To prevent the yield loss due to these diseases, farmers used different fungicides due to the faba bean disease's aggressiveness under field conditions. The most effective fungicides have been broadly used strategy and provide effective and reliable disease control measures [11], but fungicides may not be equally effective under different weather conditions and economically feasible all over the country. More research work is expected to control the faba bean chocolate spot disease through various fungicide evaluation efficacies, because the disease still causes much devastation on crop in the country. Research reports support the fact that unwise use of fungicides has led to the development of resistance to the pathogen [12, 13]. Measures

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using appropriate management options, like proper fungicides, to reduce sources of infection and prevent the spread of disease are great importance in controlling faba bean diseases during the growing periods. Thus, there is a need for alternative and effective fungicides through the introduction of a new fungicide or different formulations of the existing fungicides with the same active ingredient that might be continue to be introduced by the pesticide companies. To increase the availability of effective fungicides for the growers, the efficacy of the newly introduced fungicide on chocolate spot, ascochyta blight and rust of faba bean should be regularly tested and verified before introducing to the farming community and also the efficacy of fungicide is highly influenced by environmental factors, diseases occurrence, application time, and rates of fungicide application. Therefore, evaluation of the fungicide across the locations is greatly important to get an insight into the effects of the fungicide. Based on the above background, Areka Agricultural Research Center has been designated by the Ministry of Agriculture through Southern Agricultural Research Institute to test the efficacy of the new fungicide, Damu 45% SC against chocolate spot, ascochyta blight and rust of faba bean during the 2022 cropping season. Therefore, the objective of the study was to evaluate the efficacy of the of the new formulation fungicide : Damu 45% SC (Carbendazim 400 g/lit + Hexaconazole 50 g/lit) relative to another promising standard fungicide, Tilt 250 EC (Propiconazole), for the management of chocolate spot, ascochyta blight and rust diseases of faba bean for registration purpose.

## Material and Methods

### Descriptions of the study areas

The verification trial was conducted during 2022 main cropping season in an open environment to convince the objectives of the current verification around Wolaita Zone in three locations (Kokate, Dalibo Wogane and Bossa Qacha) of Southern Ethiopia. The two experimental sites are geographically located at 06° 85' 28" N and 037° 76' 10" E (at Kokate), 06° 88' 79" N and 037° 80' 18" E (at Dalibo Wogane) and 06° 51' 25" N and 037° 47' 30" E (at Bossa Qacha). The sites are found at an elevation of 2156 (at Kokate), 2200 (at Dalibo Wogane) and 1944.73 (at Bossa Qacha) 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°C. The soils are sandy-loam with a PH of 5.2.

### Treatments, design of experiment and trial management

The study was conducted in the natural environment to assure the incident and increase natural infections at the beginning of the study. The areas are the hot spots for the intended pest. The total width and length of the layout were designed at 35 x 33 m with a unit plot size of 10 x 10 m, respectively. Plots were spaced by 1.5 m and blocks separated by a safeguard path of 2.0 m to prevent drifts or cross-contamination. Seeds plantation are at the rate of two seeds per hole. The space between rows and plants was 40 cm and 10 cm respectively. The experiment was laid out in a randomized complete block design with five replications. Faba bean local cultivar, which is susceptible to faba bean diseases, was used in the study and planting was done on 26 June 2022 simultaneously in three locations. The recommended fertilizer rate of 100 kg ha<sup>-1</sup> of NPS was applied during planting. A total of three treatments, including control, were comprised during the study. Damu 45% SC at the rate of 0.5 lit/ha with 250 liter of water (Candidate fungicide), Tilt 250 EC at the rate of 0.5 lit/ha with 250 liter water (Standard check) and unsprayed

check were used. For the candidate fungicide, the use of the rate of fungicide per hectare and amount of water for dilution of fungicide was performed as suggested by the manufacturer. Spraying was performed using a manual knapsack sprayer. Foliar application of fungicides was applied three times starting from the onset or appearance of the disease and repeated at 14 days spray intervals. All other non-experimental variables and agronomic operations have been applied uniformly to the three locations and throughout the experimental time. The control plots were sprayed with water only.

### Disease assessment

The diseases assessment was carried out at weekly intervals right from the aspect of initial stage of disease symptoms and ceased when crop attain physiological maturity. Twelve randomly selected Faba bean plants from the middle rows of each plot were used for disease assessments to minimize border effects. A total of six assessments were made per location. The three important faba bean diseases were assessed: Chocolate spot, Ascochyta blight and Rust. Disease incidence was assessed by counting the number of diseased plants per total number of plants inspected and expressed as percentage (%) of total plants. PDI was computed (calculated) using the formula of [14]:

$$PDI = \frac{\text{number of plants infected}}{\text{total number of plants observed}} \times 100.$$

Assessments of the disease severity in the field trials were visually scored as the percent leaf area infected by the diseases. The severity was rated on plants from each plot using 0-9 scale [15]. Where 0 = no visible leaf infection; 1 = less than 5% leaf area infection; 3= 6-25% leaf area infection; 5 = 26-50% leaf area infection; 7 = 51-75% leaf area infection; 9 = more than 75% leaf area infection. The then converted into PSI for analysis using the formula of [14]. The severity scales (grades) were then converted in to Percentage of Severity Index (PSI) according to the formula by [14].

$$PSI = \frac{\text{Sum of numerical ratings} \times 100}{\text{Number of plants scored} \times \text{Maximum score on scale}}$$

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 [15].

$$AUDPC = \sum_{i=1}^{n-1} 0.5 (x_i + (x_i + 1)) (t_i + (1 - t_i)),$$

Where n is the total number of assessments, t<sub>i</sub> is the time of the i<sup>th</sup> assessment in days from the first assessment date, and x<sub>i</sub> is the percentage of disease severity at i<sup>th</sup> assessment. Agronomic data like number pod per plant, pod length (cm), plant height(cm), 100 seed weight(g) and total grain yield (kg/ha) were taken for the analysis.

### Data analysis

Analysis of Variance (ANOVA) was done by using SAS version 9.3, and means comparisons for the significantly different variables were made among treatments using Least Significant Differences (LSD) test at 0.05 levels of significance.

## Results and Discussion

### Effect of Damu 45% SC fungicide on Chocolate spot, Ascochyta Blight and Rust disease development of the faba bean

Chocolate spot, Ascochyta blight and Rust diseases were occurred on local variety of faba bean across all locations but Chocolate spot

diseases pressure was very high when compared with other diseases across all locations during 2022 main cropping season. The test fungicide (Damu 45% SC) and the standard fungicide (Tilt 250 EC) significantly reduced Chocolate spot, Ascochyta blight and Rust diseases of the faba bean over untreated check. However statistically no significant difference observed between test fungicide (Damu 45% SC) and the standard fungicide (Tilt 250 EC) in controlling Chocolate spot, Ascochyta blight and Rust diseases of the faba bean (Tables 1- 3). Even though, there was no statistically significant difference observed between test fungicide (Damu 45% SC) and the standard fungicide (Tilt 250 EC), relatively test fungicides had comparable efficacy in reducing Chocolate spot, Ascochyta blight and Rust diseases of the faba bean to the minimum possible level with standard fungicide. While based on visual field observation test fungicide (Damu 45% SC) showed similar efficacy in controlling Chocolate spot, Ascochyta blight and Rust diseases of the faba bean with the standard fungicide (Tilt 250 EC). The statistical analysis also showed that there is no significant difference observed between the test fungicide (Damu 45% SC) and standard fungicide (Tilt 250 EC) on diseases incidence, percentage Severity, area under disease progress curve and grain yield (kg/ha) of three faba bean diseases at three locations (Tables 1- 3).

Even if there is no statistically significant difference observed between test fungicide (Damu 45% SC) and standard fungicide (Tilt 250 EC) in all diseases parameters measured at three locations, test fungicide (Damu 45% SC) acted better in reducing diseases incidence,

percentage Severity, area under disease progress curve and increased grain yield (kg/ha) at three experimental locations (Table 1-3). Therefore, test fungicide (Damu 45% SC) and standard fungicide (Tilt 250 EC) controlled Chocolate spot, Ascochyta blight and Rust diseases of the faba bean compared to untreated check on local variety of faba bean (Tables 1-3).

### Conclusions and Recommendation

Chocolate spot, Ascochyta blight and Rust diseases of the faba bean cause serious problems in the study areas during the production season. The experiment result showed that, fungicide treated plots were showed significant difference compared to the control treatments in all variables. Evidence obtained from the verification trial showed that even if there is no statistically significant difference observed between candidate (test) fungicide (Damu 45% SC) and standard fungicide (Tilt 250 EC) in all diseases parameters measured at three locations, the candidate (test) fungicide (Damu 45% SC) at the rate of 0.5 lit/ha with 250 liter of water acted better in reducing diseases incidence, percentage Severity index , area under disease progress curve and increased grain yield (kg/ha) of the faba bean as compared to the standard fungicide (Tilt 250 EC) and unsprayed checks in tested locations. In nut shell, it is concluded that Damu 45% SC at the rate of 0.5 lit/ha with 250 liter of water was found the best by minimizing Chocolate spot, Ascochyta blight and Rust diseases in all experimental locations. During the growing periods, no foliar toxic effect was observed from the effect of any tested fungicides. Hence, based on strong positive merits of candidate fungicide Damu

**Table 1:** Effect of Damu 45% SC fungicide on Chocolate spot diseases and yield of faba bean at Kokate, Dalibo Wogane and Bossa Qacha during 2022 cropping season.

Treatments	Kokate				Dalibo Wogane				Bossa Qacha			
	PDI	PSI	AUDPC (%)	GY	PDI	PSI	AUDPC (%)	GY	PDI	PSI	AUDPC (%)	GY
Damu 45% SC	39.4b	38.4b	573b	4338a	46.7b	38b	487b	4018a	39.7b	39b	487b	3738a
Tilt 250 EC	45b	40.6b	572.6b	4380a	45.3b	43.6b	501.6b	3953a	40.3b	38.7b	501.6b	3729a
untreated	75a	62.2a	1646.3a	3100b	71.6a	65a	1429.3a	3150b	78.6a	70a	1429.3a	2900b
LSD (0.05%)	13.3	1.6	83.7	50	15	1.6	103.6	87.3	1.89	5.2	92.5	16
CV (%)	16	12.3	11.8	16.45	12.6	12.3	15.4	26.3	15.3	12.3	21	17.4

Means in the same column followed by the same letters are not significantly different at 5% level of significance. PDI = percent diseases incidence; PSI = Percentage Severity Index; AUDPC = Area under disease progress curve; GY = grain yield (kg/ha); CV = Coefficients of variation (%); and LSD = Least significant difference at  $p < 0.05$  probability level.

**Table 2:** Effect of Damu 45% SC fungicide on Ascochyta blight disease parameters of faba bean.

Treatments	Kokate			Dalibo Wogane			Bossa Qacha		
	PDI	PSI	AUDPC (%)	PDI	PSI	AUDPC (%)	PDI	PSI	AUDPC (%)
Damu 45% SC	58.3b	15.3b	127.6b	57.6b	18.6b	129.2b	49.3b	11.9b	137.2b
Tilt 250 EC	60.4b	19.4b	133b	57.8b	19.2b	145b	50.4b	15.4b	137.8b
untreated	73.2a	28.4a	171.6a	67.2a	38a	187.3a	63.7a	23.4a	183.4a
LSD (0.05%)	4.6	6.8	9.3	3.9	7.4	32	1.89	4.7	11.3
CV (%)	12.2	11.4	15.8	14.5	11.6	14	10.6	8.5	15

Means in the same column followed by the same letters are not significantly different at 5% level of significance. PDI = percent diseases incidence; PSI = Percentage Severity Index; AUDPC = Area under disease progress curve; CV = Coefficients of variation (%); and LSD = Least significant difference at  $p < 0.05$  probability level.

**Table 3:** Effect of Damu 45% SC fungicide on Rust disease parameters of faba bean.

Treatments	Kokate		Dalibo Wogane		Bossa Qacha	
	Terminal severity (%)	AUDPC (%)	Terminal severity (%)	AUDPC (%)	Terminal severity (%)	AUDPC (%)
Damu 45% SC	38.7b	498.4b	30.5b	502.5b	44.6b	535b
Tilt 250 EC	39.4b	497.3b	35.2b	541.3b	44.2b	607.5b
untreated	82.63a	1321a	64.3a	901a	82.5a	1113.2a
LSD (0.05%)	10.04	119.3	15.2	95.4	19.7	156.9
CV (%)	16.32	17.8	18.01	21	18.07	19.4

Means in the same column followed by the same letters are not significantly different at 5% level of significance. AUDPC = Area under disease progress curve; CV = Coefficients of variation (%); and LSD = Least significant difference at  $p < 0.05$  probability level.

45% SC in reducing Chocolate spot, Ascochyta blight and Rust diseases to the lowest level, it is recommended for registration to the management of the Chocolate spot, Ascochyta blight and Rust diseases of the faba bean.

### Competing Interests

The authors declare that they have no competing interest

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