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Management of faba bean gall in faba bean producing area of Eastern Amhara, Ethiopia

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Abstract: *Faba bean* gall caused by *Olpidium viciae* is the most destructive disease of faba bean (*Vicia faba* L.) in Ethiopia, particularly in Amhara, Tigray and some part of Oromia region. This problem needs immediate sound management strategy to protect plants against this threat, thus maximizing faba bean productivity. The objective of this study was to evaluate a set fungicides for their efficacy for the control of faba bean gall. The fungicides used were bayleton WP25 (Triadimefon 250 g a.i/kg) as seed dressing and foliar spray; mancozeb 80% WP, ridomil gold 68 WP, chlorothalonil 75%WP and cruzet (cymoxanil 8% + mancozeb 64%) as a foliar spray and apron star 42 WS and thiram 50 WP used as seed dressing. Untreated plants were used as control. The result showed that treatments significantly differed ($P<0.05$) in terms of efficacy, agronomic and yield parameter in 2013 and 2014 at Geregera and Jama. Bayleton seed dressing was found to significantly reduce the disease incidence, severity and area under disease progress curve (AUDPC) than other fungicides and untreated check at the same time significantly promoting an increase in yield, pod per plant, seed per pod and thousand seed weight. Similarly, verification of bayleton 25% wp was done at Atarimesik watershed and the result ($p<0.05$) showed that bayleton seed dressing significantly reduces the disease incidence, severity and area under disease progress curve than other fungicides and the untreated check. Therefore, bayleton wp 25% fungicide use as a seed treatment can reduce the disease pressure and protect faba bean from faba bean gall.

Keywords: faba bean gall control, fungicides efficacy, Triadimefon, AUDPC

Introduction

Faba bean (*Vicia faba* L.) is the fourth most important pulse crop in the world (Sainte, 2011) and most widely grown food legume in Ethiopia. According to Central Statistics Agency of Ethiopia (CSA, 2013), faba bean takes over 30% of cultivated

land. However, the productivity of faba bean in Ethiopia is still far below its potential. The average yield under small-holder farmers is not more than 1.6 t ha^{-1} (CSA, 2013) due to different diseases among which faba bean gall appears the most devastating and widely disseminated in the area within a few years since its occurrence (Hailu et al., 2014). This disease, caused by *Olpidium viciae*, is characterized by a great variety of symptoms and has been reported in Ethiopia in North shewa (Beyene, 2015), Selale highlands (Dereje and Wendafrash, 2012) and Wollo highlands (Hailemariam *et al*., 2014).

The faba bean gall symptoms appear on leaves and stems. At the initial infection stage, on the back side of leaves, small chlorotic galls are formed, and then progressively enlarge to become light brown. Thus, the small tumor like galls is formed, adjacently to form huge galls, resulting in rolling up and abnormal growth of leaves. At the later stage, the galls turn black or brown, the tissues decay and a few galls break to form necrotic areas. Leaves with more galls usually die earlier. Similar galls can form on the middle or lower parts of the stems. Severely infected leaves and stems are often stunted with few pods, or even fail to yield.

In faba bean producing area of Wollo similar symptoms are observed. Symptoms of the disease has been observed on limited plots around Meket, Wadila, Jamma and Woreilu before 2009 (farmers information) while in 2012 and 2013 cropping seasons, the distribution and the severity level become increased (Hailemariam *et al.*, 2014). The survey report indicated that the disease influenced by different cultural and environmental conditions. In China, treating faba bean with fungicides, such as Carbendazim, Thiram and Bayleton were recommended and practiced (Lang *et al*., 1993). In Ethiopia, there is few management options are designed for this economically important crop, such as the use high yield and moderately resistant varieties (Yitayih and Azmeraw, 2017). Therefore, the objective of this study was developed to evaluate the efficacy of a set of fungicides and their appropriate time of application.

Material and method

Seed dressing and foliar spray fungicides were tested in the experiment against faba bean gall of faba bean. Seed dressing fungicides were Triadimefon (Bayleton 25 WP), the mixture Thiamethoxam 200g Kg^{-1} + Metalaxyl 200g Kg^{-1} + Difenoconazole 20g Kg^{-1} (apron star 42 WS, Syngenta International AG - Ethiopia) and thiram 50 WP. Foliar spraying of Chlorothalonil 75 WP, mancozeb 80 WP, ridomil Gold 480EC (Ridomil gold with active ingredient of Metalaxyl 40 g/kg+Mancozeb 640 g/kg), cruzate 43.9 WP and untreated included as a control. Based on results collected during the first year trial, two chemicals (Bayleton 25 WP and Mancozabe 80 WP) were selected and approved side by side from the main experiment. The best performed

(baylaton seed dresing) were demonstrated for farmers at Atarimesk watershed in the disease prone area. Application dosage and the active compounds are presented in Table 1.

Table 1 - Dose and formulation of fungicides

Fungicides	Active compounds	Dose	Mode of action
Curtez 43.8 WP	Cymoxanil 8% + mancozeb 64%	2.5kg/ha	Foliar spray
Mancozeb 80 WP	Ethylene bisdithiocarbamate	1.5Kg/ha	Foliar spray
RidomilGold 480EC	Metalaxyl 40 g/kg + Mancozeb 640 g/kg	2.5 kg/ha	Foliar spray
Bayleton 25 WP	Triadimefon 250 g a.i./kg	300g/100kg seed	Seed treatment and foliar spray
Chlorothalonil 75 WP	2,4,5,6-tetrachloroisophthalonitrile	1.5kg/ha	Foliar spray
Thiram 50 WP	Tetramethylthiuram disulfide	250g/100kg seeds	Seed treatment
Apron star 42 WS	Thiamethoxam 200g Kg^{1}+ Metalaxyl 200g Kg^{-1} + Difenoconazole 20g Kg^{-1}	250g/100kg seeds	Seed treatment

The experiment was carried out in the farmer's field of Jama and Mekit district, Amhara region, Ethiopia, during main cropping season of 2013 and 2014. The experiment was laid out following randomized complete block design with three farmers field as a replication for each district, maintaining 3.5 m x 4 m unit plot, 0.4 m between rows and 1.0 m between plots. The seeds of faba bean (local variety) were treated with seed dressing chemicals. The demonstration of Bayleton WP25 seed dressing chemical were conducted in Atarimesk watershed, Amhara region, Ethiopia with 10m by 10m plot size.

Foliar spray chemicals were applied two times in the first year and three times in second year (at the time of diseases appearance and two weeks after the first spray). Seed dressing chemicals were treated at the time of planting and for the approval of the chemical efficacy one treatment treated before six hours of the planting.

Data on disease severity, disease incidence, plant height, and number of pod per plant, number of seed per pod, hundred seed weight and yield were recorded. Disease severity was recorded in 15 days interval started from the onset of the disease up to crop maturity and the area under disease progress curve was calculated following the formula stated below (Campbell and Madden, 1990).

The area under disease progress curve (AUDPC) was calculated for severity using the formula:

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

Where Xi is the severity of disease at ith assessment, ti is the time of the this assessment in days from the first assessment date and n is the total number of disease assessments (Campbell and Madden, 1990). Incidence and severity were expressed in percentage and time in days, AUDPC expressed in %-days.

Statistical analysis

All agronomic and disease components were subjected to analysis of variance using SAS and Genstat statistical software. Means were separated using the Duncan multiple range test at 5% significance level.

Result and discussion

The analysis of variance showed that significantly differ between treatments ($p<0.05$) on disease, agronomic and yield parameter in 2013 and 2014 main cropping season at Geregera and Jama district, Amhara, Ethiopia (table 2, 3 & 4). The ANOVA indicated that Bayleton 25 WP seed dressing significantly reduce the disease incidence, severity and area under disease progress curve than other fungicides and untreated check. In addition, Bayleton seed dressing increase the yield and agronomic traits.

Table 2 - Mean of disease parameter, yield and yield component at Geregera (2013)

Treatment	Severity	AUDPC	Incidence	PH	PPP	SPP	Yield	100SW
Control	50a	551.4a	100a	59.5bc	6.6b	2.4b	4.63b	24.367b
Curtez 43.9 WP	50a	575.9a	100a	57.7b	5.3b	2.5b	4.537b	24.867b
Mancozeb 80 WP	33.3a	503.7a	80a	67.4ab	9.1b	2.5b	4.293b	24.033b
Ridomil Gold 480EC	33.3a	510.2a	83.3a	63bc	8.8b	2.5b	5.63b	26.1b
Bayleton 25 WP SD	2.5b	278.9b	30b	74.7a	13.4a	3.5a	11.91c	31.6a
Thiram 50 WP	43.3a	574.9a	100a	58.3c	6.7b	2.5b	4.54a	25.567b
Apron star 42 WS	46.7a	595.8a	100a	55.1c	6.4b	2.5b	4.047a	25.533b
GM	37	513	84.7	62	8	2.6	5.7	26
CV	45	13	14	9.7	28	7.6	13	8
Significant level	**	**	*	*	*	**	*	*

*= significant at 5% probability level, ** =highly significant at 5% probability level, GM= grand mean, CV=coefficient of variation, AUDPC=area under disease progress curve, PH=plant height, PPP=Pod per plant, SPP=seed per pod, 100SW= thousand seed weight.

Fig 1 - Bayleton seed dressing treated and untreated control plot at Geregera in 2013

Table 3 - Mean of disease parameter, yield and yield component at Geregera (2014)

Treatment	DE	PH	PPP	SPP	TSW	Yield (kg)/ha	Incidence	severity	AUDPC
Bayleton 25 WP F	8.33	75.8	12	2	31.9	1241a	83.33	35b	750
Chlrothalonin 75 WP	8.67	79.13	11.67	2.3	34	1564a	71	38.33b	837.5
Mancozeb 80 WP	8.67	75.07	11.33	2	31.53	1293a	81.67	35b	681.2
Ridomil Gold 480EC	8.33	72.6	10.67	2	31.53	904b	88.33	57.33ab	1255
Control	8.33	73.33	10.33	2.3	33.47	887b	65	65a	1456.2
GM	8.47	75.19	11.2	2.13	32.49	1178	77.87	46.1	996
CV	9.15	6.90	13.78	14.8	4.54	19.9	16.10	17.7	33.6
Significance	NS	NS	NS	NS	NS	**	NS	*	NS

NS= non-significant at 5% probability level, *= significant at 5% probability level, ** =highly significant at 5% probability level, GM= grand mean, CV=coefficient of variation, AUDPC=area under disease progress curve, DE= day to emergence, PH=plant height, PPP=Pod per plant, SPP=seed per pod, 100SW= thousand seed weight.

Table 4 - Mean of disease parameter, yield and yield component at Jama (2013)

Treatment	Severity	AUDPC	PH	PPP	SPP
Control	1.1767a (24.667)	721.9	62.4bc	11.3	2.6
Curtez 43.9 WP	0.8033b (10.333)	322.1	59.5bc	11.9	2.8
Mancozeb 80 WP	0.8033b (10)	322.1	67abc	12.6	2.8
Redomil Gold 480 EC	0.88ab (13.33)	390.1	63bc	12.3	2.5
Bayleton 25 WP SD	0.4767c (3.33)	147.2	73.4a	15	3.1
Thiram 50 WP	1.02ab (15.33)	400.8	61.7bc	11.7	2.9
Apron star 42 WS	0.9ab (19)	619.5	69.3ab	12.1	2.9
GM	13.8	412.4	65	12	2.8
CV	19	77	7.3	13	9.5
Significance	**	NS	*	NS	NS

*= significant at 5% probability level, ** =highly significant at 5% probability level, GM= grand mean, CV=coefficient of variation, SD= seed dressing, AUDPC=area under disease progress curve, PH=plant height, PPP=Pod per plant, SPP=seed per pod

Bayleton 25 WP seed dressing treated before six hours and at the time of planting significantly reduced the disease incidence, severity and AUDPC compared to Mancozeb 80 WP foliar spray, bayleton 25 WP foliar spray and untreated check. Moreover, Bayleton 25 WP seed dressing significantly appeared to increase the yield and pod per plant compared to mancozeb and bayleton foliar sprays as well as untreated control (table 5).

The on-farm demonstration result showed that bayleton fungicide used as a seed treatment significantly reduced faba bean gall disease incidence (85%) and severity (46.67%) (Table 6). In line with our finding, treating faba bean with fungicides (like Carbendazim, Thiram and Bayleton) were also recommended and practiced in China (Lang *et al*., 1993).

Conclusion

Bayleton WP25 (Triadimefon 250 g a.i./kg) at the rate of 300g fungicide per 100 kg of faba bean used as a seed treatment can reduced faba bean gall pressure, thus minimizing farmer's losses.

Table 5 - Mean of disease parameter, yield and yield components for approve effective chemical at Geregera (2014)

Treatment	DE	PH	PPP	SPP	TSW	Yield kg/ha	Incidence	Severity	AUDPC
BSDBSH	9a	81.2	13a	2.33	34.83	1758.4a	6.67b	2.5c	87.5c
BSDAP	9.33a	72.93	13.3a	2	34.5	1609.55a	9.67b	2.5c	75c
Mancozeb foliar	7b	69.6	10.7ab	2	33.4	1071.25b	83.33a	51.67b	1050b
Bayleton foliar	7b	74	10.3ab	2	32.03	1009.65b	86.67a	66.67ab	1200b
Control	7.33b	70.87	8.67b	2	32.23	691.01c	96.67a	85a	2012.5a
GM	7.9	8.5	11.2	2.07	33.4	1227.972	56.6	41.67	885
CV	10.55	73.4	14.89	12.49	4.85	9.4	12.44	11.29	22
Significance	*	NS	*	NS	NS	**	**	**	**

*= significant at 5% probability level, ** =highly significant at 5% probability level, GM= grand mean, CV=coefficient of variation, AUDPC=area under disease progress curve, DE=days to emergence, PH=plant height, PPP=Pod per plant, SPP=seed per pod, TSW= thousand seed weight, BSDBSH=seed dressing before six hours.

Table 6 - Mean of disease parameter, yield and agronomic component due to bayleton seed dressing in Atarimesik watershed (2014)

Treatment	PH	PPP	SPP	TSW	GY	Incidence	Severity
Baylaton 25 WPSD	99.667	12.67	2.67	53.57	1471.4	11.67	3.33
Untreated	78.33	8.33	2	49.93	663.03	96.67	50
Difference	21.33	4.33	0.6667	3.63	808.37	-85	-46.67
p<0.05	*	NS	NS	*	*	**	*

*= significant at 5% probability level, ** =highly significant at 5% probability level, SD= seed dressing, PH=plant height, PPP=Pod per plant, SPP=seed per pod, TSW= thousand seed weight

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