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Evaluation of Seed Dressing Pesticides on Barely Shoot Fly, *Delia flavibasis* and Barely Stripe, *Pyrenophora graminea* Disease in South-Eastern Ethiopia

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Abstract: During *meher* season, 2013 and 2014, the efficacy of two seed dressing pesticides Apron Star 42 WS and Joint^{TM} 246 FS, possessing fungicidal and insecticidal characteristics were evaluated against plant disease (barley stripe) and insect pest (barley shootfly) in two rates and 11 locations, 8 in Arsi and West Arsi zones, and 3 in Bale zone, in South-eastern Ethiopia. Pooled zone average data revealed that Apron Star 42 WS and Joint^{TM} 246 FS with higher rates, 250g and 200m/100kgseed, respectively, give a better control of barley shootfly under Bale zone circumstances where this pest is most prevalent and severe. The lower rates of Apron Star 42 WS (125g/100kgseed) and Joint^{TM} 246 FS (100ml/100kgseed) did not significantly differ from their higher rates in barley stripe management in all zones and shootfly in Arsi and West Arsi zones, and thus, both higher and lower rates of both seed treatment pesticides are recommended to be used as one of the components of barley diseases management options in malt barley and food barley production in South-eastern Ethiopia.

Keywords: Seed Dressing, Barley Shoot Fly, Barley Stripe, Apron Star 42 WS, Joint^{TM} 246 FS

1. Introduction

Barley is one of the cereal crops produced and is used for food and malt production in Ethiopia (Maaza and Lakech, 1996, Zemede, 2002). Small scale farmers are the major barley producers (Getachew*et al*., 2011). Barley is one of the low yielding crops, 1.3 t/ha, under farm condition (CSA, 2004) due to biotic and abiotic factors. Of diseases recorded (Stewart and Dagnatchew, 1967; Eshetu, 1985), and insect pests recorded (Adunga and Kemal, 1986) on barley in Ethiopia, foliar diseases (scald, net blotch and leaf rust), and seed-borne diseases (barley stripe, loose smut and covered smut) and insect pests (barely shootfly and aphid) are significantly threatening barley production in Ethiopia. Losses from barley shootfly have been estimated to 40-50% (SARC, 2005). Moreover, unfortunately, malting barley varieties are more susceptible to barley shootfly (Tafa. 2003) and 100% crop failure can be experienced under severe pest infestation. Similarly, barley spikes severely infected early by barley stripe, a seed borne disease, fail to emerge from leaf sheath or fail to set grain or emerge to some extent but produce very few and shriveled seeds, thus, losses from this disease are proportional to the proportion of infected plants in the given fields. Efficacy of two seed dressing pesticides, Apron Star 42 WS and Joint ^{TM} 246 FS, each at two rates, was evaluated against barely stripe and barley shootfly in South-eastern Ethiopia in 2013 and 2014 cropping season and this paper presented results.

2. Materials and Methods

Infected seeds of food barley varieties HB-1307 and Guta by barley leaf stripe were collected from meher season, 2012. Infected seeds with barley stripe (HB1307 and Guta), and seeds of malt barely variety Beka have been treated with two seed dressing pesticides Joint TM 246 FS (23.3% Imidacloprid and 1.3%Tebuconazole) and Apron Star 42 WS in two rates: Joint TM 246 FS at 100ml and 200ml, and

Apron Star 42 WS at 125g and, 250g per 100kg seed (Table 1). Treated seeds with each rate of pesticide and a check, untreated seeds were planted on a non- replicated plot of 10m x 10m by broadcasting in meher season, 2013. This trial was conducted at 11 locations in Southeastern Ethiopia, three, four and four locations being in Bale, Arsi and West Arsi zones, respectively. Spaces between plots and borders were kept at 1m. The recommended fertilizer, seed rates and weeding practices were employed. Barley stripe incidence (%), shootfly infestation (%), dead heart (%), grain yield in kg/ha were taken. ANOVA was conducted for each zone using SAS Software and each location taken as a replicate in Completely Randomized Block Design (RCBD).

Table 1. *Chemical selected for their efficacy against Barley shootfly.*

Trade name (Treatment)	Common Name	Rates/ 100kg seed)
Apron Star 42 WS	Thiamethoxam 20% + Metalaxyl -20% + Difenoconazole 2%	250g
Apron Star 42 WS	Thiamethoxam 20% + Metalaxyl -20% + Difenoconazole 2%	125g
Joint TM 246 FS	23.3% Imidacloprid + 1.3%Tebuconazole	200ml
Joint TM 246 FS	23.3% Imidacloprid +1.3%Tebuconazole	100ml
Untreated check	--	0070

3. Results

3.1. Oviposition Response

The effect of two seed dressing pesticide at two rates on barley during seedling emerge 14 days after planting was significantly prevent oviposition in Apron Star 42 WS at 250g and Joint ™ 246 FSat 200ml. The higher rate (200ml) of Joint ™ 246 FS was not significantly different from Joint ™ 246 Fsat 100ml and Apron Star 42 WS at 125g, except from control check on average number eggs oviposited per seedling by Barley shootfly adults (Table 2).

3.2. Barley Shootfly Infestation (%) and Dead Heart (%)

Rates of two seed dressing pesticides reduced shootfly infestation (%) as compared to control check. Joint ™ 246 FS at 200ml, Apron Star 42 WS at 250g were reduced shootfly from 84% (control check) to 34% and 36%, respectively in Bale Zone. Likewise the lower rates of Joint ™ 246 FS at 100ml and Apron Star 42 WS at 125g reduced infestation of the pest from 84% to 62.5% and 76%, indicating that lower rates of these pesticides are less effective as compared to their higher rates. Quite the reverse, these lower rates reduced the infestation and their effects were significantly different from untreated check (Table 2).

Shoot fly infestation was not high in Arsi and West Arsi as compared with Bale zone. Seed dressing pesticide rates invariably reduced shoot fly infestation over untreated check treatment (Table 2). The two rates reduced shoot fly infestation from 32% to 12-18.7% in Arsi and from 37.5% to 19% in West Arsi zones. However, there was no significant difference among pesticide rates in Arsi zone and West Arsi Zone. However, as average of two rates over each pesticide clearly indicating in results, pesticide Joint ™ 246 FS 200ml had better performance than Apron Star 42 WS in all areas considered in numerically, but not statically (Table 2).

Apron Star 42 WS at 250g and Joint ™ 246 FSat 200ml, also, reduced the dead heart (%) significantly as compared with Joint ™ 246 FS at 100ml and Apron Star 42 WS 125gm. The Apron Star 42 WS at 250g rate and Joint ™ 246 FS at 200ml were affects the dead heart percentage form 65.3% to 34.7-39%. The Apron Star 42 WS at 125g and Joint ™ 246 FSat 100ml were not significantly differ from each other, but significantly reduced the dead heart percentage as compared to control check (Table 2).

Table 2. *Effect of seed dressing pesticides on Oviposition eggs, % dead heart and % Infestation Barley shootfly on Malt Barley (Beka variety) in south eastern Ethiopia.*

Seed dressing Insecticides	Rates/100kg	Average of eggs/seedling	Dead heart (%)	Infestation (%)		
				Bale	Arsi	West Arsi
Joint ™ 246 FS	100	1.2	53.7	62.5	24.3	22.25
Joint ™ 246 FS	200	0.75	39	34.1	18.7	19
Apron Star 42 WS	125	1.2	49	76	20.7	23.25
Apron Star 42 WS	250	0.5	34.7	36	22	21.25
Control check	0	1.5	65.3	84	32	37.5
Total Mean		0.98	48.8	58.43	23.5	24.65
Lsd		0.5	9	5.8	8	6.5
CV (%)		27	10	14	12.8	9.6
P-Value		0.01	0.0005	<.0001	NS	0.007

*Means followed by the same letter (s) within column (lower case letter) are not significantly different from each other at P<0.05.

3.3. Seed Dressing Pesticide on Grain Yield (kg/ha)

Grain yields was significantly affected with seed dressing pesticide applied (P<.0002) in Table 3. The highest grain yields were recorded by Apron Star 42 WS at 250g (2266.7kg/ha) and Joint TM 246 FS at 200ml (1997.2kg/ha) than Apron Star 42 WS at 125g (1040.5kg/ha), Joint TM 246 FS at 100m (1260.7kg/ha) and Control check (559.7kg/ha) in Bale Zone. The both lower rate of Apron Star 42 WS (125g) and Joint TM 246 (100ml) were also statically gave the

highest grain yield from the control check. The yield obtained from Arsi and West Zone was not significantly different between the rates of seed dressing pesticide. However, Apron Star 42 WS at 250g gave the highest yield (3573.7kg/ha) in West Arsi Zone in numerically.

The Apron Star 42 WS at 250g and Joint ™ 246 FS at 200ml gave 75% and 72% gave yield advantage over the control check in bale Zone respectively, whereas 52% and 26% in West Arsi for Apron Star 42 WS at 250g and Joint ™ 246 FS at 200ml in Beka variety during the managing Barley shootfly. For Barley Stripe control Joint ™ 246 FS at 200ml and Joint ™ 246 FS at 100ml have gave highest yield advantage in Guta and HB-1307 at all locations (Table 3).

Table 3. *Effect of seed dressing pesticides during management of Barley shootfly on grain yield (kg/ha) of Malt Barley (Beka variety) in south eastern Ethiopia.*

Seed dressing Insecticides	Rates/100kg	Yield (kg/ha)					
		Bale	YA (%)	Arsi	YA (%)	West Arsi	YA (%)
Joint TM 246 FS	100	1260.7	56	2635.2	6	2009.9	14
Joint TM 246 FS	200	1997.2	72	2866.2	14	2337.7	26
Apron Star 42 WS	125	1040.5	46	2679.6	8	1883.8	9
Apron Star 42 WS	250	2266.7	75	2868.8	14	3573.7	52
Control check	0	559.7	0	2468.8	0	1719.6	0
Total Means		1424.9	62.3	2703.7	10.5	2304.9	20.2
Lsd		456.7		469.1		2026.3	
CV (%)		12		6.2		31.6	
P-Value		0.002		NS		NS	

*Means followed by the same letter (s) within column (lower case letter) are not significantly different from each other at P<0.05. YA=Yield Advantage in percent over the control check

3.4. Seed Dressing Pesticide on Barely Stripe Incidence (%)

Averagely barley stripe incidence was developed to 2.4% and 3.3% in plots planted to untreated seeds of variety HB1307 in Arsi and West Arsi zones, respectively, and to 21.7% in plots planted to variety Guta in Bale zone. Two pesticide rates reduced barley stripe incidence, and the differences were observed between these pesticides rates in group and untreated check treatment. However, barley stripe incidence difference observed among pesticides rates did not significantly different in all zones, except in Bale zone (Table 4). Two rates averaged over each pesticide showed that performance of Joint ™ 246 FS is better than Apron Star 42 WS performance invariably with areas of study.

3.5. Seed Dressing Pesticide on Grain Yield (kg/ha)

The statically significant differences of seed dressing pesticide during control of barley stripe in Guta variety were observed between the treatment on measured grain yield (kg/ha) harvested (P>0.02) in Bale zone. Though, the grain yield in Arsi and West Arsi didn't show statically significant on HB-1307 treated with seed dressing pesticide for control of Barley Stripe disease. But, the seed dressing pesticide of Joint ™ 246 FS at 200ml and 100ml were shows the superior response of grain yield in figure as compared to Apron Star 42 WS at 250g and 125g and from control check (Table 4).

Table 4. *Effect of seed dressing pesticides on Barely Stripe incidence % and grain yield (kg/ha) on food barley varieties in Guta at Bale and in HB-1307 at Arsi, West Arsi.*

Seed dressing Insecticides	Rates/100kg	Barley stripe incidence (%)			yields (kg/ha)		
		Bale	Arsi	West Arsi	Bale	Arsi	West Arsi
Joint TM 246 FS	100ml	5	0.7	0.95	2622.3	2647.8	2303.5
Joint TM 246 FS	200ml	6.7	0.62	0.7	2739	2911.3	2602.6
Apron Star 42 WS	125gm	10	1	1.456	2129.7	2376.9	2216.7
Apron Star 42 WS	250gm	15	0.5	1.02	2200	2743.6	2408.1
Control check	0	21.7	2.4	3.3	1966.7	2026.9	2121.3
Total Means		11.7	1.04175	1.4775	2331	2541.3	2330.4
LSD		7.8	3.05	4.05	321	830.04	307.1
CV (%)		35	105.6	98.8	8	11.7	4.7
P-value		0.007	0.5	0.5	0.02	0.2	0.06

*Means followed by the same letter (s) within column (lower case letter) are not significantly different from each other at P<0.05.

3.6. Cost Benefit Analysis

Partial budget analyses for barley shoot fly management using seed dressing pesticide showed that the maximum total gross yield benefit (20902.1 ETB ha^{-1}) was obtained from plot dressed with Apron Star 42 WS (250gm) followed by Joint ™ 246 FS at 200ml rate (17282.6 ETB ha^{-1}). Variation in net benefit was also observed between seed dressing pesticide with their assigned rates of treatments. Apron Star 42 WS at the higher rate of 250gm had the highest net benefit of 18682.1ETB $ha^{-1}$with marginal rate of return (MRR) 395.1% followed from that plot seed dressed by Joint ™ 246 FS at 100ml (1537 ETB/ha^{-1} with MRR 283% (Table 4). The Apron Star 42 WS at lower rate (125gm), Joint TM 246 FS (100ml) of net benefit (12329.4 ETB/ha^{-1}, 13245.4ETBha^{-1}) and with

MRR (150.5%, 342.1%), respectively were obtained greater than the untreated plot of net benefit (11095.4 ETBha^{-1}).

Partial budget analyses for barley stripe disease management using seed dressing pesticide showed that Apron Star 42 WS (200ml) was the highest input and labor cost (2395 ETB ha^{-1}) and marginal cost (2095 ETB ha^{-1}) than the Joint ^{TM} 246 FS at 200ml of maximum total gross benefit (19807 ETB ha^{-1}) and net benefit (17890.0 ETB ha^{-1}). Joint ^{TM} 246 FS at 100ml has the highest net benefit (17208.5 ETB ha^{-1}) with the minimum cost of vary (968.1 ETB ha^{-1}) with 424% marginal rate of return as compared to the all treatment except Joint ^{TM} 246 FS at 200ml (19807 ETB ha^{-1}) net benefit and also marginal benefit (3515 ETB ha^{-1}) were obtained (Table 5).

Table 5. *Partial budget analyses of seed dressing pesticide treatments for Barley shoot fly in Malt Barley variety (Beka) and barley stripe disease in Food Barley (HB-1307) Management*

Parameters	T_1	T_2	T_3	T_4	T_5
Barley Shoot Fly Management					
Ad. yield (kg/ha x 0.9)	1771.7	2160.3	1681.2	2612.8	1424.4
Field price (Birr/kg)	8.0	8.0	8.0	8.0	8.0
Gross field benefit (Birr/ha)	14173.9	17282.6	13449.4	20902.1	11395.4
Total cost vary (Birr/ha)	928.5	1837.0	1120.0	2220.0	300.0
Marginal Cost (Birr/ha)	628.5	1537.0	820.0	1920.0	0.0
Net Benefit (Birr/ha)	13245.4	15445.6	12329.4	18682.1	11095.4
Marginal Benefit (Birr/ha)	2150.0	4350.2	1233.9	7586.6	0.0
MRR (%)	342.1	283.0	150.5	395.1	0.0
CBR	14.3	8.4	11.0	8.4	0.0
Barley Stripe Disease management					
Ad. yield (kg/ha x 0.9)	2272.1	2475.9	2017.0	2205.5	1834.5
Field Price (Birr/kg)	8.0	8.0	8.0	8.0	8.0
Gross field benefit (birr/ha	18176.6	19807	16135.9	17644	14676
Total Cost Vary (Birr/ha)	968.1	1916.3	1207.5	2395.0	300.0
Marginal Cost (birr/ha)	668.1	1616.3	907.5	2095.0	0.0
Net Benefit (Birr/ha)	17208.5	17890.7	14928.4	15249	14376
Marginal Benefit (birr/ha)	2832.8	3515.0	552.7	873.3	0.0
MRR (%)	424.0	217.5	60.9	41.7	0.0
CBR	17.8	9.3	12.4	6.4	0.0

T_1 = Joint ^{TM} 246 (100ml), T_2 = Joint ^{TM} 246 (200ml), T_3 = Apron Star 42 WS (125gm), T_4 = Apron Star 42 WS (250gm), T_5 = control check, MRR = Marginal Rate of Return, CBR = Cost Benefit Ratio

4. Discussions

In the present studies of evaluation of seed dressing pesticide on barley production in south western part of the country (Ethiopia) was effective to reduce barley shootfly oviposition response (eggs per seedling), infestation (%) and dead heart (%). This study revealed that the infestation level of barley shootfly in Bale were most significantly highest as compared to Arsi and West Arsi zone of barley production. The two types of seed dressing pesticide (Joint TM 246 FSFS and Apron Star 42 WS 42 WS) at the higher rate of 200ml, 250g respectively were reducing barley shootfly infestation (%), Dead heart (%) significantly than the lower rates, 100ml (Joint TM 246 FS) and 125gm (Apron Star 42 WS). The grain yield (kg/ha) harvested also from those plots treated with higher rates were increased the yield advantage as plots treated by lower rates in Bale zone. The pervious finding also reported as the infestation level of barley shootfly in Bale highlands frequently reaches 100% on susceptible varieties and it has become a hot spot area for this pest in Ethiopia (Amare, 1993; Hailu, 1997; Tafa, 2003). Barley shootfly is becoming a very important constraint to barley cultivation in Bale highlands particularly for malt barley, which the farmers grow for generating cash (SARC, 2004). In West and Arsi zone the infestation (%) and grain yield (kg/ha) obtained due to seed dressing insecticide of Joint TM 246 FS and Apron Star 42 WS at all their rates more or less not significantly different were observed. Therefore, in terms cost minimization of seed dressing pesticide to control barley shootflythe growers or farmers have to use the lower rates of 100ml (Joint ^{TM} 246 FS) and 125 g (Apron Star 42 WS) in West Arsi and Arsi zone of barley production area.

Several studies indicated that many seed dressing chemical such ascarbofuran, aldicarb, Baythroid (cyfluthrin), Decis (deltamethrin), Fonfos, permethrin, imidacloprid (Gaucho) andtebuconazole (Gaucho Raxil) have been found effective in the control of this pest (Hussien*et al*., 1993). In an insecticide screening experiment conducted at Sinana Research Center revealed that heterahabditis (at 50g, 75g, and 100g), thiamethoxam (at 250g and 375g) and imidacloprid (at 250g) per 100 Kg seed were effective as seed dressing insecticide against D. flavibasis (SARC, 2004). Imidacloprid, reduced infestation and also resulted in excellent control of barely shoot fly.

However, the single most important and effective chemical, Gaucho (Imidacloprid) could not be utilized by farmers to improve barley yield because it is not available and also very expensive (SARC, 2004). The Holeta local cultivar baleme was taken and treated with imidacloprid 70% WS, furatiocarb 400CS, Diazinon- TMTD (15% a.i. for diazinon the active insecticide component) and alderin 40% WP (standard check) at the rate of 88.2, 74, 65, and 200g a.i. per hectare (Adunga and Kama, 1986). Hussien et al. (1993) also reported that

Baythroid (cyfluthrin) and Decis (deltamethrin) as seed treatments gave 64 and 34% protection, respectively, in pot experiments with winter wheat to control D. coarctata. Altmann (1989) reported that cyfluthrin gave superior control of D. coarctata in barley grown in the field. Fonfos and permethrin (Gatehouse et al., 1982) have also been used as seed treatment for the control of D. coarctata.

5. Summary and Conclusions

Barley shootfly, *Delia flavibasis* Stein is one of the most problematic insect pests threatening barley production in Ethiopia generally and malt barley production in particular, especially in the highland of Bale. Likewise, barley stripe, *Pyrenophora graminea*, is one of seed borne diseases more and significantly affecting food barley productivity and production. High yielding varieties, HB1307 and Guta become most prone to barley stripe unless protected by seed dressing pesticides. According the results of present study seed dressing pesticides reduce barley stripe incidence, and barley shootfly infestation and dead heart although failed to eradicate and give complete pest and disease control. Seed dressing pesticides, Joint ^{TM} 246 FS and Apron Star 42 WS 42 WS at the rate of 200ml and 250g / 100kg seed, frequently resulted in lowest shoot fly infestation and dead heart, thus, could be used for shoot fly management in Bale environments, where the pest is endemic and severe, however, contrasting to Bale conditions, shoot fly infestation in Arsi and West Arsi environments and barley stripe incidence did not differ significantly and invariably with environments, with the higher and lower rates of two pesticides. Therefore, lower rates of Joint ^{TM} 246 FS and Apron Star 42 WS can be used for shoot fly and barley stripe management in Arsi and West Arsi and barley stripe management in Bale.

The findings presented here for the control of barley shootfly in Barley with seed dressing insecticide that could be developed as chemical control was an effective as an alternative to other methods of control in IMP program. From the present studies it is possible also to conclude that the uses of higher rate (Joint ^{TM} 246 FS at 200ml and Apron Star 42 WS at 250gm) should be recommended for seed dressing are advantageous for the better management of Barley shootfly.

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