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On farm demonstration of seed coating material genius coat on the performance of malt barley, Ethiopia

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Abstract
Seed coating is a technology to improve germination and homogenize stand establishment. In view of this a field experiment was carried out in 2019 cropping season on farmers and farmers training centers testing sites (FTCs) of Shashamene, Kofale and Arsi Negele of West Arsi zones; to demonstare the effects of seed dressing material ''Genius Coat'' on agronomic, yield and yield components of malt barley. Treatments applied were: (1) Genius coat + Imidam treated seed (2) Imildam only treated seed (standard check). The experiment was laid-out in randomized block design in four replications and replicated over three locations. The plot sizes were 5m x 5m = $25m^2$. Agronomic, pests and yield, data were collected based on the standard procedures. Sample sizes of ten plants/plot were used for agronomic data i.e., for plant height, panicle length, number of productive tiller and seed per panicle. Yield and yield related data; total straw wieght (STW), thousand kernel weight (TKW) and seed yeild (YLD) were collected from the entire plots. Significantly (p<0.05%) higher plant height, pencil size, spike per pencil and number of productve tiller per plant of (87.46cm, 9.15cm, 32.17 and 8) were recorded from seed treated with Genius coat + Imidam. Similarly, significantly (P<0.05%) higher thousand kernel weight (48.42g), total biomass (1156.92kg ha^1) and grain yield (6.37 t ha^1) were obtained from genius coat treated plots as compare to the standard check (seed treated with Imildam). Genius coat + Imidam seed treatement, increased the STW, TKW, YLD by (17, 12 and 26.4)%, respectively over that of the standard check. This yield increment, might associated with nutrient use efficincy of seed coating material and or could be due to the nature of coating substance that can create nitrous environment around germinating seed which might provide nutritional support in early phase of crop development. Unlike biological effects, no significant differences was obseved on disease (scald and net blotch) severity but however, the response of shootfly againest the treatement was showed a significant (p<0.05) differences in all tested areas. The highest shootfly count (2.56) was recorded for standard check as compared to the genius cout +imildam (0.81). This could be due to the effect of the seed treated chemical imildam with the geinus coat which had a sinergetic effects on the pest, rather than treating imildam lonely.
Therefore, genius coat + imidam seed treatment was found to be the best seed treatment material in terms of biological productivity and pest control. Thus, one may recommend for seed treatment in the areas and similar areas of the country where malt barley used as the main crop. However, this study should be repeated to give conclusive recommendation for practical application.

Keywords: Malt barley, genius coat, imidam, seed treatment

Introduction
Barley, /*Hordeum vungere/*, is an important cereal crop grown in most high land of Ethiopia. The crop is most stable food and subsistence crop cultivated nearly on one million hectare with the total production of 2.02 million tons and productivity of 2.1 tons per hectare (CSA, 2017/18) It is the fifth cereal crop in terms of area planted after tef, maize, sorghum and wheat in the country (CSA, 2017/18) [1]. In addition to serving the bear factory, malt barley highly consumed the crop is used for food. According, to ICARDA press released (2016/17) [2], in 2014 malt barley supply in Ethiopia met only 35% of the demand, with the remaining 65% (63,526 tons of malt) imported at a cost of 38 million USD. The favorable agro-ecology for malt barley in the highlands of represents huge opportunities to increase demotic malt barley production in the country and fill the missing gaps. Although *Arsi* and *Bale* represented a significant barley producing areas in the country (Warner J. *et al*., 2015) [9], their supply of raw materials alone couldn't be able to keep with the increasing demands of domestics' industries (Mulatu B. and Grando, 2011) [5].
Seed coating is techniques in which several materials as fertilizers, nutritional elements, moisture attractive or repulsive agents, plant growth regulators, rhizobium inoculum, chemical and pesticides, added to seed by adhesive agents and cause to increase seed performance and germination.

It leads to increase benefits in seed industries, because seeds can use all of their genetic vigor. Seed coatings keep active ingredients and other inputs on seed; and therefor, maximize the productivity of the seed and seedlings activity ingredients. It has to be held together on the seed while enabling seed flow through the treatment process and seed palatability. Polymers help active ingredient stay on the seed attached, but it is important to note that if the seed has been conditioned very well, meaning there is lots of dust on the seed from the seed itself, the polymers become ineffective and the active ingredients will not stick to the seed. If we do not have effectively conditioned seed, the treatments will not stick. Even though we have excellent polymers, that step is critical.

This demonstration was followed by, the result obtained from the verification trail conducted by Ethiopian Institute of Agricultural Research Ethiopian, in 2017/18 main cropping season at Holleta Research Center. The Seeds2 feed project in Ethiopia, the companies Koppert, Incotec and Tradecorp bring this products into the Ethiopian market, products tested, to prove whether the product has added value for malt barley in collaboration with Heineken Brewery Share Company and to show case for nearly thousands of smallholders farmers supported by Heineken/EUCORD-CREATE project in Arsi and West Arsi zones of Oromia.

Objective

- To introduce seed coating materials to Heinekens/EUCORD-CREATE project malt barley producer's farmers
- To show best technologies ''seed coating substance'' which had added value to thousands of project beneficiaries in Arsi and West Arsi zones.
- Creating the basis for further uptake produce in the barley value chain in the areas.

Materials and Methods

Descriptions of the study area

The study was conducted in three potential districts of barley growing area of West Arsi zones; (Shashamene, Negele Arsi and Kofale districst), during the main cropping season from June 20 to Nov 2019 cropping season under rain-fed conditions. The area were located in southern Eastern parts of Ethiopia at a radius of between 25-50km from the zonal town "Shashamene. Geographically, the study areas were located at 7^{o} 57N, 38^{0} 6E for Shashamane at an altitude ranging from 2200 and 2800 meters above sea level. The average annual rainfall is 800 to 1200 mm and its distribution pattern is unimodal and bimodal in most areas. The rainy period covered from May to Nov. It has a cold climate with mean minimum, mean maximum and average temperatures of 11.2°C, 23.12°C and 18.23°C, for West Arsi zones (Zonal BoA, 2019). The soil tested result from the these areas showed that, is more of acidic in nature and silty-clay in classification, table 1.

Soil properties

Table 1: The Physico-chemical properties of the soil in the study area

Physical proprieties	**Units West Arsi**	
Sand	%	20
Silt	%	40
Clay	%	40
Textural Class	-	Silt-clay
Chemical Properties	**Units**	
pH	--	5.26
Available N	%	0.28
Available P	ppm	10.56

pH =measuring of the level of soil acidity and alkalinity (0-14) and ppm= parts per meter

Experimental Materials and Procedures

Treatments and Experimental Design

The experiment consisted of two treatments; 1) seed treated with Genius Coat + Imildam, 2) Seed treated only with Imildam. The experiment was laid out in a randomized design with four replication and replicated on three location within the same zone. Malt barley variety "traveler' or locally named as 'Waliya' was planted at a plot size of 5m x 5m (25 m^2) in rows inter space of 20cm and drilled.

Crop management

These practices were conducted in two phases, the 1^{st} phase was conducted between '25 to 35' to prevent pest occurrence and the second was done between '45 to 55'days for pest minimization or if at all occurred to keep the crop free of any barley pests. Barley pests are; barley insect, weeds and foliar diseases. Accordingly, Rex-dio + Nativo) was used twice at the rate 05lt/ha to control of scald (*Rhynchosporium secalis*) and spot and net blotch (*Helminthosporium spps*). Similarly, Axial-1 (Herbicides) was used twice at the rate of 1lts/ha for the control of both grassy and broad leaved weedy species.

Harvesting and threshing

Malt barley was harvested right after the crop attained 90% physiological maturity. The crops were harvested manually at the base of the crop using sickle and threshed manually on a separate materials.

Data Collections

Phonological (days to 50% heading and 90% physiological maturity), growth parameters; productive tiller capacity (PT), plant height (PHT) data were recorded from ten central rows and randomly selected barley plants, whereas yield and yield components data were collected from the entire plot area. Diseases and insect count (shhotfly) data record was taken from the entire fields using (1-9 scale) as suggested by Prescott, *et al*., 1986 [6], for foliar disease severity.

Procedurally, total straw weight (SWT) determination was done, using the above ground entire plants by sun drying of the sampled plants to the 70 ^{0}C. Thousand seed weight (TKW) of barley was counted and weighted from the bulk of the seeds of barley at 13.5% moisture level and measured

in gram basis using sensitive balance.
Grain yield was taken after harvesting from the entire plot (5mx5m=25m^2). Seed yield was adjusted to 13.5% moisture after the seed moisture was measured using moisture tester (Dickey-john) and used the following formula for the yield adjustments.

$$\text{Adj. Seed yield (kg/ha)} = \frac{\text{100-Actu.M\% x S. yield (g/plot) x 10}}{\text{100-stan. M\%} \quad \text{plot size (m}^2\text{)}}$$

Statistical Analysis:
The data analysis was carried out using statistical package and procedures out lined by 'General Linear model' using SAS version 9.0 software (SAS Institute Inc. 2002) [7]. Mean separation was computed using 'Least Significance Difference' (LSD) at 5%. One ANOVA was used for the crop data analysis. The result was presented for each treatments over the treatments and locations.

Result and Discusstion
The combined analysis revealed that there was a statistically significant (P<0.05) difference in all growth parameters (plant height, productive tillers and no. Of spike per pencil and seed per penicle (Table 2). The maximum plant height, pencil size, spike per pencil and number of productve tiller per plant (87.46cm, 9.15cm, 32.15 and 8) were recorded from seed treated with Genius coat + Imildam. The least plant height, pencil size, spike per pencil and number of productve tiller per plant (78.1cm, 7.22cm, 26.75 & 5.5) were recorded from the standard check. The result revealed that, geinuss coat + imildam seed treatment increased plant height, pencil size, spike per pencil and number of productve tiller per plant by (5.45, 11.79, 9.16 & 18.52)%, respectively as compared to the standard check. This growth paremetes increment, might associated with nutrient use efficincy of seed coating material and or could be due to the nature of coating substance that can create nitrous environment around germinating seed which might provide nutritional support in early phase of crop development. This result will agree with Taylor and Herman 1998) [8].
Similarly, ANOVA result reviled that, total starw weight (SWT) kg ha^1), thousand kerel wieght TKW) (g) and yield t ha^1 of barley in the present study, showed significantly differences at (p<0.05) by the treatement as compared to check, which gave the highest SWT, TKW and YLD of (1156.92, 48.42 and 6.37) (table 3), which was by far better than the check. The percent SWT, TKW and YLD) difference obtained from genius coat + imildam treated plot was more by (9.26, 7.21 and 15.34%), respectively over the yield obtained from check.
Unlike the biological differences, disease severity at 1-9 scoring scale for both scald and net blotch showed insignificant (P>0.05) differences among the treatements. However, ANOVA result showed on (table 4) the response of shootfly againest the treatement was showed a significant (p<0.05) differences in all tested areas. The highest shootfly count (2.56) was recorded for standard check as compared to the genius cout +imildam (0.81). This could be due to the effect of the seed treated chemical imildam with the geinus coat which had a sinergetic effects on the pest, rather than treating imildam lonely.

Table 2: Mean value of agronomic paratmers of malt barley seed coating materials (genius Coat + Imildam) experiment conducted at West Arsi zone, Shashamene, Negele Arsi and Kofale in 2019 main cropping season

Treatments	Pht (cm)	Ps (cm)	Spp (cm)	# PT
Control	78.10b	7.22b	26.75b	5.5b
Candidate	87.46a	9.15a	32.15a	8.0a
Mean	82.78	8.19	29.46	6.8
Lsd (0.05)	0.93	0.47	1.44	0.73
CV %	2.42	6.06	6.69	11.1

Pht= plant height, Ps= Penicle size and Spp= seed per pencile, means followed the same letter along column are not statstically different from each other at 5% probabilty level

Table 3: Mean value of yield and yield paratmers of malt barley seed coating materials (genius Coat) experiment conducted at West Arsi zone, Shashamene, Negele Arsi and Kofale in 2019 main cropping season

Treatments	Swt (kg/ha)	Tkw (g)	Yld (t/ha)	#Sfy
Control	960.33b	42.67b	4.69b	2.56b
Candidate	1156.92a	48.42a	6.37a	0.81a
Mean	1098.63	45.54	5.53	1.68
Lsd (0.05)	23.18	1.98	0.04	2.5
CV %	9.64	8.05	20.16	8.5

Swt= straw weight, Tkw= Thousand kerel weight, Yld= yield, sfy=shootfly count means followed the same letter along column are not statstically different from each other at 5% probabilty level

Table 4: Mean value of diseases (Scald and Net blotch) severity and Shootfly severity of malt barley seed coating materials (genius Coat+ Imildam) experiment conducted at West Arsi zone, Shashamene, Negele Arsi and Kofale in 2019 main cropping season

Treatments	SC (1-9) scale	NB (1-9) scale	#Sfy
Control	3.00	3.08	2.56b
Candidate	2.83	3.00	0.81a
Mean	2.92	3.04	1.68
Lsd (0.05)	NS	NS	2.5
CV %	14.90	11.36	8.5

SC= scald, NB = Net blotch and sfy=shootfly count means followed the same letter along column are not statstically different from each other at 5% probabilty level, NS= None significant

Recommendations

The study was conducted with the aim to understand, the use of seed coating and its contribution towards increasing the yield of malt barley. A comprehensive review of literature on the direct and indirect roles of seed coating materials to the increament of yield and yield components of malt barley was incorporated to the present study. The present investigation has been carried out on the farmers and farmers training centers at West Arsi zones. Genius coat and Imldam seed treatments were used at standard desired qualities and quantities. The effects of this seed treating material (Genius Coat + Imildam) on the plant growth and yield and yield component were studied. The important findings emerged out during present studies were summarized and concluded here under. In this study, genius coat + imildam seed treated plot showed good result on malt barley growth and yield components. Higher significantly variations was obsorved on all plant growth and yield of malt barley. It can thus be said that genius coat + imildam seed treatment is good for agricultural application. Unlike the biological differences, the treatments showed no differences for disease severity, namely scald and net blotch. However, there was different responses for insect pests like barley shootfly, that the treatement not allowed for insect to propageted. This could be due to the effect of the seed treated chemical imildam with the geinus coat which had a synergetic effects on the pest, rather than treating imildam lonely.

Finally, the research indicated that, genius coat had a posetive and significant contribution for malt barley production Therefore, this study revealed that the genius coat can be utilized for more productivity if seed is treated in bulk before distributed to individual farmers, because treating the seed needs some espacial equipement, which is only found in some of higher seed producing companies. Finally, this needs further research to recommend to more areas and in environmentally friendly manner. Needs a big collaboration between different stakeholders namely; Research Centers, Environmental Authorities and compnaies.

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