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Research Article

Evaluation of Malt Barley (*Hordeum distichon* L.) Varieties for Yield and Agronomic Traits in South Gondar, Ethiopia

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The production and productivity of malt barley are limited using disease-susceptible and low-yielding varieties. Study was focused on identifying and selecting the best performed and adapted malt barley variety/varieties for yield and yield-related traits. We evaluated six improved malt barley varieties using a randomized complete block design with three replications. The study was conducted for 2 years (2019 and 2020 cropping season) at Lay Gayint district. The combined analysis showed highly significant differences ($P < 0.01$) among varieties, years, and their interactions in all traits. The highest yield (31.54 qt·ha^{-1}) was obtained from variety Holker. The correlation coefficient analysis showed a significant and very strong positive association of grain yield with number of effective tillers ($r = 0.953^{**}$), spike length ($r = 0.973^{**}$), and strong positive association with thousand seed weight ($r = 0.739^{**}$) with a medium positive association with seed per spike (0.554^{**}). In principal component analysis, PC1 was dominated by traits that had a greater effect on yield. A variety of Holker could be recommended in the study areas and other similar agro-ecologies. Farmers lost a lot of quintals of yield by lack of new technologies, by addressing more adapted improved production technology increased average yield.

1. Introduction

Barley is the primer cereal used in the production of malt in the world. It is the fifth main cultivated crop in the world [1]. The crop was domesticated from its wild relative (*Hordeum spontaneum C. Koch*) about 10,000 years ago, according to archaeological evidence from the Fertile Crescent [2, 3]. Since barley, cultivation and consumption have increased globally because of its high potential for adaptation to a range of agro-ecologies and its numerous uses. The first domesticated crop is growing in Ethiopia that since the beginning of agriculture is barley [4]. Malt barley is one of the principal ingredients in the manufacture of beer [5].

The global demand for malt barley is directly related to the increase in brewery industries. Malt barley is becoming the primary income source for smallholder farmers in Ethiopia's highlands, particularly where agro-ecologies cannot be more productive than other cereal crops [6]. Recently, in Ethiopia, the malt and beer industry has been rising because of amplified demand that is linked with rapid urbanization, population growth as well as increasing earnings of the inhabitants of this country [7, 8].

In Ethiopia, barley covered large cultivated land (970,053 ha), and it produced 347,497 tons. In 2019 main cropping season, 321,515.21 ha of land were covered by barley and the crop produced 2.33 qt·ha^{-1} in the Amhara region [6]. Barley grows in a wide range of agro-ecology with an altitude range of 1800–3400 m above sea level. However, it grows best in the altitude range from 2300 to 3000 m above sea level. Based on their intended purposes, crops are mainly categorized into two categories: food and malting barley [9]. Malt barley is also tolerant to drought, alkali, and saline soil conditions [10, 11].

In Ethiopia, malt barley is used for human food, animal, and poultry feed. Locally, malt barley is eaten in various forms such as *kollo, enjera, tella, Besso,* and *genfo*, which are everyday food items prepared out of malt barley [12]. Malt barley is the main (90%) raw material for industry and is utilized for extracting malt barley for brewing, distillation, baby foods, and coca malt drinks [13–15]. Nevertheless, malty barley production in Ethiopia does not cover the local breweries' [16]. Climatic factors, such as moisture and temperature, are also among the major abiotic environmental causes that are limiting malt barley production [17].

Thus, enhancing malt barley production is crucial for Ethiopia to satisfy the high demand for malt barley and increase farmers' income. Even though Ethiopia has favorable environmental conditions and potential market opportunities, malt barley production is very low (about 15%) compared to food barley. Besides, local malt barley varieties cover about 35% of the production demand; consequently, the breweries must import malt barley from a foreign country [18]. Currently, adaptation and dissemination of improved malt barley varieties among smallholder farmers in the western Amhara Region have been hampered by cultivating older malt barley varieties than improved ones [19, 20]. Low interest and acceptance in using improved malt barley variety seeds by farmers in the study area affect farmers and consumers and cause financial losses for private seed producers. Thus, generating and transferring high malt quality and high-yielded malt barley varieties MOA [6] in the study region could significantly enhance the production and yield of malt barley. Therefore, we conducted a study to evaluate and select adaptable and high-yielding malt barley varieties in South Gondar.

2. Materials and Methods

2.1. Description of the Study Area. The experiment was done at Lay Gayint district in South Gondar of Ethiopia, during the primary cropping year 2019 and 2020. Lay Gayint is located at an altitude range of 2164–3236 m above sea level. Additionally, the latitude and longitude of the study area are 12°N and 38.19°E, correspondingly (Figure 1). Based on records of 1994–2021of nearby meteorological stations, the study areas receive an average annual rainfall of the area was about 520 mm with a maximum temperature of 14.3°C and minimum temperature of 9.8°C for the 2019 cropping season and about 600 mm mean annual rainfall with 13.1°C maximum temperature 9.3°C minimum temperature for the 2020 cropping season. Barley, field pea, potato, wheat, lentils, faba bean, chickpea, teff, and root crops are the dominant crops in the study area. According to neighboring meteorological station statistics from 1994 to 2021, the study areas receive an average annual rainfall of 997 mm for the Lay Gayint site. The average monthly minimum and maximum temperatures for Lay Gayint are 7.59°C and 18.09°C, respectively (Figure 2). The rainy season is from June to August, with the rest of the year being dry [21].

According to data from the Ethiopian Mapping Agency (EMA) [22], and a reconnaissance survey conducted in 2018, the most commonly existing land use types, soil order, and climatic zones are Grassland (35.19%), eutric cambisols (63.57%), and woyine Dega (58.55%), respectively (Table 1) and (Figure 3).

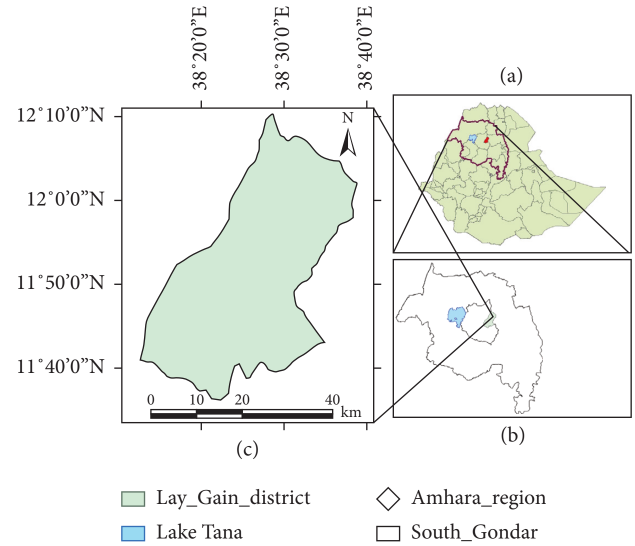

Figure 1: Map of the study areas: (a) Ethiopia, (b) Amhara region, and (c) Study district.

2.2. Experimental Materials and Design. The experiment consists of six improved malt barley varieties to evaluate their performance for yield and yield components. The varieties were two-rowed and obtained from Kulumsa and Adet Agricultural Research Centers, Ethiopia. The average days to maturity of the tested malt barley are 36 days. Descriptive features of the malt barley varieties used in this study are present in Table 2. The experiment was laid out in a randomized complete block design with three replications.

The experimental plot contained six rows of 2.5 m in width and 1.5 m in length. The space between blocks, plots, and rows was 1.5, 0.5, and 0.2 m, respectively. And 150 and 100 kg ha^{-1} of nitrogen and phosphate fertilizers were used, respectively. And 100 kg ha^{-1} of DAP and 50% of urea were used during sowing and the remaining urea was used at the tillering stage. The seeds of varieties were sowed at a rate of 100 kg ha^{-1}. Weeding was done twice at 21 days (during top dressing) and 45 days after sowing.

2.3. Data Collection. We recorded crop data such as days to 75% emergency, days to 50% heading, and days 75% to physiological maturity. Days to physiological maturity was recorded by counting the number of days from the date of sowing until when 75% of the plant changed the green color to yellowish, lost their water content, attained physiological maturity at each plot, the grain comes difficult to break with thumbnail, number of effective tillers per plant, spike length, and plant height from five plants in the middle four rows. The yield per plot was recorded from four middle rows and converted to a hectare basis.

2.4. Data Analysis. The collected data from 2 years were subjected to analysis of variance (ANOVA) [23]. The mean comparisons were made and Fischer's least significant difference (LSD) was used for the determination of significant differences among groups at a 5% probability level in the

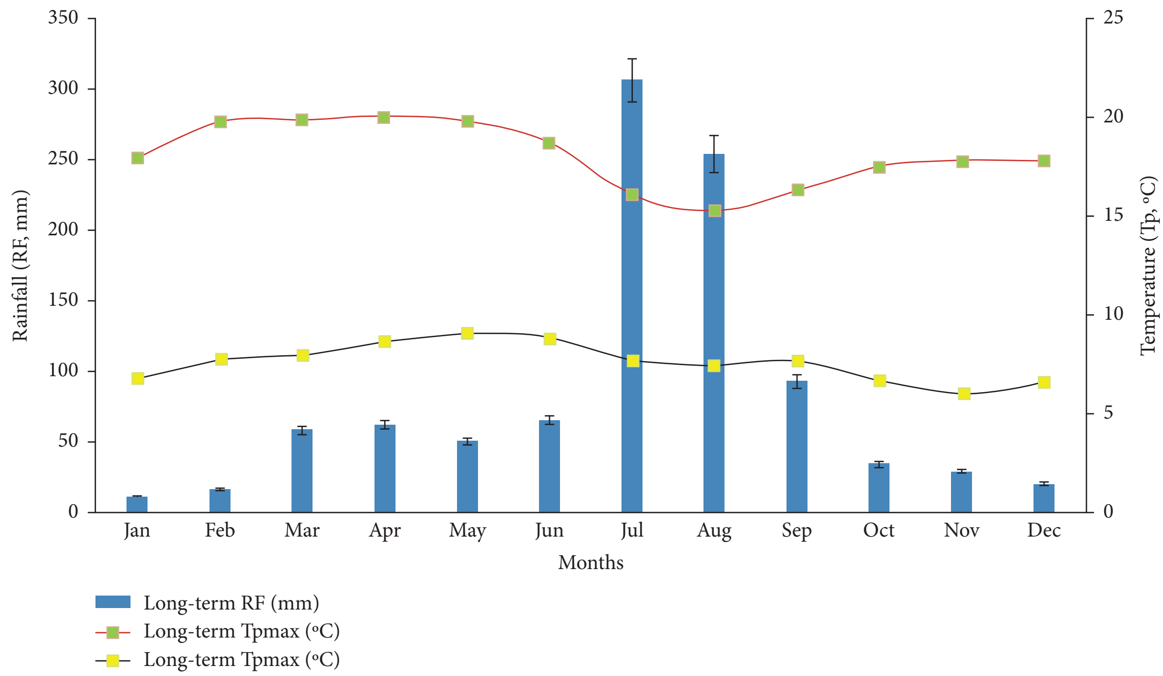

Figure 2: Long-term (1994–2021) monthly rainfall (RF), maximum temperature (T_{max}), and minimum temperature (T_{min}) in the study area.

Table 1: Existing land use, soil, and climatic conditions of the study area.

Land-use type	Area (%)	Soil type	Area (%)	Agro ecology	Area (%)
Bareland	10.12	Chromic luvisols	0.11	Dega	37.86
Cultivation	20.04	Eutric cambisols	63.57	Werich	3.58
Grassland	35.19	Eutric regosols	15.17	Woyine dega	58.55
Plantation	1.04	Lithosols	13.65		
Shrubland	33.62	Rock	7.50		

studied malt barley varieties. Principal component analysis (PCA) was performed using Statistical Package for Social Sciences (SPSS) software version 24. (SPSS Inc., Chicago, IL, USA). We performed correlation analysis to determine the relationship between yield and yield-related traits.

3. Results and Discussion

3.1. The Effect of Malt Barley Variety on Yield and Yield Components. The variance analysis showed highly significant ($P < 0.01$) differences among varieties, years, and the interaction of varieties with years in yield and yield components of malt barley varieties, except for the date of germination (Table 3). Significant variation among evaluated malt varieties for all traits was also reported by [24]. In another study, there were significant variations for all tested traits in 2 years across four environments [25].

There was a significant variation over the years in the bread wheat study [18, 26]. Significant variety by year interaction has also been reported by different scholars [27]. The interaction effect of the year on varieties showed a significant difference for all evaluated yield and agronomic Traits (Table 4). Concerning days with 75% emergency, variety IBON-174/3 (7 days) germinated early compared to Bekoji (9 days) with 2 days difference between those varieties. The lowest (59 days) mean of days to heading was recorded from IBON-174/03 while the highest was from Bekoji (67 days) and EH-1847 (66.33 days). The present result aligned with Aynewa et al. [12] and Molla et al. [18], who reported short days to head (61.67 days) for variety IBON-174/03. In another report, Bogale et al. [24] noted a shorter heading period for variety EH-1847. Although days heading are affected by the genetic character of varieties, the character is more dependent on environmental conditions.

Days to 75%, physiological maturity ranged from 136.83 to 126.66 days. The highest days to physiological maturity were recorded from Bekoji (136.83 days) while the lowest days to physiological maturity were recorded from variety Holker (126.66 days). Holker was early mature by 10 days over Bekoji maturity. This result disagreed with Bizuneh & Assefa [28], who reported variety Bekoji as early matured malt barley varieties. This is due to agro-ecological conditions that influence the maturity of the varieties apart from the genetic makeup of the varieties. There were also other reports by Bogale et al. [24] on the genetic impact of varieties on physiological maturity. The current study aligned with the result of Terefe et al. [29] and Wosene et al. [30] report the genotype might differ in days to physiological maturity.

Effective tillers are the largest yield-donating factor since the number of effective tillers determines the cereal's final economic yield. The highest (8.3) number of effective tillers

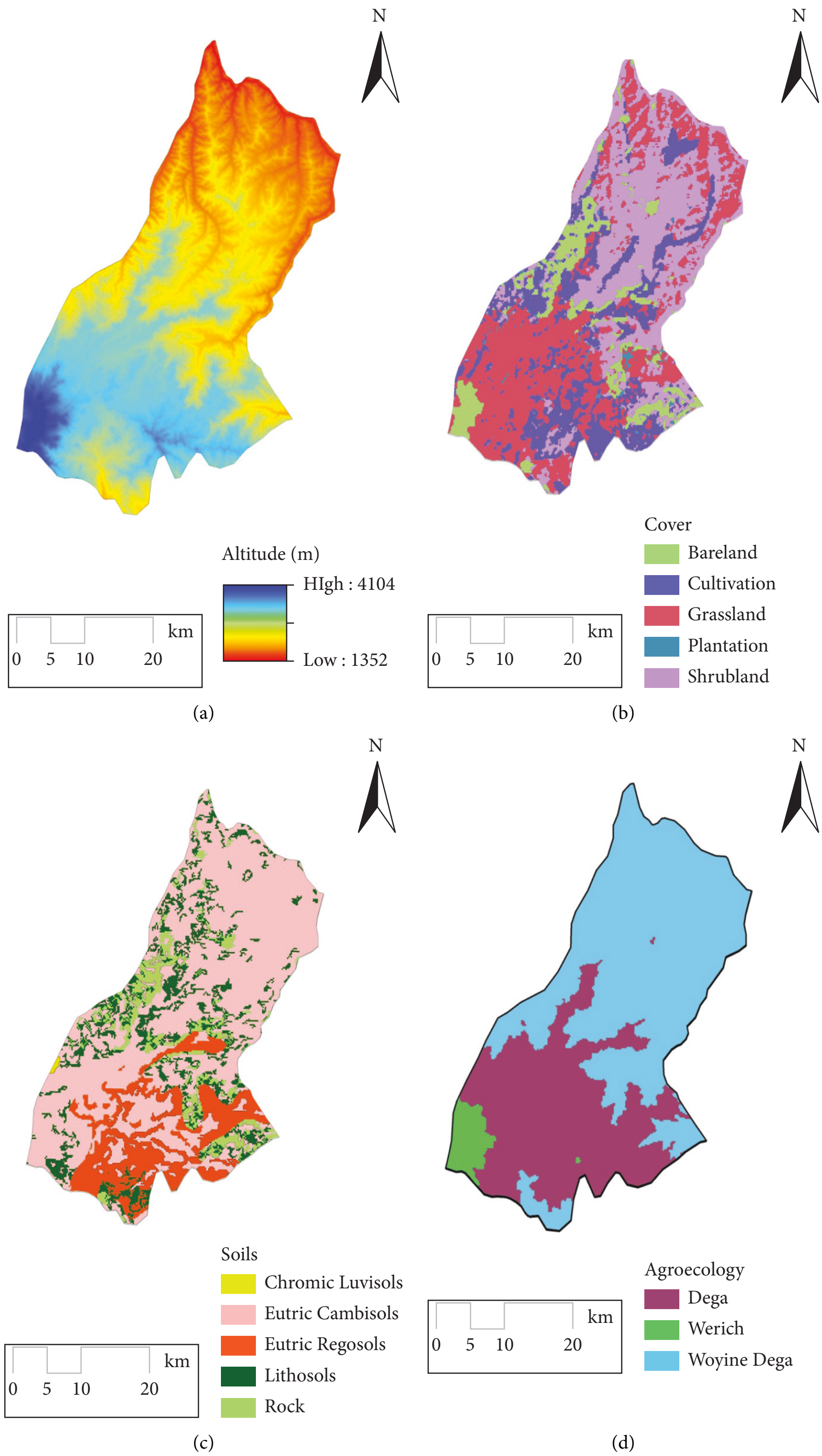

Figure 3: Description of the Lay Gaint district. (a) Altitude. Land-use type (b). Soil type (c). (d). Agroecology maps.

per plant was recorded from variety Holker compared to variety Sabini (2.14). In variety evaluation, the study by Aynewa et al. [12] noted the most extensive number of effective tillers in varieties HB52, HB120, and EH1847and the lowest number of effective tillers for varieties IBON174 and HB1533. Previous studies by Molla et al. [18] and Bizuneh & Assefa [28] reported variations between genotypes for grain yield, time of germination, flowering and

Table 2: Description of malt barley varieties used for the study.

Variety	Released year	Source[a]	DM	Altitude (m a.s.l.)	Rainfall (mm)
IBON-174/03	2012	HARC	135	2300–2800	500–800
EH-1847	2011	HARC	141	2300–2800	500–800
BH-1964	2016	HARC	138	>2300	500–700
Holkr	1979	HARC	142	2300–3000	500–700
Sabini	2011	KARC/HARC	120	2300–2500	500–800
Bekoji	2010	KARC	142	2300–3000	500–800

[a]HARC = Holleta Agricultural Research Center, KARC = Kulumsa Agricultural Research Center, m.a.s.l = meters above sea level, mm = millimeters, DM = days to maturity.

Table 3: Mean squares of yield and yield-related components of malt barley in 2019 and 2020 main cropping season.

Source of variation	Degree of freedom	Traits[a]								
		DE	DH	DM	NETP	SL (cm)	PH (m)	SPS	TSW (g)	Y (Qt ha^{-1})
Year	1	0.028^{ns}	20.25^{***}	7140.25^{***}	0.25^{***}	0.38^{***}	1.529^{***}	1154.86^{***}	1846.13^{***}	3.78^{***}
Variety (V)	5	2.96^{***}	54.25^{***}	73.56^{***}	44.71^{***}	43.14^{***}	0.0396^{***}	816.36^{***}	1090.85^{***}	325.11^{***}
V**Year	5	1.09^{ns}	15.98^{***}	80.58^{***}	1.81^{***}	0.33^{***}	0.0244^{***}	358.80^{***}	100.38^{***}	21.77^{***}
Error	24	0.53	0.39	0.23	0.002	0.005	0.0013	6.61	11.46	0.182
R^2		61.27	97.54	99.93	99.98	99.94	98.28	97.79	96.59	99.74
CV (%)		9.04	0.98	0.36	0.95	1.67	2.95	9.54	9.81	1.99

[a] DE = day to emergency, DH = days to heading, DM = days to maturity, NETP = number of effective tillers per plant, SL = spike length, PH = plant height, SPS = seeds per spike, TSW = thousands seed weight and Y = yield. ** = Significant difference at 0.05, *** = significant difference at 0.01, Ns = Non-significant difference. CV= coefficient of variation, R^2 = coefficient of determination.

Table 4: The interaction effect of varieties with years on yield and yield components of barley in the 2019 and 2020 cropping season.

Trait[a] Variety	DE	DH	DM	NET	SL (cm)	PH (m)	SPS	TSW (g)	Y (qt ha^{-1})
IBON-174/03	7.0^{c}	59.00^{e}	129.66^{e}	6.71^{b}	5.73^{b}	1.25^{bc}	26.76 b	43.38 b	27.99^{b}
EH-1847	8.0^{b}	66.33^{a}	133.83^{b}	2.99^{d}	3.21^{d}	1.33^{a}	22.38c	34.36c	20.14^{d}
BH-1964	7.5^{bc}	65.33^{b}	132.00^{d}	5.59^{c}	3.88^{c}	1.29^{ab}	24.43bc	35.75c	21.05^{c}
Holker	8.33^{ab}	62.00^{d}	126.66^{f}	8.3^{a}	8.6^{a}	1.25^{bc}	49.93a	54.23a	31.54^{a}
Sabini	8.33^{ab}	63.83^{c}	132.83^{c}	1.51^{f}	1.28^{f}	1.09^{d}	18.93 d	19.88 d	13.567^{e}
Bekoji	9^{a}	67.00a	136.83^{a}	2.14^{e}	2.03^{e}	1.21^{c}	19.16 d	19.43 d	13.55^{e}
Mean	8.03	63.91	131.97	4.54	4.13	1.24	26.94	34.52	21.31
CV (%)	9.04	0.96	0.36	0.95	1.67	2.95	9.54	9.81	1.99
LSD (5%)	0.86	0.74	0.57	0.05	0.081	0.044	3.06	4.04	0.51

[a]DE = days to emergency, DH = days to heading, DM = days to maturity, NET =number of effective tillers per plant, SL = spike length, PH = plant height, Y = yield.

Figure 4: Field performance of malt barley varieties at Lay Gayint in 2019 cropping season.

maturity, plant height, spike length, and the number of tillers. Similarly, significant differences were recorded for agronomic traits and grain yield [31]. In other studies, there was also a significant difference in malt barley variety for tillering capacity [32]. Any change in tillering number and spike length directly affects grain yield [33].

Figure 5: Field performance of malt barley varieties at Lay Gayint in 2020 cropping season.

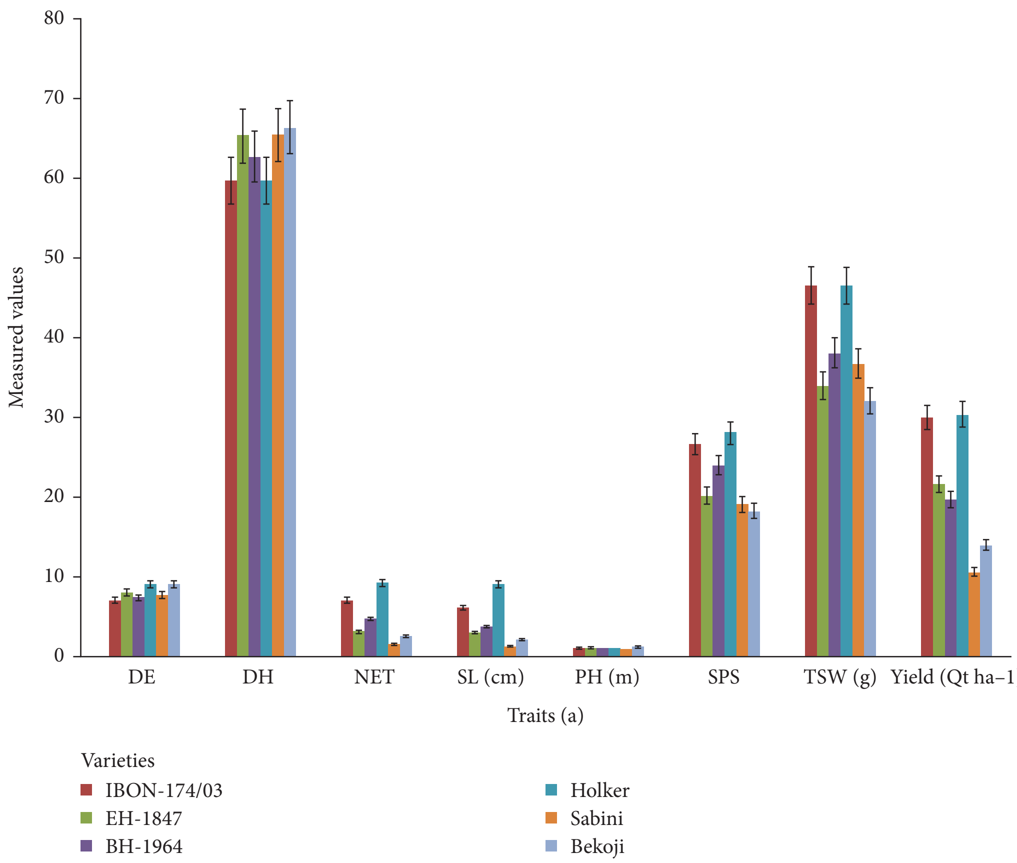

Figure 6: Mean performance of malt barley varieties in 2019 cropping season. DE = days to an emergency, DH = days to heading, NET = number of effective tillers per plant, SL = spike length, PH = plant height, SPS = seeds per spike, and TSW = thousand seed weight.

As the field performance indicates (Figure 3), the longest spike length was recorded from variety Holker (8.6 cm) and the shortest spike length was measured from Sabini (1.28 cm). In this regard, the spike length of variety Holker was higher by 0.074 m than that of variety Sabini. The present result is similar to Bogale et al. [24], who recorded the longest spike length from the Holker variety. In another study, Holker variety produced shorter spike lengths among the tested varieties [18, 28].

The highest (1.33 m) plant height was recorded on variety EH-1847 and the shortest (1.21 m) plant height was measured from variety Sabini. Comparably, about 0.12 m difference in plant height was computed between the highest and the shortest varieties. Previous studies reported significant results on plant height on the interaction of malt barley variety with location [24, 34]. In the present study, the variation in plant height among varieties may be because of a genetic characteristic of genotypes and agro-ecological effect.

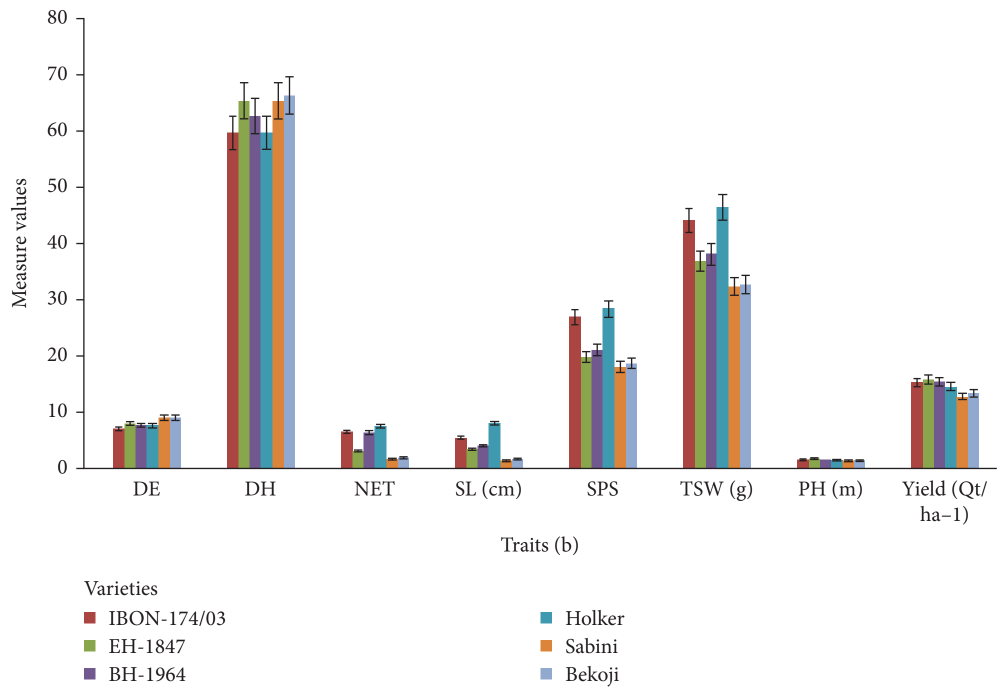

FIGURE 7: Mean performance of malt barley varieties in 2020 cropping season. DE = days to an emergency, DH = days to heading, NET = number of effective tillers per plant, SL = spike length, PH = plant height, SPS = seeds per spike, and TSW = thousand seed weight.

Holker recorded the highest number of seeds per spike and thousand seed weights (49.9 and 54.9 g) correspondingly. In another study, the highest seed per spike was recorded from the variety Bekoji-01 [28]. Sabini and Bekoji record the lowest seed per spike (18.93 and 19) and thousand seed weight (19.8 g and 19 g), respectively. As Assefa et al. [25] report, there is a variation of a thousand kernel weights for malt barley. There was also a significant difference in thousand kernel weight in the malt barley variety [28].

The highest (31.54 qt·ha^{-1}) mean grain yield was recorded from variety Holker, followed by variety IBON-174/03 (27.99 qt·ha^{-1}). The highest grain yield (3.72 qt·ha^{-1}) was recorded from variety Holker [28]. In other studies, Holker recorded the lowest (1853 kg·ha^{-1}) grain yield [25]. The present study obtained the lowest yield from Sabini and Bekoji with 13.40 qt·ha^{-1} and 13.88 qt·ha^{-1}, respectively. The lowest yield of Bekoji revealed at Koga irrigation in the western Amhara Region was also reported [18].

In another location, South Oromia, the variety Bekoji produced a low yield compared to other evaluated varieties [34]. Bogale et al. [24] reported the highest yield (4851.2 kg·ha^{-1}) from the Sabini variety in contrast to the present study. Environmental conditions highly influence the yield potential of varieties in addition to the genetic performance of genotypes. Environmental conditions and their interactions had a major effect on grain yield performance [35, 36]. In the individual years, varieties Holker and IBON-174/03 had higher yield, effective tiller, and spike length (Figures 4–7). Similarly, EH1847 and IBON174/03 varieties showed the *t* best with a grain yield of 3340 kg·ha^{-1} and 3351 kg·ha^{-1} followed by Bahati 3240 kg·ha^{-1}. [18, 37, 38].

3.2. Association of Yield and Other Agronomic Traits. Pearson's correlation coefficient analysis among agronomic traits was presented in Table 5, and the correlation was rated as per the guidelines[39]. Correlation coefficient analysis provided evidence of the relationship among the important crop variables, and hence, indicated a guiding model for direct and indirect enhancement in grain yield [40]. A date of 50% heading was a significant and medium positive association with a date of emergency ($r = 0.483^{**}$). Date of 50% heading was a significant and medium negative association with the number of effective tillers ($r = -0.553^{**}$), spike length ($r = -0.515^{**}$), and grain yield ($r = -0.597^{**}$). Date of 75% physiological maturity was significant, and medium negative association with seed per spike ($r = -0.472^{**}$) and thousand seed weight ($r = 0.599^{**}$) in the other side dates of maturity was a significant and highly positive association with plant height ($r = 0.834^{**}$).

On days of 75% physiological maturity negatively correlated with spike length and plant height [25]. The negative correlation of the date of 75% physiological maturity with the number of effective spike lengths and grain yield suggests that lately maturing varieties may provide a high number of effective tiller, long spike lengths, and high grain yield. A previous study by Molla.et al. [18] reported a significant and positive correlation between spike length and date of 75% physiological maturity. The number of effective tillers was significant and very strongly positive associated ($r = 0.944^{**}$) with spike length, seeds per spike ($r = 0.698^{**}$), thousand seed weight ($r = 0.814^{**}$), and grain yield ($r = 0.937^{**}$). There was a strong and positive association between the number of effective tillers with spike length, seeds per spike, and grain yield [28]. Spike length was

Table 5: Correlation coefficients (r) of barley varieties for yield and other agronomic traits.

Traits[a]	GD	HD	MD	NET	SL	SPS	TSW	PH	Yield
GD	1								
HD	0.483***	1							
MD	0.180	0.00	1						
NET	−0.280	−0.553***	−0.20	1					
SL	−0.193	−0.513***	−0.22	0.950***	1				
SPS	0.119	−0.10	−0.472***	0.689***	0.748***	1			
TSW	−0.237	−0.29	−0.599***	0.814***	0.831***	0.855***	1		
PH	−0.072	−0.19	0.834***	0.127	0.099	−0.299	−0.269	1	
Yield	−0.309	−0.597***	−0.11	0.921***	0.937***	0.554***	0.739***	0.170	1

DE[a] = days to emergency, DH = days to heading, DM = days to maturity, NET = number of effective tillers per plant, SL = spike length, SPS = seeds per spike, TSW = thousand seed weight PH = Plant height. * = significant difference at 0.05, ** = significant difference at 0.01, ns = non significant difference.

Table 6: Total variance is explained by principal component analysis.

PCs	Eigenvalues	% of variance	Cumulative (%)
1	3.937	49.206	49.206
2	2.042	25.520	74.726
3	1.245	15.567	90.293

Table 7: Principal Component analysis for yield attributed traits of malt barley.

Traits	Principal components		
	1	2	3
GD	0.005	0.116	0.916
FD	−0.352	−0.190	0.755
MD	−0.263	0.934	0.107
NET	0.916	0.081	−0.321
SL	0.950	0.064	−0.230
SPS	0.886	−0.310	0.206
TSW	0.878	−0.374	−0.162
PH	0.021	0.950	−0.130

DE = day to emergency, DH = days to heading, DM = days to maturity, NETP = number of effective tillers per plant, SL = spike length, PH = plant height, SPS = seeds per spike and TSW = thousands seed weight.

strongly associated with seeds per spike (r = 0.855**) and thousand seed weight (r = 0.831**).

The association indicates the large size of spike length provides increased seeds per spike. Grain yield was significantly and strongly positively associated with the number of effective tillers (r = 0.921**) and spike length (r = 0.953**), seeds per spike (r = 0.554**), and thousand seed weight (r = 0.739**). This strong and positive association indicated that the number of effective tillers and spike length, seeds per spike, and thousand seed weight are important traits for increasing grain yield. In the previous study, grain yield was significantly and strongly correlated with the number of effective tillers, seeds per spike, and spike length of barley [24, 28]. In another study, there was a negative correlation between grain yield and other agronomic traits [25]. Grain yield is the most complex component of malt barley controlled by genetic and environmental factors that verify the productivity of the varieties [24, 25]. Understanding the associations between grain yield and other traits is important for modeling the selection criteria for higher yields [24].

3.3. Principal Component Analysis of Yield and Yield-Related Traits. To identify and rank variables based on revealed eigenvalues and variability (%), principal component analysis was used [41]. In the current study, PCA was done for the yield and traits that relate to the yield of malt barley. Only three of the eight principal components (PCs) indicated a greater than 1.0 eigenvalue and revealed 90.29% trait variability.

From three Pcs first principal component analysis records, the highest variation of 49.206% (PC1) followed by 25.520% (PC2) and 15.567% (PC2) (Table 6). Similarly, highest variation revealed from PC1 to PC3 (18.784%, 15.474%, and 10.361%), respectively [42]. The first principal component has the highest variance possible (i.e., accounts for the most amount of data variability possible), and each subsequent component has the highest variance possible while still having to be orthogonal to the previous components [43].

Based on yield attribute traits out of the top three principal components, the value of PC1 was higher than PC2 and PC3. It revealed that the first principal component (PC1) dominates with contributed traits viz., number of effective tillers per plant, spike length, seed per spike, and thousand seed weight. The second principal component (PC2) was dominated by yield-related traits viz., days to 75% physiological maturity and plant height, while PC3 consisted of traits viz., days to emergency and days to 50% heading (Table 7). Based on PCA, most of the important yields attributing traits were present in PC1, and PC2 [41, 44, 45] reported more grain yield-dominated traits present in PC1 and PC2.

4. Conclusion

In the present study, Holker provided the highest yield (31.54 qt·ha^{-1}) in both years. Variety Holker also recorded more effective tiller per plant, spike length, seeds per spike, and thousand seed weight and matured earlier than the other tested varieties. Grain yield is significantly and strongly positively associated with the number of effective tillers, spike length, seeds per spike, and thousand seed weight. It indicated that an increase in the number of effective tillers, spike length, seeds per spike, and thousand seed weight is significant and directly related to increasing grain yield of malt barley. The principal component analysis divides the evaluated traits into three groups and shows that the number of effective tillers, the spike length, the number of seeds per spike, and the thousand seed weight has a significant impact on grain yield. Thus, Holker is identified as a high-yielding variety and could be recommended in the study area and other related agro-ecologies for mass seed multiplication and enhancing malt barley production.

Data Availability

All data concerning the crop plants and climatic data used to generate or analyze during the study period and support the finding of the study are within the paper.

Conflicts of Interest

The authors declare no conflicts of interest.

Authors' Contributions

Tiringo Yilak designed and conceived the experiments; exploit the experiments; analyzed and interpreted the data; and wrote the paper. Momina Aragaw conceived and designed the experiment and read and enriched the manuscript.

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