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Research Article

# The Release and Registration of *"Kejewa"* Malt Barley (HordeumdistichonL.) Variety

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## Abstract

*Kejewa*is a common name for newly released six row type malt barley (*Hordeiumvulgare*L.) variety with a pedigree designation of *TOCTE/M112/6/VMORALES CBSS04 M00436T-11M-0Y-0M-3M-0AP*. The variety has been developed and released by Sinana agricultural research center for commercial production in the high potential barley growing areas. It has been tested at Sinana, Robe, Adet and Jima areas during 2022-2023 main cropping seasons. *Kejewa* showed high mean grain yield, tolerant to major barley disease and relatively stable across locations and years than the standard checks (*HB1963, Moeta* and *HB1964)* with good physical and malting quality acceptable for industrial demand. The malt quality parameters including malt extract, protein content and friability were evaluate and comparative to the standard sated by the malt factories for malt production in the country. Kejewa was tolerant to barley shoot fly than checks and exhibit compensatory growth after shoot fly damage.

## Keywords

Kejewa, Malt Quality, Grain Yield, Disease Resistance

## 1. Introduction

Barley is a cool-season crop which grows at altitudes of about 3000 meter above sea level and commonly cultivated in stressed areas where soil erosion, occasional drought or frost limits the growth of other crops [1], [4] and [7]. Ethiopia is the second largest barley producer in Africa, next to Morocco, accounting for about 25 percent of the total barley production in the continent [2]. Barley production and consumption has a longstanding tradition in Ethiopia where the country is considered the centre of diversity or secondary origin of the crop with more than 15,000 accessions conserved in the gene bank. Barley has been malted, or germinated, prior to consumption for thousands of years. It has been documented that any barley having a sound, viable kernel will produce malt, but quality factors would be sacrificed in most cases [11-13].

In malting operations strict criteria are observed in the selection of barley for malting; among the major considerations paramount in the choice of barley for malting include genotypes, plumb seed, color brightness, a germinating capacity of greater than 96%, high extract (>80%), low protein (8-11.5%) and high friability (>70%) are the major criteria [5]. One of the important criteria besides the quality traits in malt barley breeding is the yield capacity, disease resistance and stability across the environments [14, 15]. The national barley improvement program works to develop malt barley varieties that satisfy the quality requirements by the breweries and the malt factories. Therefore, the objective of this activity was to evaluate and release high yielding, lodging and diseases tolerant barley variety with acceptable malt quality.

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## 2. Variety Origin and Evaluation

*Kejewa* (*TOC-TE/M112/6/VMORALESCBSS04M00436T-11M-0Y-0M-3M-0AP*), a six rowed malt barley variety developed by the Sinana Agricultural Research Center (SARC). It was originally developed from ICARDA barley improvement research program lines through pure line selection methods to develop stable high yielding, good grain quality traits for malting and disease resistant. The material has been evaluated together with other genotypes in different breeding nurseries from 2018-2021 and then advanced to variety trial to see its varietal performance across locations and years in barley producing highlands areas. The variety was evaluated by National Variety Release committee and officially released for wider production in the major barley growing highland areas of the country.

## 3. Morphological and Agronomical Characters

*Kejewa* is six-rowed malt barley variety, erect growth habit with average days to heading and maturity date of 62 and 117 days, respectively (Table 1). The variety has medium plant height 91.1cm and this character is preferred by the local community for its tolerance to lodging problem in major barley growing areas. On the other hand, seed color is white and has average thousand-kernel weight of 23.6 g and test weight is 39.25 kg/hl (Table 1). It is also characterized by better resistance/tolerance to main biological insect pest (shoot fly) than the standard varieties (HB1963, Moeta and HB1964) and showed rapid compensatory growth after damage by the insect.

***Table 1.*** *Agronomic and morphological characteristics of newly released malt barley variety 'Kejewa'.*

| No | Agronomical and Morphological Characteristics | |
|---|---|---|
| 1 | Adaptation area | For high potential barley growing areas in Ethiopia |
| 2 | Altitude (m.a.s.l.) | 2300-2600 |
| 3 | Rainfall (mm) | 750 – 1200 |
| 4 | Seed Rate (Kg/ha) | 100 |
| 5 | Planting date | Mid of June to Early August |
| 6 | Days to Flower | 61.7 |
| 7 | Days to Maturity | 117.3 |
| 8 | Plant Height (cm) | 91.1 |
| 9 | 1000 Seed Weight (gm) | 23.56 |
| 10 | Test weight(kg/hl) | 39.25 |
| 11 | Seed Color | White |
| 12 | Row Type | Six row |
| 13 | Growth habit | Erect |
| 14 | Crop pest reaction | Tolerant to major pests |
| 15 | Disease reaction | Moderately resistance to major barley diseases |
| 16 | Yield (t ha-1) | 15.1. Research field: 2.2 to 6.0 t ha-1<br>15.2. Farmers field: 3.4 to 5.0 t ha-1 |
| 17 | Spike density | Very dense |
| 18 | Seed size | Large |
| 19 | Year of release. | 2024 |
| 20 | Breeder/Maintainer | SARC/IQQO |

## 4. Grain Yield Potential and Stability

Twenty one malt barley genotypes along with three standard checks were evaluated at Sinana, Robe, Adet and Jima during 2022-2023 cropping seasons. Combined analysis of variance depicted that the candidate genotype *Kejewa* (*TOC-TE/M112/6/VMORALESCBSS04M00436T-11M-0Y-0M-3M-0AP*) gave the highest grain yield with range of 2.2 to 6.0t/ha on the research field whereas it gives 3.4 to 5.0 t/ha on farmers field. The candidate variety was among the top ranking genotype in grain yield potential across most of the testing environments. The newly released variety has grain yield advantages over the standard checks, (*Moeta, HB1963* and *HB1964)* varieties of the respective locations were 20.7%, 22.6% and 33.7%, respectively.

Stability analysis was done on grain yield using21 malt barley genotypes including checks were studied for two years across four locations. According to joint regression model, a variety with high mean yield, regression coefficient (bi) of unity and with deviation from regression (S2di) =0 is stable [3]. [6], [8] and [10] In this regard, *Kejewa* is stable variety with high mean grain yield, regression coefficient (bi) of 0.95 which is nearly unity and deviation from regression of 0.06 which is equivalent to zero. Therefore, it has shown stable yield performance across locations of evaluation as well as higher mean grain yield over check varieties *Moeta, HB1963* and *HB1964.*

## 5. Disease and Shoot Fly Resistance

*Kejewa*was evaluated for resistance to major barley diseases such as net blotch (*Pyrenophorateres*Drechs.), scald (*Rhynchosporiumsecalis*Oud.), stem rust *(Pucciniagraminis*f [1], [9] and [11]. sp. *Tritici)* and barley leaf rust (*Puccini-ahordei*Otth) at across all environments in fields under natural infection from 2020 to 2021 cropping session. The resistance level of the new variety was better than the standard checks for leaf rust, stem rust and net blotch and comparable for scald and shoot fly.

***Table 2.*** *Summary of Disease data of Kejewa and the check varieties tested in malt barley national variety trial through 2020 to 2021 averaged across 4 locations.*

| Diseases/insects or other hazard | HB1963 | Moeta | HB 1964 | Kejewa |
|---|---|---|---|---|
| Net blotch | 79 | 75 | 80 | 71.4 |
| Stem Rust (% & reaction) | 15S | Trsms | 10MS | Trsms |
| Leaf Rust (% & reaction) | 10MS | 10MS | 5MS | 5MS |
| Scald (0-5) | 0 | 0 | 0 | 0 |
| Shoot fly infestation | 0 | 0 | 0 | 0 |

S-Susceptible, MS-Moderately Susceptible, Tr- trace level.

## 6. Malt Quality Evaluation

***Table 3.*** *Summary of laboratory analysis for major malt barley quality traits.*

| QualityTraits | Kejewa | HB1963 | Moeta | HB 1964 |
|---|---|---|---|---|
| Malt Extract | 82.5 | 83.5 | 82.2 | 82.4 |
| Friability | 67.6 | 67.0 | 59.8 | 64.5 |
| Protein | 10.8 | 10.7 | 11.6 | 11.6 |

*Kejewa, HB1963, Moeta*and *HB1964* were evaluated for important malt quality traits. The malting profile for *Kejewa* is better than checks for kernel weight, plump kernels, hectoliter weight and grain protein content. The variety is characterized by having low percent of protein content which were in the accepted range. Desirable protein content range for 2-rowed barley is 9.0-11.0% and for 6-rowed barley is 9.0-11.5% [6]. *Kejewa* has shown relatively high percentage of malt extract to standard check (Table 3). The grain and malt quality trait analysis result of the variety are very similar to those of the malt factory standard.

## 7. Adaptation

*Kejewa* variety is recommended for production in the major barley producing highland areas of the country with annual rainfall of about 650 -1600mm and areas with similar agro-ecologies. On black soils, 100 kg NPS and 100 kg urea fertilizer is recommended to give good yield and with 100 kg seed rate. In addition, the variety can be planted early March for *Ganna* season and early August for *Bona* season.

## 8. Conclusion

*Kejewa* is superior variety compared with the standard checks in grain yield performance in the multi-location trials across the testing environments with good quality attribute and yield stability. It has better agronomic performance with moderate tolerance to leaf diseases as compared to the standard checks. Hence, cultivation of the new variety is recommended in major barley growing areas of the country having similar climatic conditions with the testing sites.

## Abbreviations

| | |
|---|---|
| DH | Day to Heading |
| DM | Day to Maturity |
| FR | Friability |
| GY | Grain Yield |
| HLW | Hectoliter Weight |
| LG | Lodging |
| M.A.S.L | Meter Above Sea Level |
| ME | Malt Extract |
| MS | Moderately Susceptible |
| NB | Net Bloch |
| PH | Plant Height |
| PR | Protein |
| SARC | Sinana Agricultural Research Center |
| ST | Stand Percent |
| TKW | Thousand Kernel Trial |

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## Conflicts of Interest

The authors declare no conflicts of interest.

## Appendix

***Table 4.*** *Combined Mean of agronomic performance and disease reactions of 21 MB genotypes tested in National Variety Trial in2020 and 2021.*

| Pedigree | Entry | DH | DM | PH | GY | TKW | HLW | ST | Lodg | NB | ME | FR | PR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COMINO/3/MATICO/JET//SHYRI /4/ALELI/5/SCARLETT CBSS01M00037S-10M-1M-1Y-1M -0Y | 1 | 61.86 | 118.14 | 94.68 | 2903.85 | 28.98 | 38.49 | 12.86 | 1.19 | 31.81 | 82.4 | 65.4 | 11.0 |
| Rhn-03/3/Mar25-84/Att/Mari/Aths* 302/4/Ssn/Badia//Arar/3Gloria'S'/C opal'S'ICB05-0304-9AP-0AP | 2 | 54.38 | 108.43 | 85.70 | 3438.63 | 26.72 | 37.93 | 11.19 | 0.00 | 33.43 | 80.2 | 62.6 | 11.3 |
| W13257/4/ALISO/CI3909.2//HB60 2/3/MOLA/SHYRI//ARUPO*2JET | 3 | 61.38 | 114.24 | 83.77 | 3039.89 | 28.15 | 44.94 | 12.38 | 1.19 | 34.38 | 95.9 | 108.1 | 8.2 |
| LBIRAN/UNA80//LIGNEE640/3L EGACYICB09-1444-0AP-0TR--0A P--0TR-0AP-0TR | 4 | 58.95 | 116.43 | 98.69 | 3217.80 | 33.32 | 41.70 | 13.10 | 0.48 | 33.10 | 81.5 | 66.3 | 12.1 |
| TOCTE/M112/6/V MORALES CBSS04M00436T-11M-0Y-0M-3 M-0AP | 5 | 61.67 | 117.29 | 91.09 | 4638.22 | 23.56 | 39.25 | 13.10 | 0.00 | 30.52 | 82.5 | 67.6 | 10.8 |
| ABN-B/KC-B//RAISA/3/ALELI/4/ FNC 122/DEFRA CBSS01M00037S-40M-1M-2Y-1M -0Y | 6 | 63.33 | 118.14 | 100.12 | 3235.20 | 26.10 | 41.40 | 12.62 | 1.67 | 34.14 | 83.7 | 67.4 | 10.4 |
| Aw-Black/Aths//Arar/3/9Cr279-07/ Roho/6/Alanda 01/5/CIO1021/4/CM67/U.Sask1800 /Pro/CM67/3/DL70 ICB95-0204-0AP-20AP- | 7 | 58.81 | 111.76 | 88.69 | 3064.69 | 24.70 | 28.48 | 11.90 | 0.00 | 33.90 | 79.1 | 60.9 | 11.9 |

| Pedigree | Entry | DH | DM | PH | GY | TKW | HLW | ST | Lodg | NB | ME | FR | PR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0AP--5AP--0AP-8AP-0AP | | | | | | | | | | | | | |
| ESMMERLAND/PALTON CBSS01M00100S-22M-M-1Y-1M-0Y | 8 | 64.52 | 116.48 | 91.71 | 3335.97 | 24.37 | 38.02 | 12.86 | 0.00 | 32.05 | 82.5 | 68.3 | 11.5 |
| Pentunia 1/Malt 2 icb-1323-0AP-0TR-0AP-OTR-0AP-0TR | 9 | 58.57 | 109.71 | 102.70 | 3645.76 | 25.81 | 39.31 | 12.86 | 0.00 | 32.19 | 84.4 | 79.3 | 10.4 |
| AF9216/3/ZHEDAR#1/SHYRI//OLMO CBSS02Y00205S-0M-0M-3Y-1M-0Y | 10 | 65.19 | 117.14 | 95.46 | 3545.06 | 30.83 | 41.56 | 12.38 | 0.00 | 31.62 | 82.3 | 61.9 | 11.0 |
| PFC9202/3/AZAF/KYOTO NA-KATE//ALELI CBSS02Y00225S-0M-0M-1Y-1Y-1M-0Y | 11 | 62.86 | 116.67 | 98.37 | 3184.39 | 28.57 | 42.35 | 12.86 | 0.00 | 30.33 | 83.3 | 68.1 | 11.0 |
| MERIT B/BCD47//CANELA CBSS02WM00045T-0TOPM-20Y-1M-1Y-1M-0Y | 12 | 62.95 | 114.52 | 104.18 | 3233.21 | 27.95 | 41.82 | 13.33 | 0.71 | 30.57 | 82.4 | 70.0 | 11.2 |
| LENT/LACEY CBSS04M00117S-0M-0Y-0M-0Y-2M-0AP | 13 | 62.86 | 117.43 | 89.40 | 3532.52 | 24.48 | 39.64 | 13.33 | 0.71 | 32.24 | 80.6 | 63.0 | 11.6 |
| MSEL/DEFRA/CL 128 CBSS01M00031S-15M-2M-1Y-1M-0Y-0AP | 14 | 63.57 | 116.76 | 94.43 | 3281.34 | 25.79 | 40.18 | 12.86 | 0.48 | 34.19 | 84.6 | 82.8 | 10.6 |
| MSEL/DEFRA/CL 128 CBSS01M00031S-72M-2M-1Y-1M-0Y | 15 | 60.86 | 113.71 | 89.08 | 3199.16 | 21.43 | 40.10 | 13.57 | 0.00 | 32.19 | 81.1 | 61.7 | 11.5 |
| CANCELA/E.ACACIA/DEFRA CBSS02M00022S-47M-2M--4Y-1M-0Y | 16 | 59.90 | 115.95 | 96.39 | 3827.66 | 27.30 | 41.39 | 12.86 | 1.19 | 32.90 | 82.9 | 68.8 | 11.7 |
| Rhn-03/OsirisICB04-1263-0AP--99AP-0AP | 17 | 59.29 | 111.33 | 90.09 | 3564.68 | 28.66 | 37.27 | 11.67 | 0.71 | 34.29 | 78.6 | 56.4 | 11.5 |
| MERIT B/BCD47//CANELA CBSS04Y00345T-C-1Y-3M-0Y-0M-0Y | 18 | 64.95 | 112.43 | 90.50 | 3084.49 | 27.87 | 38.84 | 12.86 | 0.00 | 34.90 | 81.5 | 66.0 | 11.2 |
| HB-1963 | 19 | 68.81 | 119.10 | 98.50 | 3589.05 | 28.94 | 38.02 | 13.10 | 0.24 | 30.14 | 83.5 | 67.0 | 10.7 |
| Moeta | 20 | 58.90 | 112.95 | 90.66 | 3675.80 | 23.83 | 40.39 | 13.57 | 2.86 | 31.90 | 82.2 | 59.8 | 11.6 |
| HB-1964 | 21 | 63.19 | 118.05 | 98.40 | 3075.46 | 31.54 | 38.63 | 12.86 | 0.71 | 32.10 | 82.4 | 64.5 | 11.6 |
| Mean | | 61.75 | 115.08 | 93.93 | 3395.8 | 27.09 | 39.51 | 12.77 | 0.58 | 32.52 | 82.7 | 68.4 | 11.1 |
| CV | | 5.66 | 1.31 | 6.84 | 16.17 | 7.22 | 4.04 | 14.4 | | | 2.3 | 14.8 | 6.5 |
| LSD | | 0.67 | 0.28 | 1.23 | 105.1 | 0.37 | 0.31 | 0.35 | 0.75 | 0.9 | 0.69 | 3.70 | 0.26 |

*DTH-Days to heading, DTM- Days to maturity, PH(cm)- Plant height, GFP(%)- Stand, GY(kg/ha)- Yield per hectare, TKWThousand seed weight, HLW- hecto litter weight, NB(00-99)- Net blotch, ST= Stand Count, Lodg=Lodging, NB=Net Bloch, ME=Malt Extract, FR = Friability, PR =protein

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