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Review on Barley Productivity Enhancement Through Best-Fit Management Practices in Ethiopia

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Abstract: Barley is one important cereal crop which is widely cultivated worldwide. Worldwide most important crops and ranks fourth after wheat, maize and rice and it is top ten from crop plants internationally. In Ethiopia barley is the fifth most important cereal crop after tef, wheat, maize and sorghum in total production. Barely is a reliable source of food in the temperate areas. Its grain is used for the preparation of different foodstuffs, such as injera, kolo and local drinks, such as tela, borde and beer. Barley national productivity is 2.11 t ha^{-1}, while the world average productivity was 2.4 t ha^{-1}, while the potential yield goes up to 6 t/ ha^{-1} on experimental fields. Several abiotic and biotic factors have subsidized to this low productivity, such as poor crop management practices; the use of low yielding cultivars; the limited availability of improved varieties; weeds, insects and diseases; and the inherently low yield potential of the existing local varieties. We cannot control these factors by using single management practices. A research finding indicates as barley productivity can be enhanced by using integrated nutrient management, integrated pest management, best-fit agronomic practices and appropriate cropping systems together. Therefore, these review focused on barley productivity enhancement through best-fit management practices in Ethiopia.

Key words: Barley · Agronomic · Practices · Production

INTRODUCTION

Barley (*Hordeum vulgare* L.*)* is one of important cereal crop which belongs to family *Gramineae*. It is the fourth most important cereal crop in the world after wheat, maize and rice [1] and is among the top ten crop plants in the world. Ethiopia is ranked 21th in the world in terms of barley production with a share of 1.2% of the world's total production. In Ethiopia barley is the fifth most important cereal crop after tef, wheat, maize and sorghum in total production [2].

According [3] barley total area coverage is about 959,273.36 hectares and total annual production of about 2.03 million tons in main season, whereas the mean barley productivity was 2.1 tons ha^{-1}. In Ethiopia, barley production is highly concentrated in Oromia National Regional State with total area coverage of 454,662.78 hectares and total annual production of about 1.09 million tons, whereas the mean barley productivity was around 2.4 tons ha^{-1} in main cropping season [3].

Barley is a cool-season crop that is adapted to high altitudes and grown in a wide range of agro climatic regions under several production systems. At altitudes of about 3000 m.asl, it may be the only crop grown that provides food, beverages and other necessities to many millions of people. Its grain is used for the preparation of different foodstuffs, such as injera, kolo and local drinks, such as tela, borde and beer [4]. Very recently it is being adopted for preparation of bread all alone or mixed with wheat.

Barley grows best on well-drained soils and can tolerate higher levels of soil salinity than most other crops. Food barley is commonly cultivated in stressed areas where soil erosion, occasional drought or frost limits the ability to grow other crops [5]. As a consequence, temperature and rainfall extremes may differ substantially between locations [6]. There are two types of barley in Ethiopia: food barley for human consumption and malt barley which can be converted into malt; a key ingredient in beer making. The straw and by product used for house construction and animal feed for fattening as well [7].

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Barley national productivity is 2.11 t ha^{-1} [3], while the world average productivity was 2.4 t ha^{-1}, nevertheless the potential yield goes up to 6 t/ ha^{-1} on experimental plots [8]. Several abiotic and biotic factors have contributed to this low productivity, such as poor crop management practices; the use of low yielding cultivars; the limited availability of improved varieties; weeds, insects and diseases; and the inherently low yield potential of the existing local varieties [9]. According to Assefa *et al.* [10] reported that, soils in the highlands of Ethiopia usually have low levels of essential plant nutrients, especially low availability of nitrogen and it is the major constraint to cereal crop production. To maximize yield and quality of malt barley, it has been shown that N management practices should be adjusted according to anticipated availability of water and N in the soil [11] and the needs of particular varieties [12].

Weeds compete with crop plants for various resources such as water and nutrients, resulting in low yields [13]. Under partial weed management, it is common to observe barley fields infested with grass weeds, causing yield losses of up to 60% in barley growing areas of Ethiopia [14]. We cannot control these factors by using sole management practices but it can be minimized by bringing feasible improved management practices together and barley productivity can be enhanced. Therefore, these review aimed on barley productivity enhancement through best-fit management practices in Ethiopia.

Importance of Barley: Barley is used as food, fodder and beverage in more than 20 different ways, which reflects its cultural and nutritional importance. In the western world barley is becoming less important as a human food and it is mainly used to feed farm animals. On the other hand, in the highlands of Tibet, Nepal and Ethiopia and in some areas of North Africa, China and Russia, barley is still an important human food. Because of its low demand as a human food and its lower yield potential compared to other cereals like wheat and maize, the barley area in the major barley producing countries is decreasing.

Barley is effective in lowering blood cholesterol in hyper cholesterolemic people with a higher risk of cardiovascular diseases. Its breakfast foods and snacks are increasingly available where driven by recent research findings, which show that barley fiber contains beta-glucans and tocotrinols, chemical agents known to lower serum cholesterol levels. The nutritional and clinical importance of barley foods and public consciousness regarding quality of daily diet, that is cereal diversification, may have a positive impact on the demand of barley as a human food in the future. The world has "re-discovered" barley as a food grain with desirable nutritional composition including some medicinal properties [15].

According to Hailemichael *et al.* [16], there are different reasons for farmers to produce barley. Some of the reasons that makes barley important to the farmers are: Suitable for high altitude, produced both in belg and meher seasons, Tolerant to stresses, Suitable for many kinds of dishes (including injera) with a better taste, good source of energy and medicinal purposes for gastritis, headache and can heal broken bones and fractures.

Agro-ecology of Barley: In Ethiopia, barley is grown in a diverse agro-ecology ranged from1800 to 3400 m altitude in different seasons but predominantly grown from 2000 to 3500 m.asl [17]. Drought resistant barley can be grown in a region of even minimum rainfall 200-250mm. An annual average rainfall of 1,000 to 1,700mm with 650 to 700mm well distributed during the growth period. The average optimal temperature for barley is 16ºC to 25ºC. The soils suitable for barley are well-drained loam, silt and clay loam. A red sandy clay soils with a good drainage is suitable for food barley.

Cultivation and Production: Barley is one of the most important food security crops grown in different agro-ecologies of Ethiopia. The major barley producing areas of the country are mainly located in the highlands. Landraces represent over 90% of the barley cultivation in Ethiopia. The greatest frequency and diversity of barley landraces occurs in the northern and central highlands [5]. It is cultivated in some regions in two distinct seasons: *belg* which relies on the short rainfall period from March to April and *meher* which relies on the long rainfall period from June to September [5].

According to CSA [3], about 4,170,003 smallholder farmers allocated more than of 959,273.36 ha land to barley cultivation. It covers about 7.63% of cereal and the corresponding barley production was about 2,024,921.68 tons, equivalent to 6.97 percent of the total cereal production in the country and produce average yield of 2.11t ha^{-1}. In Oromia Regional National State, it covers 454,662.78 ha and production is estimated about 1,093,944.81ton with average yield of 2.41t ha^{-1}.

Constraints of Production and Productivity

Acidity and Poor Soil Fertility: Poor soil fertility is one of the major barley production constraints in the country. In the highlands of Ethiopia, particularly soils on the

uplands and hillsides become shallow and stony as a result of severe soil erosion and nutrient depletion [18]. Poor soil fertility is the major constraint to cereal crop production [10]. Soil acidity is a common problem that has major ramifications for plant growth and cause significant losses in production, especially in high rainfall areas of Western Oromia Region [19]. Currently, it is estimated that about 40% of arable lands of Ethiopia are affected by soil acidity/Al^{3+} toxicity [20]. According to Grant [21], high numbers of sulfur in the soil significantly decrease yields of barley.

According to Kumar *et al*. [22], described that improper rates as well as time and method of nitrogen application reduces grain yield and quality of malty barley. Low productivity of barley is due to poor soil fertility of farmlands, mainly aggravated by continuous cropping, overgrazing, high soil erosion and removal of crop residues [23]. Mesfin [24], examined that N and P fertilizers and found that this components are very important nutrients in limiting the growth and development of crops which has direct effect on productivity of barley.

Lack of Improved Variety: Use of local variety which is susceptible to diseases, pest and stress is also a reason for low productivity of barley. According to Daniel [25], low productivity of barley at North Gondar were due to unavailability of improved varieties, lack of researchers working in the improvement of barley and declining the productivity of landraces from time to time.

Biotic Factors: Moreover, diseases and insect pests can cause yield losses of up to 67 and 79%, respectively [9]. Yield losses of 60% and 40% dry above ground biomass were reported in fields artificially infested with 50% wild oat weed seeds at planting. The same study reported 37% barley yield loss under natural weed infestation. The antagonism between weeds and crops in the field is a complex phenomenon that it could be physical competition, allelopathy or both. Weeds reduce crop yield by competing for light, water nutrients and carbon dioxide, interfere with harvesting and increase the cost involved in crop production.

According to Alemu Hailye *et al.* [14], barley fields infested with grass weeds can causes yield losses up to 60% in Ethiopia. Dessalegn [26], examined that plumule length of the barley seedlings which were reduced by 60 and 40% due to leaf extracts of *P. hysterophorus* and *A. hybridus* which also result reduction on percent seed germination. There are insect pest (Brown wheat mites and Weevil),diseases (Rust and Smut) and weeds (*Amaranthus (hukuma), kuskuta spp.*(konene)*, Bermuda grass* (gilma*), Guzotisscabra spp.*(mech)*, Commelinabenghalensis (*aba ayele*)* and *Cynodondactylon* (serdo) that reduce barley productivity at debub Arsi district [23].

Lack of Agronomic Practices: Planting barley on barley residue lead to reduction in stand establishment which result low productivity [27]. Yield and yield components of barley are reduced by delaying sowing time [28].

Best Management Practices

Integrated Soil Fertility Management: According to Vanlauwe *et al.* [29], defined ISFM is soil fertility management practice which necessarily includes the use of chemical fertilizer, organic input and improved germplasm, combined with knowledge on how to adapt these practices to local conditions, aiming at maximizing agronomic use efficiency of applied nutrients and improving crop productivity. Organic manures are major sources of plant nutrient in traditional agriculture but less emphasis are taken relative to chemical fertilizers. Recent researches indicated that a judicious combination of organic manures and chemical fertilizer can maintain the long-term soil fertility and sustain high levels of productivity. Combined application of fertilizer and FYM recorded higher values of yield attributes (spike length, no. of grain spike-1 and test weight) over NPK levels alone [30].

Singha [30], reported maximum grain yield and straw yield were obtained when 75% NPK+5t FYM ha-1+bio fertilizer used than using all separately. Also, Achalu *et al*. [19], showed that plant height, fresh biomass, dry biomass and grain yield of barley increased due to liming of the soils under different land uses. Woubshet *et al.* [31], also reported highest and significant crop yield response was obtained 5385.6 kg ha^{-1} at Wolmera district by applying lime 611kg/ha+ compost at 5t/ha+NPS B 150 kg/ha+KCL 100Kg/ha+ N 33Kg/ha. Andersson [32], also report effect of liming attributed to a reduction of aluminum toxicity and an increase in soil pH that can both result in an increase of microbial activity and release of labile organic matter which used to increase the yield. Application of lime and all combinations of fertilizers, either alone or combined, significantly increased barley yield over untreated control [33].

Table 1: Effect of Integrated use of lime, blended fertilizer and compost on yield and yield component of Barley

Treat ments	PH	ET	TT	SL	NK	TSW	HI	GY (kg ha^{-1})	BY (kg ha^{-1})	SY (kg ha^{-1})
T1	44.66c	2.33e	3.00d	5.70d	33.00b	9.92c	38c	1317.8c	3433.3c	2115.6b
T2	66.66b	3.66de	3.66cd	6.40c	34.66b	36.89b	39c	1617.0c	4173.3c	2556.3b
T3	63.00b	4.00cd	4.00cd	6.03d	35.66b	36.52b	37c	1682.7c	4483.3c	2800.6b
T4	70.66b	5.33bc	5.33bc	6.56bc	37.66b	36.83b	40bc	1744.8c	4266.7c	2521.8b
T5	90.33a	6.00b	6.00b	6.97a	45.66a	38.44b	43abc	3810.7b	8916.7b	5106.0a
T6	68.00b	3.66de	4.00cd	6.76ab	36.33b	36.59b	42abc	1670.2c	3966.7c	2296.5b
T7	92.33a	9.66a	9.66a	6.90ab	48.33a	45ab	44ab	37.69b	9820.0ab	5405.8a
T8	95.33a	10.66a	10.66a	7.03a	50.66a	44.02a	47a	5385.6a	11500.0a	6114.4a
T9	93.33a	11.00a	11.00a	6.83ab	45.66a	42.52a	44ab	4799.6ab	10766.7ab	5967.0a
LSD	11.41	1.65	1.74	0.35	6.92	2	0.05	1099.7	2467.9	1465.3
CV(%)	5.24	9.22	9.55	1.89	5.92	2.25	4.43	13.08	12.66	13.21
Mean	76.03	6.25	6.37	6.57	40.85	35.42	42	2938.06	6814.07	3876

Source: [31]

T1- control; T8 Lime (611 kg ha-1)+ compost (5 t ha-1)+NPSB (150 kg ha-1)+ KCl (100 kg ha-1) +Urea (72 kg ha-1); T9 Lime(611 kg ha-1)+ compost (2.5 t ha-1)+NPSB(75 kg ha-1)+ KCl (50 kg ha-1) +Urea (36 kg ha-1)

Application of organic and in organic fertilizer can increase both straw and biomass yield without affecting gran yield through lodging effect. Ethiopia can be benefited by increasing grain yield and straws to alleviate food and animal feed security by using integrated nutrient. The nutrient uptake increased through application of lime and compost with blended macronutrients and micronutrients in appropriate form of fertilizer to nutrient deficient soil. Hence, the complimentary effects of applied lime, organic and inorganic fertilizer (NPSB, urea and KCl and compost) ultimately lead to more nutrient uptake. The N losses due to leaching or denitrification might have been reduced in soil by mixing N fertilizer with organic compost, resulting in better utilization of N by plants.

Tariku Beyene *et al.* [34], showed that application of integrated nutrient management had significantly affected mean grain yield of barley. Higher grain yield (6496 kg ha^{-1}) was obtained from application of integrated nutrient application (66.6:33.4% NPS: FYM) followed by sole application recommended 100% NPS (6288 kg ha^{-1}).

Application of inorganic fertilizers (NP or NPK) with FYM gave a better yield of barley than the application of 100% inorganic fertilizers alone [35]. Inorganic fertilizer provides readily available nutrients and the organic fertilizer mainly increases soil organic matter and improves soil structure and buffering capacity of the soil (to holding water capacity, to control soil erosion, to keep soil moisture, to control soil cracking and drying then soil come to rehabilitate [36]. Gafar Ibrahim Dagash *et al.* [37], demonstrated the beneficial effect of integrated nutrient management in justifying the deficiency of several macro and micro-nutrients which affected the grain yields.

Significantly higher grain yield and biomass yield of barley were obtained with the application of sole recommended NP and the integrated use of 50?:?50% vermicompost and conventional compost with recommended NP [38]. The same author report that mean grain yield of 2567 and 2549?kg•ha^{-1} barley was obtained from application of 50?:50% conventional compost and vermicompost based on N equivalence with recommended NP fertilizer rate, which markedly reduce the cost of chemical NP fertilizer required for the production of barley.

Getachew Agegnehu *et al.*[39], found that continuous applications of inorganic fertilizers alone resulted in deterioration of soil health in terms of physical, chemical and biological properties of the soil. Organic fertilizer application has been reported to improve crop growth by supplying plant nutrients including micronutrients as well as improving physical, chemical and biological properties of the soil, thereby providing a better environment for root development by improving the soil structure [40].

Many research findings have shown that neither inorganic fertilizers nor organic sources alone can result in sustainable productivity [36]. Integrated soil fertility management involving the judicious use of combinations of organic and inorganic resources is a feasible approach to overcome soil fertility constraints and contribute high crop productivity in agriculture [41].

Integrated Pest Management: Weed control strategies should exploit the competitive ability of crops in suppressing weed growth. The competitive ability of the crop is enhanced by early emergence, high seedling vigour, high rate of leaf expansion, rapid formation of a

Table 2: Effects of the integrated use of organic and inorganic fertilizers on grain yield and thousand seed weight of barley in 2015-2016 cropping seasons.

	Grain yield (kg ha^{-1})			Thousand seed weight (g)		
Treatments	2015	2016	Mean	2015	2016	Mean
Recommended NP	3396	1566	2481	45.24	45.23	45.24
Conventional compost (N equivalency)	3502	1563	2533	45.62	45.60	45.61
Farmyard manure (N equivalency)	3276	571	1924	42.89	42.87	42.88
Vermicompost (N equivalency)	3405	1007	2206	45.85	45.83	45.84
50:50%Vermicompost:Conventional compost	3394	1086	2240	45.38	45.37	45.38
50:50%Vermicompost:farmyard manure	3339	666	2003	43.32	43.3	43.31
33:33:33%Vermicompost:Conventional compost: farmyard manure	3377	859	2118	42.62	42.6	42.61
50:50%Vermicompost:recommended NP	3547	1551	2549	43.99	43.97	43.98
50:50%Conventionalcompost: recommended NP	3630	1504	2567	43.86	43.87	43.87
50:50%Farmyard manure: recommended NP	3372	1178	2275	42.46	42.47	42.47

Source: [42]

dense canopy and tall stature. The plant density, choice of crop, time of sowing and other aspects of crop production may also influence the level of weed suppression [43].Weeds can be controlled by cultural, biological and chemical measures. Cultural methods are still useful tools but are laborious, time consuming and getting expensive. Combination of management practices provided better yield as compared with sole management practices.

Crops have different ability to compete with weed based on crop types and different crop populations. Weed biomass was lowest in turnips and greatest in dwarf French bean. The ability to suppress weeds was independent of crop growth habit, but was related to leaf size and plant growth rate. Inclusion of large leaf size and rapid growth in the selection of crops as competitors to suppress weeds should be feasible in weed management. Banding fertilizers below drilled wheat seed (Triticum aestivum) reduced grass weed growth compared to broadcast surface applications in some tillage systems [44].The same author report that several combinations of herbicides can provide good control of broad and narrow leaved weeds and cause significant reduction in their density and increase yield attributes as compared to check plots.

Russian wheat aphids (Digraphs noxia), barley shoot fly (Delia arambourgi) and menditermite (Macrotermes subhyalinus) are among the major insect pest that reduce barley productivity. The two common barley diseases that reduces barley yields are barely covered smut (Ustilago hordei) and barley loose smut (Ustilago nuda). Use of tolerant varieties ,seed treatment practice using Tilt and Bayleton fungicides, Seed washing before sowing, roughing at time of heading and maturity, rotation with other crop species like pulse and oil crops and Field sanitation are management practices that control barley diseases [45].

Improved Agronomic Practices

Appropriate Cropping Systems: Barley productivity increase when it rotates with legumes than other cereals. Arshada [46], examined that barley productivity increased when it rotate with pea than canola. Barley grain yield was 9% greater following canola than following wheat [47].

Intercropping can result in higher growth rate, reduction of weeds, pests and diseases and more effective use of resources due to differences in resource consumption [48]. Cereals and legumes intercropping are important for the development of sustainable food production systems by minimizing use external inputs [49]. In tropics cereal legumes intercropping gives greater yield stability and lower risks of crop failure that are often associated with monoculture.

Fan *et al.* [50], indicated that when cereal and legumes are intercropped because of better resource use efficiency and buffering effects of against disease and weeds. Inter cropping is advantageous as compared to sole cropping due to the interaction between components in intercrops and the difference in competition for the use of environmental and land resources [51]. Girma *et al.* [52], described that productivity and profitability improved in intercropping of barley and faba bean as compared to sole cropping. They found that faba bean and barley intercropping promotes efficient use of land and minimizes the agricultural inputs. Legume intercropped with cereal fixes atmospheric nitrogen.

Proper Land Preparation: For timely and uniform germination of food barley and to avoid early weed infestation barley fields should be well prepared. Barley field should be ploughed 2-3 times. Ploughing should be done in such a way that make the seed bed suitable for germination and growth, to control weeds and to drain excessive water as it is highly affected by water logging.

Table 3: Effect of faba bean and barley inter cropping on relative crowding coefficient

Parameters		Yield			LER of yield			Relative Crowding (K)		
Planting pattern	Mixed	FB	Barley	Total	FB	Barley	Total	FB	Barley	Total
Faba bean-sole	100	103	-	103	-	-	-	1	-	1
Barley(sole)	100	-	37.3	37.3	-	-	-	-	1	1
1B:1FB	50:50:00	38.3	51.3	69.6	0.37	1.375	1.745	0.59	-3.66	-3.07
2B:1FB	75:25:00	39	39.3	78.6	0.35	1.05	1.43	1.8	-6.55	-4.75
1B:2FB	25:75	35	45.3	83.6	0.34	1.25	1.63	0.17	-13.17	-13

Source: [52]

Table 4: Interaction effects of variety and seed rate on grains yield of food barley

	Seed rate (kg ha^{-1})				
Varieties	75	100	125	150	Mean
Cross -41/98	4.7g	4.9f	5.4ed	5.53cd	5.15
HB -1965	4.47g	4.72g	5.19ef	5.47d	4.96
HB -1966	5.1f	5.77cd	3.12ih	5.96b	5.77
Local	2.89i	2.99ih	3.12ih	3.14b	3.04
Mean	4.29	4.62	4.99	5.03	

Source: [54]

Planting on Time: Planting time depends on the onset and distribution of the rainfall. It also varies from location to location and based on the type of variety. It is also important to consider indigenous/farmers knowledge. For HB-1307 variety planting was carried out starting mid-June to mid-July depending to the locality.

Use Recommended Seed Rate and Planting Methods: Seed rate and planting methods are among the key agronomic attributes to determine barley productivity. Barley can be planted in broadcasting and in rows. However, it is recommended to plant in rows, 100 kg ha^{-1} seed rate at spacing of 20 cm between rows. In this respect, Jemal *et al.* [53], reported that the interaction effect of variety and seed rate significantly affect thousand seed weight, number of effective tillers, number of grains per spike and grain yield. The same author report the use of 150 kg ha^{-1} seed rate for variety Shorima resulted in highest thousand seed weight 39.48 g, number of grains per spike 60.23 and grain yield 5339.3 kg ha^{-1}. Also, Teferi *et al.* [54], reported that seed rate of 125 kg ha^{-1} gave maximum grain yield of 6.23 t/ha of improved food barley (HB19/66) variety at Elfata district. These differences of seed rate are due to variation of seed size, variety type, soil fertility and difference of climatic condition.

Row planting helps to maintain optimum plant density, better resource utilization of the plant, suitable for pest assessment and management, efficient application and utilization of commercial fertilizer and suitable for harvesting and weeding practices. Barley should be planted at 3-4 cm soil depth, if the depth of planting is shallow (less than 3-4 cm) it will reduced tillering and the plant will be easily lodged. Similarly, if the depth of planting is more than 3-4 cm, it will have poor germination and population density.

Use of Improved Varieties of Barley: Increasing the quality of seeds can increase the yield potential of the crop by significant folds and thus, is one of the most economical and efficient inputs to agricultural development. Generation and transfer of new technologies are critical prerequisites for agricultural development particularly for an agricultural based economy such as Ethiopia. Seed, especially that of improved varieties, is an essential input for increasing crop productivity. The improved variety must be truly superior to existing ones, it must be the latest and best variety suited to production potential and other desirable characteristics. However, the land races or local cultivars are wealth of locally adapted cultivars, many of which have highly valuable characteristics. Having involved over a period of years, these local cultivars are usually very stable so long as they are maintained within the area of origin and are subjected to traditional management practices; stability of performance rather than spectacular yield is their main asset.

Improved varieties relatively boost the yield of a given crop than local once. Most common character of the local varieties where tall with weak stem which reduce

production and productivity of barley by lodging. Teshome [55], reported that highest average grain yield of food barley (4.6 t ha^{-1}) was obtained from variety Diribe followed by HB-42 (3.5 t ha^{-1}) than local varieties.

Also, Yalemtesfa [56] reported that by comparison of four improved food barley varieties and local variety highest mean grain yield was obtained from HB-1307, 37 qt ha^{-1} and Cross 41/98 31.33 qt ha^{-1} whereas the lowest from the local variety 16.93 qt $ha^{-1.}$ Abdisa [57] also reported the by comparing three food barley varieties, the actual average yield (4.17 t ha^{-1}) was obtained from HB-1966 variety is relatively lower than the potential yield (6 t ha^{-1}). Depending on the above reason so many works have been done in Ethiopia to get improved food and malty barley variety and numbers of variety were released in the past decades.

CONCLUSION

Barley (*Hordeum vulgare* L.*)* is one of cereal crops which belong to the family of Gramineae. It is the fourth most important cereal crop in the world after wheat, maize and rice. In Ethiopia barley is the fifth cereal crop after tef, wheat, maize and sorghum. In Ethiopia barley is used for foodstuffs, such as injera, kolo, local drinks like tela, borde and beer and others. Barley national productivity is 2.11 t/ha, whiles the world average productivity was 2.4 t/ha, nevertheless the potential yield goes up to 6 t/ha on experimental plots. Several abiotic and biotic factors have contributed to this low productivity such as poor crop management practices; the use of low yielding cultivars; the limited availability of improved varieties; weeds, insects and diseases; and the inherently low yield potential of the existing local varieties. These factors are not similar across the country means the factors of one area may not problem to other areas. The other factors that concern with soil acidity is the major problem of Ethiopia which accounts 40% and poor soil fertility are limiting barley productivity. So, these all problems can reduced by using integrated soil fertility management, integrated pest management, Improved agronomic practices (land preparation, appropriate cropping systems, right planting time, use recommended seed rate and planting methods and by using improved varieties.

These all improved management practices should be used by bringing together rather using sole management practices. The research findings that have been done in different areas agree with these ideas. Generally improved management practices which done from land preparation to storing is economically and ecologically effective to enhance barley productivity.

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