

Review Article

Maize Production and Agronomic Practices in South Western Ethiopia: A Review

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Abstract

Maize is among the leading cereals in production and an important potential food security crop in South-western Ethiopia. The availability of diverse agroecology allowed the country to cultivate different maize varieties. The early, medium and late matured maize varieties were targeted in research in south western Ethiopia. Appropriate crop management practices, next to varieties are very mandatory to improve the productivity and production of maize. Suitable field management recommendations for maize varieties could be increased production and productivity. Cultural practices such as appropriate plant population, timely planting, balanced nutrient supply (right time, rate, place and source) and field management practices (timely weeding, disease and pest control) have been conducted and important information is available for users. In addition, crop rotation and intercropping have contributed to maize production and productivity. Maize intercropping and rotation with pulses improve soil fertility and increase maize crop productivity. Maize is important in the socioeconomic situation of south western Ethiopia, the information related to the agronomic practice of maize production in south western Ethiopia is scanty and poorly documented. Hence, documenting and publishing important crop information can help the producer to get better information on crop management and the researcher can explore more research gaps in the future. Therefore, the current review was made with the objective of to agronomic practices for maize production in South western Ethiopia.

Keywords

Plant Density, Fertilizer Rate, Cropping System and Maize Production

1. Introduction

In south-western Ethiopia maize being the major cereal food crop occupied the largest hectares 45% [1]. Most of the south western parts of the country are based on coffee cultivation with good potential for maize production. The altitude of the south western Ethiopia (Jimma) ranges from 1000 to 3344 m. The rainfall is 1400 mm/annum and the temperature ranges from 10 to 30 °C and the major soil is said to be nitisols. The climatic zones are about three namely; Dega, Woina Dega and Kolla constituting about 20%, 75% and 5%

respectively. The major crop grown in the zones is maize. Maize increases from year to year due to its high productivity potential. Most of the south western parts of the country are suitable for BH-661, BH-546/7, Limu and QPM maize varieties. Maize is everything for the Ethiopian maize farmers. Three-fourths of the maize produced is consumed at the household level by the small-scale producers themselves [2].

The grain is consumed in different forms of food; the Stover is used as feed, fuel and construction material. Be-

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sides, it serves as a major source of income and means of employment for tens of millions of farming and business communities [3]. The current status of maize, production in the south western part is comparable to another major maize-producing part of the country. In the south western part of Ethiopia, the average yield of 4.6 tons/ha [2] is low compared to the current average world productivity, which is close to 6 t ha⁻¹ [4]. Poor crop management practices (cultural practices, weed management, fertilizer, etc), maize lethal necrosis diseases and fall armyworm are the main constraints of maize production for low yield in the south western part of Ethiopia. A combination of crop management and high yield varieties increased the seed yield of maize, by 100-150% [5]. Generally, the largest gap in yield existing between research and production can be narrowed down by using improved agronomic practices and high yielding varieties. This paper presents a review on the agronomic practices for maize production in South western Ethiopia.

2. Literature Review

2.1. Maize Production in Ethiopia

Maize is one of the most important field crops in terms of area coverage, production, and economic importance in Ethiopia. Maize is cultivated from 58°N latitude to 40°S latitude all through the temperate, subtropical, and tropical regions of the world [6]. It grows best at moderate latitudes, but it can also be grown below sea level [7]. It is also grown from sea level to over 3000 meters above sea level (masl) elevation [8]. In the tropics, maize does best with 600-900 mm of well-distributed rainfall during the growing season [9].

Maize is a warm weather crop and is not grown in areas where the mean daily temperature is less than 19 °C or where the mean of the summer temperatures is less than 23 °C. That is, the crop tolerates a wide range of environmental conditions but grows well in warm sunny climates with adequate moisture [10]. The crop requires an average daily temperature of at least 20 °C for adequate growth and development; the optimum temperature for growth and development ranges between 25-30 °C; temperature above 35 °C reduces yields [9, 11]. Mostly, it is a tropical crop that grown well in a wide range of climates. It grows on a deep medium texture drained loam or silty loam fertile soil with a high water holding capacity, favorable morphological properties, an optimal moisture regime, prefers a soil pH of 6.0-7.0 and rich in organic matter, in addition, soils with deep, fertile rich matter and well-drained loam or silt loam soil are the best for maize cultivation [12, 13].

2.2. Crop Managements

2.2.1. Land Preparation

Maize seed needs soils that are warm, moist, well aerated,

weed free and only fine enough to give contact between the seed and the soil. The field should be well ploughed in advance of sowing and the field is ploughed three to four times increased yield up to 7-8 tons/ha [14].

2.2.2. Sowing

The time of sowing is the most critical factor affecting maize yields. Timely sowing, which costs the farmer little or nothing, is the cheapest and most effective step towards ensuring satisfactory maize yields. The time of sowing varies from region to region. As a general rule, maize should be sown as near the beginning of the rains as possible. If sowing is delayed there is a decline in the yield of maize. In late-sown maize the early growth is slow because the soil-air-moisture conditions are not ideal (most of the pores are filled with water) and later in the life cycle, late-sown maize may mature or even flower after the end of the rains. Sowing should be done 2-5 cm deep in moist soil. In midland areas of south-western Ethiopia maize sowing date is mid- April to beginning of May sowing increased yield by 70-80 quintals per ha [14].

2.2.3. Plant Density

The crop management research on maize was undertaken on plant density and seed rate in south western Ethiopia. The seed rate for a particular crop determines the final plant population density. The seed rate recommended for a crop should take into account the germination percentage and its establishment potential. The seed rate depends on how many plants are to be grown in one hectare. Mostly, maize varieties planted in the Nitsol Jimma area, optimum seed rate of 25-30 kg/ha increased yield by 50% [14]. The experiment conducted in south western Ethiopia indicated that optimum plant density varied for different maize maturity groups (early, medium and late maturity). Sisay et al. [15] concluded based on their research results that the plant density of 53,333 plants ha⁻¹ (75 cm x 25 cm) i.e. one seed in one hole, which was considered to be optimal for late maturity (BH-661), for medium matured variety (BH-546) plant density of 66,666 plants ha⁻¹ (75 cm x 20 cm) i.e. one seed in one hole, for early matured variety plant density of 66,666 plants ha⁻¹ (75 cm x 20 cm) i.e. one seed in one hole are optimum which could be effectively increased up to 88,888 plants ha⁻¹ (75 cm x 15 cm) for early matured, in case intra row spacing would be reduced from 25 cm to 15 cm.

2.2.4. Fertilizer

Maize has high demand for NP and this is often the limiting nutrient in maize production, so the amount of fertilizer to be applied depends mainly on maize yield and the fertility level of the soil as determined by soil tests. In the experiment conducted at Jimma, south western Ethiopia, the result indicated that the application of 92/69 NP fertilizer rate significantly increased maize yield by 7-8 tones /ha for late matur-

ing (BH-661). Also, the application of 75% compost + 25% recommended NP fertilizer could be recommended as an alternative for farmers [16]. Based on the current market value and economic analysis application of chemical fertilizer had 450% advantage over unfertilized [14].

The field experiment was carried out in Jimma Zone, for three consecutive years 2016-2018 main cropping seasons to affect NP fertilizer for medium maturing maize varieties at Jimma Zone. Muhidin et al. [23] concluded based on their research results that medium maturing maize BH546 variety with application 138/104 NP kg ha⁻¹ fertilizer rates taken as optimal. In general 181 NPS/69 P₂O₅/ kg ha⁻¹ and 200 Urea /92N/kg/ha but the whole NPS was applied at the time of sowing and Urea was applied as split, 1/3 of nitrogen fertilizer together with 69 kg P₂O₅ha⁻¹ while the remaining 2/3 N was applied four to five weeks after emergence. Before top-dressing N all the weeds should be removed from the field so that only the maize plants can utilize the applied Nitrogen. Research results have shown that the response of maize plants to the application of nitrogen and phosphorus fertilizers varies from variety to variety, location to location depending on the availability of the nutrients.

2.2.5. Irrigation

In south western part of Ethiopia, maize is mostly grown as a rain-fed crop during the wet season of the year. However, if the aim is to achieve maximum production, it is necessary to apply water whenever there is a shortage of rain, as maize has a high water requirement. The Critical stages of maize for irrigation are tasselling and silking, while peak consumption of water also occurs during this period at (tasselling and silking). Eshetu (2022 unpublished) [17] concluded that medium (BH-546) and late (BH-661) maturing maize varieties to planting density under irrigation gave maximum yield at Jimma south western Ethiopia. Based on his result the optimum plant density is 53,333 plants/ha for medium (BH-546) and 66, 666 plants/ha for late (BH-661) maturing maize variety in south western Ethiopia.

2.2.6. Weed Control

Inefficient weed control is one of the main factors causing the low average yields of maize in south western Ethiopia. The period between emergence and tasselling is the most critical period for weed competition in maize. Weeding is done either with small hand tools or a hand hoe. The first weeding is done about two weeks after sowing when the crop is only about 8-10 cm high and one more weeding is done at equal intervals. Tesfa [14] concluded based on his research results that two times hand weeding and one time shelshalo increased maize yield by 250%.

2.2.7. Cropping System

Maize is grown in monoculture or rotation and intercropping with other crops. Crop rotation and inter-cropping,

choosing resistant cultivars, and biological management are only a few strategies for overcoming the drawbacks of mono cropping. Crop rotation is the most established and traditional agronomic technique for maintaining water and nutrient balance; avoiding disease; insect, pest, and weed control; and boosting crop production [18]. Maize can be grown in two- or three-year rotations with crops such as grain legumes (soybean, common bean and groundnut). In most cases, maize yield was significantly increased by rotation up to 100% [14] at south-western Ethiopia. The intercropping system utilizes resources sufficiently and their productivity is increased [19]. Intercropping is higher productivity per unit area in addition to stability in production. Maize and soybean intercropping experiment conducted at Jimma, the result indicated that higher land equivalent ratio (LER) for row intercropping as compared to sole cropping had an advantage of 36% at Jimma [20]. (Tesfa [14] concluded based on his research results that maize and common bean intercropping in south-western Ethiopia, 2: 1 maize to common bean ration intercropping cropping increased the amount of nitrogen in soil by 50% and also maize to common bean intercropping cropping had 40% advantages over sole cropping.

2.2.8. Disease and Insect Control

The most common disease of maize are Maize lethal necrosis disease, Maize Cob rot, Maize Grey leaf spot, Maize Rust and Maize Leaf Blight caused by virus, bacteria and fungi [21]. They can be controlled by the use of cultural practices such as crop rotation, use clean seed, treated seeds with chemicals, etc and use of different chemicals and Integrated Pest Management [21]. Under Favorable condition some of the common insect pests affect maize crops are stem borer, stalk borers, spotted stem borer, aphids, cut worms, fall armyworm, African bollworm and weevil [22]. They can be controlled by cultural practices, such as crop rotation, early planting, use of push-push technology, field sanitation treated seed with insecticides before sowing and apply insecticides (Thiodan 3.5 G or Ambush 0.5% or Bull dock at 2 Kg per Ha, Bestox 10 EC when soils are moist and apply insecticides like Dimethoate, Malathion, Karate, etc [22].

2.2.9. Harvesting

The most suitable time to harvest is when the plants attain physiological maturity. A delay in harvesting causes a reduction in the yield. The crop is mature when the kernels reach the hard dough stage. The time of physiological maturity can be accurately determined by the development of the black layer at the point of attachment of the grain to the cob. From this stage onward, ripening consists of moisture loss, which may be quite rapid if the weather is dry. At the time of physiological maturity, the moisture content in the grain averages about 30%. If there is a facility for artificial drying, harvesting should be done as quickly as possible, just after physiological maturity. If no such facility is available, harvesting

should be delayed until the crop is dry. At this stage the moisture content of the grain is reduced to 10-12%. Grain with this moisture content can safely be stored just after harvesting and husking.

3. Summary and Conclusions

In Ethiopia, future increases in maize production to meet domestic demand will have to rely on improvements in yield per hectare rather than on the expansion of maize production area. Enhanced maize productivity can be achieved by increased use of modern production techniques such as the adoption of hybrid maize varieties, use of the best agronomic management practices, using appropriate plant population, use of chemicals and integrated nutrient management, proper manage pest, and harvesting the crop in a timely are mandatory to fulfil the food security and instability of the increasing human population of our country. From the above review I conclude that, maize is the lion shares of the Ethiopian economy, which is virtually small-scale, subsistence-oriented and crucially dependent on rainfall. There are still large pockets of food insecurity in various regions, therefore the development of the maize production in the country has been hampered by a range of constrains which include limited use of inputs (seed, fertilizer and plant density), climate change and recurrent drought, status of soil fertility, undesirable insect pest and parasitic weeds. Therefore, a well-designed and properly-operated agronomic practice with trimly checking during growing season from planting throughout growing season up to storage for maize production and productivity. Combined as well as individual agronomic attributes have proved to increase yield. This means that yield can be more than doubled in the mean time if production constraints are resolved. An important constraint responsible for poor yields is inappropriate agronomic practices. This review intended to investigate production practices that can lead to improved maize production in the south western area.

Abbreviations

QPM	Quality Protein Maize
BH	Bako Hybrid
LER	Land Equivalent Ration

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Author Contributions

Eshetu Yadete is the sole author. The author read and approved the final manuscript.

Conflicts of Interest

The author declares no conflicts of interest.

References

- [1] CSA (Central Statistical Agency)., (2022). Agricultural sample survey report on Area and production of major Crops. (private peasant holdings, meher season 2021 /2022; Addis Ababa Ethiopia, the FDRE statistical bulletin 593, Volume I. CSA, April 2022.
- [2] CSA (Central Statistical Agency)., (2017). Agricultural sample survey report on Area and production of major Crops (private peasant holdings, meher season 2016 /2017; Addis Ababa Ethiopia, the FDRE statistical bulletin 584, Volume I. CSA, April 2017.
- [3] Wolteji, E., Gedafa, B. and Gacheno, D., 2019. Participatory Demonstration and Evaluation of Improved Maize Technologies in Selected districts of West Shewa, East Wollega and Ilu-Ababora Zones of Western Oromia. *Results of Crop Improvement and Management Research 2018*.
- [4] Erenstein, O., Jaleta, M., Sonder, K., Mottaleb, K. and Prasanna, B. M. (2022). Global maize production, consumption and trade: Trends and R&D implications. *Food security*, 14(5), pp. 1295-1319.
- [5] Bent Tolessa, 1993. The need and objective of the first national maize workshop.
- [6] Hallauer, A. R. and Miranda, J. B., 1988. Quantitative genetics in maize breeding. Iowa State Univ Press, Ames, IA.
- [7] Leff, B., Ramankutty, N. and Foley, J. A., 2004. Geographic distribution of major crops across the world. *Global biogeochemical cycles*, 18(1).
- [8] Singh, H. B., 1987. Reactive nitrogen in the troposphere. *Environmental science & technology*, 21(4): 320-327.
- [9] Brink, M. and Belay, G., 2006. *Plant resources of tropical Africa 1: Cereals and pulses* (pp. 54-57). Wageningen: PRO-TA Foundation.
- [10] Purseglove, J. W., 1992. Tropical Crops, monocotyledons In: "Foods of Plant Origin". N. J. Enwere, *Afro-orbis Publications Ltd*. Nsukka: 96.
- [11] Asea, G., Serumaga, J., Mduruma, Z., Kimenyi, L. and Odeke, M., 2014. Quality protein maize production and post-harvest handling handbook for East and Central Africa. *Association for Strengthening Agricultural Research in the East and Central Africa, Entebbe, Uganda*.
- [12] Abate, T., Shiferaw, B., Menkir, A., Wegary, D., Kebede, Y., Tesfaye, K., Kassie, M., Bogale, G., Tadesse, B. and Keno, T., 2015. Factors that transformed maize productivity in Ethiopia. *Food security*, 7, pp. 965-981.
- [13] International Institute of Tropical Agriculture (IITA)., 1997. "Phenomenal increase in maize production in West and Central Africa", IITA, Ibadan, Nigeria.

- [14] Tesfa Bogale, 1999. Maize Production and Agronomic package report (unpublished)
- [15] Gurmu, S., Biya, M. and Yadete, E., 2019. Effect of NP Fertilizer Rates and Plant Population Density on Late Maturing Maize Variety. *Results of Crop Improvement and Management Research 2018*.
- [16] Gurmu, S. and Yadete, M. B. E., 2021. Evaluation of Quality Protein Maize Variety under Integrated Uses of Different Fertilizer Sources in Jimma, South Western Ethiopia. *Evaluation*, 88. <https://doi.org/10.7176/ALST/88-01>
- [17] Yadete Urge, E., 2022. *Growth and Yield Responses of Medium and Late Maturing Maize (Zea mays L.) Varieties to Planting Density in Off-Season at Jimma, South western Ethiopia* (Doctoral dissertation, Jimma University).
- [18] Belete, T. and Yadete, E., 2023. Effect of Mono Cropping on Soil Health and Fertility Management for Sustainable Agriculture Practices: A Review. *J. Plant Sci*, 11, pp. 192-197. <https://doi.org/10.11648/j.jps.20231106.13>
- [19] Reddy, K. C., Visser, P. and Buckner, P., 1992. Pearl millet and cowpea yields in sole and intercrop systems, and their after-effects on soil and crop productivity. *Field Crops Research*, 28(4), pp. 315-326.
- [20] Tilahun Tadios and Tesfa Bogale, 1996. Agronomic research in south western of Ethiopia. Proceeding of the third technology generation transfer and gap analysis work shop, 12-14 November 1996, Neqemte, Ethiopia.
- [21] IPBO (2017) Maize in Africa; University of Ghent. p 29.
- [22] African Agricultural Handbook Series (2017). Crop Production Field Guide Maize.
- [23] Biya, M., Gurmu, S. and Yadete, E., 2019. Determination of NP fertilizer requirement for newly released medium maturing maize varieties at Jimma Zone, South western Ethiopia. *Results of Crop Improvement and Management Research 2018*.

Research Fields

Eshetu Yadete: Crop Agronomy