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RESEARCH ARTICLE

A REVIEW OF CHALLENGES, OPPORTUNITIES AND MANAGEMENT PRACTICES OF MUNG BEAN (*VIGNA RADIATA* L., WILCZEK) PRODUCTION IN ETHIOPIA

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ABSTRACT

Mung bean (*Vigna radiata* L.) is an important pulse crop which resists drought. It has more protein contents and better digestibility than any other pulse crop. It can be grown under drought stress conditions, where, the short time is available for growth. The residues of mung bean are also used as feed for animals and enhance the soil fertility as well. Therefore, it is important to enhance the productivity of the agronomically valuable food grain legumes to meet the nutritious food demand of the geometrically increasing population by exploiting scarce natural resources more efficiently by selecting variety which resist salt tolerance, using soil test results and applying effective management practices.

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INTRODUCTION

World agriculture is facing a lot of challenges like producing 70% more food for an additional 2.3 billion people by 2050 while at the same time fighting with poverty and hunger, consuming scarce natural resources more efficiently and adapting to climate change (FAO, 2009). However, the productivity of crops is not increasing in parallel with the food demand. The lower productivity in most of the cases is attributed to various abiotic stresses. Curtailing crop losses due to various environmental stressors is a major area of concern to cope with the increasing food requirements (Shanker and Venkateswarlu, 2011). Mung bean [*Vigna radiata* (L.) Wilczek] is one of the most important edible food legumes of Asia. In India and some South Asian countries, it contributes significant dietary protein supply in predominantly cereal rich diets. Recently domestic consumption of mung bean has increased because of the rising popularity in Indian ethnic foods and perceived health benefits due to high levels of certain minerals and vitamins (Gupta *et al.,* 2004). It is a useful crop in drier areas and has a good potential for crop rotation and relay cropping with cereals using residual moisture. Globally, agriculture productivity is inhibited by abiotic and biotic stresses, but abiotic stresses in particular (Gong *et al.,* 2013) affect spreading of plant species across different environmental zones (Chaves *et al.,* 2003). Under this situation, the widely accepted benefits of legumes in cropping systems are needed now more than ever (Araujo *et al*., 2015). Mung bean has been consumed as a common food in China for more than 2000 years for its well-known characteristics such as gastrointestinal problems, detoxification activities, skin moisture, decreasing the stroke of heat, refresh mentality, and some other purposes related with summer heat (Min, 2001). The crop has already been transformed from a marginal to major crop for its additional benefits like enhancing soil fertility, improving rural household income, expanding employment opportunities, diversifying diets and increasing nutritional security (Shanmugasundaram, 2009). However, in low land areas of Ethiopia, the productions of mung beans are not exposed to farmers. Therefore, the purpose of this review is to find out the challenges, opportunities and management practices of mung bean production in Ethiopia.

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MATERIALS AND METHODS

Structured recent scientific findings and journals were assessed critically to examine the current trends for the challenges, opportunities and management practices of mung bean production.

Benefits of Mung Bean

Mung bean have a high nutritional value due to amino acids, ash, crude protein and crude lipid occupy an important source of food (Ullah *et al*., 2014). The plant is rich in terms of essential oil acid, high fiber content, protein, minerals such as phosphorus, calcium and vitamins like other legumes. Moreover, energy value of plant is high than other legumes. Researches focused on their functional characteristics increases their usage as a food supplement in food industry (Shaheen *et al*., 2014). Mung bean is an important crop with a cheap source of high amount of protein and amino acids, high digestion ratio, easy transportation and storage, soil improving characteristics while it is a less cultivated legume crop in global term. Besides these, mung bean can be used in health care especially as an anticancer food which makes it as a functional food. Due to these features, cultivation of mung bean should be extended in rotation programs. At present, mung bean cultivation spreads widely because of its superior digestibility in Africa, South America, Australia and in many Asian countries, and has been identified as high yielding pulse crop (Wedajo, 2015). The widespread allocation of mung bean in the tropics and subtropics of Africa, North America and Australia is relatively recent.

Resource-poor farmers should cultivate mung bean because it does not need a lot of water or other inputs and it helps to restore soil fertility through symbiotic nitrogen fixation. Its ability to fix atmospheric nitrogen, short duration maturity period, low input and minimum care requirement, and drought tolerance makes it suitable for incorporation into different cropping systems and it is a very useful forage for livestock and after picking of the pods, the whole plant may be ploughed in the soil to improve soil fertility (Subbarao *et al*., 1996). Protein malnutrition remains a major nutrition problem in Asia and affects children most severely (UNSCN, 2010). About 150 million children worldwide are underweight and 182 million are stunted. At least 70% of these children are in Asia. Meat is a good protein source, but is either excluded from vegetarian diets or unaffordable for poor households where protein and micronutrient deficiencies are most prevalent. However, mung bean is cheap source of protein, and an important nutritious dietary component of vegetarians in Asian countries especially in South-east Asia (Keatinge *et al*., 2011).

Effect of Salinity for Mung Bean Production

Salinity is the concentration of dissolved mineral salts (electrolytes of cations and anions) present in the soil and water. Sunil *et al*., (2012) also observed that salt stress adversely affected the biometric, morpho physiological, biochemical and biophysical characters of mung bean. Salinity tolerance is influenced by many plant, soil, and environmental factors and their interrelationships (Noble and Shannon, 1988). Salt stress caused increase in Na^+ and Cl^- in leaves, shoots, and roots of mung bean plants whereas decrease in other essential elements as K^+, Ca^{2+} ions as compared with the non stressed plants (Rashid *et al.,* 2004; Yasar *et al.,* 2006; Mohammed, 2007). Increasing salinity levels during mung bean seed germination significantly reduced germination characters and seedling characters with varying responses for mungbean cultivars (Win *et al*., 2011; Kandil *et al*., 2012). Salinity may affect mung bean seed germination by producing an outside osmotic potential that avoids water uptake or due to toxic effects of Na^+ and Cl^- ions during seed germination (Murillo-Amador *et al.,* 2002; Khajeh-Hosseini *et al*., 2003). Increased dormancy in crop seeds under salinity stress could results in reduction of germination. High salt depositions in the soil generate a low water potential zone in the soil making it increasingly difficult for the plant to acquire both water as well as nutrients (Mahajan and Tuteja, 2005). Therefore, salt stress essentially results in a water deficit condition in the plant and takes the form of a physiological drought. Consequently, the productivity of mung bean can be increased in soils having non saline.

Challenges and Opportunity of Mung bean Production

Despite all of the benefits, mung bean production faces a number of challenges. These include poor selection of bean seeds, poor quality of seeds, Soil degradation, poor husbandry practices, and postharvest losses (AOATM, 2011). Moreover, weather variability, grower perception, weeds and pests management practices, product quality, increasing scrutiny on food safety and value chain communication are some of the barriers for mung bean production. On the other hand, the opportunities for mung bean production include high price, a pillar spring or summer crop, good profitability, suitable for crop rotation, short duration, cash crop, high nutritional value, opportunity crop, good water use efficiency, cost efficiency, drought resistant crop, utilize soil moisture and maintain soil fertility (AMA, 2015).

Phosphorus (P) unavailability and low soil moisture are the major challenges for decreasing field crops productivity in semiarid climates (Hilhorst *et al.,* 2000; Rashid, 2001; Malik *et al*., 2002; Liu *et al.,* 2003; Asaduzzaman *et al*., 2008; Amanullah *et al*., 2011; Zare *et al*., 2012). As P is the second most critical plant nutrient for crop production after nitrogen. Application of P under semiarid climates is found to improve crop growth, yield, yield components and crop quality (Amanullah *et al*., 2012; Amanullah *et al*., 2014), while its deficiency cause significant loss in crop productivity (Raj *et al*., 1999) and profitability (Amanullah *et al*., 2012). Phosphorus has favorable effects on leguminous crops and also has positive effect on crop quality as increases protein content in mungbean (Sushil *et al*., 1997). The P deficient situation become worst in dry land condition where there is always shortage of moisture that affect fertilizer efficiency and successful crop production (Jan *et al*., 2012). Fertilizer management is therefore considered one of the challenges for improving crop productivity for resource poor farmers (Asaduzzaman *et al*., 2008; Amanullah *et al*., 2015).

Management Practices

Management practices may also enhance the crop's salt tolerance. These include breeding (cross between the salt tolerant plants and plants with high yield and good quality; rootstock grafting to prevent the injurious effects of toxic level of salt in the leaves; crop rotation, irrigation practices to leach out the salts, and soil cultivation, and gradually increase of salt stress instead of high single application (Martinez *et al.,* 2008). Under semiarid climates, tillage management is considered the most effective farm activity which improves soil physical condition, root development, nutrient uptake and crop yield (Armstrong *et al*., 2003; Rosner *et al*., 2008; Demjanova *et al*., 2009). On the other hand, inappropriate tillage practices cause soil structure destruction, accelerated erosion, loss of organic matter and fertility, and disruption in cycles of water, organic carbon, and plant nutrient. Deep tillage practices under moisture stress condition, improve aeration (Zorita, 2000), soil porosity (Hao *et al*., 2001), conserve soil moisture and plant nutrients (Patil *et al*., 2006) and increase crop productivity (Amanullah *et al*., 2015).

Nutritional Value of Mung Bean

Mung beans are a pulse or food legume crop used primarily as dried seeds and occasionally as forage or green pods and seeds for vegetables (Tomooka, 2002). Dried seeds may be eaten whole or split, cooked, fermented, or milled and ground into flour. Mung beans can also be made into products like soups, porridge, confections, curries, and alcoholic beverages. In western cultures, mung bean sprouts are popularly used as a fresh salad vegetable (Lambrides, 2007). Importantly, mung beans are composed of about 20%–24% protein. Globulin and albumin are the main storage proteins found in mung bean seeds and make up over 60% and 25% of the total mung bean protein, respectively. Therefore, due to its high protein content and digestibility, consumption of mung beans in combination with cereals can significantly increase the quality of protein in a meal (Wang *et al*., 2004; Kudre *et al.,* 2013). Mung bean protein is rich in essential amino acids, such as total aromatic amino acids, leucine, isoleucine, and valine, However, mung bean protein is slightly deficient in threonine, total sulfur amino acids, lysine, and tryptophan (Mubarek, 2005).

Mung beans have much greater carbohydrate content (50%–60%) than soybeans, and starch is the predominant carbohydrate in the legume. Due to its high starch content, mung beans have typically been used for the production of starchy noodles, also called muk in Korea. Oligosaccharides, including raffinose, stachyose, and verbascose, in raw or poorly processed legumes are associated with flatulence in the human diet. While these oligosaccharides are present in mung beans, they are soluble in water and can be eliminated by adequate presoaking, germination, or fermentation. The energy offered by mung beans and sprouts is lower than that of other cereals, which is beneficial for individuals with obesity and diabetes (Zheng, 1999). In addition, trypsin inhibitors, hemagglutinin, tannins, and phytic acid found in the mung bean have also been reported to have biological functions, promoting digestion and eliminating toxins (Lin, 1997). In addition to high protein and low energy content, mung beans also contain various enzymes and plentiful microelements. For example, superoxide dismutase (SOD) extracted from the mung bean can be chemically modified and made into an SOD oral liquid. This chemically modified SOD can avoid destruction by gastric acid and pepsin, thereby extending its half-life, making it suitable for human oral absorption (Lin, 1997). Overall, regular consumption of mung beans could regulate the flora of enterobacteria, decrease the absorption of toxic substances, reduce the risk of hypercholesterolemia and coronary heart disease, and prevent cancer (Kruawan *et al*., 2012).

Conclusion

Mung beans have wide applications in agriculture, health food, pharmaceutical, and cosmetics industries. Mung bean seeds and sprouts are excellent examples of functional foods that lower the risk of various diseases. Improved technologies, high yielding varieties, soil test results and appropriate crop management practices are major issues to enhance the productivity of mung bean. Hence, there is a need to strengthen the capacities of key stakeholders involved in mung bean production in the dry zone of Ethiopia in terms of understanding and applying best practices for enhancing climate resilience in the seed production, quality control and maintenance aspects of mung bean crop. Production of mung beans is challenged by many factors. Therefore, a concerted effort by farmers, researchers, development agencies, and government are needed to ensure the opportunities for Mung bean production

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