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Review

Current status of chickpea production: Opportunities for promoting, adoption and adapting the crop in Zimbabwe: A review

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Chickpea is a cool season, drought hardy grain legume crop that is grown in Asia, East Africa, United States of America and Europe. The crop has the potential to close the winter legume gap because it can adapt to cool season temperatures as compared to summer legumes grown in Zimbabwe. The aim of this paper is to unpack various opportunities for promoting chickpea in drought prone areas of Zimbabwe which might be relevant to other Southern African countries and to understand the major chickpea production requirements in order to merge with the prevailing environmental conditions in Zimbabwe. The crop is affected by abiotic factors and biotic factors; hence chickpea cultivars that could tolerate these factors should be bred and adopted. Consultative Group on International Agricultural Research (CGIAR), in cooperation with the National Agricultural Research Systems (NARS) in developing countries could help distribute chickpea germplasm to Zimbabwe for research and breeding work since they collectively maintain the world's largest international collections of plant genetic resources for use by researchers and farmers. Overall chickpea has great potential to enhance protein availability in drought prone areas of Zimbabwe especially during the winter season where no other legume is grown.

Key words: Cicer arietinum, Desi, Kabuli.

INTRODUCTION

Agriculture is the backbone of Zimbabwe economy for employment, incomes, poverty and hunger reduction. According to the NAPF (2018), the sector contributes 15-18% of Gross Domestic Product (GDP), 23% to the total formal employment, and provides livelihoods to approximately 70% of the rural population (54% of which are women). Like most of the countries in the Southern African region, agriculture forms an important discipline in eradicating hunger and ensuring food security and nutrition. The increase in human population and climate change will most likely to threaten food and nutritional demands in the coming decades (Mpambela and Vincent, 2017). In semi-arid regions of Zimbabwe, crop production is becoming vulnerable to climate change leading to food

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Table 1. A nutritional comparison of chickpea and other legumes grown in Zimbabwe.

Variable	Chickpea	Groundnuts	Soybeans	Cowpeas	Beans
Energy (KJ)	364	567	446	116	347
Proteins(g)	19	26	36	8	21
Fats (g)	6	49	20	0.5	1.2
Carbohydrates (g)	61	16	30	21	63
Fiber (g)	9	9	9	7	16

and nutritional challenges. Temperature extremes and drought are hindering the performance of crops such as maize, which forms part of the staple diet in most parts of the country (Manyeruke and Mhandara, 2013).

Grain legumes play an important nutritional role in the diet of millions of people in the developing countries and are thus sometimes referred to as the poor man's meat. These legume crops are normally grown in rotation with cereals because of their role in nitrogen fixation (Merga and Haji, 2019). In Zimbabwe, the commonly grown summer legumes are cowpeas, groundnuts, soybeans and sugar beans. During the winter season there is no legume that is adapted to grow during cool winter season. Chickpea (*Cicer arietinum*) has the potential to fill this winter legume gap and address many problems that are being faced by resource poor farmers, which includes malnutrition, low soil fertility and land degradation. Compared to other legumes, chickpea is a complete food source, supplying both carbohydrates and proteins (Table 1). The aim of this review is to discuss various opportunities for promoting chickpea in drought prone areas of Zimbabwe which might be relevant to other Southern African countries and to understand the major chickpea production requirements in order to merge with the prevailing environmental conditions in Zimbabwe.

CHICKPEA CROP CHARACTERISTICS

Chickpea plants have a well-developed root system. The roots usually include a central strong tap root, with numerous lateral branches that spread out in all directions in the upper layer of soils with numerous nodules on roots. The rhizobium bacteria present in these nodules fix up atmospheric nitrogen. In deep vertisols, roots penetrate deeper than 120 cm. The overall plant height ranges from 20 to 100 cm, although tall cultivars under favourable conditions can grow up to 130 cm (Rasool et al., 2015). There are two distinct types of chickpea that differ in their geographical distribution and plant type namely the *kabuli* (known as *macrosperma*) and the *desi* (known as *microsperma*). *Desi* types of chickpea have small angular seeds weighing about 120 mg, are wrinkled at the beak, and range in colour from brown to light brown and fawn. They are normally de-hulled and split to obtain *dhal*, and are favoured in the Asian sub-continent. *Desi* types are generally earlier maturing and higher yielding than the *kabuli* types. *Kabuli* types have larger, rounder seeds, weighing about 400 mg. They are white-cream in colour, and are almost exclusively used whole. They are preferred through the Mediterranean region. They are sold whole, so seed size and appearance are critically important. Yields are generally lower and more variable than *desi* varieties, although premiums for larger chickpeas can offset the yield disadvantage (Bampidis and Christodoulou, 2011).

PRODUCTION STATISTICS

Chickpea is the second most cultivated grain legume crop by smallholder farmers of the semi-arid regions around the world (Thudi et al., 2014). It is grown in more than 50 countries (89.7% area in Asia, 4.3% area in Africa, 2.6% area in Oceania, 2.9% in Americans and 0.4% in Europe). Worldwide, India is the largest producer of chickpea (Gaur et al., 2010) accounting for a total of 64% global chickpea production. In Pakistan, the chickpea growing area has increased from 0.88 million hectares between the year 1981 to 1983 and 1.07 million hectares between the year 2005-2007 with net production of 0.73 million tones at an annual rate of 1.9% (Ahmad et al., 2012). Over the past 6 years, productivity of chickpea in Zimbabwe remained constantly low (Table 2) whereas in countries such as United States of America its production has increased. In the USA, Montana accounts for a large percentage of the United States of America increase from 2001 to 2016 where chickpea hectarage grew from 54 230 to 129 504 ha because of the health and dietary concerns associated with the consumption of red meat. According to Ahmad et al. (2012) the production of chickpea around the world covers an area of about 10.7 million hectares with an average annual production of 8.2 million tonnes. Furthermore, 95% of an area is being shared in the developing countries for the production and consumption of chickpea.

Ethiopia is the largest chickpea producer since 1999 and the crop has been central in addressing food security and nutritional issues (Mcvay and Crutcher, 2012). Even though the crop has not been fully adopted in some parts of the Southern African countries as well as in Zimbabwe,

Table 2. Chickpea production between 2012-2017 in area and tonnage in Zimbabwe.

Year	Area (ha)	Production (tonnes)	Yield (t/ha)
2012	250	450	1.8
2013	250	450	1.8
2014	250	447	1.8
2015	249	465	1.8
2016	232	447	1.9
2017	229	459	2.0

Source. FAOSTAT (2019).

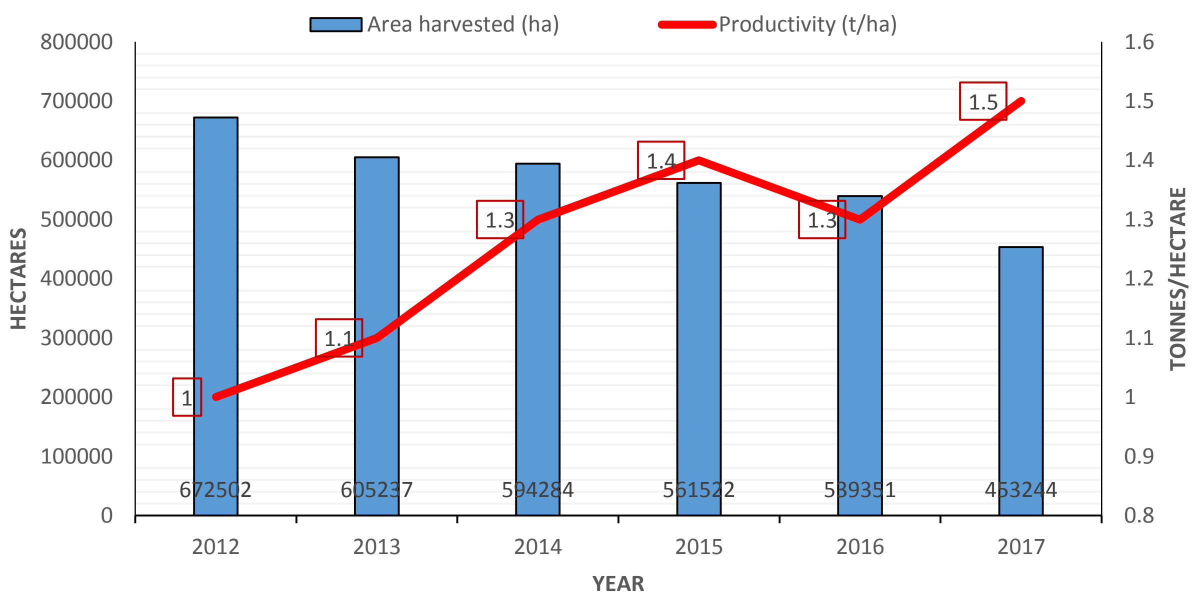

Figure 1. Chickpea production and productivity in Africa.
Source: FAOSTAT (2019).

its productivity in the African continent generally increased from the year 2012 to 2017 (Figure 1).

CHICKPEA PRODUCTION REQUIREMENTS

The crop can tolerate frost (Mckay et al., 2002) and high temperatures during flowering and behaves similar to spring cereal grains. Furthermore, it grows best when daytime temperatures are between 21 and 29°C, and nighttime temperatures are between 18 and 21°C. In Zimbabwe the crop can be grown in winter to complement other winter crops such as winter wheat in dryland farming as well as in smallholder irrigation systems. In drought prone areas or water stress conditions, the maturity requirements for the chickpea are similar or longer than the majority of winter crops grown in Zimbabwe. Furthermore, the crop has an indeterminate growth habit and deeper rooting system which may allow the crop to recover in the event of temporary moisture stress (Beyene et al., 2015). The crop grows well in areas with annual rainfall of between 400 and 600 mm, its productivity under marginal rainfall conditions may be increased through genotype selection and manipulation of planting density. Owing to its deep taproot, chickpea is fairly drought tolerant as it is able to extract moisture from deep layers of soil profile, but its productivity is reduced by the recurrence of the terminal droughts (Beyene et al., 2015).

The performance of chickpea tends to be high in well drained soils with a neutral pH and could do well in Zimbabwe Natural Region III and IV dominated by well drained soils. It is not well adapted to saline soils and does not tolerate wet or waterlogged soils. However, it can be successfully grown in a wide range of soil types. The majority of soils in Zimbabwe are derived from granite and are sandy and light textured with little inherent agricultural potential, and low levels nitrogen, phosphorous, sulphur and in cation exchange capacity. In addition, the most part of the semi-arid regions of Zimbabwe is pre-dominantly occupied with deep Kalahari sandy soils with very low agricultural potential. However, there are high chances of improving agricultural productivity of these soils by incorporating drought hardy legumes such as chickpea (Garwe et al., 2009).

BENEFITS OF CHICKPEA PRODUCTION

Chickpeas are a nutrient dense food. The food has 20% protein content and is also high in dietary fiber, folate, and dietary mineral content. Chickpeas are also rich in essential amino acids like aromatic amino acids, tryptophan, lysine, and isoleucine. These are not synthesized by the human body and are needed to meet the requirements of phenylalanine and tyrosine for protein synthesis (Pencharz et al., 2007). When cooked, chickpeas are 60% water, 9% protein, 3% fat, and 27% carbohydrates (Zia-Ul-Haq et al., 2007). In addition, mature chickpeas are either cooked to prepare various delectable dishes or eaten cold in salads. Dried chickpea seeds are also ground into flour and several fried dishes can be prepared from this flour. The crop is also used as a protein and energy source in animal feed. In the Asian continent, the leaves of young chickpea are consumed in the form of cooked green vegetables. Apart from being excellent sources of food, chickpea play a significant role in improving soil fertility by fixing the atmospheric nitrogen made it available for crop uptake. It meets 80% of its nitrogen (N) requirement from symbiotic nitrogen fixation and can fix up to 140 kg nitrogen per hectare from air. It leaves substantial amount of residual nitrogen for subsequent crops and adds plenty of organic matter to maintain and improve soil health and fertility. Because of its deep tap root system, chickpea can withstand drought conditions by extracting water from deeper layers in the soil profile, hence it is a drought hardy crop (Gaur et al., 2010). Unlike frost sensitive leguminous crops grown in Zimbabwe such as sugar beans, soybeans and cow peas, chickpea can tolerate cool temperatures and it is preferred to be planted during the winter than traditional spring in order to improve water use efficiency, better moisture conditions and increase yield (Rasool et al., 2015).

CHICKPEA MARKETS AND ECONOMICS

Worldwide, a total of 2.4 million tonnes of chickpea entered into the world trade from 1994 to 2016. Australia followed by India meets half of world export demand and provides an over 926,802 tonnes to the market annually at a value of $905.7 million. Mexico, with a large production of high quality and large seeded *Kabuli* types in the southern portion of North America, is the fifth most important exporter with the commodity being exported to over 50 countries worldwide with Algeria, Turkey, and Spain their most important customers. Turkey, also a major exporter in the Western Asian countries with over 21,615.2 tons annually, with most of the tonnage moving to neighboring countries of Iraq, Jordan, and Saudi Arabia (Merga and Haji, 2019).

In Ethiopia, most of the chickpea (about 80% of total chickpea production) is sold in the domestic markets using various market outlets For example, of the average production for 1997-2007 of 171,011 tonnes, the country's average export amounted to about 9.1% (or 15,532 tonnes) of total production (Kassie et al., 2009). Export potential of chickpea increased by 10.5% during 1997 and 1999. However, it declined between 2003 and 2006 but peaked again to 23.15% in 2007. Ethiopian desi chickpea is exported to South Asia, Middle East, North Africa, North America, Europe, Southeast Asia, and Latin America. During the period 1994-2005, Ethiopia imported 250 tonnes in order to introduce seeds of new varieties from abroad (Kassie et al., 2009). Since 2016, Ghana export chickpea to Switzerland, United Kingdom and Netherlands at US$526 000, US$170 000 and US$30000 respectively. There is no chickpea export value for southern African regions. The pricing of chickpea is not influenced by chickpea types and grain size but by the quality of the chickpea product.

FACTORS AFFECTING CHICKPEA PRODUCTION

The performance of chickpea is affected by abiotic factors such as soil salinity, extremes of temperatures and flooding. Abiotic factors affect water relations of the plant, both at cellular level as well as the whole plant level, causing both specific and non-specific reactions, damage and adaptation reactions (Potters et al., 2007). Rasool et al. (2015) states that yield performance of chickpea is also influenced by deficiencies in some elements in agricultural soils such as nitrogen, phosphorus and the presence of heavy metals such as arsenic which is found in the oxidized state as arsenite (As (III)) and arsenate (As (V)).Biotic factors such as diseases, insects, pests and plant parasitic nematodes affect chickpea productivity (Beyene et al., 2015). Castillo et al. (2008) identified chickpea parasitic nematodes that are estimated to cause annual yield losses of 14% as reniform nematode (*Rotylenchulus reniformis*), root-knot nematodes (*Meloidogyne* spp.), root lesion nematodes (*Pratylenchus* spp.) and cyst-forming nematodes (*Heterodera* spp). Root diseases (fusarium wilt, collar rot and dry root rot) and foliar diseases (ascochyta blight, botrytis grey mold) also threaten chickpea production. Insects pests such as pod borer *(Helicoverpa armigera),* cutworm and bruchids significantly reduces chickpea yield (Beyene et al., 2015).

Factors such as low yield potential of local cultivars, for example the Ethiopian *Desi* chickpea types, with small seed size and undesirable texture, are low in productivity. Moreover, poor cultural practices and susceptibility of landraces to biotic and abiotic stresses are also issues of concern in Africa. Unavailability of improved seed also contributes to low productivity and some high-yielding varieties with market-preferred traits have not reached farmers on a large scale. Farmers are growing local landraces which do not meet the quality and quantity requirements preferred by the domestic and international markets. There is also lack of a well-coordinated supply chain that links producers and buyers and the mechanism for delivering market information to the producers and traders at local markets on issues related to seasonal prices, demand and quality requirements in different markets is not well established (Dadi et al., 2005).

BREEDING CHICKPEA FOR BIOTIC AND ABIOTIC FACTORS

Chickpea improvement programmes should focus on developing varieties that adapt in the existing and evolving cropping systems, with traits preferred by farmers, industries and consumers. In addition, there is need to identified chickpea lines or accessions that show high level of resistance to pests, diseases and plant parasitic nematodes. If any African country adopts the crop, its breeding programmes should enhance the production and productivity of chickpeas under drought conditions through genetic and agronomic manipulation. This can be achieved by developing reliable screening techniques for evaluating germplasm so as to understand the genetic basis of drought tolerance and produce germplasm with the potential to make a significant contribution in raising the level of chickpea resistance drought in Southern African countries (Dixit et al., 2019).

Breeding chickpea resistant to diseases

Chickpea is normally grown in winter, exposing the crop to a high risk of *Ascochyta blight* disease. Therefore, there is need to develop chickpea resistant cultivars to *Ascochyta blight*. Sharma and Ghosh (2016) found that there is limited research on the understanding *Ascochyta blight* pathogen biology, disease epidemiology and management for the development of resistant cultivars and for developing suitable strategies to reduce disease. In addition, it is difficult to manage the pathogen in chickpea through resistance breeding because of changes and evolution of new virulent genes of *Ascochyta blight*. Furthermore, research on chickpea varieties that are resistant to *Ascochyta blight* have been hindered by the paucity of high levels of resistance in the primary gene pool, complex genetic basis of resistance conferred by several quantitative trait loci (QTLs), highly variable pathogen population and the emergence of new pathotypes due to natural recombination through sexual reproduction in the *Ascochyta blight* life cycle (Sharma and Ghosh, 2016). However, a number genetic resources of *Ascochyta blight* resistance which does not possess complete resistance to the pathogen have been identified and applied in plant breeding programmes Pande et al. (2006a) identified 29 lines with wide range of maturity which confer resistance to *Ascochyta blight.* Rasool et al. (2015) added that in some of the world such as India, Pakistan, Syria, USA, Canada and Australia*, v*arieties with enhanced *Ascochyta blight* resistance have been released. In 2001, howzat variety showing moderate resistance to *Ascochyta blight* was released in Australia, and breeders began selecting a number of *desi* and *kabuli* lines with higher levels of resistance from ICRISAT and ICARDA breeding lines, as well as existing Australian varieties.

Twenty one chickpea lines that are free from fusarium wilt disease and twenty five resistant to the same diseases were discovered by Pande et al. (2006b). Furthermore, varieties with stable resistance to fusarium wilt such as JG 315, Avrodhi, DCP 92-3, JG 74, BG 372 and KWR 108 were released in India. Pande et al. (2006b) also discovered six accessions with moderate resistance to dry root rot among 211accessions in the desi chickpea mini core collection. Chickpea lines such as GL 84102, GL 88223, GLK 88114 and GF 89-75 showed moderate resistance to stem rot and the wild *Cicer* species *C. judaicum*, *C. reticulatum*, *C. pinnatifidum* and *C. yamashitae* were tolerant to stem rot.

Breeding chickpea resistant to insect pests

Breeding chickpea resistance to insect pests is also affected by limited genomic resources and the narrow genetic diversity in the gene pool of chickpea. Slow progress in breeding chickpea resistance to insect pests has been linked with difficulties involved in ensuring adequate insect pressure for resistance screening (Khatodia et al., 2017). Kambrekar et al. (2016) stated that the development of insect resistance to insecticides, adverse effects of insecticides on natural enemies and public awareness of environmental pollution, renewed interest in the development of insect resistant cultivars. Wild relatives of chickpea such as *C. judiacum, C. bijugum* and *C. pinnatifidum* showed significant levels of resistance to *Helicoverpa armigera*, however these were post zygotic cross incompatible with the cultivated chickpea germplasms making it difficult or impossible to conduct wide hybridization (Khatodia et al., 2017). A large number of chickpea germplasm, including cultigens and wild relatives were evaluated for resistance to pod borer, and low to moderate levels of resistance were reported, with line ILL 506 possessing a good level of resistance (Rasool et al., 2015).

Breeding chickpea resistant to plant-parasitic nematodes

Valuable sources of resistance to cyst nematode in *C. bijugum*, *C. pinnatifidum* and *C. reticulatum* and some wild accessions showing resistance to more than one stress were identified. For example, ILWC 7-1 of *C. bijugum* showed resistance to ascochyta blight, fusarium wilt, leaf miner, cyst nematode and cold, and ILWC 33/S-4 of *C. pinnatifidum* to ascochyta blight, fusarium wilt, seed beetle and cyst nematode (Kumar et al., 2011).

Adaptation mechanisms of chickpea to drought and heat

Chickpea escape drought through early phenology (Short duration) mechanism. The most important phonological trait under this mechanism is days to first flowering (the number of days taken from sowing to first flowering). ICRISAT classify short duration chickpea genotypes that flowers between 25-30 days. In the Asian continent, this adaptation resulted in improved chickpea yields. Early flowering and maturity escapes drought and avoid yield losses and shorter vegetative period combined with a longer grain filling period could lead to higher yields. The roots of chickpea can use water up to 30 cm soil layer. In addition, deeper root systems and use of subsoil water above 30 cm offers survival advantage under terminal drought. Furthermore, the additive gene action controlling root length and root dry weight help chickpea escape drought. For example two crosses (ICC283 x ICC82361 and ICC4958 x ICC1882) showed that there is additive gene action controlling root length and confers survival advantage in drought areas (Devasirvatham and Tan, 2018). Devasirvatham and Tan (2018) added that heat tolerance index is used to identify stable heat tolerant and sensitive genotypes. In addition, genotype by environment interaction helps to understand the response of physiological traits to environments to improve crop adaptation to heat stress.

Breeding chickpea resistant to drought

Although chickpea is regarded as a drought tolerant crop, it is important to identify drought tolerance mechanism so as to develop new cultivars with high yield potential. Breeding chickpea resistant to drought should focus on the introduction or exploration of chickpea germplasm through interchange of genetic material, probing areas with greater genetic variation, collaboration with international research institutes such as International Center for Agricultural Research in the Dry Areas (ICARDA), Syria; International Crops Research Institute for the Semi-Arid Tropic (ICRISAT), India; United States Department of Agriculture (USDA) and Food and Agricultural Organization (FAO), Rome, Italy (Maqbool et al., 2017). Devasirvatham and Tan (2018) reported that many diverse genotypes for drought and heat tolerance breeding programmes are available. Furthermore, segregating populations from the crosses between A1 x ICC4958; ICCV2 x ICC4958 contributing to drought tolerance were evaluated for physiological traits (grain yield, root biomass).

Breeding short duration varieties

The cropping season in Zimbabwe is highly complex with the intensity, distribution, and frequency of precipitation being unpredictable. Over the past few years, the rainy season spans from December to March and highest rainfall was recorded in February (Mamombe et al., 2017). Therefore, there is need to breed and adopt short duration chickpea varieties (90-110 days) that could suit the prevailing environmental conditions in the drought prone areas of Zimbabwe. According to Dixit et al., (2019) short duration varieties such as JG 11, JAKI9218, Vijay, Vikas, Vishal, JG 16, JG 14, JGK-1 and KAK 2 were developed in some parts of the India to help in increasing chickpea productivity. In addition, more short duration varieties of chickpea which include Rajas, Pusa 547, JAKI 9218, RVG 202, RVG 203, JGK 1, KAK 2 and Shubhra were developed to perform well on short season rainfall patterns.

Marker assisted selection

Marker assisted selection is a very promising method for chickpea improvement and depends on the strength of the linkage between the marker and the gene locus controlling the trait of interest, the localization in a saturated genomic area, the high level of polymorphism, and ease of interpretation (Ali and Malik, 2014). In chickpea breeding programmes, marker assisted backcrossing was done to introgress *Ascochyta blight* resistance with double podding traits in chickpea cultivars. Chickpea cultivars resistance to fusarium wilt race and blight were developed through the use of microsatellites in each backcross generation and sequence characterized amplified regions (SCARs) SCY17590 and SCAE19336 tightly linked to QTLAR2 for Ascochyta blight resistance, were used to tag resistance lines in a collection of chickpea germplasm. The use of SCAR marker SCY17590 in combination with a co-dominant marker (CaETR) linked to QTLAR1 for resistance to *Aschochyta* in chickpea helped to detect resistance alleles in 90% of resistant accessions in a collection of landraces (Jendoubi et al., 2017). Marker assisted selection has seen the development of high-density genetic maps using different markers (Simple Sequence Repeats (SSR), Single Nucleotide

Polymorphism (SNP) and Diversity Arrays Technology (DArT)). Main effect quantitative trait loci (QTLs) and epistatic QTLs for different drought tolerance traits in two mapping populations (ICC4958 x ICC1882; ICC283 x ICC8261) revealed a genomic region referred as 'QTL-hotspot' which controls 12 drought tolerance traits such as root length density, root surface area, shoot dry weight, plant height, days to 50% flowering, days to maturity, harvest index, 100 seed weight, biomass, yield, pods per plant, and seeds per pod (Devasirvatham and Tan, 2018).

TESTING OF CHICKPEA ADVANCED BREEDING LINES: THE CASE OF ZIMBABWE

To meet the food and nutritional demand of people in Zimbabwe, it is important to find the highest yielding and disease resistance chickpea genotypes for winter production. In plant breeding programmes, multi-environment yield trails are used in the final cycle to identify superior genotypes in plant breeding programmes. Multi-environment yield trials also aim to determine if the target region can be subdivided into different multiple environments. Furthermore, investigation of multiple environments is a prerequisite for meaningful cultivar evaluation and recommendation (Erdemci, 2018). This task is however constrained by the presence of genotype by environment interaction. Genotype by environment interaction reflects that genotypes differ in relative performance over environments. According to Crossa et al. (1999) a significant genotype by environment may be either (i) a non-crossover type where the ranking of genotypes remains constant across environments and the interaction is significant because of changes in the magnitude of the response or (ii) a crossover type where a significant change in rank occurs from one environment to another. Therefore, plants breeders tend to look for a non-crossover type when selecting genotypes that are adapted to a number of environments. Since ICRISAT has some of the chickpea advanced materials, there is need to test these genotypes in isolated areas of the semi-arid regions of Zimbabwe.

Testing of chickpea lines also involves the use of participatory varietal selections. The participation of farmers in the breeding programmes has proved to be key strategy towards the promotion of newly introduced crop varieties. According to Chichaybelu et al. (2018) the use of farmers' participatory variety selection (FPVS) approach is being viewed as important aspects in building farmers' confidence on improved chickpea technologies. During the inception of chickpea in Ethiopia, farmers implementing FPVS trials were selected by development agents and trained on chickpea production and trial management. Under this techniques, selected farmers grow and manage chickpea trials under the close supervision of researchers and development expect. The trials would then be evaluated at the vegetative and maturity stage by a group of farmers using their own criteria related to yield and yield components. Based on the ratings of the criteria, varieties of their preference would be identified for further popularization.

ROLES OF CGIAR AND NARS ON THE TRANSFER OF CHICKPEA GERMPLASM TO ZIMBABWE

Plant genetic resources continue to play an important role in agricultural development, increasing food production, poverty alleviation and promoting economic growth because they are the raw materials of plant breeding. Therefore, their availability, safe use and conservation is a pre-requisite for the achievement of food production in order to feed the growing population especially in developing countries such as Zimbabwe (Cooper et al., 1994). Cooper et al. (1994) also added that the International Agricultural Research Centers of the Consultative Group on International Agricultural Research (CGIAR), in cooperation with the National Agricultural Research Systems (NARS) in developing countries provided the backbone of international collaborative effects in crop genetic resources and plant breeding. The CGIAR centers contributed to the construction of multilateral system on plant genetic resources for food and agriculture. The multilateral system under the International Treaty on Plant Genetic Resources for Food and Agriculture facilitates access to the genetic materials for research, breeding and training for food and agriculture (access and benefit sharing). The system ensures that the benefits derived from plant genetic resources are shared with the countries that provided them in order to provide incentives for effective conservation and a quid pro quo for continued access. In addition, a multilateral agreement was set to guarantee the continued availability of plant genetic resources for food and agriculture. Zimbabwe and most African countries are a signatory to the International Treaty on Plant Genetic Resources for Food and Agriculture which came into effect since 2004 and this could make it easy to have access to the chickpea lines in various CGIAR gene banks.

CONCLUSIONS

Eradicating hunger, poverty and malnutrition is the main agenda of Zimbabwe agricultural sector. This could be achieved through the introduction of drought-hardy, grain legume crops such as chickpea. Introduction and upscaling of low cost and environmentally friendly crops like chickpea has the potential to enhance agricultural productivity help propel subsistence agriculture towards commercial farming that would help farmers move outside the poverty zone. The major limitation to chickpea adoption is lack of seed systems, shortage of quality seed and lack of timely delivery, and insufficient access to production credit to farmers. Therefore, if Zimbabwe could adopt the crop, key stakeholders such as government officials, farmers, non-governmental organizations and CGIAR centers need to work together and draft mutually agreed terms in order to supply high quality seed to the farmers, researchers and private sectors. Chickpea like other food legume has narrow genetic base, hence the breeding programmes should focus on wide hybridization because some traits are available in wild *Cicer* species.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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