

International Journal of Advanced Research in Biological Sciences

ISSN: 2348-8069

www.ijarbs.com

(A Peer Reviewed, Referred, Indexed and Open Access Journal)

DOI: 10.22192/ijarbs

Coden: IJARQG (USA)

Volume 10, Issue 1 -2023

Review Article



DOI: <http://dx.doi.org/10.22192/ijarbs.2023.10.01.014>

Review on Cowpea Production, Utilization and Research Achievements in Ethiopia

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Abstract

Cowpea is one of the most important food and forage legumes in the semi-arid tropics that include parts of Asia, Africa, Southern Europe, Southern United States, and Central and South America. Besides its important, little is known about its research achievement, importance, production system and distribution in Ethiopia. Therefore the aim of this paper was to review cowpea production, utilization and research achievements in Ethiopia. In Ethiopia cowpea is primarily produced for human food, livestock fodder, medicinal purpose, and income provision to households. Cowpea production is practiced under different cropping systems including intercropping, mixed cropping and sole cropping system. However its production and productivity is low due to limited attention by research and varieties development, severe attacks of pest/insect, disease, improved varieties, low soil fertility, drought/water scarcity, poor management practices and low level knowledge of smallholder farmers about cowpea production. In Ethiopia the evidence of cowpea production and productivity is small but, over the last decades, several research activities have been conducted on cowpea improvement for bean seed yield and biomass. The Ethiopian Institute of Agricultural Research (EIAR), in collaboration with other national and international research institutions, has been making highest efforts to contribute to the cowpea development in the country for the last fifty years. To date, 15 cowpea varieties have been released by the Ethiopian Institute of Agricultural Research (EIAR), and Regional research Institutes which has high biomass and grain yield. The breeding and genetics research in the future should be focus on development of varieties resistant against multiple constraints, its agronomy, forage physiology, crop protection, and demonstration and to decentralize cowpea maintenance program based on their recommendation program.

Keywords: Cowpea, cowpea production, cowpea varieties, Ethiopia, Research

1. Introduction

Cowpea (*Vigna unguiculata*) (diploid, $2n=22$) is an annual herbaceous legume cultivated for its edible seeds or for fodder and cultivated cowpeas are herbaceous annuals that are either erect, prostrate or climbing annuals with a tap root and virtually all are glabrous. It is a self-pollinated crop, with natural cross-pollination of up to 1% and can grow up to 80 cm and up to 2 m for climbing cultivars. Cowpea is a multipurpose grain legume; in which the entire plant can be used for either human or livestock consumption (Pottorff et al., 2012). It is one of the most important food and forage legumes in the semi-arid tropics that include parts of Asia, Africa, Southern Europe, Southern United States, and Central and South America (Singh, 2005; Alemu et al., 2016). It is one of the most important native food and forage legumes, and it is grown in Sub-Saharan Africa and some temperate regions of the world (Srivastava et al., 2016).

The young leaves, green pods and green grains are used as vegetables, and the dry grains are used in various preparations for both human food and livestock feed (Filho et al., 2017; Owade et al., 2020). In Ethiopia, cowpea seed is mostly used in the form of food dishes 'nifro', 'shiro'. The cowpe grain is highly nutritious and contains about 22.8 - 28.9% protein with an average of 25.6% (Weng et al. 2019). According to Islam et al. (2006), all parts of the plant are used as food, which is nutritious, providing protein and vitamins. Cowpea is referred to as the "hungry-season crop" given that it is the first crop to be harvested before the cereal crops are ready. Immature pods and seeds are used as cooked vegetables while several snacks and main dishes are prepared from the grains (Antova et al., 2014; Agbogidi; Egho, 2012). In addition to its importance in human food and animal feed, cowpea is also useful for soil fertilization through symbiotic nitrogen fixation. Over the last three decades, global cowpea production grew at an average rate of 5%, with 3.5% annual growth in area and 1.5% growth in yield, and the area expansion accounting for 70% of the total growth

during this period (Boukar et al., 2016). Concerning its consumption, 52% for food, and 13% as animal feed, 10% for seeds, 9% for other uses, and 16% are wasted. Being a drought-tolerant and warm weather crop, it is a promising food and forage species in a typical tropical lowland climate (Alemu et al., 2016; Belay et al., 2017).

In Ethiopia, cowpea is grown in the drier areas of Oromia (the Rift Valley, highlands of east and west Hararge zone) commonly intercropped with sorghum as well as in the Northeastern part of the country Amhara region areas (around ShewaRobit, Kobo, North and South Wollo zone and Waghimira) in Southern and Eastern Tigray zone, Ethio-Somali region, Afar region, Wolayita zone and Jinka zone (Kassaye et al., 2013). Also, it is cultivated in low rainfall areas of Southern Nations, Nationalities, and Peoples' Region (SNNPR) especially in Konso, Derashe, Humbo, Hammer Bako, Loka Abaya, Gofa, and Loma woredas and South Omo zone), Tigray, and Gambella (Alemu et al., 2019). Nearly 70% of the arable land in Ethiopia falls on dry land environments where rainfall is usually inadequate, poorly distributed, and varies over years and seasons within a year (UNDP, 2014).

According to Erana and Zelalem (2020), the production of cowpea in the country are hindered by the lack of access to modern technologies such as seed of improved varieties, disease and the accompanying crop and pest management practices, inputs such as fertilizers. However, Ethiopia has a high potential for the production of various crops as more than 66.5% of the arable land is very suitable for cowpea production (Simion, 2018). Over the last decades, several research activities have been conducted on cowpea improvement for seed yield and biomass in Ethiopia. In Ethiopia, several studies were conducted, on adaption, introduction, selection and collection of landrace of Cowpea. The Ethiopian Institute of Agricultural Research (EIAR), in collaboration with other national and international research institutions, has been making utmost efforts to contribute to the

agricultural development in the country for the last fifty years.

1.1. Objective

-) To Review cowpea production and utilizations in Ethiopia
-) To Review cowpea Research Achievement in Ethiopia

2. Literature Review

2.1 Origin and History

The cowpea has originated and was domesticated in Southern Africa; later, it was spread to East and West Africa and Asia (Agbogidi, 2010). The crop belongs to the family Fabaceae and sub-family Faboideae. It is also known as southern pea, black eye pea, crowder pea, lubia, niebe, coupe or frijole. The southern African region (Namibia, Botswana, Zambia, Zimbabwe, Mozambique and South Africa) and the semi-arid West and Central Africa are reportedly considered the center of diversity of cowpea (Rivas et al., 2016). People in these areas (centre of diversity) consume cowpea and other pulses as supplements to their daily diet.

2.2. Cowpea Production and Productivity in Ethiopia

In Ethiopia, cowpea production and productivity is minor, however a few sources show that the average national yield of cowpea is estimated to be 400 kg ha⁻¹, whereas yields of 2200 to 3200 kg ha⁻¹ have been commonly recorded from improved varieties with proper crop management and protection practices (Ashinie et al., 2020). According to Zewdu et al. (2021) reported the higher average grain yield means of 15.2466 Quintal/ha (1524.66 kg/ha) was obtained from white wonder and the lowest grain yield of 6.319 Quintal/ha (631.9 kg/ha) obtained from Bole varieties. Bilatu et al. (2012) reported the highest grain yield of 28.9 Quintal/ha which was recorded from Black-eyed bean. Belay (2017) reported the early maturing varieties have been shown to yield better than the late maturing varieties.

2.3. Distribution of Cowpea Production in Ethiopia

In Ethiopia, cowpea is grown in drier pockets of the Rift Valley, and in the eastern and northeastern part of the country. It is also an important crop in low rainfall areas of southern especially, in Konso, Derashe, Humbo, Hamerbako, Loka Abaya, Ofa, and Loma Districts (Reddy and Kidane 1993)

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Cowpeas are grown as warm-season-adapted annuals in Ethiopia, like Oromia, Amhara, Tigray, Gambella and SNNP region. In northern Ethiopia, there is production of cowpea in Amhara Region mainly at East Gojam, Desse, Efratanagidem, Raya Kobo, Bati, Kalu, Lasta Lalibela, Sekota and Abergelle, in Tigray Region Kola Temben, Maerey, Tangua, Zongwi, Abiyi Adi and Werie Leke, weredas cowpea is highly produced (Mulugeta et al., 2015). In Oromia region, East hararghe (Babile, Biya Aale, Gursum), west hararghe (Habro, Mieso, Odabultum, Chiro), East Shewa (Boset), in Gambella Region Agnuwakand (Abobo, Itang), in SNNPR Gamogofa (Arbaminch), Segen People (Konso), South omo (South Ari), Wolayta (Sodo Zuri, Humbo) (Sisay et al., 2019).

2.4. Important and Utilization of Cowpea in Ethiopia

Cowpea is referred to as the "hungry-season crop" given that it is the first crop to be harvested before

the cereal crops are ready. It also cultivated in Ethiopia and use for traditional food preparation animal feed as meat source. Cowpea is primarily used for human food, livestock fodder, and medicinal purpose. In Gambella and SNNP regions the majority of farmers used different parts of the Cowpea (fresh leaves, young shoot and grain) for home consumption in the form of traditional foods (Alemu et al., 2019). In Oromia, Dire Dawa and SNNP regions (Wolayeta, Arbaminch zuriya and Derashe Woredas) cowpea is used for the human food in the form of boiled grains (Nifro), local sauces as “Shiro” “Wet” Or “Kike Wet” (split grain sauce), local soup (Shorba) and porridge (Genfo). In addition to its human food value, cowpea is also used for animal feed which can be prepared from grain and leaf (Alemu et al., 2019). In Northern part of Ethiopia, Cowpea green leaves and immature pods were found to be used for traditional food as green vegetables is found in southern and eastern Ethiopia. Seeds are a highly valued part of the crop for home consumption in the form of “Nifro”, “Kita” and “Wet”. Sometimes the green mature pods were eaten by children. Cowpea foliage is an important source of high-quality hay for livestock feed (Mulugeta et al., 2015). Furthermore, the farmers are using cowpea for income generation including by selling the grains and the leaves in the local markets and cowpea grains used as “Nifro” and leaves used as cooked vegetables (Alemu et al., 2019). Gebreyowhans and Gebremeskel (2014) reported that in Ethiopia, farmers feed cowpea fodder to livestock to increase income and collect the manure produced for use in their fields thereby reduces farmers’ reliance on commercial fertilizers and sustain soil fertility.

Cowpeas play a critical role in the management of soil fertility in cereal-based intercropped and rotational cropping systems where they are often grown in Ethiopia, in terms of nutrient improvement and resistance to certain pests. Biological nitrogen fixation is one of the major benefits of cowpea production in cropping system. The species has a unique ability to fix atmospheric nitrogen with its nodules in association with soil dwelling bacteria, known as

rhizobia. In Lasta Lalibela Wereda the crop is mainly used as ground cover and income generation. Cowpea significantly contributes to the sustainability of cropping systems and soil fertility improvement in marginal lands by providing ground cover, fixing nitrogen and suppressing weeds (Megersa et al., 2013; Beshir et al., 2019).

2.5. Cowpea Production system in Ethiopia

In Ethiopia, cowpea production is practiced under varying cropping systems including sole cropping, intercropping, mixed and relay cropping. Cowpea production system has significant differences across the major cowpea producing areas of Ethiopia. The main production practice in Gambella, SNNPR and central Oromia region were sole-cropping whereas local farmers used only intercropping with sorghum and maize for the use of improving soil fertility, to produce a diverse product and to use as a supporting mechanism for cowpea in Oromia region (East and West Harerge zones) (Alemu, 2015). However in northern Ethiopia, however, cowpea is mostly intercropped with cereals, commonly with sorghum and maize using different planting methods mainly broadcasting and row planting (Alemu, 2015; Alemu et al., 2019),.

Cowpea is produced using sole cropping in Gambella whereas both intercropping and sole cropping were used in Amhara, Oromia, SNNP and Tigray regional states (Kebede and Bekeko, 2020). Intercropping of cowpea is usually done with cereals such as sorghum and maize though a few farmers in Oromia while intercropping cowpea with groundnut and common beans reported in SNNPR. mixed cropping of cowpea, which planting of cowpea with other crops such as maize and sorghum randomly scattered in small amounts, is practiced to a lesser extent throughout the country (Alemu et al., 2016; Alemu et al., 2019; Beshir et al., 2019).

3. Major Cowpea Research Achievements in Ethiopia

3.1. Varieties Development

Despite its significance and production, cowpea has been identified as a neglected and underutilized crop species, with further research required in some parts of Africa including Ethiopia where there is limited information on its cultivation, agronomic practices, and seed handling (Chivenge et al., 2015; Mfeka et al., 2019; Selamawit et al., 2020). Over the last decades, several research activities like adaption, introduction, and selection (breeding), collection of landrace and intercropping have been conducted on cowpea for improvement of seed yield and biomass in Ethiopia. The Ethiopian Institute of Agricultural Research (EIAR), in collaboration with other national and international research institutions, has been making utmost efforts to contribute to the agricultural development in the country for the last fifty

years. The aim of the cowpea breeding program is to increase production and productivity of cowpea through provision of high yielding varieties which are preferred by stockholders and are tolerant to major biotic and abiotic stresses. To achieve this objective, the program uses different strategies to broaden the genetic base of cowpea through introduction, selection, adaption and collection of land races. To date, substantial numbers of cowpea varieties have been released by the Ethiopian Institute of Agricultural Research (EIAR), and Regional research institutes. In Ethiopia, only six varieties have been released so far (MoA, 2018). Since statistical data on cowpea area and production are not available in the country which usually is reported with that of haricot beans (*Phaseolus vulgaris* L.). But to date 15 cowpea varieties with early to late maturity cycle adapted to low and midland area have been released. These are mainly for animal feed to solve shortage of quality and quantity animal feed have been released in Ethiopia (table 1).

Table 1: Cowpea Varieties Released in Ethiopia from 1976-2022

Name of Variety	Year of Registered	Breeder Institute (Released by)
Sewunet	2009	Pawe Agricultural Research center
Temesgen	2014	Humera Agricultural Research center
Black eye bean	1976	Melkasa Agricultural Research center
Bekur	2001	Sirinka Agricultural Research center
Kenketi	2012	Melkasa Agricultural Research center
White wonder trailing	1976	Melkasa Agricultural Research center
TVU 1977OD-1	1978	Melkasa Agricultural Research center
Bole	2006	Melkasa Agricultural Research center
Asebot	2008	Melkasa Agricultural Research center
Asrat	2001	Sirinka Agricultural Research center
Melka	2018	Melkasa Agricultural Research center
Adulala	2018	Melkasa Agricultural Research center
White Wonder	-	Melkasa Agricultural Research center
ILRI-IT83D-442*	2022	Bakko Agricultural Research center
ILRI-11114*	2022	Bakko Agricultural Research center

Source: Published and Unpublished Materials, *= Unpublished

4. Conclusion

Cowpea is one of the most important food and forage legumes in the semi-arid tropics. It is one of the most important native food and forage legumes, and grown in Sub-Saharan Africa and some temperate regions of the world. The young leaves, green pods and green grains are used as vegetables, and the dry grains are used in various preparations for both human food and livestock feed. The cowpea grain is highly nutritious and contains about 22.8 - 28.9% protein with an average of 25.6%. It is referred to as the "hungry-season crop" given that it is the first crop to be harvested before the cereal crops are ready. Cowpea also cultivated in different parts of Ethiopia and use for traditional food preparation animal feed as meat source, is primarily used for human food, livestock fodder, and medicinal purpose. It plays a critical role in the management of soil fertility in cereal-based intercropped and rotational cropping systems where they are often grown in Ethiopia, in terms of nutrient improvement and resistance to certain pests. There is limited information on its cultivation, agronomic practices, and seed handling. Over the last decades, several research activities have been conducted on cowpea improvement for seed yield and biomass in Ethiopia. Several studies were conducted, on adaption, introduction, selection and collection of landrace of Cowpea. To date 15 cowpea varieties with early to late maturity cycle adapted to low and midland area have been released. Cowpea is faced with so many constraints, such as diseases, insect pests, moisture stress, absence of improved high yielding varieties, weed and the limited use of fertilizers and irrigation input for the sake of cowpea production and utilization.

Recommendations: Based on the Conclusion the following recommendations are forwarded:

Breeding and genetics research in the future should attention on development of cowpea varieties strong against several constraints, rich in nutritional value, higher grain and forage yield potential and adaptable to new production niches,

potential varieties that are suitable different cropping system.

Agronomy of optimal practices or technologies for cowpea production in different cropping systems (inter-cropping, multiple cropping, relay cropping & double cropping systems) in different agro-ecologies, effective rhizobium strains for different cowpea should be developed.

Cowpea variety maintenance program should be decentralized based on the recommended agro ecological domains of the varieties and location of research centers to diversify the alternative seed sources.

Where there is limited information on cowpea cultivation, production and utilization system, and seed handling, further research should be done for the future.

Development of relevant pre- and post-harvest agricultural mechanization technologies for cowpea would be indispensable.

Promotion of cowpea based technologies generated by different research teams would be crucial to benefit the end users to bring the desired level of impact.

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Quick Response Code	
DOI: 10.22192/ijarbs.2023.10.01.014	

How to cite this article:

Lensa Urgesa. (2023). Review on Cowpea Production, Utilization and Research Achievements in Ethiopia. Int. J. Adv. Res. Biol. Sci. 10(1): 172-180.
DOI: <http://dx.doi.org/10.22192/ijarbs.2023.10.01.014>