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Review

Cowpea (*Vigna unguiculata*) Cultivation and Breeding in the Republic of Korea: Advances and Future Perspectives

Dong-Kwan Kim [1,†], Kanivalan Iwar [2,†], Kingsley Ochar [3], Sin-Young Park [4], Eun-Byul Go [4], Kyung-Dong Lee [5] and Seong-Hoon Kim [2,*]

[1] Resource Management Division, Jeollanamdo Agricultural Research and Extension Services, Naju 58213, Republic of Korea; kms1996@korea.kr
[2] National Agrobiodiversity Center, National Institute of Agricultural Sciences, Rural Development Administration, Jeonju 54874, Republic of Korea; kani05@korea.kr
[3] Council for Scientific and Industrial Research, Plant Genetic Resources Research Institute, Bunso P.O. Box 7, Ghana; kingochar@yahoo.com
[4] Crop Research Division, Jeollanamdo Agricultural Research and Extension Services, Naju 58213, Republic of Korea; sinyoung7449@korea.kr (S.-Y.P.); star120@korea.kr (E.-B.G.)
[5] Department of Companion Animal Industry, College of Health and Welfare, Dongshin University, Naju 58213, Republic of Korea; leekd@dsu.ac.kr
* Correspondence: shkim0819@korea.kr
† These authors contributed equally to this work.

Abstract: The cowpea is one of the most important legume species globally, with both the grains and fresh pods widely consumed for the rich nutritional content. In the Republic of Korea, the cultivation and breeding progress of cowpeas is relatively low but gradually receiving interest due to its potential contribution to nutrition and sustainable agriculture. Given the changing pattern of global climatic conditions, any effort in cowpea breeding in Korea may focus on important traits such as improving yield, stress resistance, and adaptability to local climate. This review provides a discussion on the current status of the cultivation and breeding of cowpeas in the Republic of Korea, with the aim of improving crop performance, agricultural sustainability, and food security.

Keywords: breeding; cowpea; cultivation; production; variety

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1. Introduction

The cowpea (*Vigna unguiculata*) is one of the most important legume crops widely cultivated and consumed, especially in Africa, Asia, and Latin America, as a result of its rich nutritional content, environmental adaptability, and food security value [1,2]. It is an important source of plant-based proteins, carbohydrates, vitamins, and minerals for millions of people, particularly in the tropical and semi-tropical regions of the world [3]. As a legume, the cowpea contributes to soil fertility through nitrogen fixation, which makes it a crucial crop in sustainable farming systems, particularly in areas prone to poor soil fertility and unpredictable climatic conditions [4]. Cowpea cultivation is also associated with relatively low input costs, making it suitable for small-scale growers [5]. Despite its global significance, cowpea cultivation has traditionally been concentrated in regions with semi-arid climates, such as sub-Saharan Africa [6]. However, the increasing demand for plant-based protein, coupled with the need for sustainable agricultural practices, has ignited interests in its cultivation in other parts of the world, including East Asia (Figure 1) [7].

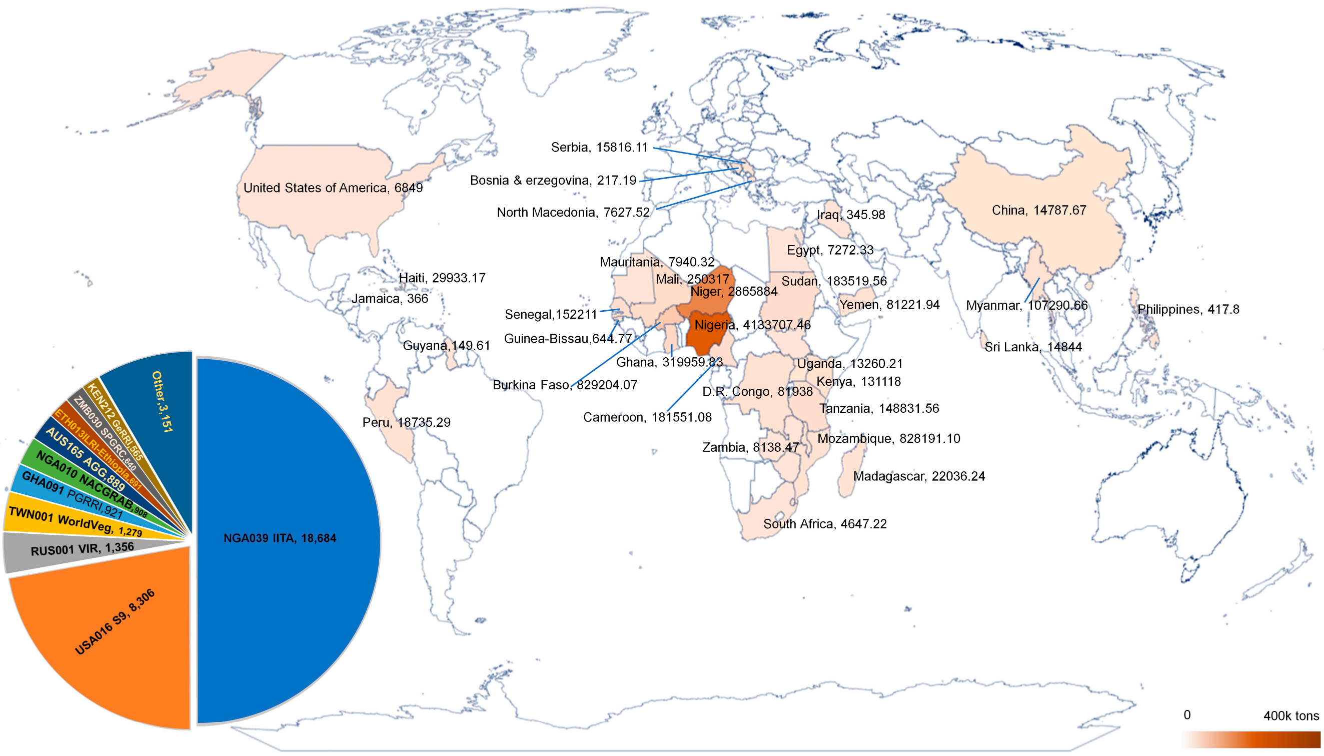

Figure 1. Country-wise cowpea production data accessed through FAOSTAT and accession holding institute accessed through Genesys, 5 November 2024.

In the Republic of Korea, cowpea cultivation has remained relatively limited compared to major staples like rice, soybean, and wheat [8]. However, recent trends in agricultural diversification and sustainable agricultural practices and a growing interest in plant-based diets have attracted attention to cowpeas as a potential crop for both food security and environmental sustainability in Korea [9]. The agricultural sector in the Republic of Korea is characterized by advanced technology, innovation, and a focus on sustainable farming practices [10]. In this context, introducing cowpeas as a viable crop can have significant implications for enhancing biodiversity, improving soil health, and promoting the sustainability of agriculture. However, the successful integration of cowpeas into the Korean agricultural system requires careful consideration of the adaptability of the crop to the local climatic conditions, pests, and diseases; thus, there is the need for developing improved varieties that can meet the specific needs of growers and consumers. Therefore, cowpea breeding efforts in Korea may focus on developing varieties that are resilient to biotic and abiotic stresses, such as pests, diseases, drought, and high temperatures. These challenges are critical given the temperate climate nature of the country and the impacts of climate change, which can exacerbate weather variability and crop stress [11,12]. Additionally, in order to meet the rising demand for plant-based protein sources in Korean diets, breeding programs must prioritize traits that enhance nutritional value, taste, and consumer acceptance. This aligns with the global trend toward healthier, more sustainable food systems [13]. Beyond domestic consumption, cowpea cultivation in Korea holds the potential for contributing to international food security. As a global trade participant, knowledge about advances in cowpea breeding and production could play a role in addressing food scarcity in regions where cowpeas are a dietary staple. By investing in research and development, Korea can contribute to creating more robust cowpea varieties that are suitable not only for local cultivation but also for export to regions with less developed agricultural infrastructures. This paper aims to explore the current state of cowpea cultivation and breeding in Korea and provide discussions on the challenges and opportunities in expanding cowpea production in Korea.

2. Nutrition and Consumption of Cowpeas in Korea

Cowpeas have multipurpose benefits (Figure 2), with the seeds and their products being a rich source of protein, carbohydrates, and lipids [14]. It also contains significant amounts of calcium, phosphorus, iron, potassium, and vitamins (Figure 3) [3]. Cowpea seeds contain a significant amount of phytochemical compounds, including phenols and flavonoids, indicating the functional properties of the crop [15–17]. The starch in cowpeas has excellent physical properties and texture, making it widely used in various traditional foods [18]. In their study, Kim et al. [19] noted higher content of total starch, a median diameter, relative crystallinity, gelatinization temperature, and pasting temperature in cowpea, suggesting that cowpeas may have superior functional properties for food applications in industrial processes compared to some other legumes. In Korea, cowpeas are consumed as a dietary supplement [16,20] in various forms, such as mixed with cereal grains, mashed bean paste, Mosi Songpyeon (traditional rice cakes), and starch gels [18,19], with the young pods often used as snack. In Korea, there are a number of specialty products using cowpeas as an ingredient, such as the Yeonggwang rice cake, which is known to generate annual sales of about KRW 30 billion [16]. Though, cowpeas make up around 23% of the ingredients, there is high reliance on imports, hence the need for strategies to boost domestic cowpea production.

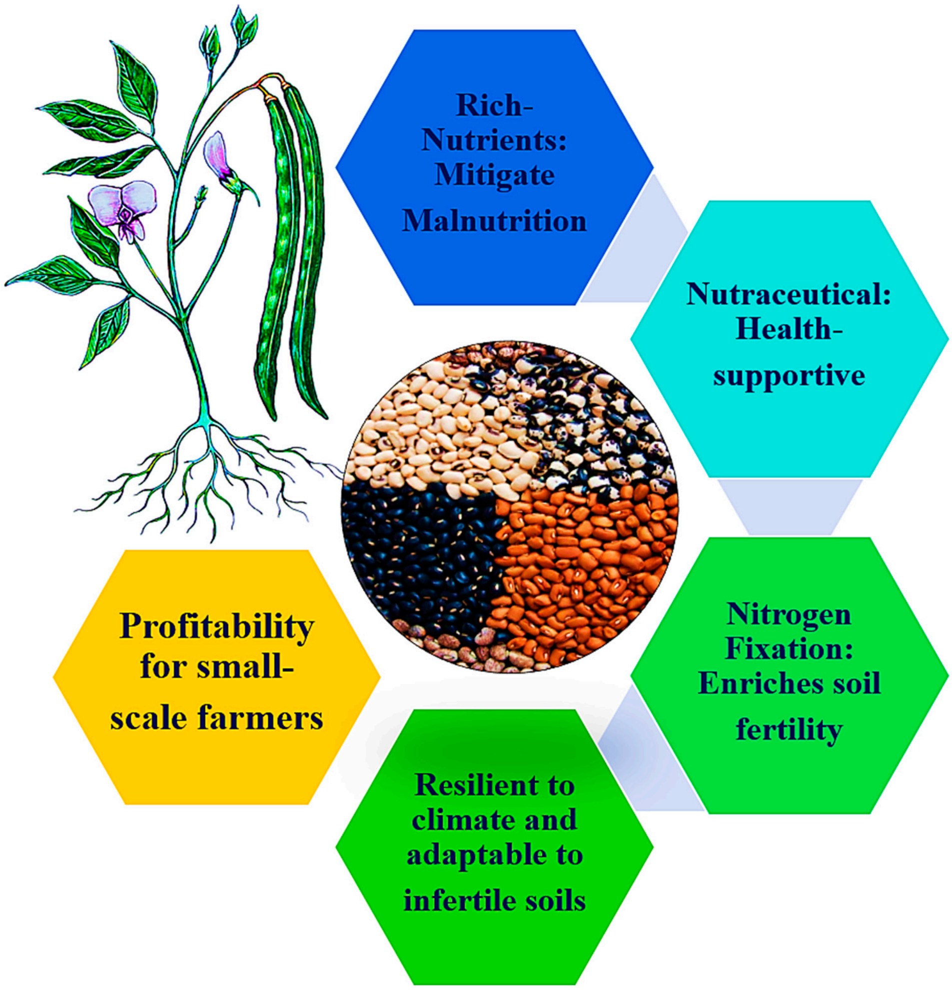

Figure 2. Multipurpose uses of cowpea.

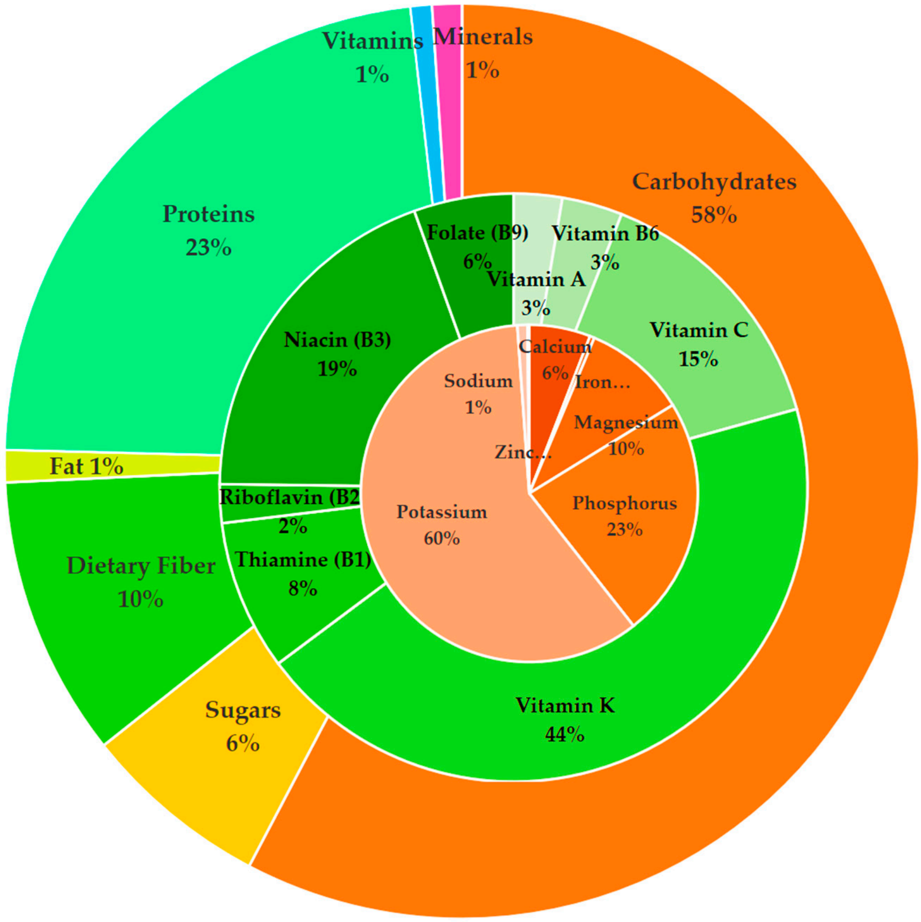

Figure 3. Nutritional importance of cowpea.

3. The State of Cowpea Cultivation, Constraints, and Breeding in Korea

Though the cowpea is native to Africa, in the Republic of Korea, it was first introduced from China between the 9th and 14th centuries [8]. As a crop native to tropical regions, cowpeas exhibit sensitivity to low temperatures so time of sowing is key in order to reduce the incidence of disease. For specific varieties such as 'Okdang' and 'Seonhyeon' sowing in mid-to-late July has been recommended to achieve optimal growth and yield [15]. Despite its high nutritional value, cowpea cultivation in Korea is limited, and the country relies on imports for its consumption. The majority of cowpea resources cultivated by farmers in Korea are indeterminate types [17]. These types have stems that can reach 2–3 m in length and require support structures, such as trellises, for cultivation. The indeterminate, vining types require trellises, and these have been reported as limiting the economic feasibility of cowpea cultivation [15]. The authors have also stressed that because the indeterminate cowpea types exhibit irregular and non-uniform flowering time, harvesting must be performed by hand, leading to lower productivity compared to other leguminous crops [15]. As a result, cowpeas are not typically grown for seed production, and most of the seeds used in Korea are imported. Apart from these factors, the continuous decline and aging nature of the rural workforce place is a constraint to commercial cultivation since multiple harvest times and manual harvesting are required and considered more laborious [17]. To ease the labor-intensive harvesting nature of indeterminate cultivars, there is a need for the adoption and development of qualified determinate cultivars and/or varieties that can be machine harvested or combined. Korea's climatic conditions during the flowering period are usually characterized by high rainfall and low solar radiation, which adversely affect pod setting. These conditions necessitate the development of cowpea cultivars capable of successful flowering and pod setting under low-light and high-moisture environments. To address this, breeding programs are focusing on selecting semi-determinate or determinate lines suitable for mechanized harvesting. Notable selections include IT145379, IT154153, IT208081, and IT121926, with breeding lines such as JC1701-5-1-2-2, JC1801-1-1-1-2, and JC1904-34-1-4-2 being developed.

4. Cowpea Breeding in the Republic of Korea

Unlike in regions where the cowpea is a staple crop, it remains a minor crop in Korea, primarily used as a nutritional supplement in diets rather than a major agricultural product [20]. As a result, research and breeding efforts for cowpeas are limited. To date, only just a few cowpea varieties have been developed in Korea [20], reflecting the relatively modest scope of breeding programs compared to those for more prominent crops, like rice and soybean. The limited advancement in cowpea breeding programs means that there is a significant gap in genetic resources and research capacity for cowpeas in Korea. Nonetheless, this gap presents an opportunity to tap into the available cowpea genetic diversity and contribute to global breeding efforts. By utilizing available genetic resources, new cowpea varieties can be developed that are better suited to the Korean climate and farming systems. Okhyun, Jang-alchan, Okdang, and Seonhyeon are four known cowpea varieties developed by the Jeollanamdo Agricultural Research and Extension Services (JARES) in Korea, with desirable agronomic characteristics (Table 1). Okhyun and Jang-alchan are the most recently developed cultivars, amenable to combine harvesting [21,22]. Kim et al. [23] introduced the cultivar 'Okdang', which is characterized by its intermediate plant habit and erect growth type, making it suitable for combined harvesting, thereby facilitating. The variety was developed using the pure line selection methods, involving the cowpea foundation stock IT145384 (IT83D-442), obtained from the National Agrobiodiversity Center. Details of the agronomic characteristics of 'Okdang" are shown in Table 1. Another cultivar, 'Seonhyeon', was described by Kim et al. [15] for its distinct plant and seed morphology, offering an improved adaptability of the crop to different growing conditions. This variety was developed using an artificial crossing of two cowpea lines, IT145737 and IT101362. The two cowpea lines differ by their seed coat colors, with IT145737 having gray seeds and IT101362 producing black seeds. Seonhyeon has a superior yield performance compared to 'Okdang'. Future breeding efforts are likely to focus on improving traits such as pest resistance, drought tolerance, and yield potential in order to enhance crop diversity and agricultural sustainability.

Table 1. Some popular cowpea varieties developed in Korea.

Variety	Year	Institution	Breeding	Agronomic Characteristics	Reference
Okhyun	2022	Jeollanamdo Agricultural Research and Extension Services (JARES)	IT145379 × IT208081	Erect plant with an intermediate plant habit, heart-shaped leaflets, light purple-colored corolla, straight black brown mature pods, green cotyledons, black seed coat, 100-seed weight of ~12.9 g, average yield of 1.97 ton/ha	[21]
Jang-alchan	2019	Jeollanamdo Agricultural Research and Extension Services (JARES)	IT145373 × IT145391	Erect plant with an intermediate plant habit, heart-shaped leaflets, light purple-colored corolla, orange-yellow seed seed coat of faint luster, brown and straight matured pods, 100-seed weight was 14.1 g, average yield of 1.85 ton/ha	[22]

Table 1. *Cont.*

Variety	Year	Institution	Breeding	Agronomic Characteristics	Reference
Seonhyeon	2017	Jeollanamdo Agricultural Research and Extension Services (JARES)	IT145373 × IT101362	Erect plant with an intermediate plant growth habit, green hypocotyls, light purple-colored corolla, heart-shaped leaflets, brown and slightly curved mature pods, black seed coat color, elliptical seeds shape, disease resistant, prone to waterlogging damage, average yield of 2.26 ton/h	[15]
Okdang	2013	Jeollanamdo Agricultural Research and Extension Services (JARES)	Pure line selection from IT45384 foundation stock	Erect plant type and intermediate plant habit, short growing period, fewer tendrils, green hypocotyls, heart leaflet, purple flowers, orange-yellow seed coat with weak luster, elliptical seed shape, and brown and slightly curved mature pods, medium seed density, 100-seed weight of ~16.6 g, high lodging resistance, susceptible to waterlogging, average yield of 1.85 ton/ha.	[15,23]

5. Cowpea Germplasm Collection, Conservation, and Evaluation Efforts in Korea

The collection and conservation of crop genetic resources are vital components of efforts to preserve the genetic diversity of the crop species and to support breeding programs [24]. These initiatives are crucial for sustaining food security and improving agricultural resilience, particularly in the face of climate change and evolving environmental challenges. In the Republic of Korea, efforts have been made to preserve the genetic diversity of gathered cowpea germplasm in order to capture a broad range of phenotypic and genotypic variability in the crop. This effort forms an integral component of promoting the cultivation and breeding of the crop. The Rural Development Administration (RDA) institutes, particularly the National Agrobiodiversity Center- Genebank, located in Jeonju, play essential roles in the collection and conservation of broad-diversity genetic resources (Figure 4), including cowpeas [25,26]. Currently, the institute holds over 700 cowpea accessions that are useful for research [20]. These collections include landraces, wild relatives, and improved varieties that are maintained in the national seed bank. As cowpea cultivation expands in the Republic of Korea, maintaining and utilizing the crop's diversity will be crucial for ensuring sustainable production and meeting growing demands. Genetic diversity allows for the selection of desirable traits, such as early maturation, drought tolerance, and resistance to diseases like powdery mildew and cowpea aphid-borne mosaic virus and is critical for breeding new varieties [20]. For instance, researchers routinely assess the germplasm to identify traits that could improve the resilience of the crop to local stresses. Yoon et al. [27] used advanced molecular markers, including simple sequence repeats (SSRs) and amplified fragment length polymorphism (AFLP) to evaluate the genetic diversity of 52 Korean cowpea accessions. In another study, SSR markers were used to assess genetic variation present in 492 landrace accessions [8]. The continued collection and characterization of genetic resources, along with the application of advanced molecular techniques, will be necessary to expand the germplasm pool and support future breeding programs aimed at developing high-performing cowpea varieties tailored to the Korean agricultural climate.

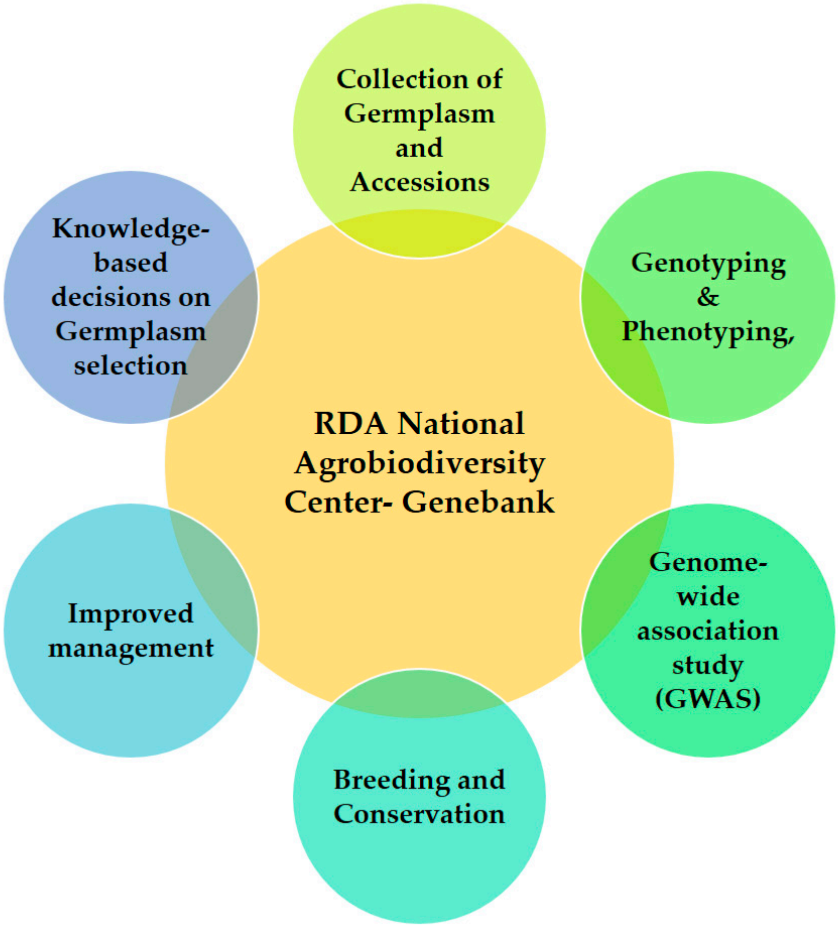

Figure 4. Current role of RDA National Agrobiodiversity Center Genebank.

6. Research Advances of Cowpeas in the Republic of Korea

Over the years, cowpea research in Korea has seen some significant advancements, focusing on areas such as genetic diversity, cultivar development, agronomic characteristics, and improving the quality and yield potential of the crop (Figure 5 and Table 2). These research efforts have provided a significant basis for promoting the cultivation and breeding of cowpeas in the country. A notable advancement in cowpea research in Korea is the exploration of genetic diversity within the local germplasm. Seo et al. [20] investigated the population structure and genetic diversity in Korean cowpeas using single-nucleotide polymorphism (SNP) markers. Their study revealed substantial genetic variation among the cowpea lines, which provide a valuable foundation for future breeding programs, targeting enhancing the resilience and productivity of the crop. Additionally, Lee et al. [8] examined the genetic diversity of cowpea landraces using simple sequence repeat (SSR) markers, further highlighting the genetic variability present in Korean cowpea germplasm and establishing a core collection for future breeding. Breeding programs in Korea have led to the development of a number of high-performing cowpea cultivars (Table 1). These cultivars are part of ongoing efforts to breed varieties that meet the demands of Korean farmers in terms of yield, disease resistance, and ease of cultivation. In terms of agronomy, cowpea research in Korea has targeted optimizing cultivation practices to enhance yield and quality. Kim et al. [17] explored the effects of sowing date and planting density on the growth of intermediate-erect cowpea types. They found that proper sowing and planting density significantly improved the crop's labor-saving cultivation potential. Furthermore, studies on the physicochemical characteristics of cowpea, such as starch properties and nutritional content, were conducted to evaluate the quality of cowpea cultivars grown in Korea. Kim et al. [19] reported differences in starch characteristics between cowpeas and mung bean cultivars, providing insights for food processing and utilization. Overall, cowpea research in Korea has made significant strides, which is a prerequisite for the development of cultivars better suited to Korean environmental conditions. Continued research will likely further improve the contribution of the crop in Korean agriculture, promoting food security and sustainable farming practices.

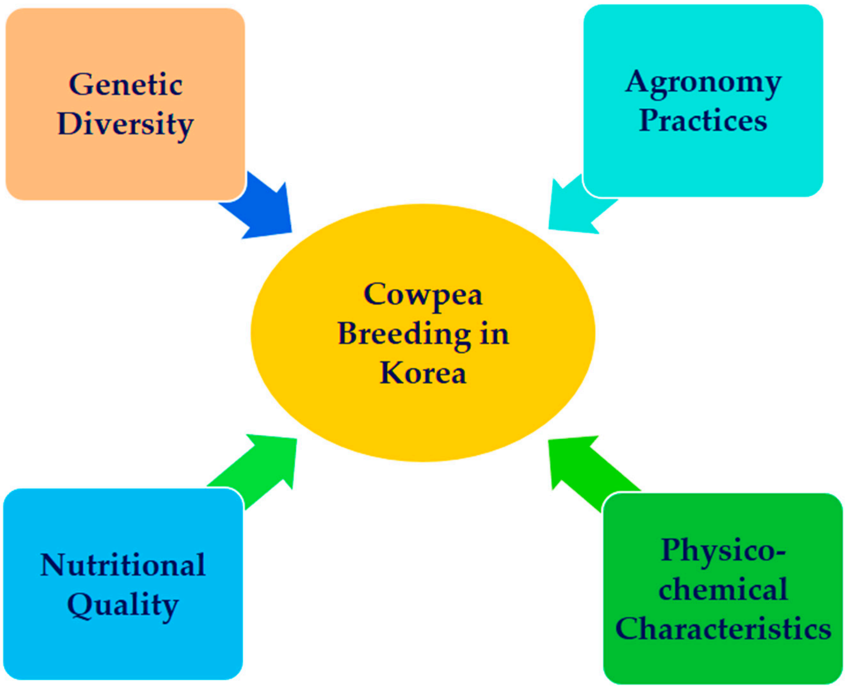

Figure 5. Aspects of cowpea breeding in Korea.

Table 2. Advances in cowpea research in the Republic of Korea.

Research Area	Description	Reference
Genetic Diversity	Genetic diversity study of Korean cowpea germplasm based on single-nucleotide polymorphisms (SNP) markers.	[20]
	Genetic diversity analysis of Korean cowpea landraces, using simple sequence repeat markers and establishment of a core collection.	[8]
Genetics and Cultivar Development	Development of new cowpea cultivar 'Okhyun' with green cotyledons and a black seed coat and amenability to combine harvesting.	[21]
	Radio sensitivity of cowpea plants after gamma-ray and proton-beam irradiation shows the optimal dose of gamma-rays and proton-beams in cowpea ranges between 200–300 Gy.	[28]
	Transcriptome analysis of cowpeas in response to two different ionizing radiations revealed the mechanism for gene regulation in response to two ionizing radiations.	[29]
	Development of the 'Seonhyeon' cowpea cultivar with distinct plant and seed morphology.	[15]
	Introduction of the 'Okdang' cultivar with intermediate plant habit, erect growth type, and amenability to combine harvesting.	[23]
	Determination of the combining ability, the gene action, and the relationships between cowpea parents and their F2 hybrids showed that for most traits, mean square value of general combining ability (GCA) seems more important than those of specific combining ability (SCA).	[30]

Table 2. *Cont.*

Research Area	Description	Reference
Agronomy and Agronomic Practices	Proper sowing date and planting density significantly improves yield and labor-saving potential.	[31]
	Effects of sowing date on agronomic characteristics of intermediate-erect type cowpeas grown in plastic greenhouse showed that seed yields were highest for sowing in middle-April.	[17]
	Agronomic characteristics and seed quality of cowpea germplasm under various environmental conditions revealed that the accessions were classified into indeterminate type (72.7%), intermediate type (25.7%), and determinate type (1.6%) growth, with significant variability observed in seed coat color.	[12]
	Comparison of weed occurrence and growth of some leguminous plants for green manure cover crop during summer fallow shows that cowpeas most effectively suppressed weed growth.	[32]
	Variations of morphological traits, yield, and yield components on different seeding dates of cowpeas showed poor bloom in late sowing after August.	[33]
	Study of the role of cowpeas in corn–legume intercropping systems for improved growth and yield showed that at the ripe stage yields were higher under intercropping (18.1 t) than under monocropping (16.6 t).	[34,35]
	Studies on corn–cowpea intercropping system revealed increased protein yield without decreasing dry matter yield in comparison with corn monocropping system.	[35]
Nutrition, Quality, and Physicochemical Characteristics	Physical, textural, and sensory characteristics of legume-based gluten-free muffin enriched with waxy rice flour revealed that the overall acceptance of muffin containing Okdang cultivar of cowpeas was the highest among legume-based muffins.	[36]
	A study on differences in starch characteristics between cowpea and mungbean cultivars grown in Korea showed that cowpea starches had higher median diameter, relative crystallinity, gelatinization temperature, and pasting temperature but lower amylose leaching than mungbean starches.	[19]
	Effects of germination and roasting on the quality and physicochemical properties of cowpea flour.	[37]
	Quality and physicochemical characteristics of the Korean cowpea cultivars grown in different seeding periods	[16]
	Anti-inflammatory effects of black-eyed cultivar of cowpea seed extracts and its bioactive compounds	[38]
	Analysis of anthocyanins in Korean cowpea germplasm, relevant for nutritional and functional food uses.	[39]
	Determination of the effects of soybean oil and chitosan on the quality characteristics of Omija Jelly made of various starches (mungbean starch, cowpea starch, and corn starch).	[18]
	Determination of the changes in development and nutrient composition of cowpea pod after flowering	[40]

7. Potential Priority Traits for New Variety Development in the Republic of Korea

7.1. Yield Improvement

Yield is a critical agronomic trait, and for most field crops, such as cowpea, grain yield is the most important [41]. The development of cowpea varieties in the Republic of Korea will intuitively target high seed and pod yield. Key traits influencing yield include the number of pods per plant, number of seeds per pod, and seed weight [42]. Varieties that produce larger seeds or more seeds per pod are particularly valued for their higher market and nutritional value. Flowering time and maturity are also critical traits to consider for cowpea breeding due to their direct impact on crop adaptability and productivity in varying climates. Cowpea varieties with significant variability in flowering time and days to maturity allow farmers to implement more flexible cropping systems, adapting to different growing seasons and environmental conditions. Early-maturing varieties in particular are beneficial, as they can be harvested before the onset of harsh weather conditions or periods of low rainfall, thereby improving yield reliability and minimizing the risk of crop failure [43,44].

7.2. Drought Tolerance

Amid the ongoing impacts of climate change, drought or water scarcity is one of the most major threats to crop yield and productivity [24]. Drought severely reduces the growth and leads to considerable yield losses in agriculture. Addressing drought through the development of drought-tolerant crop varieties is essential for sustaining food production in vulnerable regions. Though the cowpea is considered tolerant to drought, extreme conditions can have pronounced impacts on yield. Terminal and intermittent drought stress significantly affect cowpea growth and consequently reduce yield. Korea has regions that experience sporadic rainfall and water stress, making drought tolerance an essential trait for cowpea varieties. The development of drought-tolerant cowpea varieties may target important traits such as deep root systems, efficient water use, early maturation, and enhanced stomatal control, especially when using molecular-assisted approaches [45]. These traits enable cowpea plants to access water in deeper soil layers during drought conditions. Efficient water use helps the plants maintain physiological processes under limited water availability [46]. Early maturation allows cowpea varieties to complete their life cycle before severe droughts occur [47]. Enhanced stomatal control helps reduce water loss through transpiration, improving the plant's ability to survive in dry environments. Together, these traits contribute to improved drought resilience and stable yields under challenging conditions.

7.3. Pest and Disease Resistance

The cowpea is susceptible to several pests and disease resistance, including aphids, thrips, and fungal infections like powdery mildew [48]. Korean breeding programs may potentially target breeding varieties with enhanced pests and disease resistance, using both traditional and molecular breeding approaches. The use of a marker-assisted selection strategy will allow for a more efficient introduction of resistance genes into elite varieties [49,50]. The potential breeding of cowpeas for resistance to pests and diseases may focus on enhancing genetic traits that improve plant defense mechanisms. Breeding efforts may target resistance to major pests such as aphids, pod borers, and weevils, which can cause significant yield losses. Disease resistance traits, particularly for fungal, bacterial, and viral pathogens like rust, anthracnose, and cowpea mosaic virus, are crucial to ensuring healthy crop development. The integration of these resistance traits through traditional breeding or molecular techniques can reduce the need for chemical pesticides, contributing to more sustainable farming practices.

7.4. Nitrogen Fixation and Soil Improvement

The cowpea is a nitrogen-fixing crop, making it an excellent crop for improving soil fertility. Field studies have shown that cowpeas contribute significant amounts of nitrogen to the soil, enhancing the productivity of subsequent crops like sorghum, corn, cotton, rice, and wheat [51]. Thus, cowpea breeding in the Republic of Korea may also target developing super-nodulating varieties, which enhance greater soil fertility for succeeding crops, especially cereals. This will not only boost crop yields but also reduce dependence on synthetic fertilizers and contribute to more sustainable agricultural practices.

7.5. Adaptation to Mechanical Harvesting

Breeding new cowpea varieties for adaptation to mechanical harvesting may be a priority in Korea in order to reduce labor costs and ensure more efficient farming practices.

Mechanical harvesting requires plants with uniform maturity, upright growth habits, and stronger stems to withstand mechanical equipment without damage [15]. Developing cowpea varieties specifically suited for mechanization can significantly reduce labor input, improve harvesting speed, and lower production costs. Additionally, uniform pod set and maturation are essential for synchronized harvesting, which can enhance overall yield and marketability. As the Korean agriculture continues to modernize, breeding cowpea varieties that align with mechanized systems will support sustainable farming and will reduce reliance on imports. The Okhyun, Jang-alchan, and Okdang varieties have been developed by the JARES in Korea and are suitable for combine harvesting, unlike traditional varieties that require manual harvesting in multiple times [21,22,37]. More improved cowpea varieties are needed to be developed and must additionally exhibit desirable traits such as increased yield, enhanced adaptability to diverse environmental conditions, and resilience against pests, diseases, and climate stressors. These advancements will help increase productivity, reduce labor requirements, and promote large-scale cowpea farming.

7.6. Seed Quality and Nutritional Value

7.6.1. Seed Size and Color

Developing cowpea varieties with uniform seed size and appealing seed coat color will increase the commercial value of the crop and expand its adoption in diverse markets. Cowpea seeds exhibit considerable diversity in size, shape, and color, influencing both consumer preferences and marketability [52–54]. Larger seeds are often associated with higher yields and generally preferred for consumption, as they are easier to process and cook [55]. Cowpea seed coat color are diverse, including white, black, brown, red, cream, purple, and green, depending on the variety [56]. White or cream-colored seeds are often favored, as they are fast-cooking [57], though different seed colors may be selected for specific markets or specific culinary purposes. Breeding the cowpea for improved seed size and color can enhance its marketability and consumer preference in the Republic of Korea. Seed color can be targeted to meet specific cultural preferences or market demands. Given that the cowpea is often processed rather than consumed as a whole grain, there is a pressing need for cultivars with enhanced processing qualities. Generally, desirable traits include thin seed coats for improved dehulling efficiency, larger seed size to reduce the seed coat-to-cotyledon ratio, and superior starch properties.

7.6.2. Nutritional Composition and Anti-Nutritional Factors

In recent years, there is an increasing interest in the consumption of plant-based diets; thus, nutritionally superior cowpea varieties could play an essential role in promoting sustainable, health-conscious eating. Already, the cowpea is an excellent source of plant-based protein, vitamins, and minerals (Figure 6), which makes it a revered staple for diets lacking in animal protein. Breeding cowpeas for enhanced nutritional composition in Korea holds significant potential not only for improving food security but also for promoting health [9,58]. By targeting traits that increase the protein content, essential amino acids, and micronutrients like iron and zinc, cowpea breeding programs in Korea may target developing more nutritious varieties tailored to the needs of the population. Despite the rich nutritional benefits, cowpeas contain anti-nutritional factors, such as tannins, phytic acid, and trypsin inhibitors, which can reduce the bioavailability of certain nutrients [59]. Improving fiber content and lowering anti-nutritional factors like phytic acid would enhance the bioavailability and digestibility of nutrients [60,61]. Such improvement goals would align with the global effort toward promoting the consumption of more nutritious and healthier diets.

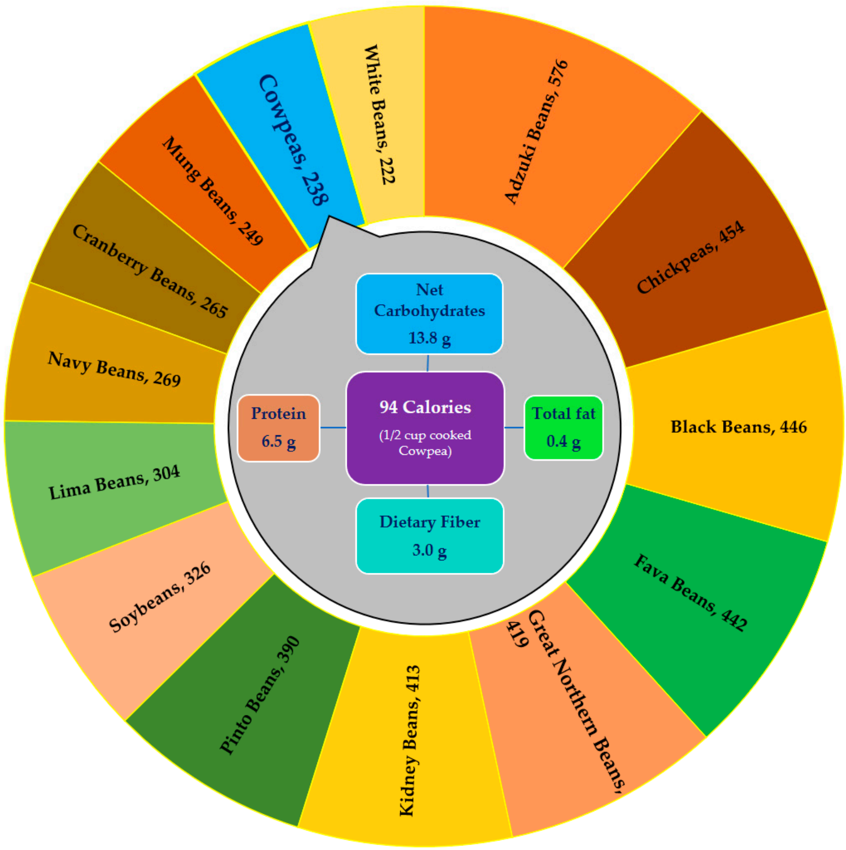

Figure 6. The Nutrivore score of the cowpea among the beans exhibits qualities of a medium nutrient-dense food with excellent health benefits.

7.6.3. Functional Properties

In addition to its high nutritional value, cowpea seeds possess several functional properties that make them valuable in food processing [62,63]. Water absorption capacity, swelling index, and emulsion stability are some of the key functional traits that determine the suitability of cowpeas for use in various processed food products [64,65]. Research is needed in evaluating Korean cowpea germplasm for their functional properties such as gelation and thickening properties and further developing new varieties suitable for use in traditional dishes, such as fermented foods that are popularly associated with bean paste or doenjang [66].

7.6.4. Conclusion and Future Perspectives

The cultivation and breeding of cowpeas in the Republic of Korea have seen significant progress over the years. Historically, the cowpea is an underutilized crop in the Republic of Korea, where it is mainly cultivated on a small-scale for snacks or as a traditional food supplement. In recent years, the increasing demand for sustainable agriculture and crop diversification appear to stimulate interest in its research and breeding towards promoting the large-scale production of the crop. Significant research efforts have particularly considered the variety improvement of the crop, particularly in enhancing traits like yield, disease resistance, lodging resistance, and earlier maturity. The development of 'Seowon' and 'Okdang' varieties that have improved growth habits and easier cultivation processes represents a noteworthy advancement. Despite these improvements, there is currently much reliance on imports for most of the domestic consumption of cowpeas since local production has not yet attained commercial viability. The current trouble associated with the amenability of available cowpea genetic resources to large-scale mechanized harvesting coupled with the aging farming population represents a limitation in efforts to increase production in the country. Generally, the limited research available on cowpea varieties suitable for different purposes such as food processing and high-stress resilience suggest that further breeding and agronomic research is needed. Looking ahead, the future of cowpea cultivation in Korea will depend on research efforts, particularly the development of new varieties that are more suitable for mechanized farming and that are well adapted to local conditions. Additionally, efforts to promote cowpeas as a viable crop for both food security and environmental sustainability could play major roles in enhancing its wider adoption. Increased collaboration between agricultural research institutions, government support, and local farmers will be crucial for ensuring the success of these initiatives. Overall, significant progress has been achieved in cowpea research in Korea, the future of cultivation and breeding holds promising potential, in particular the potential application of agricultural innovations, technology, and strategic support. Advancements in these breeding efforts are anticipated to bolster domestic cowpea production, reduce reliance on imports, and contribute to the growth of traditional food industries in Korea.

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