Soybean Breeders Deliberate Strategies for Improving Productivity

*******The breeders from USA, Brazil and across Africa, including scientists from CGIAR met at Makerere University on 28th November-1st December 2023 to share experiences, best practices and ideas on collaboration, and to brainstorm on ways of improving productivity.

Overview

Soybean (Glycine max) serves as one of the most valuable crops in the world, not only as an oil seed crop and feed for livestock and aquaculture, but also as a good and cheap source of protein for the human diet and as a biofuel feedstock. The protein content of soybean is the highest among legume crops, averaging 40% on a dry matter basis. Soy-foods are generally considered to be nutritious and healthy based on their nutrient composition which includes protein, fat, carbohydrates, dietary fibres as well as minerals and phytoestrogens (or isoflavones). Due to its nutritional superiority, soybean-based foods are highly recommended for children under 5 years, expectant mothers, and HIV/AIDS patients. Impact studies have shown that regular soy food consumption can reduce the risk of heart disease by lowering serum cholesterol by about 33%. It can also reduce the risk of rectal cancer by 80%, mammary tumour by 40%, and breast cancer by 50%.

Economic viability

Production of soybean stands at 264 million MT worldwide, with United States of America (USA), Brazil and Argentina being the largest producers. In Africa, Nigeria, South Africa, Zambia and Uganda are the largest producers, with annual volumes estimated at 1.5 million metric tonnes (FAO, 2017). The Soybean Market size is estimated to reach $259 billion by 2030 (IndustryARC – Soybean Market Forecast 2023-2028).

The economic viability of soy production is determined by the commercial utilization of both its sub-products, meal and oil, which, respectively, account for about two thirds and one third of the crop's economic value. Soymeal accounts for over 60% of world output of vegetable and animal meals and occupies a prominent position among protein feedstuffs used in the production of feed concentrates, while soybean oil is the single most important vegetable oil, accounting for 20% of global vegetable oil production. The widespread use of soybean oil in particular as edible oil is mainly due to (i) its plentiful and dependable supplies, (ii) its competitive price, (iii) its neutral flavour, and its stability in both unhydrogenated and partially hydrogenated form. Indirectly, the rapid rise in the demand for compound feed has contributed considerably to the rise in soybean and soyoil production. Soybean contributes significantly to the total value added by the

agricultural sector in the major producing countries and particularly so in Brazil, Argentina, Paraguay and the USA. In these countries, soybean and its two main sub-products also occupy an important position in export earnings from agriculture as well as in terms of total merchandise exports (FAO). In Uganda, soybean is number one income earner crop in Northern and Eastern Uganda. Farmers in the region earn at least UGX1,200,000 per hectare per season.

Challenges undermining productivity

Despite the significant strides registered by soybean growing countries, and the health and economic benefits that the crop presents, a number of challenges still undermine productivity. These include; pests and diseases, prolonged droughts and prolonged rains, poor agronomic practices, inaccessibility to good seed by farmers, drudgery in the production chain (Planting and harvesting) and market price fluctuations, as well as mismatches in supply and demand. Surging input costs, supply disruptions of fertilizers and alternative crops caused by Russia's invasion of Ukraine and lingering COVID-19 effects have added more uncertainty and volatility to the soybeans market, driving up the prices. Home grown technologies, local seed business approach, and addressing the whole value chain, are envisaged as some of the strategies to overcome the challenges. Adapting crop management, conserving and improving soil conditions by minimizing tilling, increasing crop diversification, protecting soil from erosion, as well as the development of drought-tolerant varieties, will be key to withstand the emerging climate challenges.

Soybean Breeders meeting at Makerere

Soybean breeders from USA, Brazil, and across Africa including scientists from CGIAR on 28th November 2023 met at Makerere University to share experiences, best practices, and ideas on collaboration, and to brainstorm on ways of improving soybean productivity. The meeting held at the School of Agricultural Sciences (SAS), College of Agricultural and Environmental Sciences (CAES) was organized by the Makerere University Centre for Soybean Improvement and Development (MAKCSID) and the Soybean Innovation Lab (SIL) of the University of Illinois with support from USAID. It was coordinated by Prof. Phinehas Tukamuhabwa, Principal Investigator for the Soybean Breeding and Seed Systems at Makerere, and Prof. Brian Diers from SIL, University of Illinois. It was graced by the Principal of CAES, Prof. Gorettie Nabanoga, the Deputy Principal, Prof. Yazidhi Bamutaze, and the Dean, SAS, Dr John Baptist Tumuhairwe. During the meeting, participants shared progress reports of their respective institutions, highlighting the achievements registered in soybean breeding and seed systems, best practices, challenges undermining productivity, and strategies for improvement. In his presentation, Prof. Diers briefed participants on SIL breeding efforts, indicating that 20 varieties had been developed between 2019-2022 up from

the 7 developed between 2013-2018. He also shared updates on the renewed funding from USAID, and the support extended towards new breeding programmes at IITA in Nigeria, IITA in Zambia, EIAR in Ethiopia, Makerere University, and SARI in Ghana.

Delivering a presentation on soybean research in Uganda, Prof. Tukamuhabwa noted that the country had registered significant strides with the production of six high yielding varieties namely; Maksoy IN, Maksoy 2N, Maksoy 3N, Maksoy 4N; Maksoy 5N, Maksoy 6N. Recent impact studies indicated that the new varieties developed by MAKCSID were the most planted and accounted for 93% of the soybean varieties grown by Ugandan farmers. Currently, Maksoy 1N is the most widely adopted variety by farmers, while Maksoy 3N has the largest quantities of foundation seed disseminated by the Centre. According to Prof. Tukamuhabwa, the Centre also established a state-of-the-art seed storage facility for early generation seed (Breeders and Foundation seed) and soybean germplasm used for breeding other varieties. Other facilities are soybean processing equipment (soycow) and Soybean roaster that are used to add value to soybeans. The growth of the soybean sub-sector in Uganda is mainly attributed to the availability of a wide range of improved varieties, government investment in soybean research, and increased private sector investment along the soybean value chain. Despite the achievements, Prof. Tukamuhabwa outlined a number of factors undermining soybean seed systems in Uganda including; the presumed high cost of seed by farmers, counterfeit seed in the market, limited interest in self-pollinating crops by most private seed companies, weak seed policy enforcement, limited access to seed, and unpredictable weather conditions. He expressed gratitude to all development partners that have supported the growth of the MAKCSID programme including; USAID through SIL, the Government of Uganda through the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF VODP), NARO, NAcRRI, RUFORUM, AATF, AGRA, Soybean Africa Limited, NAADS, Smart Foods, ISSD Uganda, IITA, and all local soybean stakeholders.

At the meeting, participants including Godfree Chigeza from IITA, Zambia; Abush Tesfaye (IITA, Nigeria), Masresha Yirga (EIAR, Ethiopia), Harun Murithi (SIL), Andrew Scaboo (University of Missouri), Elizabeth De Meyer (University of Missouri), and Carrie Miranda (North Dakota State University) delivered presentations on the progress of their breeding and research programmes.

A major concern arising from the meeting was the increasing threat of rust. Through efforts of the Centre for Soybean Improvement and Development (MAKCSID), the soybean rust pandemic was brought under control, through breeding and dissemination of superior varieties to the farming communities.

Going forward, participants emphasized the need to set up a rust reference centre, early warning systems, and disease nurseries – potential lines for monitoring virulence. They also called for an increase in germplasm

acquisition, capacity building for germplasm storage and utilization, introduction of bruchid tolerant genotypes, introduction of soybean genotypes suitable for mechanical harvest, mechanization of production processes, leveraging the scarce research infrastructure, and the development of necessary skills amongst scientists and staff.

In her remarks, the Principal of CAES, Prof. Gorettie Nabanoga expressed gratitude to participants for leading soybean development initiatives. She also appreciated the development partners for supporting the programme. Commenting on the significance of the crop, she said under NDPIII, soybean had been identified as a game changer and one of the crops to improve the country's food systems. "The crop has been targeted for its oils and nutritional benefits. It is therefore important that we move it to the next level in terms of resistance to diseases, adaption to climate change, and development of fast growing varieties." She specifically thanked the breeding team led by Prof. Tukamuhabwa for making Makerere the leading Centre in quality soybean seed production and distribution in the country.

During their four-day visit, the soybean breeders visited the screen houses, soybean fields, and the Early Generation Seed Unit at MUARIK where the provided enriching insights for improvement. The team also toured Nakabango/Jinja trials as well as the BugiZARDI highland soybean trials.