TROPICAL LEGUMES III

Bulletin of Tropical Legumes

11
2018

Improving chickpea production to create wider welfare impact by leveraging technology and seed system development

About the bulletin

The Bulletin of Tropical Legumes is a quarterly publication of the Tropical Legumes III (TL III) project. The project is funded by the Bill & Melinda Gates Foundation (BMGF) and jointly implemented by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), the International Center for Tropical Agriculture (CIAT) and the International Institute of Tropical Agriculture (IITA) in close collaboration with the national agricultural research systems (NARS) of target countries in sub-Saharan Africa and South Asia.

Summary

This issue of the TL III bulletin focuses on chickpea crop improvement and delivery efforts in Ethiopia, complementing inputs from various stakeholders and partners, led by the Ethiopian Institute for Agricultural Research (EIAR). Ethiopian chickpea is gaining commercial success with the aggressive promotion and marketing of high yielding kabuli varieties like Shasho, Arerti and Habru through the Tropical Legumes (TL) project. Besides the Tropical Legumes projects led by ICRISAT, various long term projects have focused on breeding and seed systems led by ICARDA as well as market systems projects led by Integrated Seed Sector Development (ISSD). Other more recent projects include the USAID-Feed the Future-funded Chickpea Innovation Lab focused on mining novel genes from wild relatives of chickpea as well as the BMGF-funded Modernization of Crop Improvement focused on enhancing breeding efficiency. N2Africa project has actively promoted the bundling of seed with biofertilizers that has contributed to further adoption. AGRA is supporting large and SME seed companies, some of which include chickpea in their portfolio, further enhancing adoption.

Introduction

Commercialization of chickpea in Ethiopia through technology adoption, supported by efficient seed systems, has emerged as an effective strategy for addressing rural poverty and food insecurity. The TL III project supported by BMGF and implemented by ICRISAT and its strategic partners in ESA and WCA, has been at the forefront of adapting and scaling up improved chickpea varieties that benefit farmers

Figure 1: Performance trials of breeding lines ICCV 96836 and ICCV 10515 in the advanced stage of crop growth at Alem Tena station.

Project: Tropical Legumes III (TL III)

This work has been undertaken as part of the CGIAR Research Program on Grain Legumes and Dryland Cereals

Investor: Bill & Melinda Gates Foundation

Partners: CIAT, ICRISAT, IITA

and value chain actors in the country. Some of the chickpea varieties like Shasho, Arerti and Habru have high potential in terms of productivity but they did not have a high adoption rate among the farmers when the TL project started in Ethiopia in 2007. Promotional efforts have resulted in a significant increase in adoption and productivity gains at the farm level. The gains have also been facilitated by an enabling policy framework supportive of legume commercialization by the government of Ethiopia through the Ministry of Agriculture and EIAR. In this brief, we have highlighted some of the achievements under the project.

Targeted improvement to address bio-challenges

Despite the enormous potential of chickpea in reducing poverty and food insecurity among smallholder farmers in Ethiopia, the productivity of this legume crop is highly constrained by both biotic and abiotic factors. Commercialization of chickpea in the country is also hampered by low productivity and inadequate grain quality. Through the TL projects, several chickpea lines and varieties have been tested and evaluated against different production and market challenges. For example, Ascochyta Blight (AB), pod borer and fusarium wilt are particularly devastating biotic stresses for desi chickpea resulting in 100% crop loss in extreme cases. Under the TL III project, two desi type chickpea breeding lines (ICCV 96836 and ICCV 10515) that were evaluated in Ethiopia have proved to be resistant to AB and have been presented for release.

During the implementation period of TL II and TL III (2007–2017), 11 improved high-yielding chickpea varieties were released in the country (Table 1).

Dhera, a kabuli variety co-developed by EIAR and ICARDA and released by EIAR in the year 2016 with the support of the TL III project, yields 17-39 q/ha on research and 13-14 q/ha on farmers' fields. This gives an advantage of about 11% over the standard check (Ejere variety) and 54% over the local check. Another factor for releasing Dhera was its suitability for mechanization and thus potential for large-scale cultivation. Dhera is currently undergoing tests for its incorporation in wheat monocropping agroecologies of the country. The tests are being conducted in partnership with GIZ Kulumsa Center and Ethiopian Seed Enterprises.

DIMTU is a desi variety that is suitable for production at high altitudes, with a yield advantage of 15% and 30% over the standard check (Minjar) and local check, respectively. HORA is a kabuli variety with a yield advantage of about 23% over the standard check (Ejere) and 70% over the local check (DZ 10-4) in high potential environments.

Breeding Program Assessment Tool

The TL II and TL III projects were designed to improve breeding efficiency and scaling up of technologies contributing to enhanced genetic gains. The national chickpea breeding program in Ethiopia has been assessed by the project using the BMGF's Breeding Program Assessment Tool (BPAT) to identify the weak links that need to be addressed. Skills for experimental/trial design, data collection and analysis plus capacity to fast-track the breeding processes were areas identified for immediate attention. Under the TL III project, Breeding Management System (BMS) training were conducted to enhance the skills of technicians and scientists in the national chickpea program. Progress towards operationalization and institutionalization

Photo: Asnake Fikre

Figure 2: The recently released chickpea variety "Dhera" suitable for mechanical harvesting, at Debre Zeit Station.

Table 1: New varieties released nationally and regionally during the project period and promoted to replace old ones.				
Breeding Lines	**Local Name**	**Type Desi/Kabuli**	**Release year**	**Description**
ICCX-910112-6	Natoli	Desi	2007	High yielding, seed quality and root rot tolerance.
Acos Dubie	Acos dubie	Kabuli	2010	Large seed size and high export market value.
ICCV 03107	Minjar	Desi	2010	Fusarium wilt and Ascochyta tolerance
ICCX-940002-F5-242p-1-1-1	Dalota	desi	2013	High yield, fusarium wilt and Ascochyta tolerance.
ICCV-00104	Teketaye	Desi	2013	High yield, fusarium wilt and Ascochyta tolerance.
ICCV-03402	Akuri	Kabuli	2011	Ascochyta blight tolerant and Seed size
FLIP-95-31C	Kassech	Kabuli	2011	Ascochyta blight tolerant, Seed size, Yield.
ICCV-01308	Kobo	Kabuli	2012	Ascochyta blight tolerant and Seed size
ICCV-10107	DIMTU	desi	2016	High yielding, suitable for production in high altitude (1800 to 2800 ab.s.l.) areas, large seed size.
FLIP 04-9C	HORA	Kabuli	2016	High yield in high potential environments.
FLIP 0163	DHERA	Kabuli	2016	High yield, tall erect growth habit suitable for mechanical harvesting.

of the BMS for routine use in crossing designs, field planning, and digital data collection is underway at EIAR . Through the project, the chickpea program at Debre Zeit Agricultural Research Center was supported to acquire a barcode printer and scanner for field labelling and tracing, and the MERCI project is currently supporting their routine use. The national program is also now able to carry out multiple generation advancements in a year. For example, the program has routinely been running 2 generations a year but is now progressing towards 3-4 generations per year shuttling between Debre Zeit and Werer research stations. Replicating these achievements in other stations will save time, increase the number of crosses in a year, increase variety replacement rate for greater genetic gains and improve overall breeding efficiency.

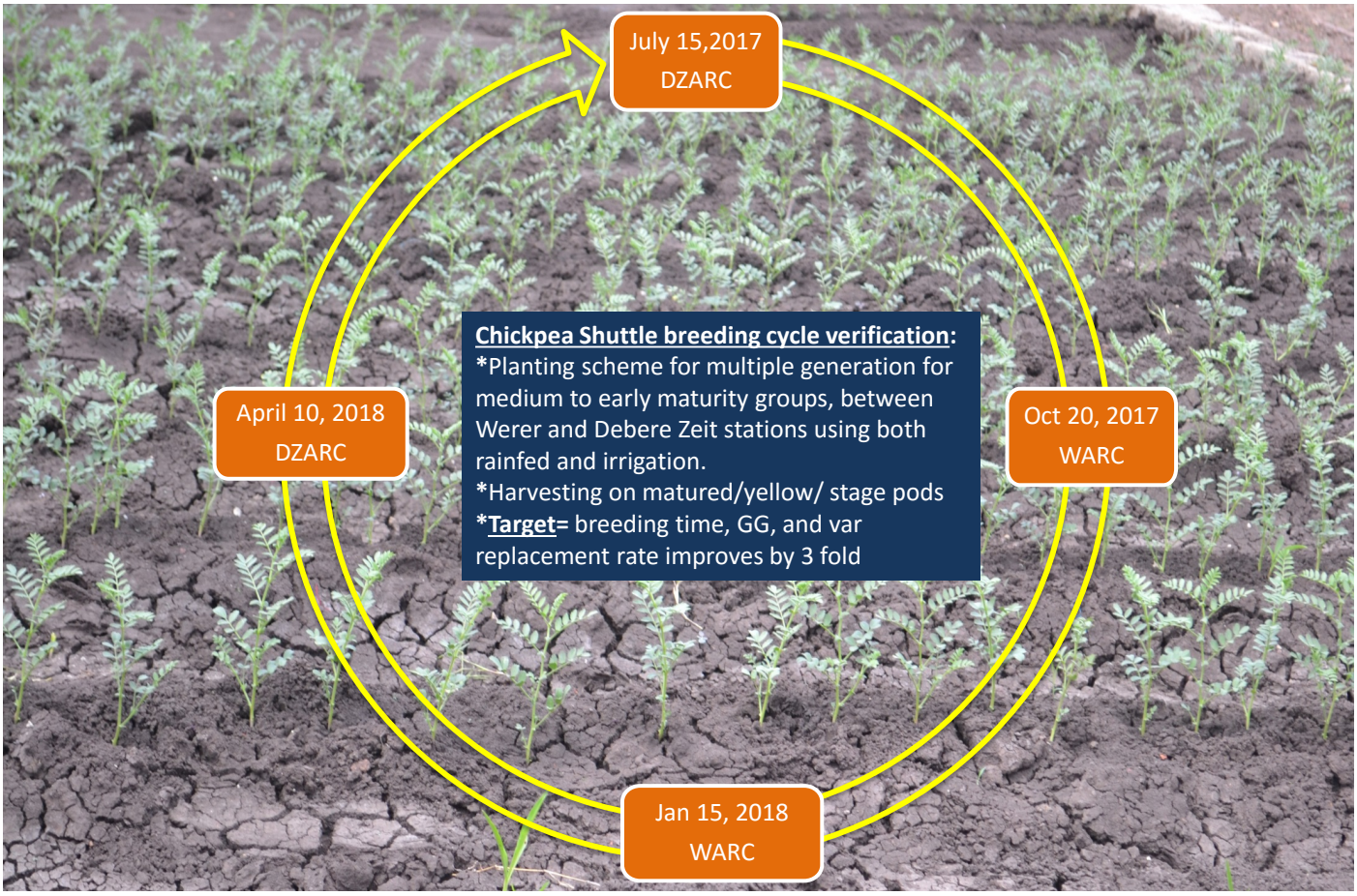


Figure 3: Pictorial representation of improving breeding efficiency by adopting multiple generations per year.

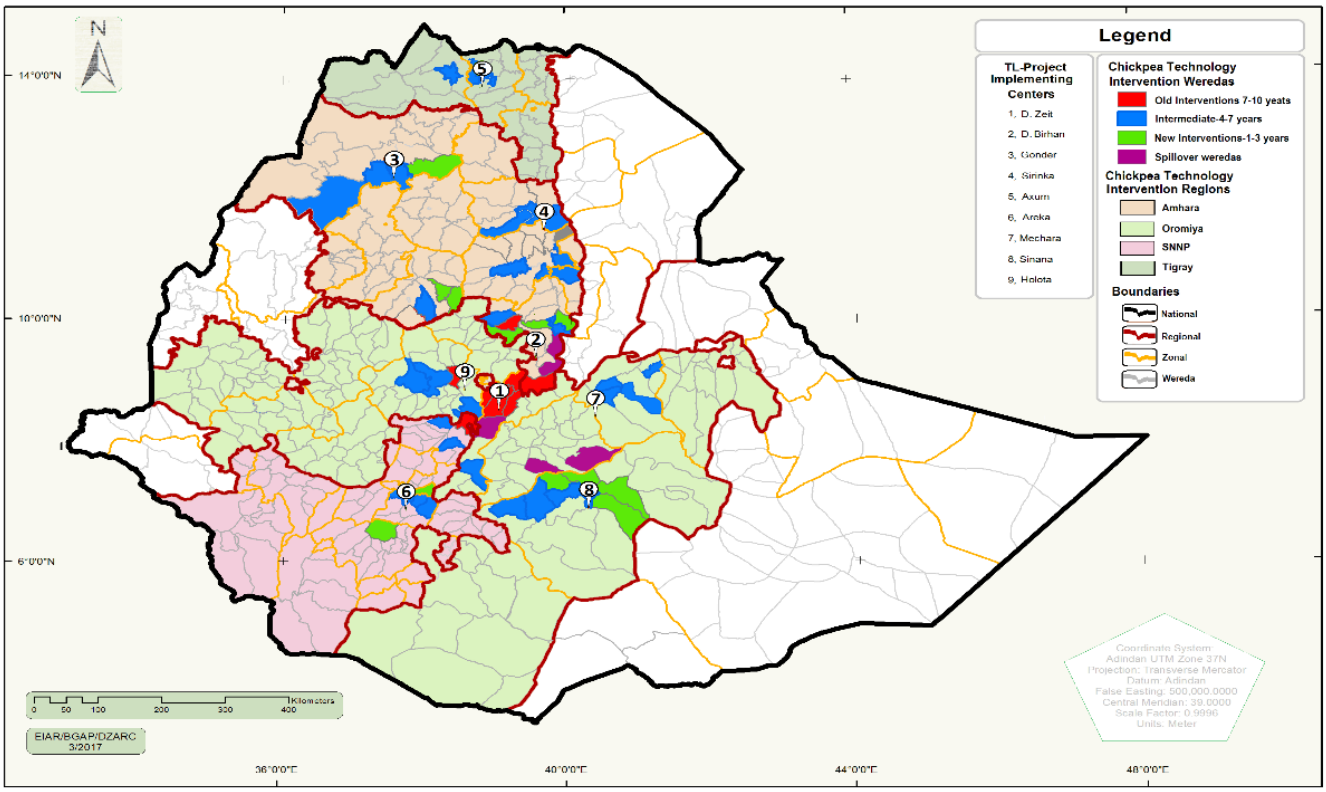


Figure 4: Chickpea intervention domains in the course of TL project phases.

Technology awareness and promotion

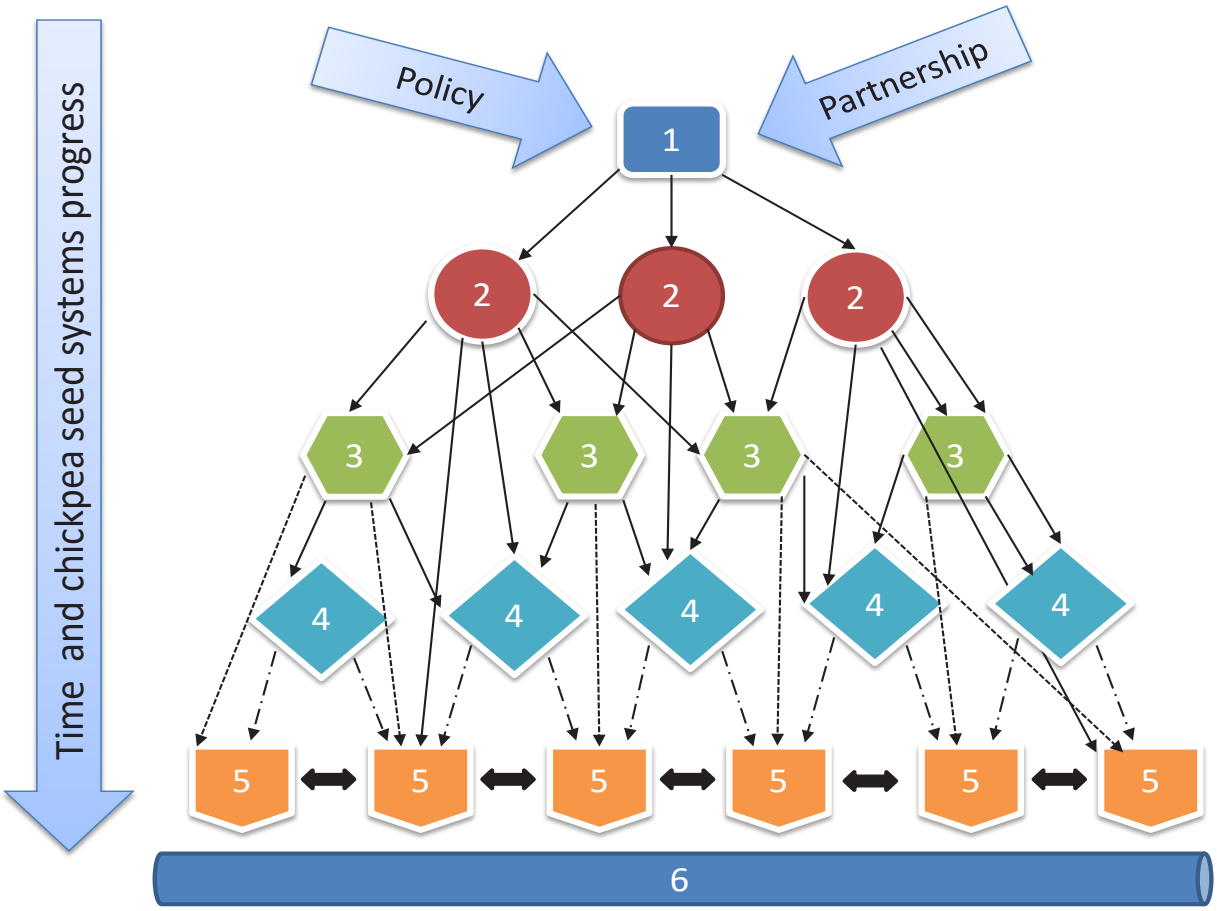
Awareness and availability of agricultural technology is critical for adoption and better welfare impacts (Shiferaw and Kebede 2008). Therefore, the best performing varieties from the evaluation exercises together with best-bet varieties that were not widely cultivated by farmers have been promoted for wider adoption during the two phases of TL projects (TL II and TL III) through awareness creation activities and revamping the seed systems. Technology awareness has been promoted through Farmer Participatory Variety Selection (FPVS). The FPVS technique evaluates and promotes the best-bet varieties in their micro ecologies and thus mediating and catalyzing variety development, promotion and adoption. To this end, a total of 140 FPVs have been conducted successfully in 32 districts (Figure 4) using a total of 14 potential varieties[1].

A total of 537 farmers (407 male and 130 female) have participated in these FPVS. Alongside FPVS, more than 900 demonstrations and 10 field days (Figure 5) have been conducted under TL III. Some 1800 farmers participated in the 10 field days with about 18% of them being women farmers. These field days were televised and appeared on prime news.

Adoption of these varieties and accompanying integrated crop management practices in Ethiopia contributed to increased chickpea productivity from 550 kg/ha in 1993 to 1,913 kg/ha in 2014 and total

1. A total of 6 desi (Mastewal, Natoli, Minjar, Dalota, Teji, Teketay) and 8 kabuli (Habru, Fetenech, Arerti, Ejere, Acos Dube, Akuri, Kassech, Kutaye) types

Figure 5: Chickpea seed producers' field day at Gitche Gara babao seed producer association plot.



1= National Improvement Program; 2= Research Centers; 3= Public Seed Enterprises; 4= CBOs (Union Farmers, Seed Producer associations); 5= Private Seed Producers; 6= Farmers

→ = EGS; ----------→ = CERTIFIED; —·—·—→ = QDs; ⟷ = Farmers to Farmers seed

Figure 6: Chickpea seed system operation scheme (Source: Mekasha et al; in press).

production from 168,000 t on about 109,000 ha to 458,682 t on about 240,000 ha in 2014 (CSA, 2015). The change in production is about 173% over the 2003 base figure, and both gains in area (120%) and productivity (248%) have contributed to these remarkable increases. The estimated level of chickpea variety adoption now is between 25 and 30% with significant impact on increased household income and reduced poverty.

Seed systems

The chickpea seed system in Ethiopia is driven by three main categories of value chain actors. The research sector is responsible for early generation nucleus seed, breeder and pre-basic seeds. The seed associations, private sector and parastatals deal with basic and certified/QDS seed classes. The cooperative unions, NGOs and other actors in the value chain handle seed promotion and distribution of certified/QDS of 1 -3 generations normally called C1, C2 and C3 (Figure 6). Projects such as N2Africa, Canadian International Food Security Research Fund (CIFSRF)- funded Legume Scaling in Southern Region led by Hawassa University, USAID-funded Seed Scaling led by ICARDA, ISSD-Ethiopia, AGRA's SSTP and PASS projects have been important stakeholders in the chickpea subsector, contributing significantly to the scaling up and adoption efforts.

Apart from this, an innovative scheme of demos/ FPVS based seed and technology promotion has been found instrumental in the TL III project. This later innovative approach has enabled this crop to be grown in non-traditional chickpea areas such as Northern Gonder Zone, Hararge, Bale, Gojam and southern areas. Under the project, producer organizations and demos produced a total of 6,498 tons of seed. Some 25 seed producer organizations and 4 parastatals were participants in this seed production. On capacity building, more than 2400 farmers have been trained under the project on chickpea seed production, management and processing.

The main challenge in the chickpea seed system is the unmet demand due to limited seed supply/production. Currently, if one calculates the ideal seed demand on and area with 75% of cultivated land under chickpea production, then about 20,800 tons of seed is needed. However, the annual average estimate of chickpea seed production does not exceed 3,000 – 4,000 tons (less than 20% of the demand). This could be highly attributed to low interest of the formal seed system in

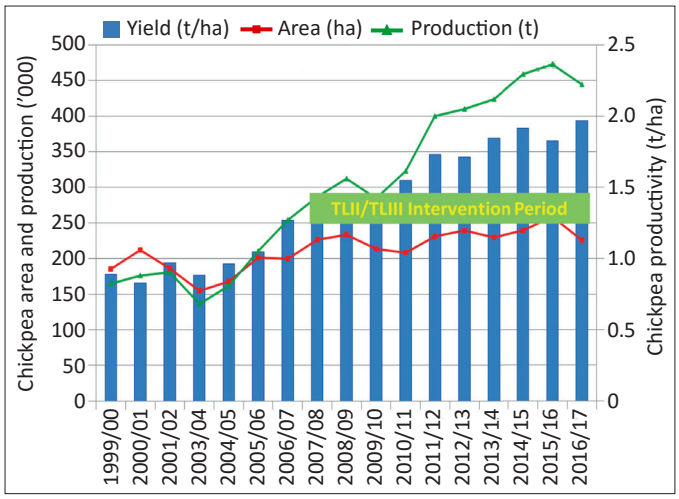


Figure 7: IMPACT ASSESSMENT: Productivity growth with adoption of chickpea varieties promoted in Ethiopia under TL II & TL III (2007-2017). Source: CSA (2007-2017).

the country's chickpea seed production because of low profitability arising from low chickpea seed production and multiplication as well as erratic demand as farmers source seed from alternatives such as grain markets. The chickpea seed production in Ethiopia is only composed of a few public and private seed enterprises.

Examples of impact

Mrs Temegnush is a single woman as she lost her husband. She has been able to secure a steady source of livelihood through the income generated from chickpea seed production. She has been able to generate ETB 10,000 – 15,000 per year during the four years of TL II. She used the income to pay for the education of her children and construct a house in a town, 20 km away from her village. Similarly, Mr Amha, chair of Amuari PLC, has been able to produce seed of improved chickpea varieties (Arerti, Habru, Natoli, Tekeay) in the range of 200 to 250 t of certified/QDS seed and made about ETB 4-5 million gross sale per annum. Mr Alemu, founder of Burka Agr PLC, is a newly recruited Amuari PLC member and is now able to provide about 100 t of foundation and QDS seed. Nationally, there are about 18 farmer-based seed producing organizations involved in chickpea seed production and making profits out of it. There are newly emerging entities working on chickpea using an agribusiness model.

Challenges

- Availability of mechanized harvester and thresher
- Climate variability (erratic rainfall) and biothreats like AB, FW,
- Private system weakness in seed development

Conclusion

Through enhanced chickpea production spurred by new varieties and technology deployment, the lives of famers have been transformed. The agribusiness model of chickpea is the main driver for fast adoption and increased productivity. Effective engagement of stakeholders and value chain partners is another critical contributor for reaching impact and scale. There is a huge untapped potential for expansion of chickpea in Ethiopia and in the rest of ESA for expansion and intensification based on existing agroecological potential.

Acknowledgements

Collaborative efforts among ICRISAT and ICARDA as CGIAR centers and higher learning institutions such as UC-Davis through the Chickpea Innovation Lab supporting EIAR in prebreeding, supply of genetic resources, variety pipeline development, variety popularization, early generation seed production, support to cooperative-based seed production among others, are acknowledged. Other actors supporting the seed systems such as N2Africa through bio-inoculant distribution, ISSD through post-harvest and market support, AGRA through support to the private sector and agro-dealer networks, KAFCI project on chickpea agribusiness incubation and MERCI project on implementation of BPAT-based program improvement plans are acknowledged. So is the Ethiopian Government through EIAR and the Ministry of Agriculture for its unreserved support to the Chickpea National Crop Improvement Program which have brought the desired success in achieving high productivity increases.

This edition is contributed by Dr Asnake Fikre, Regional Breeder – Chickpea, Ethiopia.

For TL III updates follow:

/tropicallegumesIII

/tropicallegumes

/tropicallegumes

/TLIII

Contacts: *To contribute or participate in Tropical Legumes III:*
Dr Rajeev K Varshney, *TL III - PI, Email: r.k.varshney@cgiar.org and/or*
Dr Chris Ojiewo, *TL III - Coordinator, Email: c.ojiewo@cgiar.org or*
Address: *ICRISAT-Nairobi, UN Avenue, Gigiri, Po.Box 39063 – 00623, Nairobi, Kenya, Phone: +254-20 722 4566, Cell: +254 720 351 323*
Webpage: *http://tropicallegumes.icrisat.org/*