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**2020 annual technical report of DIIVA trials in Senegal**

**Project Title (Name):** Dissemination of interspecific ICARDA varieties and elites through participatory research (DIIVA-PR)

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**Project Fund Source/Donor/Financer:** International Center for Agricultural Research in the Dry areas (ICARDA), Crop trust and Norwegian Development Cooperation (NORAD).

## Planned activities

1. Conduct trials of crop wild relatives-derived germplasm of durum wheat, barley and lentil at Fanaye.
2. Facilitate ICARDA's personnel travel to visit sites in relation to the Project
3. Promote the best material identified from the trials in one or more of the ways that follow:

## Delivered activities

During the season 2019-2020, DIIVA trials of durum wheat, barley and lentil were planted in the station of Fanaye in Senegal as international preliminary yield trial in plots of 5 m x 6 rows spaced 25 cm (7.5 m<sup>2</sup>) at a sowing density of 120 Kg/ha. A set of 24 durum wheat wild relative cultivars was grown in a statistical field design of alpha lattice with two replications and 6 sub-block of size 4 m (**Fig 1a**).

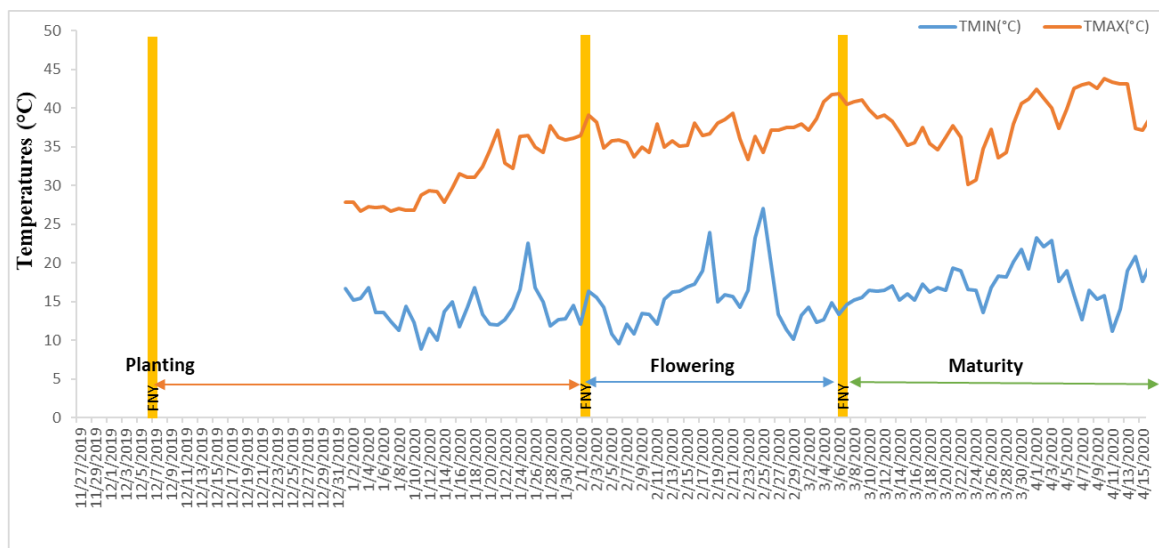
Meanwhile, 25 new CWR-derived lines of lentil trial including the check Bakria were evaluated in an alpha lattice design, with two replications and 5 sub-block of size 5 m (**Fig 1b**). For barley, 8 lines including 2 checks were planted using alpha lattice design with 4 sub-block of size 2 m and two replications two times (**Fig 1c**).



**Fig 1. Trials of crop wild relatives-derived germplasm of durum wheat (a), lentil (b) and barley (c) planted at Fanaye station in Senegal during the cropping season 2019-2020.**

Planting was completed on 07 December 2019 for all trials at Fanaye station. Principal agronomical data were collected during the growing season and after the harvest including days to heading, days to maturity, biomass and grain yield. Temperature data were also recorded at Fanaye station during the cropping season (**Fig 2**).

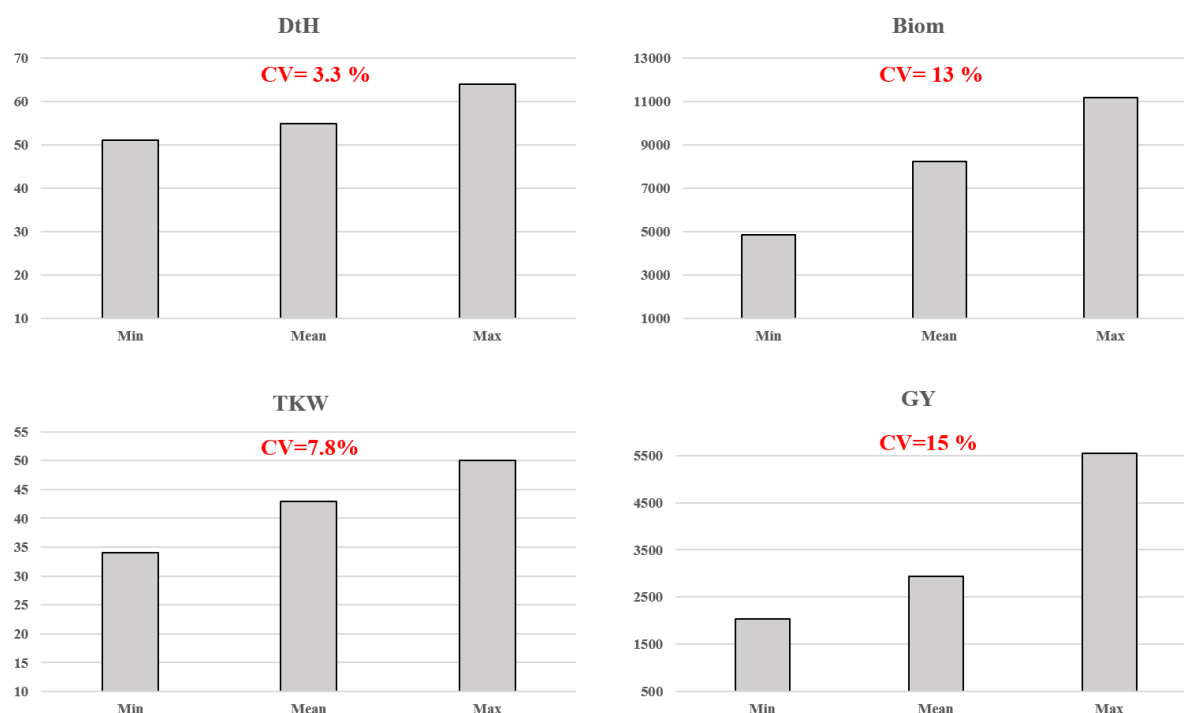
During 2019-2020 cropping season, temperature along the Senegal valley was high and varied across the growing cycle with much warmer temperatures during the flowering and grain filling period (**Fig 2**). Temperature reached 39 °C during the flowering period, while it was between 30 and 35 °C during grain filling phase. Besides high temperatures, fields were severely affected by weeds due to the lack of herbicide and late of mechanical weeding.



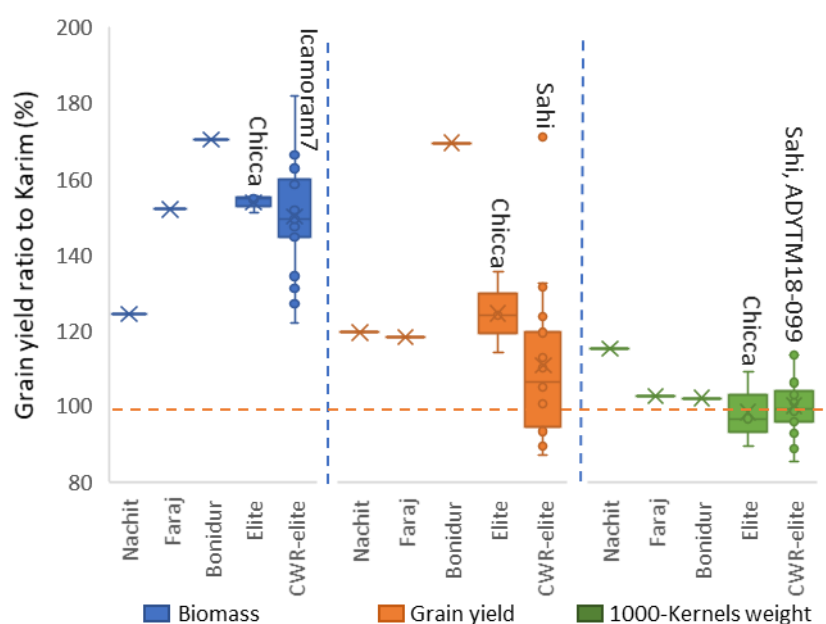
**Fig 2.** Maximum and minimum temperatures recorded at Fanaye during 2019-20 cropping season.

For the CWR-derived elites of durum wheat, flowering time mean was 55 days after planting with a maximum of 64 and a minimum of 51 days. Physiological maturity (DtM) was achieved in about 84 days on average. The ANOVA revealed a significant difference ( $p < 0.05$ ) between genotypes for days to DtM, biomass and grain yield. Good heritability of 64% was recorded for grain yield, with low coefficient of variation at 15%. The CWR-derived lines generated high biomass and the 1000-kernel weight was up to 50 g (**Fig 3**). Top grain yield was registered by the CWR elite Sahi derived from *Triticum urartu* at 5.5 t ha<sup>-1</sup>, with a mean grain yield of 4.4 t ha<sup>-1</sup>. The elite Sahi generated +70% yield advantage over the commercial check Karim, +10% larger grains and even more importantly a +50% increase in biomass. Among the cultivar, Bonidur was produced +60% more yield and biomass over the check Karim, while the elite Chicca generated +30% yield advantage, 50% more biomass and +10 larger seeds. However, the highest biomass was produced by the CWR Icamoram7 with +80% over the check Karim, and +30 more yield (**Fig 4**).

Icamoram7 and DAWRYt123 have already been identified among the best along the Senegal river sites in the previous international yield trials. DAWRYT123 was among the released durum wheat varieties in Senegal during 2019-2020 while 'ICAMORAM7' is being tested in the farmer's fields in Mauritania. A good amount of seeds from these two varieties is already available and distributed to farmers in Senegal and Mauritania for cultivation.



**Fig 3.** Agronomical performances of crop wild relatives-derived germplasm of durum wheat in heat stressed environment of Fanaye in Senegal.



**Fig 4.** Biomass, grain yield and 1000-Kernels weight of CWR elites, elites and cultivars expressed as ratio to the commercial check Karim.

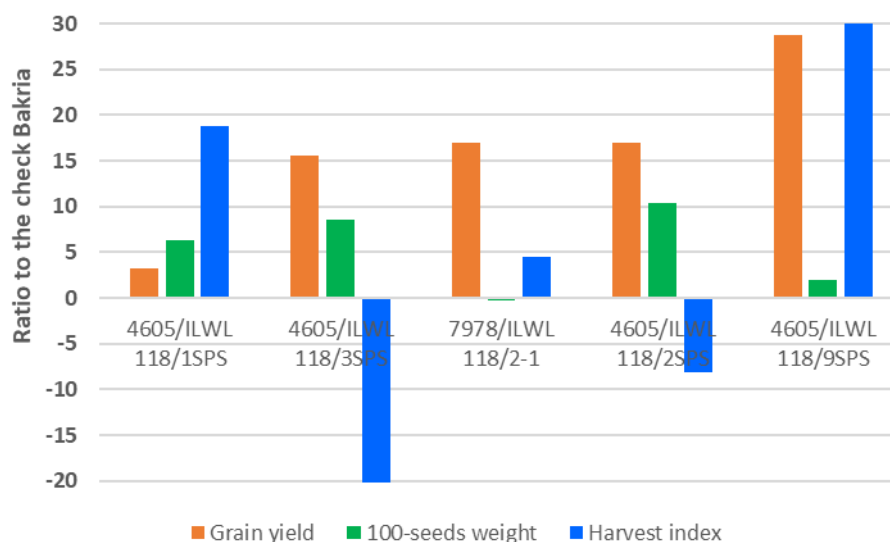
For CWR-derived lines of lentil, 50% of flowering was reached in about 53 days after planting, and 86 days to physiological maturity. In addition to the extreme temperatures ( $> 35^{\circ}\text{C}$ ) during the reproductive stage, lentil trial was influenced also by weeds. The analysis of variance showed significant differences among genotypes for all traits (**Tab 1**). High heritabilities were recorded for days to maturity, grain yield, hundred seeds weight and harvest index at 0.92, 0.71, 0.74 and 0.80 respectively. The coefficient of variation was ranged from 2.65 for days to maturity to 27.26 for grain yield. Under the high temperatures of Senegal river, five CWR-derived lines (4605/ILWL 118/9SPS, 4605/ILWL 118/2SPS, 4605/ILWL 118/3SPS,

4605/ILWL 118/1SPS and 7978/ILWL 118/2-1) were identified as a good source of heat tolerance. These new CWR-derived lines provided to 28% yield advantage over the check Bakria, with 10% larger seeds (**Fig 5**). These entries achieved the 50% of flowering in around 50 days and the physiological maturity in less than 80 days. Furthermore, multiplication of these lines was carried out at Fanaye station during the current cropping season 2020-2021 in order to plant them next season by some local farmers.

**Tab 1. Analyse of variance, mean, coefficient of variation (CV) and heritability of the 24 CWR-derived lines evaluated at Fanaye station.**

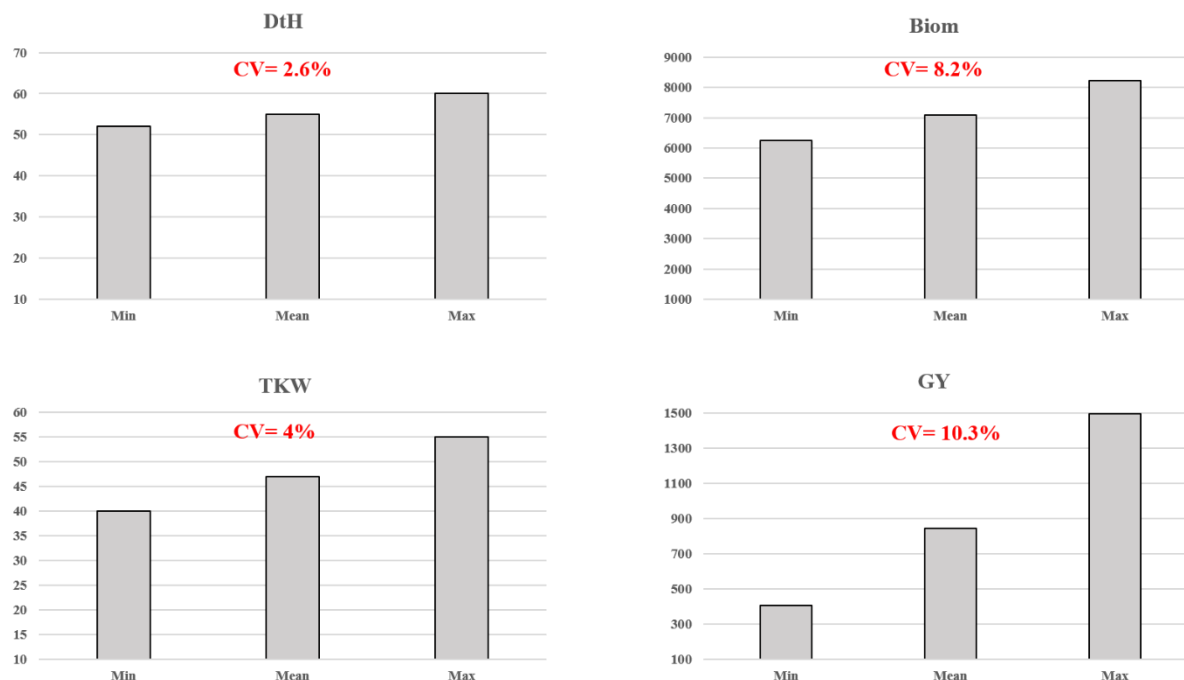
	DF	DM	PH	BY	GY	HSW	HI
<b>Genotypes</b>	*	***	**	**	**	**	**
<b>Mean±SD</b>	53.3±0.4	86.4±0.3	37.7±0.5	2226.8±80.3	310.8-13.8	4.5±0.1	13.8±0.4
<b>CV</b>	5.21	2.65	9.94	25.32	27.26	7.12	11.37
<b>Heritability</b>	0.59	0.92	0.62	0.68	0.71	0.74	0.80

Significant difference at \*  $p<0.05$ , \*\* $0<0.01$ , \*\*\* $p<0.001$ . DF, days to 50% flowering; DM, days to physiological maturity; PH, plant height; BY, biological yield; GY, grain yield; HSW, hundred seeds weight; HI, harvest index.



**Fig 5. Performance of the five top CWR-derived lines of lentil expressed as ratio to the commercial check Bakria.**

Similar to lentil, barley was also grown for the first time in Senegal, and the top six CWR-derived lines identified in Morocco were planted against two commercial checks (Furat-3 and Ksiba). Different agronomical parameters were collected for barley trial at Fanaye station (**Fig 6**). Flowering time of the pre-breeding lines varied between 52 and 60 days after planting, while the physiological maturity was achieved in 84 days on average. Two new CWR-derived lines (entry19-1 and entry19-5) registered the highest yield exceeding the two commercial checks Furat-3 and Ksiba by +30%. Entry-19-1, entry19-5 and entry19-4 generated the highest biomass with an average of 7.4 t.ha<sup>-1</sup>. The best yielding lines of barley with early flowering were selected and destined for multiplication during the cropping season 2020-2021 at Fanaye station in order to be planted in next season by farmers.



**Fig 6.** Agronomical performances of crop wild relatives-derived germplasm of Barley in a heat stressed environment

### Visit of ICARDA team

On the first week of March 2020, a team of ICARDA visited DIIVA-PR trials in Senegal. During this trip, ICARDA and ISRA teams visited the milling factories of OLAM and NMA in Dakar. OLAM team showed high motivation and involvement for the collaboration with ISRA, and confirmed their continuous support to ISRA for quality analysis and local wheat production. OLAM has planned to try dealing with farmers in order to purchase the agricultural yield from them starting next season at specific price discussed and fixed at the beginning of the season. Furthermore, Olam team indicates that they are ready to incorporate 10 to 15% of the local wheat produced in Senegal River valley into their milling system.

After milling factories, ICARDA and ISRA teams visited the field station of Fanaye and selected the best-adapted lines for three trials conducted under DIIVA-PR project. Trials were showing a high adaptation to the extremely hot temperature of Senegal which can sometimes exceed 40°C. Barley and lentil have been growing for the first time and exhibited a good adaptation to the harsh climatic conditions of the Senegal river. Seeds of the new CWR-derived line DAWRyt123 of durum wheat were provided to one farmer and planted in around 0.5 ha. Technical assistance to the farmer was covered by ISRA team to improve his agronomic skills at all the different stages. All the participants including the mayor of the region expressed a high interest and motivation for the continuous wheat production of wheat in the Senegal river valley.

Among the principal long-term achievement of ISRA members is to strengthen the links among farmers and millers and develop strong wheat value chain in Senegal. ISRA is fixing to empower female rural cooperatives to become true community-based seed enterprises capable of fostering the dissemination of wheat cultivation. For that, a meeting was held with three rural female cooperatives on the last week of October 2020. The main goal was to know how they were organized, their conditions of production, processing and selling products. ISRA team tried to identify also their markets, their processing equipment, storage warehouses, their strengths, weaknesses, opportunities and threats.

#### Acknowledgment:

We would like to acknowledge the great support of all DIIVA-PR project partners: Norwegian Development Cooperation (NORAD), Crop Trust and the International Center for Agriculture Research in the Dry Areas (ICARDA).