Original Research Article

Telangana kandi 3 (TDRG 59): A promising medium duration Pigeonpea variety for Southern Zone of India

ABSTRACT

TDRG 59 a medium duration high yielding pigeonpea culture identified at Agricultural Research Station, Tandur, Professor Jayashankar Telangana State Agricultural University, Telangana and was released by Central Variety Release Committee during 2021 in the name of Telangana kandi 3 for southern zone of India. It matures in 165-180 days in kharif and around 125-130 days in Rabi depending on the onset of cool temperatures during winter. The culture is most suitable for deep black soils to medium textured soils under rainfed or limited irrigated conditions owing to its medium duration. Theculture recorded an average seed yield of 1708 kg/ha, which was 22.52 % high over ICPL 8863 (National check), 27.4 % high over CO 8 (Local Check) and 10.5 % high over GRG 811 (Zonal check). It is moderately resistant to *Fusarium* wilt and sterility mosaic disease. The culture recorded lesser pod damage due to pod borers and pod fly when compared to checks

Keywords: *Pigeonpea, pod borer, wilt, sterility mosaic*

1. INTRODUCTION

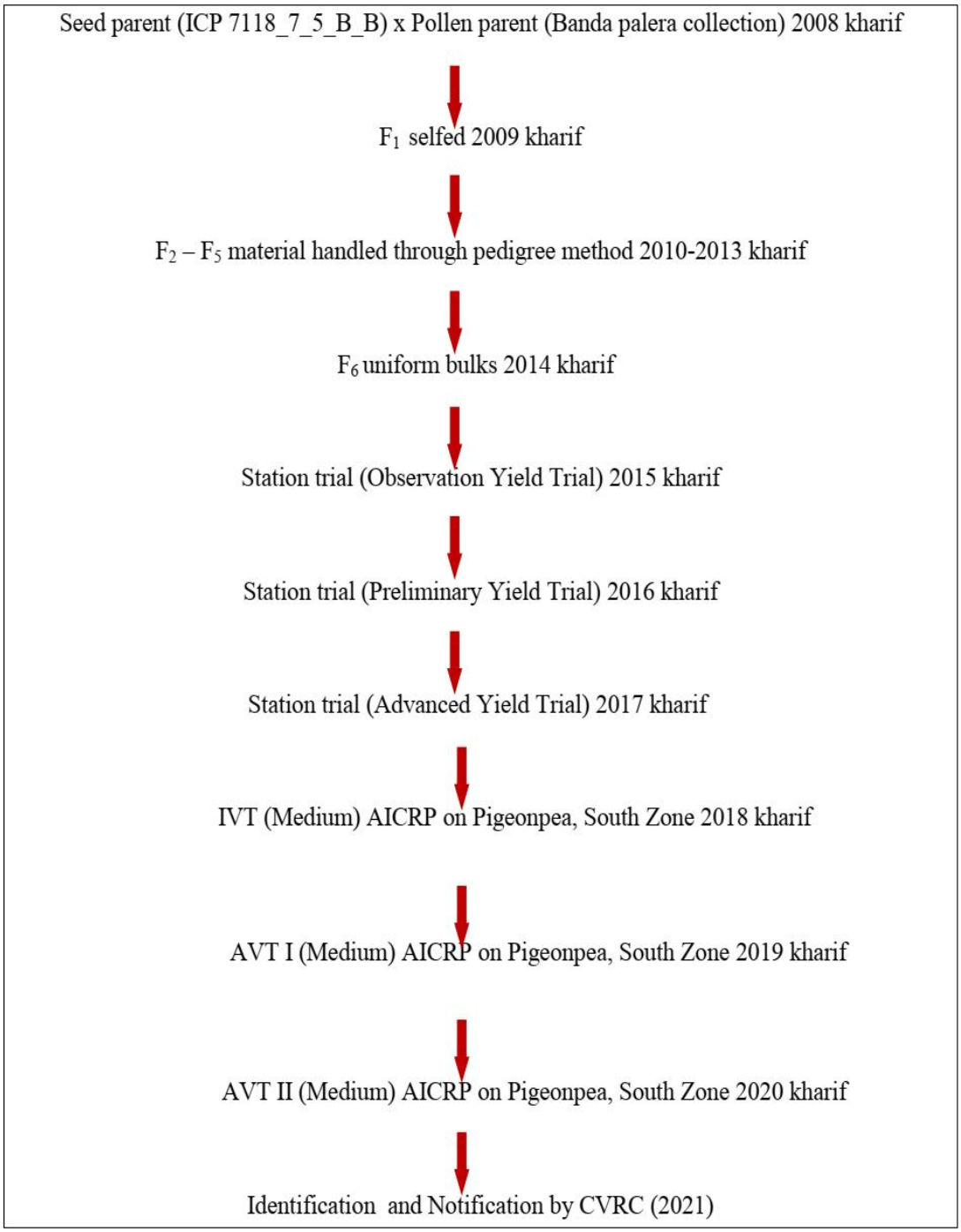
Pigeopea (*Cajanus cajan* (L.) Millsp.) is the fifth most important pulse crop in the world. In India, it is second (next to chickpea) in area and production with an area of 5.05 million hectares, production of 4.34 million tones and productivity of 859 Kg/ha (1). In India Uttar Pradesh is the leading producer (0.47 million tonnes from 0.49 million ha. and productivity of 944 kg./ha.) contributing to 34.87% of the national production. It is followed by Madhya Pradesh (0.44 million tonnes, 34.55% of national production), West Bengal (10.53%), Bihar (8.84%) and Jharkhand (4.53 %) with respect to their contribution in the national production. Pigeonpea is a key crop for food and nutritional security and more than 85% of the world pigeonpea is produced as well as consumed in India itself. Owing to more demand and poor supply for domestic pulse requirement, India has become the leading importer (92.65% Share in global pigeon pea import in 2021) with an import volume of 674.44 million kg.

Pigeonpea is a hardy, drought tolerant deep rooted grain legume crop of semi-arid tropics grown under subsistence agriculture.It fixes nitrogen, enhances the release of soil-bound phosphorus, requires less fertilizer, withstands intermittent drought and recovers quickly from the damage caused by various biotic and abiotic stresses. It is, therefore, a favourite crop in low-input, rain-fed farming situations of India.The productivity in India is low because it is mostly cultivated by farmers for their domestic consumption in poor fertile soils under limited input conditions. The major biotic constraint like wilt, caused by *Fusarium udum* Butler limits production to the extent of 100% if it occurs during flowering stage (2). The other constraints include SMD, pod borer complex and pod flies which can be controlled to a considerable extent by chemicals. The government of India is working in a big way to increase the area and thereby production of Pigeonpea in order to reduce the imports. In order to improve productivity under medium to low input conditions it is essential to identify and cultivate high

yielding genotypes which have tolerance to the above pests and diseases. Keeping this in view, Agricultural Research Station, Tandur focussed on its mandate of development of a high yielding mid early/medium duration Pigeonpea varieties with considerable wilt, SMD resistance and pod borer toleranceto avoid major yield losses and obtain sustainable productvity in the state of Telangana as well in southern India.

2. MATERIALS AND METHODS

TDRG 59 is derived from the cross between the parentsICP 7118_7_5_B_B and Banda palera collection. The $F_1$was selfed and single plant selections were made from F_2 to F_5generations at ICRISAT from 2008 to 2014. The selection criteria followed for making selections were medium height, sturdy stem, basal branching pattern, long pod-bearing branches, more number of pods per plant, 3-4 seeds per pod, bold seed size, and higher per plant yield. Uniform bulks were made in F_6generation after attaining homogenietywithin the progenies/families. The promising bulked progenies were tested in station trials (OYT, PYT and AYT) at ARS, Tandur for three years from 2015-2017.The data pertaining to yield parameters was recorded analysed in Randomised block design and the promising culture TDRG 59 was identified. The culture was nominated and tested in All india coordinated trials (IVT,AVT I and AVT II)from 2018-2021 and its performance with respect to yield, pest, disease resistance were studied (3,4,5).The nutritionalquality parameters such as moisture, Protein, Ash, crude fiber and crude fatwere estimated at Quality Control Laboratory, PJTSAU, Rajendranagar,Hyderabad using standard protocols. Thus the development of the culture and assessing its performance through field evaluation was accomplished at ICRISAT and ARS, Tandur from 2008 to 2021(Flowchart).



Flow chart of TDRG 59 development and evaluation

3. RESULTSAND DISCUSSION

3.1GRAIN YIELD PERFORMANCE

The yield performance of the pigeonpea culture TDRG 59 was presented in Table 1. In IVT (2018), TDRG 59 recorded an average seed yield of 1505 kg/ha which was 24.17% higher over CO8 (LC), 8.50% over GRG 811 (ZC) and 8.66% over ICPL 8863 (NC).In AVT 1 (2019), the culture recorded 1733 kg/ha which was 23.16% higher over ICPL 8863 (NC), 14.61 % over CO8 (LC). In AVT 2 (2020), it recorded a yield of 1919 kg/ha which is 11.24% higher over GRG 811 (Zonal Check). Based on three years data of weighted average of 21 locations in the southern zone, TDRG 59 recorded a seed yield of 1708 kg/ha, which is 22.5 % high over ICPL 8863 (National Check), 27.4 % high over CO 8 (Local Check) and 10.5 % high over GRG 811 (Zonal check) (Table 1). A variety is recommended for release for general cultivation by farmers at the national level if it exhibits a minimum yield superiority of 5-10 % over the national checks for one or more zones. Hence this culture was released in 2021 for southern zone of India which covers the states of Telangana, AndhraPradesh Tamil Nadu, Karnataka, and Odisha.

Table 1: Summary of Yield data of TDRG 59 and checks in AICRP Trials

	Year of Testing	No. of Locations	TDRG 59 (Proposed Variety)	ICP 8863 (National Check)	CO 8 (Local Check)	GRG 811 (Zonal Check)
Mean Yield (Kg/ha)	2018-19 (IVT)	8	1505	1385	1212	1387
	2019 -20 (AVT -I)	6	1733	1407	1512	-
	2020-21 (AVT -II)	7	1919	-	-	1725
	Weighted mean	**21**	**1708**	**1394**	**1340**	**1545**
% Increase or decrease over the checks	2018-19 (IVT)	8	-	(+) 8.66	(+) 24.17	(+) 8.50
	2019 -20 (AVT -I)	6	-	(+) 23.16	(+) 14.61	-
	2020-21 (AVT -II)	7	-	-	-	(+) 11.24
	% increase over mean	-	-	(+) 15.91	(+) 19.39	(+) 9.87
	% increase over weighted mean	-	-	**(+) 22.52**	**(+) 27.4**	**(+) 10.5**

3.2 MORPHOLOGY

The culture is described as tall plant type (170cm-210cm), indeterminate growth habit, semi spreading nature with the branches arising from the stem base, green stem, oblong leaves, yellow

flowers with light redstreaks on the standard petal, dark green pods with purple streaks, waxy and sticky podwall, three seeds per pod and bold brown globular seeds with test weight (100 seed weight) of 11.4 -11.9 g (Figure.1).

Figure 1:Plant, Flower,Pod, Seed and Dal of TDRG 59

3.3 DISEASE REACTION

The disease reaction of the culture TDRG 59 to the major diseases *i.e.*, *Fusarium* wilt and Sterility Mosaic Disease (SMD) was presented in Table 2 and 3**.** % incidence of <10 is scored as resistant, 11-30 as moderately resistant and > 31 as susceptible for wilt and SMD as per standard scoring method in Pigeonpea. TDRG 59 recorded a moderate resistant reaction to wilt with % wilt incidence of 20.11 as against Resistant check (10.69) and susceptible check (78.84) (Table 2). The culture recorded moderate resistant reaction to SMD with % incidence of 23.02 as against susceptible check (78.42) (Table 3). *Fusarium* wilt and sterility mosaic disease are the

two major biotic constraints affecting Pigeonpea production in India. Wilt is caused by soil borne fungus for which resistance breeding is the only feasible option for management (6). The yield loss due to wilt depends upon the stage at which it occurs, and it ranges from 50% - 100% when it occurs at the pre pod stage (7). Monogenic control (8) of *Fusarium* wilt resistance was reported in few sources. Involvement of two complementary genes (7), one or more recessive genes in controlling wilt resistance has been reported (9).

Sterility mosaic disease (SMD), caused by Pigeonpea sterility mosaic virus (PPSMV) and spread by eriophid mite is an economically important viral disease in India, causing an estimated annual loss of more than US$300 million. Acaricides are commonly used for the chemical management of the eriophyid mite vector transmitting the viral disease to manage SMD. However, the most effective and realistic approach to reduce losses caused by SMD is the use of host plant resistance or the deployment of less susceptible cultivars. (10). The genetics of resistance to sterility mosaic disease was investigated in several studies. Few studies have reported inheritance of SMD to be controlled by recessive genes (11,12,13) and few by two dominant genes with inhibitory gene interaction (14).

Table 2: Reaction to *Fusarium* wilt disease (Percent wilt incidence) recorded in AICRP trials.

Disease: Fusarium wilt	**Location**	**TDRG 59**	**Resistant Check (ICPL 8863)**	**Susceptible Check (ICP 2376)**
IVT (Medium) 2018-19	Bangalore	0	8.5	97
	Gulbarga	69.44	8.05	77.5
	ICRISAT	0	29.63	83.33
Average wilt %		**23.14**	**15.39**	**85.94**
AVT – II (Medium) 2020-21	Bangalore	40.56	9	100
	Gulbarga	8.91	9	60.25
	Warangal	1.79	0	55
Average wilt %		**17.09**	**6**	**71.75**
Overall wilt incidence % (2018,2020)		**20.11**	**10.69**	**78.84**

Table 3: Reaction to Sterility Mosaic Disease (Percent SMD incidence) in AICRP trials

Disease: Sterility Mosaic Disease	**Location**	**TDRG 59**	**Susceptible Check (ICPL 8863)**
IVT (Medium) 2018-19	Bangalore	60	100
	Coimbatore	38.46	81.54

Average SMD incidence %		**49.23**	**93.8**
AVT – I (Medium) 2019-20	Bangalore	50	100
	Coimbatore	0	50
	Dharwad	2.38	93.18
	ICRISAT	0	92.3
	Warangal	19	45
Average SMD incidence %)		**14.28**	**76.1**
AVT – II (Medium) 2020-21	Bangalore	5.36	42.33
	Coimbatore	9.04	75
	Dharwad	1.43	100
	Virinjipuram	2.17	65.08
	Warangal	9.77	44.4
Average SMD incidence %		**5.55**	**65.36**
Overall SMD incidence % (2018-20)		**23.02**	**78.42**

3.4 PEST REACTION

The culture (13.01) recorded lesser pod damage values due to gram pod borer *Helicoverpaarmigera* and Spotted pod borer *Maruca vitrata* when compared to the three checks ICPL 8863 (14.79) CO 8 (15.39) and WRP1(16.68).The culture recorded lesser pod fly (*Melanagromyza.obtusa)*damage (13.21%) when compared to the Zonal Check WRP 1(14.35) and on par values with respect to National check ICPL 8863 (12.79) and Local check CO 8 (12.10)(Table 4**).**The most serious pests of Pigeonpea are pod borers and pod fly. Among these, *H. armigera* is prevalent throughout the tropics and subtropics, costing an estimated yield loss of over $310 million annually (15). Farmers generally depend on chemical control for management of these pests. In the past five decades, the use of chemical pesticides has increased by 170 fold, from 2.2 g/ha of active ingredient in 1950 (16) to 381 g/ha in 2007 (17).However excessive use of chemical insecticides leads to resistance breakdown, outbreaks of secondary pests, contamination of food chain, and loss of biodiversity. Hence breeding for pest tolerant genotypes is indispensable and is an ecofriendly approach for management of pod borers in Pigeonpea.

Table 4: Reaction of the TDRG 59 to insect pests during 20-21.

S.No.	Location	Pest	TDRG 59	ICPL 8863 (NC)	CO 8 (LC)	WRP1 (ZC)
1	Bangalore	Pod borers	5.17	3.62	4.86	8.4
2	Coimbatore	*(Helicoverpa. armigera*& *Maruca vitrata)*	22.5	20.5	18.5	18
3	Lam		7	10.6	11.4	9.8
4	Kalburgi		16.9	24.6	25.9	18.9
5	Virinjipuram		16	23	25	30.5

6	Warangal		10.47	6.44	6.69	14.5
	Average		**13.01**	**14.79**	**15.39**	**16.68**
S.No.	**Location**	**Pest**	**TDRG 59**	**ICPL 8863 (NC)**	**CO 8 (LC)**	**WRP 1 (ZC)**
1	Bangalore	Pod fly *(M. obtusa)*	10.72	8.01	4.19	7.95
2	Coimbatore		11	12.5	13	11
3	Lam		12.1	14.6	16	15.5
4	Kalburgi		10.26	11.9	8.9	7.5
5	Virinjipuram		19.75	21	19	22
6	Warangal		15.4	8.73	11.5	22.15
	Average		**13.21**	**12.79**	**12.1**	**14.35**

3.5 QUALITY ANALYSIS

TDRG 59 recorded a higher seed protein content (22.86%) compared to the local check Hanuma (21.59%) (Table 5), while the other parameters were almost similar. The protein content in pigeonpea varies from 15.5 to 28.8 % (18) and depends on genetic and environmental factors (19).

Table 5: Quality parameters estimated in TDRG 59 and Hanuma

S. No.	Entry	Moisture (%)	Crude Protein	Crude fat (%)	Crude Fibre (%)	Ash (%)	CH_2O (%)
1	Telangana kandi 3 (TDRG 59)	10.89	**22.86**	1.89	1.63	5.44	58.92
2	Hanuma (TDRG 4)	10.62	**21.59**	1.65	3.69	3.55	62.59

4. CONCLUSION

Inheritance of yield, wilt resistance, SMD and pod borer tolerance are highly polygenic involving major Genotype/environment interactions. Focussed efforts at ARS, Tandur since 2008 could help in breeding for such a culture which has a good combination of all the above said desirable traits. Owing to the yield superiority in relation to the national, zonal and local checks, pest and disease resistance with respect to *Fusarium* wilt, sterility mosaic disease, lesser pod damage recorded due to insect pests namely pod borersand pod fly,the Pigeonpea culture TDRG 59 was released by the Central Variety Identification Committee and notified(S.O.8(E)./24.12.2021) for general cultivation in southern zone of India

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