Received: 11 Dec 2021 | Revised: 17 Jan 2022 | Accepted: 02 Feb 2022

Electronic Journal of Plant Breeding

Research Article

WRGE 121: A high yielding mid-early duration pigeonpea variety for Southern Zone of India

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Abstract
A mid-early duration high yielding pigeonpea culture WRGE-121 as Telangana kandi-2 was developed at Regional Agricultural Research Station, Warangal, Professor Jayashankar Telangana State Agricultural University, Telangana. and was released by Central Variety Release Committee during 2020. It obtained by the cross between parents WRGE-14 X IC-825406, it has a duration of 155-165 days, suitable for *kharif* sowing. This variety recorded yield on an average of 1677 kg/ha which is 30.71, 28.50 and 10.60 per cent higher over PT0012 (national check), TS-3R (Zonal check) and PRG-176 (local check), respectively. It recorded maximum yield of 3082 kg/ha in Gulbarga, Karnataka. The variety has 100 seed weight of 9.0 - 10.0 g with a protein content of 23.05 per cent. It is moderately resistant to fusarium wilt disease and tolerant to pod fly. The variety WRGE-121 is suitable for southern zone of India which includes Tamil Nadu, Karnataka, Telangana, Andhra Pradesh and Odisha.

Keywords: Pigeonpea, midearly, south zone, high yielding, wilt

INTRODUCTION

Pigeonpea [*Cajanus cajan* (L.) Milllspaugh] is an important often-cross pollinated grain legume crop of semi-arid tropics grown under subsistence agriculture. Pigeonpea ranks sixth in global grain legume production and worldwide it is cultivated in about 6.99 m. ha area with an annual production of 5.96 m.tonnes besides having a mean productivity of 852 kg/ ha.India ranks first in annual pigeonpea production with 4.29 m.tonnes followed by Myanmar (0.68 m.t.), Malawi (0.43 m.t.) and Kenya (0.085 m.t.) (FAO, 2020). India is the largest producer with about 3.5 million tons, accounting more than 80% of total world production which is concentrated in central and southern parts of India.

Pigeonpea crop is also sensitive to abiotic stresses such as terminal drought, water-logging, salinity, and frost/ cold. Terminal moisture stress lowers the productivity in late maturing (>185 Days) varieties and landraces, which are major component of subsistence agriculture involving intercropping or mixed cropping with different short-aged cereals, legumes or oil seed crops Considering the food and nutritional needs of the ever increasing population, productivity enhancement in pigeonpea is highly indispensable.

Hence, our center made a need based diversification in pigeonpea varietal breeding for development of midearly maturing pigeonpea varieties as there is a tremendous scope for the introduction these varieties (155-165 days) in black soils under rainfed condition. Keeping these points in view, pedigree breeding was employed to develop high yielding and mid early duration variety in pigeonpea.

MATERIALS AND METHODS

WRGE-121 is a derivative of the cross between, WRGE-14, which is a midearly duration pigeonpea culture with moderately resistant fusarium wilt and IC 825406 characterized by medium duration with bold seed coupled with high yield potential. The F_2 generation of above cross was evaluated with 500-650 plants, whereas in F_3-F_5 generations, progeny families were maintained with 40 plants in 4m row length. The major emphasis was given to those individual plants with desirable characters such as disease free, long fruiting branch, 100-110 days of flowering duration, red colored, bold seed with test weight of 9-10 g and maximum single plant yield. In F_5 generation, progeny families were evaluated for homozygosity and the culture WRGE-121 was identified. The culture was tested in station trials during 2015 and 2017, Multi location trial at five locations of Telangana state during the year 2018 along with standard check variety PRG-176. The culture was nominated and evaluated in mid-early yield trials during 2017-2020 in the name of WRGE-121 in twenty one locations across the nation. The culture was subjected to natural as well as artificial screening for pest and diseases **(Fig.1).**

The pigeonpea varieties were evaluated for nutritional quality at Quality control laboratory, Professor Jayashankar Telangana state agricultural university, Rajendranagar, Hyderabad. The pigeonpea varieties were analyzed for moisture, Protein (N*6.25), Ash, crude fiber and crude fat (AOAC, 2012). Carbohydrate was determined by difference. Selected mineral contents (Calcium and Iron) of malted weaning mixes were determined by using atomic absorption spectrophotometer (AAS) method (AOAC, 2000). Molecular profiling of WRGE-121 carried out by using twenty-one HASSR markers at biotechnology lab, RARS, Warangal.

RESULTS AND DISCUSSION

The culture WRGE-121 recorded a mean grain yield of 1942 kg/ha in the yield evaluation trials at RARS, Warangal from 2015 to 2017. The yield increase was 16.05 and 31.37 per cent, respectively over the checks PRG-176 (1630 kg/ha) and CORG-9701 (1333 kg/ha). In Multi Location Trials conducted during 2018 at different research stations of Professor Jayashanakar Telangana state agricultural university, WRGE-121 recorded the mean grain of 1412 kg/ ha with yield increase of 17.63 per cent over PRG-176 (1163 kg/ ha).

The overall yield performance of the pigeonpea culture WRGE-121 is presented in **Table 1**. In AICRP trial, an average yield of WRGE-121 (21 locations in 2017-2020) was 1677 kg/ha which is 30.71 per cent superior yield than PT0012 (national check), 28.50 per cent increased

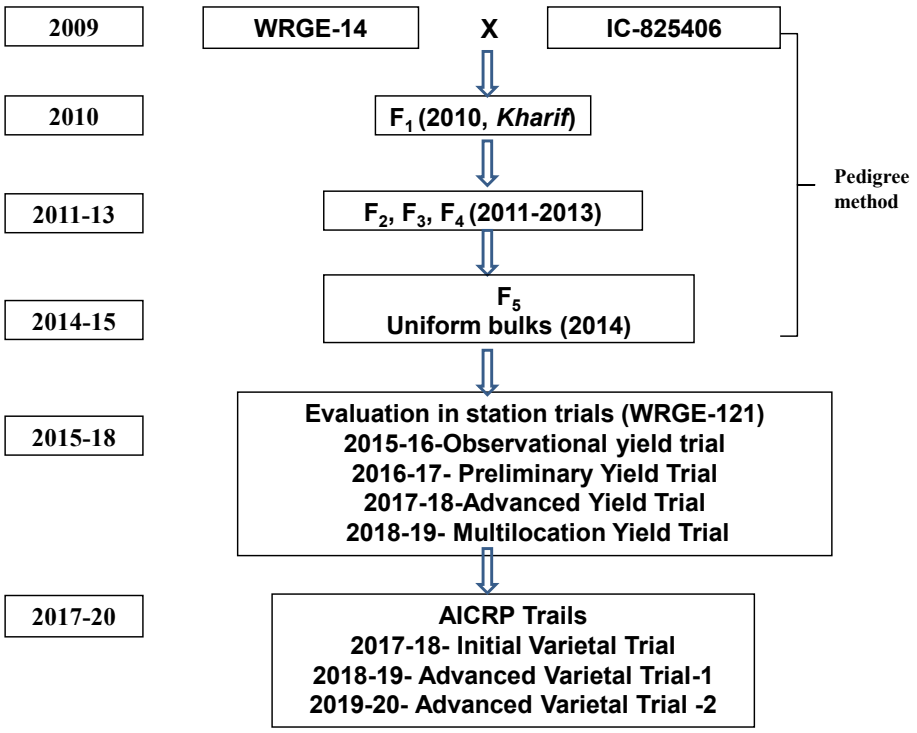

Fig.1. Flow diagram of WRGE-121 varietal development

yield than the PRG-176 (local check), 10.60 per cent increased yield than the TS-3R (Zonal check).

In IVT, WRGE-121 has recorded an average yield of 1969 kg/ha which is 28.38 per cent increased yield than PT0012 (national check), 28.11 per cent over PRG-176 (local check) and 11.09 per cent over TS-3R (Zonal check) (**Table 2**).

In AVT 1, WRGE-121 recorded an average yield of 1364 kg/ ha which is 29.92, 21.46 and 10.13 per cent, increased yield than PT0012, PRG-176 and TS-3R, respectively (**Table 3**).

In AVT 2, WRGE-121 recorded an average yield of 1712 kg/ha which is 39.62 per cent increased yield over PRG-176, 36.42 per cent increased yield than PT0012 and 10.82 per cent increased yield than TS-3R, while 6.77 per cent superior yield over the qualifying check AKTE-12-04. (**Table 4**).

As per the guidelines from PPV and FRA, New Delhi distinguishing morphological characters of the culture WRGE-121 was formulated and this culture characterized by indeterminate growth habit with semi spreading plant type, yellow flowers with brown streaks on the standard petal, the green pods with brown streaks, four seeds

Table 1.Grain yield of pigeonpea variety WRGE-121 under AICRP trials conducted in the Southern zone during 2017-2020

	Year of testing	Number of locations	WRGE-121	PT 0012 (National check)	PRG-176 (Local check)	TS3R (Zonal check)
Mean yield	2017-18	8	1969	1534	1537	1772
(kg/ha)	2018-19	8	1364	1050	1123	1238
	2019-20	5	1712	1255	1226	1545
	Weighted Mean	21	1677	1283	1305	1515
Per cent increase over the check varieties	2017-18			28.38	28.11	11.09
	2018-19			29.92	21.46	10.13
	2019-20			36.42	39.62	10.82
	Overall, per cent increase			30.73	28.51	10.68

Table 2. Grain yield of pigeonpea variety WRGE-121 in IVT trial conducted in the Southern zone during 2017-2018 (kg/ha)

Entries	Bangalore	Hiriyur	Gulbarga	Warangal	ICRISAT	Tandur	Tirupathi	Lam	Mean	Per cent increase
PT 0012 (C)	1632	1472	2197	1311	1600	1517	868	1671	1534	28.38
PRG-176 (C)	1153	1583	2079	1306	1500	1561	1314	1798	1537	28.11
TS 3R (C)	1163	1967	2822	1594	1530	2268	1012	1822	1772	11.09
WRGE-121	1512	1853	3082	2361	2010	1796	1398	1738	1969	

Table 3.Grain yield (kg /ha) of pigeonpea variety WRGE-121 in AVT 1 trial conducted in the Southern zone during 2017-2018

Entries	Bangalore	Gulbarga	Warangal	ICRISAT	Tandur	Tirupathi	Lam	Virinjipuram	Mean	Per cent increase
PT 0012 (C)	1955	406	1446	1973	1063	761	824	568	1050	29.92
PRG-176 (C)	1914	308	1131	1583	1406	677	838	1124	1123	21.46
TS 3R (C)	1929	814	1341	2046	1337	981	920	537	1238	10.13
WRGE-121	2263	872	1951	1753	993	593	909	1574	1364	

per pod and brown seeds with test weight of 9-10 g (**Table 5 and Fig. 2, 3 & 4**).

The disease reaction of pigeopea culture WRGE-121 to major diseases *viz*., wilt and SMD along with the national checks were presented in **Table 6 to Table 8**. WRGE-121recorded a moderate resistant reaction to wilt and SMD, while this culture recorded a moderate resistant reaction to maruca and pod fly at Lam and Gulbarga locations (**Table 9**). At RARI, Durgapur WRGE-121 was found to be resistant to ***M. javanica*** and At IIPR, Kanpur, WRGE 121 observed as moderately resistant to *H. cajani* (**Table 10**).

The results of the proximate analysis of WRGE-121 along with check variety were furnished in **Table 11 and 12** and the culture excels the check variety PRG-176 and found to be best in protein content (23.09) and Fe content (37.90 PPM).

DNA finger printing of pigeonpea culture WRGE-121 was done with varieties viz., PRG-176 using pigeonpea specific SSR markers. Seven markers *viz.,* HASSR 219, HASSR 289, HASSR 236, HASSR 224, HASSR 37 at 170bp, HASSR 255 at 180bp, and HASSR 302 at 150 bp were showed clear polymorphism between PRG 176 and WRGE-121 (**Fig.5**).

Table 4.Grain yield (kg/ha) of pigeonpea variety WRGE-121 in AVT 2 trial conducted in the Southern zone during 2017-2018

Entries	Gulbarga	Warangal	Tandur	Tirupathi	Lam	Mean	Per cent increase
PT 0012 (C)	1374	1112	1852	823	1113	1255	36.42
PRG-176 (C)	-	1154	1832	698	1220	1226	39.62
TS 3R (C)	2020	1981	1684	700	1338	1545	10.82
WRGE-121	1796	1937	2374	941	1511	1712	

Table 5.Distinguishing morphological characters of the culture WRGE-121 (as per PPV & FRA)

S. No.	Characteristics	WRGE-121
1	Plant : Branching pattern	Semi Spreading
2	Time of flowering (50% of the plants with at least one open flower	Medium (90-130)
3	Plant : Growth habit	Indeterminate
4	Stem : colour	Green
5	Leaf : Shape	Oblong
6	Leaf : Pubescence on lower surface of the leaf	Absent
7	Flower : Colour of base of petal (Standard)	Yellow
8	Flower : Pattern of streaks on petal (Standard)	Medium
9	Pod : Colour	Green with brown streaks
10	Pod : Pubescence	Present
11	Pod : Waxiness	Absent
12	Pod : Surface stickiness	Present
13	Pod : Constriction	Prominent
14	Pod : Size (cm)	4-5
15	Pod : No. of seeds	4
16	Plant : Height	Tall (>150)
17	Seed : Colour	Brown
18	Seed : Colour pattern	Uniform
19	Seed : Shape	Oval
20	Seed : Size (100 seed weight)	large (>9-11g)

Fig. 2. Field View

Fig. 3. Single Plant

Fig. 4. Flower, Pod, Seed and Dal

Table 6. Reaction (%) to wilt disease in pigeonpea variety WRGE-121 and checks during *Kharif* 2018-19 under field condition

Entries	South Zone					
	Bangalore	Gulbarga	ICRISAT	Tandur	Warangal	Mean
WRGE-121	17.06	9.13	6.00	22.21	15.00	13.88
ICP-2376 (Susceptible check)	97.00	77.50	83.33	100.0	88.00	89.16
ICP-87119 (Resistant check)	0.00	0.00	0.00	0.00	0.00	0.00

Table 7. Reaction (%) to wilt disease in pigeonpea variety WRGE-121 and checks during *Kharif* 2019-20 under field condition

Entries	South Zone					
	Bangalore	Gulbarga	ICRISAT	Tandur	Warangal	Mean
WRGE-121	-	21.50	26.67	31.79	15.00	23.74
ICP-2376 (Susceptible check)	-	80.10	96.83	100.0	78.60	88.88
ICP-87119 (Resistant check)	-	0.00	0.00	0.00	0.00	0.00

Table 8. Reaction (%) to *Sterility Mosaic Disease* (SMD)in pigeonpea variety WRGE-121 and checks during *Kharif* 2019-20 under field condition

Entries	South Zone				
	Coimbatore	Dharwad	ICRISAT	Warangal	Mean
WRGE-121	0.00	5.41	5.56	29.00	24.46
ICP-8863 (Susceptible check)	50.00	93.18	92.30	45.00	76.10

Table 9. Reaction ofWRGE-121 to major insect pests of under natural condition

Per cent pod damage by Insect pest	Year	Location	WRGE-121 (Damage %)	PT-0012 (National check) (Damage %)	PRG-176 (Zonal check) (Damage %)	Local Check (Damage %)
Gram podborer	2018-19	Warangal	19.4	16.7	17.6	14.65 (WRG-53)
Helicoverpa armigera		Guntur	4.45	3.18	3.53	2.36 (LRG 52)
		Bengaluru	14.17	14.44	11.21	-
		Virinjipuram	20.0	11.11	22.22	-
	2019-20	Warangal	10.5	5.0	14.7	-
		Guntur	3.0	3.4	4.5	-
		Bengaluru	9.32	15.60	4.39	-
		Virinjipuram	6.67	2.67	2.00	-
	Mean		10.9	9.0	10.03	8.51
Spotted podborer	2018-19	Warangal	2.65	1.03	1.26	0.79(WRG-53)
		Guntur	8.72	7.02	8.63	5.61(LRG 52)
Maruca vitrata		Virinjipuram	14.44	12.2	14.44	-
	2019-20	Warangal	5.2	3.9	4.9	-
		Guntur	4.9	8.6	9.3	-
		Virinjipuram	16.33	12.22	12.00	-
	Mean		6.53	5.62	6.3	3.2
Podfly	2018-19	Warangal	19.6	13.04	7.26	33.22 (WRG-53)
Melanogramyza obtuse		Guntur	13.08	10.83	13.48	18.24(LRG 52)
		Bengaluru	3.46	5.49	4.91	-
		Virinjipuram	14.44	13.33	14.44	-
		Gulbarga	10.47	17.73	18.63	19.7 (ICPL-8863)

Table 10. Reaction of pigeonpea genotypes against root knot nematodes *Meloidogyne incognita, M. javanica* and *Heterodera cajani during Kharif* 2019-2020

Roor knot Nematode Species	Location of trial	Proposed Variety (WRGE-121)	
		Gall index/ Average number of cysts/ root system	Reaction
Meloidogyne javanica	RARI, Durgapura	3.0	R
Heterodera cajani	IIPR, Kanpur	16	MR

***Note:** Gall index for *Meloidogynes* sps and Cysts for *Heterodera* sps

Table 11. Quality parameters of pigeonpea variety WRGE-121 along with check PRG-176

S. No.	Entry	Moisture (%)	Ash (%)	Crude Protein (%)	Crude Fat (%)	Crude Fiber (%)	CH_2O (%)
1	WRGE-121	10.20	4.62	23.09	1.53	2.36	58.20
2	WRGE-122	10.22	4.34	23.78	2.16	2.67	56.83
3	PRG-176 (Ch.)	9.25	3.37	21.20	1.46	3.54	64.72

Table 12. Mineral content of pigeonpea variety WRGE-121 along with check PRG-176

S. No.	Entry	Iron (ppm)	Zinc (ppm)	Calcium (ppm)
1.	WRGE-121	37.90	25.04	312.48
2.	WRGE-122	26.57	24.88	406.80
3.	PRG-176 (Ch.)	34.21	35.01	585.24

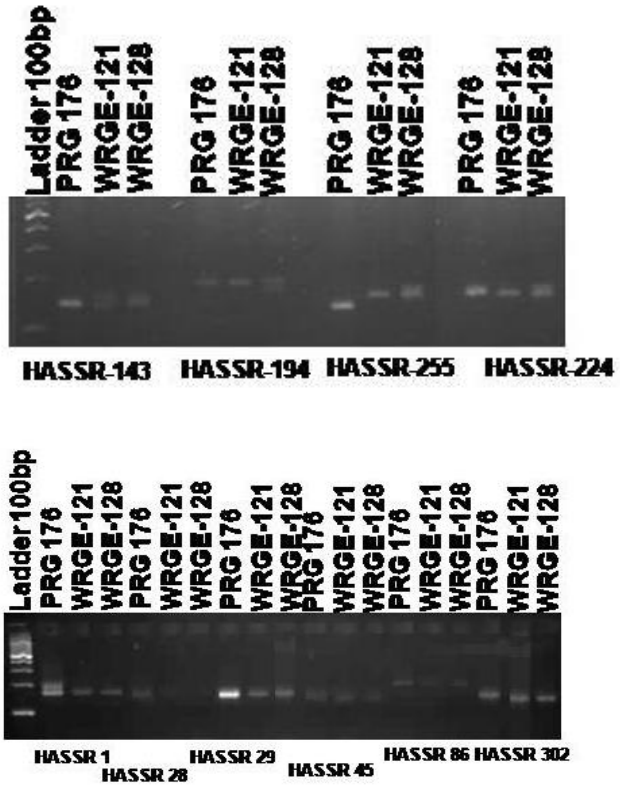

Fig. 5. DNA profiling of WRGE-121pigeonpea variety

The entry was allotted indigenous collection number IC 634964 from NBPGR, New Delhi.

Hence, based on the superiority of the pigeonpea culture WRGE-121 in mid early duration trials, it has been recommended for release by the Central Variety Identification Committee and notified (S.O.500(E)./29.01.2021) for cultivation in southern zone of India *viz.,* Tamil Nadu, Karnataka, Telangana, Andhra Pradesh and Odisha.

REFERENCES

FAOSTAT. 2020. Statistical database of food and agriculture organisation of the United Nations. Rome: FAO Statistics Division.

AICRP Annual Reports, 2017-2018. PP:44-53

AICRP Annual Reports, 2018-19. PP:62-66

AICRP Annual Reports, 2019-120. PP:42-43. [Cross Ref]

Association of Official Analytical Chemists (AOAC). 2012. Official Methods of

Analysis of AOAC International. Gaithersburg: AOAC International.

Association of Official Analytical Chemists (AOAC). 2000. Association of Official

Analytical Chemists Official journal 17th ed. Maryland: Gaithersburg, MD.