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.) Millspaugh] 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_{2}-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 Jayashankar 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
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) |
|----------------|-------------------|----------|--------------------------|----------------------|------------------|
| 2017-18        | 8                 | 1969     | 1534                     | 1537                 | 1722             |
| 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 | Virinjipuram | Mean | Per cent increase |
|----------------|-----------|----------|----------|---------|--------|--------------|------|-------------------|
| PT 0012 (C)    | 1955      | 406      | 1446     | 1973    | 1063   | 761          | 824  | 1050              | 29.92 |
| PRG-176 (C)    | 1914      | 308      | 1131     | 1583    | 1406   | 677          | 838  | 1124              | 21.46 |
| TS 3R (C)      | 1929      | 814      | 1341     | 2046    | 1337   | 981          | 920  | 537               | 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 pigeonpea culture WRGE-121 to major diseases viz., wilt and SMD along with the national checks were presented in Table 6 to Table 8. WRGE-121 recorded 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
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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 of WRGE-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)         |
|                                   |        | 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                           |                        |
| Helicoverpa armigera              | 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)          |
|                                   |        | Virinjipuram | 14.44            | 12.2                              | 14.44                           |                        |
| Maruca vitrata                    | 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)         |
|                                   |        | 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   | WRGE-121                     | 3.0                                           | *R*      |
| *Heterodera cajani*        | IIPR, Kanpur      | WRGE-121                     | 16                                            | *MR*     |

*Note:* Gall index for *Meloidogyne* spp and Cysts for *Heterodera* spp

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 (%) | CH₂O (%) |
|--------|-----------|--------------|---------|------------------|---------------|----------------|----------|
| 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-121 pigeonpea 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.

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