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TELANGANA KANDI 4 (TDRG 272): A HIGH YIELDING MID EARLY DURATION PIGEON PEA VARIETY ADAPTED TO SOUTHERN ZONE OF INDIA

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ABSTRACT

TDRG 272 is a high yielding mid early duration Pigeon pea culture developed at Agricultural Research Station, Tandur, Professor Jayashankar Telangana Agricultural University, Telangana. It was released by Central Variety Release Committee during 2024 in the name of Telangana kandi 4 and notified in 2025 for southern zone of India. It matures in 160-165 days in *kharif* and is suitable for both deep black soils and shallow red charka soils under rainfed or irrigated conditions. The culture recorded an average seed yield of 1659 kg/ha, which was 15.12% high over PT0012 (National Check) and 18.33% high over TS3R (Zonal Check). It is moderately resistant to *Fusarium* wilt and tolerant to Sterility Mosaic Disease. The culture recorded lower pod damage values due to pod borers and pod fly when compared to checks. The entry has good grain quality with good milling properties and is on par with the checks in terms of seed protein content.

Key words : Adaptability, Mid early, Pod borer, Sterility mosaic disease.

Introduction

Pigeon pea, commonly known as redgram or tur or arhar [*Cajanus cajan* (L.) Millsp.] is the second most important pulse crop after chickpea in India. It is extensively used as a source of protein in Indian diet especially by the vegetarian population (Bhattacharjee and Sharma, 2015). India contributes to about 85% to the global production and consumption making it a centre piece in attaining food security and agricultural sustainability (MoAFW, 2024). India is the largest producer of pigeon pea in the world with a production of 3.42 million tons from 4.13 million hectares of area, and a productivity of 827 kg/hectare during 2023-24 (DES, 2024). It is majorly cultivated in the states of Maharashtra, Madhya Pradesh, Karnataka, Uttar Pradesh, Gujarat, Jharkhand, Andhra Pradesh and Telangana.

Pigeon pea has multiple uses, besides its consumption in the form of dry split dhal, the tender green seeds are

used as vegetable and the stem and roots as fuel wood. It finds an important place in the farming systems adopted by small and marginal farmers as it restores the soil fertility by fixing atmospheric nitrogen. The heavy shedding of leaves adds considerable organic matter to the soil. It a favourite crop for low-input, rainfed farming situations of India as it is deep rooted, drought tolerant and requires less fertiliser. It is mostly cultivated by farmers in poor fertile soils under limited input management conditions during kharif season. Apart from the low input conditions and poor management practices, pigeon pea productivity is severely affected by diseases namely *Fusarium* wilt (FW), Sterility mosaic disease (SMD) and insect pests namely pod borers and pod flies.

Wilt caused by the soil borne fungal pathogen *Fusarium udum* is a serious problem in different states where it is predominantly cultivated. The infection ranges from 3–94% and highest mortality occurs during

flowering and podding stage leading to heavy losses (Kannaiyan *et al.*, 1980). The fungus enters the host immediately after germination through fine roots and subsequently colonizes in different plant parts including the vascular bundles affecting water transport to the shoots (Khune, 1990). The pathogen has a wide host range and survives for a long time in the field even in the absence of the host. Hence chemical control is ineffective and host plant resistance was found to be the most reliable, cost-effective, and eco-friendly approach for managing the disease (Saxena, 2008 and Jain *et al.*, 2015).

Sterility mosaic disease (SMD), caused by Pigeon pea sterility mosaic virus (PPSMV) and spread by eriophid mite (*Aceria cajani*) is an economically important viral disease affecting pigeon pea (Jones *et al.*, 2004; Sharma *et al.*, 2015). The disease manifests as a yellow mosaic, bushy pale green plants with excessive vegetative growth, reduced leaf size, stunting, leaf distortion, and partial or complete cessation of reproductive parts (Sai Prathap *et al.*, 2024). Chemical control of the vector was proven to reduce the losses but was found to be costly (De *et al.*, 1996 and Sudha Rani *et al.*, 2017). Hence, deployment of resistant/tolerant cultivars was found to be best approach for SMD management (Nene *et al.*, 1995).

Pigeon pea crop is attacked by several insect pests from seedling to pod maturation and harvesting stage especially by pod borers, which accounts for yield loss of more than 1000 dollars every year (Sharma *et al.*, 2001). About 250 species of insect pests belonging to 8 orders and 61 families have been reported to affect Pigeonpea (Sekhar *et al.*, 1991). *Helicoverpa armigera* (Gram pod borer) has attained the key pest prominence due to its direct attack on pods, voracious feeding habit, high mobility and fecundity. Its multi-voltine nature, overlapping generations with facultative diapauses, nocturnal behavior, migration, host selection and propensity for acquiring resistance against insecticides has made it as one of the most dreadful insect pests accounting for the consumption of over 30 per cent to the total insecticide use worldwide (Patoliya *et al.*, 2024).

Pod fly damage is difficult to identify because the adult fly inserts its eggs in immature pods through its ovipositor without any external signs of damage. The infested immature pods do not show external symptoms of damage until the fully-grown larvae turns in to an adult and escapes out through exit holes on the pod wall at maturity (Durairaj, 2006). Also adult flies are very minute and difficult to monitor in the field. Hence, Pod fly is called as a silent pod killer and difficult to control.

Continuous monitoring and Integrated pest management practices were suggested to reduce the pest severity

In order to improve the productivity under medium to low input conditions where Pigeonpea is cultivated in southern zone of India, which include deep fertile black soils to poor shallow red chalka soils, it is essential to identify high yielding mid early genotypes which mature early (160 days) and complete their life cycle before soil moisture recedes to affect seed yield significantly. Tolerance to wilt, SMD, pod borers and pod flies is indispensable to attain sustainable productivity in Pigeon pea with minimum production cost. Hence efforts were aimed for development of high yielding mid early Pigeon pea varieties with considerable wilt resistance, SMD tolerance, pod borer, pod fly tolerance that can be cultivated in a variety of soils (shallow to deep) spanning the state of Telangana as well in southern India.

Materials and Methods

TDRG 272 is derived from the cross between the parents RGT 44 and RGT 4. The F_1 was selfed and single plant selections were made from F_2 to F_5 generations at ARS, Tandur during *kharif* 2014 to *kharif* 2018. Medium plant height, sturdy stem, basal branching pattern, long pod bearing branches, higher pod number/plant, 3-4 seeds/pod, bold seed size and higher per se plant yield were the selection criteria followed for making selections in the

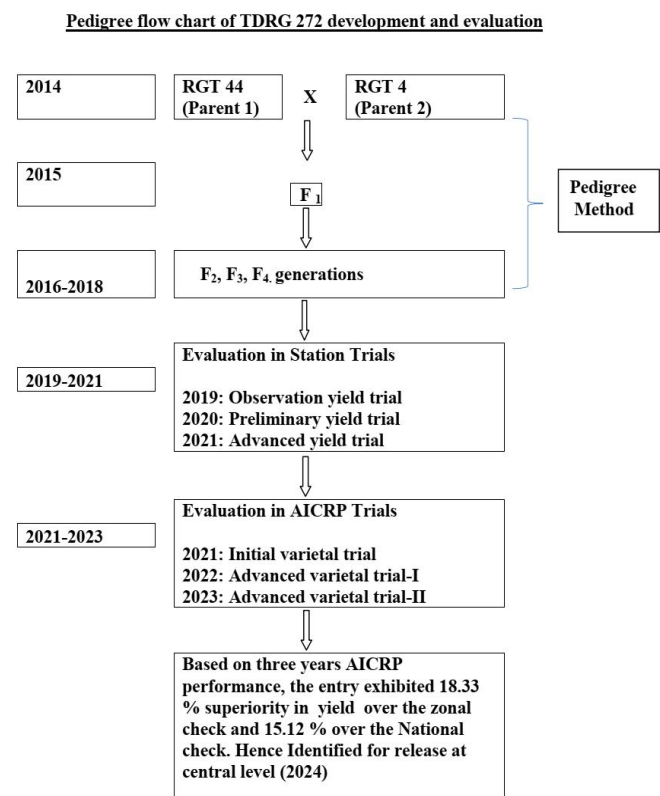


Fig. 1 : Pedigree chart of TDRG 272.



Fig. 2 : Field view, Flower, Pod, Seed and Dal of TDRG 272.

segregating generations. Uniform bulks were made in F_5 generation after attaining homogeneity within the progenies/families. The promising bulked progenies were tested in station trials (Observation Yield trial OYT, Preliminary yield trial, PYT and Advanced yield trial, AYT) at ARS, Tandur for three years from kharif 2019 to kharif 2021 and the promising culture TDRG 272 was identified. The culture was tested in All india coordinated trials (Initial varietal trial, IVT, Advanced varietal trial, AVT I and Advanced varietal trial, AVT II) from 2021-2023 and its performance with respect to yield, flowering duration, pest, disease resistance (through natural infestation at hot spot locations) were assessed. Proximate analysis was performed at Quality Control Laboratory, PJTAU, Rajendranagar, Hyderabad using standard procedures. Thus, the development of the culture was accomplished at ARS, Tandur and assessment of its performance was done through multilocation testing under AICRP system (Fig. 1, Tables 1, 2).

Results and Discussion

Yield performance

The yield performance of the Pigeon pea culture TDRG 272 was assessed for 3 years (2021-2023) in a total of 19 locations and the results were presented in Table 1. In IVT (2021), TDRG 272 recorded an average seed yield of 1435 kg/ha, which was 26.76% higher over the National check (NC) PT 0012, 12.9% over the Zonal check (ZC) TS3R and 26.9% over the local check (LC)

PRG 176. In AVT I (2022), the culture recorded average yield of 1770 kg/ha, which was 12.66% higher over PT 0012, 13.89% over TS3R and 42% higher over PRG 176. In AVT II (2023), it recorded an average yield of 1810 kg/ha which is 8.25% higher over PT 0012, 28.91% over TS3R and 16.10% higher over Zonal check WRGE 93. Based on three years data of weighted average of 19 locations in the southern zone, TDRG 272 recorded a seed yield of 1659 kg/ha, which is 15.12% high over PT 0012 (NC), 18.33% high over TS3R (ZC), 6.4% higher than WRGE 93 (ZC) and 40.10% high over PRG 176 (LC) (Tables 1, 2). Based on its superior performance in terms of seed yield when compared to national, zonal and local checks, it was identified by Central Varietal Release committee in 2024 and notified for the southern zone of India during 2025.

Disease Reaction

The disease reaction of the culture TDRG 272 to the major diseases *i.e.*, *Fusarium* wilt and Sterility Mosaic Disease (SMD) was presented in Tables 4 and 5. % 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 pigeon pea. TDRG 272 recorded a moderate resistant reaction to wilt with % wilt incidence (average of 2022, 2023) of 13.52 as against Resistant check ICP 8863 (8.26) and susceptible check ICP2376 (84.20) (Table 4). The culture recorded tolerance reaction to SMD with % incidence (average of 2022, 2023) of 36.42 as against the Resistant check ICP2376 (4.77) and susceptible check ICP8863 (86.51) (Table 5). Wilt and Sterility mosaic are the two major diseases affecting Pigeonpea production in India. Resistance breeding is the most feasible and cost effective strategy for their management. Extensive testing of germplasm and advanced breeding lines in pigeon pea resulted in identification of promising lines for regular use in breeding programs, underscoring the importance of host plant resistance. Several new resistance sources have been reported, deployed in breeding high yielding wilt resistant varieties by various Agricultural Research Institutions (Patidar, 2023). The present study is involved in the development of the culture which is moderately resistant to wilt and tolerant to SMD.

Pest Reaction

Major pests of Pigeonpea include gram pod borer *Helicoverpa armigera*, spotted pod borer *Maruca vitrata* and pod fly *Melanagromyza obtusa*. Their damage leads to considerable yield losses, necessitating urgent and effective management strategies (Sharma, 2016). To combat these insect pests, farmers use

Table 1 : Location wise and year wise seed yield (kg/ha) of Pigeon pea culture TDRG 272 and checks.

Year	Trial	Locations	TDRG 272	PT 0012 (National Check)	TS3R (Zonal Check)	WRGE93 (Zonal Check)	PRG176 (Local Check)	General Mean	CV (%)
2021	IVT (Mid early)	Warangal	1389	659	1010	-	735	1104	14.3
		Gulbarga	2308	1361	2007	-	766	1442	19
		Tandur	767	763	531	-	885	1058	12.81
		Banglore	1466	1543	1432	-	1243	1264	10.84
		Lam	2281	1848	2017	-	2364	2034	13.05
		Virnjapuram	1062	925	870	-	992	1003	14.52
		Berhampur	901	827	1033	-	932	1059	6.07
		Zonal Mean	1453	1132	1271	-	1131		
		% increase or decrease		(+) 28.3	(+) 14.3	-	(+) 28.4		
2022	AVT I (Mid early)	Warangal	1271	1671	1311	-	1300	1444	12.15
		Gulbarga	2437	2158	2217	-	1468	2084	18.8
		Banglore	1088	1704	1788	-	846	1469	12.58
		Lam	2202	1185	1352	-	1244	1573	9.2
		Tandur	1726	1664	1746	-	1735	1522	6.93
		Berhampur	1897	1046	908	-	885	1122	8.16
		Zonal Mean	1770	1571	1554	-	1246		
		% increase or decrease		(+) 12.66	(+) 13.8	-	(+) 42.0		
		2023	AVT II (Mid early)	Banglore	2191	2144	2009	1518	-
Gulbarga	2273			1731	1945	1516	-	1553	17.9
Warangal	1041			1278	859	1131	-	1027	15.5
Lam	1653			1347	1153	1385	-	1433	10.2
Tirupathi	1453			1467	956	2103	-	1522	14.9
Berhampur	2247			2065	1505	1701	-	1858	17.3
Zonal Mean	1810			1672	1404	1559	-	-	-
% increase or decrease				(+) 8.25	(+) 28.91	(+) 16.10	-	-	-

Table 2 : Summary of Yield data of TDRG 272 (kg/ha) and checks in All India Coordinated Research Project (AICRP) trials.

	Year of Testing	No. of Locations	TDRG 272	PT 0012 (National Check)	TS3R (Zonal Check)	WRGE 93 (Zonal Check)	PRG176 (Local Check)
Mean Yield (kg/ha)	2021 (IVT)	7	1435	1132	1271	-	1131
	2022 (AVT -I)	6	1770	1571	1554	-	1246
	2023 (AVT -II)	6	1810	1672	1404	1559	-
	Weighted mean	19	1659	1441	1402	1559	1184
% Increase or decrease over the checks	2021 (IVT)	7	-	(+) 26.76	(+) 12.90	-	(+) 26.9
	2022 (AVT -I)	6	-	(+) 12.66	(+) 13.89	-	(+) 42
	2023 (AVT -II)	6	-	(+) 8.25	(+) 28.91	(+) 16.10	-
	Weighted mean	19	-	(+) 15.12	(+) 18.33	(+) 6.4	(+) 40.10

Table 3 : Centre and year wise data of days to maturity (days) of Pigeon pea Variety TDRG 272 and checks.

Year and trial	Locations	TDRG 272	Check varieties			
			PT 0012 (National Check)	TS3R (Zonal Check)	WRGE 93 (Zonal Check)	PRG176 (Local Check)
2021 IVT	Warangal	159	158	156	-	157
	Gulbarga	163	160	148	-	160
	Tandur	169	163	164	-	171
	Banglore	170	162	144	-	144
	Lam	162	162	150	-	160
	Virnapuram	196	204	196	-	199
	Berhampur	168	167	156	-	161
	Zonal Mean	170	168	159	-	165
2022AVT-I	Warangal	146	133	130	-	143
	Gulbarga	159	159	158	-	166
	Banglore	142	158	154	-	154
	Lam	151	160	151	-	152
	Tandur	156	169	166	-	162
	Berhampur	165	165	163	-	161
	Zonal Mean	153	157	154	-	156
2023AVT-II	Banglore	169	168	167	181	-
	Gulbarga	169	168	157	178	-
	Warangal	170	164	156	161	-
	Lam	155	164	154	160	-
	Tirupathi	174	175	169	174	-
	Berhampur	158	161	162	164	-
	Zonal Mean	166	167	161	170	-
	Total mean	163	164	158	170	161

Table 4 : Reaction to *Fusarium* wilt disease (% wilt incidence) recorded in AICRP trials.

Disease, trial, year	Location (SZ)	TDRG 272	Resistant Check (ICP 8863)	Susceptible Check (ICP 2376)
<i>Fusarium</i> WiltAVT-I 2022	Bangalore	6.90	0.00	80.00
	ICRISAT	10.53	9.72	94.37
	Gulbarga	13.66	9.66	82.95
	Warangal	29.80	27.90	90.70
Average wilt incidence % in 2022		15.22	11.82	87.00
<i>Fusarium</i> WiltAVT – II2023	Banglore	0.00	4.32	55.66
	Gulbarga	17.73	8.21	96.35
	Warangal	17.75	3.25	73.54
	ICRISAT	11.81	3.02	100.00
Average wilt incidence % in 2023		11.82	4.70	81.39
Average Wilt incidence % over 2 years		13.52	8.26	84.20

Table 5 : Reaction to Sterility Mosaic Disease (Percent SMD incidence) in AICRP trials.

Disease, trial, year	Location(SZ)	TDRG 272	Resistant Check (ICP 2376)	Susceptible Check (ICP 8863)
Sterility Mosaic Disease AVT – I (Mid early)	2022	Bangalore	92.30	0.00 100.00
	Coimbatore	34.30	33.3	100.00
	ICRISAT	21.05	0.00	100.00
	Vijaypura	23.01	7.63	62
	Warangal	18.60	23.30	100.00
Average SMD incidence % in 2022		41.56	12.83	92.41
Sterility Mosaic Disease AVT – II (Mid early)	2023	Bangalore	90.9	0 100
	Coimbatore	23.34	0	85.12
	Vijaypura	5.56	6.67	57.14
	Warangal	58.3	8	93.30
	Dharwad	16.91	1.92	97.62
	ICRISAT	14.93	0	99.26
Average SMD incidence % in 2023		40.88	1.98	95.06
Average SMD incidence % over 2 years		36.42	4.77	86.51

Table 6 : Summary of reaction of TDRG 272 (% damage) and checks to insect pests at various locations under AICRP trials.

Locations, Year	Parameters	TDRG 272	Check entries		
			PRG176 (LC)	TS3R (ZC)	PT0012 (NC)
5 locations (Bangalore, Lam, Kalburgi, Virinjipuram, Warangal), 2022	% damage by Pod borers (<i>H. armigera</i> + <i>Maruca</i>)	19.7	19.8	22.0	21.0
	% damage by Pod fly (<i>M. Obtusa</i>)	13.4	12.6	12.0	13.1
6 locations (Bangalore, Lam, Kalburgi, Virinjipuram, Warangal), 2023	% damage by Pod borers (<i>H. armigera</i> + <i>Maruca</i>)	21.4	23.1	27.1	24.9
	% damage by Pod fly (<i>M. obtusa</i>)	11.1	15.0	13.0	10.8
Avg. % pod borer damage during 2 years based on 11 locations		20.6	21.5	24.6	23.0
Avg. % pod fly damage during 2 years based on 11 locations		12.3	13.8	12.5	12.0

insecticides that lead to the development of insecticide resistance in the insect population, residual toxicity in pigeonpea grains, which affects human and environmental health (Harischandra *et al.*, 2021). The culture TDRG 272 (20.6) recorded lesser average pod damage values at 11 locations during 2022 and 2023 due to gram pod borer and Spotted pod borer when compared to the three checks PRG 176 (21.5) TS3R (24.6) and PT0012(23). The culture recorded lesser average pod fly damage of 12.3 % when compared to the PRG 176 (13.8) and TS3R (12.5) and on par values with respect to PT 0012 (Table 6). The pod borer complex is reported to reduce the yields up to 27.77 per cent in pigeonpea (Sahoo and Senapati, 2000). There is a need to identify sources of resistance/ tolerance and design appropriate breeding strategies to

develop suitable varieties. (Thakur, 2023). The present study has led to the development a pod borer tolerant variety that can reduce the consumption of pesticide, reduce the risks of soil and water pollution and cut the cost of cultivation of the pigeon pea farmer.

Agronomic trials

The entry TDRG 272 was tested in Agronomic trials conducted at 5 locations during *khari* 2023 along with Zonal and local checks. It has recorded higher seed yield over the checks at three locations namely Berhampur, Coimbatore and Warangal and on par yield with the local check at 2 locations Bangalore and Gulbarga (Table 7). Highest mean seed yield (1144 kg/ha) over the checks indicates its superiority and stability of performance across

Table 7 : Yield data (kg/ha) of TDRG 272 and checks in Agronomic trials of AICRP during *kharif* 2024.

S. no.	Location/Entry	Bangalore	Berhampur	Gulbarga	Coimbatore	Warangal	Mean
1	TDRG 272	646	1364	1169	1212	1329	1144
2	PRG 176(ZC)	643	1299	998	950	1232 (WRGE 93)	1024
3	BRG-4 (LC)	655	1347	1264 (TS3R)	1014	1321 (WRGE 97)	1120
	S.E. (m) ±	25	71	20	21.83	17.2	-
	CD (p=0.05)	75	NS	98	54.58	52.0	-

Table 8 : Centre and year wise data of test Weight (100 grain weight in g) of Pigeon Pea Variety TDRG 272 and checks.

Year and trial	Locations	TDRG 272	Check varieties			
			PT 0012 (National Check)	TS3R (Zonal Check)	WRGE 93 (Zonal Check)	PRG176 (Local Check)
2021, IVT	Warangal	12.17	9.42	11.61	-	10.52
	Gulbarga	12	8.5	10.9	-	9.1
	Tandur	12.2	9.6	13	-	10.2
	Banglore	11.1	9.07	11.27	-	9.87
	Lam	13.8	9.83	13.1	-	11.13
	Virnapuram	9.8	9.1	9.2	-	10.1
	Berhampur	11.66	8.53	12.96	-	9.7
	Zonal Mean	11.82	9.15	11.72	-	10.09
2022, AVT-I	Warangal	10.24	7.84	9.84	-	8.67
	Gulbarga	8.9	8.3	9.4	-	8.2
	Banglore	10.73	9.67	10.2	-	10.17
	Lam	12.3	10.4	13.4	-	11.3
	Tandur	10.7	10.3	10.9	-	9.8
	Berhampur	11.26	8.67	12.01	-	9.12
	Zonal Mean	10.69	9.2	10.96	-	9.54
	2023, AVT-II	Banglore	11.7	9	11.7	9.6
Warangal		10.6	11.5	9.4	10.5	-
Lam		12.5	10.3	12.3	11.2	-
Tirupathi		12.6	10	12.5	10.6	-
Berhampur		13.2	10.2	13.4	10.6	-
Zonal Mean		12.1	10.2	11.9	10.5	-
Total mean		11.5	9.5	11.5	10.5	9.8

locations.

Quality analysis

TDRG 272 recorded similar test weight with respect to the check TS3R (11.5g) and higher values when compared with the checks PT 0012 (9.5g), PRG 176

(9.8g) and WRGE 93 (10.5g) (Table 8). Higher grain weight in the range of 10-12 g is favourable for milling and dhal making with minimal milling loss to the farmer. TDRG 272 recorded similar seed protein content values (22.37%) when compared with the checks PT 0012

Table 9 : Proximate analysis in TDRG 272 and Checks during 2023.

S. no.	Entry	Moisture (%)	Crude Protein (%)	Crude fat (%)	Ash (%)	Carbohydrate (%)
1	TDRG 272	9.8	22.37	2.05	3.54	62.24
2	PRG 176 (LC)	9.97	22.89	2.04	3.56	61.54
3	PT 0012 (NC)	9.70	21.44	2.07	3.43	63.36
4	TS3R (ZC)	9.67	23.89	1.85	3.49	61.10

(21.44%), TS3R (23.89%) and PRG 176 (22.89%) (Table 9). The protein content in pigeon pea varies from 15.5 to 28.8% and depends on complex genetic and environmental interactions (Saxena *et al.*, 2023, Salunkh *et al.*, 1989). Insufficient dietary protein intake and inadequate consumption of essential micro nutrients significantly contribute to Protein-energy malnutrition (PEM), which affects young children under five and elderly people above 65. In India, the per capita availability of dietary protein stands at 48/ g/day, which is considerably lower than the World Health Organization's (WHO) recommended intake of 80/ g/day. This protein deficiency poses a significant challenge, especially for poor populations that primarily consume vegetarian diets and avoid animal-based protein sources (Pranati *et al.*, 2024). To address this issue, it is crucial to identify and promote protein-rich food sources that can improve food security and nutritional well-being. The nutritional attributes namely protein quality, carbohydrate fractions, and digestibility patterns in pigeon pea genotypes were well studied (Tiware *et al.*, 2025). The present study resulted in identification of a culture that is on par with the checks in terms of protein content but far superior in terms of yield, quality, duration and resistance.

Conclusion

Seed yield, mid early duration, grain quality, wilt resistance, sterility mosaic disease tolerance, tolerance to pod borers and pod flies are highly complex and involve major Genotype/Environment interactions. Focussed efforts at ARS, Tandur since 2014 could help in breeding and identification of 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 due to pod borers and pod fly, mid early duration, good grain quality, the Pigeon pea culture TDRG 272 was released by the Central Variety Identification Committee in 2024 and notified in 2025 (S.O.2128 (E)/ 13.05.2025) for general cultivation in the southern zone of India spanning the states of Telangana, Andhra Pradesh, Karnataka, Tamil Nadu and Odisha.

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Competing interests

Authors have declared that no competing interests exist.

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