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Research Article

A high yielding pigeonpea variety CRG 2012-25 as CO 9 released for Southern Zone of India

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Abstract
A long duration high yielding Pigeonpea culture CRG 2012-25 as CO 9 was developed at the Department of Pulses, Centre for Plant Breeding and Genetics, Tamil Nadu Agricultural University, Coimbatore was released by Central Variety Release Committee during 2019. It is a cross derivative of CO 6 x IC 525427 with a duration of 170 -180 days, suitable for *kharif* sowing. This variety yields on an average yield of 1700 kg/ha which is 17.58, 19.00 and 14.61 per cent yield increase over CO 6 (Local check), WRP 1 (Zonal check) and ICP 8863 (national check), respectively. It recorded maximum yield of 2697 kg/ha in Tandur, Telangana. This variety has bold seeds (100 seed weight of 9.0 - 10.0 g) with a protein content of 23.65 per cent. It is moderately resistant to wilt and SMD diseases and the pests *viz., Maruca* and pod fly. This variety is suitable for the southern zone of India which includes Tamil Nadu, Karnataka, Telengana, Andhra Pradesh and Odisha.

Key words
Pigeonpea variety, long duration, national release, the southern zone

INTRODUCTION

Pigeonpea [*Cajanus cajan* (L.) Millispaugh.] is the second most important protein-rich pulse crop in India after chick pea and 5th most important crop in the world (Singh *et al.,* 2015). Pigeonpea supplies a major share of protein requirement of vegetarian population of the country. It contains about 22 per cent of protein, which is almost three times than that of cereals (Bajpai *et al.,* 2003). Its main use as pulse, its tender green seeds are used as vegetable and crushed dry seeds as animal feed, fodder, fuel, wood, etc. It plays an important role in sustaining soil productivity by fixing atmospheric N_2 and its fallen leaves enrich the soil with organic matter thus help in maintaining soil fertility. India is the largest producer of the crop contributing to 85 per cent of the total production in the world. In India, the crop occupies an area of 5.39 m. ha with an annual production of 4.87 m. t. and the productivity of 903 / ha (FAOSTAT, 2019).

The World Health Organisation recommended per capita consumption of protein around 80 g/day whereas the per capita availability of protein in the country is about 28 g /day leads to malnutrition for the growing population Saroj *et al.*(2013). To meet the protein needs genetically stable high yielding varieties are mandatory. The major constraints for productivity of Pigeonpea are inadequate availability of seeds of improved varieties, biotic and abiotic stress and poor crop management. Keeping this importance, pedigree breeding was employed to develop high yielding and long duration variety in Pigeonpea.

MATERIALS AND METHODS

Hybridization programme was made between CO 6 and IC 525427.The selection of Pigeonpea culture CRG 2012-25 was made during 2007. Preliminary Yield Trail and Comparative Yield Trails were conducted during *kharif*

2013 and *kharif* 2014. This culture was proposed and tested in Multi Location Trial (MLT) and Initial varietal Trial (IVT) during *kharif* 2015. It was promoted to Advanced Varietal Trial (AVT) I and II during 2016-17 and 2017-18, respectively. The performance was tested in 26 locations of the southern zone of India. Natural and artificial screening was also carried out for its pests and diseases reaction in different locations *viz*., Badnapur, Bangalore, Coimbatore, ICRISAT, Varanasi and Warangal.

RESULTS AND DISCUSSION

The overall yield performance of the Pigeonpea culture CRG 2012-25 was presented in **Table 1.** In AICRP trial, an average yield of CRG 2012-25 (26 locations in 2016-2018) was 1678 kg/ha which is 17.58 per cent superior yield than CO 6(local check), 19 per cent increased yield than the WRP-1(Zonal check) and 14.61 per cent increased yield than the national check ICP 8863.

In IVT, CRG 2012-25 has recorded an average yield of 1426 kg/ha which is 12.41 per cent increased yield than WRP-1 (Zonal check), 11.71 per cent over CO 6 (local check) and 6.45 per cent over ICP 8863 (national check) (**Table 2**).

Table 1. Grain yield (kg/ha) of pigeon pea variety CRG 2012-25 under AICRP trials conducted in the southern zone during 2015-2017

	Year of testing	Number of locations	CRG 2012-25	ICP 8863 (National Check)	WRP-1 (Zonal Check)	CO 6 (Local check)
Mean yield (kg/ha)	2015	8	1426	1334	1249	1259
	2016	9	1945	1575	1495	1566
	2017	9	1636	1468	1458	1437
	Weighted Mean	26	1678	1464	1410	1427
Per cent increase over the check varieties	2015			6.89	14.17	13.26
	2016			23.49	30.10	24.20
	2017			11.44	11.44	13.84
	overall percent increase			14.61	19.00	17.58

Table 2. Grain yield (kg/ha) of pigeon pea variety CRG 2012-25 in IVT trial conducted in the southern zone during 2015

Entries	Vamban	Coimbatore	Warangal	Gulbarga	Bangalore	Lam	Tirupati	Hiriyur	Mean	Per cent increase
Check varieties										
ICP 8863	949	926	1510	1132	1780	1758	1175	1444	1334	6.45
CO 6	1164	1344	1042	854	1487	2064	542	1576	1259	11.71
WRP-1	964	779	1484	1153	1322	1709	1185	1400	1249	12.41
Proposed culture										
CRG 2012-25	1169	1644	1128	1113	1631	1743	1259	1720	1426	

Table 3. Grain yield (kg/ha) of Pigeon pea variety CRG 2012-25 in AVT 1 trial conducted in the southern zone during 2016

Entries	Vamban	Coimbatore	Warangal	Gulbarga	Tandur	Bangalore	Lam	Tirupati	Hiryur	Mean	Per cent increase
Check varieties											
ICP 8863	1045	1203	1833	2173	1609	1635	2096	1339	1243	1575	19
CO 6	1338	2156	1227	614	2106	1764	2211	1751	931	1566	19.5
WRP-1	940	1316	1618	1997	1713	1004	2268	1723	877	1495	23.13
Proposed culture											
CRG 2012-25	1370	2480	1972	1431	2697	1911	2196	2114	1336	1945	

Table 4. Grain yield (kg/ha) of Pigeon pea variety CRG 2012-25 in AVT 2 trial conducted in the southern zone during 2017

Entries	Vamban	Coimbatore	Warangal	Gulbarga	Tandur	Bangalore	Lam	Tirupati	Hiryur	Mean	Per cent increase
Check varieties											
ICP 8863	962	948	1933	1968	1611	1209	1845	1079	1656	1468	10.26
CO6	1397	1088	1273	576	1596	1834	2062	1543	1565	1437	12.16
WRP-1	1000	957	1752	2441	1615	1175	1175	969	1597	1409	13.87
Proposed culture											
CRG 2012-25	1211	1685	1965	1403	1991	1475	1857	1510	1628	1636	

Table 5. Distinguishing morphological characters of the culture CRG 2012-25 and local check CO 6 (as per PPV & FRA)

S.No.	Characteristics	CRG 2012-25	CO 6
1	Plant anthocyanin coloration of hypocotyls	Absent	Absent
2.	Plant –branching pattern	Erect	Erect
3.	Time of flowering	Medium (120-130 days)	Medium (120-130 days)
4.	Plant growth habit	Indeterminate	Indeterminate
5.	Stem colour	Green with brown stripes	Green
6.	Leaf shape	Oblong	Oblong
7.	Leaf: Pubescence on lower surface of the leaf	Absent	Absent
8.	Flower: Colour of base of petal (Standard)	Yellow	Yellow
9.	Flower: Pattern of streaks on petal (standard)	Medium	Medium
10.	Pod : Colour	Green with brown streaks	Green with purple streaks
11.	Pod: Pubescence	Present	Present
12.	Pod: Waxiness	Absent	Absent
13.	Pod: Surface stickiness	Present	Present
14.	Pod: constriction	Prominent	Prominent
15.	Pod length	5.3-6.0 (cm)	5.1-5.5 (cm)
16.	Pod: Number of seeds	5-6	4-5
17.	Plant height	Tall (210-240 cm)	Tall (160-180 cm)
18.	Seed colour	Brown	Brown
19.	Seed: colour pattern	Uniform	Uniform
20.	Seed shape	Globular	Globular
21.	Seed :Size (100 seed weight)	Large (9.0-10.0 g)	Medium (7.6 to 8.8g)

Table 6. Reaction (%) to wilt disease in Pigeon pea variety CRG 2012-25 and checks during *kharif* 2016 under the field condition

Entries	South zone			
	Bangalore	Gulbarga	ICRISAT	Warangal
CRG 2012-25	12.4	12.8	9.3	8.3
ICP 2376 (Susceptible check)	86.9	92	95.9	87
ICP 8863 (Resistant check)	8.4	10	3.1	9.3

In AVT 1, CRG 2012-25 recorded an average yield of 1945 kg/ha which is 19 , 19.5 and 23.13 per cent, increased yield than ICP 8863 , CO 6 and WRP-1 ,respectively (**Table 3**).

In AVT 2, CRG 2012-25 recorded an average yield of 1636 kg/ha which is 10.26 per cent increased yield over ICP 8863, 13.87 per cent increased yield than WRP-1 and 12.16 per cent increased yield than CO 6 (T**able 4**).

Table 7. Reaction (%) to wilt disease in Pigeon pea variety CRG 2012-25 and checks during *kharif* 2017 under the field condition

Entries	South zone			
	Bangalore	Gulbarga	ICRISAT	Warangal
CRG 2012-25	26	20.83	8.6	9.5
ICP 2376 (Susceptible check)	100	75.9	100	90

Table 8. Reaction(%) to SMD disease in Pigeon pea variety CRG 2012-25 and checks under the artificial epipytotic conditions during *kharif* 2016

Entries	Badnapur	Bangalore	Coimbatore	ICRISAT	Varanasi	Warangal
CRG 2012-25	9.7	19.9	15.9	15	23	13.3
Bahar (Resistant check)	-	-	-	-	-	11.1
ICP 8863 (Susceptible check)	100	100	100	100	100	100

Table 9. Reaction(%) to SMD disease in Pigeon pea variety CRG 2012-25 and checks under the artificial epipytotic conditions during *kharif* 2017

Entries	Coimbatore	ICRISAT	Warangal
CRG 2012-25	15.4	21.4	8.3
ICP 8863 (Susceptible check)	100	-	-

Table 10. Reaction of CRG 2012-25 to major insect pests of under Natural condition

Centre	Insect name	Condition	Year	CRG 2012-25 (Damage %)	UPAS 120 (National Check) (Damage %)	CO 6 (Local check) (Damage %)
Bengaluru	*Helicoverpa*	Natural	2016	16.0	-	13.5
			2017	15.97	-	11.24
	Maruca	Natural	2016	-	-	-
			2017	1.43	-	1.81
	Pod fly	Natural	2016	4.50		6.90
			2017	4.24	-	3.66
Coimbatore	*Helicoverpa*	Natural	2016	-	-	-
			2017	3.7	4.0	6.3 (CO 8)
	Maruca	Natural	2016	-	-	-
			2017	4.7	5.0	5.7 (CO 8)
	Pod fly	Natural	2016	-	-	-
			2017	8.7	6.0	8.0
Gulbarga	Pod borers	Natural	2016	22.2	22.9	20.5
			2017	21.96	24.32	17.38
Guntur	*Helicoverpa*	Natural	2016	10.5	7.0	8.3
			2017	4.7	5.0 (WRP 1)	6.7(LRG 52)
	Maruca	Natural	2016	14.5	13.4	20.2
			2017	7.17	13.3(WRP 1)	16.2
	Pod fly	Natural	2016	5.1	6.2	12.1
			2017	7.0	8.1 (WRP 1)	9.2

Warrangal	*H. armigera*	Natural	2016	21.3	9.3	12.3
			2017	-	-	-
	Maruca	Natural	2016	0.7	2.0 (WRP 1)	1.3
			2017	-	-	-
	Pod fly	Natural	2016	6.0	20.3(WRP 1)	19.2
			2017	-	-	-
Vamban	*H. armigera*	Natural	2016	2.5	5.0	3.3
			2017	-	-	-
	Maruca	Natural	2016	4.2	4.4	3.4
			2017	-	-	-
	Pod fly	Natural	2016	2.7	13.0	8.3
			2017	-	-	-

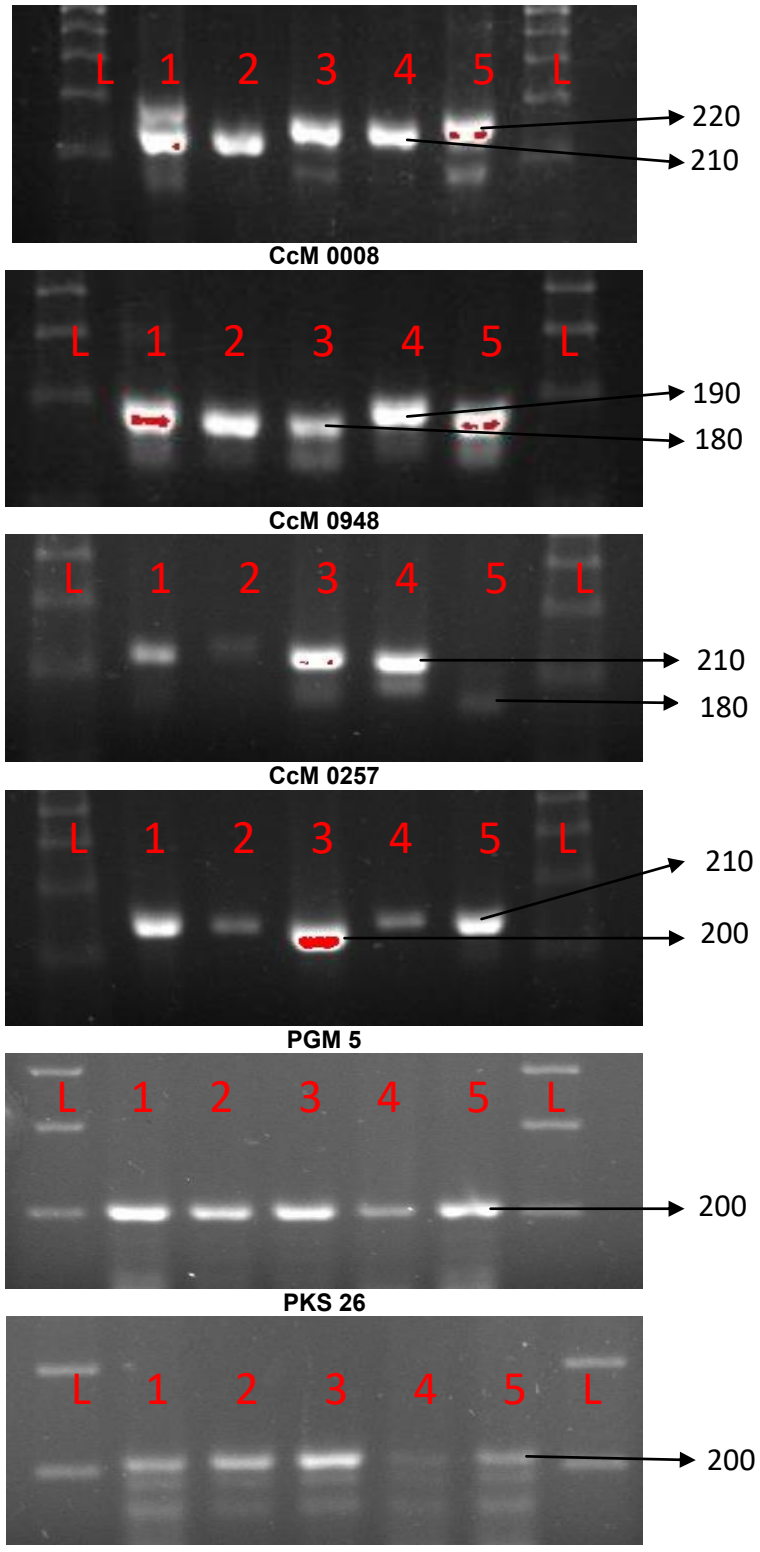
Table 11. Grain quality characteristics of Pigeon pea variety -CRG 2012-25 along with check CO 6

Variety	Pigeon pea Whole		Pigeon pea (dhal)	
Characteristics	**CO 6**	**CRG 2012-25**	**CO 6**	**CRG 2012-25**
Physical characteristics				
Length (cm)	0.6	0.62	0.58	0.6
Breadth(cm)	0.49	0.55	0.47	0.54
Thickness(cm)	0.30	0.38	0.08	0.09
100 dhal weight(g)	9.78	11.76	3.95	5.02
Sprouting volume(100 g)	176.0 ml	215.0 ml	-	-
Chemical properties				
Moisture g/100g	10.70	10.90	11.04	11.65
Ash g/100g	3.54	3.62	2.71	2.75
Protein g/100g	18.92	19.56	21.27	23.65
Starch g/100g	58.0	55.0	55.7	56.7
Fat g/100g	1.62	1.86	1.31	1.2
Crude fiber g/100g	6.7	6.78	2.05	2.09
Iron mg/100g	2.33	2.62	2.02	2.12
Cooking quality				
Cooking time (min)(open)	39	32	28	20
Increase in volume ratio	1:1.95	1:2.25	1:1.90	1:2.03
Organoleptic testing				
Color and acceptance	8	9	9	9
Flavour	8	9	8	9
Texture	8	9	8	9
Taste	8	9	8	9
Overall acceptability	8	**9**	8	9

As per the guidelines from PPV and FRA, New Delhi distinguishing morphological characters of the culture CRG 2012-25 was formulated and compared with the check variety CO 6. (**Table 5**). CRG 2012-25 has green with brown streaks pods, brown seeds and 100 seed weight of 9-10 grams.

The reaction of pigeon pea culture CRG 2012-25 to major diseases *viz*., wilt and SMD along with the national checks were presented in **Table 6 to Table 9**. CRG 2012-25 recorded a moderate resistant reaction to wilt and SMD. The reaction of pigeon pea variety CRG 2012-25 to major pests *viz*., *Maruca* and pod fly along with the national checks were presented in **Table 10.** CRG 2012-25 recorded a moderate resistant reaction to *Maruca* and Pod fly.

The results of the organoleptic evaluation of the dhal also revealed the superiority of this culture with the overall acceptability score of 9 (**Table 11**).



L-100bp Marker, **1**-BRG 2, **2**-BRG 3, **3**-Malaituvarai Local, **4**-CRG 13-01, **5**-CRG 2012-25

Fig.1. DNA finger printing profile for CRG 2012-25 (as CO 9) redgram

DNA finger printing of Pigeon pea culture CRG 2012-25 was done with varieties viz., BRG2, BRG3, Malaituvarai Local and CRG 13-01 using Pigeon pea specific SSR markers *viz*., CcM 1026, CcM 0008, CcM 0257, CcM 0948, PGM 5 and PKS 26. Out of this, four markers *viz*., CcM 1026, CcM 0008, CcM 0257 and CcM 0948 were found to be polymorphic and clearly differentiated CRG 2012-25 with other varieties (**Fig.1**).

Hence, based on the superiority of the pigeon pea culture CRG 2012-25, it has been recommended for release by the Central Variety Identification Committee and notified (SO 220(E)/5.9.2019) for cultivation in southern zone of India *viz*., Tamil Nadu, Karnataka, Telangana, Andhra Pradesh and Odisha.

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