ICP 7035 – A Sterility Mosaic Resistant Vegetable and Grain Purpose Pigeonpea Variety

KT Rangaswamy[1], V Muniyappa[1], P Lava Kumar[2]*, KB Saxena[2], M Byregowda[1], N Raghavendra[1], K Pandurangaiah[1], R Vijay Kumar[2], F Waliyar[2] and **AT Jones[3]** (1. University of Agriculture Sciences, Bangalore 560 065, India; 2. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru 502 324, India; 3. Scottish Crop Research Institute, Invergowrie DD2 5DA, Scotland, UK)
*Corresponding author: p.lavakumar@cgiar.org

Pigeonpea (*Cajanus cajan*) is an important pulse crop in Karnataka, India. Sterility mosaic disease (SMD), caused by the pigeonpea sterility mosaic virus (PPSMV) and transmitted by an eriophyid mite, *Aceria cajani,* is a major problem of pigeonpea (Jones et al. 2004). Pigeonpea yields have been declining due to heavy and recurring occurrence of the SMD in southern Karnataka. Most of the pigeonpea genotypes available for farmers are highly susceptible to the SMD. This was more so because of the PPSMV isolate prevalent in southern Karnataka–the Bangalore (B) isolate–is highly virulent and host-plant resistance to it are scarce. ICP 7035, a landrace collected in 1973 from Bedaghat (near Jabalpur) Madhya Pradesh state, India (Sharma and Reddy, unpublished), was found to be consistently resistant to PPSMV-B isolate. ICP 7035 was evaluated against ten PPSMV isolates at several locations in India, and the genotype was found resistant to all these isolates (Reddy et al. 1993; Kumar et al., unpublished).

ICP 7035 was evaluated, along with the two local varieties, TTB7 and Hy3C, in SMD and wilt nursery at the Gandhi Krishi Vignana Kendra (GKVK), Bangalore;

Figure 1. ICP 7035: Pod bearing plant (A), vegetable pods (B), dried whole seed (C) and dried decorticated split seeds - *dhal* (D).

Table 1. Green pod and grain yield of three pigeonpea genotypes at Bangalore.

	% SMD			Green pod yield (kg ha^{-1})[1]			Grain yield (kg ha^{-1})[1]		
Year	ICP7035	Hy3C	TTB7	ICP7035	Hy3C	TTB7	ICP7035	Hy3C	TTB7
1999	0	15.5	60.5	5085	4521	1785	–[2]	–	–
2000	0	11.0	82.0	3551	2958	101	–	–	–
2001	0	18.2	75.5	4268	3658	1210	1905	1825	2357
2002	0	23.0	90.3	6107	5189	521	1349	1312	1706
2003	0	<2.0	–	7153	7101	–	1824	1736	–
Mean	0	16.93	77.08	5232.8	4685.4	904.25	1692.6	1624.3	2031.5

1. Green pod and grain yields are from separate trials
2. '–' not tested

and also under natural conditions in the State Agriculture Research Stations and farmers' fields in Bangalore Rural, Tumkur and Kolar districts of Karnataka, during 1999–2004 rainy seasons. ICP 7035 produced a mean vegetable pod yield of 5232.8 kg ha^{-1} and dry seed yield of 1692.6 kg ha^{-1} as compared to 4685.4 kg ha^{-1} mean vegetable pod yield and 1624.3 kg ha^{-1} of dry seed yield for Hy3C (Table 1). Average SMD incidence in susceptible cultivars ranged from less than 2.0 to 90.3% during various years, but ICP 7035 remained free from SMD (Table 1). Stability of SMD resistance in ICP 7035 was verified by exposing test plants to high dose of PPSMV-B inoculum using viruliferous *A. cajani* by following the leaf-stapling technique. Plants were monitored for PPSMV by ELISA method as described in Kumar et al. (2002). All inoculated plants remained symptom free and

Table 2. Morphological, cooking and nutritional characters of three pigeonpea genotypes.

Character	ICP7035	Hy3C	TTB7
Plant characters			
Plant height (cm)[1]	160-180	160-170	160-180
Stem colour	Green	Purple	Green
Flower arrangement	Intermediate	Clusters	Clusters
Flower colour	Yellow purple	Red	Yellow
Pod colour	Purple with dark green streaks	Green with black streaks	Green with black streaks
Seed coat colour (fresh)	Light purple and mottled	Light green and plain	Light green and plain
Seed colour (fresh)	Plain green	Plain green	Plain green
Seed coat colour (dry)	Brown and mottled	Dull white	Brown
Seed (dhal) colour (dry)	Yellow	Dull white	Yellow
Days to 50% flowering	75–80[2]	80–90[2]	90–100[2]
Days to maturity	160–170[2]	170–180[2]	180–200[2]
Pods per plant[3]	90–110	70–80	90–110
Seeds per pod	5	4–5	4-5
Pod length (cm)	7.5	–[4]	–
100 fresh seed weight (g)	39.6	20.5	17.21
100 dry seed weight (g)	19.2	16.1	10.5
100 fresh pod weight (g)	254.2	–	79.63
Post harvest qualities of dried seed[5]			
Good quality split seed (dhal) (%)	85.8	86.47	85.53
Broken split seeds (%)	1.72	0.78	2.62
Recovery of husk (%)	14.52	14.74	13.54
Nutritional factors in dhal[6]			
Cooking time of vegetable seed (min)	35.62	35.25	35.33
Cooking time of dhal (min)	47.7	42.3	36.8
Water absorption (%)	102.06	104.12	102.54
Solids in the aqueous extract (%)	10.63	12.21	11.46
Moisture (%)	11	10.8	8.1
Protein in dried seeds (%)	19.6	22.14	23.6
Soluble sugars (%)	5.3	3.7	–
Fat (%)	2.4	2.3	–
Methionine (mg g^{-1} of seed)	1.99	2.07	–
Methionine (mg g^{-1} of protein)	8.82	9.35	–
Cystine (mg g^{-1} of seed)	1.80	1.87	–
Cystine (mg g^{-1} of protein)	7.98	8.45	–

1. At the time of pod maturity (around 170 days; plant can grow up to 2 m).
2. In Bangalore region.
3. First pod picking at maturity (around 170 days).
4. '–' Not tested.
5. Determined with mechanical 'dhal' mill.
6. Estimated at Pristine Laboratories, Bangalore.

tested negative to PPSMV, and no vector multiplication observed on these plants. To determine whether the observed resistance was against virus and/or due to vector non-preference, the genotype was tested by petiole graft inoculation as described in Kumar et al. (2002). All graft-inoculated ICP 7035 remained uninfected, indicating that plants were resistant to the virus. ICP 7035 was also evaluated for fusarium wilt and alternaria blight resistance at GKVK, Bangalore. The genotype showed moderate resistance to both these fungal diseases (<10% incidence), whereas TTB-7 is highly susceptible to wilt and blight, and Hy3C is moderately resistant to wilt (<10% incidence), but it was not tested against blight. Up to 35.7% *H. armigera* incidence was observed on ICP 7035, whereas on TTB7 and Hy3C, it was 55.3% and 28.75%, respectively.

ICP 7035 is a medium duration, non-determinate variety. Plants mature in 170–200 days (in south-central regions of India) and at this stage it reaches to an average height of 120–140 cm (Fig 1). Each plant produced around 100 pods and each pod contained 5 seeds, which are nutritionally rich and contain highest percent of digestible carbohydrates, vitamins and micronutrients (Table 2). Fresh seeds are large (9–11 mm diameter) with purple seed coat and green cotyledons, and suitable for consumption as vegetable (Table 2). Fresh seed contains 8.6% protein, 12% fibre and 45.7% carbohydrate and starch. The pinkish-purple colour of pod and seed coats was due to high anthocyanin content, which adds to health benefits as dietary antioxidants. In addition, sweetness of the pigeonpea seed is a preferred trait for vegetable purpose. While normal sugar levels in most pigeonpea varieties is about 5%, sugar content in ICP 7035 seeds is 8.8% (Faris et al. 1987). Decorticated dried split seeds measures 5–6 mm in diameter and 100 dried seeds weigh 19.2 g (Table 2). It contains 19.6% protein, 27.4% dietary fibre, 33% starch, and 67% carbohydrate. It is also rich in copper, calcium, magnesium, phosphorous, and has good dhal making quality.

SMD resistance in ICP 7035 has positive impact on yield as a result of negligible crop loss in endemic areas contributing to the revenue gains to the farmers at no additional cost. Under no disease situation, the crop yields are on par with the local varieties. ICP 7035 does not alter input requirements from existing practice. Cultivation of ICP 7035 prevents buildup of SMD inoculum during the cropping and off-season and controls the disease spread in the fields. Recently, provisional approval was given for the release of this variety in SMD endemic areas of southern Karnataka.

Acknowledgment. This document is an output from a project funded by the Crop Protection Program, Department for International Development (DFID), United Kingdom (Project No. R8205). The views expressed are not necessarily those of DFID.

References

Faris DG, Saxena KB, Mazumdar S and **Singh U.** 1987. Vegetable pigeonpea: a promising crop for India. Patancheru, Andhra Pradesh, 502 324, India: International Crops Research Institute for the Semi-Arid Tropics. 13 pp.

Jones AT, Kumar PL, Saxena KB, Kulkarni NK, Muniyappa V and **Waliyar F.** 2004. Sterility mosaic disease – the "green plague" of pigeonpea: advances in understanding the etiology, transmission and control of a major virus disease. Plant Disease 88:436–445.

Kumar PL, Jones AT and **Reddy DVR**. 2002. Pigeonpea sterility mosaic virus: detection and screening for resistance. Methods manual. ICRISAT, Patancheru 502 324, India, 65 pp.

Reddy MV, Raju TN, Nene YL, Ghanekar AM, Amin KS, Arjunan G, Astaputre JV, Sinha BK, Reddy SV, Gupta RP and **Gangadharan K.** 1993. Variability in sterility mosaic pathogen in pigeonpea in India. Indian Phytopathology. 46:206–212.