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Short Communication

Inheritance of white seed coat colour in sponge gourd [*Luffa cylindrica* (L.) Roem.]

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Sponge gourd (*Luffa cylindrica* Roem.), also known as dishrag gourd, dishcloth gourd, loofah gourd, and smooth loofah is a very popular vegetable grown under low input condition in the tropical and subtropical regions. The other vernacular names of sponge gourd in India are kali tori, ghia tori, toria, nemia, chiori, dhundul, thuppa heera kayi, ghosali, gilka, bhol or tarada. It is an important component of cropping system during *pre-kharif* and *kharif* seasons in North Indian plain region as it has the ability to set fruits at extremely high temperature prevailing during May-June and is cultivated both on commercial scale and in kitchen gardens. The sponge gourd is grown in many parts of the world but is more common crop in China and other Asian countries. It is an annual plant, which produces fruits containing a fibrous vascular system. It has a vigorous vine with slender, five angled stem, deltoid to nearly orbicular leaves in outline, but acutely pointed at the apex, usually three to seven lobed, scrabous and dentate margins (Whitaker and Davis 1962). Fruits are nearly cylindrical, 1-2 feet long, straight or curved, normally with light furrows or stripes but not ribbed. Sponge gourd is commonly grown for its tender fruits as well as for sponge which is used for scrubbing purposes. Tender fruits are rich in vitamin A, vitamin C and iron (Longvah et al. 2017). The young tender fruits of the non-bitter types are eaten fresh like cucumbers, cooked as a vegetable, or used in soups. The seeds yield colourless, odourless, tasteless oil that can be used in cooking. The plants have medicinal properties too which is used for coetaneous complaints, granular conjunctivitis, adrenal type diabetes hemorrhoids and many other diseases. Fiber is obtained from fully ripen and dried fruits which is useful in cleaning the motor car, glassware, kitchen utensils, commercial filters, for insulation in pot-holders, bathmats, and related uses (Porterfield 1955). When the fruits are cooked, they are easily digestible and are very appetizing, so its use is recommended to the patients suffering from malaria or other seasonal fevers. The dried fruits are used as a bath sponge, increase blood circulation and credited as a relief for rheumatic and arthritic suffers.

India is considered as the centre of origin of *Luffa* species (Choudhury 1996) and exhibits considerable amount of genetic diversity with respect to different characters. The improvement programme of sponge gourd is based mainly on exploiting natural sources of germplasm by means of selection and hybridization followed by selection. At the Division of Vegetable Science, ICAR-IARI, New Delhi, about 75 germplasm of sponge gourd with variable plant and fruit characteristics like colour, shape and size are being maintained. The normal seed coat colour of sponge gourd is black which may vary for colour intensity. However, among these germplasm, a plant was identified during 2003 which fruits were having white seed coat colour and later, an inbred DSG-95 was developed by continuous selfing for more than 8 generations and now it is fully homozygous having stable expression for all the morphological traits. We consider this as a first report of a novel gene for white seeded sponge gourd as to our knowledge there is no reference of inheritance of white seed coat colour in sponge gourd so far. Though we could not find any reference of utility of white seeded sponge gourd but from our personal experiences we realized that sponge quality and colour of white seeded sponge gourd were bright attractive milky white and soft texture as compared to black seeded sponge gourd which has off white/light brown sponge with rough texture. The present investigation reports the inheritance of a white seed coat colour in sponge gourd which is considered as a novel trait and it should be useful for understanding the genetic make-up of the novelty and breeders can utilize the information for transfer of this trait. Though there were some earlier reports of inheritance of seed coat colour

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in cowpea [*Vigna unguiculata* L. (Walp)] by Mustapa (2009), Nath and Khandelwal (1978) and Gusmini et al. (2013) in watermelon, Singh and Singh (1993) in lentil but this is the first conclusive report on inheritance of seed coat colour in sponge gourd.

This investigation was conducted at the research farm of Division of Vegetable Science, Indian Agricultural Research Institute during spring summer seasons of 2011 to 2013. In the spring summer season of 2011, F_1 was developed by using cultivated variety Pusa Sneha (black seed coat colour) as female parent and DSG-95 (white seed coat colour) as male parent and the F_1 seed was harvested. Forty F_1 plants were grown during spring summer season of 2012 and observation with respect to seed coat colour was recorded in all fruits. Another set of ten F_1 plants were selfed to produce F_2 seeds and also backcrossed with both parents Pusa Sneha and DSG-95 for development of backcross population. During spring summer season of 2013, all the six generations comprising of 20 number of both parents and F_1, 120 F_2 plants and 60 numbers each of BCP_1 and BCP_2 plants developed from the cross of Pusa Sneha X DSG-95 were raised to take the observation with respect to seed coat colour. Two seeds were sown on the side of the channel in a well-prepared hill, with a spacing of 2.5 m between channels and 0.75 m between hills. All the recommended agronomic practices along with plant protection measures were followed to raise a successful crop. Data on seed coat colour were recorded and analysed using Chi-square test to test the goodness of fit to different generations.

The F_1 plants from the cross between Pusa Sneha (black seed coat colour) as female parent and DSG-95 (white seed coat colour) as male parent were found to have black seed coat colour in all plants which indicated that black seed coat colour was dominant over white seed coat colour and suggested that the novel gene for white seed coat colour might be recessive in nature. To test the single gene hypothesis, the observations on seed coat colour in the F_1, F_2 and backcross generation (BC_1) were analysed and presented in Table 1 & Figure 1. The F_2 segregation indicated simple inheritance (3:1)

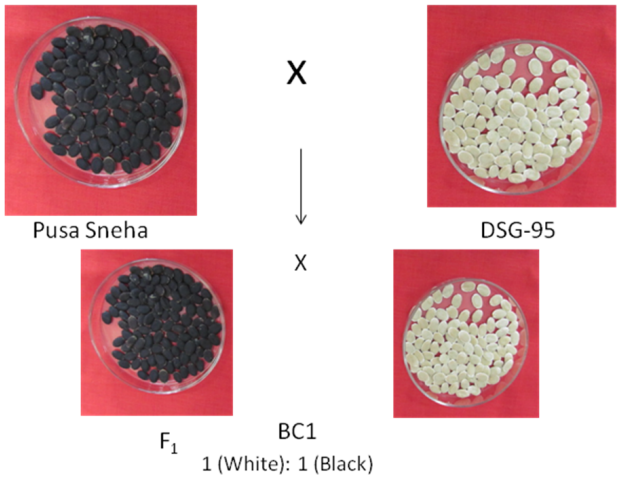

Figure 1: Genetics of seed coat colour in sponge gourd

for black and white colour of seed coat. A total of 120 F_2 individual plants segregated in the ratio of 87/33 (black/white) and the value of chi-square was 0.4 (á = 0.05, df = 1), showing that the data were consistent with a 3:1 ratio. The *P* value for this chi-square also confirmed a good fit of the data to the predicted values (*P* =0.54). The result of back cross (BCP_2) or test cross (F_1 x DSG-95 with white seed coat) of 60 plant further confirmed the results as it was segregated in the ratio of 1:1 (32 black/28 white). All 60 plants from backcross population BCP_1 (F_1 x Pusa Sneha having black seed coat) showed black seed coat colour. Thus, segregation data from backcross families clearly support the one gene hypothesis and white seed coat colour is governed by single recessive gene. In accordance with the findings Singh and Singh (1993) also found monogenic Mendelian inheritance and single dominant gene control for inheritance of seed coat colour in lentil where brown seed coat colour is dominant over grey mottled seed coat colour. Nath and Khandelwal (1978) also observed black colour monogenically dominant over brown light cream seed coat colour in watermelon. On the contrary, Zewdie and Bosland (2003) studied the inheritance of seed coat colour in capsicum by crossing black seed colour with yellow seed coat colour and found black seed coat colour is dominant over yellow. The

Table 1: Phenotypic ratio of seed coat colour in progeny from the cross between black and white seed coat colour sponge gourd.

Parents and crosses	Expected ratio	Observed (no's)		χ^2	d.f.	P
		Black colour	White colour			
Pusa Sneha	All Black	20			-	
DSG-95	All White		20		-	
F_1 (Pusa Sneha X DSG-95)	All Black	20			-	
F_2 (Pusa Sneha X DSG-95)	3: 1	87	33	0.4	1	0.54
BCP_1 (F_1 x Pusa Sneha)	All Black	60	0		-	
BCP_2 (F_1 x DSG-95)	1:1	32	28	0.27	1	0.60

segregation pattern in F_2 did not fit either single or two gene model, but showed continuous variation indicating a quantitative mode of inheritance. Amangoua et al. (2019) reported codominance of dark brown and yellow for seed coat colour (*Y/y*) in bottle gourd.

We propose nomenclature of this novel gene, with symbol *bb* for white seed coat colour and *BB* for black seed coat colour, in conformance with gene nomenclature rules for Cucurbitaceae (Vanden Langenberg and Wehner**,** Gene List Committee, 2012-13). The information obtained from the investigation will help transferring the white seed coat colour to other cultivated variety through simple backcross breeding.

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