The proposal for release of the mutant line CMN-446-4 as a new variety under the name 'NIFA-95' for general cultivation in the rainfed area of North West Frontier Province was approved by the Provincial Seed Council on 8 December 1996. The characteristics of the mutant variety NIFA-95 are presented in Table 1.

Table 1. Agronomic characters of mutant variety NIFA-95 and its parent

Characteristics	Mutant variety NIFA-95	Parent variety 6153
Growth habit	Semi spreading	Semi spreading
Plant height	86 cm	84 cm
Flower colour	Pink	Pink
Days to flowering	136	130
Days to maturity	205	190
Seed coat colour	Light brown	Dark brown
Seed surface	Rough	Smooth
1000 grain wt (g)	186	220
Blight resistance	MR	H.S
Protein content (%)	25.2	20.1
Av. yield (kg/ha)	2600	400

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IMPACT OF MUTANT VARIETIES OF BLACKGRAM IN REALISING IMPROVED PRODUCTIVITY

Blackgram (*Vigna mungo* L. Hepper) is an important pulse crop extensively grown in India. It is the cheapest source of protein for millions of Indians. The seeds contain about 22% protein. The area under cultivation in India is about 3.25 million hectares with an annual production of 1.45 million tons. About 70% of the total area is in the Central and Southern part of the country, which contributes about 77% of the total production. In the past there have been attempts to increase the production and productivity of this crop using conventional breeding approaches at different Agricultural Research Centres. However, the yield remains around 500 kg/ha. We have used induced mutation techniques to break the yield barrier. The induced mutations were used in cross breeding to synthesise an ideal plant type with high yield potential suitable for different agroclimatic conditions.

Induced mutation experiments were initiated at Nuclear Agriculture and Biotechnology Division of Bhabha Atomic Research Centre, Mumbai during 1973-74 using 'No. 55', a variety popular in Maharashtra state and later during 1986 with 'EC168200' an exotic collection obtained from AVRDC, Taiwan. The seeds were exposed to gamma rays (15 to 750 Gy). Fast neutron irradiation (20 to 60 Gy) was carried out at the 'APSARA' reactor at Trombay, BARC in a specially designed Standard Neutron Irradiation Facility (SNIF) to obtain fast neutrons free from slow neutrons and gamma rays.

In all, forty-nine true breeding mutants with distinct morphological characters were established and classified on the basis of most conspicuous and easily discernible morphological and agronomic traits like chlorophyll, growth, leaf, pod, seed characters flowering and/or maturity. Though no mutant superior in yield per se compared to the parent variety No. 55 or EC 168200 was obtained, several mutants superior in one or more yield components were isolated like early flowering, dwarf, altered branching pattern, large seed,

shiny and green seed etc. Two large seed mutants UM-196 and UM-201 with 100 seed weight 5.6 and 6.9 g respectively as compared to 4.5 to 5 g of the parent variety No. 55 were used in the cross breeding programme. The desirable recombinants having increased seed size, early maturity and high yield were selected from the segregating population and this has resulted in the development of 'TAU-1', 'TUA-2' and 'TPU-4' varieties for different agroclimatic conditions in the country [2; 3] (Table 1). Later on an early maturing mutant TAU-5 of yellow mosaic virus resistant EC168200 was used in the cross breeding programme. 'TU 94-2' with high yield and resistance to yellow mosaic virus disease was developed and released for commercial cultivation. TAU-5 has also been identified as donor parent for yellow mosaic virus resistance by the All India Pulse Improvement Programme [1].

The development, introduction and later popularization of Trombay blackgram varieties in many states have made a significant impact in increasing the production. Blackgram varieties developed at BARC are well suited to Central and Southern parts of the country. Among the blackgram varieties released, TAU-1 with large seed size has become the most popular variety in Maharashtra, Karnataka and Andhra Pradesh. Presently TAU-1 is grown on an area of 500,000 ha (95% of the total area under blackgram) in Maharashtra state. It was also released for adjoining state Karnataka during 1996. About 20,000 tons of certified seed have been distributed by Maharashtra State Seed Corporation, Akola to the farmers of Maharashtra since 1990.

Though the area under blackgram increased marginally after TAU-1 release, the production and the productivity of blackgram in Maharashtra has increased dramatically in 1999 by 60 and 50% respectively (Table 2). The additional production of 129,400 tons of blackgram achieved in 1999 in the state as compared to 1989 is due to increase in the productivity of TAU-1. The national income generated due to this increased production amounts to a considerate estimate of 67 million dollars annually. The other three varieties TAU-2, TPU-4 and TU94-4 developed under induced mutation approaches are becoming popular in Central and Southern States and the breeder seed indent of the Ministry of Agriculture, Government of India for all four varieties is almost 48% of the total indent of blackgram breeders seed during 2000-2001.

Table 1. Released and notified varieties of blackgram developed at BARC

Variety	Pedigree	Year of release	Area of adaptation	Yield (kg/ha)	Yield increase (%) and character
TAU-1	T-9 x UM-196 (Mutant of No. 55)	1985	Maharashtra Karnataka	975	27; large seed size
TAU-2	T-9 x UM-196	1992	Maharashtra	1158	18 (over TAU-1)
TPU-4	UM-201 (Mutant of No. 55) x T-9	1992	Madhya Pradesh Gujarat Maharashtra	884	22 (over check PU-30)
TU-94-2	TPU-3 x TAU-5 (Mutant of EC-168200)	1999	Andhra Pradesh Karnataka Tamil Nadu Kerala	962	35 (over PU-30); Resistance to YMV

Table 2. Area, production and productivity of blackgram in Maharashtra

Year	Area (thousand ha)	Production (thousand tons)	Productivity kg/ha
1989	513.0	215.0	419.0
1999	546.0	344.4	631.0
Increase (%)	6.4	60.2	50.6

Source: The Economics and Statistical Survey of India, Ministry of Agriculture, Govt. of India.

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AN EARLY MATURING RICE MUTANT RELEASED AS A VARIETY

In the content of food grain production deficiency (about 1.0 – 1.5 million tons of rice per year according to the Bangladesh Bureau of Statistics, 1998) an induced mutation programme was undertaken in 1985. One moderate early maturing and high yielding rice mutant line (BINA6-84-4-115) has been developed by irradiating F_2 seeds of the cross 'BR4' x 'Iratom 38'. Three treatments viz., 250, 300 and 350 Gy were given to the F_2 seeds. Finally, this line was selected in M_6 generation for advanced yield trial. The line was evaluated in comparative trials with another mutant line BINA6-84-4-163. These two mutant lines had been selected earlier from 300 Gy originated lines. The two check varieties, 'BR 11' and 'BR 22' were also included in the trial, which was conducted in two consecutive T. aman seasons (July to December) during 1994 and 1995 at five locations in Bangladesh.

From the results, it was evident that the mutant BINA6-84-4-115 did not differ much with the other mutant lines or check varieties in respect to plant height, number of effective tillers and panicle length but it was 10-18 days earlier than the other 3 entries (Table 1). It produced a similar yield as the check BR 11 in 1994 and a higher yield than the check BR 11 and BR 22 in 1995. This mutant line gave the highest yield per day among all the entries (Table 2). In addition to this, the grains are long, fine and possess a high L/B ratio, which are of high commercial value. This line has been released by the National Seed Board of Bangladesh in 1998 as a commercial variety under the name "BINADHAN-4" for cultivation throughout Bangladesh.