

Richter scale and corresponding peak ground acceleration. The recent assessment of the safety margin of TAPS 1&2 has concluded that the plants have adequate safety margins to withstand potential earthquakes in Tarapur site.

- (d) Does not arise.

WRITTEN ANSWERS TO UNSTARRED QUESTIONS

Use of Radiation Technology

3876. SHRIMATI VASANTHI STANLEY: Will the PRIME MINISTER be pleased to state:

- (a) to what extent the DAE is successful in using radiation technology in the field of agriculture, medicine and industry;
- (b) if so, the details thereof; and
- (c) if not, the reasons therefor?

THE MINISTER OF STATE IN THE PRIME MINISTER'S OFFICE (SHRI V. NARAYANASAMY):

(a) Radiation and radioisotope technologies have been successfully and extensively deployed as non-power applications for societal benefit in Agriculture, Healthcare and Industry. These applications have made considerable impact in terms of availability of improved crop varieties especially, oil seeds and pulses, microbiological safety of food and enhancement of shelf-life of certain vegetables and fruit and their export; diagnosis of and treatment of several health conditions, particularly of cancer, and industrial radiography.

- (b) The details of the applications of radiation technology are as given hereunder:-

Agriculture:

Mutation breeding for crop improvement is an active area of research at the Bhabha Atomic Research Centre, Trombay, Mumbai. Development of mutant varieties of crop seeds especially in oilseeds and pulses using radiation technology is an ongoing process at BARC. Using radiation induced mutation and cross-breeding, 39 new crop varieties (Trombay varieties) developed at BARC have been released and Gazette notified by the Ministry of Agriculture, Government of India for commercial release. These include 20 in oil seeds (14-groundnut 3-mustard, 2 soybean, 1

sunflower), 17 in pulses (8-greengram, 4-blackgram, 4-pigeonpea, 1-cowpea) and one each in rice and jute. Details are given in statement (See below). All of them are high yielding, some with additional desirable characters like disease resistance, early maturity, suitability to rice inflows, improved quality parameters etc.

Food Preservation:

BARC has been engaged in R&D work on the technology of preservation and hygeinisation of food by radiation for the past more than 50 years.

The Department of Atomic energy has the necessary expertise and know-how for setting up radiation processing plants. It has set up two technology demonstration units, one commissioned in the year 2000 for high dose irradiation at Vashi, Navi Mumbai, primarily for hygeinisation of spices. The facility is being operated by Board of Radiation & Isotope Technology (BRIT). A low dose irradiation facility, KRUSHAK at Lasalgaon, near Nashik, for sprout control during storage of onion, potato, and insect disinfestation of agricultural commodities including quarantine treatment of mango for export is being commercially operated by Maharashtra State Agricultural Marketing Board (MSAMB) under an MoU with BARG and BRIT. The facility has recently been upgraded to increase its products range.

The department is encouraging private entrepreneurs for setting up radiation processing facilities. The Board of Radiation & Isotope Technology has signed more than 24 MoUs with entrepreneurs, both in private and co-operative sectors, for setting up radiation processing plants.

Medicine:

Radioisotopes of several elements such as iodine (1-125, 1-131), Technetium (Tc-9m), Sodium (Na-24), Fluorine (F-18), Samarium (Sm-153), Lutetium (Lu-177) etc are used to make radiopharmaceuticals or tracer molecules or radioimmunoassay kits or use in healthcare. Variety of 99mTc based radiopharmaceuticals are supplied to DAE for diagnosis of cardiac, renal, liver, bone and thyroid diseases. Cancer patients are also benefited by the use of 131I based therapeutic radiopharmaceutical for treatment of thyroid cancer. 177Lu based radiopharmaceutical is used for treatment of neuroendocrine tumors. Bone metastasis is treated by 153Sm based radiopharmaceutical 125I is used for treatment of ocular cancer. In addition Radioactive cobalt (Co-60) is used for treatment of cancer (teletherapy). DAE have very successfully deployed these materials and sources not only in its own healthcare facilities such as Tata Memorial centre (TMC) and Radiation Medicine Centre (RMC) it also in several diagnostic centres across the country.

Bhabhatron:

Radiation therapy is one of the established modes for the treatment of localized cancers. In our country, there is shortage of radiotherapy treatment facilities, mainly due to the high cost of imported machines. Realizing the need of technology for affordable radiation therapy machines, Bhabha Atomic Research Centre (BARC) successfully developed indigenous Cobalt-60 Teletherapy Machine named Bhabhatron. It is not only less expensive, but also has a number of advanced features hitherto unavailable in similar imported machines presently available. This machine is now commercially produced by Panacea Ltd. and so far 18 units are operational, including one in Vietnam (donated through the IAEA). Seven more units will be commissioned shortly.

Industry:

A number of radioisotopes are routinely used in industry for addressing a variety of problems. The industries include Petroleum, Petrochemicals and Fertilizers, including overseas viz. Sri Lanka's Petroleum Industry. Some of the important applications are listed below:

- (1) Radiation processing for material modification:
 - i) Diamond irradiation for colour enhancement.
 - ii) Hydrogels for health care applications.
 - iii) Development of polymers as battery separators.
 - iv) Polymers for cleaning industrial effluents (removal of dyes, heavy metal, etc.)
 - v) Electron beam processing of cables insulations and automobile tyre.
- (2) Quality control of manufactured components:
 - i) Gamma scanning technique for online diagnosis of long columns and towers in petroleum and petrochemical industry.
 - ii) Nucleonic control system for industry.
 - iii) Radio-tracers for detecting leakages in Heat exchangers & optimizing operating process conditions.
 - (iv) Radio-tracers for sedimentation transport in all sea ports in India.
V- Radio-tracer for efficient management of oil fields.
- (3) Radio-tracer for optimum utilization of fertilizer by plants.
- (c) Does not arise.

Statement

Trombay crop varieties released and notified for commercial cultivation by Ministry of Agriculture, Government of India

Variety	Year of release	States	Special features
1	2	3	4
Groundnut			
TDG39/TBG 39	2009/ 2008	Karnataka/Rajasthan	Large seed, medium maturity, high oleic acid, more number of branches.
TG 51	2008	Orissa, West Bengal, Assam, North Eastern states	Early maturity, medium large seed, high shelling %, more 3-seeded pods
TLG 45	2007	Maharashtra	Large seed, medium maturity
TG 38	2006	Orissa, West Bengal, Assam, North Eastern states	High shelling %. more 3-seeded pods, more round seeds, stem rot tolerance
TPG 41	2004	All India	Large seed, medium maturity, 20 days fresh seed dormancy, high oleic add.
TG37A	2004	Haryana, Rajasthan, Punjab, Uttar Pradesh, Gujarat, Orissa, West Bengal, Assam, North Eastern states	High yield, smooth pods, wider adaptability, collar rot and drought tolerance
TG 26	1996	Gujarat, North Maharashtra, Madhya Pradesh	Earliness, high harvest index, 20 days seed dormancy, smooth pods, salinity tolerance

TKG 19A	1996	Maharashtra	Large seed size, 30 days fresh seed dormancy
TG2	1994	Bihar	Medium large seed, 50 days fresh seed dormancy
TAG 2A	1992	Maharashtra, Orissa, Karnataka, Rajasthan, West Bengal	Semi-dwarf, earliness, high yield, high partitioning %, wider adaptability
Somnath (TGS 1)	1991	Gujarat	Large seed, semi-runner type
TG 3	1987	Kerala	Less number of branches
TG17	1985	Maharashtra	No secondary branches, 30 days seed dormancy
TG 1	1973	Maharashtra	High yield, large seed, more branches, 50 days seed dormancy
Sunflower			
TAS-82	2007	Maharashtra	Black seed coat, tolerant to drought
Soybean			
TAMS 98-21	2007	Maharashtra	High yielding, resistant to bacterial pustules, Myrothecium leaf spot, soybean mosaic virus diseases
TAMS-38	2005	Maharashtra	Early maturing, resistant to bacterial pustule, Myrothecium leaf spot
Mustard			
TPM-1	2007	Maharashtram	Yellow seed tolerant to powdery mildew

1	2	3	4
TM-2	1987	Assam	Appressed pod
TM-4	1987	Assam	Yellow seed
Munbean (Green gram)			
TM 2002	2010	Chhattisgarh	Suitable for rice fallows and resistant to powdery mildew
TM-96-2 (Trombay)	2007	Andhra Pradesh (rabi and summer) and rice fallows	Resistant to powdery mildew and Corynespora leaf spot
TJM-3	2007	Madhya Pradesh,	Resistant to powdery mildew, yellow mosaic virus and Rhizoctonia root -rot diseases
TMB-37	2005	Eastern Uttar Pradesh, Bihar, Jharkhand, West Bengal, Assam	Tolerant to yellow mosaic virus
TARM-18	1995	Maharashtra	Resistant to powdery mildew
TARM-1	1995	Maharashtra, Gujarat, Madhya Pradesh, Andhra Pradesh, Kerala, Karnataka, Tamil Nadu, Orissa	Resistant to powdery mildew
TARM-2	1992	Maharashtra	Resistant to powdery mildew
TAP-7	1993	Maharashtra, Karnataka	Tolerant to powdery mildew
Pigeonp			
TJT- 501	2009	Madhya Pradesh, Gujarat, Maharashtra, Chhattisgarh	High yielding, early maturing, tolerant to Phytophthora blight
TT-401	2007	Madhya Pradesh, Gujarat, Maharashtra, Chhattisgarh	High yielding, tolerant to pod borer and pod fly damage

AT-10	1985	Maharashtra	Early maturing
TT	1983	Madhya Pradesh, Gujarat, Maharashtra, Karnataka, Kerala, Andhra Pradesh	Large seed
Urdbean (black gram)			
TU 94-2	1999	Andhra Pradesh, Karnataka, Kerala, Tamil Nadu	Resistant to yellow mosaic virus
TAU-2	1992	Maharashtra	High yield
TPU-4	1992	Maharashtra, Madhya Pradesh	Large seed
TAU-1	1985	Maharashtra	Large seed
Cowpea			
TRC-71-4 (Khalleswari)	2007	Chhattisgarh (rabi)	Suitable for rice based cropping system
Rice			
Hari	1988	Andhra Pradesh	Slender grain type
40	1983	Orissa	High yielding

Abbreviations: A: Akola, M: Amaravathi, B: Bikaner, D: Dharwad
G: Groundnut, J: Jawahar. K: Konkan, K: Kendrapara, L: Latur,
M: MB: Mursbean, P: Phule/Phaseolus (TAP-7)
R: Raibe Resistant (TARM-18)/Rabi (TARM-1,2), S: Soybean/ Sunflower,
T: Trombay U: urid