Resilient Crop Varieties

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A New Gamma Ray-induced Mutant Variety of Groundnut for Cultivation in Gujarat and Maharashtra

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Plant of TG 73

ABSTRACT

Gamma ray based-induced mutagenesis has played a significant role in genetic improvement of groundnut. Sustained mutation breeding efforts at BARC, Mumbai, have evolved several improved Trombay groundnut (TG) varieties that have been commercialized across the country. In continuation, a new mutant was developed by gamma ray mutagenesis of cultivar TG 38. This mutant showed an improvement in pod, kernel size and percentage of three-seeded pods. Molecular markers distinguished TG 73 from its parent TG 38 or the check variety, TAG 24. In order to test its suitability and adaptability in different agro-ecological situations, TG 73 was evaluated in multi-location trials over the years in collaboration with Junagadh Agricultural University (JAU), Junagadh, Gujarat, and Dr. Panjabrao Deshamukh Krishi Vidyapeeth (PDKV), Akola, Maharashtra, during summer. In these trials, TG 73 recorded a mean pod yield of 2541 kg/ha and 3218 kg/ha with a superiority of 16.6% and 14.3% over the best check variety, respectively. Based on consistent greater pod yields, TG 73 has been released and notified as TAG 73 and GG 37 for summer cultivation for Maharashtra (Vidharbha region) and Gujarat, respectively.

KEYWORDS: *Groundnut, Gamma rays, Mutant, Pod yield, Seed size.*

Introduction

Groundnut (*Arachis hypogaea* L.), an important edible food, feed and oilseed crop, covers 19% of the country's oilseed area, contributing 26.3% to the total oilseed production. It is distinct from other legume species by having aerial flower and subterranean fruit. It is widely used as source of cooking oil, digestible protein, minerals, vitamins and contributes considerably to food security as well as in alleviating poverty. Groundnuts have recently attracted attention as a functional food. Several studies have revealed groundnut consumption to reduce the risk of heart disease, cancer, total cholesterol, bad cholesterol and triglycerides without affecting the beneficial cholesterol. This is due to the presence of mono-unsaturated fatty acid, resveratrol, beta-sitosterol, vitamin E, folic acid and fibre [1]. In Gujarat and Maharashtra, groundnut is cultivated on 19,87,000 ha and 2,95,500 ha, with a production of 44,94,800 tonnes and 3,76,100 tonnes, respectively. Groundnut cultivation in *rabi* and summer (post-rainy) season is gaining prominence and its area is expanding with better productivity. There are very few summer-adapted, high input-responsive groundnut varieties in these states.

Groundnut exhibits narrow genetic base because of its monophyletic origin, limited gene flow due to ploidy barrier, and self-pollination. Breeding for high yield has been and will remain as one of the most important objective of any groundnut improvement programs. Induced mutagenesis using ionizing radiations has been the convenient and desirable approach for broadening genetic variability to overcome the limitations associated with a narrow genetic basis. This method is suitable for bringing specific improvement without significantly affecting other traits in groundnut [2]. Effective application of induced mutagenesis along with cross breeding has resulted in generation of a wide spectrum of mutants and mutant varieties [2]. Towards breeding of groundnut varieties with high yield potential, better heat tolerance and summer suitability, a new gamma ray groundnut mutant was developed and released for summer cultivation in Gujarat and Maharashtra.

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Materials and Methods

Seeds of groundnut cultivar, TG 38 were irradiated with 200 Gy of gamma rays (M_1 generation) from the Cobalt-60 source at the Bhabha Atomic Research Centre (BARC), Mumbai. TG 38, a gamma ray mutant, was released for cultivation for *rabi*/summer season in Odisha, West Bengal, Assam and North-Eastern states in 2006 [3]. Irradiated seeds were sown in the field along with untreated seeds in rainy season, 2008. In the M_2 generation, plants were examined carefully for various economic traits and 39 variants were selected and harvested individually. In the M_3, one progeny (TG 38-38) having more number of three-seeded, larger pod and seed compared to its parent, bred true (Fig.1). This mutant was ensured for its true breeding nature for pod and other traits in subsequent generations by growing alternately in rainy and summer seasons from M_4 to M_9 generations and designated as TG 73 (Fig.2). To test its suitability and adaptability, TG 73, was evaluated at Dr. Panjabrao Deshamukh Krishi Vidyapeeth

Fig.1: Pods of parent, TG 38 (left) and mutant, TG 73 loading %.

Fig.2: Plant of TG 73.

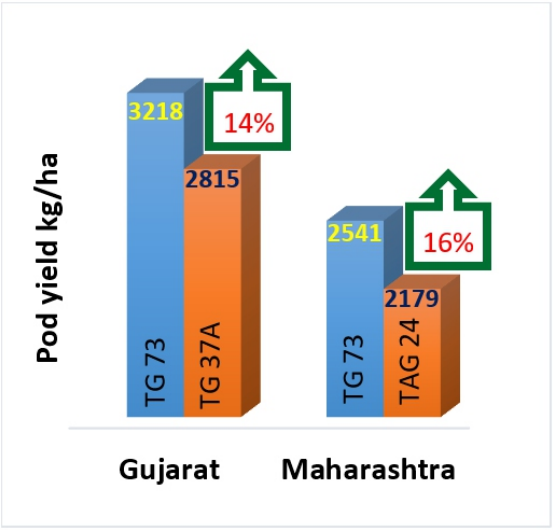

Fig.3: Pooled mean pod yield of TG 73 and best check variety in Gujarat and Maharashtra.

(PDKV), Akola, Maharashtra, during summer 2014 to 2019; and Junagadh Agricultural University (JAU), Junagadh, Gujarat, during summer 2016 to 2020. The evaluation trials included Station trials, Multi-location trials and Adaptive (On Farm) trials. Simultaneously, TG 73 was evaluated in initial varietal trials (IVT-I and II) of ICAR-All India Coordinated Research Project on Groundnut (AICRP-G) during summer 2017-18 and 2018-19.

Results and Discussion

In Maharashtra, evaluation of TG 73 was initiated in the station trial at PDKV, Akola during summer 2014 for the Vidharbha region. In this trial, TG 73 recorded pod yield of 4900 kg/ha with 14.4% advantage over check variety, TAG 24 (4282 kg/ha). Based on its superiority, TG 73 was subsequently yield-tested in the multi-location trials at four locations during summer 2015 to 2019 wherein, it had pooled mean pod yield of 2541 kg/ha, which was 16.6% more thanr TAG 24 (Fig.3). Further to study its adaptability, TG 73 was demonstrated on farmers' fields in adaptive trials wherein, it recorded 19% higher yield over TAG 24 during summer 2019. It has also greater fodder yield (which is a key contributor for livestock feed) improving the overall farm income. Considering the yield superiority, better pod or seed size and summer adaptability, TG 73 was released as TAG 73 (Trombay Akola Groundnut 73) by State Varietal Release Committee, Maharashtra. This variety was subsequently notified for commercial cultivation in Maharashtra in 2021.

For evaluation of TG 73 in Gujarat, the station trial was started at JAU, Junagadh, in summer 2016, wherein it recorded pod yield of 2355 kg/ha having 19.3% advantage over check variety, TG 37A (1973 kg/ha). Subsequently, TG 73 was evaluated in multi-location trials at four locations during summer 2016 to 2020. In these trials, it has pooled mean pod yield of 3218 kg/ha with an advantage of 14.3% over TG 37A (Fig.3). In parallel national ICAR evaluation trials, mutant TG 73 has also registered a mean pod yield of 1662 kg/ha and 3175 kg/ha with 24.2% and 6.0% superiority over the national check, TAG 24 and with 15.3% and 14.5% increase over the

Fig.4: Field view of TG 73 in Maharashtra.

Fig.5: Farmers from Andhra Pradesh, Karnataka, Gujarat and Maharashtra are displaying the better pod yield of TG 73.

zonal check, TG 37A, at Akola and Junagadh, respectively during the summer of 2017-18 and 2018-19. With consistent superior performance and desirable pod and seed features during summer, TG 73 was released as GG 37 (Gujarat Groundnut 37; Sorath Gaurav) by State Varietal Release Committee, Gujarat, followed by central notification in 2023.

TG 73 has semi-dwarf height, medium-size dark green leaflets, erect growth habit with sequential branching and maturity of 110-115 days (Fig.2). In TG 73, mutation was for the increased pod and seed size and higher number of three-seeded pods. TG 73 has greater mean hundred pod and kernel weight, shelling-out turn in comparison to the check varieties. The proportion of three seeded pods was more in TG 73 (40 %) than in its parent TG 38 (1 %) or TAG 24 (9%). Pods of TG 73 are with slight constriction and without beak and reticulation, while its seeds are more spheroidal with rose colour. Nutritionally, TG 73 has 24.5% protein, 49.1% oil content, 49% oleic acid and 32% linoleic acid. DNA profiling was carried out for TG 73 along with check variety, TAG 24 and its parent TG 38 using simple sequence repeat (SSR) and transposable element (TE) markers. Of the several markers screened, two SSR (IPAHM 23, GM 1996) and two TE (TE 113, TE 457) markers showed allelic variation among these varieties. To translate the benefits of new mutant variety, breeder seed of TG 73 were supplied to farmers of different states and farmers have cultivated and obtained encouraging returns (Fig.4, 5).

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