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Original Research Article

Effects of Mutagens on Various Traits in Mungbean (*Vigna radiata L. Wilczek*)

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ABSTRACT

In Pulses, due to their high protein content, many essential amino acids and their ability to fix atmospheric nitrogen they occupy a significant role in world's agriculture. Because of its nutritional value and ability to maintain and restore soil fertility through biological processes, mungbean is considered one of the most essential pulse crops. One of the prerequisites of crop enhancement is genetic variability. Various biotic and abiotic factors effect the grain yield of mungbean. Due to low genetic variability the common breeding methods are not useful in improving the production. so, by improving the genetic makeup and incorporating the stress resistance genes we can improve the yield. By improving the existing genotypes through mutations and other advanced breeding methods the yield can be improved. There is low variability in the mungbean, therefore mutation breeding has gained popularity over traditional breeding. Thus induced mutagenesis seems to be an optimal technique for inducing the desirable heterogeneity of genetics.The frequency of natural mutations is very low, thereby the artificial mutations are induced for improving genetic diversity in mungbean. Induced mutations may help to generate and restore the diversity lost in the course of evolution or in the process of adaptation due to various stresses. For the enhancement of conventional agricultural crops such as mungbean, The mutation breeding or induced mutation is having a great potential.

Introduction

Greengram (*Vigna radiata L. Wilczek)* also known as mung bean is one of the major pulse crop in India. It is the third most important pulse crop in India (Grover, 2011). Its origin is South Asia. It belongs to the family fabaceae and sub family papillionaceae. It is a cheap source of carbohydrate (38%-40%) and protein (24%). Mung bean is a cheap man dietary protein with high iron and foliate levels when compared with several other legumes (Keatinge *et al.*, 2011). Pulses are rich in high quality proteins, vitamins and minerals and are in seperable part of most of the Indians diet (Siag *et al.*, 2005). It also has a special property of nitrogen fixation through biological process (Stevenson and Van Kessel, 1996). There are various reasons for the lower productivity in the mungbean (Singh, 2009). Few of them are lack of high yielding varieties, seed replacement rate, improper use of nutrients and less plant protection.

Mutations in green gram

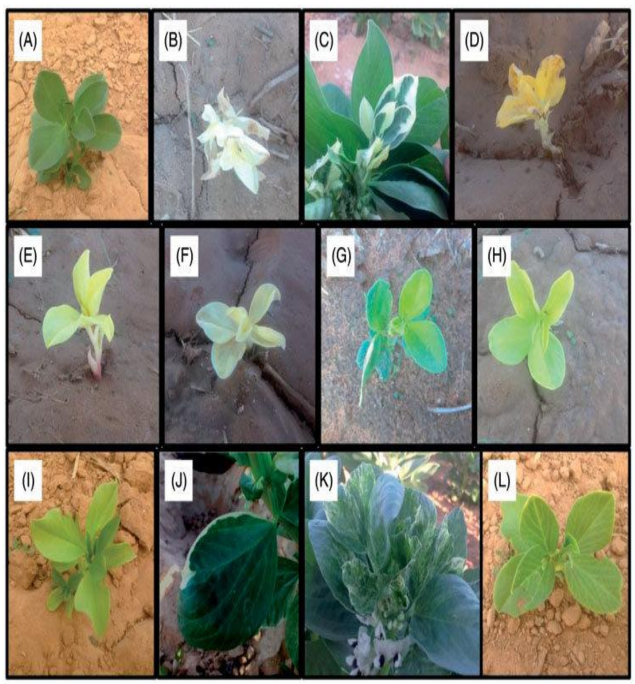
One of the prerequisites for the crop improvement is genetic variability.Within a short span of time the best way to create genetic variability is through the artificially induced mutations (Patil *et al.,* 2003 and Sigh, 2003). Induced mutations are provided a modern and fruitful method in creating genetic diversity among crop plants (Swaminathan, 1969; Gottschalk, 1972 and Khan, 1988). Mutation breeding is one of the oldest breeding methods and the most effective of the improvement of yield production (Acharya *et al.*, 2007). Mutations induced by various physical and chemical mutagens are a way to create generic variability and creation of new varieties with improved characters (Wongpiyasatid, 2000). Physical mutagens like gamma rays effect the plant growth by altering the physiological, biochemical and genetical and morphological features in the cells (Gunckel *et al.,* 1961) gamma rays and EMS can produce high yielding new verities (Khatri *et al.*, 2005). Mutation breeding mainly depends upon the efficiency and effectiveness of mutagen. The required mutation depends on the option of the effective and efficient mutagenic agent (Solanki *et al.,* 1994).

Induced mutations in mungbean

Mutation breeding has shown to be one of the significant techniques in mungbean to grown and release new genotypes and high yielding cultivars. Mutation breeding is a form of coventional breeding technique useful for producing desirable diversity in crops and inaddition to selection in mungbean, it may be a driving force for evolution (Priya Tah, 2009).

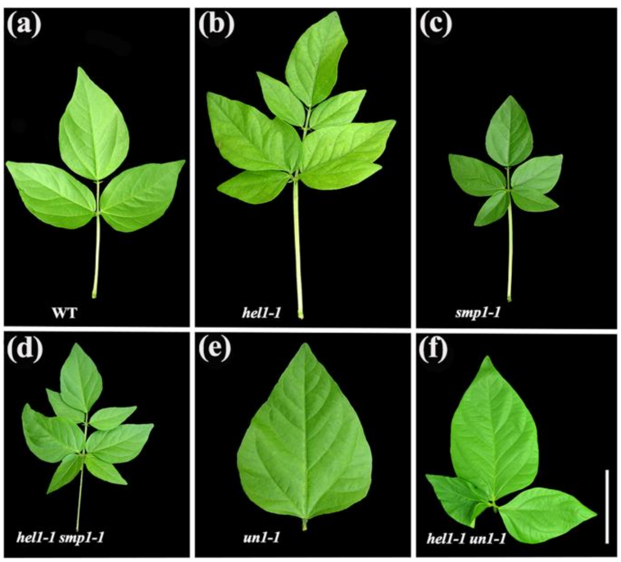
Chlorophyll mutants

The chlorophyll mutations are extensively used as genetic markers in both basic and apply research (Reddy *et al.,* 1994). Khan and siddiqui (1993) has reported a high proportion of chlorophyll mutations in mungbean verities PS-16 and Baisakhi when treated with EMS, MMS and SA(0.1,0.2,0.3 and 0.4%) obtained albina, chlorina and viridis type of chlorophyll mutations. Highest frequency of chlorophyll mutations are prodeced by EMS (0.3%) followed by MMS and SA. By using EMS and gamma radiation, chlorina, albina and xantha mutant forms have been documented by singh *et al.*, (1979). He discovered that the mutants of albina, xantha and chlorina were regulated by two recessive genes each seggregating with a ratio of 1mutant: 15 normal. Kumar *et al.*, 2009 obtained chlorophyll mutations in mungbean cultivars PS-16 and Sona with the treatment of gamma radiations (10-60KR) and EMS (0.1-0.4%) and with their combinations. This resulted out that in PS-16 highest frequency of mutations were observed in EMS (55.55%) followed by gamma rays (48.66%) and then their combinations (38.66%) while in Sona the combination of gamma rays and EMS showed the highest frequency of mutations (67.33%) more than the EMS (44.44%) and gamma radiations (39.33%).



Leaf mutants

The mungbean when treated with EMS, reported bifoliate, tetrafoliate and pentafoliate leaves (Apparao and Auti, 2005). Changes in the shape and size of leaves in leguminous limbs have been documented by a number of investigators (Gelin, 1954; Zacharias, 1956; Jana, 1962; Apparao and Jana, 1976; Kothekar, 1978; Deshpande, 1980; Hakande, 1992; Kothekar *et al.*, 1994; Satpute, 1994; Panchbhaye, 1997). The growth of leaf abnormalities has been correlated to the pleotropic action of mutated genes by Joshua *et al.*, (1972).

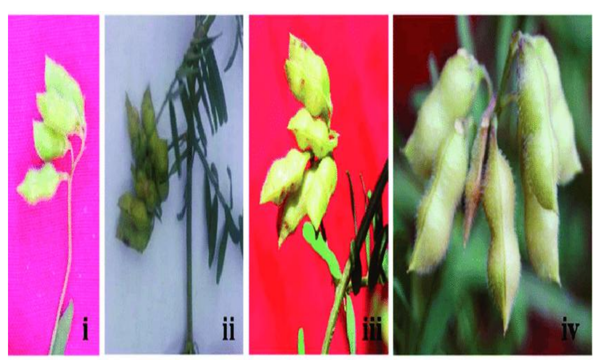


Flower mutants

In mungbean and various plants using various mutations, several workers have recorded flower colour mutations. Sangsiri *et al.*, (2005) have identified a flower mutation in mungbean that looks like a comb with pollen sterility. Flower mutation with sterility looks like cock's comb. Flower colour mutations are induced in the mungbean varieties PS-16 and Sona by treating with six gamma ray doses (10-60KR) and four EMS concentrations (0.1-0.4%) alone or in seperate combintions (kumar *et al.*, 2009). different colour flower mutations are observed in Phaseolus vulgaris variety Varun when treated with EMS and irradiated with gamma radiations (Borkar and More, 2010).

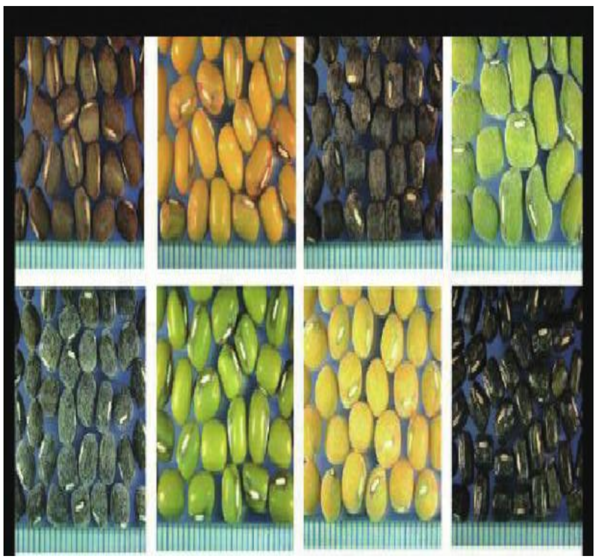
Pod mutants

Pod size mutant with EMS was reported by Singh and chathurvedi (1982). log pod mutants in mungbean were reported by sharma and Singh (1992). Pod mutation in Mungbean verities KPS2 and VC 6468-11-1B was reported in M2 generation. Lobed pod mutants with less number of seeds per pod and are associated with partial sterility and creating constriction where the seeds were undeveloped (Sangsiri *et al.*, 2005). Cluster pod and synchronous pod maturity in the mungbean cultivars K851 and Sona were reported when irradiated seeds with gamma radiations of 10, 20, 30 and 40KR (Priya Tah, 2006).



Seed mutants

Mungbean varieties Vibhav and Kopargoan when treated with gamma radiations, EMS and SA, large number of variations in deed shape (round, wrinkled and elongated), seed size (small, bold) and seed colour (brown, dark green, yellowish green and black) by Auti and Apparao in 2009. Singh and Chaturvedi 1982 reported variations in seed size in mungbean when treated with EMS and nitrozomethyl carbamide.



High yielding mutants in mungbean

The mungbean varieties when irradiated with gamma radiations, produced high yield which was reported by Dahiya (1973) and shakoor *et al.,* (1978). Disease resistant and high yielding mutants in mungbean were obtained by Tikoo and Jain (1979). High yielding and early maturing lines in mungbean were obtained by Prasad (1976), Bahl and Gupta (1983). Mungbean yellow moasaic virus resistant mutant lines in M2 generation were reported by shakoor *et al.*, (1978). Some of these mutants were dwarf in height than their parents. The mungbean varieties irradiated with gamma radiations of 10 and 20KR, more number of progenies were obtained which are resistant to Mungbean yellow mosaic virus.

Early and late maturing varieties

The mutant varieties in mungbean NIAB Mung 19-19 and NIAB Mung 121-25 matures in 65-70 days which were reported by Awan (1991). Ramaswami and Rangaswmy (1974), reported early maturing mutants in mungbean as a result of mutagenic action. Late maturing mutants in mungbean were observed when irradiated by gamma radiations by Yaqoob and rashid(2001). The mungbean varieties when treated with SA worked more effective in reducing maturity duration in M2 generation (Lavanya *et al.*, 2011). Two mungbean varieties K851 and Sona when irradiated with 10, 20, 30 and 40GY produced noval mungbean mutants with synchronous maturity (Priya Tah, 2009).

Table.1 Various mutagenic treatments and their effects in mungbean

s.no	mutagen	Dose	Mutation	References
1	EMS and NMU	0.1,0.2,0.3,0.4	Synchronous mutant	Chaturvedi and Singh, 1980
2	Gamma radiations	45-72Kr	Disease resistance	Guhardja *et al.*,1980
3	Gamma radiations and EMS	20,30,40,50kr,0.2,0.4% Combined-0.2%+20,30,40,50Kr	Chlorophyll mutations	Bhal and Gupta, 1982
4	EMS and HA	0.2,0.3,0.4%	Genetic variability in	Singh and Chaturvedi, 1982

			quantitative characters	
5	Gamma radiations and EMS	20,30,40,50kr,0.2,0.4%	Early maturing and high yielding mutants	Bhal and Gupta, 1982, 1984
6	Gamma rays, EMS and HZ	15,30,40kr EMS-0.3% HZ-0.04%	Morphological mutations	Khan, 1981, 1982, 1983, 1984
7	Gamma radiations	10,20,30,40,50,60,70,80 Kr	Leaf flowering mutant	Khalil *et al.*, 1987
8	Gamma radiations	40kr	Multifoliate mutant	Satayanarayana *et al.*,1989
9	EMS,MMS and SA	EMS-0.1,0.2,0.3,0.4% MMS and SA-0.01,0.02,0.03,0.04%	Chlorophyll mutations	Khan and siddiqui,1993
10	Diethyl sulphate	0.02,0.04,0.06%	Plant type mutants	Khan *et al.*, 1995
11	Gamma radiations and EMS	10Kr,0.1,0.2%	Disese resistant mutants	Kharkwal 1996
12	Gamma radiations	10,20,30,40Kr	Plant type mutants	Sarkar *et al.*, 1996
13	Gamma radiations	500Gy	Disese resistant mutants	Wongpiyasatid *et al.*, 1998
14	Gamma rays,EMS and NMU	45,50,60KR EMS-0.1-0.2% NMU-0.01-0.02%	Plant type mutants	Kharkwal 2000
15	Gamma radiations	10,20,30,40Kr	Qualitative and quantitative traits	Srinives *et al.*, 2000
16	Gamma radiations and EMS	500GY, 1%	Qualitative and quantitative traits	Wongpiyasatid *et al.*, 2000
17	Gamma radiations	10,20,30,40Kr	Early maturing mutants	Yaqoob and Rashid 2001
18	Gamma radiations	100-400GY	High yielding mutants	Sarwar and Ahmed, 2003
19	SA	0.01-0.02%	Genetic variability in quantitative characters	Khan *et al.*, 2005
20	Gamma radiations	500GY	Leaf,flower and pod mutants	Sangsiri *et al.*, 2005
21	Ems	0.1,0.2,0.3%	Genetic variability in quantitative characters	Wani *et al.*, 2005
22	Gamma radiations	10,20,30,40Kr	Morphological mutants	Priya tah 2006
23	EMS and HZ	0.1,0.2,0.3% HZ-0.01,0.02,0.03%	Genetic variability in quantitative characters	Khan and Wani 2006
24	Gamma radiations and	0.01,0.02,0.03,0.04M 30,40,50KR	Chlorophyll mutants	Auti *et al.*, 2007

	EMS			
25	Gamma radiations and EMS	10-40KR 0.01-0.04M	Genetic variability in quantitative characters	Singh Awnindra 2009
26	Gamma radiations and EMS	10-40KR 0.01-0.04M	Yield contributing characters	Singh Awnindra and Kumar 2009
27	Gamma radiations and EMS	10-60KR 0.1-0.4%	Induced chlorophyll and morphological	Kumar *et al.*, 2009
28	Gamma radiations	10,20,30,40GY	Synchronous in maturity of mungbean	Priya tah 2009
29	Gamma radiations and EMS	20,40KR 1-2%	Genetic variability in quantitative characters	Khan and Goyal 2009
30	Gamma radiations and EMS	10,20,30,40KR 0.1,0.2,0.3,0.4M	Morphological and chlorophyll mutants	Auti and Apparo 2009
31	Gamma radiations and EMS	500,600GY 1%	Yield improvement and powdery mildew resistant	Ngampongsai *et al.*, 2009
32	Gamma radiations	600GY	Development of yellow mosaic resistant mutants	Reddy *et al.*,
33	EMS and HA	0.1,0.2,0.3,0.4,0.5% 1.0,2.0,3.0,4.0mM	Genetic variability in quantitative characters	Prakash and Ram 2009
34	Gamma radiations	450GY	Root mutant	Dhole and Reddy 2010
35	Ems	0.1,0.2,0.3,0.4%	Yield and yield contributing characters	Kozgar *et al.*, 2011
36	SA	0.01,0.2,0.03,0.04,0.05M	Genetic variability in quantitative characters	Lavanya *et al.*, 2011

In conclusion, current literature shows that a number of attempts have been made to develop the mungbean by using various mutation breeding techniques. The narrow genetic base is the impediment breeding programme in mung bean. In the case of these crops, the selection pressure was more associated with adaptation to stress condition than with yield supplementary tool to other conventional methods of plant breeding. The variability lost during the adaptations of different stresses and during the process of evolution can be restore and regenerate by induced mutations. Various scientists have attempted to enhance genetic improvement in mungbeans. By producing diverse morphological mutants such as plant type mutations, leaf mutations, flower mutations and seed type mutations, due to increased genetic diversity all mutants became resistant to abiotic and biotic stress.

The primary achievement is the growth of high yielding mutants, mutants of synchronous pod maturity, mutants with disease tolerance and early mutants. Several studies have documented the use of mutagenesis in quantitative and qualitative characteristics to produce genetic diversity and establish new desired associations between both quantitative and qualitative characteristics. Mutation breeding in mungbeans is useful in restoring characters or deficient characteristics that are agronomically desirable. For example, by the use of mutagenesis, high yielding varieties inherited with some undesirable characters, such as flowering decline, unstable performance, late maturity and undesirable green colour can be improved. The induced mutations therefore have a tremendous potential to boost conventional agricultural crops whereas mungbean can lead to further rise in global food supply.

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