INDUCTION OF SOME PROMISING MUTANTS IN PIGEON PEA

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ABSTRACT *Two varieties of pigeonpea viz., BDN 708 and BSMR 853 were used to induce mutagenesis. Physical mutagen (Gamma rays) and chemical mutagens ethyl methanesulphonate (EMS) and sodium azide (SA) were used to induce mutation. Studies pertaining to mutation breeding of pigeonpea were spread over three generations. A wide spectrum of viable mutants with varying morphological traits was observed in M_2 and M_3 generations of both the varieties of pigeonpea. The mutant isolated from M_3 generation subjected to morphological analysis and screened accordingly. The various types of viable mutants obtained in pigeonpea comprises high yielding, tall, dwarf, branched, early flowering, early maturing, xanthaand pod mutants in both the varieties of pigeonpea.*

Keywords: *EMS, SA, Gamma rays, tall, dwarf, branched.*

Introduction:

Pigeonpea belongs to family Fabaceae. Vernacularly it is also known as Red Gram or Tur. It is an important Pulse crop widely cultivated in Indian subcontinent. Pigeonpea is useful in various ways both as human food and animal feed. It is mainly a subsistence crop in the tropics and subtropics of India, Africa, South-east Asia and the Caribbean, but also an important cash crop in West Indies. In India, pigeonpea is consumed mostly in the form of decorticated split cotyledons known as dhal, while in other semi-arid tropical countries of the world, such as Caribbean Island, it is consumed in the form of green peas. Even though pigeonpea is indigenous to India, due attention has not been paid to its improvement. In recent years, there has been significant decline in the pigeonpea production in India, leading to increase in price and reduction in per capita availability.

Pigeonpea being a self-pollinated crop, the naturally existing genetic variability is not sufficient to achieve the desired improvement. Due to small size of flower, emasculation and pollination in pigeonpea are very tedious and costly. Alternately, artificial induction of mutations with the application of mutagens is the best way to enlarge genetic variability in this species considerably within a short time.

Material and Methods:

In present research work, genetic variability was induced by using Gamma rays and chemical mutagens like EMS and SA in two varieties of pigeonpea, namely BDN 708 and BSMR 853 to study the impact of mutation in M_1, M_2 and M_3 generations. Seeds of pigeonpea varieties were obtained from the agricultural research station of Marathwada Agriculture University.

The uniform seeds of two pigeonpea varieties Amol (BDN-708) and Vaishali (BSMR- 853) were treated with different concentrations of EMS 0.05%, 0.10%, 0.15% and 0.010%, 0.015%, 0.020% for SA. Seeds were washed meticulously under running tap water and later on they were subjected to post-soaking in distilled water for one hour. Healthy and dry seeds of aforesaid varieties were packed in small polythene covers and seed samples were exposed to doses like 5kR, 10kR and 15kR of gamma rays. The seeds of each treatment were sown in the field following randomized block design (RBD) with three replications along with control for raising the M_1 generation. The seeds of all plants from each treatment in M_1 generation were harvested separately. They were used for raising M_2 and M_3 generation on plant to a row basis.

In M_3 generation grown from the harvested seeds of M_2, the study included screening and analysis of quantitative characters and the field testing of the viable macro-mutants isolated from M_2 population regarding their yield characteristics.

Results:

All the concentrations of the mutagens used succeeded in inducing the different types of viable mutants. The frequency of viable mutants revealed an increasing trend with gradual increase in concentration/dose of all the mutagens in both the varieties of pigeonpea.

Different types of viable mutants were observed in M_2 generation of pigeonpea. A wide spectrum of viable mutants with varying morphological traits was observed in M_2 generation of both the varieties of pigeonpea. The various types of viable mutants obtained in pigeonpea were: High yielding, tall, dwarf, branched, early flowering, early maturing, light green pod, small pod, two seeded pod, five seeded pod.

Description of mutants:

Viable mutants in variety BDN 708 (Table -1)

1. High yielding:- These mutants showed large number of pods per plant. The average number of pods per plant was 591.36 as compared to control (349.23).The productivity in terms of seeds per plant was better than control.

2. Tall mutants:- These mutants showed a height of 241.33 cm as in contradiction of 231.33 in control. The period for maturity in this mutant was comparable with that of control.They had lesser weight than control.

3. Dwarf mutant:- These mutants were categorised by great decrease in plant height. It was 174.33cm as against 231.33cm for control. All the characters in this mutant revealed compact values as compared with control excluding for the character of days to pod maturity.

4. Branched mutant:- These mutants showed 25.33 branches. The yield in terms of pods per plant in such mutant was superior as related to control plant. Wight of hundred seeds and seeds per pod was higher than the control.

5. Early flowring:- The period of flowering in such mutants was 102.33 days as against 116.80 days in control. They developed flowering quite earlier (13-14 days) than control.

6. Early maturing:- These mutants demonstrated a feature of early maturity of plants. They attained maturity in 158.33 days as against 169.07 days in control. They acquired flowering little earlier than control and the productivity in terms of seeds per plant was better than control. The number of seeds per pod was found to be increased as compared with control.

7. Light green pod:- These mutants were characterized by development of green pods without patches or shade like control. It yielded 198.66 pods which was less than the control plant.

8. Dark black pod:- In this mutant the pods were found to be blackish in colour as compared with control. It had more value of seeds per pod and hundred seed weight than the control plant.

9. *Xantha*:- These mutants were characterized by development of *xantha*chlorophyll as compared with control. They attained height of 206.00 cm and 164.33 days to pod maturity as against 231.33 cm and 169.07 days in control, respectively.

10. Small compact leaves:- In this mutant, leaves were found to be small in size and compactly arranged on stem as compared to control. The seeds of this mutant were more and had lesser weight than the control.

Table 1: Performance of viable mutants with respect to quantitative characters in M_3 generation of pigeonpea variety BDN 708

Name of viable Mutants	Concen - tration (%)/dose	Quantitative characters						
		Plant Height (cm)	No. of primary	Total no. of pods per	Days to 1st flowering	Days to pod maturity	Seeds per pod	Weight of 100
Control	-	231.33±2.43	23.87±0.67	349.23±31.5	116.80±0.55	169.07±0.33	101.70±1.46	11.84±0.19
High yielding	15 kR	221.00±2.61	23.66±0.93	591.36±41.5	113.33±0.47	167.00±0.21	123.34±2.19	11.31±0.15
Tall	0.020%SA	241.33±3.21	21.67±0.78	553.30±47.3	118.66±0.45	163.33±0.52	106.00±1.94	10.82±0.37
Dwarf	0.10%EMS	174.33±1.88	16.66±1.12	311.00±34.6	114.67±0.51	169.34±055	95.33±0.88	11.59±0.16
Branched	10kR	193.66±2.11	25.33±0.26	324.60±33.4	115.34±0.49	166.66±0.47	105.34±1.52	12.17±0.26
Early Flowering	0.010%SA	211.33±2.64	21.00±0.94	439.60±21.7	102.33±1.90	162.00±0.39	121.34±2.25	10.28±0.34
Early maturing	10kR	229.67±3.13	21.34±0.86	553.30±39.2	109.00±1.26	158.33±0.42	120.33±2.19	11.67±0.18
Light green pod	0.05%EMS	219.33±3.44	19.00±0.71	198.66±28.9	117.66±0.46	162.34±0.48	106.66±1.87	10.63±0.37
Dark black pod	0.015%SA	219.66±3.02	17.33±0.83	344.34±31.9	111.34±0.38	165.67±0.28	107.67±1.69	13.07±0.10
Xantha	0.010%SA	206.00±1.18	19.34±0.79	311.67±30.2	114.00±0.43	164.33±0.47	85.34±3.18	10.66±0.29
Small compact leaves	0.10%EMS	260.34±3.37	19.66±054	328.00±29.4	115.67±0.47	164.00±0.87	115.00±2.06	09.66±0.42
Erect and high yielding	0.05%EMS	222.33±2.89	22.67±1.51	516.67±38.4	114.34±0.58	167.34±0.68	101.00±1.61	10.80±0.28

Table 2: Performance of viable mutants with respect to quantitative characters in M_3 generation of pigeonpea variety BSMR 853

Name of Mutants	Concen - tration /dose	Quantitative characters						
		Plant Height (cm)	No. of primary branches	Total no. of pods per plant	Days to 1st flowering	Days to pod maturity	Seeds per pod	Weight of 100 seeds(gm)
Control	-	197.87±2.32	21.43±0.92	415.43±28.18	122.80±0.45	181.80±0.06	100.63±1.50	11.31±0.11
High yielding	0.020% SA	209.33±1.06	27.00±0.57	714.34±49.45	117.66±0.31	173.00±1.78	96.00±1.10	11.56±0.09
Tall	0.015% SA	214.34±1.79	18.33±0.87	361.00±31.57	119.34±0.45	171.67±1.89	106.33±3.35	11.77±0.05
Dwarf	0.10%E MS	148.00±4.12	16.34±0.99	208.67±20.32	117.66±0.32	175.33±0.16	77.00±0.89	11.97±0.03
Branched	10kR	200.66±1.84	28.67±0.61	267.34±34.58	115.60±0.39	173.34±1.25	118.34±4.81	10.57±0.57
Early Flowering	0.015% SA	204.66±1.96	22.67±0.88	494.00±40.29	108.66±0.29	161.33±0.52	114.33±4.53	08.98±0.69
Early maturing	10kR	174.67±1.22	14.66±0.83	225.34±24.13	111.00±0.35	158.66±0.74	98.34±4.04	10.90±0.48
Xantha	0.02%5 SA	202.67±1.69	20.66±0.38	390.33±34.87	118.00±0.39	171.34±1.78	96.33±1.13	11.56±0.22
2 seeded mutant	0.015% SA	196.00±2.36	21.00±1.50	373.66±33.75	119.67±0.43	173.67±1.18	97.64±3.30	11.25±0.15
5-seeded mutant	05kR	201.66±2.17	25.00±0.59	660.00±12.34	118.66±0.41	170.34±1.55	102.66±3.02	09.34±0.56
5 seeded mutant	0.10%E MS	202.00±2.21	22.34±0.80	510.00±42.38	118.00±0.47	171.66±1.92	105.66±3.42	13.07±0.02
Small pod	15kR	206.34±2.54	27.66±0.21	548.34±45.61	119.67±0.53	179.66±0.96	111.34±4.41	09.23±0.61

11. Erect and high yielding:- It was abranched mutant having 516.67 pods per plant against control and 22.67 numbers of branches per plant.

Viable mutants in variety BSMR 853 :- (Table -2)

1. High yielding:- In pigeonpea, these mutants showed large number of pods per plant. The average number of pods per plant was 714.34 as compared to control. They attained 209 cm height with 27 branches on stem.

2. Tall mutants:- These mutants showed a height of 214.34 cm as against 197.87cm in control whereas the yield was less than the control plant.

3. Dwarf mutant:- Reduced height of plant was demonstrated by this mutant. It was 148 cm as against 197.87 cm for control. All characters in this mutant were found reduced as compared to control.

4. Branched mutant:- These mutants showed 28.67 branches. The productivity in terms of hundred seed weight was found to be more as compared to control.

5. Early flowering:- These mutants attained flowering in 108.66 days and 11-12 days before the control. These mutants showed negative correlation between days to flowering and 100 seed weight.

6. Early maturing:- These mutants revealed a feature of early maturity of plants. They attained maturity in 158.66 days as against 181.80 days in control. They acquired flowering earlier than control and the productivity in terms of seeds per plant in such mutants was less than control. Weight of 100 seeds was found to be decreased as compared with control in such mutants.

7. *Xantha*:- These mutants attained height of 202.67 cm and 171.34 days for pod maturity as against 197.87cm and 181.80 days in control, respectively.

8. Two seeded mutant:- The pods of these mutants contained only two seeds per pod. Productivity in this mutant was lesser than control plant.

9. Three seeded mutant:- Pods of such mutants contained three seeds and weight of hundred seeds was less than the control.

10. Five seeded mutant:- These mutants produced pods which carried five seeds per pod. The number of pods per plant in them was 510 and they showed the increased 100 seed weight and number of seeds per pod than the control.

11. Small pod:- In these mutants length of pod decreased than the control. Pods were looking small in size than the control plant. They matured in 179.66 days with lesser hundred seed weight than the control plants.

Discussions:

Current researchwork was found more prominent mutants like branched, tall, dwarf, dark black pod, small pod, early flowering, early maturing, twoseeded, three seeded and high yielding mutants. Several investigators reported induction of viable mutants in various plant systems after mutagenic treatments. Such workers included Kawai *et al.,* (1961), Joshua *et al.,* (1972) and Thakare*et al.,* (1973). Mutation could extend variability in positive as well as negative directions and results in adequate variability in treated population which could be used for collection of early or late flowering plants indicated by Mahala*et al.,* (1990). Malik *et al.,* (1995) described primary and secondary branches in rapeseed exposed with Gamma rays. Expenditure of induced mutation for procurement of early maturing cultivars has been a frequent breeding objective (Micke, 1979). Genter and Brown (1941) and Down and Anderson (1956), stated that the most common observation in many mutagenic studies is the change in habit. Treatment of physical mutagen may also be the cause of alteration in the plant habit. In present research work tall mutant has been obtained in both the varieties of pigeonpea. Jana (1963) reported that tallness is basically due to an initial rise in internode length, occasionally attended by an increase in internode number. Dwarf mutants with determinate growth habit in pigeonpea could be detected and have shown appreciable decrease in height in M_2 and M_3 generations. Dwarf mutants have been detected by workers like Down and Anderson (1956) and Kothekar and Kothekar (1992) in different crop plants. Athwal*et al.,* (1970) generated variability in plant tallness in chickpea through gamma radiation. In present study mutagens have shown effect on the plant height. It indicated that the mutagen could cause positive as well as negative genetic variability in plant height.

Early maturing mutant with increased yield was reported by Kawai (1969) in rice as a result of gamma irradiation. Early maturity could be caused by irradiation and increased production of flowering hormone is described by Jana (1963). Early maturing mutants were also recovered by Down and Anderson (1956).

An Agro-economically main character is high yield. Rubaihayo (1975) has been reported high yielding mutant in *Phaseolus vulgaris*. Adams (1974) reported that the high yielding mutants have been associated to the high number of pods per plant, and appears to contribute extra to yield than the other seed yield components. Rubbeai (1982) described various mutants like early maturing, branched, tall, dwarf and high yielding types in chickpea. Various types of pod mutants were observed in existing study. Two seeded, three seeded, five seeded mutants could be observed in variety BSMR 853 and dark black pod, light green coloured pod mutant were found in variety BDN 708 of pigeonpea. Singh and Agarwal (1986) have been recorded the differences like flat pod, long pod characters in pod size of cluster bean.

Compact leaves mutant was reported in variety BDN 708.Various leaf mutants were reported by Dnyansagar and Kothekar (1983) in *Solanumnigrum*.

The small pod, two seeded mutants, dwarf, tall, high yielding, dark black pod, early flowering and branched are the promising mutants for further improvement of pigeonpea and there is opportunity for employing these characters for developing an enhanced variety of pigeonpea.

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