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BREEDING BEHAVIOR OF MUTANTS IN GREEN GRAM

Dr.ASHA RANI
Department of Botany
Bareilly College, Bareilly

Abstract

The study of productivity in induced mutants of moong bean showed a significant increase in total grain yield & protein content in M2 generation.Some of the true breeding mutants were selected from M2 population & studied for grain yield & protein content in M3 generation also. Some of the important are tetrafoliate mutants,,tall mutants, early maturing, synchronous maturing & high yielding.These mutants are induced by treatment of seeds with heavy metals (Cu++,Zn++ & Pb++) which are present in toxic amount in city waste water.

Keywords: City waste water, Heavy metals, Mutants, Productivity, Protein content.

Introduction

City waste water is an important source for heavy metal pollution. The pollution of the ecosystem by heavy metals is a real threat to the environment because metals cannot be naturally degraded like organic pollutants and persist in the ecosystem having accumulated in different parts of the food chain ((Igwe et al., 2005; Smejkalova et al., 2003). Some heavy metals (Chromium, Cadmium, Copper, Zinc and Lead) are found in toxic amount in city waste water. Cadmium and Chromium is less toxic, less mobile and is mainly found bound to organic matter in soil and aquatic environments (T. Bacquer et al; 2003). When this water goes to the field it adversely affected the germination percentage & upsets the mineral composition of the soil. But some plants growing in polluted area show the tolrence against the heavy metals. has been observed by different workers that this tolrence is due to existence of some genes. This tolrence is found to be genetic. These genes can be mutagenetically induced.

Material and Methods

The effluent of city waste water were obtained from outlet of the B.D.A. colony nalah,situated in the main city near Gulabrai Inter College,Bareilly.

The two varieties of Vigna radiata (L) Millsp. i.e.NM-1 (Narendra mung-1 & PTM-2 (Pantnagar mung-2) were obtained from Pantnagar. Seed Department Pantnagar University,Pantnagar.

After investigation different heavy metals i.e. copper, zinc & lead are found to be present in higher & toxic amount in city waste water.The quantity of copper, zinc & lead in city waste water was 7.500 mg/l,7.270 mg/l & 3.740 mg/l respectively. Both varieties of Vigna radiata i.e. NM-1 & PTM-2 were treated with different concentrations (80,90& 100%) of freshly prepared solution of $Cu^{++,}Zn^{++}$& Pb^{++} accordingly with the quantity which was present in the city waste water.

Clean, plump & uniform sized seeds were used for experiment & treated with freshly prepared solution of different concentrations (as told previously) for 15 hours & distilled water (control).The treated seeds after a through washing in running tap water to remove the city waste water from the seed surface, were sown in the field to raise M_1 generation. To ensure adequate plant stand & early vigour, the field should be well leveled free from clods & weeds.

Results and Discussion

After investigation in M_1 generation on different growth parameters there is a gradual reduction in all parameters i.e. seed germination, seedling height, fresh weight, dry weight, chlorophyll content & nitrogen content. The maximum reduction has obtained in 100% treatment of each solution in both varieties. The effect of heavy metal toxicity on the germination in moong bean were studied by Weiqianjgli et al;2005.Arey & Sarkar (2007) also have conducted the studies on the effects of heavy metal stress on growth parameters of soyabean.

M2 Generation:

The effective selection of a trait through mutagenesis is possible when the genotypic component (heritable) will be higher than the environmental (non-heritable) component with high genetic advance of the trait to next generation (Ahloowalia *et al*., 2004; Jacobsen and Schouten 2007; Jain, 2005; Julio*et al*., 2008; Schouten *et al*., 2006**)**

Some of the true brreding mutants were selected from the mutagenically treated M_2 population and studied for the grain yield per plant and protein content.

1.Synchronus Maturing Mutants:

Synchronus maturity is desirable in crops like mung (*Vigna radiata*) where several picking are necessary for crop harvest .It is a character which although not directly associated with yield, never less of very great practical significance. Most of the pulses produce pods in a highly non synchronised manner with the result that the harvesting of fruits extends over considerable period. This not only prolonge the occupation of the field by the crop but also increase the labour cost in harvesting. To overcome this problem a screening was made in the treated population and some of the plants showing synchronus maturing characters were isolated and studied for single plant yield and protein content of seeds.

It is clear from the Table (1) that there is a significant increase in total grain yield isolated from 100% CuSo4 in NM-1.The 90% of ZnSo4 also show the significant increase in total grain yield and protein content but it is not significant.

TABLE-1

Treatments	Pods/Plant	Seeds/Plant	Total Grain Yield	Protein Content
Synchronous Maturing:				
NM-1				
100%Cuso4	38.89 ±4.06	370.9±39.65	12.99**±1.09	22.99±2.09
.90% $ZnSo_4$	37.20±1.09	360.8±30.06	12.82*±1.08	22.82±196
90% PbNo3	31.60±1.69	320.40±1.24	10.67±1.06	22.09±0.39
80%C.W.W.	26.92±3.01	355.9±45.90	10.79±1.90	22.70±1.62
PTM-2				
90%$CuSO_4$	37.45±1.27	360.4±28.65	12.78±1.57	22.99±1.98
90%$ZnSO_4$	36.65±2.96	360.7±46.06	11.61±1.06	22.81±0.21
90%$PbNO_3$	30.20±1.28	315.97±15.79	10.95±0.95	22.98±0.29
100%C.W.W.	35.70±2.57	353.9±20.39	11.70±1.72	22.99±2.90
Control				
NM-1	30.2+1.29	310.00+18.75	10.65+0.65	22.08+0.28
PTM-2	28.0+1.23	283.53+53.62	10.59+0.53	21.75+1.7

Significant at 5% level of significance
Significance of 1% level of significant.

Tetrafoliate type of Mutants

It is well known that moong bean has the trifoliate leaves. But instead of the normal trifoliate leaf, some mutants develop four leaflets from the same point converting it to the tetrafoliate in nature. It is clear from the Table (2) that there is a increase in all the mutants of both the varieties but these are not significant in any of these treatments of city waste water and heavy metal. Several authors previously

reported the use of morphological mutants in legumes in the commercial breeding programs that was considered as valuable genetic resources for crop improvement (Begum et al., 2008; Gaur et al., 2008; Gaur and Gour, 2003; Khattak et al., 2001, 2003; Sadiq et al., 2006; Sangsiri et al., 2005; Srinivasan et al., 200

TABLE-2

Performance of Tetrafoliate Mutants

Treatments	Pods/Plant	Seed/Plant	Total grain Yield	Protein content
NM-1				
80% $CuSO_4$	38.8±3.89	372.6 ±37.26	10.87±1.48	22.88± 194
80% $PbNO_3$	36.9 ±2.60	360.7±29.67	10.671±1.56	22.52±1.51
80% C.W.W	36.62.±2.67	353.6± 35.36	10.681±1.63	22.12±1.17
90% C.W.W	36.1±3.60	352.4± 46.26	10.68± 1.06	22.08±1.06
PTM-2				
100% $CuSO_4$	37.25±1.25	360.2± 2.06	10.771±1.07	22.01± 1.02
80% $PbNO_3$	30.90± 1.92	283.7± 42.7	10.69± 0.59	22.07± 0.27
90% C.W.W.	30.09±1.09	284.6±44.6	10.80±1.06	22.10± 0.21
100% C.W.W	39.20±1.20	284.2±43.4	10.85±1.65	21.98±1.09
Control				
NM-1	30.2±1.29	310.00 ±18.75	10.6 ±0.65	22.08± 0.28
PTM-2	28.0± 1.23	283.53 ±53.62	10.59± 053	21.75±1.79

High Yielding Mutants

Plants with a significant increase in the total grain yield were isolated from city waste water and heavy metals mutagenic treated population of varieties NM-1 and PTM-2 the increase is not significant. The highest yield was recorded in mutant isolated from the 100% C.W.W in NM-1 which is 4.65 gm/ plant more as compare to control which is 10.65gm/plant. (Table-3) IN PTM-2 also maximum yield was observed in the 100% treatment of the C.W.W and it is 15.17 gm/plant against the control i.e.10.59/plant.It is significant in all the mutants of NM-1 but not in PTM -2

TABLE-3

Performance of High Yielding Mutants

Treatments	Pods/Plants	seeds/Plants	Total Grain Yield	Protein content
NM-1				
80%$ZnSO_4$	62.00±4.92	472.2±45.77	13.53*±1.85	23.15*±1.35
90%$ZnSO_4$	57.90±2.21	467.2±41.00	!3.53*±0.94	22.82±1.96
90%$PbNO_3$	54.20±2.60	465.0±60.28	13.16*±0.35	22.70±1.87
100%C.W.W.	60.4±5.29	524.2±30.97	15.30*±0.17	22.40±1.92
PTM-2				
100%$ZnSO_4$	60.0±5.49	398.4±10.79	12.60±0.50	22.06±1.09
100%$PbNO_3$	58.2±5.57	394.6±10.11	12.58±0.50	22.40±1.34
90%C.W.W.	55.6±2.72	385.0±30.25	12.37±0.38	22.17±1.07
100%C.W.W.	60.0±5.49	398.4±10.79	15.12±0.28	22.50±2.03
Control				
NM-1	30.2+1.29	310.00+18.75	10.65+0.65	22.08+0.28
PTM-2	28.0+1.23	283.53+53.62	10.59+0.53	21.75+1.79

Tall Mutants

Some plants were isolated from the effluent i.e city waste water and heavy metal treated M_2 population which were found much taller than their respective control. It is quite to note the tallness was positively associated with the yield. These mutanys are very important from practical point of view. As a higher no. of these types can be incorporated in a unit area of land, which can make the crop popular among the farmers. The significant increase in the total grain yield was contributed by its components. A significant increase in total grain yield was noticed in all the mutants isolated from the varity NM-1 and PTM-2 except the 80% city waste water of PTM-2. A significant increase in protein content have also been observed in mutants isolated from 90% ZnSo4 in NM-1. A significant increase in protein content have also been observed in mutants derived from 80% $PbNO_3$ treatment in PTM-2. (Table-4)

TABLE-4
Performance of Tall Mutants

Treatments	Pods/Plant	Seeds/Plant	Total Grain Yield	Protein Content
NM-1				
90%$ZnSO_4$	37.69±2.69	362.8±36.74	14.25**±0.93	23.98*±0.94
90%$PbNO_3$	35.79±1.76	359.9±33.94	14.01*±1.01	22.90±0.74
90%C.W.W.	36.64±3.06	327.50±10.52	13.21*±0.61	22.91±0.79
PTM-2				
80%$PbNO_3$	32.64±2.06	359.80±52.06	13.92*±0.94	22.80*±0.74
100%$PbNO_3$	32.56±1.56	345.94±39.74	12.64*±1.69	22.01±1.01
80%C.W.W.	32.86±1.94	349.26±32.76	12.94±0.96	21.99±1.09
100%C.W.W.	32.79±2.07	339.94±38.92	12.86*±1.80	21.89±0.82
Control				
NM-1	30.2±1.29	310.00 ±18.75	10.65±0.65	22.08±0.28
PTM-2	28.0 ±1.23	283.53±53.62	10.59± 0.53	21.751±.79

Early Maturing Mutants

Normally plants matures in 90 days but some plants mature in 60-70 days showing early maturity. These type of muants were isolated from both the varieties. It was intresting to observe that early maturity was positively associated with yield as well as with protein content of seeds as compare to their controls in both the varieties. Some early maturing mutants showed a significant increase in the total grain yield in both the varieties.

Productivity of Mutants in M_3 genertion:

An increase in total grain yield was observed in the mutants of both the varieties. The increase was significant in all the mutants of both the varieties isolated from effluent and heavy metals treated population, except 80% and 90% treatment of ZnSO4 in variety NM-1 where increase is not significant. These are the early mature and synchronous types of mutants respectively. The highest yeild was recorded in high yielding mutant isolated from 100% city waste water treatment in both the varieties . The highest yield was recorded in high yielding mutant isolated from 100% city waste water treatment in vareity NM-1 which yielded 6.76gm more than control while the high yielding mutant isolated from 100% city waste water treatment in variety PTM-2 which yielded 5.45gm more than the control.

Various researcher have used different statistical approaches to evaluate grain yield of different crops (Ali et al., 2012; Ali et al., 2014abc; Ahsan et al., 2013; Awan et al., 2015;Ramzan et al., 2015; Waseem et al., 2014). Wani and Khan (2006) worked on mungbean mutants and observed the considerable change in mean values for morphological traits like number of branches per plant, number of pods per plant and yield per plant.

Protein Content Of Seeds

Only three mutants showed a significant increase in their protein content of the seeds out of the 10 mutants. The significant increase in protein content was observed in high yielding mutant of 100% city waste water and 80% $CuSO_4$,early mature mutant of variety NM-1, as compared to their respective control.

In PTM-2 the increase in protein content was observed in synchronous maturing mutant isolated from 90% treatment of city waste water. It is clear from the table (6) that the single mutant in both varieties showed increase both in grain yield and protein content as compared to their respective control making these mutants practically very important.

Conclusion:

It is concluded by this investigation that heavy metals are mutagenic which are present in city waste water.The mutagenic nature of heavy metals is essessed on the basis of reduction in M_1 parameters, induction of mutations in M_2 generation & their true breeding nature in M_3 generation. Mutation breeding provides important informations about the ways to produce higher grain yield in mung bean and may be used as advance breeding tool in crop breeding.

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