

ABSTRACT

Title - "Studies on induced mutations in horsegram (*Macrotyloma uniflorum* (Lam.) Verdc)".

Pulses are important protein rich crops of the world, which are benefiting the poor farmers of rainfed areas. They are next to cereals in terms of economic and nutritional importance and help to increase the soil fertility by adding organic matter in soil and fixing atmospheric nitrogen. The major pulses in India are ^{P.P.P.}pea, bean, gram, mungbean, urdbean, cowpea and minor like horsegram, which is locally known as *hulga* or *kulthi*. It is drought tolerant and having good nitrogen fixing ability. In addition to the protein supplement as human food, it has nutritional and medicinal value. But for the cultivation of horsegram (*Macrotyloma uniflorum* (Lam.) Verdc) there are many constraints such as marginal soil, aberrant rainfall, non availability of improved seeds, no input and poor crop management. As a result of this its production is very low. In Maharashtra it is mainly cultivated in drought prone districts like Ahmednagar, Beed, Solapur, Sangli, Nashik, Dhule, Jalgaon, Chandrapur and Gadchiroli, over an area about 0.466 lakh ha, with seed production 0.3232 lakh tones and seed yield 693kg/ha (Anonymus 2009).

The average yield of this crop is very low (582.25Kg/ha), mainly due to lack of genetic variability and environmental constraints. Hence present investigation was undertaken for its improvement in yield and nutrient quality through induced mutations using gamma radiation, EMS and their combinations.

Significant findings and conclusions

Percent seed germination and seedling growth ^{were} was significantly ^{reduced} hampered due to higher doses/ concentrations of mutagens but lower doses/ concs. of gamma rays as well as EMS had shown stimulatory effect.

All the treatments of mutagens (GR, EMS and GR + EMS) have induced pollen sterility in M₁ generation. The rate of pollen sterility increased with increase in dose/ concs. of the mutagens, however the survival rate was highly reduced.

The percentage of average frequency of chlorophyll mutations in M₂ was highest in EMS followed by GR and their combination treatments. The chlorophyll mutants like albina, xantha, chlorina and viridis were recorded in both the mutagens.

The effectiveness and efficiency of different mutagenic treatments assessed on the basis of percent seed germination, lethality, seedling growth, pollen sterility and survival at maturity in M_1 generation and chlorophyll as well as viable mutations in M_2 revealed that the mutagenic effectiveness decreased with increased dose/concs. of mutagens. ^{High} Maximum mutagenic efficiency with reference to seedling injury was recorded in 300Gy, 0.3%EMS and 200Gy + 0.4%EMS. ^{and} Highest mutagenic efficiency with reference to pollen sterility was noted in 200Gy, 0.3%EMS and 100Gy + 0.3%EMS.

Highest rate of mutations was noted in EMS with reference to lethality, pollen sterility and effectiveness. Higher rate of mutations with reference to seedling injury was observed in ^{mutagenic} combination treatments.

All the treatments had induced widest spectrum of viable mutations and the highest frequency was noted in 100Gy, 0.2% EMS and 400Gy+0.4%EMS. Higher frequency of viable mutations was recorded in EMS as compared to gamma rays.

The viable mutants such as tall, gigas, bouquet, dwarf, compact, spreading, tendrilar and erect were obtained due to the treatments of ^{gamma rays} (GR), EMS and their combinations. More than 10 different types of leaf mutants such as supergigas, gigas, broad, narrow, small, tiny, stalked, close pinnae, curly, long leaf were recorded. The pod mutants like long, broad, narrow and small were isolated in the treatments of (GR), EMS and their combinations. The maturity mutants like early and late were also noted. The sterile and high yielding mutants were also recorded.

Both the mutagens proved to be very effective to induce variability in quantitative traits like plant height, primary branches per plant, number of days required for first flowering and first pod maturity, number of pods per plant, pod length, number of seeds per pod, 1000 seed weight and yield per plant in M_2 and M_3 generations.

All the treatments of gamma radiation showed negative effect (except few) on number of nodules, seed yield per plant, biological yield and harvest index. ^{the} Maximum seed yield as well as biological yield was recorded in 300Gy. The harvest index was highest in 400Gy. ^{the} Maximum seed yield and biological yield as well as highest harvest index ^{were recorded} was noted in 0.2% and 0.5% EMS.

The physiological and biochemical characterization of M₂, M₃ generation and viable mutants revealed that the lower doses/concs. of gamma radiation, EMS and their combinations caused increase in total chlorophyll contents in M₂ and M₃ generations. Maximum photosynthetic pigments were recorded in 200Gy. All mutants such as gigas, tall, dwarf, semidwarf, bushy, compact, tendrilar, high yielding, early, late, long, broad and short pod except spreading showed significant increase in total chlorophyll contents. Total carbohydrates increased in the lower dose/concs. of both the mutagens and highest value was recorded in 300Gy. Viable mutants such as gigas, tall, dwarf, tendrilar, high yielding, early, late and long pod also showed enhancement in carbohydrate contents of seeds.

Analysis of protein contents in pulses plays a pivotal role and hence efforts were made to screen the M₂ and M₃ population and mutants for this parameter. Protein contents increased in M₂ and M₃ populations due to lower dose/ concs. of both the mutagens, but the higher doses/ concs. had inhibitory influence. Highest protein contents ^{was recorded} were noted in 300Gy in M₂ generation. The mutants like gigas, tall, high yielding, early and late ^{had} also shown high level of proteins.

All the mutants showed enhancement in total free amino acids but the highest contents were noted in 0.5% EMS.

The activity of NR is crucial in legumes for biological nitrogen fixation. Its ^{ment} assessed revealed that the activity in leaf, root and root nodules was positively influenced in lower concentrations of GR, EMS and GR + EMS. The antioxidants which have paramount importance in scavenging of ROS under stressful condition e.g. proline, glycine betaine and phenols increased in M₂, M₃ and in mutants of horsegram ^{induced by} due to higher doses/concs. of GR, EMS and their combinations.

The quantitative characters like tallness, high branching, earliness (flowering within 30.60 DAS), early maturity (65.80 DAS), high pods, highest pod length and seeds/pod, 1000 seed weight- short pod and high seed yield/ plant- high yielding were recorded in M₃.

The seed nutrient quality in horsegram plays a dominant role in consumer's / acceptability. The results revealed that seeds of all viable mutants showed reduced level of polyphenols, except, gigas and tall. Lowest level of polyphenols was recorded

in the seeds of early mutants. The viable mutants, tall, compact, high yielding, early, late and long pod had reduced contents of polyphenols. Seeds of all the mutants except dwarf and compact were having very low level of phytates. Similarly the seeds of almost all the mutants were significantly very low in trypsin inhibitor and the lowest value of TI was found in seeds of early mutants. Almost all the antinutritional factors in horsegram seeds were reduced in the mutants which is great success of this investigation.

In conclusion both the mutagens GR, EMS and GR + EMS had induced sufficient genetic variability in horsegram cv. Dapoli Kulthi-1. The desirable mutants were high yielding, early maturity and low level of polyphenols and TI ^{thus} as promising material for plant breeding in future.

The high yielding mutants will play a major role to break the yield constraints in horsegram as a result of this the farmers can be attracted towards the cultivation of this low input nitrogen fixing legume crop. The early maturity of the mutants within 65 DAS as compared to control days of 120 DAS is a great success of this investigation. The reduction in duration of crop life cycle has a paramount importance in dry land agriculture. The desirable mutants had reduced level of antinutritional factors, which will be released in ^{feed} future after multi location trails. It will be a good addition in vegetarian diet of Indians.

The stabilization and multilocation trails are in progress on farmer's field.