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Mutagenic Effects on Seed Oil Content in Seeds of M_3 Mutants of Winged Bean

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Abstract
Pulses occupy an important position in world agriculture because of their high protein content, several essential amino acids and their capacity for fixing nitrogen. Winged bean (*Psophocarpus tetragonolobus* (L.) DC.) is one of the most important pulse crop due to its nutritive value and property of maintaining restoring soil fertility through biological nitrogen fixation. The nutritional value of the winged bean is mainly due to the various positive attributes carried by its mature seeds. By keeping this view in mind, the seeds of winged bean variety II-EC-178313 and 2I-EC-38825 were treated with chemical mutagens like Ethyl Methane Sulfonate (EMS) and Sodium Azide (SA) separately. Mutagenic treatments resulted in induction of nine types of viable promising mutants inM_2 and M_3 generations successively.These nine mutants are early flowering, late flowering, early maturing, *chlorina*, linear leaflet, flat pod, long pod, anthostem and high yielding. These mutants were analyzed for quantitative estimation of seed oil content.This present research work is beneficial for development of improved varieties of winged bean for oil yielding.
Key words : Winged bean, Mutants, Oil content, Anthostem, EMS, SA.

Introduction

The oils and fats comprise important materials for the human dietary system. They form the major ingredients of foods, flavours, condiments, cosmetics, soaps, detergents, lubricants and laxatives apart from possessing medicinal and therapeutic applications. The major objective in mutation breeding has been to obtain mutants with higher oil content and desirable fatty acid profile in winged bean plant. Winged bean botanically described as *Psophocarpus tetragonolobus* (L.)DC. Belongs to family fabaceae. It is popularly known as chavdhari ghevda, Goa bean, four angled bean, Manila bean, Mauritius bean, Dragon bean, winged pea etc. It is a tropical legume plant native to New Guinea and now-a-days it is cultivated throughout the world. It has been described as wonder legume in the sense that virtually all parts of this plant are edible and immensely nutritious. The various parts like leaves, flowers, tuberous roots and seeds were fit for human consumption. These parts are rich sources of the protein, vitamin, minerals and calories so often in short supply in tropical countries. The winged seeds rivals the soybean in quantity and quality of its protein and oil. The seeds contain high amount of proteins (29% - 42%) and good quality edible oil (15% - 20%), (NAS, 1975). The seeds are similar in composition to soybean averaging 20% edible oil with a good proportion of polyunsaturated fatty acids, (Claydon, 1978). Similarly (Pospisil et al., 1971) and (Cerney et al., 1971) were the first to report the fatty acid analysis of the winged bean oil.

From the above account, it would clear that although several positive attributes are possessed by the winged bean, it is amazing still that the crop has remained obscure and neglected all over the globe. As it has remained unfamiliar among society because of the high amount of antinutritional factors, absence of market demands, labour intensive nature of crop and long duration of its life cycle. To overcome these negative properties its an urgent need to develop improved varieties of winged bean by using the novel approach of mutation breeding.

Materials and Methods

The experimental plant material selected for the present investigation comprised two varieties (cultivars) of winged bean (*Psophocarpus tetragonolobus* (L.)DC.) namely II-EC-178313 and 2I-EC-38825. Germplasm of these two cultivars was procured from National Bureau of Plant Genetic Resources, Regional station PKV, Akola (M.S.).

Mutagens Used

The chemical mutagens like Ethyl Methane Sulfonte (EMS) a monofunctional alkylating agent and Sodium Azide (SA) manufactured by Sigma chemical Ltd. U.S.A. was used in the present investigation.

Details of Mutagenic Treatments

The pilot experiments were conducted for determining the suitable concentrations for further studies. Prior to mutagenic treatments seeds were immersed in distilled water for 6 hours. The presoaking enhances the rate of uptake of the mutagen through an increase in cell permeability and also initiates metabolism in the seeds for treatment. Such presoaked seeds were later on immersed in the mutagenic solutions for 6 hours with an intermittent shaking. Seeds soaked in distilled water for 12 hours served as control. All the chemical mutagenic treatments were given at room temperature of 25 ± 2^{o} C.

The different concentrations used for the chemical treatments were 0.05% , 0.10% and 0.15% for EMS and 0.01% , 0.02% and 0.03% for SA respectively. Immediately after the completion treatment the seeds were washed thoroughly under tap water. Later on they were kept for post soaking in distilled water for 2 hours. After the completion of treatment process, the seeds were sown in field following randomized block design (RBD) with three replications along with control as the M_1 generation. Seeds were harvested separately from each plant of M_1 progenies, stored in polythene bags and used for M_2 generation. Collected seeds were sown to raise M_2 generation. Later on M_2 population was screened keenly for selection different types of viable mutants. Further the seeds from each selected viable mutants is collected separately and used to raise M_3 generation. From M_3 generation different nine promising viable mutants were selected for quantitative estimation of seed oil. These nine mutants are, early flowering, late flowering, early maturing, *chlorina*, linear leaflet, flat pod, long pod, anthostem and high yielding.

Quantitative Estimation of Seed Oil

There are various methods which are available for the determination of oil content in seeds. Of these the Soxhlet method in the Soxtec system – HT (1043) was used in the present studies for the estimation of total seed oil content. For this a thimble cup (cup of paper) was prepared by taking 2 gm. of fine macerated seed powder. This thimble was placed in metallic cup (Aluminum cup of known weight). Six cups were placed in the Soxtec system and 40 ml of petroleum ether was added in each cup. At constant temperature (110^{o} C) the material was boiled for 30 minutes. After completion of boiling, the system was allowed to rinse for 20 minutes at same temperature. Then the cups extracted with oil in petroleum ether were evaporated for 50 minutes. The weight of the cup with oil was taken after evaporation of petroleum ether. The oil content was determined by subtracting the weight of metallic cup from the cup of oil. The oil content was expressed in terms of percentage.

Results and Discussion

The seed oil content in control was 17.84% in variety II-EC-178313 of winged bean. The mutants like linear leaflet (18.22%), long pod (19.74) and anthostem (19.49%) revealed slight elevation in the oil content as compared with control. The remaining mutants like the early flowering, *chlorina*, flat pod and high yielding exhibited marginal decrease in seed oil content. The highest value was observable in the long pod and anthostem mutants while the lowest value (16.74%) of seed oil percentage could be recorded in the late flowering mutant.

In variety 2I-EC-38825 the seed oil percentage in the control was 18.22% . Three mutants demonstrated increased values for this parameter. They comprised: the linear leaflet, long pod and the anthostem mutants. The remaining mutants displayed reduction in the percentage of their seed oil. The highest seed oil content (20.23%) could be noticed in the long pod mutant while the lowest seed oil content (16.13%) was observable in the flat pod mutant. **(Table) .**

The oil and fats play vital role in human nutrition because of their high energetic property. But the nutritional quality of the oil is mainly dependent upon its fatty acid composition.

In the present investigation, the significant enhancement in the seed oil content has been observed in some of the mutants of both II-EC-178313 and 2I-EC-38825 varieties of winged bean. The mutants like linear leaflet, long pod and anthostem developed from variety II-EC-178313 demonstrated an increased oil content as compared with control. While the mutants such as linear leaflet, long pod and anthostem developed from variety 2I-EC-38825 revealed the similar feature as regards the oil content.

(Jahagirdar, 1975) in *Foeniculum vulgare* has reported an increase in seed oil content particularly at lower doses/concentrations of gamma rays, EMS, and their combination treatments. A decrease in oil content at higher doses/concentration of gamma rays and EMS has been noted by (Khanolkar, 1977) and (Deshpande, 1980) in *Carum capticum* and *Momordica charantia*.

By giving gamma treatment to *Jatropha curcus*, a wide range of variability in regard to seed oil content could be recorded by (Datta and Pandey, 1992).

(Reddy et al., 1991) have reported a significant change in oil content due to SA and gamma rays treatment in sunflower. Similar findings have been reported by (Khandelwal ,1996) in winged bean; and (Panchbhaye, 1997) in sunflower.

(Indurkar and Khalatkar, 1995) have reported 7.76% increase in the total oil content in *Brassica juncea* through SA mutagenesis.

The improvement of oil crops through induced mutation has been reported by several investigators in crops like groundnut, (Patil and Mouli, 1978), sesame, (Anwar et al., 1993), soybean, (Li , 1987), and mustard, (Kumar et al., 1988).

Thus from the present investigation, it is clear that lot of scope exists for improving winged bean through mutation breeding pertaining to very important attribute like the seed oil.

Conclusion

From the present research work, it is concluded that the data regarding seed oil content revealed an enhancement in the level of seed oil in mutants like linear leaflet, long pod and anthostem in both the varieties of winged bean, respectively. This present research work helps to develop improved varieties of winged bean in future with edible high amount of oil.

Table : Seed oil content in seeds of M_3 mutants of variety II-EC-178313 and variety 2I-EC-38825 of *Psophocarpus tetragonolobus* (L.)DC.

Sr.No.	Name of Mutant	Seed Oil Percentage (%)*	
		II-EC -178313	2I-EC-38825
1	Control	17.84	18.12
2	Early flowering	16.59	17.24
3	Late flowering	16.20	16.36
4	Early maturing	17.39	16.66
5	*Chlorina*	17.35	16.55
6	Linear leaflet	18.22	18.82
7	Long pod	19.74	20.23
8	Flat pod	15.47	16.13
9	Anthostem	19.49	18.92
10	High yielding	16.26	17.27

*Mean of three replication values.

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