

COMBINATION OF THE THREE CHARACTERS (HIGH OIL CONTENT, HIGH IODINE VALUE, AND HIGH YIELD) IN A SINGLE VARIETY OF LINSEED, *LINUM USITATISSIMUM* L. OBTAINED BY MUTATION BREEDING

D. SRINIVASACHAR, A. SEETHARAM AND R. S. MALIK

Division of Genetics, Indian Agricultural Research Institute, New Delhi

ABSTRACT

Combination of high oil content and high iodine value of oil of yellow seeded varieties of linseed with the high seed yield of brown seeded ones, which was not found feasible by the ordinary methods of hybridization, was achieved by mutation breeding as yellow seeded mutation possessing all the desirable qualities. High seed yield, high oil percentage and high iodine value of oil, were induced in the three brown seeded varieties, NPRR 9, EB 3 and M 10, by gamma rays and ethylmethane sulphonate.

INTRODUCTION

ALTHOUGH mutation breeding cannot be said to be an alternative to the conventional methods of breeding, it can, in some situations, substitute hybridization very effectively. In linseed, *Linum usitatissimum* L. high oil content and high iodine value of the oil are associated with the yellow colour of the seeds, the dark coloured ones having less oil of low iodine value. The brown seeded varieties, however, are superior grain yielders. Obviously the breeder's aim is to combine high seed yield, high oil content and high iodine value of the oil in a single variety. Attempts to combine by hybridization the high oil content and high iodine value of oil of the yellow seeded varieties with the high yielding brown seeded ones have been rather disappointing¹. The present experiments have shown that the combination of all the three desirable qualities in a single variety of linseed can be achieved by mutation breeding.

MATERIALS AND METHODS

Three cultivars of linseed, NPRR 9, EB 3 and M 10, all brown seeded, were included in these studies. NPRR 9 is a high yielding, medium maturing variety resistant to wilt and rust caused by the organisms, *Fusarium lini* (Bolley) and *Melampsora lini* (Pers.) Lev. respectively but has oil of low iodine value. EB 3 is an early maturing variety with a fairly good quality of oil but is highly susceptible to rust. M 10 is susceptible to both wilt and rust but has a high oil content in the seeds. Dormant seeds of EB 3 were irradiated with 40, 60 and 80 kilo rads of gamma rays from a ⁶⁰Co source and those of M 10 were treated

with 0.2, 0.4 and 0.6% ethyl methanesulphonate (EMS) for a period of four hours. One set of seeds of NPRR 9 were irradiated as in the case of EB 3 and another set treated with EMS as in M 10. The M₂* progeny was scored for the yellow seeded mutations. A randomized replicated trial of the yellow seeded mutations of EB 3 was laid out in the M₃* generation and the data collected on the yield and yield components analysed statistically. The M₃* seeds of a few mutations were analysed for their oil content by the cold percolation method⁶ and the iodine value of the oil found out by the Wijs method (Official and tentative methods of the American Oil Chemists Society. AOCS Chicago, 1962).

EXPERIMENTAL RESULTS

Out of the 318 and 107 M₂ families of NPRR 9 and EB 3 respectively raised from gamma irradiated seeds 5 families from NPRR 9 and three from EB 3 were found to be segregating for the yellow seed colour. Thirteen mutants were obtained from NPRR 9 and 10 from EB 3. Out of 86 and 55 M₂ families raised from EMS-treated seeds of NPRR 9 and M 10 respectively four and three families were found to be segregating for the yellow seeds giving one mutation each (Table I). In all 30 yellow seeded mutations were obtained. Both gamma rays (40 and 60 kR) and EMS (0.2 and 0.4%) were effective in inducing the seed colour mutations. The highest dose of gamma rays (80 kR) and the highest concentration of EMS used in these experiments produced no such mutations in any of the varieties studied.

Seed samples of 10 mutations in the M₃ generation, 7 from NPRR 9, 2 from EB 3 and one from M 10, together with their appropriate controls, were analysed for their oil content and iodine value of the oil (Table II). It is

* M₂ and M₃ = The second and third generations after the mutagenic treatment of the seed.

TABLE I
Frequency of yellow seeded mutants in the M_2 generation

Treatment	No. of families scored	No. of families segregating	% families segregating	No. of mutants obtained
NPRR 9				
40 kR gamma rays	148	3	2.0	8
60 "	136	2	1.5	5
80 "	34	0	0.0	0
0.2% EMS	30	3	10.0	3
0.4 "	30	1	3.3	1
0.6 "	26	0	0.0	0
EB 3				
40 kR gamma rays	53	2	3.8	6
60 "	40	1	2.5	4
80 "	14	0	0.0	0
M 10				
0.2% EMS	15	2	13.3	2
0.4 "	20	1	5.0	1
0.6 "	20	0	0.0	0

TABLE II
Oil content and iodine value of yellow seeded mutants and their control

Treatment	Oil %	Iodine value of oil
NPRR 9		
40 kR gamma rays	46.6	166.9
60 "	42.9	160.4
0.2% EMS	42.6	148.1
"	42.8	160.3
"	44.5	159.9
"	44.3	168.6
0.4% "	35.3	153.2
Control	41.7	144.3
EB 3		
40 kR gamma rays	41.6	159.5
"	45.1	171.4
Control	42.8	151.4
M 10		
0.4% EMS	47.6	155.5
Control	47.1	152.2

seen from the table that the oil content is higher in all the treatments and varieties as compared to the control except in two cases, one in 0.4% EMS-treated NPRR 9 and another in 40 kR gamma ray treated EB 3. While the cause for the depression in the oil content of the EB 3 mutant is perhaps due to rust attack to which this variety is very susceptible, that for the NPRR 9 is not clear. The iodine value of the oil, in all the cases, was invariably higher than that of the control. It is, therefore, apparent that high oil content and high iodine value have accompanied the change in seed colour from brown to yellow.

A randomized trial in four replications was laid out with the ten yellow seeded mutations of EB 3 against the untreated parental strain as the control. Data collected on plant height, number of primary tillers, number of seeds per capsule, single plant seed yield and 1000-grain weight, on 12 plants selected at random from each of the treatments in each of the replications, were analysed statistically (Table III). The difference between the

TABLE III
Mean values of yield and yield components of yellow seeded mutants and their control in EB 3

Mutant No.	Plant height cm.	No. of tillers	No. of seeds per capsule	Plant yield g	1000-grain weight g
1	54.0	8.5	7.5	10.8	6.1
2	58.2	13.2	7.1	16.0	5.7
3	60.1	15.2	6.3	18.1	6.7
4	66.2	15.5	7.6	10.3	6.5
5	53.5	13.0	7.0	9.4	5.7
6	60.2	15.2	7.1	12.2	6.0
7	58.8	9.2	7.0	18.8	6.7
8	59.2	9.5	7.6	11.9	5.9
9	58.5	9.2	6.4	15.8	6.8
10	59.0	10.5	6.6	17.9	6.1
Control	50.2	9.2	6.2	13.0	9.7
CD 5%	4.69	3.06	0.62	4.50	0.41
SE _m	1.61	1.30	0.21	1.56	0.14

mutants and the control was found to be highly significant for all the characters studied.

DISCUSSION AND CONCLUSIONS

The occurrence of high yielding mutations with high oil content of superior quality in the M_2 generation of gamma-irradiated and EMS-treated progenies of linseed is of considerable significance. High oil content and high iodine value are important qualities of linseed. If these characters were associated with an easily discernible morphological character such as seed colour it would greatly facilitate linseed improvement. These experiments have shown that in the three varieties, NPRR 9, EB 3 and M 10, mutations for seed colour have accompanied high oil content, high iodine value of the oil and high seed yield, all simultaneously. Bari¹ reported that in a 600 R/day chronically gamma-irradiated flax a yellow seeded mutant appeared that produced about 50% more seed than the non-irradiated plants.

The yellow seed colour is known to be positively associated with high oil content of superior quality⁴ and is attributed to the homozygous recessives of one or more genes². High oil content and high iodine value have been shown to be associated with seed colour as conditioned by the b_1 locus^{4,5} and by the g locus³. The change of seed colour from brown to yellow could, therefore, be due to a gene mutation. By inducing such mutations it is possible to develop desirable characters in plants without disrupting seriously the otherwise superior gene combinations.

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OCCURRENCE OF ALGAL STROMATOLITE FROM LOWER KALADGI LIMESTONES (PRECAMBRIAN) NEAR NIDGUNDI, BIJAPUR DISTRICT, MYSORE STATE

M. N. VISWANATHIAH AND T. R. SREEDHARA MURTHY

Department of Geology, Manasa Gangotri, Mysore-6

THE algal stromatolites are the only organic activity so far found in the Kaladgi sediments (Precambrian). Different types of algal stromatolites have been described from Lower Kaladgi limestones by Viswanathiah, Govinda Rajulu and Sathyanarayan⁸ (1964) and Govinda Rajulu and Chandrasekhara Gowda^{3,4} (1966) (1968), Viswanathiah and Chandrasekhara Gowda⁵ (1970). During the recent investigations around the village Devalapur, about 2.4 km northwest of Nidgundi (Lat. 16° 22', Long. 75° 44') an interesting stromatolite band was traced. It consists of algal colonies which show peculiar configuration hitherto not described from the Kaladgi area.

The stromatolitic band occurs in the dolomites of the Lower Kaladgis trending north 80° east with a northerly dip of 25°. The band which is 2 to 3 metres in width can be traced for about 12 metres in the field before it disappears in the soil. The stromatolitic rock is greyish-white, hard and compact with thin veins of calcite.

The stromatolite under study shows prominently both horizontal and vertical colonies. In vertical section, the colonies consist of a number of hemispheroidal laminae, which are

closely spaced and convex upwards. The laminae of one are not linked with the laminae of the adjacent ones. The growth appears to have begun from a point on the substratum expanding upward by the addition of crude hemispheroidal laminae. On the average 6 to 8 laminae can be counted per centimetre. In horizontal section the colony consists of closely spaced circular but crenulated laminae which are disposed around a nucleus. Four to six laminae can be counted per centimeter. The colony is ovoidal in outline and measures 28.5 cms in longer diameter and 25.6 cms in shorter diameter.

Thin sections of intracolony dolomitic limestone associated with stromatolitic band are medium to fine-grained sparites with occasional grains of micrites. Patches of coarse-grained interlocking crystals of calcite, a few grains of quartz, white mica and tourmaline are also observed in association with the matrix. Similarly, the thin sections of stromatolitic band show fine-grained micrites with intergranular sparry dolomites, which are elongated and oriented according to the laminae observed in the specimens. In some sections medium-grained chert also occurs in the form