Theor. Appl. Genet. 53, 125-128 (1978)

Study on Induced Mutants Resembling Commercial Varieties in Bread Wheat

V.P. Kulshrestha and V.S. Mathur
Cummings Laboratory, Indian Agricultural Research Institute, New Delhi (India)

Summary. The occurrence of variants with phenotypic resemblance to the existing cultivated varieties of wheat, such as 'Sonalika', 'Arjun' and 'Kalyansona', evolved by hybridisation, has been found in various generations of the mutagen-treated populations of the variety 'Zaafrane'. The repetition and involvement of common genes in certain genotypes in the evolutionary history of these varieties is attributed to the induction of such intervarietal mutants.

It is shown that selective reconstruction of a particular variety in bread wheat is not only possible, but also relatively easy, especially from a closely related variety.

The study opens the possibility of utilising this method as a technique for developing components of a multiline.

Key words: Induced mutation – Bread wheat – Multiline

Introduction

The enormous amount of CIMMYT's germplasm over the past twenty years or so has utilised a rather limited number of genetic stocks in multiples of combinations and thereby giving out a large number of varieties having a restricted gene base. Therefore, a few varieties evolved in India, though phenotypically different, have great genetic similarities because of the many common genotypes involved in their evolution. These varieties suffer from one or more drawbacks. Keeping in view their almost common pedigree, an attempt was made in the present study to explore the possibility of inducing mutations which would morphologically and physiologically resemble the sister varieties. The results obtained are summarised in this paper.

Materials and Methods

Seeds of wheat variety 'Zaafrane' (*Triticum aestivum*) were irradiated with 15, 20 and 25 Kr of gamma rays (^{60}Co source at a dose rate – 2500 r per min). The selfed seeds of the main tillers of the M_1 plants were carefully collected to raise M_2. The M_2 was raised as M_1 progeny rows and subjected to selection pressure. Selection was continued in M_3 and M_4 generations also. The material was screened for reaction to rusts under artificial epiphytotic conditions.

Results

In the M_2 and M_3 a wide range of genetic variability for a number of characters was observed, which included among others: plant height, kernel weight, heading, maturity and reaction to rusts. Some of the selected mutants showed a near resemblance to the widely cultivated semi-dwarf varieties of wheat viz., 'Sonalika', 'Arjun' and 'Kalyansona', developed through conventional hybridisation. The diagnostic features of these mutants in comparision to the resembling cultivated varieties and the parent variety 'Zaafrane' are given in Table 1.

It may be seen from the Table that, in general, the mutants showed only minor differences from the respective varieties to which they nearly resembled for characters: days to heading, days to maturity, height and kernel weight, though marked differences for reactions to rusts in certain mutants were also observed. Thus, mutant no. 82 and 103 were different from 'Sonalika' in reaction to all the rusts. Compared to 'Kalyansona', marked differences were noticed in reaction to black rust for nos. 14 and 18 and to brown rust in all the mutants. All the mutants, however, differed from the parent variety, 'Zaafrane', for most of the characters.

Discussion

Occurrence of mutants simulating in one or a cluster of characters of the allied species, subspecies or varieties in mutagen-treated population, has been reported in many crop plants, including the *Triticum* complex (Swaminathan 1963). This phenomenon has been explained, however, depending upon the material, as largely due to gen-

0040-5752/78/0053/0125/$ 1.00

Tabel 1. Characteristics of Sonalika, Arjun and Kalyansona and resembling mutants

Variety/ Mutant		% Reaction to rusts Black	Brown	Yellow	Heading (days)	Maturity (days)	Height (cm)	1000 kernel wt. (gm)	Colour Glume	Grain
Sonalika		20 S	40 S	5 S	94	140	101	37.0	Brown	Amber
Mutant nos.	82	10 S	5 S	0	91	141	100	36.0	,,	,,
resembling	83	20 S	10 S	0	90	143	96	36.8	,,	,,
Sonalika	84	20 S	5 S	5 R	89	142	98	37.6	,,	,,
	86	30 S	10 S	5 R	90	143	98	36.2	,,	,,
	90	20 S	20 X	5 S	87	137	96	36.6	,,	,,
	93	10 S	10 R	10 S	88	140	100	35.6	,,	,,
	94	10 S	5 S	10 R	91	144	97	36.0	,,	,,
	96	20 S	0	10 S	89	142	97	37.0	,,	,,
	97	5 S	5 S	5 S	92	144	99	37.0	,,	,,
	103	10 S	10 S	5 R	91	144	98	37.8	,,	,,
	104	20 S	10 S	5 S	86	142	96	37.8	,,	,,
	105	30 S	0	0	88	140	99	37.0	,,	,,
	106	10 S	5 S	10 S	89	142	98	37.8	,,	,,
Arjun		0	10 R	10 R	91	136	90	34.8	White	,,
Mutant nos.	31	0	30 S	10 R	86	138	92	33.0	,,	,,
resembling	32	0	10 S	10 S	90	135	92	34.6	,,	,,
Arjun	46	5 R	40 S	15 S	91	137	89	34.6	,,	,,
	77	10 R	10 R	10 S	91	135	90	34.0	,,	,,
	78	5 R	10 R	20 S	90	134	90	35.0	,,	,,
	98	0	30 S	20 S	90	136	88	35.0	,,	,,
Kalyansona		40 S	80 S	50 S	107	148	103	29.4	Brown	,,
Mutant nos.	4	20 S	10 S	60 S	103	147	97	29.6	,,	,,
resembling	13	20 S	30 S	30 S	107	142	100	29.4	,,	,,
Kalyansona	14	10 S	30 S	40 S	105	146	96	30.0	,,	,,
	18	10 R	20 S	40 S	105	145	100	31.0	,,	,,
	19	50 S	20 S	40 S	106	145	96	29.8	,,	,,
Zaafrane		40 X	15 S	0	101	149	100	34.6	White	Red

R = Resistant S = Susceptible X = Mesothatic

uine visible mutation affecting key diagnostic character directly or through inhibitor genes, criptic deletions etc. Also, the role of micro-mutations has been indicated by some workers (Stubbe 1959).

In the present study a number of variant types were obtained in M_2 and M_3 from 'Zaafrane' resembling three other commercial varieties of *T. aestivum*. These could be due to multiple gene mutations or rare intragenic recombinations (Jain 1967). The other possibilities of obtaining variant types resembling cultivated varieties through chance out-crossing and mechanical mixture could be ruled out in the present studies. The M_1 sterility at the doses used was negligible and also proper care was taken to self the plants. In the event of mechanical mixture, the recovered plants should have been exactly similar for all the characters. A close examination of all the mutants did reveal some differences among them with respect to certain characters like resistance to rusts, plant height, time of heading and maturity and kernel weight.

The probable mechanism of origin of these mutant lines can now be examined. As mutant lines differ from the original variety, 'Zaafrane', in several characters governed by both major and minor genes, the possibility of their occurrence due to mutation alone is very remote. A more likely possibility is the alteration in the pattern of gene arrangement along with mutation and intragenic recombination. Jain (1967) argued from the available evidence on both lower and higher organisms that intracodon recombination can play a great role in the creation of new variability just as mutation can. Evidence favouring this mode of origin of the variant lines was obtained when a critical comparision of the pedigree of 'Zaafrane' was made with that of 'Sonalika', 'Arjun' and 'Kalyansona'.

In the evolution of 'Zaafrane', apart from others, Tim-

Table 2. Parentages of the varieties

Variety	Parentage
Zaafrane	Sonora 64 X Klein Rend
Sonora 64	Yaktana 54 - Norin 10 - Brevor X Yaqui 54^2
Yaktana 54	Yaqui 48 - Kentana 48 X Frontana
Yaqui 48	Newthatch X Marroqui
Kentana 48	Kenya 324 X Mentana
Yaqui 54	Yaqui 48 X Timstein - Kenya
Yaqui 48	Newthatch X Marroqui
Sonalika	II 53-388-Andes X Pitic 'S' - Lerma Rojo 64
Andes	Kentana 48 - Frontana X Mayo 48
Kentana 48	Kenya 324 X Mentana
Mayo 48	Newthatch X Marroqui
Pitic 'S'	Yaktana 54 X Norin 10 - Brevor
Yaktana 54	Yaqui 48 - Kentana 48 X Frontana
Yaqui 48	Newthatch X Marroqui
Kentana 48	Kenya 324 X Mentana
Lerma Rojo 64	[(Yaqui 50 X Norin 10 - Brevor) Lerma 52] Lerma $Rojo^2$
Yaqui 50	Newthatch X Marroqui
Lerma 52	Kenya 324 X Mentana
Lerma Rojo	Lerma 50 (Yaqui 50-Maria $Escobar^2$ X Supremo 211)
Lerma 50	Kenya 324 X Mentana
Yaqui 50	Newthatch X Marroqui
Arjun	Lerma Rojo 64A X Nainari 60
Lerma Rojo 64A	[(Yaqui 50 X Norin 10 - Brevor) Lerma 52] Lerma $Rojo^2$
Yaqui 50	Newthatch X Marroqui
Lerma 52	Kenya 324 X Mentana
Lerma Rojo	Lerma 50 (Yaqui 50-Maria $Escobar^2$ X Supremo 211)
Lerma 50	Kenya 324 X Mentana
Yaqui 50	Newthatch X Marroqui
Nainari 60	[(Supremo-Mentana X Gabo) Thatcher-Queretaro X Kenya 324 X Mentana] Gabo
Supremo	Supremo 211 X Kenya 324
Kalyansona	[(Frontana X Kenya 58 - Newthatch) Norin 10 - Brevor] X Gabo 55

stein, Kenya, Newthatch × Marroqui, Kenya 324 × Mentana, Norin 10 × Brevor and Frontana have been used once each (Table 2). An examination of the traceable ancestry of 'Sonalika' would reveal that the combinations: Newthatch × Marroqui, Kenya 324 × Mentana, Norin 10 × Brevor and Frontana are repeated; the first two being used four times each and the latter twice each. The first three combinations listed above are also common in the parentage of 'Arjun'; the first being used twice, the second three times and the third once. Kenya 324 and Mentana are again separately involved once each. Norin 10 × Brevor, Frontana and Newthatch once each have also gone into the parentage of 'Kalyansona'.

Because of the largely common parentage, most of the genes responsible for the evolution of 'Sonalika', 'Arjun' and 'Kalyansona' are available in the variety 'Zaafrane' but not in specific combinations. The mutagenic treatment, along with the suitable selection pressure, resulted in the isolation of lines resembling the three varieties.

It is thus obvious from the foregoing discussion that certain genotypes have been repeated several times at various stages of development of the variety 'Sonalika'. Accordingly, the mutants with phenotypic nearness to 'Sonalika' showed the highest frequency (13/134) in the various mutagen-treated generations. These genotypes have been used relatively less extensively in the evolution of 'Arjun', as is evident from the comparatively low frequency of the mutants close to 'Arjun' (6/134). A similar trend is observed in the case of 'Kalyansona', with a frequency of 5/134.

This would seem to suggest that the genotypes mentioned above, so frequently used all over the world in the evolution of a large number of dwarf varieties in the recent years, might have contributed a large number of their genes into the dwarf varieties. The different varieties represent only slightly different combinations of the same genes. The proximity of these genes in different varieties facilitates induction of intervarietal mutants with ease.

In the light of the present findings it appears that selective reconstruction of a particular variety in bread wheat is not only possible but also relatively easy, especially from a closely related variety. The extent of success, however, would depend on the involvement of the genotypes carrying the desired character in the evolutionary history of the variety under study.

The study opens the possibility of utilising this method as a technique for developing components of a multiline with phenotypic resemblance but differing in disease reaction. The reverse possibility, that of producing components of a multiline from a single variety by induced mutation, may be more cumbersome as it will involve testing of disease reaction at early generations.

Acknowledgment

The authors feel grateful to Drs. E.A. Siddique and R.N. Raut for helpful suggestions and critically reading the text.

Literature

Jain, H.K.: Genetic recombination in the evolution of protein molecules. Curr. Sci. **36**, 90-92 (1967)

Stubbe, H.: Considerations on the genetical and evolutionary aspects of some mutants of *Hordeum, Glycine, Lycopersicon* and *Antirrhinum*. Cold Spring Harbour Symp. Quant. Biol. **24**, 31-34 (1959)

Swaminathan, M.S.: Mutation analysis of the hexaploid *Triticum* complex. Proc. 2nd Intern. Wheat Genet. Symp. 418-438 (1963)

Received April 25, 1978
Communicated by K. Tsunewaki

V.P. Kulshrestha
V.S. Mathur
Cummings Laboratory
Indian Agricultural Research
Institute, New Delhi 110012
(India)