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IDENTIFICATION OF UNKNOWN INTERCHANGES IN PEARL MILLET THROUGH THE USE OF TRANSLOCATION TESTER-SET

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ABSTRACT

The unknown interchanges of pearl millet, *Pennisetum americanum* (L.) Rich. Syn. *P. typhoides* (Burm.) S. & H. were crossed with each other as well as with the members of tester-set and other interchanges. The F_1s were analysed for chromosome configurations at diakinesis. The information so generated was interpreted keeping in view the knowledge about chromosomes involved in tester-set and other interchanges.

Key Words : Chromosomal interchanges, pearl millet, translocation tester-set

Translocation tester-sets are important cytogenetic stocks for the identification of chromosomes involved in translocations or in aneuploidy. In pearl millet, *Pennisetum americanum* (L.) Rich. Syn. *P. typhoides* (Burm.) S. & H. reports on the induction and maintenance of interchanges exist [1-5]. Using the principles of Burnham [6], five of the stocks were grouped as a tester-set[7]. The translocated chromosomes in these stocks were identified by following cytogenetic approach[8]. In this communication we report the use of tester-set and some known interchanges in determining the identity of chromosomes involved in unknown translocations of pearl millet.

MATERIALS AND METHODS

The investigation was carried out on interchange stocks of pearl millet. Stocks, viz., RT-2, -7, -8, -9 and -23 comprised a tester-set [7], RT-31, -32, -33 and -34 were unknown stocks [5] while RT-1, -3, -4 and -17 other known interchanges[8]. The tester-set and other known interchanges were developed and maintained as homozygous stocks by following standard test cross procedure[5]. The unknown interchange stocks were crossed with each other and as well as with the tester-set and other known interchanges. The F_1s were meiotically screened at diakinesis for

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chromosome configurations, viz., 7 II, 5 II + I IV, 4 II + 1 VI and 3 II + 2 IV, respectively. The results were interpreted in light of principles of Burnham[6].

RESULTS AND DISCUSSION

The higher chromosome configurations observed at diakinesis in the PMCs of the F_1 progenies of 38 inter-translocation crosses are given in Table 1.

Table 1. Higher chromosome configurations in F_1s of inter-translocation crosses of pearl millet at diakinesis

Unknown stocks	Unknown stocks				Tester-set					Other interchanges			
	RT-31	RT-32	RT-33	RT-34	RT-2 (T1.2)	RT-7** (T5.6)	RT-8 (T2.4)	RT-9 (T2.5)	RT-23 (T5.7)	RT-1 (T1.2)	RT-3** (T3.4)	RT-4** (T4.6)	RT-17 (T1.5)
RT-31	X	2IV	1VI	2IV*	1 VI	2 IV	1 IV	1 VI	-	1 VI	1 VI	1 VI	2 IV
RT-32		X	2IV	2 IV*	2 IV	1 VI	2 IV	1 VI	1 VI*	2 IV	1 VI	2 IV	1 VI
RT-33			X	2 IV*	1 VI	1 VI	1 VI	1 VI	2 IV*	1 VI	2 IV	1 VI	2 IV
RT-34				X	1 VI*	2 IV*	2 IV*	2 IV*	1VI*	1 VI*	-	-	-

IV : Quadrivalent; VI : hexavalent; Figures represent number, —Progeny was not recovered.

*Chromosome configurations attached to the nucleolus

Given within paranthes are the chromosomes involved in the interchange stocks.

**Only one of the interchanged chromosomes in RT-3, -4 and -7 was known[8]. The present investigation helped in deciphering other involved chromosomes in these stocks.

In 20 crosses presence of a VI indicated that one translocated chromosome was common in the two parental interchanges used in the crosses. Likewise, occurrence of 2 IV in 17 crosses meant that the parental stocks involved entirely different chromosomes in translocations whereas in only one cross i.e. RT-31 × RT-8, a IV was recorded. This implied that both these stocks possessed same translocated chromosomes but had different locations of interchange breakpoints. Kaul and Sidhu[8] reported RT-8 as a translocation between chromosome 2 and 4. Hence, it could be concluded that RT-31 also involved these very chromosomes in translocation. The stock was therefore designated as T2.4. The study (Table 1) further indicated the involvement of chromosome 2/4 in RT-33 but not in RT-32 and RT-34, respectively.

On the basis of the study of relevant configurations in the progenies using RT-32 as one of the parents, the possibility of its translocated chromosomes being chromosome 1, 2, 4 and 7 was ruled out (Table 1). Therefore, this stock involved

two out of three chromosomes, viz., 3, 5 and 6 in translocation (*n* being 7 in pearl millet). In the F_1s of RT-32 × RT-23, a VI suggested that one of their translocated chromosomes was same. The stock RT-23 was identified as T5.7 [8]. Hence, RT-32 involved either chromosome 5 or 7 in translocation. In pearl millet chromosome 7 was known to be nucleolus organiser and was found involved in translocation in two stocks, viz., RT-23 and RT-34, respectively[5, 7]. Therefore, it could be put forth that RT-32 carried chromosome 5 as one of its translocated chromosomes. The observation of a VI each in crosses using RT-2, -8 and -9 as one of the parents with RT-33 implied the role of chromosome 2 in RT-33 (Table 1). This observation further suggested that chromosomes 1, 4, 5 and 7 were not involved in translocation in this stock (Table 1). Therefore, the other chromosome involved in RT-33 was deduced to be either chromosome 3 or 6. The presence of two IV in the F_1s between RT-33 and RT-3 meant that none of their translocated chromosomes was same. Kaul and Sidhu[8] reported latter to involve chromosome 3 in break point, thereby its role in RT-33 was negated as per the principles of Burnham[6]. In other words, chromosome 6 was figured to be translocated in this stock. Accordingly, RT-33 was designated as T2.6.

The identification of RT-33 made possible to unravell the other interchanged chromosome in RT-32. One of its translocated chromosomes was precisely identified as chromosome 5. Whether chromosome 3 or 6 was involved in interchange was deciphered from the study of higher configuration of 2 IV in F_1s between RT-32 and RT-33 (Table 1). As a consequence, the role of chromosome 6 could be eliminated since RT-33 was identified as T2.6. This observation suggested chromosome 3 to be involved in translocation in this stock. Hence, RT-32 was labelled as T3.5. In RT-34, one of its interchanged chromosomes was already identified as chromosome 7 - a nucleolus organiser due to its association with nucleolus[5]. On the basis of relevant meiotic configurations of F_1s between RT-34 and members of tester-set and other interchanges the possible involvement of chromosomes 2, 4, 5 and 6 was excluded (Table 1). The appearance of a VI in the F_1 progeny of RT-34 and RT-2 indicated one of their translocated chromosomes to be same (Table 1). The stock RT-2 was known to involve the exchange of segments between chromosome 1 and 2[6]. Since the role of chromosome 2 was already ruled out, hence, RT- 34 was identified to carry chromosome 1 as translocated. This stock was, therefore, designated as T1.7.

One of the interchanged chromosomes in each of RT-3, RT-4 and RT- 7 was identified precisely[8]. The present analysis was found to be helpful in establishing the identity of the other chromosomes involved in these stocks. RT-7, a member of tester-set [7] was known to involve chromosome 5 in translocation[8]. The F_1s between RT-33 × RT-7 showed a VI (Table 1). This configuration was possible only when

one of the translocated chromosomes in RT-33 (either chromosome 2 or 6) would be common to the two chromosomes involved in RT-7. At the same time, the role of chromosome 2 was eliminated since the F_1s between RT-7 and RT-31 displayed 2 IV at diakinesis (Table 1). Therefore, it could be put forth that RT-7 involved chromosome 6 in translocation. This interchange stock was labelled as T5.6. The translocation stock RT-4 was known to involve exchange of segments between chromosome 4 and either chromosome 3 or 6[8]. The configurations presented in Table 1 revealed the occurrence of a VI in the PMCs of F_1s between RT-23 and RT-4 which suggested either chromosome 2 or 6 to be translocated in RT-4. The studies of Kaul and Sidhu[8] demonstrated no role of chromosome 2 in translocation. Hence it was concluded that RT-4 involved translocation between chromosome 4 and 6. The stock was duly designated as T4.6.

The identification of chromosomes involved in stocks RT-4 and RT- 7 made it possible to study the other chromosome involved in RT-3 (since one was already identified as chromosome 3) [8]. On the basis of meiotic configurations, one of the involved chromosomes in RT-4, either chromosome 4 or 6 was found to be common with RT- 3 (Table 1). The F_1s between RT-31 × RT-3 displayed a VI at diakinesis (Table 1). The present analysis demonstrated RT-31 to be T2.4. It meant that RT-3 possessed one of these chromosomes in translocation. Kaul and Sidhu[8] reported the occurrence of 2 IV in the F_1s between RT-1 & RT-3 and RT-2 & RT-3, respectively. The interchange stocks RT-1 and RT-2 were known to be T1.2[8]. This observation suggested that neither chromosome 1 nor 2 was involved in RT-3. In other words, chromosome 4 could be deduced to be interchanged. Hence, the stock RT-3 was labelled as T3.4.

Translocation testers have been found to be helpful in identifying chromosomes in emmer wheat, barley, cotton, pearl millet, *Phaseolus* etc. [9, 10]. The present analysis also demonstrated their successful use in detecting the identity of interchanged chromosomes of translocation stocks in pearl millet. Properly documented interchanges with regard to their involved chromosomes and breakpoints are expected to prove valuable in cytogenetic studies as well as breeding programmes.

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REFERENCES

1. B. R. Tyagi. 1975. Translocation stocks in pearl millet. Nucleus., **18**: 151-155.
2. B. R. Tyagi and R. B. Singh. 1975. Induced translocations in pearl millet. Nucleus., **18**: 24-33.

3. J. S. Sidhu, J. L. Minocha and B. S. Gill. 1977. Cytological studies on some chromosomal interchanges in pearl millet. Crop Imp., **4**: 28-34.
4. D. S. Brar and J. L. Minocha. 1982. Multiple chromosomal interchanges in pearl millet. Theor. Appl. Genet., **61**: 105-108.
5. J. Kaul and J. S. Sidhu. 1999. Induction and development of homozygous translocations in pearl millet. Adv. Biosci., **18**: 17- 24.
6. C. R. Burnham. 1962. Discussions in cytogenetics. Minneapolis, Minn. Burgess.
7. J. L. Minocha, D. S. Brar, R. S. Saini, D. S. Multani and J. S. Sidhu. 1982. A translocation tester-set in pearl millet. Theor. Appl. Genet., **62**: 31-33.
8. J. Kaul and J. S. Sidhu. 2000. Identification of chromosomal interchanges of pearl millet through cytogenetic technique. Indian J. Genet., **60**: 117-121.
9. B. R. Tyagi. 1976. Cytological identification of translocated chromosomes in *Pennisetum typhoides* (Burm.) Stapf. and Hubb. by observing hybrids between translocation homozygotes and translocation testers. Proc. Indian Natn. Sci. Acad. B., **42**: 117- 121.
10. P. K. Gupta. 1997. Cytogenetics. Rastogi Publications. Meerut, India, pp. 61-108.