Madras Agric. J., 94 (7-12) : 151-155 July-December 2007
https://doi.org/10.29321/MAJ.10.100656

Gamma ray induced variation for lodging resistance and its associated characters in littlemillet *(Panicum sumatrense* Roth Ex-roem and schult)

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Abstract: An investigation was carried out to study the nature and amount of gamma ray induced genetic variability in littlemillet during *kharif,* 2006 and *rabi,* 2006-2007. Two released varieties CO3 and CO(Samai) 4 were treated with gamma rays. The maximum variability was observed for plant height and total number of tillers in M_2 generation of both CO3 and CO(Samai)4. A high heritability associated with a high genetic advance as percentage of mean was observed for total number of tillers and grain yield in M_2 generation. With reference to lodging character CO (Samai)4 mutants showed high heritability with genetic advance in the progenies of 500 and 600 Gray of M_2 generation. Mutants in 500 and 600 Gray also exhibited maximum variability, heritability and genetic advance for plant height, total number of tillers, number of nodes, inter-nodal length, culm thickness and grain yield. Therefore, selection in these progenies would be rewarding to have lodging resistance with reduced plant height and inter-nodal length and increased number of nodes, culm thickness and grain yield. These desirable mutants would be forwarded to further generation until they obtain homozygosity.

Key words : Littlemillet, Gamma irradiation, lodging resistance, variability.

Introduction

Littlemillet is a self pollinated crop with less variability. Most of the released strains were evolved through mass selection or pureline selection methods. Breeding of new varieties by hybridization has not been very successful because of the difficulties encountered in the manipulation of the tiny spikelets on brittle pedicels. In view of the above situation, mutation breeding can complement the conventional breeding methods in the improvement of littlemillet. Induced variability and applying selection can provide wider scope for evolving new varieties with desirable attributes. Therefore, induced mutagenesis has been resorted to expand variability followed by efficient selection for non-lodging and high yielding varieties in littlemillet.

Materials and methods

Recently released littlemillet varieties from Tamil Nadu Agricultural University, Coimbatore *viz.,* CO3 and CO(Samai)4 were selected for the present mutation study during *kharif,* 2006 and *rabi,* 2006-2007. They were exposed to 300, 400, 500, 600 and 700 Gray of gamma rays from ^{60}Co source at BARC, Mumbai. The treated seeds were sown in the field along with control (untreated seeds) in a Randomized Complete Block Design with two replications. In each treatment of both the varieties, the plants were harvested separately and the seeds

Table 1. Variability parameters in M_2 generation of Littlemillet variety CO3 through Gamma irradiation

Characters	Treat-ment (Gy)	Mean	PCV (%)	GCV (%)	h^2(%)	GA(% of mean)
Plant height	300	106.82	11.19	9.98	79.51	18.33
	400	102.05	12.99	11.85	83.32	22.29
	500	97.38	12.94	11.69	81.56	21.74
	600	91.99	14.05	12.76	82.46	23.87
	700	96.34	11.92	10.52	77.80	19.11
Total number of tillers	300	16.29	40.09	35.76	79.58	65.72
	400	14.96	39.67	34.42	75.27	61.51
	500	14.01	37.05	30.48	67.67	51.64
	600	15.41	40.57	35.77	77.72	64.96
	700	15.73	35.95	30.66	72.76	53.87
Number of nodes	300	4.59	14.45	11.11	59.09	17.59
	400	4.49	11.57	6.68	33.33	7.95
	500	4.55	13.55	9.83	52.63	14.69
	600	4.57	13.67	10.03	53.85	15.16
	700	4.23	11.34	5.29	21.74	5.08
Inter-nodal length	300	13.07	24.21	19.49	64.84	32.33
	400	13.13	19.31	12.99	45.26	18.00
	500	12.17	21.97	15.66	50.77	22.98
	600	13.06	19.20	12.74	44.04	17.42
	700	13.40	18.02	11.34	39.62	14.71
Culm thickness	300	2.70	38.49	37.41	94.44	74.88
	400	2.23	24.15	21.51	79.31	39.45
	500	2.45	22.73	20.41	80.65	37.75
	600	2.48	28.23	26.44	87.76	51.03
	700	2.06	32.92	30.70	86.96	58.98
Grain yield	300	16.07	46.45	38.85	69.96	66.94
	400	15.43	45.60	37.09	66.18	62.16
	500	19.19	38.41	31.95	69.18	54.74
	600	17.71	43.54	36.91	71.85	64.44
	700	19.45	35.21	28.24	64.31	46.64
Lodging susceptibility	300	4.03	12.14	7.43	37.50	9.38
	400	4.63	13.27	8.85	44.44	12.15
	500	4.46	13.40	8.21	37.50	10.36
	600	4.58	12.09	7.40	37.50	9.34
	700	3.82	11.93	7.31	37.50	9.22

Table 2. Variability parameters in M_2 generation of Littlemillet variety CO (Samai) 4 through Gamma irradiation

Characters	Treat-ment (Gy)	Mean	PCV (%)	GCV (%)	h^2(%)	GA(% of mean)
Plant height	300	87.06	13.27	11.90	80.36	21.97
	400	95.15	12.19	10.94	80.53	20.23
	500	90.04	13.54	12.29	82.36	22.97
	600	102.31	14.15	13.23	87.48	25.50
	700	109.61	14.39	13.61	89.46	26.52
Total number of tillers	300	12.53	35.69	33.82	89.80	66.02
	400	13.99	42.41	41.17	94.21	82.31
	500	16.93	32.87	31.76	93.41	63.24
	600	14.13	39.70	38.39	93.52	76.47
	700	13.33	31.18	29.28	88.19	56.64
Number of nodes	300	4.62	11.86	5.73	23.33	5.70
	400	4.84	14.01	9.91	50.00	14.43
	500	5.05	14.28	10.66	55.77	16.40
	600	4.59	13.43	8.44	39.47	10.92
	700	4.49	11.79	4.98	17.86	4.34
Inter-nodal length	300	2.03	19.08	13.03	46.67	18.34
	400	2.32	23.21	19.75	72.41	34.63
	500	2.25	26.67	23.52	77.78	42.73
	600	2.35	24.07	20.85	75.00	37.19
	700	2.15	19.73	14.71	55.56	22.58
Culm thickness	300	12.69	14.99	11.77	61.60	19.03
	400	12.26	20.63	18.26	78.28	33.28
	500	13.03	16.51	13.81	69.98	23.81
	600	13.18	17.99	15.60	75.27	27.89
	700	12.47	12.63	8.37	43.95	11.43
Grain yield	300	18.82	37.72	31.49	69.70	54.15
	400	20.57	33.42	27.49	67.68	46.59
	500	18.82	37.16	30.81	68.77	52.64
	600	17.80	37.39	30.26	65.52	50.47
	700	18.88	35.22	28.49	65.46	47.49
Lodging susceptibility	300	5.00	13.40	9.48	50.00	13.81
	400	4.68	11.76	7.70	42.86	10.38
	500	4.04	14.18	10.98	60.00	17.53
	600	5.05	16.18	12.91	63.64	21.21
	700	5.17	13.57	10.12	55.56	15.54

gathered from each M_1 were used to raise M_2 generation in a plant progeny basis. The observations on lodging and its associated characters *viz.,* plant height, total number of tillers per plant, number of nodes per culm, inter-nodal length, culm girth and grain yield per plant were recorded. The mean and variability parameters were estimated for the M_2 generation of different treatments as per the standard method.

Results and Discussion

Presence of genetic variability in the available population is the prerequisite for any crop improvement programme. The estimates of range, mean, phenotypic and genotypic co-efficient of variation (PCV and GCV), heritability and genetic advance as per cent of mean are given in Table 1. The genetic changes in the recorded characters could be realized with an increased variance in M_2 generations over corresponding checks. The co-efficient of variation helps to measure the range of diversity available in the character with reference to its mean and provides a route to compare the variability present in the quantitative characters. In M_2 population, in all the five irradiated doses of both the varieties recorded high co-efficient of variability for total number of tillers and grain yield. Where as the other characters showed low to medium variability in both the varieties. Moreover, plant height and inter-nodal length recorded PCV and GCV in equal magnitude in M_2. This indicated the lesser influence of environmental factors on expression of the character in the corresponding population. Same results had been reported in littlemillet by Rao (1991), in foxtailmillet by Lakshmana and Guggari (2001), in fingermillet by Suryakumar (1995), in prosomillet by Prasad *et al.* (1995) and in kodomillet by Kandasamy *et al.* (1990).

The estimates of both heritability and genetic advance are helpful for making effective selection than the heritability estimates alone. The higher magnitude of heritability indicates that the genotype is inherited to the next generation and therefore selection based on phenotype will reflect the genotype. In M_2 generation, the heritability and genetic advance were higher for total number of tillers and grain yield for all the mutagenic treatments of CO3 and CO(Samai) 4 and hence selection based on these characters would improve the variety. The increased heritability and genetic advance might be due to increased mutations and recombinations. Therefore these characters could be transmitted to further generations and a potential gain could be achieved through selection in all the families of both the varieties for improvement of these characters. Similar results were earlier reported in littlemillet by Padmaja (1998) and in prosomillet by Nirmalakumari *et al.* (2006). The character, plant height showed maximum heritability with low to medium genetic advance in M_2 generation of CO3.

With reference to lodging susceptibility, the maximum heritability and genetic advance were recorded in the progeny of 500 and 600 Gy in M_2 generation of CO(Samai)4 and 300 Gy in M_3 generation of CO3. Selection for improving resistance to lodging could be made in these populations. The lodging resistance is closely associated with shorter plant height, thick culm and reduced internodal length. Accordingly, selection based on these characters along with lodging resistance can be effective for evolving a high yielding and non-lodging littlemillet variety.

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