Indian J. Genet., **56** (1): 100–103 (1996)

EFFECT OF CHEMICAL GAMETOCIDES ON POLLEN STERILITY AND SEED SET IN RICE (*ORYZA SATIVA* L.)

M. A. SHAMSI, B. KRISHNA MURTHY,* D. S. MANYAM AND M. V. B. RAO

Department of Genetics and Plant Breeding, Agricultural College Bapatla 522101

(Received: September 17, 1994; accepted: June 11, 1995)

ABSTRACT

Of the three chemical gametocides tested on four genotypes of rice, ethrel and sodium methyl arsenate were found to induce maximum pollen sterility in all the genotypes. Phytotoxic effects were also produced by ethrel to a certain extent in all the genotypes, especially in IR-57311-95-2-3, like reduced panicle length and spikelet size. The genotypes IR-72 and Swarna recorded minimum seed set under selfing.

Key words: Chemical gametocides, pollen sterility, rice, selfing, open pollination.

Owing to the difficulties in producing hybrid seed commercially through the use of cytoplasmic-genetic male sterility-restorer systems in rice, chemical hybridization is one of the best alternatives for commercial exploitation of hybrid vigour. Earlier works on this aspect resulted in identifying ethrel [1] and sodium methyl arsenate [2] as effective gametocides in rice. The present investigations has been carried out to identify the best gametocide, standardizing the dose which induces maximum pollen sterility with minimum adverse effects.

MATERIALS AND METHODS

Three chemicals, viz., ethrel at 10,000 and 12,000 ppm, sodium methyl arsenate at 500 and 600 ppm, and natrium arsenate at 800 and 1,000 ppm were applied at two growth stages (one week and two weeks after panicle initiation) on three IRRI genotypes of rice possessing synchronous flowering and more outcrossing, viz. IR-57311-95-2-3, IR-54950-181-2-1-2-3, IR-72 along with Swarna (a local variety). The chemicals were sprayed on different cultivars at their respective growth stages, i.e. IR-57311-95-2-3 at 88 and 95 days; IR-54950-181-2-1-2-3

*Addressee for correspondence.

at 89 and 96 days; IR-72 at 91 and 98 days; and Swarna at 112 and 119 days after sowing. The maturity durations of the above genotypes, respectively were 130, 130, 140 and 150 days from sowing. Distilled water was sprayed on the control pots along with the treatments to reduce variation.

The experiment was carried out in pot culture with four plants per pot, and the pots were arranged in simple randomized block design with three replications. Observations were recorded on 3–4 panicles per pot at random for pollen sterility, spikelet size, panicle length, and per cent seed set per panicle under selfing. Pollen sterility was assessed by the standard acetocarmine stain technique. Seed set on selfing was recorded by bagging the selected panicles with butter paper bags and counting the filled and unfilled grains.

Asymmetric factorial design with three factors and a single control was used for the experiment and analysed accordingly [3].

RESULTS AND DISCUSSION

The pollen sterility was maximum in the ethrel and SMA treatments, while natrium arsenate was less effective in inducing pollen sterility (Tables 1 and 2). Among the two concentrations, the higher concentrations of all the chemicals induced more pollen sterility than the lower concentrations. Maximum pollen sterility was recorded in IR-57311-95-2-3 (95.7%) with 12000 ppm ethrel, followed by Swarna (95.5%), and IR-72 (94.7%) with 600 ppm sodium methyl arsenate [2].

Spikelet length varied significantly in all the genotypes except Swarna, while the variation in spikelet breadth was significant only in IR-72. Significant differences in spikelet size were reported earlier in the rice variety HGR-626 [4]. Panicle length was significantly affected in all the genotypes with ethrel and sodium arsenate. The genotype IR-57311-95-2-3 produced smallest panicle (13.6 cm with 12000 ppm ethrel).

Seed set per panicle on selfing was minimum at the higher concentrations of sodium methyl arsenate and ethrel. Natrium arsenate was less effective in reducing seed set under selfing. Seed set under selfing was directly related with pollen fertility.

Among the genotypes tested, IR-57311-95-2-3 was sensitive to all the chemicals. Besides recording high pollen sterility, it also showed phytotoxicity effects, especially with ethrel and sodium methyl arsenate. Ethrel at 10,000 and 12,000 ppm reduced panicle length at 17.67 and 33%, respectively, while the decrease with sodium methyl arsenate was 16.9 and 24.6%

Table 1. Effect of chemical gametocides on pollen sterility and seed set in rice

Genotype	Treatment		Pollen sterility (%)	Spikelet size (mm)		Panicle length (cm)	Seed set on selfing (%)
	chemical	conc. (ppm)		length	breadth		
IR-57311-95-2-3	Control	—	11.8	9.2	2.3	21.7	92.1
	Ethrel	10,000	89.5	8.7	2.2	16.7	15.5
		12,000	95.7	8.6	2.4	13.6	10.7
	Sodium methyl	500	86.3	8.8	2.3	16.8	20.1
	arsenate	600	92.7	9.1	2.4	17.3	11.9
	Natrium	800	68.7	8.7	2.3	21.1	41.8
	arsenate	1,000	77.6	8.4	2.3	22.2	30.7
	SEm		1.5	0.1	0.04	1.28	1.31
	CD		4.6	0.3	0.12	3.96	4.03
IR-54950-	Control	—	13.5	9.2	2.4	22.6	90.9
181-2-1-2-3	Ethrel	10,000	85.5	8.7	2.4	16.6	18.7
		12,000	91.2	8.9	2.4	15.6	12.9
	Sodium methyl	500	86.3	8.9	2.4	20.7	19.7
	arsenate	600	93.3	8.4	2.3	19.9	11.9
	Natrium	800	59.7	8.8	2.4	21.1	51.8
	arsenate	1,000	66.8	9.1	2.4	21.6	37.8
	SEm		2.4	0.05	0.03	1.04	1.45
	CD		7.3	0.16	0.08	3.21	4.45
IR-72	Control	—	14.1	8.7	2.4	23.7	89.0
	Ethrel	10,000	88.4	8.5	2.3	22.7	17.1
		12,000	92.9	8.6	2.3	22.2	9.9
	Sodium methyl	500	89.7	8.4	2.3	21.6	21.70
	arsenate	600	94.7	8.7	2.4	16.3	8.9
	Natrium	800	67.5	8.5	2.3	22.7	41.9
	arsenate	1,000	75.7	8.3	2.4	22.3	32.7
	SEm		2.2	0.06	0.03	0.88	1.66
	CD		6.9	0.18	0.09	2.72	5.10
Swarna	Control	—	12.7	7.0	2.1	24.5	90.6
	Ethrel	10,000	86.9	6.6	2.1	19.7	18.2
		12,000	93.7	7.1	2.1	18.3	12.6
	Sodium methyl	500	88.3	7.0	2.2	23.1	21.0
	arsenate	600	95.5	7.0	2.2	23.0	9.1
	Natrium	800	65.9	6.7	2.1	21.7	44.1
	arsenate	1,000	72.8	7.4	2.1	22.3	36.8
	SEm		1.3	0.19	0.04	1.07	1.67
	CD		3.9	0.58	0.12	3.31	5.14

at 500 and 600 ppm, respectively, over the control (20.25 cm). Spikelet length was also reduced by 5.7 and 6.4% with the two concentrations of ethrel. Sodium methyl arsenate decreased panicle length by 4.6 and 6.2% with the two concentrations in relation to the control (9.24 mm). The seed set on selfing was less in IR-72 and Swarna. However, ethrel at both concentrations induced more phytotoxic effects on the genotypes than sodium methyl arsenate. Therefore, it cannot be considered to be an ideal gametocide at least for the genotypes of rice.

Based on these findings, IR-72 and Swarna are the most suitable genotypes for hybrid seed production through gametocidal treatments, maximum pollen sterility was observed with sodium methyl arsenate at 600 ppm concentration with minimum seed set under selfing.

Table 2. Interaction of rice genotypes with gametocide chemicals and their concentrations on pollen sterility (%)

Genotype	Ethrel	Sodium methyl arsenate	Natrium arsenate	Mean
IR-57311-95-2-3	92.6	89.5	73.1	85.1
IR-54950-18-2-1-2-3	88.3	89.8	63.3	80.5
IR-72	90.6	92.2	71.3	84.8
Swarna	90.3	91.9	71.5	83.9
Mean	90.5	90.8	69.3	83.6
	SEm 1.43		CD 4.08	

Concentration	IR-57311-95-2-3	IR-54950-18-2-1-2-3	IR-72	Swarna	Mean
Lower	81.5	77.2	81.8	80.4	80.2
Higher	88.7	85.8	87.7	87.3	86.9
Mean	88.1	80.5	84.8	83.9	82.6
	SEm 1.17		CD 3.33		

Chemical	Lower concentration	Higher concentration	Mean
Ethrel	87.6	93.4	90.5
Sodium methyl arsenate	87.7	94.0	90.8
Natrium arsenate	63.4	73.2	69.3
Mean	80.2	86.9	83.6
	SEm 1.01	CD 3.33	

REFERENCES

1. K. S. Parmar, E. A. Siddiq and M. S. Swaminathan. 1979. Chemical induction of male sterility in rice. Indian J. Genet., **39**(3): 529–541.

2. S. Y. Cho, Y. H. Son, H. C. Choi, H. P. Moon, R. K. Park, N. K. Park and C. H. Kim. 1989. Effect of sodium methyl arsenate as a male gametocide on rice (*Oryza sativa* L.). Korean J. Crop Sci., **34**(1): 55–59.

3. V. G. Panse and P. V. Sukhatme. 1978. Statistical Methods for Agricultural Workers. ICAR, New Delhi.

4. Y. Takeoka, M. Ito, S. Yamamura and H. Saka. 1990. Morphogenetic alterations of rice floral organs as affected by spray of chemical hybridizing agent, HGR-626. Japan. J. Crop Sci., **59**(3): 528–534.