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Influence of Source and Sink on Spikelet Sterility in Rice

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Reduction in leaf area (source size) by removal of different leaves enhanced spikelet sterility of rice in the order, all leaves (64.3) > flag leaf (38.8) < second leaf = 3rd leaf = 4th leaf (27.5)-28.9) < control (25.6). Defoliation combined with shading of different plant parts also indicated that leaf is an important organ in deciding sterility. Panicle tailoring studies indicated that reduction in spikelet number (sink size) especially the lower 1/3rd spikelets of a panicle, reduced sterility in the remaining spikelets.

Spikelet sterility is one of the major constrainks for achieving higher grain yields in rice especially during the wet (monsoon) season. Hence identification or evolution of varieties with low sterility is essential for further improvement of grain yield in rice. In the present paper, the influence of source and sink size on spikelet sterility has been assessed with a view to identify the desirable traits for selection or breeding varieties for low sterility.

MATERIAL AND METHODS

Defoliation studies:

Field trial on defoliation was conducted for two seasons (*kharif* 1976 and *rabi* 1977) with four early modern cultivars (*Ratna*, *Pusa* 2-21, *Pallavi* and *IET*-2233) under standard package of practices. The source size (leaf area) was moderated by clipping individual leaves (flag leaf or leaf 2, 3, 4, and all leaves) while all leaves were kept intact in the control treatment The trial was laid out in a split-plot design with varieties as main and leaf clipping as sub-plots, replicated in quadruplicate

Defoliation + Shading trials: Pot culture trials with complete defoliation coupled with shading individual plant parts (stem, panicle, whole plant) were conducted for two seasons (*kharif* 1977 and *rabi* 1977) to study the effect of removal of each organ on sterility. Varieties used were *Ratna* and *Pallavi*. The sterility in the control was taken as the base and it was subtracted from the respective treatments, to obtain the effect of removal of various plant organs.

Panicle tailoring studies: The sink size (spikelet number) was monitored in the field trials *kharif* 1976 and *radi* 1977) by removal of spikelets from different portions of the panicle (top, middle and lower 1/3rd panicle). The data were analysed in a split-plot fashion.

The sterility was assessed as per Matsushima and Yamaguchi (1953)

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and statistical analysis was done as per Snedecor and Cochran (1967).

RESULTS AND DISCUSSION

Defoliation studies: Excission of flag leaf or entire foliage at flowering resulted in a significant increase in sterility in all the varieties in both *kharif* 1976 and *rabi* 1977 seasons (Table 1) as has also been reported by several earlier workers Narasinga Rao, 1962 and Prabhakar *et al.*, 1977). The excission of flag leaf increased sterility by 13.2 (*kharif* 1976 and 13.9% (*rabi* 1977) over controls, and accounted for a major portion of increase in sterility compared to other leaves, which may be ascribed to its important role in grain filling because of higher rates of Co_2 fixation than all the basal leaves (Ramson and Hofstra, 1969 and Yoshida, 1972). Translocation of assimilates also may be affected by the removal of flag leaf (Ramdas and Rajendrudu, 1977). The clipping of entire foliage might have resulted in an extreme limitation of source and subsequent non-availability of carbohydrates to meet the demand of all the spikelets in the panicle (Nagato and Chaudhry, 1970).

Defoliation+Shaiding individual plant parts :

A further enhancement in sterility, was observed in all the varieties viz., *Ratna*, *Pusa* 2-21, *Pallavi*, and *IET* 2233 when shading of any plant part was super - imposed over clipping of entire foliage (Table 2). Maximum sterility of 100% was recorded when the entire foliage was removed and the whole plant was covered. When the adverse effects of the different treatments were delineated, it was found that the mean increase in sterility on account of leaf clipping (removal of foliage) was highest (32.1) followed by covering panicle (20.8) and culm (7.1). Thus the present trial has clearily ly demonstrated that leaf is an important organ in deciding sterility, as has also been stressed by Venkateswarlu (1976).

The above studies indicate that an enhancement in source (leaf) size and capacity is likely to result in an improvement in grain filling. since leaf has a pivotal role to play in determining the extent of fillage of grain.

Sink size :

Cut panicle studies indicated a significant reduction (by 28.1%) by tailoring the panicle to 2/3rd of its size, in all the four varieties, during both seaaons (Table 3). This diminutive effect on sterility was more pronounced when the lower 1/3rd portion of panicle was clipped off. The percentage reduction in sterility (over control) by the cut panicle treatments were 35.6 (lower 1/3rd), 27.3 (Middle 1/3rd and 20.9 (Top 1/3rd), Varietal differences in sterility were highly significant with *Ratna* and *Pusa* 2-21 showing higher sterility (27.6 and 23.8%) than *IET*-2233 and *Pallavi* 19.8 and 16.6%). The improvnment in the grain filling in cut panicle treatments may be attributed to the compensation mechanism leading to increased carbohydrate allocation consequent on the reduced competition for nutrieuts among the spikelets (Nagato and Chaudhry, 1970). Such compensation was more marked when the lower 1/3rd panicle portion was clipped, evidently due to the efficient translocation and greater availability of assimilates to the spikelets in the upper branches. A strong positive correlation was observed between spikelet number and sterility (0.87**) which lends support to the above finding that by reducing the spikelet number on the panicle, sterility also could be reduced.

Thus selection or breeding of varieties for higher source capacity at flowering (LAI) and moderate sink (spikelet number per panicle) is benefical to realise varieties with low sterility and high grain yield through more number of fertile grains.

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Table 1 Effect of leaf clipping on sterility

Removal of	Sterlity % (transformer)									
	Ratna		Pusa 2-21		Pallavi		IET-2233		Mean	
	K	R	K	R	K	R	K	R	K	R
Flag leaf	47.8	38.5	38.5	35.5	31.6	32.5	36 0	33.8	38.5	35.5
Leaf-2	36.7	33.6	31.8	28 8	28.4	25.1	32.5	27.2	32.3	28.9
Leaf-3	38.7	32.1	34.5	26.1	28.1	24.0	24.4	25.6	31.4	27 5
Leaf-4	40.7	30.3	31.0	27.6	27.0	25.5	26.6	24.2	31.3	27.1
All leaves	61.6	50.0	54.2A	44.5	48.4	43.6	52.1	42.1	54.1	45.1
Control	37.1	28.9	32.3	28.0	24.9	22.4	26.2	24.0	30.4	26.4
Mean	43.5	35.9	36.6	32.6	31.6	29 5	33.1	29.9	36.6	32.1

V: Varieties   L. C : Leaf Clip Treatment   K : Kharif   R : Rabi (dry)

	V		LC		VLC	
	K	R	K	R	K	R
C.D. 5%	3.45	2·47	5.18	2.95	NS	NS

Table 2. Effect of leaf clipping and shading different plant parts on sterility

Treatments	Sterility% Transformed					
	Kharif 1977			Rabi 1977		
	Ratna	Pallavi	Mean	Ratna	Pallavi	Mean
All leaves clipped	61.6	52.1	56.7	54.6	46.5	50.5
All leaves clipped + Stem covered	66.4	54.5	60.1	58·6	53.2	55.9
All leaves clipped + Panicle covered	78.8	65.9	71.3	72.4	61.0	66.2
All leaves clipped + whole plant covered	90.0	90.0	90.0	90.0	90.0	90.0
Control (All leaves intact without covering)	42.4	32.5	37.5	36.7	27.0	32.1
Mean	63.9	55.7	59.6	58.8	52.4	55.5

V : Varieties T : Treatments

	V	T	VxT	V	T	VxT
CD 5%	3.45	4.59	5.72	2.00	2 62	3.72

Table 3. Effect of panicle tailoring on the sterility

		Sterility (Transformed)				
		Top 1/3rd portion removed	Branches in middle 1/3rd portion removed	Branches in lower 1/3rd portion removed	Control	Mean
Ratna	Kharif	32.8	32.6	32.7	39 3	34.6
	Rabi	28.7	27 3	25.8	32.2	28.6
Pusa 2-21	Kharif	31.2	29.3	32.5	37.2	32.6
	Rabi	26.2	24.8	20.6	30.1	25.5
Pallavi	Kharif	28.0	25.9	20 9	29.7	26.3
	Rabi	20.8	21.2	18.5	25.5	21.7
IET-2232	Kharif	29.4	28.1	23.9	31.6	28 3
	Rabi	25.1	23.5	21.6	27.7	24.5
	Kharif	30.4	29.0	28.0	34.5	30.5
	Rapi	25.4	24.3	21.7	29.0	25.2
Crand Mean		28.0	26.7	25.0	31.8	

V : varieties T : Treatments

	Kharif			Rabi		
	V	T	VxT	V	T	VxT
C.D.5%	1.02	1.19	1.68	2.79	1.65	ns