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Relative Efficency of Different Emasculation Methods in Rice (*Oryza sativa* L.)

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Abstract The efficiency of an emasculation method based on amount of self seed set determines the trueness of hybrids and quantity of hybrid seed produced. Quantitative comparisons between emasculation techniques in rice are scarce and the objective of present investigation was to assess the relative efficiency of four different emasculation methods viz. hand emasculation, suction method, 70% ethanol and absolute ethanol based on the amount of self seed set upon emasculation followed by no pollination. The comparison of mean efficiency of emasculation methods over five genotypes and two seasons revealed that hand emasculation (84.05% efficiency) followed by suction method (75.74% efficiency) were most efficient, that is least self seeds were set upon emasculation followed by no pollination. The study also revealed that there were no genotypic differences for emasculation efficiency. Keeping in view the results, we recommend hand emasculation the most efficient but laborious method. However, suction method will be very useful as time saving and less laborious method for removal of anthers in rice.

Keywords Rice, Emasculation, Self seed, Efficiency.

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Introduction

Emasculation is an essential pre-requisite for undertaking hybridization between two or more crop plants. In order to successfully cross-pollinate two different rice plants, the anthers must be removed from the rice floret so that self-pollination will not occur [1]. The hybrid seed produced may be either supplied to farmers for general cultivation or may be used for evaluation of combining ability among different rice genotypes. several types of emasculation methods are available in rice viz., hand emasculation, suction method, alcohol treatment, hot water and cold water emasculation. At International Rice Research Institute (IRRI),emasculation is made by anther aspiration [2]. They got 40—50% hybrid Fl

plants in the dry season, 20—30% in the wet season. This indicates that efficiency of method of emasculation in rice varies with season/environment.

The efficiency of any of these emasculation methods determines the trueness of the hybrids and the hybrid seed set upon crossing. Hence, determination of an efficient emasculation method is essential for sexual hybridization-mediated gene transfer and hybrid development based crop improvement programs. The utilization of the determined efficient emasculation method will allow us to achieve the desired goals in crop improvement programs much precisely. Keeping in view, the varied efficiency of emasculation methods over environments/locations and scarce quantitative comparisons among emasculation methods in rice, the present investigation was carried out to compare the efficiency of different emasculation methods during two seasons (*kharif* 2014-15 and 2015-16) at crop Research Center of G B Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, based on the amount of self seed set in emasculated panicles without pollination.

Materials and Methods

The present investigation was used to compare the efficiency of four emasculation methods viz., hand emasculation, suction method and alcohol treatment (70% and absolute ethanol). Ten panicles of each of the five genotypes (TN1, Pusa Basmati 1, MRST 3, PHS 29 and MRST 7) were subjected to each of the four emasculation methods during each season. In all the methods, mother plants were subjected to emasculation when one third to one half of the panicle was exerted. Self-pollination can occur by emasculating florets which are too mature. In order to minimize this risk, emasculation was effected in florets at the middle part of the panicles, while florets at the top bottom were discarded in all the four techniques. All the four methods were practiced during evening hours starting from 4 PM. In case of hand emasculation, the anthers were removed from florets in middle part of the panicle with the help of forceps without injuring the stigma. Whereas, in case of suction method the anthers were removed with a microtip connected by a plastic tube to a motor which acts as vaccum aspirator [3, 4]. As far as alcohol treatment is concerned, the panicles (with top and bottom florets clipped) were dipped for two minutes in a beaker carrying 70% ethanol and 100% ethanol. The panicles subjected to the emasculation methods were bagged with a butter paper bag and labeled appropriately. The data was recorded on the number of self seeds set (without pollination) per 100 florets emasculated. The efficiency of emasculation method was worked out as per the formula given below :

Efficiency of emasculation (e)

$$= \left(1 - \frac{\text{Number of selfed seeds}}{\text{Total number of florets subjected to given emasculation method}}\right) \times 100$$

The percent values (Proportions) of efficiency of each emasculation technique averaged over all the genotypes during each season were statistically compared using *Z*-test of significance [5] and the *Z* values were calculated using Microsoft Office Excel. The emasculation efficiency averaged over the season and genotypes of each method was also compared for statistical significance using *Z*-test.

Results and Discussion

Emasculation being an important pre-requiste for sexual gene transfer across crop plants. However, the efficiency of an emasculation method is very important for production of true F_1 seeds, that too in abundant quantity. In rice, several methods are available for emasculating the florets. The present investigation was carried out to assess the relative efficiency of four types of emasculation methods in rice viz., hand emasculation, suction method, 70% and absolute ethanol treatment on the basis of amount of self seed set.

The investigation revealed significant differences among emasculation methods for percent mean efficiency over five genotypes during each season. During *kharif* 2014-15, the percent efficiency of hand emasculation method ranged from

Table 1. Efficiency of various emasculation methods exercised on five different rice genotypes during *kharif* 2014-15. f = number of florets emasculated ; s = self seeds obtained from emasculated florets without pollination; e = efficiency of emasculation method; *Significant differences at $p > 0.05$ level of significance (evaluated using *Z* test of significance).

Genotypes	Hand emasculation			Suction method			70% ethanol			100% ethanol		
	f	s	e	f	s	e	f	s	e	f	s	e
TN 1	300	40	86.67	400	84	79.00	370	109	70.54	280	92	67.14
Pusa Basmati 1	450	57	87.33	460	101	78.04	350	95	72.86	360	111	69.17
MRST 3	280	55	80.36	380	69	81.84	302	120	60.26	375	102	72.80
PHS 29	350	52	85.14	305	88	71.15	370	110	70.27	410	105	74.39
MRST 7	310	53	82.90	330	89	73.03	410	105	74.39	305	107	64.92
Mean	338	51.4	84.48*	375	86.20*	76.61	360.4	107.8	69.66	346	103.4	69.68

82.90 to 87.33 with mean efficiency of 84.48%. As far as suction method is concerned , the percent efficiency ranged from 71.15 to 81.84. Whereas, the range was 60.26 to 74.39% and 64.92 to 74.39% in case of 70% and absolute ethanol based emasculation, respectively. The percent mean efficiency over all the genotypes obtained through suction method, 70 % ethanol and absolute ethanol was 76.61, 69.66 and 69.68 respectively (Table 1). During *kharif* 2015-16, the mean efficiency of hand emasculation, suction method, 70% and 100% ethanol treatments was 83.63, 74.87, 66.60 and 66.30%, respectively (Table 2). The mean efficiency of hand emasculation over the two seasons of hand emasculation was 84.05%. Whereas, it was 75.74, 68.13 and 67.09 % for suction method, 70 % and 100% ethanol treatment, respectively (Table 3). As far as influence of genotypes over efficiency of an emasculation method are concerned , no significant differences were identified among genotypes. This infers that emasculation efficiency is genotype independent and it only depends on the physical technique of removing or killing anthers. The percent mean emasculation efficiency over all the emasculation techniques and seasons of genotypes TN 1, Pusa Basmati 1, MRTS 3, PHS 29 and MRST 7 was 74.42, 74.86, 73.98,74.71 and 71.94 (Table 1).

The above data reveals that hand emasculation method was significantly superior in percent mean efficiency as compared to other methods, that is, least self seeds were produced in panicles subjected to hand emasculation followed by no pollination. Garcia-Yzaguirre and Carreres claimed that hand emasculation followed by brush pollination of crushed anthers produced an average of 48.2% hybrid F_1 plants [6]. The next best emasculation method in terms of superiority in less self seed set, was suction method which was significantly superior to 70% and absolute ethanol based emasculation. Berdrejo [7] and Sha [8] also recommended hand emasculation as the most efficient but laborious technique and suggested utilization of alcohol based emasculation under circumstances of labor shortage. Re-

Table 2. Efficiency of various emasculation methods exercised on five different rice genotypes during *kharif* 2015-16. f = number of florets emasculated; s = self seeds obtained from emasculated florets without pollination; e = efficiency of emasculation method ; * Significant differences at $p > 0.05$ level of significance (evaluated using Z test of significance).

Geno-type	Hand emasculation			Suction method			70 % ethanol			100% ethanol		
	f	s	e	f	s	e	f	s	e	f	s	e
TN 1	255	37	85.49	258	63	75.581	252	88	65.08	240	82	65.83
Pusa Basmati 1	240	47	80.42	202	53	73.76	237	73	69.20	310	99	68.06
MRST 3	344	51	85.17	199	56	71.86	201	55	72.64	275	91	66.91
PHS 29	277	47	83.03	255	54	78.82	242	64	73.55	248	96	61.29
MRST 7	263	42	84.03	230	59	74.35	198	94	52.53	330	101	69.39
Mean	275.8	44.8	83.63*	228.80	57.00	74.87*	226.00	74.80	66.60	280.60	93.80	66.30

Table 3. Mean efficiency of various emasculation methods exercised on five different rice genotypes over two the years.* Significant differences at $p>0.05$ level of significance (evaluated using Z test of significance).

Genotype	Efficiency (%)				
	Hand emasculation	Suction method	100% ethanol	70% ethanol	Mean
TN 1	86.08	77.29	67.81	66.49	74.42
Pusa Basmati 1	83.88	75.90	71.03	68.62	74.86
MRST 3	82.77	76.85	66.45	69.85	73.98
PHS 29	84.09	74.99	71.91	67.84	74.71
MRST 7	83.47	73.69	63.46	67.16	71.94
Mean	84.05*	75.74*	68.13	67.99	

searchers at IRRI reported that emasculation using immersion methods (alcohol immersion or hot water immersion) had lower seed set than hand or vaccum (suction) emasculation because culms were bent to introduce panicles into a container which affects seed set and may result in breakage of panicles [9].

Conclusively, it can be stated that hand emasculation though being most efficient in terms of the lowest self seed set , yet, it is time consuming as compared to as other emasculation methods, thereby, incurring extra costs and labor. Suction method although being less efficient as compared to hand emasculation, however, it is less time consuming and hence can be more useful in rice hybridization programs.

References

1. Tong L, Yoshida T (2008) Can hot-water emasculation be applied to artificial hybridization of Indica-Type Cambodian Rice ? Pl Prod Sci 11 : 132—133.
2. Datta K, Baisakhi N, Thet KM, Tu J, Datta S (2002) Pyramiding transgenes for multiple resistance in rice against bacterial blight, yellow stem borer and sheath blight. Theor Appl Genet 106 : 1—8.
3. Chandraratna MF (1964) Genetics and breeding of rice. Longmans , London.
4. McDonald DJ (1994) Temperate rice technology for the 21st century : an Australian example. Aust J Exp Agric 34 : 877-888.
5. Rangaswamy R (2006) A text book of agricultural statistics. New Age International (P) Ltd, Publ , New Delhi, India, pp 102—119.
6. Garcia-Yzaguirre A, Carreres R (2008) Efficiency of different hybridization methods in single crosses of rice for pure line breeding. Span J Agric Res 6 : 395—400.
7. Berdrejo JV (1994) Efficiency of five emasculation techniques in rice. http : //agris.fao.org/aos/records/PHS9510079.
8. Sha X (2013) Rice artificial hybridization for genetic analysis. Methods Mol Biol 956 : 1—12.
9. Jennings PR, Coftman WR, Kauffman HE (1979) Rice improvement. IRRI, Los Banos, The Philippines.