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Analysis on the Behavior and Yield Component of Relations of Interspecific Hybrids Rice and Cultivated Rice in Yadanabon University

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Abstract

The main objectives of this study are to determine the cytological behaviour and yield component relations of F_1 hybrid between *Oryza sativa* L. Ayaramin cv. and days (90). As living condition are being improved human demand for high quality rice is continuously on increase, which entailed in incorporation of preferred grain quality features as the most important objective next to yield enhancement. The study was conducted at Botany Department, Yadanabon University. *Oryza sativa* L. Ayarmin cv. ♂ × days (90) ♀ were used for hybridization efficiency of crossing methods. This method involves emasculation by anther aspiration suitable to this variety. The emasculation of anther aspiration achieved significantly more seed set was obtained from F_1 hybrid plants. Pollen fertility was determined from more than 1000 pollen grains from parents and F_1 hybrids. The pollen grains were stained in 1%. I_2 KI solution. Pollen fertility of hybrid was 94.10%. The interspecific hybrid of *Oryza sativa* L. of yield component were significant for all characters in F_1 generation except number of plant height. Although meiotic abnormalities showed significant association with pollen fertilites more than 90% of the PMCs of the hybrids showed normal meiosis cell division. The yield related to traits such as plant height, days to heading, days to maturity length, tiller per plant, grains per panicle 1000 grains weight were analysis and compared with student 't' test.

Keywords : Hybrid, Pollen, Meiotic

Introduction

Rice productivity growth is critical to improving the livelihoods of households throughout Asia. Higher yield is increase on-farm incomes and ensure supplies of rice that reduce or stabilize prices for both urban and rural food-insecure households Lin and Pingali 1994. Hybrid rice provides one important avenue through which these higher yields can be achieved. Moreover, because hybridization provides innovators with the ability to recoup their investments in research, hybrid rice represents a technology platform on which both private-sector scientists and entrepreneurs can make profitable and socially beneficial investments.

The development and promotion of hybrid rice over the past several decades has led to widespread adoption, with hybrids accounting for more than half of all area under rice cultivation in the country as of 2010. The increase in rice yields attributable to hybrid rice has, in turn, improved food security for an estimated 60 million additional people per year (Li et al. 2010).

The main objectives of this study were to determine the cytological behaviour and yield component relations of F_1 hybrid between *Oryza sativa* L. Ayaramin cv. and days (90). As living condition are being improved human demand for high quality rice is continuously on increase, which entailed in incorporation of preferred grain quality features as the most important objective next to yield enhancement.

Materials and Methods

Material

This studies were conducted at the experimental area, Department of Botany Laboratory during the years 2017 to 2018 at Yadanabon University. The required materials are magnifying lens, forceps, scissors, needles, brushes, bags, alcohol, tags, meter scale, field note book for controlled selfing, pollination and for observation.

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Methods

This work included emasculating tests and single crosses between different varieties of *Oryza sativa* L. (90) days and Ayarmin (145) days. Parent seeds were shown in an experimental area. Mother plants for hand emasculation were transplanted outdoors to pots filled with clay- loam soil. Pollen donor plants and mother plants of for anther aspiration were transplanted to pots filled with the same soil. Mother plants were emasculated when one third to one half of the panicle was exerted from 8:00 am to 10:00 am, on the first week of August 2017. The selected panicle is separated from surrounding ones to make it easy to emasculate. The flag leaf sheath is removed carefully to avoid breaking the stem. All florets that have pollinated in the top of the panicle are cut off with scissors. About one – third to one-half of each of the remaining florets is cut away obliquely to expose another.

$$\text{Pollen fertility (\%)} = \frac{\text{No. of fertile pollen grains}}{\text{Total no. of pollen grains}}$$

Collection of Pollen Mother Cells (PMCs)

The pollen mother cells (PMCs) of cultivar days (90) ♀ and Ayarmin ♂ were collected at young panicle and immediately fixed with Carnoy's solution; (i.e 3 ethanol: 1 glacial acetic acid) for 24 hrs. The pollen grain were stained with iodine and potassium iodide solution (I_2 - KI). The yield components were recorded by statistical analysis and photograph.

Slide Preparation

After fixing for 24 hrs in the fixative solution, one or two anthers were dissected out from young spikelet. These anthers were placed on the slide. After that the undersired materials were removed from the slide. They were smeared in 1% aceto- carmine on the slide. Then, the sample was covered with cover slip. In this way the slide was ready to observed the PMC's characters under the microscope.

Results

A significant correlation was found among meiotic abnormalities, pollen and spikelet fertility. Univalent were highly but negatively correlatated with bivalents, spikelet fertility and showed highly positive association with laggards & micronuclei persporetetrad. Bivalents showed a significant positive correlation with laggards micronuclei persporetetrad and showed highly positive association with spikelet fertility. It was observed that increase in bivalents will results decrease in meiotic abnormalities and spikelet fertility (Fig. 2 and Table 3).

In the present study hybrids rice obtained by crossing *Oryza sativa* L. cv. Ayarmin × days (90) were highly fertile. It was found that pollen fertility of the hybrids 94.10% and spikelet fertility 98.55% were observed (Fig. 1 and Table 1). It was observed that pollen stain ability ranges from 953 - 925 and unstained ability ranges from 47- 75 (Table 1). It was observed that the F_1 plant mean values of plant height 110.70 cm for *Oryza sativa* L. Ayarmin cv. and days (90) rice cross. The plant height of Ayarmin cv. male and days (90) female parent were ranged between 129.500 cm and 84.100 cm. This agrees with the target of rice breeders for selected ideal plant height for resistance (Fig. 1 and Table 2).

The interspecific hybrid of F_1 plant exhibited high significant than its parents for number of tillers per plant and panicle length per plant at 1% and 5% level respectively. Grain yield per panicle of F_1 hybrid was found to be 155.967 mean number higher than the parent 121.367 Ayarmin. Ayarmin and days (90) 88.00 mean number for rice cross. In addition, the F_1 hybrid had heavier 1000 grain weight 24.833 (g) parent of Ayarmin 22.500 (g) and days (90) 19.833 (g) were observed respectively (Fig. 1 and Table 2).

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The interspecific F_1 hybrid *Oryza sativa* L. cv. Ayarmin ♂ × *Oryza sativa* L. cv. days (90) ♀ was also highly pollen and spikelet fertility. Pollen sterility was 5.9% and spikelet sterility was 10.448%. A total of 1000 pollen grains were analyzed, out of them 941 were fertile, whereas 59 were sterile (Table 1). Meiotic division of interspecific hybrid F_1 univalent showed significantly high correlation with laggard and micronualei per sporetetrad. The number of bivalent of metaphase I 11.700 had the most impact on pollen fertility and seed set. It was found that normal meiosis division showed significant correlation with spikelet fertility yet more than 94.10% of the (PMCs) pollen mother cells (Fig.1 and Table 3) .

Table 1. Pollen and Spikelet fertility of *Oryza sativa* L. cv. and their F_1 hybirds.

parents / Hybrids pollen grains				**Florets**		
strains	stained	unstained	pollen fertility %	filled	unfilled	spikelet fertility %
Oryza satival L. cv. Ayarmin	953	47	95. 30	300	50	85.71
Oryza satival L. cv. days (90)	925	75	92.50	300	35	80.00
Oryza satival L. (Hybrids)Ayarmin ♂ × days (90) ♀	941	59	94.10	300	35	89.552

Table 2. Hybrid yield components of *Oryza sativa* L. cv. Ayarmin and days (90).

Characters	days (90) Mean ± SD	Ayarmin Mean ± SD	Hybrid Mean ± SD	't' value
Plant height (cm)	84.100±2.583	129.50 ± 6.501	110.7±8.995	2.804**
Days to heading	66.133±2.583	113.333±3.356	93.433±4.408	5.766**
Days to maturity	95.333±3.457	141.167±4.251	120.667±3.556	28.056**
Panicle length (cm)	21.942±1.466	24.333±1.124	30.767±1.223	6.013**
tiller / plant	9.833±0.699	11.50±0.974	14.400±0.987	10.553**
Grains/panicle	88.00±9.702	121.367±3.327	155.967±14.016	16.886**
1000 grains weight (g)	19.833±0.109	22.500±0.097	24.833±0.109	0.749 ^{ns}

ns = non significant
*, ** = statistically significant at 5% and 1% level respectively.
SD = standard deviation.

Table 3. Correlation among meiotic abnormalities and spikelet fertility

	Bivalent	Laggards	micronuclei per sporetetrad	Spikelet fertility
Univalent	–0.765**	0.049**	0.758**	–0.621**
Bivalent		0.723**	0.685**	0.872**
Laggards			–0.842**	–0.958**
micronuclei per sporetetrad				–0.869**

*, ** = Significant at $p < 0.05$ and $p < 0.01$ levels, respectively.

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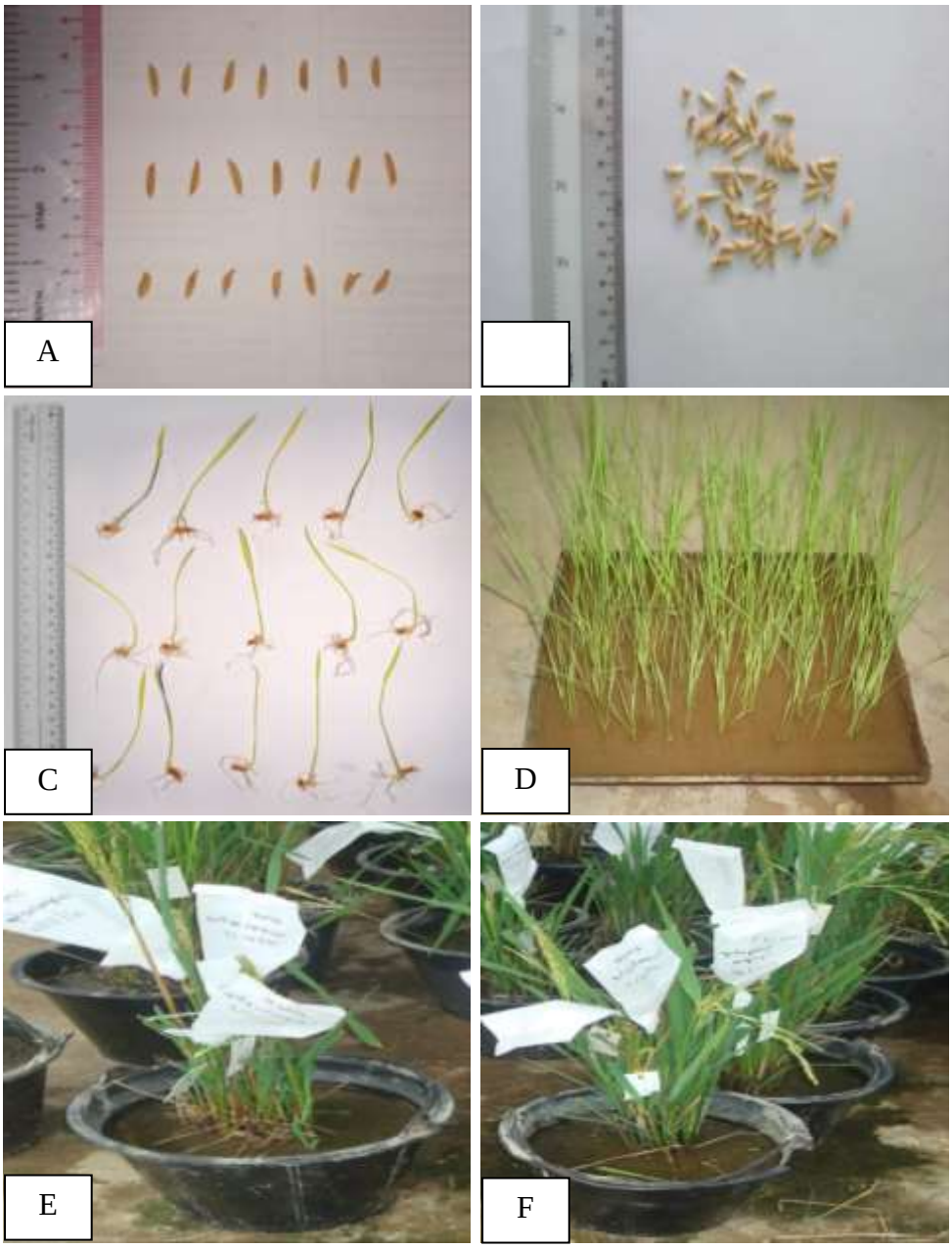

Fig 1. The F_1 hybrid seedling nursery *Oryza sativa* L. days (90) ♀ and Ayarmin ♂

A. Dehull Grain
B. Dehull Grain of F_1 hybrid seeds
C. F1 seedling nursery of *Oryza sativa* L.
D. Evenly sow the germinated seeds onto the soil surface of the seedbed.
E. The crossing tag and glassine bag are fastened securely with a paper clip
F. Anther aspiration treatment used for opening the florets

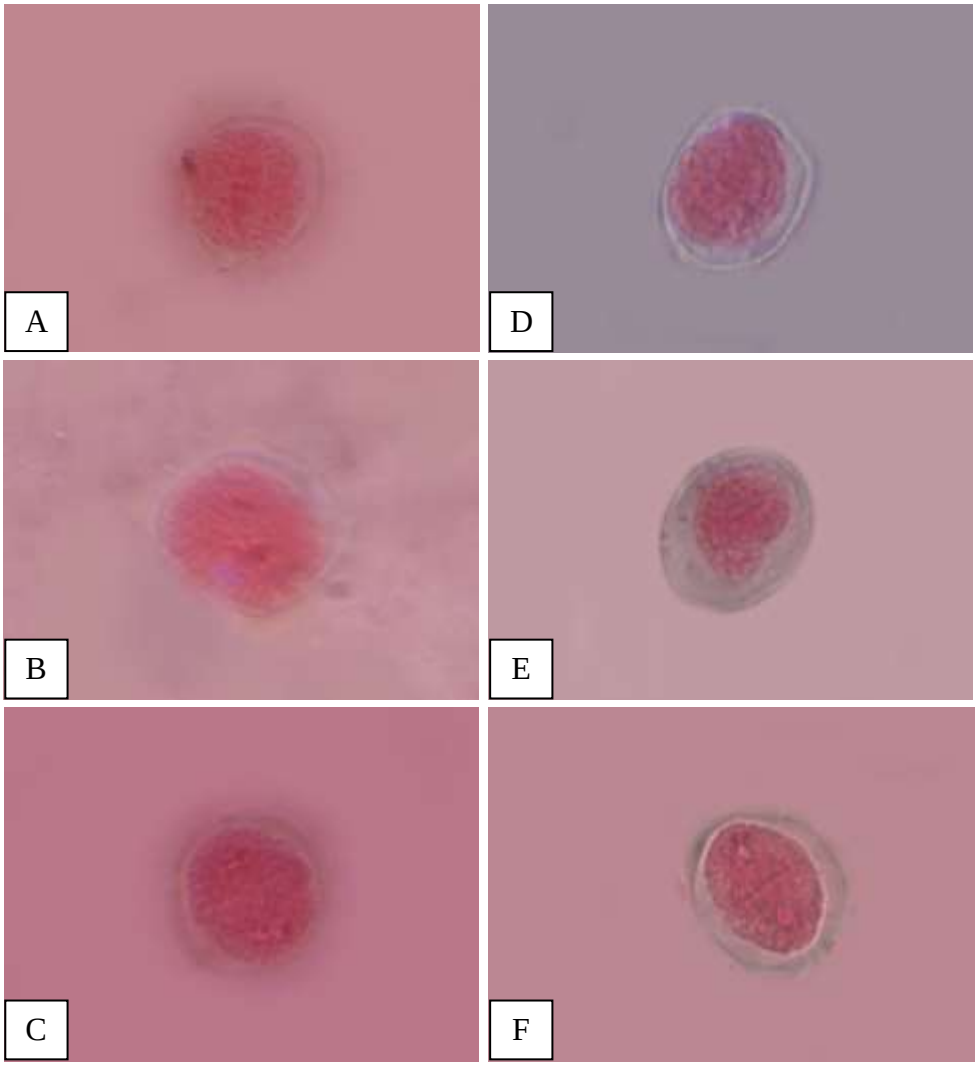

Figure 5. Meiotic Characters of days (90) ♀ and interspecific hybrid rice *Oryza sativa* L.

A. Metaphase I
B. Anaphase I
C. Telophase I
D. Metaphase I
E. Anaphase I
F. Telophase I

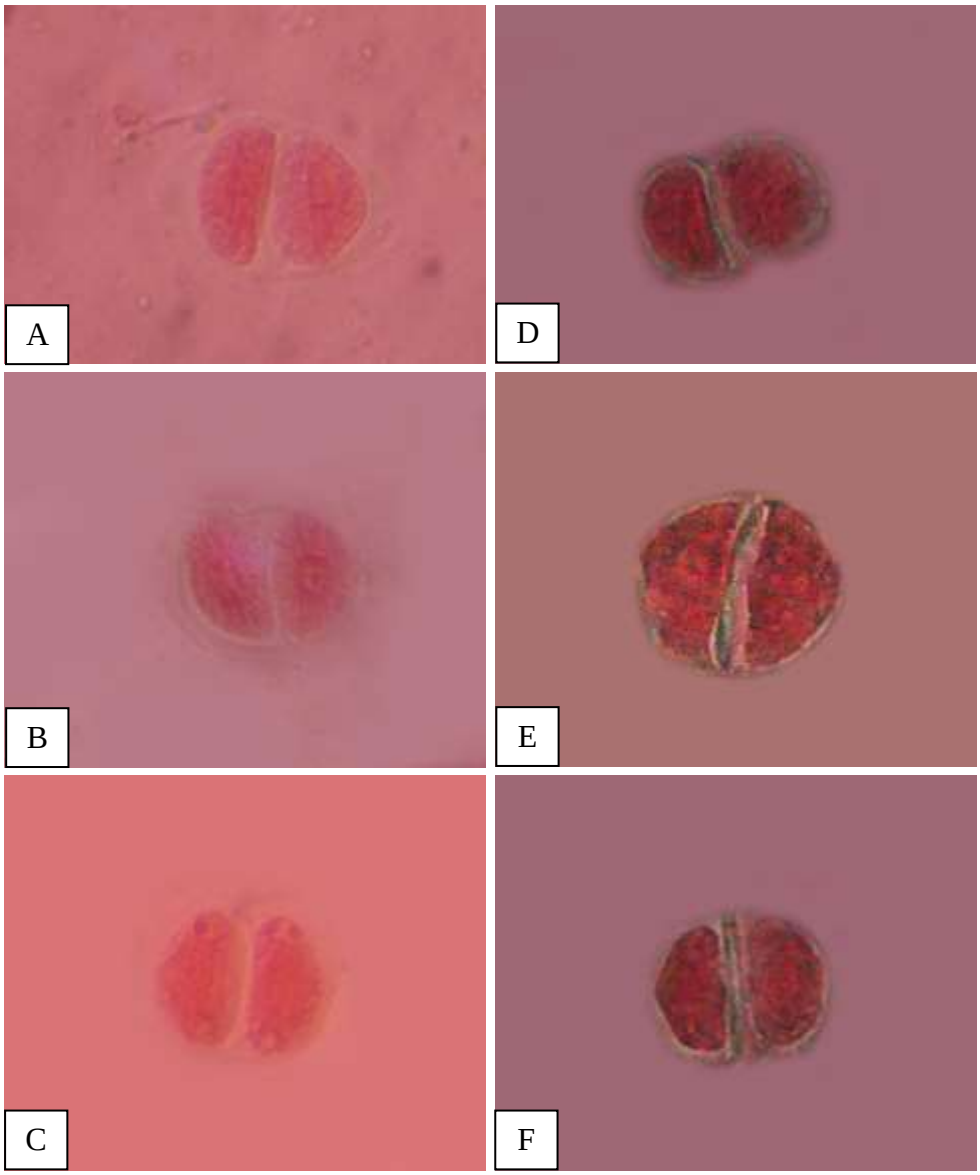

Figure 6. Meiotic Character of days (90) ♀ and interspecific hybrid rice *Oryza sativa* L.

A. Metaphase II
B. Anaphase II
C. Telophase II
D. Metaphase II
E. Anaphase II
F. Telophase II

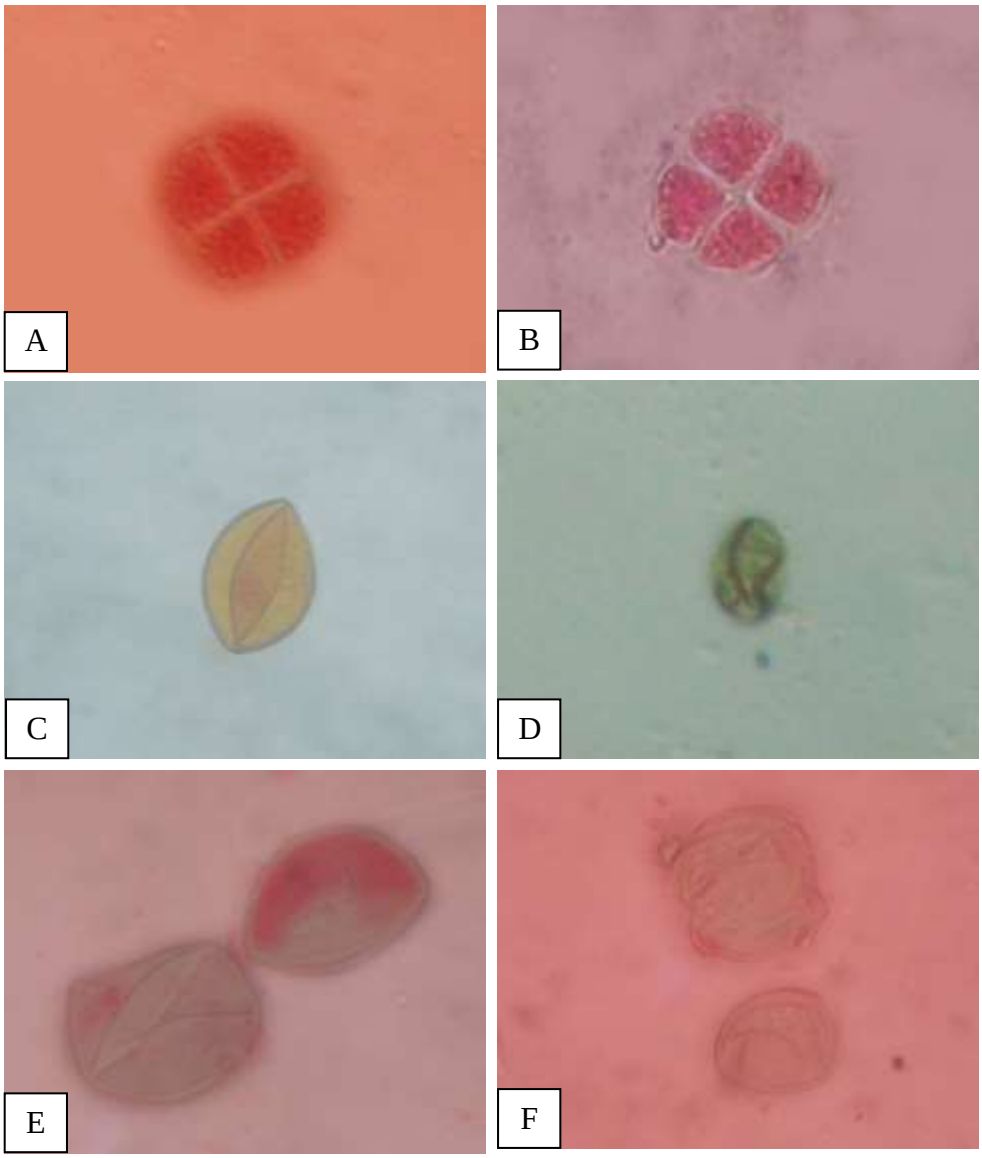

Figure 7. Meiotic Character of interspecific rice *Oryza sativa* L.

A. Normal tetrad
B. Abnormal pollen
C. Fertile pollen
D. Sterile pollen
E. Normal and Abnormal pollen
F. Abnormal pollen

Conclusion

It was concluded that out of more than 1000 pollen grains, 853 were darkly stained and were counted as fertile, whereas 47 pollen grains remain unstained and were considered as sterile. Pollen fertility of *Oryza sativa* L. cv. Ayarmin was thus 95.30% and spikelet fertility was 85.71%.

In the present study of *Oryza sativa* L. cv. that out of (90) days more than 1000 pollen grains, 925 were darkly stained and were counted as fertile, where as 75 pollen grains remain unstained and were considered as sterile. The interspecific hybrids of pollen grains, were darkly stained and were counted as fertile whereas 59 pollen grains remain unstained and were considered as sterile. This suggests that the pollen and spikelet fertilities were controlled partly by the same genes probably. Therefore, the pollen and seed fertilities were not significantly suggested that they were controlled by different genes (Table 1).

In the hybrid yield contributing traits like grains per panicle, spikelet fertility had high direct effect on seed yield. Similar report was given by Begali et al. Therefore, the interspecific hybrid rice *Oryza sativa* L. of grains per panicle was the fore most factor responsible for grain yield followed by spikelet fertility. It is found that grains per panicle should be preferable for high yield of interspecific rice (Fig. 1 and Table 2).

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