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Comparative Analysis of Effectiveness of Wide Compatibility (WC) Trait Between Improved Maintainer Line Having *WC* and *eui* Genes and Maintainer Line with *eui* and Without *WC* Genes in Rice (*Oryza sativa* L.)

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Abstract The present study was carried out to know the effectiveness of wide compatibility trait. The compatibility as measured by percentage pollen and spikelet fertitility in F_1s revealed it to vary with the IR 58025eWCB having *WC* and eui genes and IR58025eB with *eui* gene. In crossing of IR58025eWCB with *indica, japonica* and *tropical japonica* testers, group mean spikelet fertility (83.62%), (77.03%) and (68.84%) respectively, the comparison with crossing of recurrent parent JR58025eB with *indica*, *Japonica* and *tropical japonica* testers, group mean spikelet fertility (82.19%), (43.85%) and (59.54%) respectively. The estimated increase in group mean percentage overcome with *indica, japonica* and t*ropical japonica* testers 7.18% 17.00% and 40.00% for pollen fertility and 1.74%, 75.66% and 15.61% for spikelet fertility respectively. The effectiveness of wide compatibility trait in improved parental line helps us to further exploitation of it in hybrid rice breeding program.

Keywords Hybrid rice, Maintainer line, Inter-subspecific crosses, WC trait, EUI trait.

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Introduction

Rice (*Oryza sativa* L.) is the most important staple food crop in the world. Worldwide, rice is cultivated in area -161.87 million hectare and average productivity is 4.57 tonnes/hectare [1]. Hybrid rice has shown 15-20% yield advantage over the best cultivated rice varieties. In hybrid rice development, a serious problem associated with CMS lines is incomplete panicle exsertion, which reduces outcrossing rate and hybrid seed production. CMS lines with WA cytoplasm have a problem of incompletepanicle exertion in which 30-40% of the spikelets remain enclosed in flag leaf sheath [2]. To overcomethe panicle exsertion of CMS lines, eui gene provides a genetic alternative for GA_3 application in hybrid rice seed production.

Most of the hybrids released *(indica/indica)* nature, wherein magnitude of yield heterosis cannot be expected to exceed more than 20%. In henceusing diverse parental lines can achieve further yield advantage using inter-subspecific crosses. Whereas inter-specific crosses show higher yield heterosis than intra-subspecific crosses [3].

Discovery of the neutral allele *(n)* is generally called *WC* gene in rice offers an opportunity for overcoming the reproductive barrier exhibited in hybrids between *indica* and *japonica* for better heterosis. The objective to comparative study of effectiveness of *WC* trait between improved line having *WC* and eui genes and improved line with *eui* gene.

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Materials and Methods

Plant materials

The experimental study was conducted at Barwale Foundation Research Farm, Hyderabad, during *kharif* 2014 to *rabi* 2014-15. IR58025eB (NBPGR registration no. IC 524011) is an improved maintainer with eui gene and IR58025eWCB having cui and *WC* genes and list of testers used to generate F1 presented in Table 1.

Evaluation of pollen and spikelet fertility

Pollen fertility was studied for the 30 F_1s. Spikelets were collected from each entry. The anthers from each spikelet were collected on a clean glass slide and crushed using 1% lodine- Potassium lodide solution; the slides were examined under microscope by using 40X magnification. The pollen with deeply stained andround was considered as fertile and the pollen with pale stain and shriveled was considered as sterile were counted and expressed as percentage. For calculating spikelet fertility percentage five main panicles were collected from each entry and average the number of filled grains and unfilled grains per panicle were counted and expressed as percent. Pollen and spikelet fertility were calculated as follow :

Table 1. List of testers.

Indica	*Japonica*	*Tropical japonica*
APO, IR36, IR72, IR 64 and Shan Huang Zhan 2	Kinmaze, Nipponbare, Tainung 67, CT9993 and M 201	Moroberekan, IR68552-55-3-2, Azucena, Banten and Calotoc

$$\text{Pollen fertility (PF) \%} = \frac{\text{Number of fertile pollens}}{\text{Total number of pollens}} \times 100$$

$$\text{Spikelet (SF) \%} = \frac{\text{Number of filled spikelet in the panicles}}{\text{Total number of spikelet in the panicle}} \times 100$$

Spikelet fertility classified in three groups [4].

Results and Discussion

In crossing of IR58025eWCB with *Indica, japonica* and *tropical japonica* pollen fertility ranged from 73.33% (Shan Huang Zhan 2) to 90.00% (IR72), 65.63% (Kinmaze) to 87.03% (Nipponbare) and 64.02% (Moroberekan) to 74.75% (calotoc) andin comparison to IR58025eB with *indica, japonica* and *tropical faponica* testers pollen fertility ranged from 73.33% (Shan Huang Zhan 2) to 83.33% (IR72), 27.81 (Kinmaze) to 61.31% (Nipponbare) and 51.21% (Banten) to 68.88% (Calotoc) respectively. It was observed that estimates of group mean pollen fertilityin IR58025eWCB with *indica, japonica* and *tropical japonica* testers (58.26%), (83.62%) and (77.03%); and in comparison to crossiong of recurent parent IRS58025eB with *indica, japonica* and *tropical japonica* testers, group mean pollen fertility (82.19%), (43.85%) and (59.54%) respectvely (Fig. 1).

In crossing of IR58025eWCB with *indica, japonica* and *tropical japonica* testers, spikelet fertility ranged from 80.28% (APO) to 88.78% (IR72), 65.63% (Kinmaze) to 87.03% (Nipponbare) and 64.02% (Moroberekan) to 74.75% 74.75% (Calotoc) and in comparison to IR58025eB with indica, japonica and tropical japonica testers, spikelet fertility ranged from 79.67% (APO) to 87.56% (IR72), 27.81 (Kinmaze) to 61.31% (Nipponbare) and 51.21% (Banten) to 68.88% (calotoc) respectively. In crossing of IR58025eWCB with indica, japonica and tropical joponica testersd,

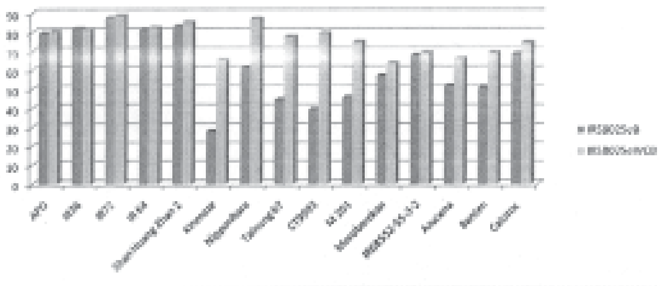

Fig. 1. Comparative Study of Pollen Fertility Percentage in F_1 of IR58025eB and IR58025eWCB with *Indica, Japonica* and *Tropical japonica*.testers

group mean spikelet fertility (83.62%), (77.03%) and (68.84%), and in comparison to crossing of recurrent parent IR58025eB with *indica, japonica* and *tropical japonica* testers, group mean spikelet fertility (82.19%), (43.85%) and (59.54%) respectively (Fig. 2).

The estimated group mean pollen percentage overcome with indica, japonica and tropical japonica testers were 7.18%, 17.00% and 40.00%; and for spikelet fertility percentage overcome 1.74%, 75.66% and 15.61% respectively. Embroyo-sac fertility was more than 93% in the $S5^n$ gene-harboring hybrids, whereas embryo-sac fertility was relatively low in control hybrids between typical *indica* and *japonica* cultivars without the $S5^n$ gene, suggesting that $S5^n$ can overcome the sterility between *Indica-japonica* hybrids [5]. Ealier study suggested that the role of epistatic interactions for differential exppression of hybrid semi sterility. An *indica* variety when crossed with a set of *japonica* varieties would give hybrids of relatively uniform fertility as against variable fertility in crosses of a japonica with a set of indica varieties [6]. It has been subsequently observed that $S5^n$ did not neutralize hybrid sterility in all combinations suggesting the possibility of involvement of more neutral genes [7]. One hundred and fifty F_1 hybrids, *indica* × *japonica (I × J)*, were evaluated for their hybrid sterility and spikelet fertility percentage ranged from 4 to 97%. [8]. The new materials developed showed overcome the hybrid sterility and will prove useful to *indica-japonica* hybrid technology to increase in yield. Besides ideotype breeding/superrice breeding canbe initiated by combining desirable traits from indica genotypes (Desirable grain shape, texture and quality) with japonica genotypes (lodging resistance, early maturity and cold tolerance) and reciprocally through combination breeding.

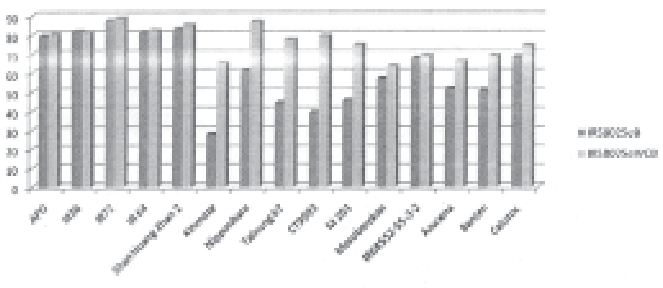

Fig. 2. Comparative Study of Spikelet Fertility Percentage in F1 of IR58025eB and IR58025eWCB with *Indica, Japonica* and *Tropical japonica* testers

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