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Research Article

INFLUENCE ON SEED DESIGNING ON THE PRODUCTIVITY AND THE RESULTANT SEED QUALITY OF RICE *CV.* ADT 39

SOWMIYABHANU S., SRIMATHI P. AND VAKESWARAN V.*

Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore, 641003 Tamil Nadu
*Corresponding Author: Email-vakeswaran@gmail.com

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Abstract- To evaluate the influence of seed designed with different seed management techniques in rice, the seeds of rice *cv.* ADT 39 were imposed with physiological (seed hardening with KCl one per cent for 16h and drying back to original moisture content), physical (seed coating with polymer @ 3 ml that followed with sequential application of imidacloprid @ 2 ml, P. fluorescens @ 10 g and Azophos @ 120 g kg $^{-1}$ of seed) and their combinational seed treatment (designer seed) (seed hardening with KCl one per cent for 16h and drying back to original moisture and combined with seed coating treatments *viz*., polymer @ 3 ml + imidacloprid @ 2 ml, P. fluorescens @ 10 g and Azophos @ 120 g kg^{-1} of seed) and were evaluated for their production potential in comparison with untreated seed. The results revealed that the field emergence was four per cent higher with designer seed than untreated seed and hardened seed. The yield attributing characters measured through number of panicles plant^{-1}, panicle yield plant^{-1}, seed yield plant^{-1} and the seed yield ha^{-1} were higher with designer seed which exerted a percentage increase of 4.0, 29.1, 61.1 and 22.5 per cent in comparison with untreated seed on seed yield. The resultant seed quality characters observed germination, shoot length and vigour index were also higher than untreated seed by 3.2, 0.71 and 9.1 per cent.

Keywords- Designer seeds, Seed Hardening, Seed coating and Rice.

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Introduction

The seeds are recommended with various seed management techniques to mobilize the seeds for their own resources and to augment them with external resources for their maximum output on stand establishment and yield [16]. Physical and physiological seed treatments are recommended for seeds from time immemorial to adjust itself with several soil and hydrological constraints. Physiological seed treatments are primarily coined based on hydration and dehydration technique [7]. Film coating is another seed management techniques that provides an ideal room for the application of chemical and biological seed treatments. Pelleting is one another physical pre-sowing seed management technique, in which growth promotive or any needy substances (protective, nutritive, in vigourative) are applied on the seed to enhance the seed-soil interface [18] at the rhizosphere region. Seed functioning is achieved through physiological treatment (fortification / hardening / priming), while seed designing is achieved through physical and physiological (fortification, hardening, coating and pelleting) seed treatment. Among the economically important crops, rice (*Oryza sativa* L.) is the prime source of food for nearly half of the world's population [12], obviously it plays a vital role in the national food grain supply. It has been estimated that demand for rice in 2025 will be around 140 million tonnes. Seed irrespective of kind undergoes deterioration from germination to death and exhibit various seed quality characters with different age of the seed. Hence, the scientists recommend various seed treatment for specific purpose as dealt earlier. With advances in pre-sowing seed management techniques, to harvest the benefit of both physical and physiological seed treatment, integration of seed treatments (seed designing) were practiced [2] with cumulative benefit of seed invigoration and protection against pests that extend upto productivity [11]. Hence studies were initiated to evaluate the influence of individual and integrated seed management techniques on the productivity of rice with *cv* ADT39.

Materials and Method

Genetically pure seeds of rice *cv.* ADT39 were obtained from the Paddy Breeding Station , Tamil Nadu Agricultural University, Coimbatore. The seeds are graded for uniformity and were imposed with the following seed treatments.

T_1 - Physiological - Seed hardening - Hydration of seeds in 1% KCl for 16 h with 1:1 seed to solution ratio and dry back to original moisture content.

T_2 - Physical - Seed coating with polymer @ 3 ml that followed with sequential application of imidacloprid @ 2 ml, P. fluorescens @ 10 g and Azophos @ 120 g kg^{-1} of seed .

T_3 – Designer seed - Integrated - $T_1 + T_2$

T_4 - Control

The field experiment was laid out at Pungar block of Agricultural Research Station, Bhavanisagar, Tamilnadu Agricultural University Coimbatore, Tamilnadu, India with the seeds treated as above along with untreated seed to assess their efficacy on seed and resultant seed quality characters. The experiment was conducted adopting RBD with five replications adopting the plot size of 3×4 m with the spacing of 20 x 10cm with the recommended common package of practices. At field level the observations on field emergence, days to first flowering, plant height at vegetative, flowering and maturity phase (cm), productive tillers plant^{-1}, panicle yield plant^{-1} (g), seed yield plant^{-1} (g), seed yield plot $^{-1}$(kg), seed yield (t ha^{-1}) were made.

In addition the seed quality characters such as Germination (%)[9], Root length (cm), Shoot length (cm), Dry matter production 10 seedlings $^{-1}$ (mg) [6], Vigour

index [1] of the resultant seeds were observed.

The data obtained from the experiment were analysed for 'F' test of Significance following the methods described by [15]. Wherever necessary the per cent values were transformed to angular (Arc-sine) values before analysis. The critical differences (CD) were calculated at 5 per cent probability level. If F test is non-significant, it was indicated as NS.

Results and Discussion

Evaluation of the integrated seed treatment along with individual seed treatment had proved their invigourative influence upto productivity in many crops (Suma, 2005). In green gram, Kokila, (2012) exposed improvement in seed yield due to integration of seed management techniques. In the present study, the field emergence obtained with designer seed was four per cent higher than control and hardened seed but only by two per cent with physical seed treatment [Table-1]. Influence on field emergence may be due to activation of cells, resulted in the enhanced mitochondrial activity led into increased high energy compounds and vital biomolecules, which were made available during the early phase of germination [4]. The fortified seeds triggered germination events that were halted on drying back the seed to its original moisture content and when the seeds are sown, germination event begins from the point where it stopped previously [8], due to this consequences early emergence and establishment of seedling were achieved [5]. [17] reported that hydrophilic polymers enhanced the water uptake of the seeds.

Highly significant differences were obtained for all the yield attributing parameters except for days to first flowering. 100 seed weight (g), root length (cm) and dry matter production (mg) of the resultant seed, which were non-significant. The field emergence was maximum with designer seed (96 %) while the minimum was with untreated seed (92 %). Similarly the plant height (cm) at different growth stages *viz*., vegetative, flowering and maturity were also maximum with integration of treatment (as 80.5, 162.3, 163.9cm, respectively) and was followed by physical seed coating treatment (76.3, 158.2 and 160.4cm, respectively), the physiological seed treatment (74.3, 149.4, 150.2cm, respectively) and the untreated seed (72.3, 143.5 and 145.1cm, respectively). The plant height measured at different phases of crop growth highlighted that at each phase, the designer seed improved the plant height with the overall percentage increase of 13, 9.1 and 2.1 per cent respectively compared to (integrated) physical treatments, hardened and control seed. However, the flowering was not influenced by the integrated seed management techniques. The panicles per plant, panicle yield per plant and the seed yield per plant (31, 22.3 and 29 g, respectively) recorded were also the maximum with T_4 and was the minimum (24, 21.3 and 18 g, respectively) with untreated seed. The plot and seed yield per ha observed the hike in ascending order from untreated seed (294.4kg ha^{-1}, 3.68t ha^{-1}, respectively) to primed seed (336.8kg ha^{-1}, 4.21t ha^{-1}, respectively) to seed coating treatment (365.8kg ha^{-1}, 4.46 t ha^{-1}, respectively) to integrated seed treatment (360.8kg ha^{-1}-, 4.5t ha^{-1}, respectively). Thus the yield attributing characters measured as number of panicles plant^{-1}, panicle yield plant^{-1} (g), seed yield plant^{-1} (g) and the seed yield (t ha^{-1}) were higher with designer seed which exerted a percentage increase that ranges between 0.9 to 61.1 per cent in comparison with individual seed treatment. [3,14] in blackgram also reported that designer seed improved the seed yield. The yield increase obtained in the present study might be due to the combined effect of fortification, coating and pelleting that had enhanced the root-shoot ratio and nutrient uptake and had improved the yield attributing characters. The increased grain yield could be due to the increased photosynthetic efficiency through stabilization of chlorophyll, higher production of photosynthates that resulted in increased translocation of organic material from the source to sink in the treated plants as reported [10] on investigating the effect of seed hardening and film coating on sorghum. [20] in maize reported increased productivity with coated seeds. However [13] in blackgram, [22,19] in maize reported that designer seed i.e. the integrated seed management techniques (hardening + coating + pelleting) improved the productivity of seeds.

Among the resultant seed quality characters the germination were higher in coated seed and primed seed which were on par as 97 per cent and was followed by designer seed (96%) and untreated seed (93%), while the resultant seed quality characters measured in terms of root length and dry matter production were non-significant while observation on germination and shoot length and vigour index were higher than untreated seed by 3.2, 0.71 and 9.1 percentage. Similar results were also reported [21] in sesame and [11] in greengram. Thus, the results revealed that treated seeds enhanced the productivity better than untreated seed. Among the treatments, integration of physical and physiological seed treatments had synergistic influence on productivity on integration and also on the resultant seed quality characters.

Table-1 *Performance of integrated seed management techniques on productivity and the resultant seed quality characters of rice cv. ADT 39*

Parameters	T_1	T_2	T_3	T_4	SEd	CD (P=0.05)
Field performance						
Field emergence (%)	92 (73.52)	96 (78.46)	92 (73.57)	96 (78.46)	(0.90)	(1.91)
Plant height (cm)						
At vegetative phase	72.3	74.3	76.3	80.5	1.04	2.22
At flowering phase	143.5	149.4	158.2	162.3	1.94	4.11
At maturity phase	145.1	150.2	160.4	163.9	2.25	4.79
Days to first flowering	94	93	94	93	1.06	NS
Panicles plant^{-1}	18	22	25	29	0.68	1.45
Panicle yield plant^{-1} (g)	24	26	29	31	0.71	1.51
Seed yield plant^{-1} (g)	21.3	21.7	22.1	22.3	0.10	0.22
Panicle to seed recovery (%)	29.4	33.7	35.7	36.0	0.57	1.22
100 seed weight (g)	1.72	1.74	1.75	1.75	0.013	NS
Seed yield plot (kg)	294.4	336.8	356.8	360.8	1.15	2.51
Seed yield (t ha^{-1})	3.68	4.21	4.46	4.51	0.06	0.12
Resultant seed quality characters						
Germination (%)	93 (74.66)	97 (80.02)	97 (84.26)	96 (78.46)	(0.98)	(2.01)
Root length (cm)	15.7	15.6	16.4	16.5	0.36	NS
Shoot length (cm)	7.0	7.5	7.3	7.5	0.11	0.23
DMP 10 seedlings^{-1} (mg)	207	208	209	211	1.73	NS
Vigour index	2111	2240	2275	2304	29.37	62.28

T_1 – Untreated seed ; **T_2 –** Hardening with KCl 1%; **T_3 -** T_1 + Polymer 3ml kg^{-1} + Imidacloprid 2ml kg^{-1} + *P.fluorescens* 10g kg^{-1} + Azophos 120g kg^{-1}; **T_4 -** T_2 + Polymer 3ml kg^{-1} +Imidacloprid 2ml kg^{-1} + *P.fluorescens* 10g kg^{-1} + Azophos 120g kg^{-1}; Figures in the parenthesis are arcsine transformed values. **DMP –**Drymatter production.

Conclusion

Designer seed - seed hardening with KCl one per cent for 16h and drying back to original moisture and combined with seed coating treatments *viz*., polymer @ 3 ml + imidacloprid @ 2 ml, P. fluorescens @ 10 g and Azophos @ 120 g kg^{-1} of seed increases the seed yield and seed yield attributing characters and resultant seed quality over the untreated seeds in rice *cv* ADT 39.

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Author Contributions

1) S. SOWMIYABHANU- Post Graduate student conducted the experiment.
2) P.SRIMATHI- Chairman of the Advisory Committee of The Study
3) V.VAKESWARAN - Raised the field trial at Agricultural Research Station, Bahvanisagar

Abbreviations

Cv – Cultivar, KCL – Potasium Chloride, h- hours, ml – milliliter, ha – hectare, m – metre, cm- centimeter, g – gram, kg – kilogram, t ha^{-1}- tonnes per hectare,% - percentage

Conflict of Interest: None declared

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