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Influence of Iron Coated Seeds on time of Sowing in Wet Direct Seeded Rice (*Oryza sativa* L.)

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ABSTRACT

Background: Wet direct seeding technique in rice, which aims to realize labour saving in paddy rice cultivation, has continued to gain popularity in recent years. Because the work of raising and transplanting seedlings can be omitted, wet direct seeding can make an important contribution to labour saving. In wet DSR, iron coated seed that is, seed is coated with iron powder, which increases its weight so that seed settle easily in water and forms a tough coating that preventing birds from eating the seeds.

Methods: Studies were conducted during the year 2018 and 2019 at the Department of Rice, TNAU, Coimbatore on influence of iron coated seeds and time of sowing in wet direct seeded rice. Experiment was laid out in split plot design with three replications. In main plot, different time of sowing at weekly interval *viz.,* first, second, third and fourth week of August sowing, where as in sub-plot iron coated seeds broadcasting in 1-2 mm water level condition; iron coated seeds broadcasting in wet condition; uncoated seeds broadcasting in 1-2 mm water level condition; uncoated seeds broadcasting in wet condition and normal method of transplanting.

Result: The results indicated that iron coated seeds of variety Swarna, broadcasting in 1-2 mm water level condition during the first fortnight of August sowing resulted higher grain yield (5653 kg/ha) when compared delayed sowing. The Fe coating significantly increased grain yield over non-coating. Iron coated seeds recorded lesser occurrence of pest and disese incidence when compared to un-coated seeds.

Key words: Iron coated seed, Time of sowing, Uncoated seeds, Water seeding, Wet seeding.

INTRODUCTION

Rice is a staple food crop in Asia and has been traditionally cultivated mainly by transplanting. Raising seedlings in nurseries, pulling and bundling, transporting to the field and transplanting are laborious and time-consuming. Puddled soil is soft, which not only facilitates the transplanting work of farmers but also favours the growth of seedlings. Puddling controls weeds efficiently by killing them before planting and by suppressing the emergence of new weeds after planting. Labour shortages brought about by high economic growth prompted farmers to shift from transplanting method to direct seeding method. The area that shifted to direct seeding reached as much as 14 per cent of all irrigated rice fields, but further expansion has been limited by inconsistent plant stands and the infestation of weeds that are difficult to control (Pandey and Velasco, 2005). The wet direct seeding technique, which aims to realize labour saving in paddy rice cultivation, has continued to gain popularity in recent years (Ryma Labad *et al.*, 2020). Unlike the traditional transplantation method, in which young rice plants are first grown and then transplanted to a paddy field, wet direct seeding is a technique in which the seed is sown directly, where it germinates and establishes and the rice is harvested from the same paddy. Because the work of raising and transplanting seedlings can be omitted, wet direct seeding can make an important contribution to labour saving (Kumar and Ladha, 2011). In seed coating, seed is coated with iron powder, which increases its weight so that seed settle easily in water and forms a tough coating that preventing birds from eating the seeds. Seeds had been soaked and then dried have increases amylase activity and a high germination rate (David *et al.*, 2020). Seed treatment of soaking, incubation and drying is a useful priming method. Primed rice seeds could be utilized in direct seeding in lieu of pre-germinated seeds (Andoh and Kobata, 2002). In this context, this study was conducted to assess the impact of the iron coated seeds on crop establishment and productivity with different time of sowing under wet direct seeded rice eco system.

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MATERIALS AND METHODS

A field experiment was conducted during *Kharif,* 2018 and 2019 at the Department of Rice, Tamil Nadu Agricultural University, Coimbatore, to study the productivity of direct

seeded rice with iron coating under different rice ecologies. The soil of the experimental field was clay in texture with a pH 8.28, organic carbon (0.44%), low in available nitrogen (216 kg/ha), medium in available phosphorus (22 kg/ha) and high in available potassium (466 kg/ha). Entire dose of phosphorus applied as basal, N and K applied in four spilits at basal, tillering, panicle initiation and flowering stages. Time of sowing in weekly intervals *viz.,* M_1 - first week of August sowing, M_2 - second week of August sowing, M_3 – third week of August sowing; M_4 – fourth week of August sowing in main plot where as in sub-plot S_1- Iron coated seeds broadcasting in 1-2 mm water level condition; S_2 - Iron coated seeds broadcasting in wet condition; S_3 - Uncoated seeds broadcasting in 1-2 mm water level condition; S_4 - Uncoated seeds broadcasting in wet condition and S_5 – Normal method of transplanting. The variety chosen for this study was Swarna and the experimental trial was laid out in split plot design with three replications. A technology in which Fe coated primed dry rice seeds are sown directly onto a flooded, puddled field was invented in direct seeded rice (Yamauchi, 2004). Seed treatment of soaking, incubation and drying increases the germination rate of rice even at low temperatures or under anoxiaand that the treatment is effective not only in Japonica cultivars but also in Indica cultivars (Mori *et al.,* 2012). Iron coated seeds are prepared in three steps are as follows, the granulation of pre-germinated seeds with a mixture of reduced Fe powder and calcined gypsum or silica gel; the oxidation of Fe on the husk with the simultaneous discharge of heat and drying. The amount of Fe used to coat a seed is expressed as the Fe-coating ratio, that is, the weight of the reduced Fe powder to the weight of the seeds. The Fe powder on the seed surface was oxidized, producing rust, which serves as a binder for the formation of a hard coating layer. The dried Fe-coated seeds could be prepared manually or mechanically in large quantities and stored for more than 1 yr at room temperature (Yamuchi, 2017). The ratio can be varied from near 0 to 4.0. The optimum Fe coating ratio varies with the seeding conditions. A ratio of 0.5 is commonly used in water seeding with pinpoint or delayed flooding water control. Water seeding with continuous flooding in a puddled field under direct seeded rice, a ratio as high as 2 was preferable. In preliminary study indicated that the Fe-coating ratio could be reduced to as low as 0.05 without sacrificing grain yield (Yamauchi, 2006). When farmers use primed seeds, they do not need to pre-germinate the seeds before planting. The use of Fe coated seeds prevents the occurrence of floating seedling in the water seeding of puddled soil. Integrating the preparation of primed and Fe-coated seeds make water seeding in puddled soil without soaking and incubation during the busy farm season feasible. All the recorded data were analysed statistically as per the method suggested by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Yield attributes and grain yield

Based on the two years of experimental study, the result revealed that first fortnight of August sowing using iron coated seeds broadcasting in 1-2 mm water level condition resulted higher number of panicles / m^2 (361) and panicle weight (2.73 g) when compared to delayed sowing (Table 1 and 2). Grain and straw yield was recorded higher under first fortnight of August sowing using iron coated seeds broadcasting in 1-2 mm water level condition (5275 kg/ha) than those of delayed sowing in second fortnight of August (Table 3). There was a significant reduction in grain yield due to a delay of one week from second sowing (Fig 1). However, Fe coating significantly increased grain yield over non-coating. There is a significant increase of grain yield to the tune of 9.85 per cent due to iron coating of seeds which felicitated a better system of establishment and growth (Fig 2). Higher straw yield was also noticed in iron coated seeds broadcasting in 1-2 mm water level condition when compared to delay sowing during second fortnight of August. It is mainly due to the iron coated seed rice is coated with iron powder, which increases its weight so that seed settle easily in water and forms a tough coating that preventing birds from eating the seeds. The seeds were floated less

Table 1: Effect of iron coated seeds with different time of sowing on number of panicles / m^2 of rice (Pooled data of two years).

Treatments	Number of panicles / m^2				
	Ist week of August sowing	IInd week of August sowing	IIIrd week of August sowing	IVth week of August sowing	Mean
S_1 - Iron coated seed broadcasting in 1-2 mm water level condition	353	361	327	318	340
S_2 - Iron coated seed broadcasting in wet condition	338	343	323	316	330
S_3 - Un-coated seed broadcasting in 1-2 mm water level condition	328	337	314	310	322
S_4 - Un-coated seed broadcasting in wet condition	318	319	302	300	310
S_5 - Normal transplanting method	356	367	336	328	347
Mean	339	345	320	314	
	M	S	M at S	S at M	
S.Ed	6	5	13	11	
CD(0.05)	11	10	25	23	

and rooted and anchored better as the increase in the density. It was determined that rice seeds with a density greater than 2.11 Mg m^{-3} allowed the seminal roots to penetrate into the puddled soil at a water depth of 10 cm. The seed density required for direct seeding should be determined not only by field conditions but also by cultural practices. Field conditions may include water movement as affected by wind speed and soil physical surface conditions (Pragyan Kumari *et al.,* 2017). The density required in the continuous flooding of water seeding might be greater than that required delayed flooding (Yamuchi, 2017). Iron-coated rice seeds exhibit high density, improved anchorage and resistance to sparrow attack and seed borne diseases. These iron coated seeds can be stored at room temperature

Table 2: Effect of iron coated seeds with different time of sowing on panicle weight (g) of rice (Pooled data of two years).

Treatments	Panicle weight (g)				
	Ist week of August sowing	IInd week of August sowing	IIIrd week of August sowing	IVth week of August sowing	Mean
Iron coated seed broadcasting in 1-2 mm water level condition	2.64	2.73	2.29	2.17	2.46
Iron coated seed broadcasting in wet condition	2.48	2.56	2.17	2.10	2.33
Un-coated seed broadcasting in 1-2 mm water level condition	2.27	2.36	2.10	1.88	2.15
Un-coated seed broadcasting in wet condition	1.97	2.04	1.91	1.73	1.91
Normal transplanting method	2.72	2.78	2.59	2.42	2.63
Mean	2.42	2.49	2.21	2.06	
	M	S	M at S	S at M	
S.Ed	0.03	0.07	0.09	0.10	
CD(0.05)	0.09	0.12	0.23	0.22	

Table 3: Effect of iron coated seeds with different time of sowing on grain yield (kg/ha) of rice (Pooled data of two years).

Treatments	Grain yield (kg/ha)				
	Ist week of August sowing	IInd week of August sowing	IIIrd week of August sowing	IVth week of August sowing	Mean
Iron coated seed broadcasting in 1-2 mm water level condition	5517	5653	5043	4840	5263
Iron coated seed broadcasting in wet condition	5340	5553	4890	4767	5138
Un-coated seed broadcasting in 1-2 mm water level condition	4830	4737	4530	4377	4619
Un-coated seed broadcasting in wet condition	4753	4667	4367	4203	4498
Normal transplanting method	5687	5763	5590	5347	5597
Mean	5225	5275	4884	4707	
	M	S	M at S	S at M	
S.Ed	52	60	110	122	
CD(0.05)	110	135	230	250	

Table 4: Effect of iron seed coating of seeds on pest incidence of rice.

Treatments	% Dead heart symptom		% White ear symptom	% Silver shoot symptom		BPH (No. / hill)	
	55 DAT	75 DAT	Pre harvest	55 DAT	75 DAT	55 DAT	75 DAT
Iron coated seed broadcasting in 1-2 mm water level condition	2.8 (1.9)b	5.1(2.2)b	5.8(2.4)a	15.0(3.5)b	10.5(3.1)b	16(3)bc	20(5)b
Iron coated seed broadcasting in wet condition	2.2(1.5)b	1.4 (1.2)c	3.3(2.1)b	10.0(3.2)c	7.1(2.3)c	8(2)d	11(3)c
Un-coated seed broadcasting in 1-2 mm water level condition	5.4 (2.3)a	7.6(2.9)a	7.2(2.4)a	23.8(4.7)a	19.3(4.2)a	23(4)ab	37(6)a
Un-coated seed broadcasting in wet condition	2.3(1.5)b	5.0(2.3)b	7.1(2.3)a	13.8(3.5)b	9.5(3.1)b	15(3)cd	21(5)b
Normal transplanting method	7.1(2.5)a	5.5(2.4)b	6.1(2.2)a	29.3(5.1)a	17.9(4.2)a	24(4)a	36(6)a
LSD (0.05)	0.54	0.42	0.34	0.52	0.43	0.81	1.01
CV (%)	12.07	9.62	7.78	6.3	6.61	9.66	9.81

Data subjected to Arc sin transformation.

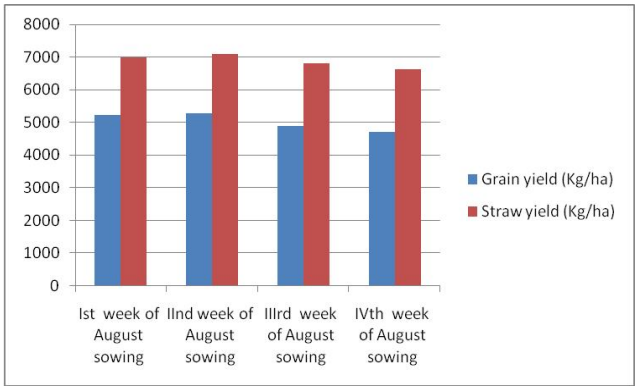

Fig 1: Grain and straw yield (kg/ha) as influenced by time of sowing.

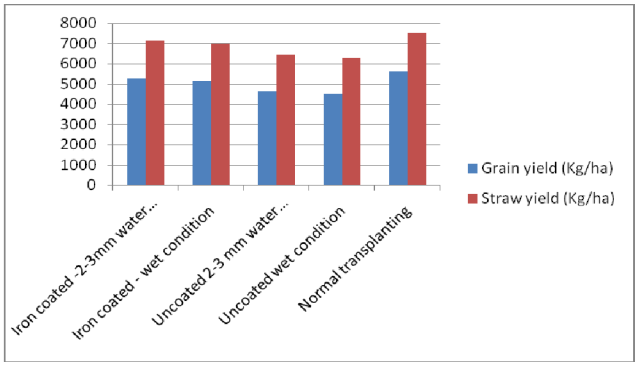

Fig 2: Effect of method of sowing on grain and straw yield (kg/ha) of rice.

for more than one year and can be sown without soaking or incubation.

Iron coating efficiently controlled seed density over the range of 1.1 and 3.1 Mg m^{-3} with a coating ratio between 0 (non-coating) and 4. The seeds prepared using a standard Fe coating ratio of 0.5 had a density of 1.6 Mg m^{-3}, which is not attainable biologically. Therefore, Fe coating is an efficient method for increasing seed density.

Effect of iron coated seeds on pest incidence of rice

Effect of iron coated seed on insect pest incidence (ESCP) revealed that low pest incidence in different treatments (Table 4). Stem borer incidence was at par in different seed coated treatments (0.5 – 10.6% DH and 3.9 – 16.6% WE) and also in different sowings (0.1 – 10.8% DH and 4.1 - 16.4% WE). However, gall midge (9.2 – 13.9% SS) and BPH incidence (11-19) /hoppers hill) was found low in iron coated seed treatments compared to normal transplanting (24.6% SS and 33/ hill) and uncoated seed treatments (22.6% SS and 32/ hill). Seed coating also provided protection against the pests. When the Fe- coating ratio is increased, the damage is reduced (Yamuchi, 2006; Chikawa *et al.,* 2014). The Fe-coating ratios required for preventing pests are 0.5 and 1.0, respectively.

CONCLUSION

In wet direct seeded method, iron coated seeds broadcasting in 1-2 mm water level condition during first fortnight of August sowing resulted higher grain yield when compared to delayed sowing of second fortnight sowing. The Fe coating significantly increased grain yield over non-coating. When the Fe-coating ratio is increased, the damage is reduced. This technology has been successfully introduced in water seeding in puddled fields in an irrigated ecosystem by broadcast, row and hill seeding.

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