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I Chinnamani
Ph.D. Scholar, Department of Agronomy, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai, Tamil Nadu, India

R Durai Singh
Professor and Head, Department of Agronomy, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai, Tamil Nadu, India

VK Paulpandi
Professor, Department of Agronomy, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai, Tamil Nadu, India

R Geetha
Professor, Seed Science and Technology, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Chettinad, Tamil Nadu, India

E Murugan
Professor, Department of Plant Breeding and Genetics, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai, Tamil Nadu, India

S Selvam
Professor, Department of Social Science, Anbil Dharmalingam Agricultural College and Research Institute, Tamil Nadu Agricultural University, Trichy, Tamil Nadu, India

Corresponding Author:
I Chinnamani
Ph.D. Scholar, Department of Agronomy, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai, Tamil Nadu, India

The adaptability of different rice seed shapes of (*Oryza sativa* L.) on paddy drum seeder slot modification

I Chinnamani, R Durai Singh, VK Paulpandi, R Geetha, E Murugan and S Selvam

Abstract
To evaluate the adaptability of different seed shapes on paddy drum seeder slot modification during *Rabi* 2022, a calibration study and field experiment were conducted at Central Farm, Agricultural College and Research Institute, Madurai. The split plot design was used for the experiment. Varieties in the main plot include ADT 45 (Medium slender), MDU 6 (Long slender), and ASD 16 (Short bold), as well as the medium duration variety VGD 1. (Short Slender). Modifications to the drum seeder slot include round slots, oval slots, round slots with guiding pipes, oval slots with guiding pipes, and self metering slots were used in sub plot. To evaluate seed flow rate, total seed dispersion, seed dispersion rate, and seed rate, a calibration study was performed using a paddy drum seeder. When compared to other slot modifications, the oval slot with guiding pipe had a lower seed flow rate (2.8 g), total seed dispersion (84 seeds), seed dispersion rate (5.62 seeds m^{-1}) and seed rate (9.25 kg ha^{-1}). Because of the nature of the grain shape, VGD 1 had the lowest seed flow rate, total seed dispersion (297.6 g), and seed rate (31.01 kg ha^{-1}) of the varieties tested. While ASD 16 had a lower seed dispersion rate (11.07 seeds m^{-1}). The oval slot with guiding pipe had the lowest plant population m^{-2} (49.3 plants m^{-2}) and the highest ASD (16) (55.04 plants m^{-2}). When used with an oval slot fitted with guiding pipe, ASD 16 and MDU 6 responded similarly.

Keywords: Modification, seed dispersion, plant population

Introduction

Over half of the world's population relies on rice (*Oryza sativa* L.) as their primary source of nutrition (Bandumula, 2018) [1]. The annual production on a global scale of 755.5 million tonnes and a productivity of 4.66 t ha^{-1}, rice is grown in a variety of environments. According to the global scenario, the current population of six billion people is predicted to grow to nine billion by 2050, necessitating one billion tonnes of food. With an area of 45.1 million hectares, India is the largest rice-growing nation in the world and produces 122.27 million tonnes of rice annually (Indiastat, 2020-21) [4]. It is the second largest rice-producing nation in the world. However, the productivity of rice is 4,057 kg ha^{-1} lower than the global average and substantially lower than China's productivity of 7,056 kg ha^{-1} (FAO, 2019) [3]. With a productivity of 2,308 kg ha^{-1}, Over an area of 1.90 million hectares, Tamil Nadu is accountable for the production of 7.17 million tonnes of rice annually (Indiastat, 2019-20) [4].

Transplanted puddled rice (TPR) has a number of drawbacks that make it unaffordable for many farmers, especially small and marginal farmers in Southeast Asia. These drawbacks include a huge water demand (1000-2000 mm) for puddling and maintaining continuous flooding, a huge energy requirement ranging from 5630 to 8448 MJ ha^{-1}, and nearly 15-20% higher labour inputs than direct-seeded rice (DSR) (Shekhawat, Kapila *et al*., 2020) [6].

Due to the risk of oncoming flooding, a labour scarcity, and damaged soil structure brought on by puddling, direct sowing must take the place of the traditional method of transplanting rice. Direct Seeded Rice (DSR) can yield as much grain as a transplanted crop while using less water and labour and decreasing the crop duration by 7 to 10 days by avoiding soil splashing, nursery management, and planting activities. The cost of the transplanted crops is also decreased by 29%, and just 34% of the total labour is required. (Jehengir *et al*., 2021) [5].

Materials and Methods

Experimental details

A split plot design with three replications was used for the field experiments. The main plot with different seed types and sub plots for slot modification.

The gross plot size in Rabi 2022 was 3.6 m x 9 m, and the net plot size was calculated using TNAU Paddy Drum seeder spacing. The test varieties for this study were the short duration rice varieties ADT 45 (Medium slender), MDU 6 (Long slender), and ASD 16 (Short bold), as well as the medium duration variety VGD 1 (Short Slender). In the subplot, five types of slots were used: round slots, oval slots, round slots with guiding pipes, oval slots with guiding pipes, and self metering slots.

Evaluation of modified drum

Flow rate of drum seeder

The drum seeder was fixed to a platform that allowed it to freely rotate, and sprouted paddy seeds were filled to 3/4 level in each of four drums and uniformly rotated five times. After five rotations, the seeds were collected, and the total number of seeds was counted and weighed, and the flow rate was expressed in Nos and g.

Seed dispersion in one running meter length

The number of seeds dispersed in one running metre length was recorded by counting and expressing the number of seeds that germinated in one metre length.

Effect of different drum slots used on seed rate

After filling the four drums of a drum seeder with 1 kilogram of seeds, the final weight of the seeds used in different slots was estimated and expressed as kg ha^{-1}.

Effect of different drum slots on plant population m^{-2}

The population was computed using a quadrat (0.25 m^2) at 3 different spots in each plot at 15 DAS. The mean value was expressed as No. hill m^{-2}.

Results and Discussion

Seed flow rate (g)

In terms of slot modification, the Oval slot fitted with guiding pipe (OS - GP) had the lowest flow rate (3.1 g five $rotations^{-1}$) and was followed by the self metering slot (SMS) (5.9 g five $rotations^{-1}$) was tabulated in Table 1. The Round slot had the highest flow rate (16.7 g five $rotations^{-1}$) (RS). In terms of varieties, Short slender has lower seed dispersion (4.6 g five $rotations^{-1}$) due to the smaller grain size. Because of the nature of the grain size and the size of the hole with orientation in the drum seeder, there was a significant difference among the factors.

Table 1: Effect of various slot modifications and their applicability to diverse seed shapes on seed flow rate during *Rabi* 2022

Seed flow rate (No)/Five rotation							**Flow rate (g)/Five rotation**						
	RS	OS	RS-GP	OS-GP	SMS	Mean		RS	OS	RS-GP	OS-GP	SMS	Mean
SS	977.0	753.0	535.0	149.0	291.0	541.0	SS	7.7	6.3	4.8	1.4	2.7	4.6
MS	984.0	762.0	559.0	164.0	321.0	558.0	MS	18.1	14.4	10.7	3.3	6.3	10.6
LS	987.0	769.0	550.0	157.0	310.0	555.0	LS	16.0	13.0	9.6	2.8	5.5	9.4
SB	1037.0	791.0	578.0	175.0	349.0	586.0	SB	25.1	19.7	14.8	4.7	9.1	14.7
Mean	996.0	768.0	556.0	161.0	318.0		Mean	16.7	13.3	10.0	3.1	5.9	
	M	S	M at S	S at M				M	S	M at S	S at M		
S.Ed	12.25	8.18	26.73	22.06			SEd	0.23	0.13	0.43	0.33		
CD (p=0.05)	28.82	17.60	47.64	47.21			CD (p=0.05)	0.54	0.28	0.76	0.73		

Note: (i) Seed type: VGD 1 Short Slender (SS), ADT 45 Medium Slender (MS), MDU 6 Long Slender (LS), ASD 16 Short Bold
(ii) Slot modification: Round Slot (RS), Oval Slot (OS), Round Slot with guiding pipe (RS-GP), Oval Slot with guiding pipe (OS-GP), Self Metering Slot (SMS)

Seed dispersion in one running meter length (seeds m^{-1})

The data depicted on Table.2 revealed that seed types and slot modification have a significant impact on seed dispersion. In terms of slot modification, the Oval slot fitted with guiding pipe (OS - GP) had the lowest seed dispersion (5.34 seeds m^{-1}) and was followed by the self metering slot (SMS) (9.65 seeds m^{-1}). The round slot had the greatest seed dispersion (16.35 seeds m^{-1}) (RS). In terms of varieties, Short bold has less seed dispersion (11.77 seeds m^{-1}) due to grain size and was found to be comparable to Long slender. (10.85 seeds m^{-1}). There was a significant difference among the factors due to grain size and hole size with orientation in the drum seeder.

Table 2: Effect of various slot modifications and their applicability to diverse seed shapes on total seed dispersion in one running meter length (seed m^{-1}) during *rabi* 2022

Seed dispersion (seed m^{-1})						
	RS	OS	RS-GP	OS-GP	SMS	Mean
SS	18.00	17.80	13.10	6.51	11.96	13.47
MS	15.92	15.14	11.32	5.36	9.56	11.46
LS	16.24	15.06	9.86	4.98	8.12	10.85
SB	15.24	14.78	10.38	4.52	8.94	10.77
Mean	16.35	15.70	11.17	5.34	9.65	
	M	S	M at S	S at M		
S.Ed	0.13	0.21	0.68	0.68		
CD (p=0.05)	0.30	0.45	1.21	1.21		

Note: (i) Seed type: VGD 1 Short Slender (SS), ADT 45 Medium Slender (MS), MDU 6 Long Slender (LS), ASD 16 Short Bold
(ii) Slot modification: Round Slot (RS), Oval Slot (OS), Round Slot with guiding pipe (RS-GP), Oval Slot with guiding pipe (OS-GP), Self Metering Slot (SMS)

Seed rate (kg ha^{-1})

The total number of seeds used in the drum was calculated using the rate of seed dispersion and presented in Fig 1. In terms of slot modification, the Oval slot fitted with guiding pipe (OS - GP) had the lowest seed rate (8.8 kg ha^{-1}) followed by the self metering slot (SMS) (17.0 kg ha^{-1}). The round slot had the highest seed rate (54.63 kg ha^{-1}) (RS). In terms of varieties, Short slender has a lower seed rate (28.89 kg ha^{-1}) due to a lower grain test weight. There was a significant difference among the factors due to grain test weight and hole size with orientation in the drum seeder.

Plant population m^{-2}

Data furnished in Table. 3 revealed that there was a significant difference between seed varieties in terms of slot modification, with the Oval slot fitted with guding pipe (OS - GP) having the lowest plant population m^{-2} (49.45), followed by the self metering slot (SMS) (52.00). In a round slot, the maximum plant population per m^{-2} is 59.85. (RS). In terms of variety, there was a significant influence. In terms of varieties, Short slender has a lower plant population m^{-2} (54.36) due to less seed drop.

Table 3: Effect of various slot modifications and their applicability to diverse seed shapes on plant population m^{-2} during *rabi* 2022

Plant population (m^{-2})						
	RS	**OS**	**RS-GP**	**OS-GP**	**SMS**	**Mean**
SS	59.60	58.00	52.60	49.60	52.00	54.36
MS	60.20	56.40	54.80	49.00	52.00	54.48
LS	59.60	58.20	53.70	49.60	52.00	54.62
SB	60.00	58.20	53.70	49.60	52.00	54.70
Mean	59.85	57.70	53.70	49.45	52.00	

Note: (i) Seed type: VGD 1 Short Slender (SS), ADT 45 Medium Slender (MS), MDU 6 Long Slender (LS), ASD 16 Short Bold
(ii) Slot modification: Round Slot (RS), Oval Slot (OS), Round Slot with guiding pipe (RS-GP), Oval Slot with guiding pipe (OS- GP), Self Metering Slot (SMS)

Summary and Conclusion

When comparing the different slot modifications in a drum seeder with varying seed shapes, the minimum flow rate and seed dispersion with an oval slot fitted with guiding pipe used with different seed shapes of rice varieties used in the experiment were noted. When compared to other slot modifications in the drum seeder, the round slot with VGD 1, ADT 45, MDU 6 and ASD 16 had the highest flow rate and seed dispersion. The minimum flow rate and seed dispersion were measured in an oval slot with a guiding pipe. Because of the different seed sizes among the varieties, there is a significant influence among them. The minimum flow rate, seed dispersion, seed rate, and plant population were recorded by MDU 6 and ASD 16. Similar findings given by Singh *et al*., (2016) [7].

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