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Influence of establishment methods, water and nutrient management practices on physiological traits and yield attributes of Wet-DSR and Transplanted rice

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ABSTRACT: Rice is a widely cultivated cereal crop that is traditionally grown in a flooded system under transplanted conditions due to its semi aquatic nature. Planting methods, water and nutrient management has a significant effect on growth and yield of crop. Crop growth rate was influenced by intercepted radiation and provide base for assimilation of photosynthates. However, water scarcity and rising labor costs prompt the search for alternative rice cultivation methods. Augmentation of crop growth and yield requires appropriate management practices. This document discusses the best alternatives discovered during the study conducted during *rabi* 2020-21 and 2021-22 at College Farm, PJTSAU. Hyderabad. The experiment is replicated thrice with establishment and water management methods, as main plots and nutrient management practices, in a strip plot design. Direct seeded rice with alternate wetting and drying (AWD) produced a higher yield (5530 kg ha^{-1}) and yield attributes. Crop growth rate, net assimilation rate, and photo synthetically active radiation were found to be higher in AWD-sown direct seeded rice. Among the nutrient management practices evaluated, poultry manure applied plot yielded higher yields and supported the improvement of physiological characteristics.

Keywords: Drum seeder, AWD, Poultry manure, CGR, NAR and PAR.

INTRODUCTION

Sustainable rice cultivation necessitates irrigation and nutrient resources reducing methods while maintaining (or improving) grain yields and nutritional quality. Food security in the world can be achieved by sustainable cultivation of staple crops like rice. Productivity of rice has been decreasing day by day due to various reasons like lack of proper establishment methods, nutrient supplements and water scarcity. Wet-seeded rice (WSR) has been proposed as an alternative rice production strategy because it reduces water consumption by 30% (Pepsico International, 2011) and labor requirements and increases system productivity and resource use efficiency (Tao *et al.*, 2016). Direct seeding of sprouted seeds in puddle soil (wet seeding) either manually or drum seeding method holds special significance in the present day production systems by saving time, labour and energy.

AWD irrigation (alternate wetting and drying) is a water-saving technique used in rice production (Hiya *et al.*, 2020). AWD improves yield, but mechanisms may include leaf angle changes that allow greater light penetration of the canopy thereby boosting photosynthesis (Price *et al.* 2013). AWD can be applied during grain filling to stimulate the remobilization of stem carbohydrates that can contribute up to 40% of grain mass accumulation (Yang and Zhang 2010). The frequency, duration, and level of water stress during non-submerged periods are most likely the most

important factors influencing yield (Mote *et al.,* 2022). Combined application of organic manures and inorganic fertilizers helps in providing all the necessary nutrients in available form which helps in improving growth and yield characters (Ramalakshmi *et al.,* 2012). Physiological parameters are indicators of increment of crop growth at various crop phenological stages (Theerthana *et al.,* 2021).

MATERIALS AND METHODS

A field experiment was conducted during *rabi* 2020-21 and 2021-22 at COA, R' nagar, Professor Jayashankar Telangana State Agricultural University with twenty treatments in sandy clay soils, laid out in strip plot design replicated thrice. The experimental soil is pH 7.91, EC 0.90 dSm^{-1}, low in organic carbon and available nitrogen (142 kg ha^{-1}), medium in available phosphorous (40 kg ha^{-1}) and high in available potassium (270 kg ha^{-1}). The variety chosen for experiment is Tellahamsa (10754). The treatments consists of four main plots and five nutrient management methods as submains *viz.*

Main plot: Establishment and water management practices

M_1: Normal Transplanting
M_2: Direct seeded rice with drum seeder
M_3: Normal Transplanting with alternate wetting and drying at depletion of 5 cm
M_4: Direct seeded rice with alternate wetting and drying at depletion of 5 cm.

Sub-mains: Nutrient management practices
N_1: 100% RDF
N_2: 75% RDN+25% N Biogas Slurry @ 2.5 t/ ha
N_3: 75% RDN+25% N *Azolla* Compost @1.8 t/ha
N_4: 75% RDN+25% N Vermicompost@ 3.1 t/ha
N_5: 75% RDN+ 25%N Poultry Manure @ 2.7 t/ha.

Recommended dose of P and K (60:40) was applied equally to all the plots as basal. Well decomposed organic manures which provide 25% of the recommended dose of nitrogen was incorporated in the soil 20 days before sowing and transplanting. Nitrogen is applied in splits *i.e,* 75% of the recommended dose of fertilizer was applied as 25% N each at basal, tillering and Panicle initiation stages. Under continuous flooding, the crop was submerged to a depth of 2-5 cm of water, depending on the crop's growth stage. Under AWD system Bowman pipes were placed in the plots between the rows to a depth of 15 cm below the soil surface. Irrigation was given at 5 cm depth if the water level in the tube falls below 5cm. Water level inside the tube was measured using a simple measuring scale. Water meter was used to measure the quantity of water and water was applied to the field using canvas pipe from the source.

Five rice plants were randomly selected and labelled in the net plot and all the biometric observations during the experiment were recorded from these plants. For destructive sampling plants from the boarder rows were taken.

RESULTS AND DISCUSSION

A. Physiological parameters

Crop Growth Rate (g m^{-2} d^{-1}). Direct seeded rice with AWD recorded higher CGR (19.77g m^{-2} d^{-1}) which was on par with normal transplanting with AWD (16.97 g m^{-2} d^{-1}) (Table 1). However, least growth rate was reported in normal transplanting. Crop growth rate during early stages was less compared to later stages is due to less leaf area which could not intercept the required PAR and hence less crop growth rate. Higher crop growth rate is usually upon rapid expansion of leaf area index to intercept available radiation in the growing season the result is partially in line with Kumar *et al.* (2016). AWD might have provided better aeration to soil and less competition between plants might have favored better root growth and photosynthesis. Theerthana *et al.* (2021).

All the treatments were on par with each other however Application of 75% RDN + 25% N Poultry Manure (19.92 g m^{-2} d^{-1}) recording higher CGR. However, least crop growth rate was reported in 100% RDF (14. 25g m^{-2} d^{-1}). The higher growth rate achieved by using poultry manure and NPK fertilizer treated plants associated with the positive effect of nitrogen, phosphorus and potassium.CGR was significantly influenced due integrated nutrient management. Comparatively high CGR was found in application of poultry manure at 2.5 t ha^{-1} along with recommended dose of nitrogen in clay soils of Bangladesh as reported by Paul *et al.* (2014). Similar results were reported by with Hasanuzzaman *et al.* (2010), Muthukumararaja and Sriramachandrasekharan (2020).

Net Assimilation Rate (g cm^{-2} d^{-1}). The pooled data presented in Table 1 reported that among the establishment methods direct seeded rice with AWD(0.0481 g cm^{-2} d^{-1}) was on par with transplanted rice with AWD (0.0471 g cm^{-2} d^{-1}), while least recorded in normal transplanting showing a significant effect of establishment and water management practices on NAR. Mansab *et al.* (2003) reported that for maximum crop growth, enough leaves must be present in the canopy to intercept most of the incident NAR. Increase in NAR is effected by a wide range of factors, including temperature, light, CO_2 content, water, leaf age, mineral nutrients, chlorophyll content, and genotype, influence net assimilation rate (Theerthana *et al.,* 2021). Numerically higher NAR was recorded in poultry manure along with 75% RDN (0.0489 g cm^{-2} d^{-1}), while 100% RDF (0.0429 g cm^{-2} d^{-1}) recorded the least NAR in pooled means.

Table 1: Effect of Establishment methods, water management and organic manures on Crop growth rate (g m^{-2} d^{-1}) (CGR), Net Assimilation Rate(g cm^{-2} d^{-1}) (NAR), Photosynthetically active radiation PAR (%), Total no of grains $panicle^{-1}$, No. of filled grains $panicle^{-1}$ and Length of panicle.

	CGR	NAR	PAR	Total no of grains $panicle^{-1}$	No. of filled grains $panicle^{-1}$	Length of panicle
Treatments						
Mains plots: Establishment methods and Irrigation management (M)						
M1: Normal Transplanting	14.57	0.0432	75.98	118.57	106.83	21.44
M2: Direct seeded rice with drum seeder	15.57	0.0457	78.92	122.82	107.92	21.75
M3: Normal Transplanting with alternate wetting and drying at depletion of 5 cm	16.97	0.0471	**81.20**	123.53	109.40	22.02
M4: Direct seeded rice with alternate wetting and drying at depletion of 5 cm.	**19.77**	**0.0481**	**84.98**	**126.37**	**112.21**	**22.07**
SE(m)±	0.28	0.0003	1.66	1.72	1.18	0.36
CD (p=0.05)	0.96	0.009	5.73	NS	NS	NS
Sub main plots: Organic manures (N)						
N1: 100% RDF	14.25	0.0429	75.79	120.70	106.71	20.83
N_2:75% RDN+25% N Biogas Slurry @ 2.5 t/ ha	15.75	0.0452	76.72	120.79	107.79	21.43
N_3:75% RDN+25% N *Azolla* Compost @1.8 t/ha	16.67	0.0457	79.57	123.18	108.47	21.86
N_4:75% RDN+25% N Vermicompost @ 3.1 t/ha	17.00	0.0476	**80.83**	123.71	109.65	21.94
N_5:75% RDN+ 25%N Poultry Manure @ 2.7 t/ha	**19.92**	**0.0489**	**88.43**	**125.73**	**112.83**	**23.04**
SE(m)±	0.37	0.0005	2.46	1.39	1.78	0.52
CD (p=0.05)	1.20	0.001	8.04	NS	NS	NS
Interaction						
M×N						
SE(m)±	0.91	0.0008	3.49	2.42	2.27	0.92
CD (p=0.05)	NS	NS	NS	NS	NS	NS
N×M						
SE(m)±	0.91	0.0009	3.86	2.15	2.59	0.97
CD (p=0.05)	NS	NS	NS	NS	NS	NS

The results are in line with Paul *et al.* (2014) who reported that the highest NAR was observed application of poultry manure at 2.5 t ha^{-1} along with 50% RDN which might be due to organic manures increased nutrient availability in soil which improve dmicrobial action and soil physical condition. This could have aided in increasing leaf area, resulting in higher photo assimilation according to Muthukumararaja and Sriramachandrasekharan (2020).

Photo synthetically active radiation (PAR) (%). There is a significant linear relationship between PAR and establishment and water management (Table 1). Direct seeded rice with AWD (84.98 %) reported significantly higher PAR which was comparable with normal transplanting with AWD at depletion of 5 cm (81.20 %). However, lowest PAR was recorded in normal transplanting (75.98%) during both the years of study and in pooled means. The efficiency of interception of PAR depends on the leaf area of the plant population as well as on the shape and inclination angle of the leaf or canopy.

Application of 75% RDN + 25% N through poultry manure (88.43 %) recorded significantly higher percent of PAR which was on par with vermicompost (80.83 %) and significantly superior over *Azolla* compost (79.57%) and biogas slurry (76.72%) and 100% RDF (75.79%) during the period of study. Nutrient management has a significant effect on PAR interception at all growth stages of crop. However, the interaction was non-significant.

B. Yield attributes and Yield

Total number of grains $panicle^{-1}$. Direct seeded rice with AWD recorded higher number of grains per panicle of 126.37 followed by normal transplanting with AWD(123.53) and direct seeded rice with drum seeder (122.82)while least number of grains per panicle were recorded under normal transplanting (118.57) (Table 1). The effect of establishment and water regimes on total number of grains per panicle was non-significant. This could be attributed to better root development in direct seeding of sprouted seed, which resulted in healthier panicles, longer panicles, and better assimilate translocation to the sink. The results are in line with Jat *et al.* (2022)and drum seeded rice has reported an increase of 20% in total number of grains over transplanting method as reported by Kumari and Sudheer (2015), Ravi Kumar *et al.* (2018).

Application of 75% RDN + 25% N through poultry manure (125.73) recorded higher total number of grains per panicle followed by 75% RDN + 25% N through vermicompost (123.71), 75% RDN+25% N through *Azolla* compost (123.81) and 75% RDN + 25% N through biogas slurry (120.79). Total number of grains

per panicle were lowest in 100% RDF. During both the years of study as well as in pooled means. Saha *et al.* (2013) higher number of grains panicle^{-1} (151.33) was obtained with the application of poultry manure @ 6 t ha^{-1} and it was the lowest (113.78) in control in clay soils of Bangladesh as and in shallow red brown soils of Dhaka by Hasanuzzaman *et al.* (2010) reported similar results.

Number of filled grains panicle^{-1}. The number of filled grains per panicle were not significantly influenced by establishment methods, irrigation regimes and nutrient management practices (Table 1) Among the main plots direct seeded rice with AWD recorded (112.21) highest number of filled grains followed by normal transplanting with AWD (109.40) and direct seeded rice with drum seeder while least number of grains were reported in normal transplanting (106.83). The same trend was observed for both the years and also in pooled means. Direct seeding by drum seeder has recorded highest number of filled grains panicle^{-1} over direct seeding by broadcasting method as reported by Lavanya and Reddy (2019) in clay soils of Hyderabad and in clay soils of Kerala by Muralidharan *et al.* (2015). Higher number of filled grains per panicles were reported in AWD (214.6) as reported by Narappa *et al.* (2020).

Lowest number of filled grains were reported in 100% RDF(106.71) while highest number of filled grains were reported in poultry manure (12.83) with inorganics applied treatment followed by 75% RDN + 25% N through vermicompost (109.65). The influence of nutrient management practices was non-significant on number filled grains per panicle. Nitrogen absorbed by rice during the vegetative growth stages contributes in growth during reproduction and grain-filling through translocation. According to Farid *et al.* (2011), the combined application of manures and fertilizers had a significant increasing effect on the number of filled grain panicle^{-1}.

Panicle length (cm). In establishment and irrigation regimes direct seeded rice with AWD (22.07 cm) reported lengthy panicles followed by normal transplanting with AWD(22.02 cm) and Direct seeded rice with drum seeder (21.75 cm) while panicles of short length were reported in normal transplanting (21.44)(Table 1). The effect of establishment and irrigation regimes on panicle length was non-significant. Improved growth parameters and translocation of more assimilates to the panicles might be the reason for the heavier panicles in direct seeding methods. Lavanya and Reddy (2019), Dange *et al.* (2014)

Application of 75% RDN+ 25% N through poultry manure reported lengthy panicle of 23.04 cm followed by 75% RDN + 25% N through vermicompost (21.94 cm), 75% RDN + 25% N through *Azolla* compost (21.86 cm) and 75% RDN + 25% N through biogas slurry (21.43 cm). Shorter panicles are recorded in 100% RDF (20.83). Farid *et al.* (2011) reported lengthy panicles of 25.41 cm was reported in 70% NPKS + poultry manure applied plot and lengthy panicles are might be due to application of organic manures and chemical fertilizers elevated the panicle length.

Panicle weight (g). During both the years of study and pooled means direct seeded rice with AWD reported higher panicle weight (2.85 g) among the establishment and irrigation regimes followed by normal transplanting with AWD (2.76 g) and direct seeded rice with drum seeder (Table 2). While least panicle weight was reported in normal transplanting (2.64 g). However, there is no significant effect of establishment and water management practices on panicle weight (cm). Narappa *et al.* (2020) reported 3.4 g of panicle weight in drum seeded rice as compared to transplanted rice.

75% RDN+ 25% N through vermicompost recorded higher panicle weight of 2.80 g followed by 75% RDN + 25% poultry manure (2.79 g), 75% RDN + 25% N *Azolla* compost (2.72 g) and 75% RDN + 25% N biogas slurry (2.73). Lesser panicle weight was observed in 100% RDF (2.69g). The heavier panicles in direct seeding methods may be due to improved growth parameters and the translocation of more assimilates to the panicles. Manjunatha *et al.* (2009) and Dange *et al.* (2014).

Grain yield (kg ha^{-1}). Persual of data (Table 2) on grain yield reported that Direct seeded rice with AWD at depletion of 5 cm recorded significantly higher grain yield of 5530 kg ha^{-1} over Normal transplanting(5086 kg ha^{-1}) while it was comparable with normal transplanted rice with AWD (5495 kg ha^{-1}) and direct seeded rice with drum seeder(5191 kg ha^{-1}). Among the nutrient management practices application of 75% RDN+ 25%N through poultry manure (5624 kg ha^{-1}) recorded significantly higher grain yield which was comparable with 75% RDN + 25% N through vermicompost (5380 kg ha^{-1}) and 75% RDN + 25% N through *azolla* compost (5377kg ha^{-1}). DSR with AWD was significantly superior to 75% RDN + 25% N through biogas slurry (5189kg ha^{-1}) and 100% RDF recorded least grain yields (5057 kg ha^{-1}). Higher grain yield under DSR was because of larger leaf are which resulted in higher photosynthesis and established better source to sink relationship, higher number of filled grains and lesser unfilled grains and lack of transplantation shock which helped the crop in early establishment. The results are in line with Gangaiah *et al.* (2019).

AWD might have attributed to better nutrient uptake along with root proliferation which encouraged the plants to take more nutrients and water and resulted in better grain and straw yield. Choudhary *et al.* (2021) and Pascual *et al.* 2016. Poultry manure is proved to be an efficient replacement inorganic fertilizers as it has provided a balanced nutrition compared to other organics. The results are in line with Iqbal *et al.* (2020).

Table 2: Effect of Establishment methods, water management and organic manures on Panicle weight(g) and Grain yield (kg ha^{-1}) during *rabi* 2020 and 2021.

Treatments		
	Panicle weight(g)	**Grain yield (kg ha^{-1})**
Vertical plots: Establishment methods and Irrigation management (M)		
M1: Normal Transplanting	2.64	5086
M2: Direct seeded rice with drum seeder	2.73	5191
M3: Normal Transplanting with alternate wetting and drying at depletion of 5 cm	2.76	5495
M4: Direct seeded rice with alternate wetting and drying at depletion of 5 cm.	2.85	5530
SEm+	0.06	99.23
CD at p-0.05	NS	343.39
Horizontal plots: Organic manures (N)		
N1: 100% RDF	2.69	5057
N_2:75% RDN+25% N Biogas Slurry @ 2.5 t/ ha	2.73	5189
N_3:75% RDN+25% N *Azolla* Compost @1.8 t/ha	2.72	5377
N_4:75% RDN+25% N Vermicompost @ 3.1 t/ha	2.80	5380
N_5:75% RDN+ 25%N Poultry Manure @ 2.7 t/ha	2.79	5624
SEm+	0.05	109.76
CD at p-0.05	NS	357.96
Interaction M×N		
SEm+	0.11	160.11
CD at p-0.05	NS	500.64
N×M		
SEm+	0.11	163.86
CD at p-0.05	NS	503.44

CONCLUSION

The results of the study showed that direct seeded rice with AWD has supported better crop growth, intercepted higher PAR due to maintaining optimum plant geometry, enhanced NAR, accumulated more photosynthates, improved all yield attributing characters, and reported a 9% increase in the yield over transplanted rice. Among the nutrient management practices, substitution of 25% RDN with poultry manure improved grain yield by 11.2% than 100% RDN.

FUTURE SCOPE

Further research into the quantification of greenhouse gases emitted by the use of organic manures, as well as regression or correlation studies, can aid in understanding the impact of each factor on grain yield.

REFERENCES

Iqbal, A., He, L., Ali, I., Ullah, S., Khan, A., Khan, A., Akhtar, K., Wei, S., Zhao, Q., Zhang, J, and Jiang, L. (2020). Manure combined with chemical fertilizer increases rice productivity by improving soil health, post-anthesis biomass yield, and nitrogen metabolism. *Plos one*, *15*(10).

Kumar, G.S., Kumar, R.M., Srinivas, A., Ramesh, T, and Jayasree, G. (2016). Performance of different methods of crop establishment in relation to nutrient management in rice-rice system. *Ph.D. Thesis. Professor Jayashankar Telangana State Agricultural University, R' Nagar, Hyderabad, Telangana*.

Kumari, R. C. and Sudheer, J. M. (2015). On-farm evaluation of paddy drum seeder (8 row) in farmers fields. *Advance Research Journal of Crop Improvement*, *6*(2): 139-143.

Lavanya, N, and Reddy, M.M. (2019). Yield attributes and quality parameters of rice under different establishment methods and varieties with nitrogen levels under late sown conditions in Telangana state. *Journal of Pharmacognosy and Phytochemistry*, *8*(3): 4185-4192.

Manjunatha, M.V., Reddy, M. B. G, and Joshi, V.R. (2009). Performance of rice (*Oryza sativa*) under different methods of establishment in Tungabhadra canal command, Karnataka. *Karnataka Journal of Agricultural Sciences*, *22*(5): 1151-1152.

Mote, K., Rao, V. P., Ramulu, V., Kumar, K, and Devi, M. U. (2022). Performance of rice (*Oryza sativa* L.) under AWD irrigation practice—A Brief review. *Paddy and Water Environment*, 1-21.

Muralidharan, P., Rajeev, M.S., Anand, R, and Nathan, A.R. (2015). Drum seeder is an effective mean for timely sowing of rice. *Journal of Tropical Agriculture*, *53*(1): 66-69.

Muthukumararaja, T, and Sriramachandrasekharan, M.V. (2020). Growth and productivity response of rice to applied zinc and organic manure. *Indian Journal of Agricultural Research*, *54*(2): 187-192.

Narappa, G., Mastanreddy, B.G, and Channabasavanna, A.S. (2020). Yield and yield parameters of transplanted rice genotypes under different irrigation regimes in TBP

area. *International Journal of Current and Microbiology Applied Science*, *9*(2): 510-514.

Pascual, V. J. and Wang, Y. M. (2016). Utilizing rainfall and alternate wetting and drying irrigation for high water productivity in irrigated lowland paddy rice in southern Taiwan. *Plant Production Science*, *20*: 24–35.

Paul, S. K., Islam, S. M. M., Sarkar, M. A. R., Alam, A, and Zaman, F. (2014). Physiological parameters of transplant aman rice (cv. BRRI dhan49) as influenced by weeding regime and integrated nutrient management. *Journal of Agroforestry and Environment*, *8*(2): 121-125.

Pepsico International. (2011). Direct seeding of paddy the work of pepsico reported in India water portal.

Price, A. H., Norton, G. J., Salt, D. E., Ebenhoeh, O., Meharg, A. A., Meharg, C., Islam, M. R., Sarma, R. N., Dasgupta, T., Ismail, A.M., McNally, K.L., Zhang, H., Dodd, I. C., and Davies, W. J. (2013). Alternate wetting and drying irrigation for rice in Bangladesh: is it sustainable and has plant breeding something to offer. *Food Energy Security*, *2*: 120–129.

Ramalakshmi, Ch. S., Rao, P. C., Sreelatha, T., Mahadevi, M., Padmaja, G., Rao, P. V, and Sireesha, A. (2012). Nitrogen use efficiency and production efficiency of rice under rice-pulse cropping system with integrated nutrient management. *Journal of Rice Research*, *5*(1&2): 42-51.

Ravi, A. K., Madhavi. M., Pratibha, G, and Ram Prakash, T. (2018). Impact of different crop establishment methods and weed management options on growth and yield of rice. *Green Farming*, *9*(6): 982-986.

Saha, R., Saieed, M. A. U, and Chowdhury, M. A. K. (2013). Growth and yield of rice (*Oryza sativa*) as influenced by humic acid and poultry manure. *Universal Journal of Plant Science*, *1*(3): 78-84.

Tao, Y., Chen, Q., Peng, S.B., Wang, W.Q., Nie, and L.X. (2016). Lower global warming potential and higher yield of wet direct-seeded rice in Central China. *Agronomy for Sustainable Development*, *36*: 1–9.

Theerthana, T., Fathima, P. S., Denesh, G. R., Prakash, S. S, and Asha, N. N. (2020). Influence of irrigation management practices and different establishment methods on nutrient use efficiency of rice. *International Journal of Current Microbiology and Applied Science*, *9*(11): 3213-3233.

Wang, Z., Gu, D., Beebout, S. S., Zhang, H., Liu, L., Yang, J, and Zhang, J. (2018). Effect of irrigation regime on grain yield, water productivity, and methane emissions in dry direct-seeded rice grown in raised beds with wheat straw incorporation. *The Crop Journal*, *6*(5): 495-508.

Yang, J, and Zhang, J. (2010). Crop management techniques to enhance harvest index in rice. *Journal of Experimental Botany*, *61*: 3177–3189.

Zhao, L., Wu, L., Li, Y., Animesh, S., Zhu, D, and Uphoff, N. (2010). Comparisons of yield, water use efficiency, and soil microbial biomass as affected by the system of rice intensification. *Communications in Soil Science and Plant Analysis*, *41*(1): 1-12.

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