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RESEARCH ARTICLE :

Effect of sturdy rice seedlings on the growth and yield of machine transplanted rice

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SUMMARY : Field experiments were conducted at Agricultural College and Research Institute, Killikulam, Tamil Nadu Agricultural University during Pishanam season of 2014-15 and 2015-16 to sustain the rice seedlings through different nutrient media and its influence on the growth and yield of machine transplanted rice. The experiments were laid out in Randomized Block Design (RBD) with three replications having ten treatments *viz.*, Three nutrient media such as 70 % soil + 20 % well decomposed FYM + 10 % rice hull+ *Azospirillum* @ 7 g/tray + DAP @ 7 g/tray, 70 % soil + 20 % well decomposed FYM + 10 % rice hull + DAP @ 7 g/tray +Vermicompost @ 100 g/tray + *Azophos* @14 g/tray, 70 % soil + 20 % well decomposed FYM + 10 % rice hull + DAP @ 7 g/tray + Vermicompost @ 100 g/tray + *Azophos* @14 g/tray + Cycocel @100 ppm as seed treatment coupled with different seed rate of 20, 15 and 10 kg/ha and it was compared with farmers practice of soil media using 20 kg/ha of seed rate. Rice variety ADT (R) 45 was used as test crop. Media with 70% soil + 20% well decomposed FYM + 10 % rice hull + DAP @ 7 g/tray + Vermicompost @ 100 g/tray + *Azophos* @ 14 g/tray with a seed rate of 20 kg/ha has produced the sturdy rice seedlings and produced the higher growth and yield of rice.

KEY WORDS :
Sturdy rice seedling, Growth, Yield of machine transplanted rice

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BACKGROUND AND OBJECTIVES

Rice is one of the most predominant crop and staple food for millions of people which is grown in many countries of the world and considered as the "Global grain". India ranks second in the production of rice; as it is grown in almost all the states in India. Total estimated area under rice in India is 42.75 m ha with a production of 105.24 mt and the average yield is 2,462 kg ha^{-1} (GOI, 2013). To meet the food demands of the growing population and to achieve food security in the country, the present production levels need to be increased by two million tonnes in every year. It is estimated that 120 million tonnes of rice is required to feed the growing population by 2020 (Viraktamath *et al.*, 2006).

In order to get higher yields, transplanting of healthy and vigorous seedlings is pre-requisite which produces uniform stand with higher yield than direct seeded rice. Rice seedlings can be transplanted either manually or mechanically. Manual transplanting is the most popular and effective means of rice cultivation in Tamil Nadu. However, it is laborious, time consuming and involve

drudgery, including shortage and high cost of labour during peak periods of agricultural operations. Under such situation, a less expensive and labour saving method of rice transplanting without reduction in grain yield is the need of the hour. The mechanical rice transplanting is an alternate and promising option, as it saves labour, ensures timely transplanting and also contributes to higher grain yield.

Success of machine transplanted rice cultivation depends upon the seedling and its characteristics. Such seedlings may be raised in the tray and it can be directly used to the rice transplanter. In general, soil alone is used as medium for the production of seedlings and it produces less vigorous seedlings and difficult to transplant due to less mat stiffness, poor strength, thin seedling and high number of damaged seedlings (Mamum *et al.*, 2013). It can be planted more number of seedlings per hill causing more seed rate and in-turn its cost. Production of healthy seedlings in each tray with special care is necessary for machine transplanting. Among the different components of nursery management, adequate nutrition, better seeding densities and transplanting seedlings at the appropriate age represent important factors to obtain vigorous stands after transplanting (Ahamed *et al.*, 2008).

RESOURCES AND METHODS

Field experiments were conducted at Agricultural College and Research Institute, Killikulam, Tamil Nadu Agricultural University during Pishanam 2014-15 and 2015-16 to produce sturdy seedlings and its effect on growth and yield of machine transplanted rice. The experiments were laid out in Randomized Block Design (RBD) with three replications having ten treatments *viz*., Three nutrient media such as 70 % soil + 20 % well decomposed FYM + 10 % rice hull+ *Azospirillum* @7 g/tray + DAP @ 7 g/tray, 70 % soil + 20 % well decomposed FYM + 10 % rice hull + DAP @ 7 g/tray +Vermicompost @ 100 g/tray + *Azophos* @14 g/tray, 70 % soil + 20 % well decomposed FYM + 10 % rice hull + DAP @ 7 g/tray + Vermicompost @ 100 g/tray + *Azophos* @14 g/tray + Cycocel @100 ppm as seed treatment coupled with different seed rate of 20, 15 and 10 kg/ha and it was compared with farmers practice of soil media using 20 kg/ha of seed rate. Rice variety ADT (R) 45 was used as test crop. In nursery, Seedling vigour index was worked out by using the formula of [(Root length + Shoot length) x (Germination percentage)]. In the main field, 17 days old seedlings were transplanted by using Korean model 4 row walk behind rice transplanter. The growth parameters like plant height, DMP and No. of tillers were recorded at active tillering, flowering and harvest stages. Yield attributes (No. of productive tillers, No. of filled grains per panicle, 1000 grain weight) and yield were recorded in the main field and presented.

OBSERVATIONS AND ANALYSIS

The results obtained from the present study as well as discussions have been summarized under following heads:

Effect of nutrient media and seed rate on rice seedling vigour index:

Media with 70 % soil + 20 % well decomposed FYM + 10 % rice hull + DAP @ 7 g/tray + Vermicompost @ 100 g/tray + *Azophos* @ 14 g/tray with a seed rate of 20 kg/ha recorded higher seedling vigour index (2758 and 2879) followed by Media with 70 % soil + 20 % well decomposed FYM + 10 % rice hull + + DAP @ 7 g/tray + Vermicompost @ 100 g/tray + *Azophos* @ 14 g/tray with a seed rate of 15 kg/ha (T_5). This might be due to addition of vermicompost and *Azophos* in nursery medium which improves the physical and chemical properties of the nursery medium and additionally supplies micronutrients. Similar findings are also reported by several workers (Sudhakar *et al.*, 2002; Tharmaraj *et al.*, 2011 and Kalra *et al.*, 2013). *Azophos* as the bacterial mixture of nitrogen fixing and phosphorus solubilising bacteria provided a more balanced nutrition supply to the plants and this was in accordance with earlier findings of Belimov *et al.* (1995) and further *Azospirillum* produced growth hormone and Phosphobacteria increased root biomass through phosphorus solubilisation, which gave better nutrition (Bharathi *et al.*, 2009).

Effect of nutrient media and seed rate on growth of rice:

Initial plant population m^{-2} after machine transplanting was increased when the seed rate increased from 10 kg ha^{-1} to 20 kg ha^{-1}. Media with 70 % soil + 20 % well decomposed FYM + 10 % rice hull + DAP @ 7 g/tray + Vermicompost @ 100 g/tray + *Azophos* @ 14 g/tray with a seed rate of 20 kg/ha also recorded higher

plant population of 16.8 and 16.9 hills/ m^2 for both the years of study. In higher seed rate, lesser number of missing hill was recorded due to uniformity and more availability of seedlings for picking and transplanting. This line of result was also documented earlier by Garg *et al.* (1982); Alizadeh *et al*. (2011) and Chaudhary and Varshney (2003). However, initial plant population under cycocel seed treated treatments (T_7 – T_9) registered lowest plant population due to production of less vigourous and weak with sparsely seedlings which might be due to germination related traits caused by cycocel.

Sturdy seedlings produced from the nursery medium of 70 % soil + 20 % FYM + 10 % rice hull + DAP @ 7 g/tray + vermicompost @ 100 g/tray + *Azophos* @ 14 g/tray with a seed rate of 20 kg ha^{-1} registered taller plants at all the growth stages of rice during both the years of study. Sridevi (2011) reported that enhancement in growth with increase the fertility in the nursery medium was owing to rapid conversion of synthesized photosynthates into protein to form more protoplasm, thus

Table 1: Effect of nutrient media and seed rate on seedling vigour index and growth of rice

Treatments	Seedling vigour index		Initial plant population m^{-2}		No. of tillers m^{-2}		Plant height (cm) 2014-15			Plant height (cm) 2015-16		
	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	Active tillering	Flowering	Harvest	Active tillering	Flowering	Harvest
T_1	2717	2819	15.1	14.0	309	328	56.66	92.13	106.60	57.00	92.00	106.5
T_2	2626	2592	13.8	11.6	292	305	55.60	90.93	104.33	53.30	91.10	106.3
T_3	2531	2560	11.6	10.7	287	294	53.26	89.40	102.33	52.70	89.55	104.0
T_4	2758	2879	16.8	16.9	322	341	57.13	93.20	111.00	58.50	92.10	110.4
T_5	2737	2842	14.3	12.4	316	330	57.13	92.33	108.93	57.60	91.28	108.2
T_6	2677	2588	12.8	12.3	305	324	56.33	90.20	105.53	54.50	90.10	106.2
T_7	1597	2097	11.9	9.4	272	284	49.33	85.70	97.66	49.20	87.70	95.2
T_8	1574	1929	11.5	9.3	272	280	49.00	84.86	96.46	46.60	86.20	93.5
T_9	1513	1702	10.5	9.1	264	273	46.46	84.40	95.80	45.30	85.00	92.1
T_{10}	2496	2380	12.7	10.5	279	291	50.40	88.86	101.66	52.50	88.20	104.1
S.E.±	-	-	0.45	0.41	16.38	17.46	1.77	2.87	4.40	1.98	2.77	4.69
C.D.(P=0.05)	-	-	0.97	0.91	34.42	37.80	3.88	6.17	9.26	4.35	6.08	10.23

Treatment T_1 – T_3 (Media M_1 with different seed rate of 20, 15 and 10kg/ha.) Treatment T_4 – T_6 (Media M_2 with different seed rate of 20, 15 and 10kg/ha.)
Treatment T_7 – T_9 (Media M_3 with different seed rate of 20, 15 and 10kg/ha.) Treatment T_{10} (Soil media alone with 20 kg /ha seed rate)

Table 2 : Effect of nutrient media and seed rate on rice DMP

Treatments	DMP (kg/ha.) 2014-15			DMP (kg/ha.) 2015-16		
	Active tillering	Flowering	Harvest	Active tillering	Flowering	Harvest
T_1	2677	7772	14766	2784	8587	15509
T_2	2388	7588	14083	2534	8076	14882
T_3	2344	7116	13238	2435	7454	13826
T_4	2777	7822	15338	2898	8656	16050
T_5	2599	7616	14799	2655	8343	15549
T_6	2413	7327	13805	2564	8008	14564
T_7	2311	7161	14155	2654	7908	12653
T_8	2288	6999	13594	2445	7009	11314
T_9	2233	6955	12827	2324	6374	11298
T_{10}	2333	7266	14694	1565	8760	14016
S.E.±	82.7	194.9	346.2	88.9	232.4	362.8
C.D.(P=0.05)	180.3	411.1	748.0	193.9	487.0	791.0

increasing the number and size of cell which might have increased the plant height.

Tillering capacity is the most important characteristic feature of rice, but their emergence and developments are greatly influenced by the factors such as nursery medium and seed rate. Media with 70 % soil + 20 % well decomposed FYM + 10 % rice hull + DAP @ 7 g/tray + Vermicompost @ 100 g/tray + *Azophos* @ 14 g/tray with a seed rate of 20 kg/ha recorded maximum tiller production of 322 and 341 per m^{-2} at active tillering stage during both the years, respectively. This is in line with Veeramani (2010). The minimum number of tillers produced under the cycocel treated seedlings due to weak rooting pattern, seedling vigour and seedling characteristics in the nursery.

Media with 70 % soil + 20 % well decomposed FYM + 10 % rice hull + DAP @ 7 g/tray + Vermicompost @ 100 g/tray + *Azophos* @ 14 g/tray with a seed rate of 20 kg/ha recorded higher drymatter production at all the growth stages during both the years of study. Dry matter production of rice in the main field was significantly increased due to planting sturdy seedlings which received vermicompost and *Azophos* in the nursery medium. Addition of vermicompost and *Azophos* in nursery medium effected good nursery growth as well as main field which increased leaf area, tiller numbers and in turn higher DMP. Growth retardant nature of cycocel caused lesser DMP when compared to all other treatments in all

Table 3 : Effect of nutrient media and seed rate on yield attributes of rice

Treatments	No. of productive tillers m^{-2}		No. of filled grains per panicle		Test grain weight (g)	
	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16
T_1	293	318	150	174	17.4	17.7
T_2	271	282	142	168	17.4	17.6
T_3	264	278	139	160	17.3	17.1
T_4	305	322	162	184	17.6	17.8
T_5	296	318	150	172	17.5	17.7
T_6	286	306	148	169	17.5	17.2
T_7	238	264	126	149	17.3	17.2
T_8	237	246	120	146	17.3	17.1
T_9	228	240	119	132	17.2	17.1
T_{10}	265	272	130	163	17.3	17.2
S.E.±	11.4	12.6	6.25	7.09	0.2	0.2
C.D.(P=0.05)	25.0	27.2	13.5	15.4	NS	NS

NS= Non-significant

Table 4: Effect of nutrient media and seed rate on yield of rice

Treatments	Grain yield (kg/ha)		Straw yield (kg/ha)	
	2014-15	2015-16	2014-15	2015-16
T_1	5935	6332	7122	7718
T_2	5770	6246	6924	7495
T3	4890	5608	5628	6617
T_4	6490	7056	7788	8467
T_5	6280	6802	7536	8162
T_6	5260	5815	6312	7097
T_7	4070	5010	4884	6012
T_8	3860	4560	4632	5472
T_9	3530	4067	4236	4758
T_{10}	5380	5938	6456	7125
S.E.±	207	212	243	300
C.D. (P=0.05)	449	463	556	658

the stages.

Effect of nutrient media and seed rate on yield attributes of rice:

Machine transplanting of sturdy seedlings which produced from the media with 70% soil + 20% well decomposed FYM + 10 % rice hull + DAP @ 7 g/tray + Vermicompost @ 100 g/tray + *Azophos* @ 14 g/tray with a seed rate of 20 kg/ha recorded more productive tillers/m^2 (305 and 322) and number of filled grains per panicles (162 and 184) for both the years of study. Combined use of organic manures with chemical fertilizers and bio-fertilizers improved soil physical properties in nursery, thus helping to form more photosynthates from source to sink thereby enhanced the crop growth and in turn increased the yield attributes of rice. This was also evidenced by studies of Sharma and Mittra (1998); Dubey and Verma (1999) and Kumar *et al*. (2010).

Effect of nutrient media and seed rate on yield of rice :

With regard to yield, media with 70% soil + 20% well decomposed FYM + 10 % rice hull + + DAP @ 7 g/tray + Vermicompost @ 100 g/tray + *Azophos* @ 14 g/tray with a seed rate of 20 kg/ha (T_4) and planted by machine transplanting recorded higher grain (6490 and 7056 kg/ha) and straw (7788 and 8467 kg/ha) yield of rice during both the years of study. It was at par with media with 70% soil + 20% well decomposed FYM + 10

Fig. 1: Media + Vermicompost + DAP + Azophos + 20 kg/ha seed rate

Fig. 2: Soil alone + 20kg / ha seed rate

Fig. 3: Media + Vermicompost + DAP +*Azophos* + *CCC* + 20kg seed

Fig. 4: Media + *Azospirillum* + DAP + 20 kg seed rat

% rice hull + + DAP @ 7 g/tray + Vermicompost @ 100 g/tray + *Azophos* @ 14 g/tray with a seed rate of 15 kg/ha. This was due to different components in nursery medium *viz*., supply of required nutrients through inorganic (DAP), organic (FYM, rice hull and vermicompost) and bio-fertilizer (*Azophos*) had facilitated balanced nutrients supply to the seedlings without any limitations and supported the crop growth in favourable way might had attributed to production of more grain and straw yield of the crop. Lowest grain and straw yields were recorded when the rice seedlings produced from media with cycocel treated seeds.

Conclusion :

From the studies it was concluded that, the higher growth and yield of machine transplanted rice has achieved by using sturdy seedlings produced from the nuirsery media with 70% soil + 20% well decomposed FYM + 10 % rice hull + DAP @ 7 g/tray + Vermicompost @ 100 g/tray + *Azophos* @ 14 g/tray with a seed rate of 20 kg/ha.

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