The Pharma Innovation Journal 2022; 11(2): 756-761

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(2): 756-761

www.thepharmajournal.com
Received: 03-11-2021
Accepted: 14-01-2022

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Improved nursery management enhances post flood survival, productivity and economics of rice (*Oryza sativa* L.) under flash flood condition

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Abstract
A field experiment was conducted at the Instructional Farm of the College of Agriculture, Chiplima, Sambalpur, Odisha during *kharif* seasons in the year 2020 where submergence tolerant rice (Cultivar *'Swarna sub 1'*) was taken as test crop to investigate the effect of nursery management on seedling vigour and post flood survival of rice (*Oryza sativa* L.) as well as to study its subsequent effect on yield and economics under submergence. Application of fertilizers and sowing of the pre germinated seeds were done as per the treatments. The Main field lay out was done as per the nursery lay out. A common Fertilizer dose of $N:P_2O_5:K_2O$ at 80:40:40 kg ha^{-1} was applied in the main field. Plants were completely submerged at 10 DAT with a water depth of 1.1 meter for a period of 15 days. From the experimental findings it revealed that application of $N:P_2O_5:K_2O$ at 100:40:40 kg ha^{-1} in the rice nursery produced the highest dry matter production $plant^{-1}$, seedling length and leaf area $seedling^{-1}$ at transplanting in nursery and was comparable with application of $N:P_2O_5:K_2O$ at 80:40:40 kg ha^{-1} (25 kg N ha^{-1} from FYM at 5 t ha^{-1}). The lower seeding density of 40 g m^{-2} and seedlings of 40 days old registered significantly higher dry matter production, seedling length and leaf area $seedling^{-1}$ in nursery than the higher seeding density of 60 g m^{-2} and seedlings of 30 days old respectively. The highest survival of plants after de submergence in the main field was recorded with application of $N:P_2O_5:K_2O$ at 80:40:40 kg ha^{-1} (25 kg N ha^{-1} from FYM at 5 t ha^{-1}) which was significantly higher than all other lower level of nutrients and higher than all treatments. The lower seeding density of 40 g m^{-2} and seedlings of 40 days registered significantly higher post flood survival% than the higher seeding density of 60 g m^{-2} and seedlings of 30 days old, respectively. Application of $N:P_2O_5:K_2O$ at 80:40:40 kg ha^{-1} (N_2) in the main plot treatment of rice nursery treatment also recorded higher grain yield & straw yield than all other nutrient treatments. The lower seeding density of 40 g m^{-2} (D_1) in the nursery and older seedlings of 40 days recorded significantly higher grain yield and straw yield than higher seeding density of 60 g m^{-2} (D_2) in the nursery and younger seedlings of 30 days, respectively. Such practices significantly increased the post flood survival of rice leading to record higher grain yield and return $rupees^{-1}$ invested of rice in flood prone low land condition.

Keywords: Rice, submergence, nursery management, nutrient management, age of seedling, seeding density

Introduction
Rice plays a vital role in India's agrarian economy as it is the source of livelihood for a millions of rural households as well as it plays an important role in food security of the nation. World's rice demand is projected to increase by 38% from the year 2001 to 2025-2030 which is to be produced to keep pace with population growth with less land, water, labor and chemical inputs (Khush, 1997) [9] as well as under different biotic and abiotic stresses. The rain-fed low land rice occupying a major portion of total rice area has a significant role in total rice production of India. However, rice grown in these areas is very often subjected to partial or complete submergence for a period of one to two week at different stages of growth leading to poor yield of rice. About 13 m ha of rice land prone to floods, partial to complete submergence every year are present in eastern India including Odisha (Ram *et al.*, 2009, Bishoyi *et al.*, 2017) [14, 4]. Odisha is one of the eastern states occupying 4.7% of total geographical area of country and about 10.2% of total rice area of the country. About 36% of the rice growing area in this state comes under the purview of rain-fed low lands, which suffer from frequent flash floods due to erratic behavior of the monsoon during *kharif* season causing drastic crop yield reduction. However, these flood prone ecosystems have enormous potential for higher food production to meet the ever increasing demands for rice supply because of predominance of good soils and freshwater resources (Ismail *et al.*, 2013) [8].

In west central table land zone of Odisha, the lowlands adjacent to river banks and natural drainage lines are subjected to partial to complete submergence for a period of 3 to 12 days at the time of heavy rainfall both in catchment and command area of the Hirakud dam, mostly in the month of August causing poor yield to complete damage of rice and heavy economic losses to the poor farmer of the region as well as the state. The average rice productivity of submergence prone areas in eastern India is 0.5 to 0.8 t ha^{-1}, whereas it is about 2.0 tha^{-1}in favorable rain-fed low lands, which is much lower than the input intensive irrigated system (Bhowmick *et al.,* 2014) [3]. The low productivity of rice in these areas is mainly due to the use of traditional long duration land races or old varieties and suboptimal agronomic practices in the nursery as well as in the main field, which adversely affects the post flood survival and subsequent stand establishment (Sarangi *et al*., 2015) [16]. The adverse effects of flooding on rice vary by genotypes and of particular importance is the carbohydrate status of the plant before and after submergence, the developmental stage at which flooding occurs, duration and depth of submergence and level of turbidity of flood water (Colmer and Pedersen, 2008) [5]. The availability of tolerant varieties provide more opportunity for developing and validating proper management options for flood prone condition which could further boost and stabilize the productivity of rice in the submergence prone ecosystem. Proper nursery management is helpful for raising healthy and vigorous seedlings. Apart from having a big impact on survival and recovery after flooding, healthy seedlings can also produce up to 40% more rice even if complete submergence takes place during the vegetative stage (Ella *et al*., 2010) [7]. Practices such as balanced nutrition, optimum seeding density in the nursery, proper seedling age and careful handling at transplanting have been reported to mitigate the adverse effects of floods and other abiotic stresses following transplanting. (Sarangi *et al*., 2015) [16]. Therefore present study was designed to develop the nursery management techniques such as proper nutrient management, seeding density in nursery and suitable age of seedling for transplanting for enhancing the post flood survival of rice seedling and maximizing the productivity of rice in submerged areas.

Materials and Methods

The field experiment was conducted at the Instructional Farm of the College of Agriculture, Chiplima, Sambalpur, Odisha in the year 2020 in *kharif* season where submergence tolerant rice (Cultivar *'Swarna sub 1'*) was taken as test crop. The area is situated in the eastern part of the country which falls under the sub-humid climatic condition and it belongs to the West central table land Agro climatic Zone of Odisha. The experimental site falls under the sub-humid subtropical region with average annual rainfall of 1400 mm, concentrated mostly in the months of June to October. The experimental plot situated at an altitude of 155 m above mean sea level and is intersected by 20º21' N latitude and 80º85' E longitude. The soil at the experimental site is loamy sand. The soil pH of the experimental plot is 6.7. The bulk density and particle density of the soil were 1.55 and 2.44 g cm^{-3}, respectively. The organic carbon (%), available nitrogen (kg ha^{-1}), phosphorus (kg ha^{-1}) and potassium (kg ha^{-1}) status were 0.60, 382, 19.7 and 175.6, respectively. The experiment was laid out in split-plot design with three replications having sixteen treatment combinations. The treatments consist of four nutrient management *viz.* Farmers' practice - 25 kg N ha^{-1} with no P_2O_5 and K_2O (N_1); Recommended fertilizer dose- $N:P_2O_5:K_2O$ at 80:40:40 kg ha^{-1} (N_2); 75% of recommended dose of nitrogen - $N:P_2O_5:K_2O$ at 60:40:40 kg ha^{-1} (N_3) and 125% of recommended N - $N:P_2O_5:K_2O$ at 100:40:40 kg ha^{-1} (N_4) were assigned in the main plot. In each treatment 25 kg N through 5 t ha^{-1} of FYM was applied including in the farmers' practice and remaining N along with full P and K were applied through chemical fertilizer. The combinations of seeding density in nursery and age of seedling at transplanting each at two levels were allotted in sub plots. Four sub plot treatments were the combinations of 40 g m^{-2} seeding density (D_1); 60 g m^{-2} seeding density (D_2); transplanting of 30 days old seedling (T_1) and transplanting of 40 days old seedling (T_2). Seedlings were raised with staggered wet bed nursery with 10 days interval and transplanted on the same day. Application of fertilizers and sowing of the pre germinated seeds were done as per the treatments. The Main field lay out was done as per the nursery lay out. Two seedlings per hill at a spacing of 20 cm × 15 cm were transplanted. Ten extra rows of '*Swarna'* variety was planted on one side of the experimental plot as sensitive check to determine the time of de-submergence. A common Fertilizer dose of $N:P_2O_5:K_2O$ at 80:40:40 kg $ha^{-1}$was applied in the main field. All P & K as basal and N in four equal split *i.e*. at basal, 7 days after de-submergence, maximum tillering stage and PI stage were applied in the experimental plot. Gap filling was done to ensure 100% plant population before submergence. Plants were completely submerged at 10 DAT with a water depth of 1.1 meter for a period of 15 days.

The biometric observation on seedling characters like seedling height, dry matter accumulation and leaf area of seedling were taken. The post survival% was recorded at seven days after de- submergence. The observations on grain and straw yield were taken. Economics of rice production in different treatments under submergence condition was also calculated. Data were subjected to analysis of variance (ANOVA) using MS-Excel worksheet.

Results and Discussion

Dry matter of seedling at transplanting

Application of nitrogen at 100 kg ha^{-1} (N_4) in rice nursery registered significantly higher dry matter accumulation $seedling^{-1}$ at transplanting than all other main plot treatments except the treatment receiving the recommended dose of nutrient (80 kg ha^{-1}), this treatment was statistically at par with the treatment receiving 100 kg nitrogen ha^{-1} in this years. Application of higher dose of nitrogen in the nursery increased the nitrogen availability and uptake by the seedlings which in turn increased the production of photosynthates and also the dry matter accumulation. Panda *et al.* (1991) [12] also indicated the higher dry matter accumulation with application of 100 kg N ha^{-1} in the nursery as compared to other lower levels of nitrogen.

Seedlings raised with lower seeding density (40 g m^{-2}) in nursery produced significantly higher dry matter of seedlings at transplanting as compared to higher seeding density (60 g m^{-2}). This was mainly because of less plant population in lower seeding density as compared to higher seeding density. The limited plants with same level of growth factors i.e. nutrient, space and light utilized the available resources and promoted vigorous and speedy growth of seedlings leading to more dry matter accumulation. This result was in congruity with findings of Naem *et al.* (2010).

The older seedlings (40 days old) recorded significantly higher dry matter than that of younger (30 days) seedlings. This was simply because of earlier sowing and spending more time in nursery by the older seedlings. Similar results were also reported by Pervin *et al.* (2010) [13].

Seedling height at transplanting

The data on seedling height of rice presented in Table 1 revealed that the seedling height of rice varied significantly with nutrient management. The seedling height increased with increase in nitrogen levels up to 100 kg N ha^{-1}. However, the treatment receiving 80 kg N ha^{-1}(N_2) was second in order and was at par with 100 kg N ha^{-1} (N_4) at transplanting.

Lower seeding density of 40 g m^{-2} (D_1) in the nursery was capable of producing significantly higher seedling height than that of higher seeding density of 60 g m^{-2} (D_2) at transplanting. Lower seeding density in nursery provided more space to the rice seedlings, leading to less intra species competition for light, water and nutrients and supplying more quantity of growth factors leading to more seedling height. This was in accordance with the findings of Naem et al. (2010).

The seedlings of 40 days old (T_2) produced significantly higher seedling height than that of seedlings of 30 days old (T_1) in the nursery at transplanting.

Table 1: Dry matter production, Seedling height and leaf area of seedling at transplanting as influenced by nursery management

Treatments	Dry matter accumulation (g $plant^{-1}$)	Seedling height (cm)	Leaf area (cm^2 $seedling^{-1}$)
Nutrient Management (N)			
N_1	0.781	26.7	18.9
N_2	1.107	28.8	23.0
N_3	0.907	28.0	20.2
N_4	1.157	30.1	23.4
S.Em (±)	0.031	0.61	0.78
CD (P=0.05)	0.108	2.10	2.71
CV (%)	11.0	7.40	12.69
Seeding density (D)			
D_1	1.040	29.0	22.4
D_2	0.936	27.8	20.3
S.Em (±)	0.015	0.39	0.33
CD (P=0.05)	0.045	1.13	0.95
CV (%)	7.7	6.66	7.48
Age of seedling at transplanting (T)			
T_1	0.850	27.5	20.6
T_2	1.126	29.3	22.2
S.Em (±)	0.015	0.39	0.33
CD (P=0.05)	0.045	1.13	0.95
CV (%)	7.7	6.66	7.48

N_1: Farmer's practice - 25 kg N ha^{-1} with no P_2O_5 and K_2O

N_2: Recommended dose of nitrogen with 40 kg each of P_2O_5 and K_2O - $N:P_2O_5:K_2O$ at 80:40:40 kg ha^{-1}

N_3: 75% of recommended nitrogen with 40 kg each of P_2O_5 and K_2O - $N:P_2O_5:K_2O$ at 60:40:40 kg ha^{-1}

N_4: 125% of recommended nitrogen with 40 kg each of P_2O_5 and K_2O - $N:P_2O_5:K_2O$ at 100:40:40 kg ha^{-1}

(In each treatment 25 kg N was applied through 5 t ha^{-1} of FYM including in the farmers' practice)

D_1: 40 g m^{-2} seeding density in nursery

D_2: 60 g m^{-2} seeding density in nursery

T_1: Age of seedling at transplanting (30 days),

T_2: Age of seedling at transplanting (40 days)

Leaf area of seedling at transplanting

Application of 100 kg N ha^{-1} in the nursery recorded the highest leaf area (Table 1), which was at par with 80 kg N ha^{-1} and significantly higher than all other treatments. The beneficial effect of higher doses of nitrogen in recording higher leaf area could be attributed to the greater availability of N, thereby inducing production of more soft tissues of leaves leading to their elongation (Mengel and Kirkby, 1978). As the level of N supply increased, the extra protein produced presumably enlarged the leaves, which prevailed larger area for photosynthesis and increased the leaf area. This corroborated the findings of Sarangi *et al.* (2015) [16].

Lower seeding density in the nursery (40 g m^{-2}) and older seedlings (40 days old) recorded significantly higher leaf area $seedling^{-1}$ at transplanting than that of higher seeding density (60 g m^{-2}) and younger seedlings (30 days old), respectively.

Post flood survival: Nutrient management in the nursery had considerable influence on post flood survival of rice (Table 2). Farmers' practice (5 t ha^{-1}FYM) recorded significantly lower survival than that of the treatments receiving nitrogen at different levels (N_2, N_3 and N_4) during post flood period. This might be due to production of weaker seedlings due to imbalanced fertilization. However, application of balanced fertilizer in the form of 40 kg P_2O_5 and 40 kg K_2O ha^{-1} along with different levels of nitrogen, where 25 kg of recommended N was applied from 5 t ha^{-1} FYM registered higher survival rate as compared to 5 t ha^{-1} alone after 15 days of submergence. This was because of combined application of balanced chemical fertilizers along with FYM supplied the nutrient to the rice seedlings in a balanced and sustained manner which increased seedling vigour in the form of dry matter, seedling height and leaf area at transplanting (Table

1). These robust seedlings were capable of sustaining the ravages of flood due to more carbohydrate content at the time of flooding and also having quick regeneration ability as explained by Sarkar (1997) [17] and Bhowmick *et al*. (2014) [3]. During the year of study the treatment received 80 kg N ha^{-1} was also recorded highest survival rate, which was at par with the treatment received 100 kg N ha^{-1}. It was interesting to note that the survival% decreased both at lower level of nitrogen i.e. 60 kg ha^{-1} (N_3) and at higher level of nitrogen i.e. at 100 kg ha^{-1} (N_4). Seedlings fertilized with 100 kg N ha^{-1} recorded lower survival rate as compared to 80 kg N ha^{-1} might be due to application of excess nitrogen beyond 80 kg N ha^{-1} increased the nitrogen content in plant tissue rather than carbohydrate content, which made the plant susceptible to flooding as explained by Ella and Ismail (2006) [6]. Similar findings were also reported by Ravi Kumar *et al*. (2012) [15] and Bhowmick *et al*. (2014) [3].

In the sub plots, the lower seeding density (D_1) and older seedlings (T_2) registered significantly higher survival percent than the higher seedling density (D_2) and younger seedlings (T_1), respectively. The beneficial effect of lower seeding density was due to production of healthy and robust seedlings owing to availability of wider space and greater accessibility to the growth factors. Similarly, the older plants having more mature tissue and sachharides content survived under submergence avoiding the damage from flood (Ram *et al*., 2009) [14].

Table 2: Effect of nutrient management, seeding density in nursery and age of seedling on post flood survival of rice

Treatments	Post flood survival
Nutrient Management (N)	
N_1	9.10 (82.5)
N_2	9.724 (94.1)
N_3	9.472 (89.2)
N_4	9.605 (91.8)
S.Em (±)	0.056
CD (P=0.05)	0.195
CV (%)	2.06
Seeding density (D)	
D_1	9.555 (90.9)
D_2	9.398 (87.9)
S.Em (±)	0.029
CD (P=0.05)	0.086
CV (%)	1.51
Age of seedling at transplanting (T)	
T_1	9.392 (87.8)
T_2	9.561 (91.0)
S.Em (±)	0.029
CD (P=0.05)	0.086
CV (%)	1.51

* Figures in the parentheses are the original values (X). The data transformed to SQRT(X + 0.5)

N_1: Farmer's practice - 25 kg N ha^{-1} with no P_2O_5 and K_2O

N_2: Recommended dose of nitrogen with 40 kg each of P_2O_5 and K_2O -N:P_2O_5:K_2O at 80:40:40 kg ha^{-1}

N_3: 75% of recommended nitrogen with 40 kg each of P_2O_5 and K_2O - N:P_2O_5:K_2O at 60:40:40 kg ha^{-1}

N_4: 125% of recommended nitrogen with 40 kg each of P_2O_5 and K_2O - N:P_2O_5:K_2O at 100:40:40 kg ha^{-1}

(In each treatment 25 kg N was applied through 5 t ha^{-1} of FYM including in the farmers' practice)

D_1: 40 g m^{-2} seeding density in nursery, D_2: 60 g m^{-2} seeding density in nursery

T_1: Age of seedling at transplanting (30 days), T_2: Age of seedling at transplanting (40 days)

Grain yield

The data on grain yield of rice presented in Table 3 expressed that it varied significantly among the different main plot treatments. The main plot treatment which received 80:40:40::N:P_2O_5:K_2O kg ha^{-1} (N_2) registered the highest grain yield, which was significantly higher than that of farmers' practice of 25 kg N through FYM at 5 t ha^{-1} (N_1) and the treatments of 60:40:40::N:P_2O_5:K_2O kg ha^{-1}(N_3) and was at par with 100:40:40::N:P_2O_5:K_2O kg ha^{-1}(N_4). These seedlings having higher vigour, established faster after transplanting and showed higher survival rate during post submergence period as evident from Table 2. The treatment receiving 80 kg N ha^{-1} in (N_2) in the nursery recorded the highest survival even higher than application of 100 kg nitrogen ha^{-1} (N_4). This was mainly due to higher N content of leaves with higher dose of nitrogen beyond a certain limit (80 kg N ha^{-1}). This was inconformity with the findings of Ella and Ismail (2006) [6] who explained that high N content of leaves at the time of transplanting reduced survival rate and recovery. The treatment N_2 having higher survival rate produced more number of tillers per unit area and also recorded the highest number of panicles m^{-2} which was an important criteria determining the grain yield of rice. Seedlings raised with balanced fertilization in nursery might have showed better growth trends during post submergence period and also higher dry matter accumulation during pre-anthesis period. The rice plants which recorded higher values of growth attributes during pre-anthesis period also promoted the production of higher grain yield. Similar observations were reported by several workers (Adhikar et al. 2013 and Bhowmick *et al*., 2014) [1, 3].

Among the sub plot treatments the seeding density in the nursery did not have significant effect on grain yield of rice. However, seedlings raised with seeding density of 40 g m^{-2}(D_1) in the nursery, when transplanted produced higher grain yield than that of higher seeding density of 60 g^{-2} (D_2) under submerged condition. Lower seeding density of 40 g m^{-2}(D_1) was found to be better in recording higher grain yield of rice as compared to higher seeding density of 60 g m^{-2} (D_2) in the nursery. This is because seedlings grown with wider spacing were healthier and more vigorous and capable of higher post flood survival as well as higher growth and yield parameters resulting in production of higher grain yield as compared to higher seeding density. This was in accordance with the findings of and Adhikari *et al*. (2013) [1].

Older seedlings had a highly significant and positive effect on grain yield. The older seedlings increased grain yield by 4.3% in the experiment year. These results were in agreement with (Bhagat *et al*., 1991) [2] who found that 40 days old seedlings produced higher grain yield as compared to 30, 50 and 60 days old seedlings. It must be noted in the present experiment that the sowing of seeds for older seedlings was done 10 days ahead (but transplanted at the same time as young seedlings) availing more favourable environment for growth and produced more vigorous seedlings. These seedlings also registered higher post flood survival rate leading to production of more number of tillers and panicles per unit area and ultimately the grain yield of rice. Similar opinions were put forward by Mustari *et al*. (2013) [11] and Sumon *et al*. (2013) [20].

Straw yield

It was observed that the straw yield of rice varied significantly among the main plot treatments in the nursery during this study. Application of 80:40:40::N:P_2O_5:K_2O kg ha^{-1} (N_2) in the nursery produced significantly higher straw yield than that of all other treatments except the treatments receiving 100:40:40::N:P_2O_5:K_2O kg ha^{-1} (N_4) in this study. This treatment (N_2) also produced the highest straw yield and was statistical at par with the treatments receiving 100:40:40::N:P_2O_5:K_2O kg ha^{-1} (N_4) in this study.

With regards to seeding density and age of seedlings both showed significant influence on straw yield of rice. Lower seeding density (40 g m^{-2}) produced 4.14% higher straw yield as compared to higher seeding density (60 g m^{-2}). Similarly the older seedlings produced 4.59% higher straw yield as compared to that of younger seedlings (30 days). Similar findings have also been reported by Singh *et al*. (2014) [18] and Sarangi *et al*. (2015) [16].

Return rupees^{-1} invested

It was indicated that among the nutrient management treatments, application of 80:40:40::N:P_2O_5:K_2O kg ha^{-1} (N_2) in the nursery recorded the highest value of return rupees^{-1} invested ratio followed by the treatment receiving 100:40:40::N:P_2O_5:K_2O kg ha^{-1} (N_4). Farmers' practice of 25 kg N through FYM at 5 t ha^{-1} (N_1) recorded the lowest value. Which was linked with the higher grain and straw yield and comparatively lower cost of production. Similar monetary benefit was also reported by Singh *et al*. (2005) [19] and Sarangi *et al*. (2015) [16].

Among the sub plot treatments, the lower seeding density of 40 g m^{-2} (D_1) in nursery and transplanting of seedlings of 40 days (T_2) recorded higher return rupees^{-1} invested than that of higher seeding density of 60 g m^{-2}(D_2) and seedlings of 30 days (T_1).

Table 3: Yield and economics of rice as influenced by nursery management

Treatments	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Return rupees^{-1} invested
Nutrient Management (N)			
N_1	3.38	4.29	1.32
N_2	4.05	4.96	1.57
N_3	3.81	4.65	1.47
N_4	3.92	4.78	1.52
S.Em (±)	0.06	0.08	-
CD (P=0.05)	0.22	0.29	-
CV (%)	11.93	9.06	-
Seeding density (D)			
D_1	3.87	4.77	1.49
D_2	3.72	4.58	1.45
S.Em (±)	0.05	0.06	-
CD (P=0.05)	NS	0.17	-
CV (%)	6.69	6.17	-
Age of seedling at transplanting (T)			
T_1	3.71	4.57	1.44
T_2	3.87	4.78	1.51
S.Em (±)	0.05	0.06	-
CD (P=0.05)	0.15	0.17	-
CV (%)	6.69	6.17	-

N_1: Farmer's practice - 25 kg N ha^{-1} with no P_2O_5 and K_2O
N_2: Recommended dose of nitrogen with 40 kg each of P_2O_5 and K_2O -N:P_2O_5:K_2O at 80:40:40 kg ha^{-1}
N_3: 75% of recommended nitrogen with 40 kg each of P_2O_5 and K_2O - N:P_2O_5:K_2O at 60:40:40 kg ha^{-1}
N_4: 125% of recommended nitrogen with 40 kg each of P_2O_5 and K_2O - N:P_2O_5:K_2O at 100:40:40 kg ha^{-1}
D_1: 40 g m^{-2} seeding density in nursery, D_2: 60 g m^{-2} seeding density in nursery
T_1: Age of seedling at transplanting (30 days), T_2: Age of seedling at transplanting (40 days)

Conclusion

Application of N:P_2O_5:K_2O at 80:40:40 kg ha^{-1} where 25 kg N applied through FYM @ 5 t ha^{-1}, seeding density of 40 g m^{-2} in the nursery and transplanting of 40 days old seedlings resulted comparable growth parameters of seedling at transplanting. Such practices significantly increased the post flood survival of rice leading to record significantly higher grain and straw yield and return rupees^{-1} invested of rice in flood prone low land condition. These practices can effectively be implemented in other states of India as well as in the regions having similar ecologies

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