EFFECT OF NURSERY NUTRIENTS MANAGEMENT PRACTICES ON GROWTH AND YIELD OF SAMBHA MAHASURI RICE (*ORYZA SATAIVA L.*) UNDER FLOOD PRONE ECOSYSTEM

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Abstract: Present investigation was carried out to study the "Effect of nursery nutrients management practices on growth and yield of sambha mahasuri rice (*oryza sataiva* L.) under flood prone ecosystem" during wet season, 2013-14 and 2014-15. Experiment was laid out in randomized block design with three replication and one variety Sambha Mahsuri *sub1* in cemented pond (size; 21x17.50 m x1.25 m). Twenty five days old seedlings were transplanted in ponds. Recommended dose of nursery N, P, K& silicate @ 40:40:40 +120, 50 ppm Kg ha^{-1} was applied at 10 DAS. Main field accompined with nursery reframed with time schedule as ($T_3 N_2$) N 30 Kg ha^{-1} with combination of P and K @ 60, 50 Kg ha^{-1} applied as basal before transplanting followed by ($T_7 N_4$) N 30Kg ha^{-1} as top dressing at 5th day after de-submergence and P full dose before transplanting and K 20 kg ha^{-1} at 5th days de-submergence one week before flowering respectively (30Kg N ha^{-1} at each days), ($T_3 N_2$), N 30 Kg ha^{-1} with 40 Kg ha^{-1} P and K as basal application @ N 30 Kg ha^{-1} at 5th , 20th days after de-submergence and one week before flowering and with 40Kg ha^{-1} P and K as basal further recommended dose of N applied during post flood @ 60, 30 and N 30 Kg ha^{-1} at subsequently at 5th, 20th days after de-submergence and one week before flowering as foliar respectively. fifthteen (15) days complete submergence treatment was given after 20 days transplanting. Results indicated that before submergence lower dose of N @ (30 Kg ha^{-1}) and potassium (1/2) 25, 20 kg ha^{-1} at 5th days after de-submergence significantly increased the maximum plant survival ,plant height, dry weight, ear bearing shoot m^{-2} panicle length number of grain per panicle, test wt. in samba mahsuri *sub1* rice variety at par with $T_7 N_4$ in which N was applied in foure split doses (N 30 Kg ha^{-1}) as basal top dressing was higher in comparison $T_4 N_2$ $T_5 N_2$ $T_6 N_4$, $T_2 N_2$ and $T_1 N_1$ 5th days after de-submergence corresponded N 30 Kg ha^{-1} applied as basal at transplanting, mean while, plant mortality at recovery was higher (6.68 to 5.58%) in comparison to $T_7 N_4$ (6.32 to 5.92%). Although maximum plant mortality (6.68 to 5.58%) was recorded with N 30 Kg ha^{-1} applied as basal. Moreover, lower dose of N 30 Kg ha^{-1} applied with P and K @ 50, 40 Kg ha^{-1} as basal at transplanting and rest N applied in three split doses (30Kg ha^{-1} each split) with time frame *i.e.* bfore 5th days 20th days and booting and panicle emergence after de-submergence and one week before flowering significantly improved survival and yield (Kg/plot) of samba mahsuri *sub1* rice variety. Above package and practice might be recommended for farmer practice after further validation.

Keywords: Nursery nutrient management, Plant height, Dry biomass, Panicle length

INTRODUCTION

Rice (*Oryza sativa* L., 2n= 24), belongs to the family Poaceae. Rice is the most important food crop of the developing world and is the staple food of more than half of the world's population. It is especially important crop of Asia, where more than 90% of world rice is grown and consume. Rice farming is about 10,000 year old and largest single use of land for producing food. Rice fields covers 11% of Earth's entire arable land. Two rice species are important cereals for human nutrition *i.e.* *Oryza sativa* grown worldwide and *Oryza glaberrima* grown in parts of West Africa. Growth duration of rice crop ranging from 70 to 160 days exist in diverse environments. Flooding affects about 20 million ha in Asia each year and estimates indicate that submergence stress in rice causes corresponding annual losses of US$ 650 million to US$ 1 billion (Herdt, 1991; Dey and Upadhyaya, 1996). In India, about 16.1 million ha of rainfed lowland rice are

grown each year, of which 4.4 million hacter are highly submergence-prone (intermediate rainfed lowlands; Haefele and Hijmans, 2007). In addition, submergence might also occur in shallow rainfed lowlands and irrigated lowlands. Recent research has identified the *SUB1* gene as the main gene controlling submergence tolerance in rice. The cloning of the gene underlying Rice in India was found area 37.48 million ha and production 88 million tons during 2014-15. Nutrient management in the nursery-submergence greatly affects N, P availability and assimilation, which can influence submergence responses and which have been implicated in difference tolerance between cultivars. Submergence rapidly depletes the protein reserves of the plants through hydrolysis to amino acids and other soluble N-containing compound. Useful nursery management options are particularly attractive to farmers since they need to apply them only on the small area occupied by the seed bed. Effective management strategies that can be applied

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at the nursery level include proper nutrient management, the use of organic manures, the use of a lower seeding density, proper water management, and transplanting of older seedlings when flooding is anticipated early after transplanting. Excess nutrient applications (especially N and Si) should be avoided because this results in vigorous growth and loss of stored carbohydrate reserves needed for survival during submergence. Higher soil fertility was also associated with enhanced shoot elongation and faster chlorophyll degradation during submergence (Ella and Ismail, 2006. Ella et al., 2011). Silicon (Si) is the second most abundant element both on the surface of the Earth's crust and in the soils. Although silicon has not been considered to be an essential element for higher plants, yet its beneficial effects have been demonstrated for many plants, especially when they are subjected to biotic or abiotic stresses (Ma and Yamaji, 2006; Sivanesan et al., 2011). Slag silicate fertilizer is applied to paddy fields in Japan to enhance rice Si uptake. However, the effect of slag silicate fertilizer on Si supplies in to soil solution various among different types of paddy soil. A part of the adsorbed Si in the soil solid phase can then be adsorbed and re-dissolved in to soil solution. However, the Si adsorption capacity differs between paddy soils and is associated with amount of active aluminum (Al), iron (Fe) and manganese (Mn), hydroxides, which function as Si absorbents the dissolution of Si from a SSF into aqueous solution decreases with increasing pH and calcium concentration in the solution. Therefore the effects of SSF on Si apply into the soil solution may vary with the chemical properties of the soil. Silicon is an important micronutrient for healthy and competitive growth of all cereals including rice in Asia (Bruing et al., 2009).

MATERIALS AND METHODS

The present investigation was carried out in *Kharif* season, during 2013-2014 to 2014-2015 at the Instructional Farm, Department of Crop Physiology, Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (U.P.) India This site lies in the Gangetic alluvium of eastern UP, situated at latitude 26°47' North and longitude 82°12' East and at an altitude of 113 m above sea level. This is in a semi-arid zone receiving a mean annual rainfall of above 1,100 mm, of which about 80% is precipitated during the monsoon season (July to end of September) with the remainder falling mainly as showers in winter. The pooled nursery physicochemical soil test results of the experimental site in 2013-14 and 2014-15 were as follows: sand 35.20%, silt 48.60%, clay 16.20%, field capacity 39.60%, bulk density 1.3 g cm^{-2}, pH 7.6, EC 0.2 dSm^{-1}, organic carbon 0.3%, available N 57 ppm, available HAEFELE 7 ppm ($NaHCO_3$ pH 8.5) and available K 218 ppm. Nitrogen, phosphorus (P) and

K content were estimated and calculated according to the methods given by Subbiah and Asiza (1956), Jackson (1969), and Olsen method.

Main field experiment (in side pond)
The 25-day old seedlings were transplanted into a newly constructed submergence pond covered with plastic sheets (size: 20x17x1.5 m^3) at NDUAT' Crop Physiology research field and were retained there until the end of experiment. FYM (cow dung) was applied at 6 t ha^{-1} one week before transplanting. N-P_2O_5-K_2O 120-40-40 kg ha^{-1} was applied in the side pond. The P and K was applied as a basal dressing whereas N was applied in three split doses: the first in the form of a top-dressing of N 40 kg ha^{-1} five days after de-submergence, and 20th days de-submergence the second and third top-dressings of N 20 kg ha^{-1} were made at 60 and 90 days after transplanting. The seedlings were transplanted at 20x15 cm spacing using single seedlings per hill before submergence and after de-submergence, while grain yields were recorded at maturity of all treatments on a per plot basis which was converted into t ha^{-1}. The samples were oven dried at 70 ^{0}C to obtain constant weight. All these observations were recorded on 10 initially tagged hills from each plot. Grains were harvested, dried, and weighed. Concentrations of N, P and K in the dried shoot material were determined in plants obtained before transplanting, before submergence and after de-submergence using methods described by Lindner (1944) and Jackson (1973). Nutrient uptakes were calculated as the product of concentration and biomass. Collected data were analyzed statistically following the method of Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Growth and yield: Under normal condition application of nitrogen along with potassium and phosphorus provide mortality or strength to the plant. Application of nitrogen in nursery increases plant vigour in terms of plant height and dry matter accumulation. Maximum plant height before submergence (Table-1). Maximum plant height was recorded in treatment containing higher doses of N, P &K $T_3 N_2$ and $T_7 N_4$ in Sambha Mahsuri *Sub1 viz,* (42.38), (41.88) respectively. Maximum dry weight at before submergence table 2 existed in higher dose of nitrogen applied as a basal in respect to lower dose *i.e.*, (2.423, 2.446), (2.323, 1.664) respectively in Sambha Mahsuri *Sub1* rice variety. Survival (%) Data related to plant survival as affected by the different nursery nutrient management accompanied with main field nutrient management are presented in table3. 5th days after de-submergence was maximum survival percent was recorded in $T_3 N_2$ (98.79, 98.47) at par with $T_7 N_4$ (98.46, 98.46) followed by $T_8 N_2$ (98.44, 97.69) $T_5 N_2$ (98.08, 98.29), $T_4 N_2$ (96.89, 95.79) and minimum plant survival was obtained with $T_1 N_1$ (92.60, 94.23), $T_2 N_2$ (94.64, 94.32) and T_6

N_3 (94.62 , 97.45) and 20th days after de-submergence maximum $T_3 N_2$ (96.27, 96.94), at par with $T_7 N_4$ (95.68, 95.47) followed by $T_8 N_2$ (89.69, 85.49), $T_5 N_2$ (89.69, 91.85), $T_4 N_2$ (90.58, 87.30) and minimum plant survival was obtained with $T_1 N_1$ (77.83, 78.25) ,$T_2 N_2$ (84.50, 94.27) and $T_6 N_3$ (84.30, 82.30) respectively Chaturvedi *et al.,* (1995), similarly in contrast Voesenek *et al.*, (2006) reported that rapid shoot elongation increases carbohydrate consumption which resulting less survival percentage after flooding and Ella and Ismail (2006) also suggested that plant enrichment with nitrogen before submergence adversely affected survival after submergence reported that old seedling tend to have large carbohydrate reserves, therefore good survival during submergence. Unlike deep water and other aquatic plants, the importance of slow growth in rainfed lowland rice during submergence has been suggested to be beneficial in that it prevents damage due to lodging once water recedes following a flash flood. Similar result also found by (Singh, 2001; Jackson and Ram, 2003). Srivastava, (2007) Winkel *et al.* (2013) and Winkel *et al.,* (2014) reported that rice leaves have gas films that aid O_2 and CO_2 exchange and that underwater photosynthesis can take place supported by high irradiance at depth during submergence, resulting in biomass production after de-submergence It seems that high nitrogen in combination with phosphorus and potassium helpful in shoot growth. (Mahyer Gerami *et al.,* 2012) reported that where silicate applied in the source of silicon in stem and leaf tissues were increases .had a positive effect on morphological characters thus further study N_2 (N_{40}:P_{40}:K_{40} kg ha^{-1}) treated seedling were used for main field. experiment which comprises eight treatments to assess the response of different level of N, P and K for and silicate applied before and after de-submergence on rice plants periodically submerged at 60 days crop growth stage for 15 days with clear water. A. AHMAD *et al.,* (2013) A field experiment was conducted at University of Agriculture, Faisalabad, Pakistan, to investigate the of foliar application of silicon on yield and quality of fine rice (*Oryza sativa* L.). The research was designed as randomized complete block design (RCBD) having three replications and 6m x 4.5 m net plot size was maintained. Foliar applications of silicon's aqueous solution were used as treatments comprised of control, 0.25%, 0.50%, 1.00% silicon solutions. Nursery of 30 days old seedling nursery was transplanted to the plots under

aerobic condition and 22.5 cm hill to hill distance was maintained. Sodium silicate (20.35% Si) as the source of silicon (soluble in warm water) was used. Fertilizer inputs as nitrogen, phosphorus and potassium were uniformly applied at the rate of 100, 67, 67 kg ha^{-1} while all other agronomic practices were kept constant for all the treatments. The data from the field (yield components) as well as lab analysis (quality parameters) was recorded according to the standard procedures. Fisher's analysis of the variance technique was used for statistical analysis and treatment's mean differences were compared using least significant difference (LSD) test at 5% probability level. It was observed that plant crop stand, plant height , Ear bearing shoot m^{-2}, panicle length, number of grains panicle^{-1}, test weight, total seed number panicle^{-1}, fertile grains panicle^{-1}, sterile grain panicle^{-1}, sterility %, biological yield, grain yield, straw yield and harvest index significantly enhance with enrichment of seedling nutrient and survival. Yield and yield contributing characters significantly influenced by irrespective doses and integrated nutrient management in nursery and N, P &K application just after de-submergence (5th day after submergence. Maximum plant height table 4 at maturity $T_3 N_2$ (83.00, 94.38) ear bearing shoot m^{-2} was observed with $T_3 N_2$ (488.30, 487.33) whereas, maximum panicle length and number grain panicle^{-1} was observed in $T_3 N_2$ (21.66, 23.04),(215.33, 215) followed by $T_7 N_4$, $T_4 N_2$, $T_5 N_2$, $T_6 N_3$, $T_8 N_2$ and $T_2 N_2$, shows superiority over other treatments. It is also reflected from maximum test weight observed maximum in higher doses of N,P &K (N_{120}:P_{60}:K_{50}) $T_3 N_2$ (22.43, 22.30), $T_7 N_4$ (N_{120}:P_{60}:K_{40}) (21.56, 21.83) followed by $T_4 N_2$, $T_5 N_2$, $T_6 N_3$, $T_8 N_2$ etc. Since, that phosphorus and potassium both helpful in re-establishment of plant and maintain the plant growth during submergence than nitrogen. (Singh *et al.*, 2006). Mustafa *et al.,* (2011) application of N, P and K significantly affected total number of tillers, number of panicle, and number of grain per panicle. Silicon showed no significant effect on plant height harvest index, number of kernels and opaque kernels percentage. Silicon (0.50% silicon solution) produced maximum grain diameter and grain protein while silicon @ 1.00% silicon solution resulted maximum in number of productive tillers, straw yield, spike per panicle, 1000 grain weight, paddy yield and grain starch. All others parameters have overlapping results of different silicon level.

Table 1. Effect of various fertilizer combinations in main field on plant height (cm) of Sambha mahsuri *Sub1* under flood prone ecosystem completely submerged for 15 days.

Treatments	Before submergence		After de-submergence (5th days)		After de-submergence (20th days)	
	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
$T_1 N_1$	38.10	35	68.16	68.16	55.16	55.68

T_2N_2	39.27 (3.07)	36.33 (3.80)	70.33 (3.10)	70.33 (3.18)	62.23 (12.81)	61.66 (10.73)
T_3N_2	42.38 (11.23)	46 (31.4)	80.43 (18.00)	80.43 (18.00)	73.56 (33.35)	73.83 (32.59)
T_4N_2	41.63 (9.26)	36 (2.85)	72.10 (5.74)	72.10 (3.94)	63.33 (14.81)	63.5 (14.04)
T_5N_2	40.38 (5.98)	37.16 (6.17)	68.66 (0.73)	68.66 (0.73)	60.16 (9.06)	60.33 (8.35)
T_6N_3	40.33 (5.85)	36.66 (4.70)	69.26 (1.60)	69.26 (1.61)	58.16 (5.43)	59.00 (5.96)
T_7N_4	41.88 (9.92)	37.66 (7.60)	72.16 (5.80)	72.16 (5.8)	69.33 (25.68)	69.33 (24.51)
T_8N_2	38.29 (0.49)	35.88 (2.51)	70.16 (2.90)	70.16 (2.93)	59.83 (8.46)	60 (7.75)
SEm ±	3.81	0.65	0.45	0.45	1.69	1.41
CD at 5%	1.26	0.21	0.15	0.15	0.56	0.46

*Parenthesis indicate percent increase/decrease

Table 2. Effect of various fertilizer combinations in main field on plant dry weight (mg plant^{-1}) of Sambha mahsuri *Sub1* under flood prone ecosystem.

Treatments	Before submergence		After de-submergence (5th days)		After de-submergence (20th days)	
	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
T_1N_1	0.876	1.173	0.794	0.795	1.085	1.087
T_2N_2	0.969 (10.61)	1.470 (25.20)	0.994 (25.18)	1.981 (149.18)	1.620 (49.30)	1.612 (52.50)
T_3N_2	2.423 (176.50)	2.446 (108.50)	2.774 (249.00)	2.166 (172.45)	2.361 (117.60)	2.363 (117.00)
T_4N_2	2.053 (134.30)	1.448 (23.40)	1.785 (124.00)	1.780 (123.83)	2.003 (91.80)	1.818 (67.24)
T_5N_2	1.247 (42.30)	1.365 (16.30)	0.866 (9.06)	0.870 (9.43)	1.863 (71.70)	2.006 (84.50)
T_6N_3	2.049 (133.90)	1.243 (5.90)	0.908 (14.35)	0.900 (13.20)	1.206 (11.15)	1.208 (11.13)
T_7N_4	2.323 (165.10)	1.664 (41.80)	2.124 (167.00)	1.870 (135.00)	2.063 (90.10)	2.066 (90.00)
T_8N_2	1.628 (85.80)	1.630 (38.90)	0.986 (24.18)	0.990 (24.52)	1.940 (78.80)	1.942 (78.61)
SEm ±	0.01	0.03	0.20	0.10	0.00	0.01
CD at 5%	0.00	0.01	0.06	0.03	0.00	0.00

*Parenthesis indicate percent increase/decrease

Table 3. Effect of various fertilizer combinations in main field on plant survival (%) of Sambha mahsuri *Sub1* under flood prone ecosystem.

Treatments	Survival (%)			
	After de-submergence (5th days)		After de-submergence (5th days)	
	2013-14	2014-15	2013-14	2014-15
T_1N_1	92.60	93.02	77.83	78.25
T_2N_2	94.64 (2.20)	94.32 (1.39)	84.5 (8.50)	94.27 (20.47)
T_3N_2	98.79 (6.68)	98.47 (5.85)	96.27 (30.40)	96.94 (23.88)
T_4N_2	96.89 (4.63)	95.79 (2.97)	90.58 (16.30)	87.30 (11.56)
T_5N_2	98.08 (5.91)	98.29 (5.66)	91.76 (17.80)	91.85 (17.83)

T_6N_3	94.62 (2.18)	97.45 (4.76)	84.30 (8.30)	82.3 (5.17)
T_7N_4	98.46 (6.32)	98.46 (5.92)	95.68 (22.90)	95.47 (22.00)
T_8N_2	98.44 (6.28)	97.69 (5.02)	89.69 (15.20)	85.49 (9.25)
SEm ±	0.03	1.68	6.38	0.03
CD at 5%	0.01	0.55	2.10	0.01

*Parenthesis indicate percent increase/decrease

Table 4. Effect of various fertilizer combinations in main field on ear bearing shoot (m[-2]), panicle length, no. of grains panicle[-1] and test wt. of rice plants

Treatments	Ear bearing shoot (m[-2])		Panicle length (cm)		No. of grains panicle[-1]		Test weight (g)	
	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
T_1N_1	323.3	325.33	19.50	21.28	117.33	119.00	19.33	**18.83**
T_2N_2	394.0 (21.8)	393.33 (20.90)	20.66 (5.90)	21.50 (1.00)	176.66 (50.56)	177.67 (49.30)	20.63 (34.70)	20.30 (8.01)
T_3N_2	488.3 (31.7)	487.33 (49.70)	21.66 (11.07)	23.04 (8.20)	215.33 (83.52)	215.00 (80.60)	22.43 (16.00)	22.30 (18.43)
T_4N_2	383.6 (3.50)	382.66 (17.60)	20.66 (5.90)	22.16 (4.10)	167.67 (42.90)	168.33 (41.45)	20.83 (7.75)	20.60 (9.39)
T_5N_2	418.3 (29.30)	419.33 (28.80)	20.00 (2.56)	21.33 (0.23)	147.33 (25.00)	148.33 (24.60)	21.22 (9.70)	21.29 (12.70)
T_6N_3	383.3 (3.42)	385.33 (18.40)	19.83 (1.60)	21.27 (0.21)	137.33 (17.00)	138.33 (16.24)	22.09 (10.50)	20.90 (10.90)
T_7N_4	432 (12.70)	433.33 (33.10)	21.16 (8.51)	21.43 (0.70)	186.33 (58.80)	189.00 (58.80)	21.56 (9.90)	21.83 (15.90)
T_8N_2	370.6 (3.30)	421 (29.40)	19.83 (1.60)	21.42 (0.68)	183.33 (56.20)	184.00 (54.60)	20.9 (7.80)	22.09 (17.30)
SEm ±	16.95	37.1	1.06	0.54	2.16	1.35	0.64	1.09

*Parenthesis indicate percent increase/decrease

CONCLUSION

The results of the experiment indicated that N, P, K 40:40:40 kg ha^{-1} alone or supplied together with silicate fertilizer produced significantly higher root length, root number, root dry wt., root CHO and biochemical activities there after helped in rapid regeneration, which was reflected in the form of higher yield. Proper nursery nutrient management using K can contribute considerably to maximizing submergence tolerance and grain yield of the rice crop in the field. A slightly higher dose of P along with the normal K dose also produced a higher yield than the normal P dose used in nursery management. These results, however, need further validation on farmers' fields applying lower N doses with K and P.

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