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Effect of planting methods and integrated nutrient management on growth parameters, yield and economics of rice

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Abstract
In order to study the effect of planting methods and integrated nutrient management in rice. A field experiments was conducted at Agronomy Research Farm of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (Utter Pradesh) during *Kharif* 2014. The experiment was laid out in split plot design with four replications. The treatment consisted of four planting methods (S_1- transplanting, S_2-SRI, S_3- drum seeded and S_4- direct seeded) and three integrated nutrient management (F_1- 100% NPK, F_2- 75% NPK+25% FYM and F_3- 50% NPK+ 50% FYM) in this way there were 12 treatment combinations. The values of growth contributing characters viz. plant height (cm), number of tillers m^{-2}, dry matter accumulation (g m^{-2}), leaf area index, and yield attributes like number of panicles m^{-2}, length of panicle (cm), number of panicle^{-1}, grain weight panicle^{-1}, test weight (g), grain and straw yield (q ha^{-1}) and nutrient uptake of rice were increasing significantly with SRI method (S_2) followed by transplanting method (S_1) and significantly superior over rest of the treatments. In case of integrated nutrient management the growth characters like plant height (cm), number of tillers m^{-2}, dry matter accumulation (g), LAI, yield attributes' number of panicle m^{-2}, length of panicle, grain weight panicle^{-1},test weight (g), nutrient uptake, grain and straw yield (q ha^{-1}) of rice were maximum under F_2 (75% NPK+25% FYM) which was at par with F_1 100% NPK during course of investigation. The maximum gross return and net return were noted under SRI with 75% NPK+25% FYM (S_2F_2) application. The highest benefit cost ratio (2.47) were recorded with SRI method with 100% NPK treatment (S_2F_1) followed by SRI with 75%NPK+25% FYM (S_2F_2) they proved more remunerative then other treatment combinations.

Keywords: planting methods, integrated nutrient Management, growth parameters

Introduction
Rice (*Oryza sativa* L.) belongs to family Poaceae. Rice is one of the most important cereal crops of *kharif* season. Rice is cultivated world-wide over an area of about 160.68 million ha^{-1} with an annual production of about 650.19 million tonnes. In India rice is cultivated over an area of about 39.16 million hectares with an annual production of about 85.59 million tonnes and the productivity of 2.20 tonnes ha^{-1}. Utter Pradesh is an important rice growing state in the country. The area and production of rice in this state is about 13.84 million hectare and 14.00 million tonnes respectively with an average production of 2.35 tonnes (Anonymous, 2013) [3]. Production of rice rank second among the food grain and half of the world population receiving the highest (26.2%) calories intake from it in the developing countries of their dietary protein (FAO, 2009) [11]. Rice is an excellent source of carbohydrate and to a certain extent it provides protein to regular human diet. So it is used as staple food crop by about half of the world population and eaten as cooked rice and also used for various preparations inhabiting in the humid tropics and subtropics. Further, rice has commercial and industrial importance also beside grains. Rice straw and rice hulls are used as fodder, mulching, packing and as insulation material etc.
The scarcity of water for agriculture production is becoming a major problem in many countries, particularly in word's leading rice-producing countries like China and India.
Rice cultivation in India is predominantly practiced under transplanting method that involves raising, uprooting and transplanting of seedlings. This technique requires continuous ponding of water. To avoid these difficulties several other methods of rice cultivation have been developed so far. Among those SRI (System of Rice Intensification), drum seeder, direct seedling technique are gaining acceptance by the growers day by day.
SRI is the acronym for system of rice intensification. The SRI is a new promising resources-saving method of growing rice under irrigated as well as under rain-fed conditions. Studies in a number of countries have shown a significant increase in rice yield with substantial saving of

seed (80-90%), cost (10-20%) and chemical fertilizer compared to conventional method of transplanting.

Thakur *et al*. (2009) [58] suggested that the system of rice intensification holds a great promise in increasing the productivity. The basic principles of SRI are planting young seedling (<14 days) singly in a square pattern (Stoop *et al*, 2002) [56]. According to proponents, SRI encompasses asset of principles, each of them fairly simple, but working synergistically with the others inorder to achieve higher grain yield. Since optimum number of tillers per unit area is a prerequisite for obtaining maximum yield from a rice cultivar. Hence removal of excess tiller from the mother hill may or may not create any adverse effect on mother crop. However, it makes room for further development of the same caused by food/natural hard but also substitutes the local varieties. Thus it could be an important aspect to know the strength of minimum number of tiller to be transplanted per unit area and hill for optimizing yield.

Transplanting of rice seedling being a labour-intensive and expensive operation, it need to be substituted by direct seeding which could reduce labour need by more than 20% in terms of working hour. With the advent of improved agriculture machinery coupled with shortage of farm labor, mechanization is becoming inevitable and we must strive to take advantage of those. The manually operated drum seeder is a fast planting technique that can be used for a wet seeding. Further, it requires less labour as compare to other methods.

Direct wet seeding is an alternative method of growing rice instead of conventional transplanting. In this method, sprouted (pre-germinated) seeds are sown on well prepared puddle land. Direct seeding can be done either by hand broadcasting or by line sowing.

Many Asian countries are now increasingly shifting to direct wet-seeded method of growing rice. However, the practice of direct wet seeding rice is very negligible in India. Though research results have clearly shown the superiority of direct seeding rice to conventional transplanting. In India direct seeded rice production has been achieved about 2-12% higher grain yield than transplanting (Husain *et al.* 2003) [16]. Satter and khan (1994) reported that direct-wet seeded rice required about 20% less water as compared to transplanted rice. Isvilanonda (2002) [18] reported that direct seeded rice reduced 2-6% production cost and increased net return by 37% in dry season. Direct seeding eliminates the need for seedbed preparation, seedling uprooting and transplanting and the associated cost and energy. In addition direct seeded rice mature about 8-10 days earlier and 10-15% higher yield than transplanted rice. So, direct seeded method is adopted in areas where there is a shortage of labour or otherwise labour is expensive for transplanting.

The long term fertilizer experiment have sown that continuous application of sub-optimal dose of chemical fertilizer alone to soil has resulted in the deterioration of soil health. As it will not only improve the nutrient status and soil health but also proved to be a boon in stabilizing the crop yield over a period of time. Hence, integrated use of organic manure with optimal level of NPK fertilizer is the need of the hour. Therefore, INM system is the only way to the maintain and improve the nutrient status of Indian soil.

In recent year concept of INM involving combined use of organic and inorganic fertilizer has been developed. The uses of adequate dose of organic sources coupled with chemical fertilizer are expected to ensure optimum growth condition under intensive pattern of farming using high yielding varieties.

INM helps to restore and sustain fertility and crop productivity. Integrated nutrient management favorably affected the physical, chemical and biological environment of soil.

In view of above facts the present investigation entitled, "Effect of planting methods and integrated nutrient management in rice" has been carried out during *Kharif* season of 2014 at the Agronomy Farm of Narendra Deva University of Agriculture & Technology, Narendra Nagar Kumarganj Faizabad, (U.P) with following objectives;

1. To study the effect of planting methods (transplanting, SRI, drum seeded and direct seeded) on growth and yield of rice,
2. To study the effect of integrated nutrient management on growth and yield of rice,
3. To study the effect of organic and inorganic fertilizer in rice, and
4. To work out the economics of various treatments and integrated nutrient management in rice.

Materials and Methods

The experiment was laid out during *Kharif* 2014 at Agronomy Research Farm of Narendra Deva University of Agriculture & Technology, Narendra Nagar (Kumarganj), Faizabad, Uttar Pradesh India. The field was well leveled having good soil condition. Geographically, Faizabad (Kumarganj) falls in subtropical climate and is situated at 26^0.47 North latitude, 82.12^0 East longitude with an altitude of 113 meters above mean sea level. The experimental site is situated in main campus of university on left side of Faizabad- Raibarelli road at the distance of 42 km from Faizabad district headquarter. Geographically the experimental site falls under sub humid, sub-tropical climate of Indo-gangatic alluvial (IGP) plains having alluvial calcareous soil. The weekly mean minimum and maximum temperature during the crop season ranged from 28.9 to 35.2 ^{0}C and 18.7 to 36.2 ^{0}C, total rainfall received was 1100 mm during the entire crop season, relative humidity, and sunshine hours were found to vary from 69.4 to 87.98 per cent, and 1.4 to 7.5 hours, respectively. The soil of experimental field was slightly alkaline in reaction (7.9 pH), low in organic carbon (0.42%) and low in available nitrogen (160 kg ha^{-1}), phosphorus (16.5 kg ha^{-1}) and medium in potassium (260 kg ha^{-1}). The experimental was laid out in Split plot design (SPD) where 12 treatments were replicated four times. The treatments were allotted separately to various plots main plot and sub plot. In all, there were 12 treatments included in the experiment in main plot and sub plot. The detail of treatments with their symbols four planting methods [Transplanting (S_1), SRI (S_2), Drum Seeded (S_3), Direct Seeded (S_4)] and three integrated management practices [100% NPK (F1), 75% NPK + 25% FYM (F2), 50% NPK + 50% FYM (F3)]. A common procedure was followed in raising seedlings in the seedbed. The seedbed was prepared by puddling with repeated ploughing followed by laddering. Weeds were removed and irrigation was gently provided to the bed as and when necessary. For SRI, sprouted seeds were sown as broadcast in two portable trays containing soil and cow dung. Thin plastic sheets were placed at the base of the trays to protect water loss. The moisture of the trays was controlled accurately by applying water every day, which ensured proper growth of all the seedlings in the trays. These trays were kept inside a room at night to protect the seedlings from freezing temperature of the season and kept in sunlight at daytime for proper development of seedlings. After the harvest of previous crop the experimental field was ploughed once with soil turning plough and cross harrowed two times. After each ploughing, planking was done to level the field and obtain the fine tilth and lay out was done. The specific quantity of each fertilizer was calculated on the basis of gross plot size and as per treatment taken per plot. The optimum dose of manure and fertilizers was recorded for rice. The half quantity of nitrogen and full quantity of phosphorus and potassium were broadcasted in the field during final field preparation after the transplanting and sowing the fertilizer thoroughly in the field. The rest half dose of nitrogen was top-dressed in two splits after first irrigation and second 45 DAT. The sowing of experiment crop was done in line at 20 cm. apart by using the seed rate 40 kg ha^{-1}. In the plots where crop establishment was through transplanting, 22 days old seedling were transplanted at the spacing of 20x10 cm using three seedling $hill^{-1}$ on. In case of SRI method, 12 days old seedlings were transplanted in the prepared plot just after uprooting and this process completed within one minute. Only one seedling is used for SRI transplanting in square pattern (25x25). During the year of experimentation, there were occurrence of sufficient rains during vegetative stage, however, there was occasional moisture stress during reproductive phase, hence two irrigations were given at flowering and milking stages. The crop was harvested manually by serrated edged sickles at physiological maturity when panicle had about 85% ripened spikelets and upper portion of spikelets look straw coloured. At the time of harvesting the grains were subjected to hard enough, having less than 16 per cent moisture in the grains. First of all, the border area was harvested. The harvesting of net plot area was done separately and the harvested material from each net plot was carefully bundled and tagged after drying for three days in the field and then brought to the threshing floor. The bundle of harvested produce of each net plot was weighed after sun drying for recording biological yield. Threshing of each bundle of individual plot was done manually by wooden sticks. The grain yield of individual plot after winnowing was weighed. The quantity of straw per plot was calculated by subtracting the weight of grains from biological produce. Yield of both grain and straw was expressed in q ha^{-1}.

Results and Discussion

Growth characters

Plant height (cm)

Plant height was significantly influenced by various planting methods at all the stages of crop growth. Maximum plant height was recorded with the SRI method (S_1) which was statistically at par with the transplanting method and significantly superior to rest of the treatments at all the stages of crop growth. Wider spacing particularly under in SRI method recorded significantly taller plant than the closer spacing, due to the fact that under wider spacing, the plant get sufficient space above the ground (shoot) and below the ground (root) to grow as well as the increased light transmission in the canopy, leading to greater plant height. At harvest, the tallest plants were recorded in SRI. It might be due to more space, sunlight and nutrients available to wider spaced plants of SRI than close spaced plants which facilitated the plants to attain more height. Shriame *et al*. (2000) reported that the number of functional leaves and leaf area were higher under wider spacing, which increased the photosynthetic rate leading to taller plant. Younger seedlings have more vigor, root growth and lesser transplant shock because of lesser leaf area during initial growth stages which stimulate the cell division causing more stem elongation and ultimately have might increased plant height where SRI method of transplanting was opted. (Rahman, 2001 and Sangsu *et al*. 1999) [34, 40].

Plant height influenced by integrated nutrient management was not significant at 30 days of DAT/DAS of the crop. Significantly higher plant height was recorded where application of 75% NPK+25% FYM through inorganic and organic fertilizer was given & it remained at par with 100% NPK inorganic fertilizer. Plant height increased mainly due to adequate nutrient supply to the plant which resulted into rapid growth by good establishment of root and various metabolic process and ultimately performed better mobilization of synthesized carbohydrates in to amino acid and protein which stimulated the rapid cell division and cell elongation. Finally, it resulted in to growth of plant faster as compare to other treatments tested during in course of investigation.

The lowest plant height was recorded with 50% NPK+50% FYM through inorganic and organic fertilizer all growth stags. It might be due to poor availability of nutrient which caused poor growth and poor nutrient mobilization. (Kumar and Yadav 1995) [22].

Number of tillers (m^{-2}), Number of shoot, LAI and Dry matter accumulation (g m^{-2})

The number of tillers was significantly affected by various planting methods at different stages of crop growth. The highest numbers of tilllers m-2 were recorded in SRI which was at par with transplanting method at 30 days of transplanting. Significantly higher number of tillers was counted under SRI method as compared to rest of the treatments at 60,90and harvest stages. The higher number of tillers $hill^{-1}$ might be due to wider spacing, transplanting younger seedlings, earlier transplanting and better water management. Earlier transplanting reduces the transplanting shock at a more convenient point in the growth cycle when they could rebound faster and had little effect on tiller age (Uphoff, 2002) [63]. Use of plastic trays for raising seedlings, and dry cultivation of the nursery was beneficial to boost the vigorous root system for earlyand quick growing of tillers after transplanted in SRI. Alternate wetting and drying maintaining a thin film of water that might open the soil for both oxygen and nitrogen and promoted the root growth during initial growth stages which ultimately increased tiller density (Uphoff, 2001) [61]. Nissanka and Bandara (2004) [27] observed that the tiller number $plant^{-1}$ was higher in the SRI compared to conventional transplanting.

Number of shoot, LAI and dry mater accumulation were recorded higher in SRI methods followed by (S_1) transplanting methods. Plant established by SRI method had an opportunity of availing more inter and intra plant spacing, thus making better use of growth factor to increase number of shoots per unit area. Reduced number of shoots under direct seeded method might have been due to lesser intra plant space and heavy occurrence of weed resulting in more weed competition.

Higher number of tillers m^{-2}in SRI method increased the leaf area that covered the ground area, hence enhancing the leaf area index. High leaf area index is associated with increased in assimilation of food material through photosynthesis on account of vigorous root and shoot growth, which ultimately led to higher dry matter production at each of the stages of observation. Similar results have been reported by Hussain *et al.* (2012) [17] and Thiyagarajan *et al.* (2002).

Integrated nutrient management affected significantly higher number of $tiller^{-2}$ and leaf area index. The significantly higher number of tiller^{-2} and leaf area index was recorded with 75% NPK+25% FYM through inorganic and organic fertilizer which was at par with 100%NPK as compared to rest of the treatment. It might be attributed to adequate nutrient availability which provided favorable condition for better synthesis of growth favoring constituents in plant system. The lower number of tillers and LAI was recorded under 50% NPK+50% FYM at all growth stages mainly due to inadequate nutrient supply system. Results are in agreement with findings of Pandey (1997) [29].

Integrated nutrient management affected significantly the dry matter accumulation (gm^{-2}) at all growth stages 30, 60, 90 and harvest stages, as well. Higher dry matter accumulation was recorded under 75%NPK+25%FYM through inorganic and organic fertilizer which was at par with treatment F_1 (100%NPK) as compared to rest of treatment. This might be due to the adequate nutrient management which increased plant height, produced more number of shoot and leaf area index. Lower dry matter accumulation was recorded under treatment F_3 (50%NPK+50%FYM) at all growth stages mainly due to in adequate nutrient supply resulting in reduction in plant height, number of leaves, number of shoots/hill and nutrient absorption from the soil. Finally it led to decline in photosynthesis activity which ultimately recorded lowest dry matter accumulation (Kumar *et al.* 2013) [23].

Yield

Grain yield (q ha^{-1}) and Straw yield (q ha^{-1})

Grain yield and straw yield of rice was influenced significantly by crop planting methods. The crop established under wider spacing SRI (25x25cm) method resulted in significantly higher grain yield followed by transplanting method and lowest grain yield under direct seeded method was obtained, respectively. Yield is functions of complex inter relationship of growth in vegetative phase and yield attributes, as well. Higher yield under SRI method was due to better crop growth and development resulting in to higher value of yield attributes which had direct bearing on the grain yield. Higher number of panicle per unit area, panicle size and filled grains percentage in case of SRI method as compared to other method of crop establishment might be responsible for superiority of this treatment over other in respect of grain yield. Similar results have been reported by Krishna *et al*. (2008) [21]

Straw yield of rice were also highest where rice crop was established by SRI method followed by transplanting method. Higher number of tiller m^{-2} with moderate plant height and better performance of yield attributing ultimately led the increase the biomass in the SRI method of rice establishment. The lowest yield was recorded direct seeded method due to lesser of effective tiller m^{-2} and increased inter and intra plant competition for available growth resources on account of heavy weed infestation.

Grain and straw yield were affected significantly due to various integrated nutrient management practices. Significantly higher grain and straw yield of rice were obtained with the application of 75% NPK+25% FYM which was at par with 100% NPK as compared to over rest of treatments. This might be due to increased yield attributes *viz*-number of effective tillers, length of panicle, number of grains/panicle, weight of grain/panicle which resulted in higher yield. Further, sufficient nutrient management which contributed to increased dry matter production as well. The better vegetative growth coupled with high yield attributes resulted in higher grain and straw of rice Sengar *et al*. (2000) [42]. Lowest grain and yield were recorded with application of 50%NPK+50%FYM. This was due to poor growth and metabolic process and lesser number of grain/panicle. The results are in accordance with Reddy *et al.* (2002) [38].

Nutrient uptake (kg ha^{-1})

Higher NPK uptake by grain and straw were recorded with SRI method as compared to the other treatment, while lower NPK uptake by direct seeded methodby grain and straw, respectively. The total NPK uptake followed the similar trend. The higher nutrient uptake was attributed to the higher grain and straw yield.

The higher nutrient uptake was mainly due to higher biological (grain+straw) yield. This is attributed to the higher tillers number and dry matter production by younger seedlings ultimately resulting in higher straw and grain yield and nutrient removal. This is also attributed to deeper and more prolific root system developed by young seedling gown under SRI method where plants get well aerated conditions (Barison, 2002) [6].

Various integrated nutrient management affected significantly nutrient uptake by rice. The maximum NPK uptake was recorded by the application of 75%NPK+25%FYM through inorganic and organic fertilizer which was at par with 100%NPK. Availability of nutrients might be sufficient & it led to higher nutrient uptake. Minimum nutrient uptake was recorded where 50%NPK+50% FYM) was applied. It might be due to inadequate availability of nutrient. The results are in close proximity of Talathi *et al.* (2009) [57].

Harvest index (%)

Harvest index is the function of grain yield to the total biological yield (grain+straw). Harvest index was also influenced significantly due to various planting methods. The higher harvest index was recorded with SRI method. Similar findings have also been reported by Stoop (2005) [56] and Hussain *et al*. (2003) [17].

Economics

Analysis of economics factors like cost of cultivation, gross return, net return, and B:C ratio are important to evaluate the effect of the treatment from practical point of view to the farming community as well as to the planner. Grain yield was major factor which caused differences in net income and net return per rupees invested. Maximum Gross return and net return was recorded in (S_2F_2) SRI method+75%NPK+25%FYM which was followed by ((S_2F_1) SRI and 100%NPK. This is due to higher production of grain and straw yield and higher increased in output in comparison to input.

Tables

Table 1: Plant height (cm) as influenced by planting methods and INM at various stages of rice.

Treatment	Plant height (cm)			
	30 DAT/DAS	**60 DAT/DAS**	**90 DAT/DAS**	**At harvest**
Planting methods				
Transplanting	52.61	76.56	99.36	100.64

SRI	55.14	79.58	102.08	106.45
Drum seeded	48.35	72.54	95.46	98.56
Direct seeded	47.44	71.52	94.06	95.34
SEm±	1.402	1.86	2.56	2.72
C.D. (P=0.05)	3.28	4.32	5.32	6.37
Integrated nutrient management				
100% NPK	50.21	76.00	99.08	101.26
75%NPK+25% FYM	50.41	77.00	99.64	103.24
50%NPK+ 50% FYM	52.05	72.00	95.28	96.24
SEm±	0.77	1.15	1.17	1.53
C.D. (P=0.05)	NS	2.43	2.86	3.21

Table 2: Effect of planting methods and INM on number of tillers/m^2 at different stages of rice.

Treatments	**Number of tiller (m^{-2})**			
	30 DAT/DAS	**60 DAT/DAS**	**90 DAT/DAS**	**At harvest**
Planting methods				
Transplanting	581.4	601.8	594.66	589.04
SRI	604.2	643.1	635.47	629.68
Drum seeded	552.9	572.3	565.51	559.44
Direct seeded	541.5	560.5	553.85	548.4
SEm±	14.33	16.06	14.75	14.18
C.D. (P=0.05)	33.57	37.71	34.55	33.21
Integrated nutrient management				
100% NPK	547.20	604.09	596.61	590.51
75% NPK+ 25% FYM	582.10	608.54	601.63	599.02
50% NPK +50% FYM	547.20	570.65	563.88	588.89
SEm±	8.81	9.032	9.63	9.12
C.D. (P=0.05)	18.50	18.96	20.23	19.59

Table 3: Leaf area index (cm^{-2}) of rice as influenced by planting methods and INM at various stages of rice.

Treatment	**Leaf area index**		
	30 DAT/DAS	**60 DAT/DAS**	**90 DAT/DAT**
Planting methods			
Transplanting	3.97	4.29	4.44
SRI	4.25	4.59	4.74
Drum seeded	3.78	4.08	4.22
Direct seeded	3.70	4.00	4.13
SEm±	0.10	0.11	0.12
C.D. (P=0.05)	0.24	0.26	0.28
Integrated nutrient management			
100% NPK	3.99	4.30	4.45
75%NPK+ 25% FYM	4.03	4.36	4.49
50% NPK+ 50% FYM	3.77	4.07	4.21
SEm±	0.06	0.07	0.07
C.D. (P=0.05)	0.13	0.14	0.15

Table 4: Dry matter accumulation (gm^{-2}) of rice as influenced by planting methods and INM at various stages of rice

Treatment	**Dry matter accumulation (g m^{-2})**			
	30 DAT/DAS	**60 DAT/DAS**	**90 DAT/DAS**	**At harvest**
Planting methods				
Transplanting	316.2	489.6	775.20	999
SRI	337.9	523.2	828.40	1068
Drum seeded	300.7	465.6	737.2	950
Direct seeded	294.5	456	722.0	931
SEm±	7.89	13.10	19.23	25.70
C.D. (P=0.05)	18.48	30.68	45.04	60.20
INM				
100% NPK	317.06	490.62	771.64	996.59
75% NPK+ 25% FYM	320.08	495.93	790.39	1017.60
50% NPK +50% FYM	299.83	464.26	735.07	947.86
SEm±	5.05	7.34	12.56	16.08
C.D. (P=0.05)	10.62	15.42	26.37	33.78

Table 5: Grain, straw yield and harvest index as influenced by planting methods and integrated nutrient management of rice.

Treatment	**Grain yield (q/ha)**	**Straw yield (q/ha)**	**Harvest index (%)**
Planting methods			
Transplanting	42.36	65.22	39.38
SRI	46.70	70.80	39.76
Drum seeded	37.60	58.30	39.24
Direct seeded	35.78	55.63	39.16
SEm±	1.10	1.56	-
C.D. (P=0.05)	2.5	3.67	-
Integrated nutrient management			
100% NPK	41.50	63.05	39.69
75% NPK +25% FYM	41.80	64.57	39.28
50% NPK +50%FYM	38.53	59.84	39.19
SEm±	0.62	1.04	-
C.D. (P=0.05)	1.30	2.18	-

Table 6: Nitrogen uptake in grain and straw and total nitrogen uptake as influenced by planting methods and INM of rice crop.

Treatment	**Nitrogen uptake (kg ha^{-1})**		
	Grain (q ha^{-1})	**Straw (q/ha^{-1})**	**Total N_2 uptake (kg ha^{-1})**
Planting methods			
Transplanting	52.13	30.67	82.80
SRI	58.87	34.71	93.58
Drum seeded	44.76	26.25	71.01
Direct seeded	41.52	23.93	65.45
SEm±	1.33	1.19	2.43
C.D. (P=0.05)	3.13	2.80	5.69
Integrated nutrient management			
100% NPK	46.95	28.89	78.84
75% NPK + 25% FYM	55.01	30.58	82.59
50% NPK+ 50% FYM	46.00	27.20	73.20
SEm±	0.75	0.88	1.83
C.D. (P=0.05)	1.58	1.85	3.86

Table 7: Phosphorus uptake in grain and straw as influenced by planting methods and INM of rice crop.

Treatment	Phosphorus uptake (kg ha^{-1})		
	Grain (q/ha)	(Straw q/ha)	Total Phosphorus uptake
Planting method			
Transplanting	10.18	5.87	16.05
SRI	11.69	7.09	18.77
Drum seeded	8.66	5.25	13.91
Direct seeded	7.88	4.45	12.33
SEm±	0.25	0.14	0.37
C.D. (P=0.05)	0.60	0.33	0.87
Integrated nutrient management			
100% NPK	9.92	5.78	15.71
75% NPK+ 25% FYM	10.08	5.98	16.06
50% NPK + 50% FYM	8.79	5.24	14.03
SEm±	0.14	0.10	0.30
C.D. (P=0.05)	0.31	0.21	0.63

Table 8: Potassium uptake in grain and straw on as influenced by planting methods and INM of rice crop.

Treatment	Potassium uptake (kg ha^{-1})		
	Grain (q/ha)	Straw (q/ha)	Total potassium uptake kg/ ha
Planting methods			
Transplanting	18.66	83.55	102.21
SRI	21.97	92.83	114.79
Drum seeded	16.19	73.51	89.70
Direct seeded	15.04	69.04	84.09
SEm±	0.48	1.97	1.75
C.D. (P=0.05)	1.13	4.62	4.11
Integrated nutrient management			
100% NPK	18.58	81.48	100.06
75% NPK+ 25% FYM	18.90	84.19	103.09
50%NPK + 50% FYM	16.41	73.52	89.93
SEm±	0.27	1.33	1.47
C.D. (P=0.05)	0.57	2.7	3.10

Table 9: Effect of planting methods and INM on economics of rice.

Treatment combination	Grain yield (q/ha)	Straw yield (q/ha)	Gross return (Rs ha^{-1})	Cost of cultivation (Rs/ha^{-1})	Net return (Rs/ha^{-1})	B:C ratio
S1F1	43.18	65.57	60532	22907	37625	1.6
S1F2	43.71	67.48	61385.5	23756	37629	1.58
S1F3	40.19	62.60	56497.5	24606	31891	1.29
S2F1	47.35	71.12	66299.5	19102	47197	2.47
S2F2	48.44	73.42	67892	19951	47941	2.40
S2F3	44.31	67.86	62173.5	20801	41372	1.98
S3F1	38.61	59.01	48321.5	18152	30169	1.60
S3F2	38.52	60.09	54159	19001	35159	1.85
S3F3	35.52	55.80	49980	19851	30129	1.51
S4F1	36.86	56.52	51737	19952	31785	1.59
S4F2	36.53	57.28	51390.5	20801	30589	1.84
S4F3	33.95	53.10	44474.5	21651	22823	1.28

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