JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Effect of crop establishment techniques and fertility level on growth attributes and yield of rice

Dherendra Kumar[1] and Dig Vijay Dubey[2]

[1]Ph.D. Scholar, Department of Agronomy, Faculty of Agriculture, Bhagwant University, Ajmer, Rajasthan

[2]Assistant Professor, Department of Agronomy, Faculty of Agriculture, Bhagwant University, Ajmer, Rajasthan

ABSTRACT

A field experiment was conducted during two kharif season of 2021 and 2022 at Agriculture Research Farm, Department of Agronomy, Faculty of Agriculture, Bhagwant University, Ajmer, Rajasthan to study the effect of Influence of Different Planting System and Level of Nitrogen on Growth, Yield, Quality and Economics of Rice (Oryza sativa L.). The results revealed that crop establishment through SRI technique has recorded significantly higher in growth attributes such as plant height, number of tillers, dry weight, crop growth rate, relative growth rate and yield) compared to other establishment methods during both of the years. Whereas the application of different fertility level of fertilizer F_3 N : P : K @ 150 : 75 : 75 kg ha^{-1} significantly maximum growth attributes and yield of rice crop during both of the experimental year.

INTRODUCTION

Rice (Oryza sativa L.) is one of the most important staple food crops of the world. More than two billion people in Asia are getting 60-70 % of their energy requirement from rice and its derived products. Human consumption accounts 85 % of total production for rice and it deserves a special status among cereals as world's most important wetland crop. Worldwide, rice is being cultivated in an approximate area of 147 million hectares with a total production of 525 million tonnes and average productivity of 3571 kg ha-1. Asia contributes 59 per cent of world population and accounts for 92 per cent of global rice production. Among many food grains cultivated in India, rice has the pride of being cultivated over an area of 43.49 million hectares with a production of 104.41 million tonnes, which contributes to 41.5 % of total food grain production of our Country (Ministry of Agriculture and Farmers Welfare, 2016). Considering these facts "International year of rice- 2004 had the slogan of "Rice is life". Transplanting has many methods like manual line and random planting, mechanical transplanting, system of rice intensification. Direct sown can be classify into wet direct seeding and dry direct seeding. Drum seeding is a method of direct sown rice system. Transplanting and direct seeding are two common methods of rice

establishment in the world. The assumption of direct seeded rice system is highly constrained as the crop face severe weed infestation. Rice yield may extremely decline in direct seeded rice system if weed management is not done properly. But the weed problem is not a major issue in transplanted rice because of puddling of soil eliminates the weeds before transplanting. Increasing water scarcity and weeds are becoming real threat to rice cultivation. In such a situation it is a necessary to develop the water saving technology for rice cultivation. SRI method has found to save 22 to 38 per cent of water respectively during dry and wet season over other method of rice establishment (Singh et al., 2015). The system of rice intensification is a one of the method of transplanted rice cultivation by manipulating the genetic potential of rice provides a favorable growing environment to rise the productivity and economic returns. Besides it enhance the soil health with reduction in inputs use such as seeds, water etc. (Singh et al., 2018). Fertility management form application of organic and inorganic sources of nutrients used for maintaining the plant nutrients in soil and improves nutrients-use efficiency that is essential in sustainable crop production. Organic matter acts as a source and a sink for plant nutrients as well as provides energy substrate for soil microorganisms. Thus, it enhances activities of soil, flora and fauna as well as intrinsic soil properties, soil nutrient capital, water-holding capacity and soil structure in turn makes soilless susceptible to leaching and erosion. Therefore, these practices are essential to maintained and enhanced the soil quality and sustainability of an agro-ecosystem (Kumar et al., 2021).

MATERIALS AND METHODS

The experimental site is located at Instructional Farm of the Bhagwant University, Ajmer, Rajasthan, Puskar Bypass Road, about 12 km away from Ajmer city. The experimental site falls under subtropical region in Rajasthan and situated at 24.40-26.470 N latitude and 82.120-83.980 E longitude at an altitude of 113 meters from, mean sea level. The filed experiment conducted in split plot design where main plot applied five crop establishment techniques such as C_1 -Integrated crop management, C_1 -Line planting, C_3 - Farmers' practice, C_4-Drum seeder and C_4- SRI Technique and in sub plot F_1 - No fertilizer, F_2 - N: P : K @ 120 : 60 : 60 kg ha^{-1} and F_3 -N : P : K @ 150 : 75 : 75 kg ha^{-1} was applied. The plant height was recorded at 30, 60 and 90 DAS. Five plants were selected randomly in each plot and tagged for observation. The plant height was measured from base near ground to top most tip of the plant. The measurement of all five plants was averaged to express the plant height (cm). In main field half dose of nitrogen and full dose of phosphorus and potassium were applied as basal. Rest of the nitrogen was top dressed in two equal splits at 25 days after sowing/transplanting (tillering stage) and at 50 days after sowing/transplanting (panicle initiation stage). Whereas, in nursery fertilizers was applied @ 12: 6: 4 kg N: P_2O_5: K_2O per 1000 sq m. In conventional transplanting, half dose of N and full dose of P2O5 and K2O were applied as basal and remaining N was top dressed at 15 DAS. While, in case of rice nursery for mechanical transplanting full dose of N was applied as basal. For conventional transplanting, seeds were sown in nursery and seedlings were raised by wet nursery method and 2-3 seedlings/hill (21 days old) were transplanted at 20 x 15 cm spacing. Whereas, in case of mechanical transplanting seedlings were prepared on mat type nursery and 4-5 seedlings/hill (15 days old) were transplanted at 25 x 15 cm spacing. Sprouted seeds were used for direct seeding

by broadcasting and drum seeding with 20 cm row spacing. Observations on yield attributes and yield were recorded. Collected data was statistically analyzed as per the methods by (Gomez and Gomez, 2003).

Result and Discussion

Plant height (cm)

The plant height as influenced by different crop establishment techniques and fertility levels interaction, was recorded at 30, 60 and 90 DAT, presented in Table 1. Effect of different crop establishment techniques, fertility levels, and their interaction on plant height at 30 DAT was non-significant. At 60 and 90 DAT/DAS, plant height was, however, significantly influenced, during both the years of experimentation. At 60 DAT/DAS, C_5 (SRI technique) recorded maximum plant height (79.79 and 81.57 cm in 2007 and 2009, respectively) followed by 78.24 and 79.98 cm with C1 (ICM). C_4 (drum seeder) recorded the minimum (74.20 and 75.67 cm). SRI technique of crop establishment produced tallest plants closely followed by ICM, whereas, minimum height of plants was recorded with drum seeder during both the years of experimentation. The plant height gradually increased at successive growth stages with increase in fertility level. Maximum plant height was recorded with NPK 150: 75: 75 kg ha^{-1} followed by NPK 120: 60: 60 kg ha^{-1}. Minimum plant height was recorded in the plots in which no fertilizer was applied. Combination of SRI and also produced tallest plants during both the years of experimentation. Abundant supply and availability of nitrogen, phosphorus and potassium in balanced combination as well as availability of sufficient light and spacing between the plants might have helped the plants to attain more vigour thereby increasing the plant height than lower level NPK or no fertilizer. Higher nitrogen levels also significantly increased the plant height because of enough availability of nitrogen at growing stages. These findings are in close conformity with the results reported by (Achanl, et al., 2012; Bhardwaj, R. et al. 2018; Dubey, et al., 2017).

Number of tillers $hill^{-1}$

Different crop establishment techniques, fertility levels and their interaction had non-significant effect on number of tillers $hill^{-1}$ at 30 DAT (table-2). At 60 and 90 DAT/DAS, the crop establishment techniques, fertility levels and their interaction significantly influenced the number of tillers $hill^{-1}$ during both of the experimental years. Maximum number of tillers $hill^{-1}$ was recorded with SRI technique of crop establishment at all the stages of growth. With increase in the dose of NPK from 0 to 120: 60: 60 kg ha^{-1} and 150: 75: 75 kg ha^{-1}, the number of tillers $hill^{-1}$ gradually increased at all the growth stages. Maximum number of tillers $hill^{-1}$ was recorded with SRI and NPK 150: 75: 75 kg ha^{-1}. The interacting treatment combination comprising of SRI + 150: 75: 75 kg ha^{-1} also recorded maximum number of tillers $hill^{-1}$. Higher number of tillers $hill^{-1}$ might have been possible due to more vigour and strength attained by the plants as a result of better photosynthetic activities with sufficient availability of light, spacing between the plants and supply of nutrients in balanced quantity to the plants at growing stages. Dubey, et al. (2017)) reported almost similar results in their experiments.

Dry weight (g plant^{-1})

Dry matter production was recorded maximum with SRI technique of crop establishment followed by ICM. Dry weight of plant gradually increased at successivegrowth stages with increase in the fertility level from no fertilizer to NPK 120: 60: 60 kg ha^{-1} and 150: 75: 75 kg ha^{-1}. Combination of SRI and 150: 75: 75 kg ha^{-1} also recorded maximum plant dry weight. Dry matter production with treatment combination SRI + 150: 75: 75 kg ha^{-1} was nearly 95% higher than the minimum withdrum seeder + no fertilizer. The plants attained more vigour with higher fertility level as compared tolower fertility level as well as no fertilizer, due to adequate supply and availability of nitrogen, phosphorus, potassium and FYM in balanced combination, resulting into increased dry weight of plant. Better photosynthetic activity due to greater exposure to light and increased availability of nutrients to plants with adequate spacing might have resulted into higher dry weight of plant (Jnanesha, et al., 2017).

Table : 1. Effect of different crop establishment techniques and fertility levels on plant height (cm) of rice at differentintervals

Treatment		Plant height (cm)					
		30 DAT		60 DAT		90 DAT	
		2022	2023	2022	2023	2022	2023
Crop establishment techniques (C)							
C_1	Integrated crop management	50.22	51.31	78.24	79.98	103.20	105.17
C_2	Line planting	49.34	50.43	76.77	78.46	101.73	103.63
C_3	Farmers' practice	48.24	49.26	75.95	77.63	99.54	101.45
C_4	Drum seeder	47.39	48.37	74.20	75.67	97.03	98.88
C_5	SRI technique	51.40	52.50	79.79	81.57	104.55	106.58
	S.Ed. (±)	**NS**	**NS**	**0.30**	**0.31**	**0.41**	**0.42**
	C.D. (P = 0.05)	**-**	**-**	**0.62**	**0.64**	**0.84**	**0.85**
Fertility levels (F)							
F_1	No fertilizer	45.20	46.18	70.20	71.73	93.77	95.56
F_2	N : P : K @ 120 : 60 : 60 kg ha^{-1}	48.93	49.96	77.56	79.19	101.28	103.19
F_3	N : P : K @ 150 : 75 : 75 kg ha^{-1}	53.82	54.98	83.22	85.07	108.57	110.67
	S.Ed. (±)	**NS**	**NS**	**0.24**	**0.24**	**0.32**	**0.32**
	C.D. (P = 0.05)	**-**	**-**	**0.48**	**0.49**	**0.65**	**0.66**

Table : 2 **Effect of different crop establishment techniques and fertility levels on number of tillers hill^{-1} of rice at different intervals**

Treatment		Number of tillers hill^{-1}					
		30 DAT		60 DAT		90 DAT	
		2022	2023	2022	2023	2022	2023
Crop establishment techniques (C)							
C_1	Integrated crop management	14.24	14.78	29.15	30.24	23.17	24.04
C_2	Line planting	13.83	14.35	27.55	28.57	20.57	21.33
C_3	Farmers' practice	13.33	13.81	26.41	27.39	19.87	20.60
C_4	Drum seeder	12.90	13.39	25.58	26.52	18.67	19.34
C_5	SRI technique	15.24	15.81	31.00	32.15	25.46	26.39
	S.Ed. (±)	**NS**	**NS**	**0.16**	**0.17**	**0.12**	**0.13**
	C.D. (P = 0.05)	**-**	**-**	**0.34**	**0.34**	**0.26**	**0.27**
Fertility levels (F)							
F_1	No fertilizer	11.66	12.09	19.88	20.63	14.29	14.83
F_2	N : P : K @ 120 : 60 : 60 kg ha^{-1}	13.97	14.50	27.71	28.74	21.89	22.69
F_3	N : P : K @ 150 : 75 : 75 kg ha^{-1}	16.09	16.69	36.22	37.56	28.47	29.50
	S.Ed. (±)	**1.00**	**1.03**	**0.13**	**0.13**	**0.10**	**0.10**
	C.D. (P = 0.05)	**2.04**	**2.12**	**0.26**	**0.27**	**0.20**	**0.21**

Table : 3 **Effect of different crop establishment techniques and fertility levels on dry weight (g plant^{-1}) of rice atdifferent intervals**

Treatment		Dry weight (g plant^{-1})					
		30 DAT		60 DAT		90 DAT	
		2022	2023	2022	2023	2022	2023
Crop establishment techniques (C)							
C_1	Integrated crop management	6.70	6.95	37.72	39.12	76.62	79.45
C_2	Line planting	5.71	5.92	34.97	36.27	75.01	77.77
C_3	Farmers' practice	4.91	5.12	33.02	34.24	71.69	74.33
C_4	Drum seeder	4.41	4.57	31.94	33.13	65.54	67.99
C_5	SRI technique	7.56	7.85	39.30	40.77	79.54	82.47
	S.Ed. (±)	**NS**	**NS**	**0.22**	**0.22**	**0.30**	**0.31**
	C.D. (P = 0.05)	**-**	**-**	**0.45**	**0.46**	**0.62**	**0.63**
Fertility levels (F)							
F_1	No fertilizer	3.65	3.80	28.25	29.29	59.43	61.62
F_2	N : P : K @ 120 : 60 : 60 kg ha^{-1}	4.88	5.06	34.39	35.69	72.32	75.00
F_3	N : P : K @ 150 : 75 : 75 kg ha^{-1}	9.04	9.39	43.53	45.14	89.29	92.59
	S.Ed. (±)	**1.06**	**1.10**	**0.17**	**0.17**	**0.23**	**0.24**
	C.D. (P = 0.05)	**2.17**	**2.25**	**0.35**	**0.35**	**0.48**	**0.48**

Crop growth rate (g m^{-2} day^{-1})

CGR was corresponding to the plant dry weight at all the growth stages duringboth the years. SRI recorded maximum CGR as in case of other growth parameters, followed by line planting and the minimum remained with drum seeder. It alsoregistered increase with the higher fertility level, maximum was recorded with NPK 150: 75: 75 kg ha^{-1} followed by NPK 120: 60: 60 kg ha^{-1} while the minimum was observed with no fertilizer. Combination of SRI + NPK 150: 75: 75 ha^{-1} also recordedmaximum CGR. Greater exposure to light and proper spacing between the plants leading to better photosynthetic activity and increased availability of nutrients to resulted into higher dry matter production which in turn registered better CGR. These findings are in close conformity with the results reported by (Kumar and Ladha, 2018).

Relative growth rate (g g^{-1} day^{-1})

The relative growth rate (RGR) as influenced by different crop establishment techniques, fertility levels and their interaction, worked out during 0 – 30, 30- 60 and 60 – 90 DAT is presented in Table 1. During 60 – 90 DAT, C_3 (farmers' practice) recorded maximum RGR (0.0260 and 0.0260 g g^{-1} day^{-1} in 2007 and 2009, respectively) followed 0.0255 and 0.0255 g g^{-1} day^{-1} with C_2 (line planting). C_1 (ICM) and C_5 (SRI) recorded the minimum (0.0236 and 0.0236 g g^{-1} day^{-1}). C_1 (ICM) and C_5 (SRI) were at par during both the years. RGR was corresponding to the plant dry weight at all the growth stages duringboth the years. At 0 – 30 DAT/DAS, SRI recorded maximum RGR followed by ICM and the minimum remained with drum seeder. NPK 150: 75: 75 kg ha^{-1} recorded maximum RGR followed by NPK 120: 60: 60 kg ha^{-1} while the minimum was observed with no fertilizer. Combination of SRI + NPK 150: 75: 75 ha^{-1} also recordedmaximum RGR. It also registered increase with increase of fertility level. Results reported by (Rana et. Al., 2014) are more or less similar to these findings. Out of the five techniques of crop establishment and three fertility levels tried in this experiment, system of rice intensification (SRI) (C_5) and fertility level NPK 150: 75: 75 kg ha^{-1} (F_3) was found to be the appropriate crop establishment technique and fertility level, respectively. The interacting treatment combination of SRI technique + NPK 150: 75: 75 kg ha^{-1} (C_5 F_3) maintained its superiority over all other treatment combinations in relation to growth of rice.

Table :4 **Effect of different crop establishment techniques and fertility levels on crop growth rate (g m^{-2} day^{-1}) ofrice at different intervals**

Treatment		Crop growth rate (g m^{-2} day^{-1})					
		0 - 30 DAT		31 - 60 DAT		61 - 90 DAT	
		2022	2023	2022	2023	2022	2023
Crop establishment techniques (C)							
C_1	Integrated crop management	3.58	3.71	16.54	17.16	20.75	21.51
C_2	Line planting	3.04	3.16	15.61	16.19	21.35	22.13
C_3	Farmers' practice	2.62	2.73	14.99	15.53	20.63	21.38
C_4	Drum seeder	2.35	2.44	14.68	15.23	17.92	18.60
C_5	SRI technique	4.03	4.18	16.93	17.56	21.46	22.24
	F - test	NS	NS	S	S	S	S
	S.Ed. (±)	-	-	**0.75**	**0.76**	**0.07**	**0.13**
	C.D. (P = 0.05)	-	-	**1.54**	**1.57**	**0.15**	**0.27**
Fertility levels (F)							
F_1	No fertilizer	1.95	2.02	13.12	13.60	16.63	17.24
F_2	N : P : K @ 120 : 60 : 60 kg ha^{-1}	2.60	2.70	15.74	16.33	20.23	20.97
F_3	N : P : K @ 150 : 75 : 75 kg ha^{-1}	4.82	5.01	18.39	19.07	24.41	25.31
	F - test	S	S	S	S	S	S
	S.Ed. (±)	**0.57**	**0.59**	**0.58**	**0.59**	**0.06**	**0.10**
	C.D. (P = 0.05)	**1.16**	**1.20**	**1.19**	**1.21**	**0.12**	**0.21**

Table : 5 **Effect of different crop establishment techniques and fertility levels on relative growth rate (g g^{-1} day^{-1}) ofrice at different intervals**

Treatment		Relative growth rate (g g^{-1} day^{-1})					
		0 - 30 DAT		31 - 60 DAT		61 - 90 DAT	
		2022	2023	2022	2023	2022	2023
Crop establishment techniques (C)							
C_1	Integrated crop management	0.0581	0.0593	0.0625	0.0625	0.0236	0.0236
C_2	Line planting	0.0555	0.0567	0.0625	0.0625	0.0255	0.0255
C_3	Farmers' practice	0.0504	0.0517	0.0656	0.0654	0.0260	0.0260
C_4	Drum seeder	0.0459	0.0471	0.0689	0.0690	0.0239	0.0239
C_5	SRI technique	0.0608	0.0621	0.0610	0.0609	0.0236	0.0236
	F - test	NS	NS	NS	NS	S	S
	S.Ed. (±)	-	-	-	-	**0.0001**	**0.0002**
	C.D. (P = 0.05)	-	-	-	-	**0.0002**	**0.0004**
Fertility levels (F)							
F_1	No fertilizer	0.0414	0.0427	0.0697	0.0696	0.0248	0.0248
F_2	N : P : K @ 120 : 60 : 60 kg ha^{-1}	0.0512	0.0524	0.0667	0.0667	0.0248	0.0248
F_3	N : P : K @ 150 : 75 : 75 kg ha^{-1}	0.0698	0.0710	0.0559	0.0558	0.0240	0.0240
	F - test	S	S	S	S	S	S
	S.Ed. (±)	**0.0050**	**0.0050**	**0.0050**	**0.0049**	**0.0001**	**0.0001**
	C.D. (P = 0.05)	**0.0102**	**0.0102**	**0.0102**	**0.0101**	**0.0002**	**0.0003**

Grain yield (t ha^{-1})

The grain yield per hectare worked out for different crop establishment techniques, fertility levels and their interaction is presented in Table-5. The data reveals that the grain yield was significantly influenced by different crop establishment techniques, fertility levels andtheir interaction. Maximum grain yield (6.14 and 6.37 t ha^{-1} in 1st year and 2nd year, respectively) was recorded with C5 (SRI) followed by 5.91 and 6.12 t ha^{-1} with C1 (ICM), whereas, the minimum (5.33 and 5.52 t ha^{-1}) was recorded with C4 (drum seeder). Grain yield per hectare was commensurate with yield attributes like effective tillers, number of length of panicles, number of spikelets per panicle. C5 (SRI) and F3 (NPK 150: 75: 75 kg ha^{-1}) were most appropriate and suitable crop establishment technique and fertility level for grain yield per hectare and their combination C5 F3 (SRI + NPK 150: 75: 75 kg ha^{-1}) also recorded maximum grain yield (7.35 and 7.61 t ha^{-1} in 2007 and 2009, respectively. The behavior of NPK could be explained by the fact that it is builder of protein and form the main constituents of protoplasm with induced cell division and initiated meristematic activity. The synthesis of amino acid in plant seemed to have accelerated, which is exhibited by enhanced grain yield. It is, therefore, logical to correlate the increased grain yield with the increased level of nitrogen, phosphorus and potassium.

Conclusion

On the basis of two years experimental result concluded that crop establishment through SRI technique has recorded significantly higher in growth attributes such as plant height, number of tillers, dry weight, crop growth rate, relative growth rate and yield) compared to other establishment methods during both of the years. Whereas the application of different fertility level of fertilizer F3 N : P : K @ 150 : 75 : 75 kg ha^{-1} significantly maximum growth attributes and yield of rice crop during both of the experimental year.

Table :6 Effect of different crop establishment techniques and fertility levels on test weight (g) of rice

Treatment		Test weight (g)	
		2022	**2023**
Crop establishment techniques (C)			
C_1	Integrated crop management	21.23	22.14
C_2	Line planting	20.83	21.78
C_3	Farmers' practice	20.14	21.05
C_4	Drum seeder	19.49	20.33
C_5	SRI technique	21.68	22.66
	F - test	S	S
	S.Ed. (±)	**0.05**	**0.06**
	C.D. (P = 0.05)	**0.10**	**0.13**
Fertility levels (F)			
F_1	No fertilizer	18.70	19.52
F_2	N : P : K @ 120 : 60 : 60 kg ha^{-1}	19.70	20.56
F_3	N : P : K @ 150 : 75 : 75 kg ha^{-1}	23.62	24.69
	F - test	S	S
	S.Ed. (±)	**0.04**	**0.05**
	C.D. (P = 0.05)	**0.08**	**0.10**

Reference

Bhardwaj, R., Singh, M. K., Singh, C. S. and Singh, A. K. (2018). Efficacy ofcrop establishment methods on yield and economics of rice (*Oryza sativa* L.) under puddled condition. *International Journal of Current Microbiology and Applied Sciences,* ISSN: 2319-7706, Special Issue- 7, pp. 3625-3631.

Dubey, R., Singh, D. and Mishra, A. (2017). Effect of weed management practices and establishment methods on growth, productivity and economics of rice. *International Journal of Current Microbiology andApplied Sciences.* 6(3): 65-72.

Gill, M. and Daberkow, S. (2012). Crop sequences among 1990 major field cropsand associated farm program participation. *Agricultural Resources Situation and Outlook Report* No 24, 39 – 46.

Gomez, K. A., and Gomez, A. A. 2003. Statistical Procedure for Agricultural Research. John Wiley and Sons, London. Pp. 139-167, 204-207.

Jnanesha, A.C. and Kumar. A. (2017). Effect of crop establishment methods on growth, yield and water productivity of rice. *International Journalon Agricultural Sciences,* 8 (1): 40-45.

Kumar S. S., Velu V., Balasubramanian V. and Ramanathan S. (2007). Effect of integrated crop management practices (ICM) on yield and yield attributes of rice at different rice soils of Tamil Nadu. *Research on Crops,* 8 (2) : 296 – 300.

Kumar, G.N., Singh, PK., Naresh, R.K., Chandra, M.S., Kumar, A. (2021) Effect of Planting Techniques with Organic and Inorganic Nutrient Management on Growth, Yield Attributes and Productivity of Rice (Oryza sativa L.) under Rice-Wheat Cropping System. Journal homepage. 2021; 10(01).

Ministry of Agriculture and Farmers Welfare, Govt. of India. (ON1394) 2016. State/Season-wise Area, Productionand Productivity of Rice in India(2015-2016) 2nd Advance Estimates. http://117.239.107.122:2199/ table/agticulture/2/rice/17194/1004419/data.aspx.

Singh, C.S.; Mohit, S.S.; Singh, K.; Singh, A.K. and Ashok, K.R. (2015). Growth and yield response of rice cultivars under system of rice intensification and conventional method of rice production system. Int. J. Environ. Res. 9(3&4): 1077-1081.

Singh, G., Singh, O.P., Kumar, V. and Kumar, T. (2018). Effect of method of establishment and tillage practices on productivity of rice-wheat cropping system in lowlands. Indian. J. Agric. Sci., 78:163-166.