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

Influence of crop establishment techniques and fertility level on yield attributes, yield and economics 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

ABASTRACT

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 "Influence of Different Planting System and Level of Nitrogen on Growth, Yield, Quality and Economics of Rice (*Oryza sativa* L.)". The soil of the experimental field was Sandy loam in texture having medium to poor drainage, low in available nitrogen (184.2 kg ha^{-1}), low in available phosphorus (28.4 kg ha^{-1}) and medium in available potassium (157.0 kg ha^{-1}) with 7.60 –pH. The results revealed that crop establishment through SRI technique has recorded significantly higher yield attributes such as Number of panicles hill^{-1}, Length of panicle (cm), Number of spikelets panicle^{-1} and grain yield 6.14 and 6.37 t ha^{-1} in 2021 and 2022, respectively, 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 grain yield (7.35 and 7.61 t ha^{-1} in 2021 and 2022, respectively) and economics of rice crop during both of the experimental year.

Introduction

Rice *(Oryza sativa* L.) belongs to Poaceae family. Rice is importantstaple food crop by majority (more than 60%) of world's population."Rice is life" is the most appropriate for India as rice plays a vital role in national food security and is slogan a means of livelihood for millions of rural households. India ranks first in area and second in production after China. West Bengal is the highest producing state and other leading statesare Uttar Pradesh, Punjab and Chhattisgarh. Among the cereal crops, it serves as the principal source of nourishment for over half of the global population (Davla *et al*., 2013). India occupies a pride place in rice production among the food crops cultivation in the world. India ranks first in area and second in production in after china. In Worldwide, rice is cultivated over an area of about 158.80 mm hectares with production and productivity of 700.00 million tonnes and 4.20 tonnes/ha, respectively. In India, the cultivation of rice was done over an area of about 43.79 million hectares with production and productivity of 115.60 million tonnes and 25.78 q/ha, respectively during (Anonymous, 2020). In Rajasthan Rice occupied 231.2 thousand hectares of area with the production of 633.3 thousand tonnes and average productivity was 4498 kg ha^{-1} during the year 2020-21 (GOI 2022). The method of establishment in rice is largely affects the initial stand and uniformity. Transplanting method of in rice cultivation is considered the best for higher productivity of point of view, but it is not profitable due to higher labour wages and problem of unavailability of labour during the peak period of transplanting. There are some of alternative method like system of rice intensification (SRI) and direct sowing of sprouted seeds under puddle condition, which may be helpful to improve the productivity and profitability of rice. Weeds compete with crop plants for moisture, nutrients, light, space which effects reflected in growth factors. A crop weed competition is started under direct sown unpadded, as compare to transplanted rice or direct seeded rice under puddled condition earlier, more so under direct sown conditions in rice. Rice (*Oryza sativa* L.) belongs to the family Gramineae and contains: Moisture – 13.7%, Protein – 6.8%, Minerals – 0.6%, Fibre – 0.2%, Carbohydrates – 78.2 %, Calcium – 10 mg, Phosphorus – 160 mg, Iron – 3 .1 mg, and small amount ofvitamin B complex. Rice is primarily grown by transplanting of seedlings in puddled field which is very cumbersome and labour intensive as it requires 30 man days' ha^{-1} (Prasad, 2004). It requires nursery raising, it's uprooting and supply for transplanting in the field and continuous ponding of water for the first 15 days. This leads to nutrient losses through leaching besides causing high evapotranspiration (ET) losses during the hot summer months. Flooded rice culture with puddling and transplanting is considered one of the major sources of methane (CH_4) emissions and accounts for 10-20% (50-100 t g $year^{-1}$) of total global annual CH_4 emissions (Reiner and Aulakh, 2000). Annually, 4.5 million tons of methane is emitted from paddy soils in India (Pepsico International 2011). It is imperative to identify alternative methods of rice establishment/cultivation to overcome these constraints.

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

Yield attributes

The number of effective tillers $hill^{-1}$ is presented in Table -1. The data shows that there was a significant effect of different crop establishment techniques, fertility levels and their interaction on the number of effective tillers $hill^{-1}$ during both the years of experimentation, i.e. 2021 and 2022. C_5 (SRI technique) recorded maximum number of effective tillers $hill^{-1}$ (22.02 and 23.00 in 2021 and 2022, respectively) followed by 20.45 and 21.33 with C1 (integrated crop management). C_4 (drum seeder) recorded the minimum (17.00 and 17.75). Under fertility level F_3 (NPK 150: 75: 75 kg ha^{-1}) recorded maximum number of effective tillers $hill^{-1}$ (25.35 and 26.45) followed by 18.46 and 19.27 with F2 (NPK 120: 60: 60 kg ha^{-1}). The minimum (14.28 and 14.92) remained with F_1 (no fertilizer). Highest number of effective tillers $hill^{-1}$ was observed with SRI technique of crop establishment, fertility level of NPK 150: 75: 75 kg ha^{-1}, which was found to be the appropriate crop establishment technique and fertility level, respectively. Their combination also recorded maximum number of effective tillers $hill^{-1}$. Increase in NPK from 120: 60: 60 kg ha^{-1} to 150: 75: 75 kg ha^{-1} registered significant increase in number of effective tillers $hill^{-1}$.Dubey et al., 2017 observed that greater exposure to light leading to better photosynthetic activity and increased availability of nutrients to plants due to proper spacing between plantsmight have resulted into higher number of effective tillers $hill^{-1}$. The data related to relation between different crops established methods and fertility level effect on number of effective tillers. C_5 (SRI) recorded maximum number of effective tillers m^{-2} (306.87 and 312.62 in 2007 and 2009, respectively) followed by 292.00 and 298.45 with C_1 (ICM). C_4 (drum seeder) recorded the minimum (246.33 and 251.50). F3 (NPK 150: 75: 75 kg ha^{-1}) recorded maximum number of effective tillers m^{-2} (365.80 and 372.89) followed by 264.53 and 269.22 with F2 (NPK 120: 60: 60 kg ha^{-1}). The minimum (197.80 and 202.40) remained with F_1 (no fertilizer). Greater exposure to light leading to better photosynthetic activity and increased availability of nutrients to plants due to proper spacing between plantsmight have resulted into higher number of effective tillers m^{-2}. Results reported by (Jnanesha, et al., 2017; Laik, et al., 2014; Rana et al. 2014; Bhardwaj, R. et al., 2018) are in close conformity with these findings. Maximum number of panicles $hill^{-1}$ (14.73 and 15.35 in 2007 and 2009,respectively) was recorded with C5 (SRI) followed by 14.10 and 14.71 with C1 (ICM). C_4 (drum seeder) recorded the minimum (12.57 and 13.11). Highest number of spikelet's $panicle^{-1}$ was observed with SRI technique of crop establishment, fertility level of NPK 150: 75: 75 kg ha^{-1}, which was found to be the appropriate crop establishment technique and fertility level, respectively. Their combination also recorded maximum number of spikelet's $panicle^{-1}$. Increase in NPK from 120: 60: 60 kg ha^{-1} to 150: 75: 75 kg ha^{-1} registered significant increase in number of spikelet's $panicle^{-1}$. Increase in fertility level from no fertilizer to NPK 120: 60: 60 kg ha^{-1} and NPK 150: 75: 75 kg ha^{-1} resulted into higher test weight. SRI (C5) and NPK 150: 75: 75 kg ha^{-1} (F3) were found to be the appropriate crop establishment technique and fertility level; and their

Table: 1 Effect of different crop establishment techniques and fertility levels on yield attributes of rice

Treatments	Number of effective tillers hill^{-1}		Number of panicles hill^{-1}		Length of panicle (cm)		Number of spikelets panicle^{-1}		Test weight (g)	
	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
Crop establishment techniques (C)										
C_1	20.45	21.33	14.10	14.71	27.96	29.15	200.74	209.07	21.23	22.14
C_2	19.24	20.09	13.48	14.07	27.70	28.87	199.42	207.69	20.83	21.78
C_3	18.10	18.89	12.99	13.52	27.48	28.66	197.25	205.44	20.14	21.05
C_4	17.00	17.75	12.57	13.11	27.29	28.46	195.58	203.73	19.49	20.33
C_5	22.02	23.00	14.73	15.35	28.27	29.48	204.78	213.29	21.68	22.66
C.D. (P = 0.05)	0.23	0.24	0.11	0.14	0.13	0.14	1.65	1.72	0.10	0.13
S.Ed. (±)	0.7	0.9	0.06	0.07	0.07	0.07	0.80	0.84	0.05	0.06
Fertility levels (F)										
F_1	14.28	14.92	10.76	11.20	26.77	27.91	188.90	196.74	18.70	19.52
F_2	18.46	19.27	13.55	14.17	27.77	28.96	200.78	209.13	19.70	20.56
F_3	25.35	26.45	16.41	17.08	28.68	29.89	208.98	217.66	23.62	24.69
C.D. (P = 0.05)	0.18	0.19	0.09	0.11	0.10	0.11	1.28	1.33	0.04	0.05
S.Ed. (±)	0.6	0.5	0.04	0.05	0.05	0.05	0.62	0.65	0.08	0.10

Table: 2 Effect of different crop establishment techniques and fertility levels on yield and harvest index in rice

Treatments	Grain yield (t ha^{-1})		Straw yield (t ha^{-1})		Harvest index (%)	
	2021	2022	2021	2022	2021	2022
Crop establishment techniques (C)						
C_1	5.91	6.12	8.09	8.69	42.10	41.24
C_2	5.70	5.91	7.80	8.38	42.18	41.31
C_3	5.52	5.72	7.58	8.14	42.09	41.22
C_4	5.33	5.52	7.44	7.97	41.70	40.85
C_5	6.14	6.37	8.30	8.91	42.43	41.56
C.D. (P = 0.05)	0.05	0.05	0.07	0.08	0.19	0.20
S.Ed. (±)	0.02	0.02	0.03	0.04	0.09	0.10
Fertility levels (F)						
F_1	4.86	5.04	6.78	7.28	41.76	40.90
F_2	5.56	5.75	7.85	8.42	41.45	40.60
F_3	6.75	6.99	8.90	9.56	43.09	42.22
C.D. (P = 0.05)	0.04	0.04	0.05	0.07	0.07	0.08
S.Ed. (±)	0.02	0.02	0.02	0.03	0.15	0.15

combination C5 F3 (SRI + NPK 150: 75: 75 kg ha^{-1}) was foundbest for test weight, as it recorded maximum as compared to all other treatment combinations. Higher vigour and growth attained by the plants due to sufficient absorption ofnutrients (FYM and NPK) as well as light and proper spacing might have resulted into higher test weight. Results reported by (Prasad *et al*. (2001), Anupama and Ajay (2004), Gobi *etal*. (2006) and Hugar *et al*. (2009) more or less similar to these findings.

Yield (t ha^{-1}) and harvest index (%)

The data reveals that the grain yield was significantly influenced by different crop establishment techniques, fertility levels andtheir interaction shown in table-2. Maximum grain yield (6.14 and 6.37 t ha^{-1} in 2021 and 2022, respectively) was recorded with C5 (SRI) followed by 5.91 and 6.12 t ha^{-1} with C_1 (ICM), whereas, the minimum (5.33 and 5.52 t ha^{-1}) was recorded with C_4 (drum seeder). Grain yield per hectare was commensurate with yield attributes like effective tillers, number of length of panicles, number of spikelets per panicle. C_5 (SRI) and F_3 (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 2021 and 2022, respectively). Straw yield per hectare was commensurate with grain yield. C5 (SRI) and F3 (NPK 150: 75: 75 kg ha^{-1}) were most appropriate and suitable crop establishment technique and fertility level for straw yield per hectare and their combination C5 F3 (SRI + NPK 150: 75: 75 kg ha^{-1}) also recorded maximum straw yield (9.48 and 10.18t ha^{-1} in 2021 and 2022, respectively). Maximum harvest index (42.43 and 41.56% in 2021 and 2022, respectively) was recorded with C5 (SRI) followed by 42.18 and 41.31% with C2 (line planting), whereas, the minimum (41.70 and 40.85%) remained with C4 (drum seeder). Increase in fertility level from NPK 120: 60: 60 kg ha^{-1} to NPK 150: 75: 75 kg ha^{-1} resulted into higher harvest index. SRI (C5), NPK 150: 75: 75 kg ha^{-1} (F3) and their combination C5 F3 (SRI + NPK 150: 75: 75 kg ha^{-1}) recorded maximum harvest index as compared to all other treatment combinations. Harvest index was commensurate with the grain yield and straw yield.

Economics

The data pertaining to economics of mustard crop viz., Cost of cultivation (Rs ha^{-1}), gross return (Rs ha^{-1}), net return (Rs ha^{-1}) and B:C ratio as influenced by different integrated nutrient management practices were statistically analysed and presented in Table 3. Cost of cultivation was higher under the Crop establishment techniques C_3 (Rs 38956.00) which received Farmers' practice followed by C_4 (Rs 37589.00) and under Fertility Levels N: P: K @ 150: 75: 75 kg ha^{-1} (F_3) (Rs 45237.00), respectively during the observation period. The lowest cost of cultivation was noticed in C_1 and F_1 (Rs 32568.00 and 42242.00 ha^{-1}) treatment during both the years, respectively. Gross return under Fertility level was higher under N: P: K @ 150: 75: 75 kg ha^{-1} (F_3) 95049 and 103415 Rs ha$^{-1.}$ The least value of gross return was recorded under C_4 and F_1 (Rs 80154.00 and 76150.00 ha^{-1}) during both the years, respectively.

Table 3 Effect of different crop establishment techniques and fertility levels on Economics of rice

Treatment	Cost of cultivation (ha^{-1})	Gross Return (ha^{-1})		Net return (ha^{-1})		Benefit: cost ratio	
	2021-22	2021	2022	2021	2022	2021	2022
Crop establishment techniques							
C_1	32568	98204	101108	65636	68540	3.02	3.10
C_2	36501	94252	95234	57751	58733	2.58	2.61
C_3	38956	83776	90559	44820	51603	2.15	2.32
C_4	37589	80154	105414	42565	67825	2.13	2.80
C_5	32659	107892	110356	75233	77697	3.30	3.38
Fertility levels (F)							
F_1	42242	76150	79150	33908	36908	1.80	1.87
F_2	43739	85520	94556	41781	50817	1.96	2.16
F_3	45237	95049	103415	49812	58178	2.10	2.29

The last value of gross return was recorded under C_4 and F_1 (Rs 42565.00 and 33908.00 ha-1) during both the years, respectively. These results are more or less in conformity with the findings reported by Dubey, et al. (2017). B:C ratio under Fertility level was higher at N: P: K @ 150: 75: 75 kg ha^{-1} (F_3) 2.10 and 2.29. The least value of B:C Ratio was recorded under C_4 and F_1 (Rs 2.13 and 1.80) during both the years, respectively. These results are more or less in conformity with the findings reported by Dubey, R et al. (2017).

Conclusion

The present study, it were found that crop establishment through SRI technique has recorded significantly higher yield attributes such as Number of panicles hill^{-1}, Length of panicle (cm), Number of spikelets panicle^{-1} and grain yield 6.14 and 6.37 t ha^{-1} in 2021 and 2022, respectively, 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 grain yield (7.35 and 7.61 t ha^{-1} in 2021 and 2022, respectively) and economics of rice crop during both of the experimental year.

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 and Applied 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.