The Pharma Innovation Journal 2022; 11(4): 2049-2053

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(4): 2049-2053

www.thepharmajournal.com
Received: 07-02-2022
Accepted: 16-03-2022

BD Shende
M.Sc. Student, Department of Agronomy, Dr. PDKV., Akola, Maharashtra, India

YD Chanjan
Associate Professor, Department of Agronomy, Agriculture Research Station, Achalpur, Maharashtra, India

RS Wankhade
Assistant Professor, Agriculture Research Station, Achalpur, Maharashtra, India

SM Nage
Assistant Professor, Agriculture Research Station, Achalpur, Maharashtra, India

PN Magare
Assistant Professor, Agriculture Research Station, Achalpur, Maharashtra, India

AS Lawhale
Junior Resident Assistant, Agriculture Research Station, Achalpur, Maharashtra, India

Corresponding Author:
BD Shende
M.Sc. Student, Department of Agronomy, Dr. PDKV., Akola, Maharashtra, India

Effect of fertilizer levels, spacing on yield and economics of paddy (*Oryza sativa* L.)

BD Shende, YD Chanjan, RS Wankhade, SM Nage, PN Magare and AS Lawhale

Abstract
A field experiment entitled "Effect of fertilizer levels, spacing on yield and economics of Paddy (*Oryza sativa* L.)" was conducted at Agriculture Research Station, Sakoli. The experiment was laid out in split plot design with three replication. The main plot treatments comprised of two varieties (SKL-3-1-41-8-33-15 and Sakoli-6) and sub-plot treatment comprised of combinations two levels of spacing (20 × 20 and 20 × 15 cm) and three levels of fertilizer (75%, 100% and 125% RDF).
Results reveal that the rice transplanted with rice variety SKL-3-1-41-8-33-15 recorded significantly higher yield attributes resulting into significantly more grain and straw yield over than Sakoli-6. The highest net returns of 76715 Rs. ha^{-1} with B:C ratio of 2.27 were obtained by rice variety SKL-3-1-41-8-33-15 followed by Sakoli-6 (50800 Rs. ha^{-1}) with B:C ratio 1.84 during the year of field experiment. The net monitory returns and B:C ratio were non-significant but higher for spacing 20 × 15 cm (66646 Rs. ha^{-1}) with B:C ratio 2.09 which was higher than 20 × 20 cm. Application of 125% RDF recorded significantly higher values of yield contributing characters resulting into significantly more grain and straw yield than rest of the fertilizer levels. Application of 125% RDF recorded highest net returns (67236 Rs. ha^{-1}) followed by application of 100% RDF (65010 Rs. ha^{-1}) and 75% RDF (46322 Rs. ha^{-1}) in the descending order. Whereas, B:C ratio of application of 125% (2.02) and 100% RDF (2.01) was at par with each other.
The economics of treatment combinations reveal that the highest net returns were obtained when the rice crop was transplanted with variety SKL-3-1-41-8-33-15 at spacing 20 cm x 15 cm fertilized with 125% RDF which was closely followed with variety SKL-3-1-41-8-33-15 with 20 x 15 cm spacing and fertilized with 100% RDF. While, the B: C ratio was recorded higher with rice variety SKL-3-1-41-8-33-15 at 20 × 15 cm spacing and application of 125% RDF.

Keywords: Fertilizer, spacing, paddy, economics

Introduction

Rice (*Oryza sativa* L.) is the staple food crop of India accounting for 40 per cent of the total food grain production. At the global level, India stands first in rice area with 43.90 million hectares and second in rice production with 116.42 million tons (Agricultural Statistics at a glance- 2019a). Rice production needs to be increased to meet future food requirements of increasing population day by day. The average productivity of rice in India is 2455 kg ha^{-1} against world is 4602 kg ha^{-1}. The highest average productivity of rice is 6917 kg ha^{-1} of China followed by Brazil (6210 kg ha^{-1}), Vietnam (5548 kg ha^{-1}) Indonesia (5155 kg ha^{-1}), Bangladesh (4345 kg ha^{-1}) etc. There is a need to implement improved varieties alongside integrated crop management system that include mechanization, nutrient, pest and water management.

Rice is also an important cereal food crop of Maharashtra state, which contributes 3.6 per cent of area and 2.8 per cent of production of rice at national level. Total area, production and productivity of rice were 15.47 lakh hectares, 31.37 lakh tons and 20.28 quintal ha^{-1} (Anonymous, 2020) [1]. Among the different rice growing states of India, there are regional imbalances with regard to the average yield. The reasons are more than 70 per cent of rice area is rainfed, depends on the irregular rainfall, less fertilizer uses, adoption of traditional varieties, insect and disease problems are responsible for limiting rice yields, Rice is the main food crop grown in Vidarbha region, which occupies an area of 8.36 lakh hectares with production of 14.52 lakh tones and productivity of 1745 kg ha' (Anonymous, 2020) [2]. The main reasons of low productivity and profitability are mainly *viz*., vagaries of monsoon, low fertilizer use efficiency, poor crop management and adherence of farmers to traditional crop management practices.

It is rather difficult to achieve this target with the present local low yielding varieties. Therefore, to sustain self-sufficiency in rice, additional production of 1.5 million tons is needed every year. Among the limited options, improved high yielding rice varieties is one of the proven methods currently available for stepping up the rice production significantly in sustainable manner. The success of rice cultivation depends on the exploitation of the full heterotic potential of the high yielding variety with improved package of practices such as suitable optimum plant population and optimum nutrition. The cost of improved high yielding rice seeds is not very high and need not to be replaced every season. But for increasing the production of it is very essential to optimizing the seed rate through appropriate adjustment in seedling density and planting geometry. This would definitely help a long way in popularizing the cultivation of improved high yielding rice varieties.

Among various agronomic factors for limiting yield, planting pattern is considered of great importance. The plants grown with wider spacing have more area of land around them to draw the nutrition and had more solar radiation to absorb for better photosynthetic process and hence performed better as individual plants. In densely populated rice field, the inter-specific competition between the plants is high in which sometimes results in gradual shading and lodging and thus favor increased production of straw instead of grain. Profuse tillering of the improved rice may compensate the yield due to reduction in plant population. It is therefore necessary to determine the optimum plant spacing for obtaining high yield of rice.

Among the different factors of rice productivity, desired number of plant and spacing per unit area is an important one for getting higher yield. Improper spacing reduces rice yield up to 20-30 per cent (IRRI, 1997), while optimum spacing ensures better plant growth through efficient utilization of solar radiation and nutrients (Mohaddesi *et al.*, 2011) [8]. Plant spacing directly affects the normal physiological activities through intra-specific competition. Proper planting geometry has more advantages such as maximizes light utilization efficiency, improves aeration within crop canopy, enhances soil respiration and provides better weed control thereby higher crop yield. Maintenance of a critical level of rice plant population in field is necessary to maximize grain yield.

Methodology

Experiment was conducted at Agronomy farm, Agriculture Research Station, Sakoli Dist. Bhandara (M.S.) during *Kharif* season of the year 2020-21. The soil of experimental plot was clay loam in texture, slightly acidic in reaction with high organic carbon content. It was medium in available nitrogen, low in available phosphorus and high in available potassium during the years of experimentation. Geographically it is situated in the subtropical region at 21° 08' N latitude and 79°.98' E longitude having elevation of about 233 m above mean sea level. The climate is sub-tropical which is characterized by warm and humid atmosphere. The relative humidity during entire crop season ranged from 65 to 93 per cent during morning and 30 to 72 per cent during afternoon, respectively during the *kharif* 2020. An amount of 1519.40 mm of annual rainfall was received during the cropping season from June-2020 onward against the average of annual rainfall 1716.40 mm. During the crop growth period, an amount of 1520 mm of rainfall in 100 rainy days was received throughout the crop growth during 2020. A highest intensity rainfall recorded during 33 and 34 Meteorological Week (345.2 and 180.0 mm), respectively

The field experiment was laid out is split plot design comprising of 36 treatment combination replicated thrice. The main plot comprising of two varieties (SKL-3-1-41-8-33-15 and Sakoli-6) and sub plot comprising of three levels of fertilizes (75, 100 and 125% RDF) against RDF: 100 kg N + 50 kg P_2O_5 + 50 kg K_2O ha^{-1} and two spacing (20 X 20 and 20 X 15 cm). The nursery area for raising the seedlings of SKL-3-1-41-8-33-15 was ploughed and subsequently brought under fine tilth with the help of tractor drawn rotavator. The raised bed of 10 m length, 1 m breadth and 10 cm height were prepared. A well decomposed FYM @ 1 kg $sq.m^{-1}$ was spread over the beds and mixed with the soil. Urea @ 1 kg and single super phosphate @ 3 kg per 100 $sq.m^{-1}$ were applied at the time of sowing. The seed of rice SKL-3-1-41-8-33-15 which was treated with thiram @ 3 g kg^{-1} was sown in the lines 10 cm apart at 2-3 cm depth on 13 July, 2020. Germination started from the third day and completed by the fifth day. Top dressing with urea @ 1 kg per 100 m area was done 15 days after sowing. The required plant protection and weed control measures were carried out in the nursery during the seasons land preparation as per recommended tillage. Fertilizer applications were done as per the treatment. Basal dose of 50 per cent nitrogen (urea) along with full dose of phosphorus (single super phosphate) and potash (muriate of potash) was applied at the time of transplanting. The remaining 25 per cent nitrogen was applied at maximum tillering stage and another 25 per cent at panicle emergence stage as per the treatments.

Imidacloprid 17.8 SL @20 ml per 10 liter of water and lambda Cyhalothrin 5% EC @ 20 ml per 10 liter of water was sprayed to protect the crop against Rice Brown plant Hopper and rice stem borer respectively. The harvest index (%) was calculated as HI (%) = Grain yield / Total biological yield x 100 data collected were subjected to the statistical analysis by using Analysis of variance' technique. Wherever 'F' test revealed significant treatment effects, critical difference was worked out at five per cent level of probability for the treatment comparison (Panse and Sukhatme, 1967). Data have been suitably illustrated with graphs at appropriate places in the text. The gross monetary returns in rupees per hectare were worked out on the basis of prevailing market prices for the grain and straw. Similarly, the total cost of cultivation of the crop under the individual treatment was worked out by direct-indirect cost method. The net returns were calculated by deducting the total cost of cultivation from the gross returns per hectare. B:C ratio was calculated by dividing gross returns with total cost of cultivation.

Result and Discussion

Table 1: Yield contributing characters of rice as influenced by different treatments.

Treatments	Numbers of effective tillers plant^{-1}	Length of panicle (cm)	Numbers of filled grains panicle^{-1}	Numbers of unfilled grains panicle^{-1}	Test weight (g)
A] Main plot					
1] Varieties					
V_1- SKL-3-1-41-8-33-15	15.38	25.07	228.42	11.85	26.33
V_2- Sakoli-6	12.49	23.67	176.72	9.91	22.20
S.E (m) ±	0.47	0.23	2.31	0.30	0.25
C.D at 5%	2.86	1.40	14.03	1.81	1.50
2] Spacing					
S_1- 20 × 20 cm	13.51	24.28	200.86	9.63	23.95
S_2- 20 × 15 cm	14.36	24.46	204.28	12.13	24.58
S.E (m) ±	0.47	0.23	2.31	0.30	0.25
C.D at 5%	NS	NS	NS	NS	NS
B} Sub plot					
3] Fertilizer levels					
F_1 – 75% RDF	11.39	23.44	178.97	13.83	22.02
F_2 - 100% RDF	14.94	24.68	213.99	9.78	24.93
F_3 – 125% RDF	15.49	24.99	214.75	9.03	25.86
S.E (m) ±	0.65	0.41	10.12	0.68	0.83
C.D at 5%	1.92	1.21	29.86	2.02	2.45

The length of panicle (cm) of rice variety SKL-3-1-41-8-33-15 was significantly more as compared to the second variety of rice Sakoli-6. The highest length of panicle (cm) of rice variety SKL-3-1-41-8-33-15 was 25.07 cm recorded at harvest while the lowest length of panicle (cm) was 23.67 cm observed with Sakoli-6. Similar results were confirmed by Mamun *et al*. (2010) and Damor (2017) [7, 4]. The length of panicle (cm) of rice was not significantly influence by different type of spacing. Application of 125% RDF recorded significantly a highest length of panicle (cm) than all the remaining levels of fertilizer at harvest. However, the treatment with application of 125% RDF and 100% RDF were at par. The highest length of panicle 24.99 (cm) of rice was noted at harvest with 125% RDF. Similar results were recorded by Banerjee and Pal (2011) [3].

The highest mean number of filled grains panicle^{-1} of rice variety SKL-3-1-41-8-33-15 was 228.42 recorded at harvest while the lowest mean number of filled grains panicle^{-1} was 176.72 recorded with Sakoli-6 at harvest observation. Similar findings were recorded by Kumar *et al*. (2017) [6]. The number of filled grains panicle^{-1} of rice was not significantly influence by different type of spacing. Application of 125% RDF recorded significantly a highest number of filled grains panicle^{-1} than the remaining levels of fertilizer at harvest. However, the treatment 125% RDF and 100% RDF were at par with each other. Similar findings were noted by Pawar (2017) [10].

The significantly highest mean number of unfilled grains panicle^{-1} of rice variety SKL-3-1-41-8-33-15 was 11.85 recorded at harvest while the mean number of filled grains panicle^{-1} was 9.91 recorded with Sakoli-6 at harvest observation. Similar results were recorded by Damor (2017) [4]. Same parameter was not significantly influence by different type of spacing. Application of 125% RDF recorded significantly a lesser number of unfilled grains panicle^{-1}fallowed by application of 100% and 75% RDF. Similar findings were recorded by Kumar *et al*. (2017) [6].

The mean test weight of rice variety SKL-3-1-41-8-33-15 was significantly more as compared to the second variety of rice Sakoli-6, the test weight of rice was not significantly influence by different type of spacing. Application of 125% RDF recorded significantly higher test weight fallowed by application of 100% and 75% RDF except application of 100% RDF which was statistically at par with 125% RDF. The number of filled grains panicle^{-1} of rice was not significantly influence by different type of spacing. Similar findings were confirmed by Paramasivan *et al*. (2016) [9].

Table 2: Grain yield, straw yield (q ha^{-1}) and harvest index (%) of rice as influenced by the different treatments.

Treatments	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Harvest Index (%)
A] Main plot			
1] Varieties			
V_1- SKL-3-1-41-8-33-15	52.76	62.73	45.68
V_2- Sakoli-6	42.60	51.44	45.29
S.E (m) ±	0.64	1.05	-
C.D at 5%	3.88	6.37	-
2] Spacing			
S_1- 20 × 20 cm	46.33	56.32	45.13
S_2- 20 × 15 cm	49.04	57.86	45.87
S.E (m) ±	0.64	1.05	-
C.D at 5%	NS	NS	-
B} Sub plot			
3] Fertilizer levels			
F_1 – 75% RDF (75:37:37 kg ha^{-1})	42.08	52.06	44.70
F_2 - 100% RDF (100:50:50 kg ha^{-1})	49.80	58.82	45.85
F_3 – 125% RDF (125:63:63 kg ha^{-1})	51.16	60.38	45.87
S.E (m) ±	2.17	2.30	-
C.D at 5%	6.39	6.79	-

The rice variety SKL-3-1-41-8-33-15 was recorded 52.76 q ha^{-1} mean grain yield followed by 42.60 q ha^{-1} with Sakoli-6. Similar results were recorded by Kumar *et al.* (2017) [6]. The mean grain yield of rice was not significantly influence by different type of spacing. The mean grain yield of rice at spacing 20 × 20 cm was 46.33 (q ha^{-1}) and for 20 × 15 cm was 49.04 (q ha^{-1}) at harvest. Application of 125% RDF recorded significantly highest mean grain yield (q ha^{-1}), while application of 125% RDF was statistically at par with application 100% RDF. The mean grain yield of rice was 42.08, 49.80 and 51.16 q ha^{-1} at 75, 100 and 125% RDF respectively. Similar findings were confirmed by Shende *et al.* (2019).

The rice variety SKL-3-1-41-8-33-15 (V1) gave significantly higher straw yield over Sakoli-6. The mean straw yield of rice variety SKL-3-1-41-8-33-15 was recorded 62.73 q ha^{-1} while the mean straw yield was recorded 51.44 q ha^{-1} with Sakoli-6 The mean grain yield (q ha^{-1}) of rice was not significantly influence by different type of spacing. The mean straw yield of rice was significantly influence due different levels of fertilizer. With application of 125% RDF was statistically at par with application 100% RDF. The mean straw yield of rice was 52.06, 58.82 and 60.38 q ha^{-1} at 75,100 and 125% RDF respectively. Similar findings were recorded by Shende *et al.* (2019). The harvest index was higher in rice variety SKL-3-1-41-8-33-15 than rice variety sakoli-6, 20 × 15 cm and application of 125% RDF.

Table 3: Economics of rice cultivation as affected by the different treatments

Treatments	GMR (Rs. ha^{-1})	COC (Rs. ha^{-1})	NMR (Rs. ha^{-1})	B:C ratio
A) Main plot				
1) Variety				
V1 – SKL-3-1-41-8-33-15	137069	60381	76715	2.27
V2 – Sakoli-6	110681	59881	50800	1.84
SE (m) ±	1655	-	1655	-
CD at 5%	10070	-	10070	-
2) Spacing				
S_1- 20 × 20 cm	120373	59131	61242	2.04
S_2- 20 × 15 cm	127377	60731	66646	2.09
SE (m) ±	1655	-	1655	-
CD at 5%	NS	-	NS	-
B) Sub-plot				
3) Fertilizer doses				
F1- 75% RDF	109369	63047	46322	1.73
F2- 100% RDF	129363	64353	65010	2.01
F3 – 125% RDF	132892	65656	67236	2.02
SE (m) ±	5616	-	5616	-
CD at 5%	16568	-	16568	-

The gross monitory return recorded with rice variety SLK-3-1-41-8-33-15 (137069 Rs. ha^{-1}), spacing of 20 cm × 15 cm (120373 Rs. ha^{-1}) and application of 125% RDF (132892 Rs. ha^{-1}), respectively. The net returns with rice variety SLK-3-1-41-8-33-15 (76715 Rs. ha^{-1}) was gained higher than Sakoli-6 (50800 Rs ha^{-1}). The higher net returns were associated with the spacing of 20 × 15 cm (66646 Rs ha^{-1})) which was closely followed by the spacing of 20 ×20 cm (61242 Rs ha^{-1}). The application of 125% RDF (67236 Rs ha^{-1}) recorded higher value of net returns. The B:C ratio was higher with rice variety SLK-3-1-41-8-33-15 (2.27) with spacing 20 cm × 15 cm gave higher B:C ratio (2.09) along with application of 125% RDF (2.02). Similar results were confirmed by Shende *et al.* (2019) [11].

The highest net returns and B:C ratio were obtained when the rice was transplanted with variety SKL-3-1-41-8-33-15, 20 x 15 cm spacing and fertilized with 125% RDF which followed by rice variety SKL-3-1-41-8-33-15, 20 x 15 cm spacing and 100% RDF.

References

1. Anonymous. Agricultural statistics at glance-2019a, Normal Estimates (Average of 2013-14 to 2017-18) of Area, Production and Yield of Major Crops in India, 2019a, pp 44
2. Anonymous. Second advance estimates of area, production & productivity of principal kharif and rabi crops during 2020-21 in M.S., Ministry of Agriculture, Government of India, 2020.
3. Banerjee H, S Pal. Effect of planting geometry and different levels of nitrogen on hybrid rice. Oryza, 2011;48(3):274-275.
4. Damor Kavita S. Evaluate the performance of rice varieties (*Oryza* sativa L.) under different spacing and age of seedling in south Gujrat conditions. M.Sc. (Agri.), Thesis submitted to Navsari Agril. Univ. Navsari, 2017.
5. IRRI (International Rice Research Institute). *Rice Production Manual*: 95. UPLB, Los Banos, the Philippines, 1997.
6. Kumar S, S Kour, M Gupta, D Kachroo, H Singh. Influence of rice varieties and fertility levels on performance of rice and soil nutrient status under aerobic conditions. J. Appl. Nat. Sci. 2017;9(2):1164-1169.
7. Mamun AA, Sarkar MAR, Uddin FM Jamil. Effect of variety, number of seedling plant-1 and fertilizer application on the growth and yield offine rice under late transplanted condition. J. Agroforestry and Environ. 2010;4(2):177-180.
8. Mohaddesi A, A Abbasian, S Bakhshipour, H Aminpanah. Effect of different levels of nitrogen and plant spacing on yield, yield components and physiological indices in high yield rice. Amer-Eur J. agric. environ. 2011;10:893-900.
9. Paramasivan M, V Arunkumar, N Senthilkumar. Effect of nutrient levels on productivity, profitability and soil fertility in rice (*Oryza* sativa L.) in alfisols of

Tambiraparani tract. Madras Agric. J. 2016;103(1-3):31-34.
10. Pawar SB. Study the response of hybrid rice (Oryza sativa L.) to the age of seedlings at transplanting, spacing and levels of fertilizer under South Konkan condition on lateritic soil having low to moderate soil fertility status. Ph.D. Thesis Submitted to Dr. B.S.K.K.V., Dapoli, Ratnagiri, India (MS), 2017.
11. Shende SM, VB Gedam, AV Satpute, NV Kashid. Response of dry seeding of kharif paddy (*Oryza sativa* L.) varieties to different fertilizer levels on economics. IJCS. 2020;8(6):1872-1876.