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Influence of SRI Cultivation on Seed Yield and Quality in Short Duration Rice Variety

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ABSTACT An investigation to evaluate the Influence of system of rice intensification (SRI) on seed yield, quality in rice was carried out in ES-18 a short duration variety at Agricultural Research Station Gangavati during *rabi* 2004-05. SRI method of cultivation, application of FYM and RDF significantly increased the growth parameters such as number of tillers, productive tillers, days to 50% flowering, seed yield and seed quality parameters. Under SRI method, the days to 50 per cent flowering and maturity were four to five days earlier, compared to traditional method. Number of tillers per plant (21.79) and productive tillers per plant 19.53 were higher in SRI method. RDF application also significantly contributed to the total number of spikelets and filled spikelet production. SRI method produced significantly higher (2.88 t ha^{-1}) seed yield over traditional method. Seed germination did not differ significantly among methods of cultivation and manures and fertilizer application and vigour index recorded significantly higher values in SRI method.

Key words: SRI, traditional cultivation, seed yield and seed quality

Rice cultivation is a high water-demanding farming enterprise. It is estimated that around 50 per cent of total irrigation water available is used for rice cultivation. Inadequate rainfall, lack of water harvesting measures and improper use of water for agriculture, have brought down the per capita availability of water in many countries including India. The depletion of ground water and inadequate water in the reservoirs has forced many farmers to abandon rice cultivation. Therefore, the future of rice cultivation mostly depends on developing and adopting technologies, which would ensure the efficient water use.

In recent years, water table is running down at a very rapid rate throughout the globe, thus, sending alarming threats to limiting the scope for cultivation of high water required crops seriously. Rice being the crop having high water requirement, there is a need to search for alternate methods to reduce water requirement of rice without reduction in the yield. In recent years, with the introduction of new aerobic rice technology in rice cultivation, it has become possible to get reasonably good yields with two to three irrigations, thus resulting in saving of 30-40 per cent of water.

System of rice intensification (SRI) is the method, developed in Madagascar in the early 1980's, where, it has been shown that yields can be enhanced by suitably modifying certain management practices such as controlled supply of water, planting of younger seedlings and providing wider spacing [1]. The main objective of SRI is to enhance the productivity by better utilization of resources *viz.*, land, labour, capital and water. This methodology is gaining momentum all over the world, although it is in a budding stage in India. SRI method of cultivation is said to promote greater root growth and higher soil biological activity in the rhizosphere. By adopting this system of cultivation we can save water, protect soil productivity, save environment by checking

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methane gas from water submerged paddy cultivation practices, bring down the input cost, besides, increasing the production for providing food to the growing population. Keeping the above views in mind, a study on "Influence of System of Rice Intensification (SRI) on seed yield, quality in ES-18 rice variety" was undertaken to find out the suitability of SRI method of cultivation over traditional method for obtaining higher yield and quality seeds.

MATERIALS AND METHODS

This study was carried out at Agricultural Research Station, Gangavati during *rabi* season of 2004-05. The seeds of ES-18 rice variety (duration of 100-110 days) collected from Agricultural Research Station, Gangavati were used for the experiment. The main plots are methods of cultivation (C_1. Traditional method C_2: System of rice intensification (SRI), sub plots :Manures M_1:FYM @ 101 ha^{-1} and M_2: Vermicompost @ 5 t ha^{-1}) and sub-sub plots: Fertilizers (NPK) (F_1:Recommended dose of fertilizer (150:75:75 NPK Kg/ha for Gangavati area) (RDF), F_2:50 per cent recommended dose of fertilizer and F_3: Without fertilizer). The experiment was laid out in double split design with three replications. In SRI method, the raised dry nursery beds of 1.0 m length and 1.2 m width and 0.1 m height were prepared by adding required quantity of farmyard manure. Recommended dose of fertilizers (1.0, 0.5 and 0.5 kg urea, single super phosphate and muriate of potash, respectively per 100 m^2 area) were incorporated in beds as per the nursery area. Drainage channels were provided all along the bed to drain out the excess water. On the nursery beds, sprouted seeds were sown sparsely and covered with thin layer of soil. The nursery beds were watered with a rose can daily in the morning and evening. The main field was prepared by ploughing twice followed by thorough puddling. The organic manures *viz.*, farm yard manure @ 10 tonnes per ha and vermicompost @ 5 tonnes per ha were incorporated into the soil as per the treatments two weeks before planting in both SRI and traditional methods. The fertilizers N, P_2O_5 and K_2O at 150:75:75 NPK kg ha^{-1} were applied in accordance with the treatments. Eight days old seedlings were transplanted in the main field in square pattern at a spacing of 30 x 30 cm with single seedling per hill. Eighty per cent field capacity was maintained throughout the vegetative phase. This was achieved by irrigating the field at fine cracks stage. From flowering to 10-12 days before harvesting, a thin film of water was maintained continuously by frequent irrigation. The rotary weeder was employed 15 days after transplanting (DAT). Irrigation was given on the previous day to facilitate smooth functioning of weeder. During the entire crop growth period weeding with rotary weeder was done four times at the interval of eight days in both the directions. Only one manual weeding was taken up at peak tillering stage to remove weeds around the clumps. Separate land preparation and cultural practices were followed in traditional method of cultivation. Observations on growth parameters *viz.*, tiller number, leaf area per plant and dry matter per plant at harvest were recorded. Yield components like filled spikelets per panicle, spikelet sterility and seed yield per ha were calculated. Pure seed fractions of freshly harvested seeds were used to assess the seed quality parameters.

RESULTS AND DISCUSSION

The number of tillers per plant was significantly higher in SRI method of cultivation and application of recommended dose of fertilizer (RDF) treatments at harvest. However, application of manures did not influence the tiller production. Planting in square method with wider spacing might have resulted in profuse tillering under SRI cultivation, which might have facilitated plants for better utilization of the resources. This advantage of SRI method in enhancing tiller numbers has been reported earlier [2]. The increase in the productive tillers with SRI method was to the extent of 153 per cent over traditional method and 35 per cent with RDF over no fertilizer (Table 1). The increase in the productive tillers per plant might be due to the better spacing provided to the plants by planting in square method. This might have facilitated better utilization of resources by the plants converting majority of the tillers into productive tillers [3, 4].

Table 1. Effect of methods of cultivation, manures and fertilizers on seed yield and seed quality parameters

Treatment	No. of tillers/ plant	No. of productive tillers/plant	Days to 50% flowering	Seed yield (t/ha)	Cost: benefit ratio	Germination %	Vigour index
Methods of cultivation (C)							
C_1	21.79	19.53	93.9	2.88	1.44	97.3(80.5)*	2314
C_2	10.18	7.49	98.8	2.28	1.14	96.9(79.8)	2050
SEm±	1.82	0.36	0.1	0.18	0.05	0.6	7
CD(p=0.05)	5.46	1.08	0.3	0.54	0.15	NS	21
Manures (M)							
M_1	17.32	15.38	96.3	2.67	1.34	97.2(80.3)	2239
M_2	14.55	11.65	96.4	2.49	1.25	96.9(79.8)	2125
SEm±	1.75	0.61	0.2	0.13	0.12	0.50	5
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS
Fertilizers (F)							
F_1	18.36	16.70	95.5	2.95	1.48	97.3(80.5)	2337
F_2	16.13	13.16	96.5	2.73	1.37	97.1(80.1)	2199
F_3	13.47	10.67	97.0	2.07	1.04	96.8(79.6)	2020
SEm±	2.44	0.75	0.1	0.16	0.17	0.70	24
CD(p=0.05)	7.12	2.25	0.3	0.48	0.54	NS*	72

Methods of cultivation: C_1= SRI method, C_2= Traditional method; Manures: M_1 = FYM @ 10 t ha, M_2= Vermicompost @ 5 t ha; Fertilizers: F_1 = RDF, F_2= 50% RDF, F_3= No fertilizer; NS = Non significant; *Values in parenthesis are arc sin transformation values

The rice variety Es-18 took 93.9 days for 50 per cent flowering, in SRI method as compared to 98.8 days in traditional method. The early flowering in SRI method might be attributed to transplanting of younger seedlings, which might have established quickly in the field and started growing at a faster rate. Similar observations of early flowering with younger seedlings were conformed by Raju *et al.* [5] and Biradarpatil [6]. The number of days taken for 50 per cent flowering was decreased significantly with the application of FYM. The probable reason might be the application of FYM resulted in the development of efficient photosynthetic structure which enabled the plants to intercept higher quantity of radiant energy resulting in higher dry matter production, early initiation and greater development of reproductive system. Application of RDF enhanced the days to 50 per cent flowering compared to other doses of fertilizers. Plants grown under SRI method with FYM and RDF flowered and matured early as compared to other treatment interactions. In SRI method, the young seedlings were transplanted along with intact soil, thus making the plants to establish quickly and grow at a faster rate.

SRI method has recorded significantly higher seed yield ha^{-1} (2.88t ha^{-1}) as compared to traditional method (2.28t ha^{-1}). The per cent increase in seed yield ha^{-1} under SRI method was 20.25 over traditional method. These results are in conformity with the findings of Krupakar Reddy [7] and Udaykumar [2]. SRI method provides better aeration, more spacing, and less competition, which enabled the plants to grow vigorously. The plants in SRI method had better partitioning of dry matter, which lead to increase

Table 2. Interaction effects due to methods of cultivation, manures and fertilizers on seed yield and seed quality parameters

Treatment	No. of tillers/ plant	No. of productive tillers/plant	Days to 50% flowering	Seed yield (t/ha)	Cost: benefit ratio	Germination %	Vigour index
Interactions of C x M							
C_1M_1	23.21	23.18	93.6	3.01	1.51	97.5(80.9)*	2351
C_1M_2	20.37	15.89	94.2	2.76	1.38	97.2(80.3)	2276
C_2M_1	11.63	7.58	98.9	2.33	1.17	97.1(80.1)	2127
C_2M_2	8.74	4.41	98.6	2.23	1.12	96.8(79.6)	1973
SEm±	2.48	0.87	0.2	0.19	0.18	0.5	28
CD(p=0.05)	7.44	2.61	0.6	0.57	0.54	NS	87
Interactions of C x F							
C_1F_1	25.67	24.22	93.3	3.33	1.67	97.7(81.2)	2504
C_1F_2	23.10	19.14	93.8	3.17	1.59	97.3(80.5)	2329
C_1F_3	16.67	15.24	94.8	2.19	1.10	97.1(80.1)	2108
C_2F_1	1 1 .06	9.19	97.8	2.60	1.30	97.1(80.1)	2151
C_2F_2	9.16	7.19	99.7	2.29	1.15	97.1(801)	2068
C_2F_3	10.33	6.10	99.7	1.94	0.97	96.6(79.3)	1931
SEm±	3.03	1.07	0.2	0.27	0.22	0.5	45
CD(p=0.05)	9.09	3.21	0.6	0.90	0.66	NS	135
Interactions of M x F							
M_1F_1	18.67	17.81	95.8	3.02	1.51	97.6(80.0)	2399
M_1F_2	16.15	14.65	96.3	2.86	1.43	97.2(80.3)	2249
M_1F_3	17.44	13.67	96.8	2.12	1.06	97.1(80.1)	2071
M_2F_1	18.06	15.59	95.3	2.87	1.44	97.1(80.1)	2256
M_2F_2	16.11	11.68	96.7	2.60	1.30	97.1(80.1)	2149
M_2F_3	9.50	7.67	97.2	2.01	1.01	96.7(79.5)	1969
SEm±	3.03	1.07	0.2	0.23	0.22	0.5	45
CD(p=0.05)	NS	NS	0.6	NS	NS	NS	NS

Methods of cultivation: C_1= SRI method, C_2= Traditional method; Manures: M_1 = FYM @ 10 t ha, M_2= Vermicompost @ 5 t ha; Fertilizers: F_1 = RDF, F_2= 50% RDF, F_3= No fertilizer; NS = Non significant; *Values in parenthesis are arc sin transformation values

in the number of filled spikelets and decrease in the spikelet sterility. Application of FYM @ 10t ha^{-1} resulted in higher seed yield compared to vermicompost. The treatment RDF also recorded significantly higher seed yield of 2.95 t ha^{-1} compared to no fertilizers (2.07t ha^{-1}). These results are in conformity with findings of Udaykumar [2].

Significantly higher C:B ratio was observed under SRI method as compared to traditional method. The earlier studies on economics of SRI cultivation also indicated higher profit with this method of cultivation [4, 8].

Seed germination did not vary significantly due to methods of cultivation, manures and

Table 3. Interaction effects due to methods of cultivation, manures and fertilizers on seed yield and seed quality parameters

Treatment	No. of tillers/ plant	No. of productive tillers/plant	Days to 50% flowering	Seed yield (t/ha)	Cost: benefit ratio	Germination %	Vigour index
Interactions of C x M x F							
$C_1M_1F_1$	26.22	26.35	93.3	3.40	1.70	98.1(82.0)	2565
$C_1M_1F_2$	22.20	22.00	93.3	3.36	1.68	97.3(80.5)	2338
$C_1M_1F_3$	21.22	21.18	94.3	2.26	1.13	97.1(80.1)	2152
$C_1M_2F_1$	25.11	22.09	93.3	3.19	1.60	97.3(80.5)	2444
$C_1M_2F_2$	24.00	16.28	94.3	2.97	1.49	97.2(80.3)	2321
$C_1M_2F_3$	12.00	9.30	95.2	2.13	1.07	97.1(80.1)	2065
C_2F_1	11.11	9.27	98.3	2.65	1.33	97.1(80.1)	2231
$C_2M_1F_2$	10.00	7.30	99.3	2.35	1.18	97.1(80.1)	2160
$C_2M_1F_3$	13.67	6.17	99.3	1.99	1.00	97.0(80.0)	1989
$C_2M_2F_1$	11.00	9.10	97.3	1.55	0.78	97.0(80.0)	2069
$C_2M_2F_2$	8.22	7.08	99.3	2.23	1.12	97.0(80.0)	1977
$C_2M_2F_3$	7.00	6.07	99.3	1.90	0.95	96.3(78.9)	1873
SEm±	4.29	1.51	0.3	0.33	0.25	0.8	18
CD(p=0.05)	NS	NS	0.9	NS	NS	NS	NS

Methods of cultivation: C_1= SRI method, C_2= Traditional method; Manures: M_1 = FYM @ 10 t ha, M_2= Vermicompost @ 5 t ha; Fertilizers: F_1 = RDF, F_2= 50% RDF, F_3= No fertilizer; NS = Non significant; *Values in parenthesis are arc sin transformation values

fertilizers. Seeds produced under SRI method showed significantly higher vigour index value (2314) as compared to that observed under traditional method (2050). The FYM and RDF also enhanced the vigour index significantly in all the treatments. The application of FYM and RDF under SRI cultivation produced better quality seeds. The better filling of seeds was due to accumulation of better food reserves in the seeds. These results are in agreement with the observations of Nandisha and Mahadevappa [9] and Udaykumar [2].

Plants grown under SRI method with FYM and RDF treatments flowered and matured early compared to other interactions. The probable reason could be delayed accumulation of threshold levels of photosynthetic substances that transforms the plant from vegetative to reproductive phase [10]. Supply of more P and K fertilizers in RDF, might have helped in plants flower early [6]. The interaction of SRI method with FYM (23.18) and SRI method with RDF (24.22) recorded significantly higher productive tillers per plant (Tables 2 & 3). In the present investigation, the seed yield ha^{-1} was significantly higher in SRI method compared to traditional method. This might be due to higher input efficiency under SRI method of cultivation. SRI method provides better aeration, more spacing, and less competition, which enabled the plants to grow vigorously. The plants in SRI method had better partitioning of dry matter, which lead to increase in the number of filled spikelets and decrease in spikelet sterility. It is also clear from the present investigation that application of FYM along with RDF under SRI method resulted in higher cost benefit ratio. The application of FYM and RDF under SRI cultivation produced seeds with better quality.

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