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Effect of paddy straw mulch and different nutrient sources on yield and economics of rice-potato sequence

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Abstract
A two years (2020-21 and 2021-22) field study was carried out at ICAR-CPRI-RS, Gwalior, to evaluate the effect of paddy straw mulch and different sources of nutrients on yield and economics of rice - potato cropping system. The experiment was conducted in randomized block design with three replications. The treatment combination consisted of two factors such as paddy straw mulch and different sources of nutrients. Data revealed that the significant difference was observed with paddy straw mulch on effective tillers (316.2 and 318.3 m^2), panicle length (22.2 and 22.9 cm), weight/panicle (3.23 and 3.36 g), filled grains/panicle (107.4 and 111.0) and grain yield (2699 and 2768 kg/ha) in rice during 2020-21 and 2021-22, respectively. Application of paddy straw mulch recorded higher tuber/plant (8.55 and 9.58), weight of tuber/plant (409.4 and 417.7), dry tuber weight/plant (72.3 and 74.0) and tuber yield (23.16 and 23.79 t/ha) in potato during 2020-21 and 2021-22, respectively as compare to non-mulched treatment. Application of 100% RDF (NPK) through inorganic sources gave highest yield attributing characters and yield of both crops (rice and potato) which was significantly superior over other treatments. Test weight (1000 grain weight) of rice was not varied significantly under different treatments. The highest rice grain yield of 3754 and 3857 kg/ha during 2020-21 and 2021-22 were recorded with 100% RDF (NPK) which was 24.88 and 23.41% higher than FYM @ 25 t/ha + Jeevamrut @ 500 l/ha during 2020-21 and 2021-22, respectively. The highest tuber yield of 25.72 and 27.14 t/ha were recorded during 2020-21 and 2021-22 which was 8.98 and 11.68% higher than FYM @ 25 t/ha + Jeevamrut @ 500 l/ha during 2020-21 and 2021-22. Paddy straw mulch @ 5 t/ha with 100% RDF (NPK) resulted in higher rice grain and potato tuber yield than without mulched treatment. But differences among the interaction of treatments did not reach to the level of significance. Application of FYM @ 25 t/ha + Jeevamrut @ 500 l/ha with paddy straw mulch @ 5 t/ha obtained the highest net returns (₹ 44012 and 50820 ha) in rice and (₹ 231304 and 259822 ha) in potato during 2020-21 and 2021-22, respectively. Thus organic production of rice – potato sequence proved economically viable option.

Keywords: Paddy straw mulch, nutrient sources, rice, potato and economics

Introduction
In India, the rice-based cropping system is a major food production system with rice as the first food crop. The cereal-based cropping system is low-yielding and highly nutrient exhaustive resulting in the declining of soil fertility. Fertilizers have an important role in enhancing food production and quality especially after the introduction of high yielding and fertilizer responsive varieties. From most of the major crops study, it is contented that organic sources of nutrient may be one of the important option for rice-potato system in general but potato in particular which respondent make to organic treatments. Rice - rice based cropping system are of prime importance in global food production especially in south-east Asia. There has been a decline in productivity of rice in India; this decline has been attributed to continuous mono-cropping of rice and excessive dependence on chemical fertilizers that has led to decrease in soil "N" and degradation of soil. Use of imbalanced and inadequate chemical fertilisers by farmers has also deteriorated soil health resulting in decline of crop response to recommended dose of N fertilizers and declines soil organic carbon content, which is posing increased sustainability threats. In addition, demand for the chemical fertilizers is becoming more expensive over the years which resulted in reduced income of farmers.

Use of organic manures in present agriculture is demanding day by day, because of its utility not only for improving the physical, chemical and biological properties of soil but also maintaining the good soil health, plant as well as human health. So, it is time to look for measures to stimulate sustainability in production of rice on long-term basis using locally available organic materials. Organic manures like FYM, crop residue based compost, poultry manure, vermicompost and neem cake deserves priority for sustained production and better utilization in organic rice production (Dahiphale *et al.*, 2003) [2]. Application of organic manures and bio-fertilizers not only improves the availability of macronutrients but micronutrients too. Hence, present investigation was under taken to develop nutrient module for rice-potato cropping system for enhancing its sustainability and profitability in accordance with nature. Additionally environment concerns due to excessive use of chemical is enhancing climate change issues.

Materials and Methods

The field experiment was conducted in two cropping seasons of 2020-21 and 2021-22 at ICAR-CPRI-RS, Gwalior. Field was laid out in randomized block design. Treatments consisted of two level of mulch (M_1- no mulch and M_2- paddy straw mulch @ 5 t/ha) as main plot and four different sources of nutrients {F_1- 100% RDF (NPK), F_2- Crop residue @ 25 t/ha + *Azotobacter* @ 1.25 l/ha + PSB @ 1.25 l/ha + Jeevamrut @ 500 l/ha, F_3- FYM @ 25 t/ha + Jeevamrut @ 500 l/ha and F_4- Control} as sub-plot which were replicated three times. The soil of the experimental site was silty-clay-loam in texture, with neutral in reaction pH (6.81), EC (0.23 dS/m), organic carbon (0.27%) and available N, P & K were 170.33, 14.15 and 320.56 kg/ha, respectively.

The rice variety "*Sharbati*" was direct sown at the spacing of 20 cm × 5 cm during *kharif* season and potato variety "*Kufri Chandramukhi*" was planted during *rabi* season using seed rate of 80 kg and 3500 kg/ha for rice and potato, respectively were used. Recommended dose of 120:60:40 kg/ha of $N:P_2O_5:K_2O$, respectively for rice and 180:80:120 kg/ha of $N:P_2O_5:K_2O$, respectively for potato crop were used. Potato was planted at spacing of 60 cm from row to row and 20 cm from plant to plant manually. Five plants were randomly sampled from the inner rows of the each plots leaving the border rows. The sampled plants were carefully dugged up, roots were thoroughly washed under running water, put in labelled envelop bags and taken to the laboratory where the yield attributing parameters were recorded at maturity. Yield of crop was calculated from net plot area.

Results and Discussion

Rice crop

Effect of mulch: Results revealed that yield components and yield were significantly affected by paddy straw mulch during both the years 2020-21 and 2021-22 (Table 1). Data analysis showed that application of paddy straw mulch significantly increased effective tillers/m^2 (316.2 and 318.3), panicle length (22.2 and 22.9 g), panicle weight (3.23 and 3.36 g), filled grains/panicle (107.4 and 111.0), and grain yield (2699 and 2768 kg/ha) during 2020-21 and 2021-22, respectively of rice. However, 1000 grain weight was not found significant. This suggests that there was positive role of paddy straw mulch in increasing yield components and yield of rice compared to without mulch. Organic mulching added organic matter and plant nutrients to the soil profile after decomposition, altered temperature and soil conditions, reduces nutrient leaching and increased nutrient availability which helped in increasing the yield of crops (Haraguchi *et al*., 2004) [4]. This result was supported by Prosdocimi *et al*., (2016) [10] who revealed that the mulching practices directly and indirectly exert positive impacts on micro-climate and crop yield.

Effect of different sources of nutrient: Effective tillers/m^2 (372.7 and 378.1), panicle length (22.9 and 23.6 cm), panicle weight (3.83 and 3.98 g), filled grains/panicle (118.7 and 127.4) and grain yield (3754 and 3857 kg/ha) during 2020-21 and 2021-22, respectively of rice were significantly maximum under 100% RDF (NPK) over control during both the cropping seasons (2020-21 and 2021-22) (Table 1). Grain yield is a function of interplay of various yield components such as number of productive tillers, panicle length, filled grain and 1000-grain weight (Singh *et al.*, 2019) [17]. Application of 100% RDF (NPK) through inorganic source of nutrients resulted in significantly highest yield components (except test weight) and grain yield of rice during both cropping seasons. It may be due to timely supply of sufficient and balanced amount of nutrients to plants. It ultimately produced more number of effective tillers, lengthy panicle and more filled grains/panicle, which ultimately resulted in higher yield. Whereas, minimum yield attributes as well as yield were obtained from control treatment (where no nutrient was applied). This may be due to insufficiency of available nutrient in soil profile causing lower biomass production upto harvest. Similar results were found previously by Sahu *et al.*, (2017) [13], Pant *et al.* (2020) [9] and Mangaraj *et al*. (2022) [7].

Table 1: Effect of paddy straw mulch and different sources of nutrients on yield attributes and yield of rice

Treatments	Effective tillers/m^2		Panicle length (cm)		Panicle weight (g)		Filled grain/panicle		Test weight (g)		Grain yield (kg/ha)	
	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22
Mulches												
M_1- No mulch	296.6	300.1	21.8	22.1	2.92	2.99	101.1	104.5	20.8	21.0	2521	2598
M_2- Paddy straw mulch @ 5 t/ha	316.2	318.3	22.2	22.9	3.23	3.36	107.4	111.0	20.9	21.0	2699	2768
SEm±	2.98	2.86	0.11	0.13	0.047	0.057	1.83	2.13	0.18	0.16	46.6	54.0
CD (P=0.05)	9.02	8.67	0.34	0.40	0.141	0.173	5.54	6.45	NS	NS	141.1	163.3
Nutrient sources												
F_1- 100% RDF (NPK)	372.7	378.1	22.9	23.6	3.83	3.98	118.7	127.4	21.1	21.5	3754	3857
F_2- Crop-Residue @ 25 t/ha + *Azotobacter* @ 1.25 l/ha + PSB @ 1.25 l/ha + Jeevamrut @ 500 l/ha	299.7	311.5	21.7	22.2	2.84	3.01	107.0	112.6	20.6	20.9	2272	2429
F_3- FYM @ 25 t/ha + Jeevamrut @ 500 l/ha	324.3	335.8	22.2	23.2	3.02	3.22	110.8	114.7	21.0	21.0	2820	2954
F_4- Control	228.8	211.2	21.1	21.0	2.59	2.48	80.4	76.2	20.6	20.7	1595	1492
SEm±	4.21	4.05	0.16	0.19	0.066	0.081	2.59	3.01	0.26	0.22	65.9	76.3
CD (P=0.05)	12.75	12.26	0.49	0.56	0.199	0.245	7.83	9.12	NS	NS	199.5	230.9

Interaction effect of mulch and different sources of nutrient

The interaction between paddy straw mulch and different sources of nutrient treatments is illustrated in Table 2. Highest yield attributes *viz.,* effective tillers/m^2 (389.9 and 387.9), panicle length (23.3 and 24.4 cm), panicle weight (4.17 and 4.37 g), filled grains/panicle (121.7 and 131.3) and grain yield (3872 and 3981 kg/ha) during 2020-21 and 2021-22, respectively of rice were recorded by paddy straw mulch @ 5 t/ha with 100% RDF (NPK) (M_2xF_1) as compare to other nutrient sources. However, higher yield attributes and grain yield was obtained in paddy straw mulch. Whereas, without paddy straw mulch along with control treatment gave the lowest yield components and grain yield of rice.

The maximum panicle weight (4.17 and 4.37 g) was recorded under paddy straw mulch @ 5 t/ha with 100% RDF (NPK) (M_2xF_1) during both the cropping seasons (2020-21 and 2021-22, respectively) which was significantly superior over other treatments. This may be due to availability of sufficient quantity of nutrient as compare to control, optimum utilization of water, light, space and nutrient by the plants led to production of more yield attributing characters and yield than without mulch. Whereas, minimum panicle weight of 2.53 and 2.41 g, respectively in 2020-21 and 2021-22 were recorded under without mulch along with control treatment (M_1xF_4). This result is also supported by Sharma *et al*., (2018) [14] and Mangaraj *et al.*, (2022) [7].

The maximum cost of cultivation ₹ 67500 and 64500 /ha in 2020-21 and 2021-22, respectively were registered under without mulch along with FYM @ 25 t/ha + Jeevamrut @ 500 l/ha (M_1xF_3), while it was lowest under without mulch with control treatment (M_1xF_4) (₹ 28600 and 25600 /ha, respectively in 2020-21 and 2021-22) (Table 5). Organic treatments resulted into more common cost of cultivation owing to more labour requirement for plant protection, higher quantity of FYM, crop residue and bio-fertilizers. Paddy straw mulch @ 5 t/ha along with FYM @ 25 t/ha + Jeevamrut @ 500 l/ha (M_2xF_3) gave maximum gross returns (₹ 106512 and 110320/ha) and net returns (₹ 44012 and 50820 /ha) during 2020-21 and 2021-22, respectively. This is due to higher market value of economical yield under organic treatments. The findings are in close conformity with the findings of Rahman *et al*. (2005) [11], Kumar and Kumar (2020) [6].

Potato crop

Effect of mulch

The maximum yield attributes *viz.,* tubers/plant (8.55 and 9.58), tuber weight/plant (409.4 and 417.7 g), dry tuber weight/plant (72.3 and 74.0 g) and tuber yield (23.16 and 23.79 t/ha) during 2020-21 and 2021-22, respectively were recorded under paddy straw mulch @ 5 t/ha which was significantly superior over non-mulched treatment (Table 3). Highest dry tuber yields (4.34 and 4.42 t/ha) were recorded under mulched treatment which was significantly higher than non-mulched treatment during 2020-21 and 2021-22. The increase in yield attributes and tuber yield with the application of mulch may be due to increasing soil carbon and root activity thereby overall increase in absorption of applied water and nutrients by plants which indirectly increased the yield attributes and crop yield. These finding are in close agreement with those reported by Sadawarti *et al.,* (2013) [12] and Banerjee *et al*., (2016) [1].

Table 2: Interaction effect of paddy straw mulch and different sources of nutrients on yield attributes and yield of rice

Interaction	Effective tillers/m^2		Panicle length (cm)		Panicle weight (g)		Filled grain/panicle		Test weight (g)		Grain yield (kg/ha)	
	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22
M_1 x F_1	355.6	368.3	22.5	22.8	3.50	3.59	115.7	123.5	21.1	21.4	3636	3733
M_1 x F_2	294.3	303.1	21.6	22.2	2.72	2.81	104.4	109.5	20.6	20.9	2216	2366
M_1 x F_3	319.3	331.8	22.1	22.8	2.92	3.14	108.6	112.3	21.0	21.0	2682	2842
M_1 x F_4	217.1	197.1	21.0	20.9	2.53	2.41	75.6	72.6	20.6	20.7	1552	1452
M_2 x F_1	389.8	387.9	23.3	24.4	4.17	4.37	121.7	131.3	21.2	21.5	3872	3981
M_2 x F_2	305.1	319.9	21.8	22.2	2.96	3.21	109.7	115.8	20.7	20.9	2328	2492
M_2 x F_3	329.4	339.9	22.4	23.7	3.12	3.30	113.0	117.2	21.0	21.1	2959	3067
M_2 x F_4	240.4	225.4	21.2	21.1	2.66	2.55	85.3	79.8	20.6	20.7	1638	1532
SEm±	5.96	5.73	0.23	0.26	0.093	0.114	3.66	4.26	0.37	0.32	93.2	107.9
CD (P=0.05)	NS	NS	NS	0.79	0.282	0.346	NS	NS	NS	NS	NS	NS

M_1- No mulch and M_2- Paddy straw mulch @ 5 t/ha; F_1- 100% RDF (NPK), F_2- Crop residue @ 25 t/ha+ *Azotobacter*@1.25 l/ha + PSB @ 1.25 .l/ha + Jeevamrut @ 500 l/ha, F_3- FYM @ 25 t/ha+Jeevamrut @ 500 l/ha and F_4- Control (No nutrient was applied) *Jeevamrut spray weekly intervals

Effect of different sources of nutrient

Yield attributes (*viz.,* tubers/plant, tuber weight/plant and dry tuber weight/plant) and tuber yield were significantly influenced by different sources of nutrients in potato (Table 3). The highest tubers/plant (9.58 and 10.90), tuber weight/plant (439.8 and 466.6 g), dry tuber weight/plant (82.0 and 84.1 g) and tuber yield (25.72 and 27.14 t/ha) were found in the plants supplied with 100% RDF (NPK) through inorganic source of nutrient (F_1) during 2020-21 and 2021-22. However, the minimum yield attributes and tuber yield were recorded under control treatment during both the years of investigation. Application of 100% RDF (NPK) recorded highest dry tuber yield which was significantly higher than all other treatments. It was followed by FYM @ 25 t/ha + Jeevamrut @ 500 l/ha. The results were in conformity with the findings of Banerjee *et al.,* (2016) [1] who stated that yield parameters like tubers/plant, tuber weight/plant and dry tuber weight/plant and tuber yield were influenced with the increase in the per cent of RDF. Similar results were obtained by Kumar *et al.,* (2017) [6], Gaur *et al.,* (2019) [3] and Tiwari *et al.,* (2021) [18].

Table 3: Effect of paddy straw mulch and different sources of nutrients on yield attributes and yield of potato

Treatments	Tubers/plant		Tuber weight/plant (g)		Dry tuber weight/plant (g)		Tuber yield (t/ha)		Dry tuber yield (t/ha)	
	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22
Mulches										
M_1- No mulch	7.94	9.01	374.3	381.0	65.8	66.8	21.68	22.16	4.09	4.16
M_2- Paddy straw mulch @ 5 t/ha	8.55	9.58	409.4	417.7	72.3	74.0	23.16	23.79	4.34	4.42
SEm±	0.139	0.180	7.16	6.11	1.53	1.14	0.481	0.417	0.089	0.081
CD (P=0.05)	0.420	0.546	21.66	18.49	4.64	3.45	1.456	1.262	NS	0.245
Nutrient sources										
F_1- 100% RDF (NPK)	9.58	10.90	439.8	466.6	82.0	84.1	25.72	27.14	4.88	5.12
F_2- Crop residue @ 25 t/ha + *Azotobacter* @ 1.25 l/ha + PSB @ 1.25 l/ha + Jeevamrut @ 500 l/ha	7.36	9.80	382.4	386.2	66.5	67.2	22.21	23.04	4.16	4.26
F_3- FYM @ 25 t/ha + Jeevamrut @ 500 l/ha	8.38	10.07	425.4	448.1	80.0	83.5	23.41	23.97	4.41	4.50
F_4- Control	7.65	6.41	319.7	296.6	47.8	46.7	18.36	17.77	3.40	3.28
S.Em±	0.196	0.255	10.12	8.64	2.17	1.61	0.681	0.590	0.125	0.115
CD (P=0.05)	0.594	0.772	30.63	26.15	6.56	4.87	2.060	1.785	0.380	0.347

Table 4: Interaction effect of paddy straw mulch and different sources of nutrients on yield attributes and yield of potato

Interaction	Tubers/plant		Tuber weight/plant (g)		Dry tuber weight/plant (g)		Tuber yield (t/ha)		Dry tuber yield (t/ha)	
	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22
M_1 x F_1	9.35	10.33	431.5	457.4	76.3	82.4	25.34	26.47	4.81	4.99
M_1 x F_2	7.27	9.67	348.3	349.7	60.6	60.5	21.20	22.19	3.98	4.15
M_1 x F_3	8.10	9.97	405.4	435.6	78.5	81.2	22.89	23.42	4.37	4.43
M_1 x F_4	7.02	6.08	311.8	281.3	48.0	42.9	17.30	16.57	3.20	3.06
M_2 x F_1	9.81	11.47	448.1	475.8	87.8	85.7	26.10	27.80	4.96	5.24
M_2 x F_2	7.45	9.93	416.4	422.7	72.4	73.8	23.21	23.89	4.35	4.37
M_2 x F_3	8.67	10.17	445.4	460.7	81.6	85.9	23.93	24.51	4.46	4.56
M_2 x F_4	8.28	6.75	327.6	311.8	47.5	50.5	19.42	18.98	3.60	3.50
S.Em±	0.28	0.36	14.31	12.22	3.06	2.28	0.962	0.834	0.177	0.162
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

M_1- No mulch and M_2- Paddy straw mulch @ 5 t/ha; F_1- 100% RDF (NPK), F_2- Crop residue @ 25 t/ha+ *Azotobacter* @ 1.25 l/ha + PSB @ 1.25 l/ha + Jeevamrut @ 500 l/ha, F_3- FYM @ 25 t/ha + Jeevamrut @ 500 l/ha and F_4- Control (No nutrient was applied) *Jeevamrut spray at weekly intervals

Interaction effect of mulch and different sources of nutrient

Yield attributes and tuber yield of potato were recorded under paddy straw mulch and different nutrient sources is presented in Table 4. It was found non-significant during both the years of investigation. Highest tubers/plant (9.81 and 11.47), tuber weight/plant (448.1 and 475.8 g), dry tuber weight/plant (87.8 and 85.7 g) and tuber yield of potato (26.10 and 27.80 t/ha) were recorded with 100% RDF (NPK) along with paddy straw mulch @ 5 t/ha during 2020-21 and 2021-22 as compare to organic sources of nutrients with and without mulch. This may be due to better, balanced and higher availability of nutrient under inorganic fertilizer application as a result production of higher yield attributes which directly increased the crop yield. Whereas, without paddy straw mulch along with control treatment (M_1xF_4) gave the lowest yield attributes and tuber yield of potato during both the years of investigation due to insufficiency of available nutrient in soil profile causing lower biomass accumulation upto harvest. These results are in consonance with the finding of Singh *et al.*, (2011) and Tiwari *et al.*, (2021) [18].

The maximum total cost of cultivation was recorded under without mulch along with FYM @ 25 t/ha + Jeevamrut @ 500 l/ha (M_1xF_3) (₹ 132550 and 131550 /ha) and with mulch along with FYM @ 25 t/ha + Jeevamrut @ 500 l/ha (M_2xF_3) (₹ 132550 and 131550 /ha) during first and second years recorded (Table 6). However, the maximum gross return (₹ 363854 and 391372) and net return (₹ 231304 and 259822 /ha) were recorded under paddy straw mulch with FYM @ 25 t/ha + Jeevamrut @ 500 l/ha (M_2xF_3) during 2020-21 and 2021-22, respectively, while it was lowest under without mulch along with control treatment (M_1xF_4) in both the years due to low production of economical yield as compare to other treatments. This result also lined with the findings of Singh *et al.*, (2011) [16], Shubha *et al.*, (2019) [15] and Mukhopadhyay *et al.*, (2021) [8].

Table 5: Effect of paddy straw mulch and different sources of nutrients on economic of rice production

Interaction	Total cost of cultivation (₹/ha)		Gross return (₹/ha)		Net return (₹/ha)	
	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22
M_1 x F_1	34784	31784	70709	75364	35925	43580
M_1 x F_2	56000	53000	80159	85739	24159	32739
M_1 x F_3	67500	64500	96797	102456	29297	37956
M_1 x F_4	28600	25600	56720	53093	28120	27493
M_2 x F_1	39574	36574	75180	80120	35605	43546
M_2 x F_2	51000	48000	84115	90167	33115	42167
M_2 x F_3	62500	59500	106512	110320	44012	50820
M_2 x F_4	33600	30600	59788	56003	26188	25403

Table 6: Effect of paddy straw mulch and different sources of nutrients on economic of potato production

Interaction	Total cost of cultivation (₹ /ha)		Gross return (₹ /ha)		Net return (₹ /ha)	
	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22
M_1 x F_1	111891	110891	274892	287900	163001	177009
M_1 x F_2	120586	119586	335216	352714	214631	233129
M_1 x F_3	132550	131550	346807	370601	214257	239051
M_1 x F_4	99100	98100	264194	267944	165094	169844
M_2 x F_1	116401	115401	282699	303781	166298	188380
M_2 x F_2	120586	119586	349651	372403	229065	252818
M_2 x F_3	132550	131550	363854	391372	231304	259822
M_2 x F_4	104100	103100	312293	307212	208193	204112

M_1- No mulch and M_2- Paddy straw mulch @ 5 t/ha; F_1- 100% RDF (NPK), F_2- Crop residue @ 25 t/ha+ *Azotobacter* @ 1.25 l/ha + PSB @ 1.25 l/ha + Jeevamrut @ 500 l/ha, F_3- FYM @ 25 t/ha + Jeevamrut @ 500 l/ha and F_4- Control (No nutrient was applied) *Jeevamrut spray at weekly intervals

Conclusion

From the results of the present investigation, it can be concluded that application of FYM @ 25 t/ha + Jeevamrut @ 500 l/ha with paddy straw mulch @ 5 t/ha for organic farming in both crops (rice and potato) which better alternative option. However, 100% RDF (NPK) without mulch in rice production and 100% RDF (NPK) with paddy straw mulch @ 5 t/ha in potato production for conventional farming may be used to obtain the highest gross and net returns of both crops (rice and potato). Lower yield of these crops compared to inorganic production can be compensated by higher market value of organic product. In direct benefit of organic production will be through use of crop residues as test liber which reduced pollution.

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