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Yield and yield attributing characters of scented rice (*Oryza sativa* L.) as influenced by nutrient and weed management practices in vertisols of Chhattisgarh plain

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Abstract
A field experiment was conducted at the Instructional Farm, DKS CARS Bhatapara, during *Kharif* season 2021, to study the ''Effect of nutrient and weed management practices on scented rice (*Oryza sativa* L.) in Vertisols of Chhattisgarh plain''. The Experiment was laid out in Split Plot Design (SPD) with three replications. Treatment nutrient management practices was taken as main plot and weed management practices in sub plot. The experiment comprised three different nutrient management practices *viz*. N1 – 100% Organic, N2 – 100% Inorganic (RDF), N3 - 50% Organic + 50% Inorganic and four different weed management practices *viz*. W0 – Weedy check, W1 – Weed free check, W2 -Two hand weeding, W3 – Conoweeder + One hand weeding was conducted in scented rice in Vertisols of Chhattisgarh plain. The result revealed that nutrient management N2 – 100% Inorganic (RDF) produced significantly higher growth parameters, yield attributing characters, yield, gross return, net return and B:C ratio as compared to all other nutrient management practices. W1 – Weed free check was recorded significant higher growth parameters, yield attributing characters and yield, gross return, net return and B:C ratio as compared to all other weed management practices. The interaction between nutrient and weed management practices revealed that nutrient management practice N2 – 100% Inorganic (RDF) with weed management practice W1 – Weed free check was produce significant higher seed yield, stover yield, gross return, net return and B:C ratio as compared to all other treatment combination on scented rice in Vertisols of Chhattisgarh plain.

Keywords: Scented rice, nutrient management, weed management, yield and yield attributes, vertisols

Introduction
Rice (*Oryza sativa* L.) is a golden crop that is important to the Indian economy and is grown in 114 nations worldwide. Paddy cultivation encompasses a wide array. The altitude is 2000 meters below sea level. Deep water to rainfed dry climates (50 mm to 3000 mm rainfall levels), with temperatures ranging from 7° to 45 °C, can be found up to a considerable distance on either side of the equator. The oldest grain samples discovered in Pakistan's Mohanjodaro date back to around 2500 B.C. (Andrus and Mohammed, 1958) [3].

The state of Chhattisgarh has primarily produced paddy crop from its inception. Paddy is grown on three-quarters of the entire sown area during the *Kharif* season. In the states of Chhattisgarh and Madhya Pradesh, Dubraj is a highly popular aromatic short medium grain type. Dubraj accounts for 10% of the entire paddy growing area in Chhattisgarh (Sharma *et al*., 2017) [25]. Chhattisgarh, commonly known as India's paddy bowl, covers 3.84 million hectares and produces 6.09 million tonnes of rice and 1.5 tonnes ha-1 of productivity, respectively. Dubraj, Badshahbhog, Vishnubhog, Gopalbhog, Kubrimohar, Tulsi Manjari, Laxmibhog, Jawaphool, and other short thin/medium slender aromatic rice varieties are widely grown in Chhattisgarh. In different sections of the state, over a hundred traditional land races of aromatic rice with a nice aroma are grown. Due to its great cooking quality and taste, Dubraj, the most popular type in Chhattisgarh's local markets and marketed under the brand names "Pride of Chhattisgarh" and "Chhattisgarh ka Basmati," commands a premium price. However, as high-yielding non-aromatic varieties gain land, the area under Dubraj is shrinking. Photo sensitivity, late maturity (>150 days), tall plant stature (>140 cm), lodging susceptibility, and poor fertilizer reaction are the main disadvantages of Dubraj. Despite its low yield potential, Dubraj commands a high price and is grown by small-scale growers.

Scented rice types can be found in almost every Indian state, and specialised locations of aroma generation and cultivation are well-known. These locations have been determined based on the farmers' hundreds of years of expertise (Nene, 1998) [18]. Aroma is the most significant qualitative feature among the others. 2-acetyle-l-pyrroline, a 'popcorn'-like scent component, has been described as a key flavour component of various aromatic cultivars. To reach high production potential, integrated nutrition management combining both organic and inorganic sources is required. Organic food consumption is continuously rising in both developed and emerging countries, with an annual growth rate of 20 to 25%. (Ramesh *et al*., 2005) [20].

Cereal yields are currently between 40 and 65 percent of their potential, owing to nutrient management that ignores the crop's dynamic response to the environment and site-specific nutrition management Gaire *et al*., (2016) [8]. Yadav *et al*. (2013) [30] conducted research at the ICAR Research Station in Tripura on the growth of low land rice during both the *kharif* and *rabi* seasons and found that using 50 percent recommended N fertilizer dose along with organic source as FYM@ 11.2 t/ha, not only were maximum values of growth parameters such as plant height, tillers/hill, and total dry matter accumulation/hill obtained, but also 50 percent inorganic source was saved.

Weed control, on the other hand, is critical; the goal of weed control is to eradicate or reduce the negative effects of weeds on paddy productivity. Due to their early low growth, scented rice varieties are genetically poor weed competitors (Chander and Pandey, 2001) [6]. The use of multiple approaches, such as mechanical, cropping, biological, and chemical treatments, to manage weeds has been found to be useful depending on the circumstances. The main bottleneck in DSR, particularly in arid fields, is high weed infestation (Rao *et al*., 2007) [23]. Weed growth reduced grain output by up to 53 percent in wet seeded rice and 74% in dry seeded rice, respectively (Ramzan, 2003) [22]. Weeds are regarded as one of the main biotic obstacles to increasing agricultural productivity and can reduce grain output by up to 10% to 90% Kumar *et al*. (2016) [15].

Materials and Methods

The experiment was conducted at DKS College of agriculture and Research Station Bhatapara (Chhattisgarh) during *Kharif* season 2021.

The Experiment was laid out in Split Plot Design (SPD) with three replications. Treatment nutrient management practices was taken as main plot and weed management practices in sub plot. The experiment comprised three different nutrient management practices *viz*. N1 – 100% Organic, N2 – 100% Inorganic (RDF), N3 - 50% organic + 50% inorganic and four different weed management practices *viz*. W0 – Weedy check, W1 – Weed free check, W2 - Two hand weeding, W3 – Conoweeder + One hand weeding was conducted in scented rice in Vertisols of Chhattisgarh plain.

Result and Discussion

Data pertaining to yield and yield attributing characters as influenced by the different treatments is presented in Table 1, 2 and 3.

Number of tillers plant-1

The data pertaining to effect of nutrient and weed management practices on number of tillers plant-1 have been presented in Table 1. The data shows that during the trial year, there was a substantial variation in treatment. N2 – 100% Inorganic (RDF) were found significantly highest number of tillers plant-1 as compared to N1– 100% Organic and N3 - 50% Organic + 50% Inorganic at 30, 60, 90, DAT and at harvest under study. Sultana *et al*. (2015) reported that with (90 kg N ha-1 from urea + 30 kg N ha-1 from vermicompost), no. of tillers (16.67) was discovered. However, no. of tillers plant-1 obtained in N3 - 50% Organic + 50% Inorganic were at par with N2 - 100% Inorganic (RDF) at 30,90 DAT and at harvest and which are also better than N1 – 100% Organic number of tiller plant-1. Higher number of tillers was recorded at harvest. The possible reason is due to favorable conditions and stages of the rice plant, which resulted in the production of more tillers. In different weed management practices, W1 – Weed free check recorded higher number tillers among all the treatment but W2 - Two hand weeding was recorded at par at 90 DAT and at harvest except 30 and 60 DAT. Among all weed control strategies, W1 - weed free-check and W0 - weedy check had the highest and lowest number of tillers plant-1, respectively. It's possible that this is due to decreased crop-weed competition and greater resource usage during tillering, as weeds were effectively controlled. At 90 DAT and at harvest maximum number of tillers recorded in W1 followed by W2 and W3. It could have resulted in a decrease in bulk density, allowing for enhanced root proliferation for nutrient and soil moisture uptake. Singh *et al*., (2018) [26]. Akabar and Ali (2011) [1] shared a similar perspective.

No. of panicles plant-1

The data pertaining to effect of nutrient and weed management practices on number of panicles plant-1 have been presented in Table 2. N2 - 100% Inorganic (RDF) were found significantly higher number of panicle plant-1 were significantly maximum as compare to N1 - 100% Organic under study. However, value obtained in N3 - 50% Organic + 50% Inorganic was at par with N2 and was also better than N1 value. Variations in number of panicle plant-1 due to nutrient management practices were found to be significant. In different weed management practices, W1 - Weed free check recorded higher number of panicles plant-1 among all the treatment. Amongst all weed management techniques, weed free-check and weedy check correspondingly recorded the highest and lowest numbers of panicles plant-1. Effective weed control reduced or nearly eliminated crop weed competition for moisture, nutrients, and light & space, allowing for the greatest buildup of photosynthetic material, which in turn led to a greater number of panicles. This outcome closely resembles that of Ramesha *et al*., (2017a) [21]. Additionally, this outcome was consistent with Singh *et al*., (2018) [26] and Naik *et al*., (2018) [17].

No. of grains panicle-1

The data pertaining to effect of nutrient and weed management practices on number of grains panicle-1 have been presented in Table 2. Effects of nutrient management practices on number of grains panicle-1 were significant. N2 - 100% Inorganic (RDF) was significantly higher number of grains plant-1 as compare to N1 - 100% Organic under study. However, value obtained in N3 - 50% Organic + 50% Inorganic was at par with N2 and was also better than N1 value. Variations in number of grains panicle-1 due to nutrient management practices were found to be significant. The different weed management practices had statistically effect on grains panicle-1, the significantly highest number of grains

panicle-1 was recorded in W1 - Weed free check followed by W2 - Two hand weeding. W2 - Two hand weeding at par with W1 – Weed free check and W3 - Conoweeder + One hand weeding also at par followed by W1 – Weed free check respectively. While the minimum number of grains was recorded with W0 -Weedy check during the experimentation. In contrast to the Absolute control, the rice crop may have been able to carry a promising architecture of yield parameters and a greater grain filling percent due to effective weed growth suppression throughout the crucial phase of crop weed competition. The findings closely match those of Ramesha *et al*., (2017a) [21], Rajput *et al*. (2020) [19] and Zhimomi *et al*. (2021) [31].

Test weight (g)

Test weight of scented rice was affected by different treatment and data are given in Table 2. Scented rice nutrient management treatment N2 - 100% Inorganic (RDF) was found significantly highest test weight. However, N3 - 50% Organic + 50% Inorganic was at par with N2 - 100% Inorganic (RDF) and N1 - 100% Organic was recorded lowest test weight of grains respectively. In case of different weed management practices W1 - Weed free check was recorded significantly higher test weight among all the treatment, and lowest test weight was observed in treatment W0 – Weedy check. However, W2 - Two hand weeding recorded at par with W1 – Weed free check. This may be the result of better and more prompt weed management from early growth periods by hand weeding and sequential administration of fertilisers, which may have led to higher production and translocation of photosynthates to grains due to appropriate resource availability. Eventually, this led to improved grain yield and yield components. Results closely match expectations with Duttarangvi *et al*. (2016) [7].

Length of flag leaf (cm)

The data pertaining to effect of nutrient and weed management practices on Length of flag leaf (cm) have been presented in Table 2. Effects of nutrient management practices on length of flag leaf (cm) were significant at N2 - 100% Inorganic (RDF) were found significantly higher length of flag leaf (cm) were significantly higher as compare to N1 – 100% Organic under study. However, value obtained in N3 - 50% Organic + 50% Inorganic were at par with N2 and which is also better than N1 – 100% Organic value. Variations in length of flag leaf (cm) due to nutrient management practices were found to be significant. In case of different weed management practices W1 – Weed free check was recorded significantly higher length of flag leaf among all the treatments, and lowest length was observed in treatment W0 – Weedy check. However, W2 - Two hand weeding recorded at par with W1 – Weed free check and W3 – Conoweeder + One hand weeding was also at par followed by W1 – Weed free check respectively. Flag leaf synthesises up to 70 percent of the carbohydrates that are stored in grains. Results closely match expectations with Ashrafuzzaman *et al*. (2009) [2] and Tambussi *et al*. (2007) [29].

Seed yield (kg ha-1)

The data pertaining to effect of nutrient and weed management practices on Seed yield (kg ha-1) have been presented in Table 3. The data reveals that grain yield of scented rice was affected significantly N2 – 100% Inorganic (RDF) has been recorded (3677 kg ha-1) highest and N1 – 100% Organic recorded lowest (2096 kg ha-1) grain yield. However, N3 - 50% Organic + 50% Inorganic was recorded at par (3567 kg ha-1) with N2 – 100% Inorganic (RDF) seed yield in nutrient management practices. The higher crop dry matter accumulation, more effective tillers and less yield due to less dry matter accumulation, and less number of tillers per meter square, this result similarly with Khalil *et al*., (2016) [13], Ghuman *et al*., (2008) [11] and Kaur and Singh (2014).In case of different weed management practices W1 – Weed free check was recorded significantly maximum grain yield (3966 kg ha-1) among all the treatment, and lowest grain yield was observed in treatment W0 – Weedy check (1750 kg ha-1). However, W2 - Two hand weeding was recorded (3504 kg ha-1) at par with W1 – Weed free check. Reduced crop and weed competition, fewer weeds, improved soil moisture, and increased nutrient availability led to superior production factors like effective tillers, panicle length, and grain panicle-1, all of which cumulatively contributed to higher grain yield & together boosted grain output. These findings are also confirmed by Barik *et al*. (2003) [5], Ghodke *et al*. (2008), Satyanarayana *et al*. (2006) [24], Baig *et al*. (2004) [24], Ramesha *et al*., (2017a) [21] and Ghosh *et al*., (2016) [10].

Straw yield (kg ha-1)

Data presented in table 3, reveals that straw yield was practices. Scented rice treatment in N2 – 100% Inorganic (RDF) was recorded highest straw yield (7863 kg ha-1) and lowest in N1 – 100% Organic (4747 kg ha-1) respectively. However, were N3 - 50% organic + 50% inorganic was found at par (7241 kg ha-1) with N2 – 100% Inorganic (RDF) during experiment. In case of different weed management practices W1 – Weed free check was recorded significantly higher straw yield (8621 kg ha-1) among all the treatment, and lowest straw yield was observed in treatment W0 – Weedy check (4747 kg ha-1) respectively. This rise in straw production might be the result of weeds being effectively controlled. This is brought on by an increase in the number of shoots per unit area and height of the plant, as well as an accumulation of dry materials. Similar result has been reported by Baig *et al*. (2004) [24], Satyanarayana *et al*. (2006) [24], Kumar *et al*. (2005) [14] and Suman and Bhist (2010) [28], Kumar *et al*. (2021) [16], Zhimomi *et al*. (2021) [31].

Biological yield (kg ha-1)

The data pertaining to effect of nutrient and weed management practices on biological yield (kg ha-1) have been presented in Table 3. The data reveals that biological yield of scented rice was affected significantly N2 – 100% Inorganic (RDF) has been recorded highest value (11540 kg ha-1) and N1 – 100% Organic recorded lowest (6843 kg ha-1) biological yield. However, were N3 - 50% Organic + 50% Inorganic recorded at par value (10808 kg ha-1) with N2 – 100% Inorganic (RDF) seed yield in nutrient management practices respectively. In case of different weed management practices W1 – Weed free check was recorded significantly higher biological yield (12587kg ha-1) among all the treatments, and lowest biological yield was observed in treatment W0 – Weedy check (6497 kg ha-1). Similar results have been given by Singh *et al*. (2021) [27] and Kumar *et al*. (2021) [16].

Conclusion

Pre harvest parameter like Plant height (cm), No. of tillers plant-1, Dry matter accumulation (g plant-1), Leaf area index (LAI), were recorded significantly maximum under N2 – 100% Inorganic (RDF). In case of weed management all these parameters were recorded significantly maximum in W1 – Weed free check.

Yield and yield attributing characters were recorded significantly maximum under plant like Number of tillers plant-1, Number of panicles plant-1, Length of flag leaf affected significantly by various nutrient management (cm), Number of grains panicle, Test weight of 1000 grain (g), Seed yield (kg ha-1), Straw yield (kg ha-1), Biological Yield (kg ha-1) was recorded significantly higher in N2 – 100% Inorganic (RDF) as compare to other nutrient management practices. Significantly all parameters maximum value under weed management practices observed in W1 – Weed free check as compare to other weed management practices. Interaction effect of nutrient and weed management on all above parameters of straw and biological yield was recorded N2 – 100% Inorganic (RDF) with W1 – Weed free check. In terms of economics the feasibilities maximum gross return, net return and B:C ratio were recorded significant maximum under N2 - 100% Inorganic (RDF) and W1 - Weed free-check.

Table 1: No. of tillers plant-1 of scented rice as influenced by nutrient and weed management practices

Treatments	No. of tillers plant-1			
30 DAT		**60 DAT**	**90 DAT**	**At harvest**
Nutrient management (N)				
N1 – 100% Organic	5.75	9.41	10.16	10.69
N2 – 100% Inorganic (RDF)	8.33	13.66	15.66	16.42
N3 - 50% organic + 50% inorganic	7.41	12.08	14.83	15.55
S.E(m)±	0.26	0.36	0.46	0.58
CD = (0.05%)	1.06	1.45	1.88	2.33
Weed management (W)				
W0 – Weedy check	5.66	10.55	12.55	12.94
W1 – Weed free check	9.11	13.44	15.22	16.02
W2 - Two hand weeding	7.22	12.00	13.88	14.48
W3 – Conoweeder + One hand weeding	6.66	10.88	12.55	13.43
S.E(m)±	0.32	0.53	0.66	0.69
CD = (0.05%)	0.96	1.59	2.00	2.06

Table 2: No. of panicle plant-1, No. of grains panicle-1, Test weight (g) and Length of flag leaf (cm) of scented rice as influenced by nutrient and weed management practices

Treatments	No of panicle plant-1	No. of grains panicle-1	Test weight (g)	Length of flag leaf (cm)
Nutrient management (N)				
N1 – 100% Organic	9.31	115.4	20.29	22.92
N2 – 100% Inorganic (RDF)	13.76	152.7	22.69	30.17
N3 - 50% organic + 50% inorganic	13.19	150.5	22.25	27.66
S.E(m)±	0.59	4.57	0.45	1.07
CD = (0.05%)	2.39	18.43	1.83	4.33
Weed management (W)				
W0 – Weedy check	9.03	125.39	20.27	22.62
W1 – Weed free check	15.50	149.54	23.27	29.88
W2 - Two hand weeding	12.92	146.43	22.21	28.41
W3 – Conoweeder + One hand weeding	10.90	136.94	21.22	26.76
S.E(m)±	0.64	5.28	0.53	1.06
CD = (0.05%)	1.92	15.82	1.59	3.18

Table 3: Yield of scented rice as influenced by nutrient and weed management practices

Treatments	Seed yield (kg ha-1)	Straw yield (kg ha-1)	Biological yield (kg ha-1)
Nutrient management (N)			
N1 – 100% Organic	2096	4747	6843
N2 – 100% Inorganic (RDF)	3677	7863	11540
N3 - 50% organic + 50% inorganic	3567	7241	10808
S.E(m)±	157.9	267.7	384.2
CD = (0.05%)	636.9	1079.5	1549.1
Weed management (W)			
W0 – Weedy check	1750	4747	6497
W1 – Weed free check	3966	8621	12587
W2 - Two hand weeding	3504	7393	10897
W3 – Conoweeder + One hand weeding	3232	5709	8941
S.E(m)±	193.7	374.2	457.2
CD = (0.05%)	580.1	1120.6	1368.9

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