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Evaluation of Scented Rice Varieties under Organic Mode of Cultivation in North West Plains of India

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***Abstract*:** Field experiment was conducted at GBPUA&T, Pantnagar during *kharif* 2020 to evaluate ten traditional scented rice varieties namely Kubri Mamhani, Kudrat-5, Chinar-20, Kesho Pohu, DRK, Kudrat-5, Pusa-1121, Type-3, Taraori and Tilak Chandan under organic mode of cultivation. Sesbania as a green manure and 2.5 t vermicompost/ha were used as top dressing to rice crops. The grain yield (42.46 q/ha) and straw yield (53.27 q/ha) were highest in variety Kudrat-5. The N, P and K contents and their uptake were also maximum in variety Kudrat-5. Under organic mode of cultivation, variety Kudrat-5 was suitable for North West plains of India.

Keywords: Green manure, Scented rice, Harvest Index, Organic, Vermicompost

The green revolution introduced new varieties of rice that had shorter stature (dwarf variety) and were responsive to high levels of inputs, such as chemical fertilizers and irrigation. These HYV were capable of producing higher yields compared to traditional rice varieties (Supriya et al 2023). The traditional varieties with good qualities were ignored because immense attraction with hybrid variations, and are now rarely in cultivation. Before the era of HYV about 30,000 traditional varieties were grown in India) including coarse, fine, scented and non-scented types (Ahuja et al 2008). Among these, traditional scented rice varieties often possess unique and diverse genetic traits and often grown for their distinct aroma (Praveen et al 2022), which can be easily affected by chemical residues. The genetic diversity was reduced as a result of a greater preference for hybrid variants over traditional kinds (Das et al 2014). The long-term sustainability and environmental impacts of the intensive practices have since led to the need of more sustainable and balanced approaches such as organic cultivation and microbial inoculation (Verma et al 2018). The use of synthetic fertilisers, pesticides, and herbicides is avoided in organic farming which ensures that the soil, crop and environment remain free from harmful chemicals. The experiment aimed to investigate the impact of organic cultivation on traditional scented rice varieties, focusing on nutrient content, uptake, and yield.

MATERIAL AND METHODS

Experimental site: Field experiment was conducted at Norman E. Borlaug Crop Research Centre of G. B. Pant University of Agriculture and Technology, Pantnagar (Uttarakhand) during *kharif* season 2020. This centre is located at 29^{0}N latitude and 79.5^{0}E latitude and 243.84 meter above mean sea level. It falls under subtropical climate at the foot hills of “Shivalik” ranges of Himalaya a narrow belt. The summer season experiences high temperatures with humid and hot conditions. The maximum temperature varies from 31.4-45.2^{0}C. The winter season lasts from November to February and is extremely chilly. The south-west monsoon typically starts in the second or third week of June and lasts into September. The average annual rainfall is 1420 mm, with 75% of that beginning over the four-month period from June to September. There are an average of 58.1 wet days each year. Few showers may also be received in winter months due to the western disturbances. The Tarai region's soil (Mollisol) formed from calcareous coarse parent material under the dominance of vegetation from forests and under conditions of poor to moderate drainage. These soils originate from the alluvial sediments of the Indo-Gangetic plains.

Treatment details and crop management: The experiment was carried out in randomized block design with ten treatment and three replications. Gross plot size was 7.75 m × 3.75 m (29.06 m^2) and net plot 5.75m × 2.75 m (15.81 m^2). Ten traditional scented rice varieties *viz*., Kubir Mamhani, Kudrat-5, Chinar-20, Kesho Pohu, DRK, Kudrat-1, Pusa-1121, Type-3, Traori and Tilak Chandan were taken as treatment. The seedlings of 22 days old of different rice varieties were grown using wet bed method. Transplanting was done at spacing of 25cm × 12.5 cm (row to row- hill to hill)

using two seedlings/hill. Seeds were treated with 5% salted water for 30 minutes prior to soaking followed by Pant Bioagent-3 (mixture of *Tricoderma* and *Pseudomonas*) @ 10g/kg seed at the time of incubation before nursery sowing. The presence of *Trichoderma* and *Pseudomonas* helped to control fungal and bacterial pathogen, also in robust growth. The nursery used the wet bed method to raise the seedlings. Large, dry seed beds of 3.5 metres by 1.5 metres were constructed. The beds were saturated with water the day before sowing, and the next day they puddled. Sprouted seeds @500g for 10m^2 plots were broadcasted on 5th June. Beds were then kept saturated with water initially up to a week and then submerged with a thin layer of water gradually to 5 cm and irrigated on alternate days in the evening. Green manuring of *Sesbania* was done, likely biomass 16 t/ha equivalent to 3.5 t/ha on dry weight basis, along with green manuring, vermicompost @ 2.5 ton/ha was applied 20 days after transplanting. The nursery beds were irrigated to soften the soil a day before the plants were plucked. Seedlings were removed one by one, and the roots were cleaned to remove any mud. Following that, rows of seedlings were spaced 25 cm apart by 12.5 cm apart and moved using nylon rope. Two seedlings were transplanted each hill. Additional agronomic practises were followed in addition to the standard set of practises for the cultivation of rice.

Plant sample analysis: Grains and straw were analysed separately for different nutrients.

Samples of rice grain and straw were taken from the harvest of the net plot and dried in the dryer. After thoroughly grinding the samples, representative samples were each individually examined for N, P, and K content.

For both grains and straw, nutrient uptake was determined individually. Grain and straw uptake were combined and expressed as kg/ha for the overall uptake. The following equation was used to compute the uptake of N, P, and K:

$$\text{Nutrient uptake (kg/ha)} = \frac{\text{Nutrient content in grain /straw (\%)} \times \text{Grain/straw yield (kg/ha)}}{100}$$

Statistical analysis: Data analysis with the help of MS-excel 2019 and using OPSTAT which is programmed by HAU, Hisar, Haryana was done.

RESULTS AND DISCUSSION

Grain yield: The yield of grain of all the traditional short grain scented rice varieties differed significantly (Table 2). The rice variety Kudrat-5 (42.46 q/ha) registered significantly the highest grain yield among all the scented rice varieties and was 17.61% higher than variety Pusa-1121. It was due to highest number of effective tillers. Similar findings were observed by Singh et al (2007).

Straw yield: The straw yield varied significantly among the varieties (Table 2). Significantly highest straw yield was in Kudrat-5 (53.3 q/ha). In present study, varieties with high effective tillers produced higher straw yield even though had short stature. These results were also supported byKumari et al (2010).

Biological yield: The biological yield varied significantly where Kudrat-5 produced the significantly highest biomass (95.7 q/ha) followed by kudrat-1 (84.0 q/ha) (Table 2). Chinar-20 recorded the lowest biological yield (55.7 q/ha). The biological yield did not differ significantly among Kesho Pohu, DRK, Type 3 and Tilak Chandan. The variation total biomass may be ascribed to the capacity of a genotype to utilize the resources more efficiently and convert them into dry matter. Davari and Sharma (2010) also observed that biological yield was significantly improved by organic cultivation.

Harvest Index: The harvest index of scented rice varied significantly (Table 2) and the grain yield and straw yield were highly correlated. Chinar-20 was the variety with the highest harvest index value (48%). Varieties with good grain yield and good straw yield attained the higher harvest index. Hussain et al (2014) also noted variations in harvest index among scented rice varieties.

N, P and K contents in grains and straw: The highest N content in grains was in Pusa 1121 (1.36 %) and the lowest

Table 1. N, P, K content analysis

Particulars	Methods
Nitrogen (%)	Modified Micro-Kjeldhal`s method (Jackson 1973)
Phosphorus (%)	Vanadomolybdo phosphoric acid yellow color method (Jackson 1973)
Potassium (%)	Flame photometer method (Jackson 1973)

Table 2. Yield and harvest index of different scented rice varieties

Variety	Yield (q/ha)			Harvest Index (%)
	Grain	Straw	Biological	
Kubri Mamhani	27.89	45.56	73.45	37.95
Kudrat-5	42.46	53.27	95.72	44.09
Chinar-20	26.53	29.14	55.66	47.57
Kesho Pohu	29.04	34.07	63.11	45.95
DRK	28.68	33.66	62.34	46.06
Kudrat-1	37.54	46.49	84.03	44.64
Pusa 1121	34.98	41.70	76.67	45.63
Type-3	26.82	37.56	64.38	41.77
Traori	25.17	42.94	68.10	37.00
Tilak Chandan	29.01	34.53	63.55	45.67
CD (p=0.05)	3.08	4.27	6.84	0.02

for y Kesho Pohu (1.31%) though was statistically at par (Table 3). The N content in straw did not vary significantly among Kudrat-5 Kesho Pohu, Kudrat-1 and Tilak Chandan.The P content in grains differ significantly among the varieties maximum in Kudrat-5 and Chinar-20 (0.65%) followed by, Kudrat-1 and Pusa 1121. Kudrat-1 had significantly the maximum content of P in straw (0.17%). Except varieties DRK and Pusa 1121, all other varieties were at par with each other for P content in straw. The K content in grains of scented rice ranged from 0.23% (Kudrat-1) to 0.30% (Pusa 1121). Variety Pusa 1121 had significantly higher K content in grains. The K content in grains did not vary significantly among varieties DRK, Type-3 and Traori (0.29%). The K content in straw was the maximum for variety Kudrat-1 (1.33%), which was significantly higher than rest of the varieties. The minimum K content in straw was in Kesho Pohu (1.16%) which was at par with variety DRK. The N, P and K content in grains and straw were mainly influenced by genetic traits and nutrients translocation in rice plants.Kumari et al(2013) also observed that the effect of organic nutrient management (green manuring) on nutrient content of scented rice variety Birsamati was positively correlated. Kumari et al (2010) also observed the same trend.

N, P and K uptake by grainand straw: The N, P and K uptake in grain straw and total uptake varied significantly among varieties (Table 4). The maximum and significantly higher N uptake in grains (55.77 kg/ha), straw (27.60 kg/ha) and total (83.4 kg/ha) were in Kudrat-5 than other varieties.

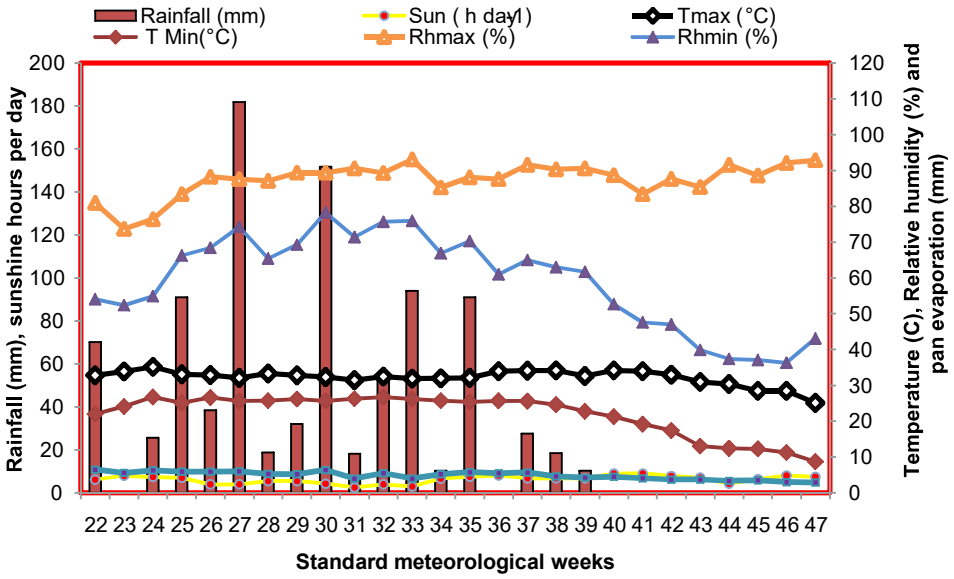

Fig. 1. Mean standard week-wise rainfall, temperature, relative humidity, evaporation and sunshine hours during cropping period (2020)

Table 3. N, P and K content in grain and straw of different rice varieties

Variety	N (%)		P (%)		K (%)	
	Grain	Straw	Grain	Straw	Grain	Straw
Kubri Mamhani	1.31	0.49	0.49	0.17	0.24	1.27
Kudrat-5	1.31	0.65	0.65	0.16	0.26	1.27
Chinar-20	1.33	0.65	0.65	0.16	0.24	1.24
Kesho Pohu	1.31	0.59	0.58	0.16	0.27	1.16
DRK	1.35	0.56	0.56	0.16	0.29	1.22
Kudrat-1	1.34	0.58	0.62	0.17	0.23	1.33
Pusa 1121	1.36	0.61	0.61	0.16	0.30	1.23
Type-3	1.36	0.50	0.50	0.16	0.29	1.28
Traori	1.34	0.50	0.50	0.16	0.29	1.25
Tilak Chandan	1.33	0.59	0.59	0.16	0.23	1.25
CD (p=0.05)	NS	0.03	0.05	0.008	0.005	0.06

Table 4. Uptake of N, P and K by different scented rice varieties

Variety	N uptake (kg/ha)			P uptake (kg/ha)			K uptake (kg/ha)		
	Grain	Straw	Total	Grain	Straw	Total	Grain	Straw	Total
Kubri Mamhani	36.62	13.62	50.23	6.68	4.64	11.32	15.09	35.49	50.58
Kudrat-5	55.77	27.60	83.37	10.93	6.89	17.81	24.95	53.78	78.73
Chinar-20	35.19	17.16	52.34	6.35	4.33	10.68	14.85	32.94	47.80
Kesho Pohu	37.92	16.80	54.73	7.93	4.75	12.68	17.08	33.75	50.83
DRK	38.81	15.99	54.80	8.18	4.45	12.64	13.79	35.03	48.82
Kudrat-1	50.45	23.36	73.81	8.52	6.54	15.06	21.82	49.95	71.77
Pusa 1121	47.76	21.58	69.34	10.39	5.45	15.85	18.35	43.24	61.59
Type-3	36.38	13.40	49.78	7.70	4.35	12.05	12.02	34.34	46.36
Traori	33.74	12.66	46.39	7.28	4.06	11.34	11.96	31.60	43.46
Tilak Chandan	38.58	17.07	55.65	6.76	4.72	11.48	16.50	36.28	52.78
CD (p=0.05)	4.80	3.38	8.01	0.95	0.61	1.51	2.03	4.63	6.48

The P uptake in grains (10.93 kg/ha), in straw (6.89 kg/ha) and total P uptake (17.81 kg/ha) were also highest for variety Kudrat-5.

Variety Kudrat-5 also recorded the maximum K uptake by grains (24.95 kg/ha), straw (53.78 kg/ha). Except K uptake by straw, this variety recorded significantly higher K uptake by grain and total uptake than rest of the varieties. The contribution of contents was less and uptake was largely governed by the amount of biomass produced. Therefore, varieties which produced more biomass resulted in higher uptake of nutrients. Yadav et al (2014) also observed the similar variations in nutrient uptake among scented rice varieties. The findings were also similar with the earlier findings of Singh et al (2017).

CONCLUSION

The highest grain yield as well as nutrient content and uptake was found in scented variety Kudrat-5 which can be grown successfully under organic mode of cultivation.

CONTRIBUTION OF AUTHORS

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