Original Research Article

Assessing the performance of farmers' wheat (*Triticum aestivum* L.) varieties for yield and its attributing traits under organic cultivation

ABSTRACT:

The local cultivars and farmers' plant varieties have good yield potential under a minimal input system. Therefore, the present investigation was carried out to assess the performance of the farmers' wheat varieties in Gandhinagar, Gujarat condition under organic cultivation during November-March (winter season) 2015-16 and 2016-17.

Study Design and Methodology: The field experiments were constituted in Randomized Complete Block Design having three replications of fifteen treatments comprising twelve farmers' varieties and three checks. The observations on yield and its attributing traits were recorded.

Results: The pooled data analyzed over both years showed that the variety Mohit Gold was found significantly superior in terms of spike length (15.33 cm) and the number of spikelets per spike (22.97) among all the tests and checks during both years. Whereas, the significantly longest awn length was found in the Rajyog variety (14.48 cm). The number of grains per spike was reported superior in RK-7 (68.39) with at par RK-2 (64.18). However, the number of spikes per square meter (499.38) was recorded as significantly superior in HZG 30 which also reported a higher grain yielder per hectare with the next-best leaf length to superior check Bansi and at par to a second-best plant height of 94.05 cm after Mohit Gold (96.65 cm) and Rajyog (95.71 cm). Henceforth, HZG 30 can be a suitable option for wheat growers which might produce good biomass as well. Thus, it is concluded more such trials are

recommended in different wheat growing areas to generate authentic production data to identify potential cultivars for recent breeding programs.

Keywords: Organic Farming, Cultivars, Farmers' Variety, Landraces, field evaluation

Introduction:

Wheat is one of the most important food crops in the world [1]. Wheat is a prominent crop of India from the point of view of food security [2]. As farmers increasingly adopt modern varieties of wheat, traditional wheat landraces are on the decline. Yet the genetic diversity found in these hardy traditional varieties could be crucial for the future of wheat production [3]. Still, many local/traditional cultivars of various crops are being conserved and cultivated by farmers in different parts of the country and they improve such varieties by adopting selection methods based on desirable traits [4,5,6]. The cultivars which are being grown/ improved traditionally or have a landrace/ wild relative or the farmers possess common knowledge about it are identified as Farmers' plant varieties [7]. Across the world, such farmers are playing a crucial role in the biodiversity conservation of various crops through the application of their knowledge base where locally adapted farmers' practices of seed selection, and farm management is used [8]. They have continuously engaged in new varietal development through constant efforts in desirable trait selection [9]. Such conserved ancient wheat varieties were found richer in protein, crude ash, crude fibre, and lipids than the grains of common wheat varieties [10,11].

Nowadays consumers become more aware of healthy and safe food produced which has a low environmental impact. The popularity of food produced through organic farming and farming area managed by incorporating the practices of organic agriculture have been increasing [12]. Even a higher wheat quality can be achievable by applying lower inputs in organic farming which also safeguard natural resources [13].

Therefore, such improved farmers' varieties need to be recognized by comparing them with the popular check varieties for the betterment of growers. The National Innovation Foundation (NIF) - India is a national initiative to strengthen grassroots technological innovations and outstanding traditional knowledge. As a part of it, the comparative study on the farmers' developed twelve wheat varieties with three local state and national checks were carried out at NIF research farm, Gandhinagar, Gujarat during November-March (winter season) 2015-16 and 2016-17 under organic cultivation.

Materials and Methods:

The study was conducted under organic cultivation in Gandhinagar, Gujarat conditions during November-March (winter season) 2015-16 and 2016-17. The experiments were accommodated in a randomized complete block design that comprises fifteen treatments consisting of twelve farmers' wheat varieties i.e. Mohit Gold; Rajyog; Kudrat-9, Kudrat-7, Kudrat-17; HZG-30; BLK Balaji; RK-2, RK-4, RK-7, RK-Shital; and AR-64 developed by Satveer Singh (Uttar Pradesh), Rajkumar Rathore (Madhya Pradesh), Prakash Singh Raghuvanshi (Uttar Pradesh), Rudrappa Zulapi (Karnataka), Bajarang Lal (Rajasthan), Ranjit Kumar Singh (Uttar Pradesh), and Agyaram Verma (Uttar Pradesh) respectively with three checks *viz.* Banshi, GW-496 and, HD 2969 replicated thrice. The seeds of farmers' varieties were collected from respective innovators while checks were procured from an agri-input shop in Gandhinagar. The observations on the parameters like plant height, leaf length, number of spikes per square meter, spike length, spike hair length, number of spikelets per spike, number of grains per spike and, yield per hectare were recorded from ten randomly selected plants and/or plant parts and subjected to statistical analysis using standard protocols. The pooled data was worked out from both years for all the parameters observed during the study. The nutrient management was done through green manuring and vermicompost. For green manuring, cluster bean was sown in the first week of July and incorporated into the soil during the second fortnight of September. Two hand weeding were performed at 25 and 45 days after sowing for the management of weeds.

Result and Discussion:

The data thus recorded were analyzed using standard statistical protocols for Randomised Complete Block Design and presented in Tables 1 and 2. Both years' data revealed a significant difference among all the treatments for the parameters observed i.e. plant height, number of spikes per square meter, spike length, spike hair length, spikelets per spike, and grains per spike except leaf length and grain yield per hectare which was observed during the second year (2016-17). The pooled data analysed and presented in tables 1 and 2, revealed a significant difference between the treatments which indicates the variation between all the test and check varieties. However, leaf length, awn length, and the number of spikelets per spike the interaction between years and treatment showed no significant difference and variation in data recorded.

Looking towards the data presented in table 1, the plant height of HD2969 (National check) was reported higher during both the years as well as in their pooled with 99.41 cm, 100.79 cm, and 100.10 cm respectively as compared to all the tested and check varieties. During the first year, Rajyog (98.69 cm) and in case of second year Mohit Gold (95.44 cm) was recorded as the next best plant height to HD2969. Whereas, the pooled data analysed from both years reported Mohit Gold (96.65 cm) as the next best and at par variety to HD2969, which indicates no statistically significant difference among them. However, Mohit Gold (96.65 cm), Rajyog (95.71 cm), and HZG-30 (94.05 cm) reported at par with each other and respectively showed 6.44% and 13.98%; 5.52% and 13.13%; 3.86% and 11.60% higher plant height than the Bansi (local check) and GW-496 (state check). The present result revealed considerable variations in plant height among wheat varieties which might be due to the genetic potential of a certain variety and higher inheritance of this character. Similar findings were reported by Abinasa et al. [14] and Munsif et al. [15].

In the same way, the Bansi variety showed superior leaf length among all tested varieties during the first (44.22 cm) and second (52.18 cm) year as well as in their pooled (48.20 cm). However, RK-Shital (25.67 cm) and HZG-30 (24.27 cm) were recorded next best and superior varieties respectively during the first and second year. While in the case of pooled data again HZG-30 (24.50 cm) was recorded next best to superior Bansi, however, it was recorded 8.38% and 10.94% higher leaf length than the GW-496 (22.44 cm) and HD2969 (21.82 cm) respectively (Table 1). The data presented in table 1 indicated that among all tested and check varieties Mohit Gold was noticed significantly superior in terms of Spike length with 14.92 cm and 15.74 cm during both the first and second year. It was also reported significantly superior with 15.33 cm Spike length in pooled data of both the years which reflected 56.31%, 43.99% and 42.37% more Spike length than the Bansi, GW-496 and HD2969 respectively with 6.70 cm, 8.59 cm and 8.83 cm Spike length (Table 1). In the same way, awn length was also reported significantly longer in Rajyog variety during the first year (14.48 cm), second year (14.48 cm) and their pooled (14.48 cm). In the case of pooled, Rajyog was recorded with 35.92%, 49.57%, and 49.78% significant higher awn length than all the three checks namely Bansi (9.28 cm), GW-496 (7.30 cm) and HD2969 (7.27 cm) (Table 1).

Similarly, the data presented in table 2 indicated that HZG 30 was statistically significant and superior with 525.10, 473.67, and 499.38 spikes per square meter during the first and second year as well as in their pooled respectively. In case of pooled, HZG 30 was reported with 21.75%, 20.46% and 13.44% higher spikes per square meter than Bansi, GW-496 and HD2969 recorded with 390.78, 397.22 and 432.28 spikes per square meter respectively. The maximum spike of the variety might affect by the genetic makeup of the variety. The result revealed by Haq et al. that the number of spikes per plant showed moderate heritability with modest genetic progress partially supports the present condition [16].

Where significantly the highest number of spikelets per spike was observed in Mohit Gold during the first year (23.70) and second year (22.23). It was also reported significantly superior in case of pooled data with 22.97 spikelets per spike which found 36.84%, 38.37% and 23.64% higher than the checks Bansi (14.50), GW-496 (14.15) and HD2969 (17.54) respectively (Table 2). However, in case of number of grains per spike, RK-7 recorded significantly superior with 82.06 grains during first year whereas RK-2 with 69.79 grains per spike recorded superior during the second year among all tested and checks. While, pooled data analyzed from both the year noticed RK-7 as superior with 68.39 grains per spike while RK-2 reported at par to it with 64.18 grains per spike. The data reflects that the wheat variety RK-7 reported with 40.09%, 38.06% and 29.20% and variety RK-2 36.16%, 33.99% and 24.55% higher grains per spike respectively than the Bansi, GW-496 and HD2969 noticed with 40.97, 42.36 and 48.42 grains per spike (Table 2). Li et al. [17] revealed that a variable number of spikelets could be present in wheat spikes due to containing several florets. In relation to the different developmental stages, number, and fruiting efficiency, the weight of the grains might differ, when it is compared among various spikelets, and even within the individual spikelets. This finding supports the variation in data reported in the present study.

The grain yield data presented in Table 2, revealed the superior performance of HZG-30 during both first year (3740.00 kg/ha) and second year (3325.81 kg/ha). Similarly, it also recorded with higher grain yield of 3532.91 kg/ha in the pooled data analyzed which was respectively 18.79%, 10.90% and 12.61% higher than the checks Bansi (2868.91 kg/ha), GW-496 (3147.84 kg/ha) and HD2969 (3087.33 kg/ha). However, the test varieties Kudrat 9 (3369.56 kg/ha), BLK-Balaji (3265.07 kg/ha), RK-4 (3246.76 kg/ha), Mohit Gold (3127.32 kg/ha), Rajyog (3108.98 kg/ha) and check varieties GW-496 (3147.84 kg/ha) and HD 2969

(3087.33 kg/ha) reported at par to HZG-30, showed no significant grain yield difference among them. The higher grain yield of HZG-30 might be due to more spikes per square as reported in the present findings. Where the favorable correlation between spike count and grain yield reported by Haq et al. [16] is in line with the present findings.

The wheat variety Bansi is popular for organic cultivation among farmers. Under the conventional cultivation practices, the wheat variety HD 2967 gives an average yield of 5.456 t/ha (ICAR-IARI, New Delhi) [18] and GW 496 yields 37.44 q/ha to 47.12 q/ha Yadav et al. [19]. However, the yield gap in the present study might be due to the practice of organic cultivation. Around 20% yield reduction in organic farming as compared to conventional farming revealed by Ponisio et al. [20] and Ponti et al. [21] supports the present yield gap. Moreover, during the previous studies, the farmers' improved variety Mohit-gold reported higher magnesium (Mg) and potassium (K) contents. While RK-7 exhibited a significantly higher sugar and carbohydrate content whereas Kudrat-7 contained higher fibre. The higher iron content was found in HZG-30, Kudrat-7, and Bansi-local, cultivars [10]. This shows the richness of essential nutrient content in farmers' wheat varieties which can be the better alternative among growers and consumers.

Conclusion:

In the present study, the farmers' wheat varieties had performed superior and/or at par with the popular checks in the parameters observed under irrigated, timely sowing conditions showed their potential and compatibility with farmers' preferences. The adoption of these varieties may play important role in the livelihood improvement of the farming communities. It is necessary to conduct participatory field research trials of these outperformer varieties at different sowing times with standard organic cultivation practices for large-scale adoption of these varieties. It might help in the selection of suitable varieties in the targeted area for better adoption in the future. The biochemical analysis of such organically cultivated varieties is also warranted to validate the claims.

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Table 1: Mean Performance of farmers' wheat varieties in comparison with checks under organic cultivation during Rabi 2015-16 and 2016-17

T. No.	Treatment Details	Plant Height (cm)			Leaf length (cm)			Spike length (cm)			Awn Length (cm)		
		2015-16	2016-17	Pooled	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled
T1	Mohit Gold	97.86	95.44	96.65	25.54	19.59	22.57	14.92	15.74	15.33	8.22	7.99	8.10
T2	Rajyog	98.69	92.72	95.71	24.25	24.59	24.42	5.49	5.55	5.52	14.48	14.48	14.48
T3	Kudrat-9	82.50	82.79	82.64	24.19	22.07	23.13	8.27	8.17	8.22	8.21	7.57	7.89
T4	HZG-30	97.06	91.04	94.05	24.72	24.27	24.50	12.25	13.24	12.74	8.14	7.90	8.02
T5	BLK Balaji	81.94	75.26	78.60	24.26	22.97	23.61	9.68	9.79	9.74	8.36	8.01	8.19
T6	RK-2	81.96	80.71	81.34	24.65	22.94	23.80	12.05	13.06	12.55	7.76	7.76	7.76
T7	RK-4	79.90	83.36	81.63	19.63	20.61	20.12	8.34	8.42	8.38	6.98	6.92	6.95
T8	RK-7	93.38	91.42	92.40	23.22	20.75	21.99	13.61	10.67	12.14	8.08	8.08	8.08
T9	RK-Shital	80.56	85.11	82.83	25.67	22.89	24.28	8.00	8.33	8.17	6.78	6.78	6.78
T10	Kudrat-7	85.40	86.78	86.09	20.40	21.52	20.96	9.50	9.58	9.54	7.32	7.25	7.28
T11	Kudrat-17	85.67	86.09	85.88	21.40	20.79	21.09	10.30	10.47	10.38	7.35	7.58	7.46
T12	AR-64	82.50	82.78	82.64	19.57	19.60	19.58	9.37	9.64	9.50	7.50	7.59	7.54

T13	Banshi	93.58	87.27	90.42	44.22	52.18	48.20	6.07	7.32	6.70	9.22	9.33	9.28
T14	GW-496	81.74	84.53	83.14	22.16	22.73	22.44	8.24	8.93	8.59	7.13	7.47	7.30
T15	HD2969	99.41	100.79	100.10	20.78	22.85	21.82	8.33	9.34	8.83	7.21	7.33	7.27
S. Em. ± (T)		2.09	1.68	1.35	4.71	7.63	4.43	0.43	0.41	0.29	0.58	0.29	0.34
CD (T)		6.04	4.87	3.82	13.63*	22.11*	12.53	1.23	1.18	0.83	1.67	0.84	0.96
S. Em. ± (Y X T)				1.91			6.26			0.41			0.48
CD (Y X T)				5.40			17.72*			1.17			1.36*
CV%		4.10	3.35	3.77	33.52	55.02	44.85	7.65	7.15	7.35	12.20	6.17	10.20

Note: T: Treatment; Y = Year; * = Non significant

Table 2: Mean Performance of farmers' wheat varieties in comparison with checks under organic cultivation during Rabi 2015-16 and 2016-17

T. No.	Treatment Details	Number of spikes per square meter			Number of pikelets per spike			Number of grains per spike			Grain yield (kg/ha)		
		2015-16	2016-17	Pooled	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled
T1	Mohit Gold	438.00	451.33	444.67	23.70	22.23	22.97	49.34	66.71	58.03	3023.30	3231.33	3127.32
T2	Rajyog	423.67	420.67	422.17	16.36	15.02	15.69	37.72	41.36	39.54	3156.70	3061.26	3108.98

T3	Kudrat-9	445.23	417.67	431.45	15.37	15.29	15.33	40.47	43.14	41.80	3470.00	3269.12	3369.56
T4	HZG-30	525.10	473.67	499.38	20.42	19.82	20.12	42.03	45.77	43.90	3740.00	3325.81	3532.91
T5	BLK Balaji	472.00	435.00	453.50	17.24	17.19	17.21	49.16	55.58	52.37	3393.30	3136.85	3265.07
T6	RK-2	259.77	293.33	276.55	16.84	17.34	17.09	58.57	69.79	64.18	2173.30	2324.29	2248.80
T7	RK-4	459.23	454.67	456.95	14.54	14.67	14.60	31.80	39.81	35.80	3243.30	3250.23	3246.76
T8	RK-7	274.10	334.67	304.38	20.00	16.58	18.29	82.06	54.72	68.39	2063.30	2437.67	2250.49
T9	RK-Shital	327.10	355.33	341.22	15.22	15.89	15.56	34.22	47.44	40.83	2453.30	2569.95	2511.62
T10	Kudrat-7	446.23	440.00	443.12	16.40	17.54	16.97	50.67	51.89	51.28	3200.00	3174.64	3187.32
T11	Kudrat-17	329.33	375.00	352.17	16.30	17.26	16.78	56.33	57.13	56.73	2453.30	2758.91	2606.11
T12	AR-64	326.67	350.00	338.33	15.90	16.53	16.21	51.33	48.33	49.83	2696.70	2740.02	2718.36
T13	Banshi	412.57	369.00	390.78	14.40	14.61	14.50	36.60	45.34	40.97	3016.70	2721.12	2868.91
T14	GW-496	426.77	367.67	397.22	13.44	14.87	14.15	39.39	45.33	42.36	3366.70	2928.98	3147.84
T15	HD2969	418.90	445.67	432.28	16.99	18.09	17.54	46.66	50.19	48.42	3056.70	3117.95	3087.33
S. Em. ± (T)		4.76	2.63	5.18	0.71	0.65	0.47	2.82	3.54	2.24	191.95	256.66	160.01
CD (T)		13.80	7.63	14.65	2.05	1.89	1.34	8.17	10.27	6.35	556.06	743.50*	453.02
S. Em. ± (Y X T)				7.32			0.67			3.17			226.29

CD (Y X T)			20.72			1.90*			8.98			640.67
CV%	2.07	1.14	3.18	7.27	6.71	6.88	10.37	12.08	11.23	11.21	15.14	13.28

Note: T: Treatment; Y = Year; * = Non significant