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Evaluation of Response of Different Varieties of Major Crops for Organic Farming under North Gujarat Condition

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment was conducted during 2015-16 to 2021-22 at Centre for Research on IFS, S.D.A.U., Sardarkrushinagarto study the evaluation of response of different varieties of major crops for organic farming under north Gujarat condition. Total eight different varieties of each crop groundnut, wheat and green gram were taken for study during the *kharif, rabi* and summer season, respectively. The experiment was laid down in randomized block design with three replications. Significantly higher groundnut pod yield (1813 kg/ha) and haulm yield (2755 kg/ha) were recorded in GJG 17 (S) in pooled results and also in individual years. The significantly higher groundnut equivalent yield (2115 kg/ha), economic performance in terms of net return (82404 ₹/ha) was recorded higher in case of GJG 17 (S) as compare to other variety. In case of wheat variety, significantly higher groundnut equivalent yield (1850 kg/ha), gross return (1,18,047 ₹/ha) and net return (50,239 ₹/ha)) was recorded under GW 451, which was at par with GW 496 wheat variety.

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During summer season, significantly highest groundnut equivalent yield (612 kg/ha), gross return (39031 ₹/ha) and net return (9730 ₹/ha) were recorded with greengram variety GM4. There was improvement in soil nutrients status over its initial value by using the organic manure in cropping system. The percent increase in soil organic carbon was 32.6%, available nitrogen 17.3%, available phosphorus 78.9%, available potassium 5.8%.,while 21% increase in water holding capacity and 4.3% reduction in bulk density due to continuous use of organic manures as a sources. The bacterial population, *actinomycetes* and fungi population were increased over first year after conversion period and recorded higher in last year 2021-22 under groundnut-wheat-greengram crop sequence.

Keywords: Crop sequence; greengram; groundnut; microbial counts; organic; variety; wheat.

1. INTRODUCTION

In the agricultural economy of India, oilseeds are important next only to food grains in terms of area, production and value. Wheat (*Triticum aestivum*L.) is the most important among all cereals used as a food grain in the world. It ranks first in the world cereal production and is a staple food of about one third of the world's population. Green gram (*Vigna radiate* L.) is one of the most vital and third important pulse crop cultivated throughout India (after chickpea and pigeon pea) for its versatile uses as vegetable, pulse, fodder and green manure crop. Organic manures have traditionally been the important input as sources of plant nutrients. They play a direct role in supplying macro and micronutrient and indirectly improve the physical, chemical and biological properties of soils [1]. Further organic farming in recent years is gaining impetus due to better price for the farm produce. Use of farmyard manure with other organic amendments like vermicompost, neem seed cake, phosphocompost and poultry manure, etc., provide a safer and environment friendly way of applying nutrients to crops [2]. Integrated approach of nutrient supply by organic sources combination *i.e* FYM, vermicompost, caster cake and biofertilizers is gaining importance because they not only reduces the use of inorganic fertilizers, but completely stopped the dependence of inorganic fertilizer, sustaining the crop productivity by improving soil health and is also an human and environment friendly approach [3]. At present the breeding criteria and evolution strategy to bread the variety for high potential yield under regular package of practices for nutrient management mostly based on chemically nutrient management supply system. In each crop different variety are being tested for the adaptability, nutrient and water management and optimum geometry. Very merger attempt has been made by various scientists of the state as well as nation to identify the variety/ varieties for their potential evolution under certain nutrient supply system that is organic, inorganic and integrated nutrient management. Farmers now come forward for organic crop production but there is no information to answer the question regarding suitable variety under organic production system. Because there may be certain hidden potentiality to produce more under organic production system rather than chemical nutrient supply system. Hence it is necessary to test different verities of crops of this region under organic production system. Therefore the following experiment is planned to assess the performance of different verities of groundnut, wheat and summer greengram under North Gujarat condition" at Centre for Research on IFS, SDAU, Sardarkrushinagar.

2. MATERIALS AND METHODS

A field experiment was conducted during 2015-16 to 2021-22 at Centre for Research on IFS, S.D.A.U., Sardarkrushinagar to study the the evaluation of response of different varieties of major crops for organic farming under north Gujarat condition. The soil was very low in organic carbon and available nitrogen (147 kg ha^{-1}) and medium in available P (10.92 kg ha^{-1}) and available K (170 kg ha^{-1}). Total eight varieties of each crop were taken as treatment crop, *viz;1.* GJG HPS-1(Sprading), GG 20 (Semi sprading), GG 7 (Bunch)), TG 37 (A) (Banch), GJG 9 (Banch), GG 5 (Banch), GJG 17 (Sprading) and KDG 123 (Banch) of groundnut, GW 451, GW 366, GW 322, GW 273, GW496, GDW 1255, GW1139, and HI 8498 of wheat and. GM 4, Meha, K 851, PDM 139, IPM 410-3, GM 5, PKVAKM 4 and greengram BGS 9 were taken. The organic manure were applied based on recommended dose of nitrogen of each crop by using the FYM, vermicompost and castor cake as a sources of organic manure in the ratio of one third of each sources. The soil was very low

in organic carbon and available nitrogen (141 kgha^{-1}) and medium in available P (13.47 kg ha^{-1}) and available K (180 kg ha^{-1}). The all crops were fertilized as per treatments details and sown as per recommended spacing for each crops by using recommended varieties and seedrate. The castor cake was applied 10 days before sowing of crops.

3. RESULTS AND DISCUSSION

3.1 Groundnut

Yield attributes, yield and economics of different groundnut varieties showed significant variations among tested varieties. Significantly higher groundnut pod yield (1813 kg/ha) and haulm yield (2755 kg/ha) were recorded in GJG 17 (S) in pooled results and also in individual years (Table 1). The significantly higher groundnut equivalent yield (2115 kg/ha), economic performance in terms of net return (82404 ₹/ha) was recorded higher in case of GJG 17 (S) as compare to other variety under organic condition and at the same time groundnut variety GG 5 (B_1) performed lowest in groundnut equivalent yield (1345 kg/ha) and economics (33321₹/ha) parameter under organic package of practices (Table 4).These results are in accord with those reported by Elayaraja and Singaravel [4] and Panwar and Munda [5].

3.2 Wheat

After application of organic package of practices in different variety of wheat plant population at initial and at harvest, plant height at 30 and 60 DAS, effective tillers per meter row length, number of grain per ear head and test weight of grain noted non significant results during course of investigation, whereas plant height at harvest of wheat showed significant variation among different wheat varieties. In case of grain yield, straw yield and economics performance point of view GW 451 variety recorded significantly higher grain yield (2873 kg/ha), straw yield (3804 kg/ha) (Table 2). The significantly higher groundnut equivalent yield (1850 kg/ha), gross return (1,18,047 ₹/ha) and net return (50,239 ₹/ha)) was recorded under GW 451, which was at par with GW 496 wheat variety. The lowest GEY and economic performance was recorded with wheat variety GW 322 (Table 4). Attainments of particularly higher or lower yield attributing character among the different varieties are the genetically controlled phenomenon [6-8].

3.3 Green Gram

The data revealed that the plant population at initial and at harvest and 1000 seed weight were found non significant, while remaining plant height at 30 DAS, plant height at harvest, number of branches/plant, number of pods/plant, number of seeds/pod, seeds yield and stover yield of green gram showed significant variation among different green gram varieties (Table 3). Significantly higher seed yield (598 kg/ha) and stover yield (1079 kg/ha) in pooled were recorded in GM 4 as compare to other variety. The significantly highest groundnut equivalent yield (612 kg/ha), gross return (39031 ₹/ha) and net return (9730 ₹/ha) were recorded with GM4. Under organic condition even as IPM 410-3 variety of green gram performed lowest in groundnut equivalent yield (382 kg/ha) and negative economics under organic package of practices(Table 4).Such variations in yield attributes among the mungbean varieties have also been observed by Goswami et al. [9] and Bekele et al. [10].

3.4 Soil Fertility Statusand Microbial Counts at the End of the Crop Sequence

Data presented in Table 5 shown that there was improvement in soil nutrients status over its initial value by using the organic manure in cropping system. The percent increase in soil organic carbon was 32.6 %, available nitrogen 17.3%, available phosphorus 78.9%, available potassium 5.8%.,while 21% increase in water holding capacity and 4.3% reduction in bulk density due to continuous use of organic manures as a sources. From the data presented in the Table 6 in can be seen that the bacterial population, *actinomycetes* and fungi population were increased over initial year (2019-20) of conversion period and recorded higher in last year 2021-22 under groundnut-wheat-greengram crop sequence. Soil microorganisms play a significant role in regulating the dynamics of organic matter decomposition and availability of plant nutrients.

Table 1. Pod yield, haulm yield, GEY and economics of groundnut (pooled)

Treat.	2018-19	2019-20	2020-21	2021-22	Pooled	2018-19	2019-20	2020-21	2021-22	Pooled
	Pod yield (kg/ha)					Haulm yield (kg/ha)				
V_1	1258	1898	1389	1247	1448	2028	3488	2407	1713	2409
V_2	1428	1944	1636	1410	1605	2341	3611	2685	1898	2634
V_3	1152	1759	1019	1145	1269	1826	2623	2006	1537	1998
V_4	1379	2037	1543	1333	1573	2015	3580	2593	1759	2487
V_5	1184	1852	1173	1185	1349	1924	3272	2099	1682	2244
V_6	1135	1420	988	1114	1164	1504	2068	1481	1559	1653
V_7	1549	2346	1728	1627	1813	2238	3673	2901	2207	2755
V_8	1256	1883	1296	1238	1418	1872	2963	2253	1682	2193
SEm±	134.7	162.7	91.48	95.88	45.4	154.5	241.2	132.4	131.3	104
CD (P=0.05)	NS	NS	277.5	290.8	133	468.8	731.7	401.7	NS	307
Y*V	SEm±				124					170
	CD (P=0.05)				353					484
CV %	18.06	14.89	11.77	484.3	14.8	13.6	13.22	9.96	12.96	12.8

Table 2. Grain yield (kg/ha), straw yield (kg/ha), groundnut equivalent yield, and economics of of wheat(pooled)

Treat.	2018-19	2019-20	2020-21	2021-22	Pooled	2018-19	2019-20	2020-21	2021-22	Pooled
	Grain yield (kg/ha)					Straw yield (kg/ha)				
V_1	3964	3287	3935	3565	3688	5630	4907	4722	4456	4929
V_2	3433	2407	3206	2604	2913	4741	3912	4028	3843	4131
V_3	3250	2338	2727	2530	2711	4711	3681	3750	3507	3912
V_4	3639	2824	3241	3102	3201	4963	4398	5023	4109	4623
V_5	3862	3102	3542	3380	3471	5304	4676	4769	4259	4752
V_6	3624	2546	2975	2854	3000	4830	4167	3727	4132	4214
V_7	3604	2477	3067	2771	2980	5170	3958	3889	3935	4238
V_8	3364	2315	2507	2676	2716	4659	3472	3495	3912	3885
SEm±	194	185	249	232	66	194	264	280	258	118
CD (P=0.05)	NS	561.8	754.9	NS	193.4	588	802	850	NS	348
Y*V	SEm±				216					251
	CD (P=0.05)				614					712
CV %	9.37	12.05	13.69	13.68	12.1	6.71	11.04	11.62	11.14	10.0

Table 3. Seed yield (kg/ha), stover yield (kg/ha), GEY (kg/ha) and economics of greengram (Pooled)

Treat.	2018-19	2019-20	2020-21	2021-22	Pooled	2018-19	2019-20	2020-21	2021-22	Pooled
	Seed yield (kg/ha)					Stover yield (kg/ha)				
V_1	487.4	697.5	679.0	756.2	655	903	925	1419	1064	1078
V_2	425.2	472.2	617.3	614.2	532	883	864	1334	972	1013
V_3	357.0	425.9	601.9	611.1	499	785	709	1080	941	879
V_4	296.3	373.5	447.5	567.9	421	746	601	972	824	786
V_5	288.9	354.9	416.7	561.7	405	765	540	825	753	721
V_6	471.1	555.6	663.6	713.0	600	888	895	1396	978	1039
V_7	349.6	413.6	555.6	608.0	481	798	679	1034	938	862
V_8	346.7	401.2	540.1	583.3	467	740	663	987	861	813
SEm±	28.9	27.6	48.1	41.9	16.8	44.8	51.6	78.8	70.9	37.1
CD (P=0.05)	87.7	83.6	145.8	127.1	49.4	NS	156.6	239.0	NS	109
Y*V	SEm±				37.6					63.0
	CD (P=0.05)				106					178
CV %	13.25	10.34	14.73	11.58	12.8	9.53	12.17	12.06	13.40	12.1

Table 4. GEY (kg/ha) and economics of groundnut, wheat and greengram (Pooled)

Treat.	Groundnut			Wheat			Greengram		
	GEY kg/ha	GP Rs/ha	NP Rs/ha	GEY kg/ha	GP Rs/ha	NP Rs/ha	GEY kg/ha	GP Rs/ha	NP Rs/ha
V_1	1712	109250	56732	1850	118047	50239	612	39031	9730
V_2	1894	120816	68298	1472	93944	26136	506	32262	3221
V_3	1488	94926	42407	1374	87653	19846	470	29963	355
V_4	1846	117776	65258	1622	103506	35699	399	25474	-4594
V_5	1595	101746	49228	1747	111453	43646	382	24379	-5845
V_6	1345	85839	33321	1515	96633	28825	564	36001	6596
V_7	2115	134922	82404	1507	96149	28342	454	28980	-841
V_8	1659	105834	53316	1447	92348	24541	440	28049	-1612
SEm±	53	3413	3413	45.62	2910	2910	14.72	939	821
CD (P=0.05)	157	10041	10041	134	8561	8561	43	2762	2416
CV %	8.89	8.89	17.4	5.82	5.82	18.1	6.15	6.15	18.8

Table 5. Year wise soil nutrients and properties after completion of crop sequence (at the end of 2022 summer greengram)

Treatment	EC (dSm^{-1})	pH	SOC (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)	MWHC (%)	BD (gm/cc)
T_1	0.137	7.72	0.252	171.4	18.85	168.0	32.21	1.417
T_2	0.132	7.99	0.238	164.1	19.04	178.8	31.26	1.428
T_3	0.141	7.81	0.226	167.2	19.60	167.2	31.17	1.422
T_4	0.125	7.96	0.233	172.5	17.55	169.5	30.78	1.419
T_5	0.127	8.09	0.226	165.1	17.64	166.5	31.16	1.429
T_6	0.130	7.99	0.238	166.2	19.23	172.5	29.98	1.426
T_7	0.126	8.02	0.233	163.1	17.64	177.0	30.76	1.421
T_8	0.129	7.92	0.240	172.5	18.57	179.9	31.06	1.427
Initial	**0.090**	**7.14**	**0.190**	**147.0**	**10.92**	**170.0**	**26.62**	**1.480**

Table 6. Microbial count at the end of year (2021-22) in different varieties of crop sequence

Treatments	2019-20			2020-21			2021-22		
	Bacteria ($\times 10^6$)	*Actinomycete* ($\times 10^5$)	Fungi ($\times 10^4$)	Bacteria ($\times 10^6$)	*Actinomycetes* ($\times 10^5$)	Fungi ($\times 10^4$)	Bacteria ($\times 10^6$)	*Actinomycetes* ($\times 10^5$)	Fungi ($\times 10^4$)
T_1	6.03	0.322	1.02	205.33	453.2	183.5	244.87	323.5	201.5
T_2	34.3	0.251	5.51	128.24	326.8	117.6	218.27	272.8	142.7
T_3	2.05	0.515	7.54	55.34	72.3	40.1	198.34	312.7	221.2
T_4	18.1	3.21	4.25	12.39	23.8	46.9	202.39	242.8	102.8
T_5	27.2	2.28	3.4	67.25	92.3	51.3	240.08	194.7	174.8
T_6	8.02	0.87	6.06	31.56	65.6	29.1	237.11	227.8	133.3
T_7	10.4	62.9	629	83.18	144.1	83.1	205.37	184.5	214.6
T_8	13.6	71.3	537	5.25	33.3	34.5	233.41	308.1	193.3

1.	Selling price of groundnut pod(25% premium price)	₹ 63.8/kg	4.	FYM ₹ 0.6/kg
2.	Selling price of wheat (25% premium price)	₹ 28/ kg	5.	Vermi compost ₹ 6/kg
3.	Selling price of green gram(25% premium price)	₹ 54/kg	6.	Castor cake ₹ 7.8/kg
4	Labour charge	₹ 340/day		

4. CONCLUSION

This study clearly established the effect of different vareties of groundnut, wheat and greengram under organic farming. In view of the results obtained from the present investigation, it is concluded that the farmers growing crops under organic farming are recommended to grow the groundnut GJG-17(S), wheat GW 451 or GW 496 and greengram GM 4 with recommended dose of nitrogen of respective crop in the ratio of one third of each sources (FYM, vermicompost and castor cake on the nitrogen base) for achieving higher yield and economics of each crop variety and improving soil health.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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