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Effect of natural farming on growth, yield attributes and quality of groundnut: Wheat crop sequence

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Abstract
A field experiment entitled, "Evaluation of natural farming practices in groundnut - wheat crop sequence under North Gujarat condition" was carried out during two consecutive kharif and rabi seasons of 2022-23 and 2023-24 on loamy sand soil of in texture with low organic carbon and available N, medium in available P2O5 and high in available K2O at Department of Seed Technology, S. D. Agricultural University, Sardarkrushinagar. The six treatments consisted in groundnut + blackgram intercrop under natural farming practices were laid down in randomized block design followed by wheat + chickpea intercrop during rabi on same site. The result revealed that under groundnut + blackgram intercrop conventional farming (100% of RDF + 10 t/ha FYM) registered significantly higher plant height number of branches per plant, number of pods per plant in both the crop and higher pod yield (1588, 1524 and 1556 kg/ha, respectively), highest haulm yield (2580, 2238 and 2609 kg/ha, respectively) in blackgram and seed yield (308, 288 and 298 kg/ha, respectively), stover yield (582, 570 and 576 kg/ha, respectively) in blackgram during 2022-23 and 2023-24 and in pooled study. In case of wheat + chickpea intercrop recorded significantly higher plant height at harvest, number of tillers and effective tillers, length of spike, highest grain yield (3584, 3402 and 3493 kg/ha, respectively), higher straw yield (4674, 4336 and 4505 kg/ha, respectively) in wheat and chickpea found non significant result in seed and stover yield.

Keywords: Conventional farming, Natural farming, Wheat, Blackgram, Wheat, Chickpea, Growth and yield attributes

Introduction
'Green revolution' technology (intensive use of HYV seeds, chemical fertilizer and irrigation) adopted in mid 1960s helped in overcoming the food shortage in the country. However, intensification of agriculture had led to considerable adverse environmental impacts, soil degradation, eutrophication of land and water bodies, greenhouse gas emissions and biodiversity losses. Natural farming is purported to be a disruptive farm practices addressing major concerns of farmers of rising cost of production. It basically envisages ecological or regenerative agriculture approaches under which application of any kind of chemicals to soil biosystems are prohibited. It relies more on soil biology than soil chemistry by encouraging multicropping, round the year soil cover, addition of formulation made up of cow dung and urines to trigger the microorganisms in the soil system. However, it is being dubbed by the scientific fraternity as unscientific and hype-created story. Contrary to it, thousands of farmers across the states in India are using one or the other components of the natural farming practices. The proponents and practitioners are confident and upbeat about it, while non-practitioners and scientific community has serious doubt about the claim. Hence, it is imperative to study the adoption of natural farming practices and its effect on crop choices, crop yield, farm income as well as scalability and sustainability at farmers' fields. It is considered to drastically cut down production costs by replacing the chemical fertilizers and pesticides with home grown product like Jeevamrut, Beejamrut, Neemastra, etc., and adopting intercropping and mulching. According to the Zero budget natural farming method requires only one indigenous cow for 30 acres of land. It is also contemplated to promote soil health, improves soil organic carbon even without need of adding huge quantity of FYM as

in the case of organic farming and thus help in attaining sustainable agriculture with reduced carbon footprint. The importance of Zero budget natural farming as one of the alternative farming practices for improving the farmers' income in the backdrop of declining fertilizer response and farm income. Natural farming has following four essential components:

- Jivamrut
- Bijamrut
- Mulching
- Intercropping/crop rotation.

Groundnut-wheat is an important cropping system with groundnut as a kharif and wheat as a rabi crop particularly under irrigated system. This system is commonly practiced in areas like North Gujarat. It's a popular choice because groundnut, a legume, can enhance soil fertility through nitrogen fixation, benefiting the subsequent wheat crop. However, there are indications of stagnation or even decline in the productivity of groundnut-wheat cropping system due to decline in soil organic matter, deficiency of secondary and micronutrients and non-availability of cost-effective fertilizers.

The shortage of pulses and oilseeds has also aggravated the problem of malnutrition. Thus, introduction of crops in an intercropping system offers scope for maximizing and stabilizing return from oilseed crops rather than as a sole crop (Maitra *et al*., 2021) [3]. In order to exploit the production potential of pulses and oilseed crops, it is urgent need to increasing the area and the productivity of these crops (Hussainy *et al*., 2020) [2]. Intercropping is an age-old practice of growing two or more crops simultaneously on the same piece of land. Intercropping has been recognized as a potentially beneficial system of crop production and evidences indicate that it can provide substantial yield advantage over sole cropping. The major considerations for intercropping are the contrasting maturities, growth rhythm, height and rooting pattern and variable insect pest and disease associated with component crops, so that these complement each other rather than compete for the resources and guard against weather adversities. Under rainfed conditions where chances of crop failures are greater, an intercropping is more stable and dependable than growing a sole crop (Singh *et al*., 2009) [4].

Intercropping groundnut with black gram is a system of growing both crops simultaneously on the same land, offering advantages such as increased yield and resource utilization. Black gram, a short-duration legume, is a suitable companion crop for groundnut, and studies suggest that it can enhance groundnut's root development and overall yield. Intercropping wheat and chickpea involve growing both crops together in the same field, aiming to improve overall productivity and resource utilization. This system can increase land use efficiency, suppress weeds, and potentially lead to higher net income for farmers, especially in regions like India.

Materials and Methods

An experiment was conducted under North Gujarat agro climatic condition at the Dept. of seed technology, S.D Agricultural University, Sardarkrushinagar, Dist. Banaskantha (Gujarat) during 2022-23 and 202-24 with a view to study the "Evaluation of natural farming practices in groundnut - wheat crop sequence under North Gujarat condition". The soil of experimental field was sandy in texture, low in available nitrogen (Kjeldahl method) medium in available phosphorus (Olesen's method) and medium in available potassium (Flam photometric method). Randomized Block Design in both the season was laid out with four *viz*., T1: Control (No addition of inputs, only weeding), T2: Bijamrut 200 ml/kg of seeds + Ghanjivamrut @ 500kg/ha in kharif and 1.5 t/ha in rabi + Jivamrut @ 500 lit/ha/ irrigation twice in month + Residue mulch @ 5 t/ha + Irrigation at 50 % deficit of normal requirement, T3: Bijamrut 200 ml/kg of seeds + Ghanjivamrut @ 500kg/ha in kharif and 1.5 t/ha in rabi +Jivamrut @ 500 lit/ha/irrigation twice in month + Residue mulch @ 5 t/ha irrigation at 100 % water requirement, T4: FYM + Vermicompost + Neem cake (1/3 of each on N based) + Bio consortium 10 ml/kg of seed, T5:FYM + Vermicompost + Neem cake (1/3 of each on N based) + IOP : Bijamrut200ml/kg of seeds + Ghanjivamrut @ 500 kg/ha + Jivamrut @ 500 lit/ha/irrigation twice in month and T6: Conventional farming (100 % RDF + 10 t/ha FYM in kharif). The variety were groundnut (GJG 2), blackgram (GU 1), wheat (GW 451) and Chickpea (GG 5) selected for the present investigation.

Result and Discussion

Effect of natural farming, organic farming and conventional farming on groundnut + blackgram intercrop

Growth and Yield Attribute

Groundnut and Blackgram

The data present in Table-1, revealed that conventional farming registered significantly higher plant height (62, 59 and 60.50 cm, respectively) during 2022-23, 2023-24 and in pooled study and remained statistically at par with T3 (58.43, 58.63 and 58.53cm, respectively) and T2 (55.80, 54.18 and 54.99 cm, respectively). In case of blackgram (51.11, 51.34 and 51.23 cm, respectively) and statistically at par with T3, T2 (47.23 cm in 2022). Whereas, T1 control was recorded lower plant height during 2022-23, 2023-24 of experiments and in pooled results. Significantly higher number of branches per plant (10.50, 10.20 and 10.35, respectively) by T6 and at par with T3 (9.90, 10.25). In case of blackgram recorded significantly higher (3.42, 3.21 and 3.32, respectively) were statistically at par with T3 and T2 2022-23, 2023-24 except pooled. Whereas, lower branches per plant found under control in both the crop during 2022-23, 2023-24 of experiments and in pooled results. Increase in plant height and branches under inorganic practices might be ascribed to increased supply of plant nutrients particularly nitrogen in the growth medium and their sufficient uptake by plant. The results were in line with the findings of Yogananda *et al*. (2018) [6], Singh and Kumari (2023) [5]. Application of jivamrut attributed to solubilisation of nutrients in soil and absorption of nutrients and moisture, foliar spray enhanced the growth rate of plant, favorable macro and micro nutrients and growth hormones in liquid formulation. These results are in conformity with the findings of Gowthamchand *et al*. (2019) [8] in and Reshma *et al*. (2019) [7]. Treatment T6 registered significantly higher pod per plant (27.08, 25.15 and 26.11, respectively) were at par with T3 and T1 (control) gave the lower pod per plant among the treatments. In case of blackgram registered significantly higher pod per plant (26.99, 26.56, 26.77, respectively) and statically at par with T3 and T2 (24.25 in

2022). The minimum pod per plant showed under T1 control during 2022-23, 2023-24 and in pooled study. Due to increased number of branches per plant provide basic plant infrastructure for the development of more number of reproductive parts and there by increased the sink size in term of more number of pods per plant. These results are in conformity with Gowthamchand *et al*. (2019) and Reshma *et al*. (2019) [8, 7]. Higher number of pods per plant might be owing to better vegetative growth and photosynthetic activity ascribed by larger uptake of nutrients and water from the soil by well-developed root system and profuse nodulation which caused an increase in nitrogen supply from symbiotically fixed nitrogen in root nodules. These results are in conformity with the findings of Dekhane *et al*. (2011) [9], Patel Z. B. (2019) [10], and Singh *et al*. (2020) [4] the experiment did not exert any significant effect on the number of kernel per pod and seed index in both the crop during 2022-23 and 2023-24 of experimentation and in pooled study.

Yield

In groundnut, conventional farming T6 registered significantly higher pod and haulm yield (1588, 1524 and 1556 kg/ha, respectively) and yield (2580, 2238 and 2609 kg/ha, respectively) during 2022-23 and 2023-24 and in pooled study and remained statistically at par with T3 (1421, 1455 and 1438 kg/ha respectively) and T2 (1373 kg/ha in 2023), wheare as control recorded lowest pod and haulm (652, 614,and 633 kg/ha, respectively) and (1064, 962 and 1013 kg/ha, respectively). The magnitude of increase in pod yield to the tunes of 15.34 and 8.20 perecent over T3 and T2 in pooled study. In case of blackgram significantly higher seed yield (308, 288 and 298 kg/ha, respectively) and during 2022-23, 2023-24 and in pooled study, were statistically at par with T3 (267 and 246 kg/ha) both the year and T2 (243 kg/ha in 2023). Whereas, significantly stover yield ((582, 570 and 576 kg/ha, respectively) under T6, it were at par with T3 (551, 545 and 548 kg/ha, respectively) and T2 (536, 528 and 532 kg/ha, respectively) and lower seed and stover yield were recorded under control in both year as well as in pooled. The highest pod and seed yield of crop recorded with the supply of inorganic sources of nutrients due to the availability of nutrients and immediate release as compared to organic source of nutrients, which release the nutrient slowly., natural farming component it could be better availability of nutrients throughout the crop growth, which was ensured further by improved microbial activity in the soil and mulching improved moisture availability, which enhances the activities of indigenous microorganism and boosts the strength of plants and yield of crops due to the favourable effects of growth hormones like IAA, GA3 macro and micronutrients and also beneficial microorganisms present in the liquid organic manures when foliar sprayed of *jivamrut.* These results are in confirmation with the findings of Korat *et al.* (2023) [11], Singh *et al.* (2023) [5] and Mallikarjun *et al.* (2024) [13].

Effect of natural farming, organic farming and conventional farming on wheat + chickpea intercrop

Growth and Yield Attribute

Groundnut and Blackgram 00% of RDF + 10 t/ha FYM was applied found significantly higher plant height at harvest (92.76, 96.65 and 94.85 cm, respectively) and remained statistically at par with T_3 and T_2.

Whereas, control T_1 reorded lower plant height (75.79, 74.07 and 74.93 cm, respectively) during 2022-23, 2023-24 of experiments and in pooled results. Increase in plant height inorganic practices might be ascribed to increased supply of plant nutrients particularly nitrogen in the growth medium and their uptake by plant. The results were in line with the findings of Singh and Kumari (2023) [5]. Significantly higher number of tillers (198.12, 204 and 201.06, respectively) and effective tillers (117.84, 123.53 and 120.68) and length of spike (7.47, 7.55 and 7.51 cm, respectively) it were were at par with T_3 and T_2. Whereas, control registered lower number of tillers (159.11, 161.17 and 160.14, respectively), effective tillers (93.96, 95.72 and 94.84, respectively) and length of spike (6.76, 6.54 and 6.70, respectively) during 2022-23, 2023-24 of experiments and in pooled results. Due to rapid supply of nitrogen from chemical fertilizers at the initial crop growth stages and steady supply of nitrogen from the mineralization of FYM throughout the growing season leading to higher yield and yield components. The results are in close agreement with those of Seth and Kumar (2019) in wheat + chickpea, The IAA and GA present in jivamrut, when applied to the soil, increase high microbial load, which includes effective microorganisms and methyl trophs profile bacteria also, could have hastened length of spike resulting in maximum number of spikelets and ultimately increase grain setting. This is evidently due to cumulative effect of yield attributes. The results are in close agreement with those of in wheat and Parewa *et al.* (2021) [14] in wheat. Test weight (g) did not exert any significant effect on the test weight (g) during 2022-23, 2023-24 of experimentation and in pooled study. In case of chickpea Plant height (cm), Number of branches per plant at harvest, Number of pods per plant, Seed index (g) did not exert any significant effect on different treatment during 2022-23, 2023-24 of experimentation and in pooled study.

Yield

In wheat significantly highest grain yield (3584, 3402 and 3493 kg/ha, respectively) recorded under Treatment 100% of RDF + 10 t/ha FYM. However, the lowest seed yield recorded under T_1 Control (1693, 1550 and 1622 kg/ha, respectively), during 2022-23, 2023-24 and in pooled study. The magnitude of increase in grain yield under T_6 to the tunes of 22.81, 26.83, 41.58 and 34.50 per cent over T_2, T_3, T_4 and T_5, in pooled study, respectively. Conventional farming (T_6) resulted significantly higher straw yield (4674, 4336 and 4505 kg/ha, respectively) were at par with T_3 (4368, 4281 and 4325 kg/ha, respectively) T_2 (4049 and 4053 kg/ha, respectively) during both year. However minimum straw recorded under control (2182, 2152 and 2167 kg/ha, respectively).

This is evidently due to cumulative effect of yield attributes *viz.,* number of tillers and effective tillers of plant, and length of spike. The higher availability of nutrients and their efficient absorption by the roots of crop and enhanced release of growth promoting substances produced by the microbes present in jivamrut. Adequate quantity of enzymes present in the cells might have favored rapid growth and yield in wheat + chickpea, in wheat and Parewa *et al.* (2021) [14]. In case of chickpea seed and stover yield were not exert any significant effect on different treatment during 2022-23, 2023-24 of experimentation and in pooled study.

Table 1: Effect of natural farming practices on growth and yield attribute of groundnut in groundnut + blackgram intercrop

Treatments	Plant height (cm)			Number of branches per plant			Number of pods per plant			Number of kernel per pods			Seed index (g)		
	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled
T_1	48.23	47.65	47.94	8.65	7.15	7.90	15.56	14.45	15.01	2.55	2.41	2.48	34.79	34.53	34.66
T_2	55.80	54.18	54.99	9.75	9.70	9.73	22.95	20.85	21.90	2.44	2.34	2.39	34.31	34.93	34.62
T_3	58.43	58.63	58.53	10.20	9.90	10.05	24.24	23.57	23.90	2.41	2.41	2.41	35.03	34.14	34.58
T_4	50.65	49.38	50.01	8.80	8.55	8.68	19.14	19.11	19.12	2.61	2.36	2.48	34.74	34.95	34.84
T_5	54.10	52.35	53.23	9.00	8.95	8.98	20.05	19.98	20.02	2.75	2.51	2.63	34.25	35.25	34.75
T_6	62.00	59.00	61.50	10.50	10.20	10.35	27.08	25.15	26.11	2.55	2.33	2.44	35.14	35.10	35.12
S.Em.±	2.91	2.70	1.99	0.55	0.43	0.35	1.03	1.31	0.83	0.14	0.11	0.09	0.37	0.50	0.31
C.D. (P=0.05)	8.78	8.14	5.73	NS	1.28	1.01	3.10	3.94	2.40	NS	NS	NS	NS	NS	NS
C.V.%	10.61	10.09	10.36	11.67	9.37	10.64	9.56	12.75	11.20	11.3	9.18	10.4	2.13	2.90	2.54

Table 2: Effect of natural farming practices on yield and quality of groundnut in groundnut + blackgram intercrop

Treatments	Pod yield (kg/ha)			Haulm yield (kg/ha)			Shelling%			Protein content (%)		
	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled
T_1	652	614	633	1064	962	1013	64.84	66.62	65.73	18.96	19.19	19.07
T_2	1325	1373	1349	2287	2241	2264	67.42	66.20	66.81	21.51	21.84	21.67
T_3	1421	1455	1438	2310	2286	2298	66.00	67.68	66.84	22.07	22.48	22.28
T_4	904	857	880	1593	1464	1529	65.62	65.89	65.75	21.45	21.73	21.59
T_5	994	992	993	1849	1752	1800	65.75	66.82	66.28	21.51	21.74	21.62
T_6	1588	1524	1556	2580	2638	2609	67.38	68.95	68.16	22.24	22.53	22.49
S.Em.±	57.64	68.37	44.71	143.08	111.99	90.85	1.02	1.22	0.79	0.53	0.69	0.43
C.D. (P=0.05)	174	206	129	431	338	262	NS	NS	NS	1.58	2.08	1.25
C.V.%	10.05	12.04	11.08	14.70	11.85	13.39	3.08	3.64	3.37	4.94	6.41	5.73

Table 3: Effect of natural farming practices on growth and yield attribute of blackgram in groundnut + blackgram intercrop

Treatments	Plant height (cm) at harvest			Number of branches per plant			Number of pods per plant			Seed index (g)		
	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled
T_1	40.92	41.80	41.36	2.69	2.49	2.59	18.78	19.09	18.93	41.43	40.56	41.00
T_2	47.29	44.53	45.91	3.22	2.99	3.11	24.25	22.85	23.55	42.29	41.80	42.04
T_3	49.11	46.91	48.01	3.36	3.10	3.23	25.86	26.15	26.00	41.25	41.34	41.29
T_4	43.92	42.02	42.97	2.90	2.65	2.78	19.52	19.94	19.73	41.48	41.64	41.56
T_5	45.18	43.06	44.12	3.12	2.97	3.05	22.12	22.43	22.27	41.46	40.70	41.08
T_6	51.11	51.34	51.23	3.42	3.21	3.32	26.99	26.56	26.77	41.89	42.06	41.98
S.Em.±	2.13	2.06	1.48	0.10	0.08	0.07	0.97	1.06	0.72	0.51	0.38	0.32
C.D. (P=0.05)	6.43	6.22	4.28	0.31	0.25	0.19	2.94	3.20	2.08	NS	NS	NS
C.V.%	9.22	9.18	9.20	6.56	5.82	6.23	8.50	9.30	8.91	2.46	1.84	2.17

Table 4: Effect of natural farming practices on yield and quality of blackgram in groundnut + blackgram intercrop

Treatments	Seed yield (kg/ha)			Stover yield (kg/ha)			Protein content (%)		
	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled
T_1	145	130	137	275	278	276	19.36	20.08	19.72
T_2	256	243	249	536	528	532	20.72	21.25	20.99
T_3	267	246	257	551	545	548	21.52	21.44	21.48
T_4	197	172	184	425	344	384	20.16	20.11	20.14
T_5	227	217	222	483	429	456	20.53	20.70	20.62
T_6	308	288	298	582	570	576	22.04	22.01	22.02
S.Em.±	13.38	16.56	10.30	25	28	19	0.48	0.46	0.33
C.D. (P=0.05)	40	47	30	76	83	54	1.46	1.37	0.96
C.V.%	11.48	14.49	12.97	10.64	12.26	11.43	4.68	4.35	4.52

Table 5: Effect of natural farming practices on growth and yield attribute of wheat in wheat + chickpea intercrop

Treatments	Plant height (cm) at harvest			At harvest (Per metre row length)						Length of spike (cm)			Test weight (g)		
				Number of tillers			Number of effective tillers								
	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled
T_1	75.79	74.07	74.93	186.25	182.05	184.15	110.83	109.30	110.06	6.76	6.64	6.70	43.63	43.38	43.51
T_2	86.63	86.71	86.67	192.21	187.93	190.07	112.56	114.44	113.50	7.31	7.37	7.34	43.99	43.68	43.83
T_3	88.36	89.56	88.96	167.15	168.04	167.59	98.27	99.86	99.07	7.45	7.39	7.42	44.16	43.80	43.98
T_4	80.81	79.10	79.95	169.16	168.55	168.86	98.35	100.28	99.32	6.89	6.76	6.83	43.69	43.51	43.60
T_5	83.00	82.09	82.55	198.12	204.00	201.06	117.84	123.53	120.68	7.00	6.97	6.98	43.76	43.53	43.65
T_6	92.76	96.95	94.85	9.08	8.31	6.15	5.63	6.13	4.16	7.47	7.55	7.51	44.31	44.43	44.37
S.Em.±	3.48	4.63	2.89	27.37	25.04	17.77	16.96	18.49	12.02	0.15	0.14	0.10	0.35	0.29	0.23
C.D. (P=0.05)	10.48	13.95	8.36	10.17	9.30	9.74	10.68	11.45	11.08	0.46	0.41	0.29	NS	NS	NS
C.V.%	8.22	10.92	9.67	186.25	182.05	184.15	110.83	109.30	110.06	4.23	3.81	4.02	1.58	1.33	1.46

Table 6: Effect of natural farming practices on yield and quality of wheat in wheat + chickpea intercrop

Treatments	Grain yield (kg/ha)			Straw yield (kg/ha)			Protein content (%)		
	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled
T_1	1693	1550	1622	2182	2152	2167	9.51	9.20	9.35
T_2	2882	2627	2754	4049	4053	4051	11.50	11.40	11.45
T_3	2936	2752	2844	4368	4281	4325	11.41	11.45	11.43
T_4	2500	2434	2467	3000	2975	2988	10.46	11.28	10.87
T_5	2635	2558	2597	3395	3235	3315	10.61	11.32	10.97
T_6	3584	3402	3493	4674	4336	4505	11.68	11.54	11.61
S.Em.±	155	167	114	186	203	138	0.29	0.26	0.20
C.D. (P=0.05)	467	504	329	561	611	397	0.87	0.79	0.56
C.V.%	11.45	13.10	12.26	10.30	11.56	10.93	5.30	4.78	5.04

Table 7: Effect of natural farming practices on growth and yield attribute of chickpea in wheat + chickpea intercrop

Treatments	Plant height (cm) at harvest			Number of branches per plant			Number of pods per plant			Seed index (g)		
	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled
T_1	26.96	27.07	27.02	40.09	41.00	40.55	5.63	5.65	5.64	22.28	22.31	22.30
T_2	27.89	27.80	27.84	40.59	41.56	41.07	6.24	6.06	6.15	22.52	22.47	22.49
T_3	28.24	28.32	28.28	41.67	41.58	41.63	6.37	6.12	6.24	22.57	22.48	22.52
T_4	27.65	27.13	27.39	41.84	41.98	41.91	6.00	5.89	5.94	22.36	22.35	22.35
T_5	27.88	27.57	27.72	42.29	42.13	42.21	6.13	6.01	6.07	22.48	22.37	22.42
T_6	28.32	28.99	28.65	42.58	43.94	43.26	6.68	6.12	6.40	22.64	22.63	22.63
S.Em.±	0.92	0.66	0.56	0.90	1.15	0.73	0.25	0.26	0.18	0.15	0.15	0.11
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C.V.%	6.60	4.72	5.73	4.35	5.48	4.96	8.04	8.62	8.33	1.35	1.31	1.33

Table 8: Effect of natural farming practices on yield and quality of chickpea in wheat + chickpea intercrop

Treatments	Seed yield (kg/ha)			Stover yield (kg/ha)			Protein content (%)		
	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled
T_1	133	121	127	130	120	125	18.96	19.74	19.35
T_2	149	155	152	138	145	141	20.49	21.44	20.97
T_3	154	159	156	141	150	146	20.67	21.96	21.32
T_4	135	125	130	131	123	127	20.31	20.94	20.62
T_5	141	134	138	137	126	132	20.49	20.98	20.74
T_6	170	157	164	169	147	158	21.19	22.58	21.88
S.Em.±	9.75	11.15	7.80	8.97	9.87	6.67	0.44	0.56	0.36
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS	1.33	1.69	1.03
C.V.%	13.28	15.71	15.29	12.71	14.61	13.66	4.32	5.26	4.84

Conclusion

Based on the two years of experimentation, it can be concluded that for getting higher system groundnut equivalent yield under groundnut+blackgram–wheat+chickpea crop sequence, crops should be fertilized with 100% RDF+10 t/ha FYM in groundnut+blackgram intercrop and 100% RDF in wheat+chickpea intercrop (conventional farming), However, economical viable crop sequence can be taken under complete natural farming with the application of *Bijamrut* 200 ml/kg of seeds+*ghanjivamrut* @ 500 kg/ha + *Jivamrut* @ 500 lit/ha twice in month with irrigation + residue mulch @ 5 t/ha in groundnut+blackgram intercrop with 50% irrigation, while *Bijamrut* 200 ml/kg of seeds+*ghanjivamrut* @ 1.5 t/ha+ *Jivamrut* @ 500 lit/ha twice in month with irrigation + residue mulch @ 5 t/ha in wheat+chickpea intercrop with 50% irrigation.

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