Economics of wheat as influenced by natural farming, organic farming and recommended package of practices

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Abstract

A field experiment was laid out on split-plot design with two uneven controls viz. four foliar concentrations of cow urine and jeevamrutha under natural farming which were compared with Organic farming (OF) and Recommended package of practices (RPP) given by UAS, Dharwad. The treatments were replicated thrice. The study revealed that RPP recorded significantly higher grain yield, straw yield, gross return, net return and B:C ratio than OF and natural farming practices. The grain yield reduction in the best treatment (cow urine @ 50 % + jeevamrutha @ 100 %) was 16 % lesser than RPP and 2 % higher than OF. However, the cost of cultivation in natural farming with cow urine @ 50 % + jeevamrutha @ 100 % was lesser to the extent of 6.91 and 30.42 % than RPP and OF. Our study indicates that the irrigated wheat can be grown under natural farming conditions profitably.

Background

India is leading to achieve its trillion economies by 2024-25 with the current GDP 8.4 % (Anon., 2021). But where are we going by leaving behind the farming community those were dominated by the other sectors. The agriculture sectors proved to be most powerful arm of the Indian economy by showing positive contribution (around 4.5 %) to the GDP during the covid pandemic. It is the only sector which was sustained the Indian economy. But the current conventional agricultural system associated with huge cost of cultivation, atmospheric pollution, human health issues etc. To revert this system, there were some alternative ways of agriculture has been popped up such as organic farming and natural farming practices.

Zero budget natural farming is a hot topic in the present time brought up in India by Padma Shree awardee Shri Subhash Palekar who demonstrated the farming procedures for the upliftment of our farmers (Shankaranna, 2018). The Indian prime minister recently addressed the farmers to adopt natural farming to save costs and increase yields (Anon., 2021a). The ZBNF method is meant to reduce input costs by eliminating the need for expensive fertilizers and pesticides, and also protect soil health and conserve water resources. Senior agricultural scientists had also expressed concern about a wholesale shift to unproven methods. The Indian Council for Agricultural Research is conducting ongoing studies on the impact of ZBNF methods on productivity, economics and soil health at multiple locations in the grain basket States of north-western India, but has yet to release any results.

By keeping an eye on the current situation, this comparative study was conducted to prove the impact of natural farming on cost of cultivation of wheat as compare to organic farming and recommended package of practices.

Methods

Treatment details: A field experiment was carried out at Main Agricultural Research Station, Dharwad during *rabi* 2020-21. The experiment was laid out in split plot design with four main treatments (CU₁: Cow urine @ 10 %, CU₂: Cow urine @ 25 %, CU₃: Cow urine @

50 % and CU₄: Cow urine @ 100 %), four sub plot treatments (JA₁: Jeevamrutha as per ZBNF recommendations, JA₂: Jeevamrutha @ 25 %, JA₃: Jeevamrutha @ 50 % and JA₄: Jeevamrutha @ 100 %) under natural farming and two uneven control (C₁: Organic farming practice and C₂: Recommended package of practices) and all the treatments were replicated thrice.

Cultural operations: The wheat variety UAS- 304 was sown in a plot size of 4.5 × 3.2 m for each treatment. The sowing operation was done by bullock drawn seed drill (pora method) with 22.5 cm row spacing. The seeds were treated with beejamrutha for all the natural farming treatments and with azospirillum and P- solubilizing bacteria for recommended package of practice and organic farming practice treatments prior to sowing. The seeds were sown at the rate of 150 kg ha⁻¹ and covered with bullock drawn harrowing on 2nd November 2020.

Nutrient management: To all the natural farming treatments, common application of Ghanajeevamrutha @ 1000 kg ha⁻¹ was applied in two equal splits on the day of sowing operation and at 30 DAS and thoroughly mixed to soil through intercultivation. Mulching was done with crop residues @ 5 t ha⁻¹ after intercultivation. Soil drenching of jeevamrutha (5 times) was done @ 500 l ha⁻¹ at every 21 days interval from 21 to 93 DAS. The NPK fertilizers were applied based on recommendation of UAS package of practices by calculating in the form of Urea, DAP, and MOP to the RPP treatment to supply fertilizers @ 100, 60 and 40 Kg N: P₂O₅: K₂O ha⁻¹. The recommended nitrogen doses were applied in three splits at the time of sowing as basal dose, tillering stage and flowering stage @ 50:25:25 kg Nha⁻¹, respectively. The entire dose of phosphorus and potassium were applied as basal dose. In organic farming practices, FYM and Vermicompost were incorporated to the soil equivalent to 100 per cent recommended dose of nitrogen based on its N content.

Application procedures: Jeevamrutha was prepared as per the procedure and desi cow urine was collected from natural farming project cattle shed farm and filtered properly before spraying to the crop foliage as per treatments. The treatment formulations were made by v/v method and sprayed with suitable dilution with water. To prepare 5 % jeevamrutha spray solution, 5 ml of jeevamrutha was diluted in 95 ml of water. For the preparation of uniform spray solution, the requirement of jeevamrutha and cow urine was adjusted with recommended water volume of 500 l ha⁻¹ for spray. In the similar fashion the jeevamrutha 5 %, 7.5 %, 10 %, 25 %, 50 % and 100 % spray solutions were prepared and sprayed from

Table 1. Grain yield of wheat as influenced by different concentrations of foliar application of cow urine and jeevamrutha

Treatments	Grain yield (kg ha ⁻¹)	Straw yield (kg ha ⁻¹)
Main plot: Foliar spray of cow urine (CU) at 3 weeks interval from 21 to 105 DAS		
CU ₁ : 10 %	2195	2654
CU ₂ : 25 %	2410	3145
CU ₃ : 50 %	2547	3156
CU ₄ : 100 %	2755	3432
S.Em. ±	51.99	57.96
CD at 5 %	179.89	200.56
Sub Plot: Foliar spray of Jeevamrutha (JA) at 3 weeks interval from 30 to 93 DAS		
JA ₁ : JA as per ZBNF recommendation (5 %, 7.5 %, 10 % at vegetative, flowering and panicle initiation stage)	2218	2968
JA ₂ : 25 %	2389	2978
JA ₃ : 50 %	2646	3216
JA ₄ : 100 %	2655	3226
S.Em. ±	47.30	19.54
CD at 5 %	138.07	57.05
Interactions : Cow urine (CU) x Jeevamrutha (JA)		
T ₁ - CU ₁ JA ₁	1582	2155
T ₂ - CU ₁ JA ₂	2075	2559
T ₃ - CU ₁ JA ₃	2546	3009
T ₄ - CU ₁ JA ₄	2577	2895
T ₅ - CU ₂ JA ₁	2734	3327
T ₆ - CU ₂ JA ₂	2411	2976
T ₇ - CU ₂ JA ₃	2495	3145

T ₈ - CU ₂ JA ₄	2550	3132
T ₉ - CU ₃ JA ₁	2508	3216
T ₁₀ - CU ₃ JA ₂	2650	3275
T ₁₁ - CU ₃ JA ₃	2798	3473
T ₁₂ - CU ₃ JA ₄	3066	3710
T ₁₃ - CU ₄ JA ₁	2047	3009
T ₁₄ - CU ₄ JA ₂	2420	3127
T ₁₅ - CU ₄ JA ₃	2743	3327
T ₁₆ - CU ₄ JA ₄	2428	3214
S.Em. $\pm$	97.03	67.12
CD at 5 %	283.22	195.91
To compare controls with other treatments (T₁ + T₁₆)		
C ₁ - Organic farming practices (OF)	3012	5422
C ₂ - Recommended package of practices (RPP)	3670	7138
S.Em. $\pm$	101.27	149.71
CD at 5 %	291.06	430.27

-30 to 93 DAS at 3 weeks intervals. Similarly, cow urine @ 10 %, 25 %, 50 % and 100 % spray solutions were prepared and sprayed from 21 to 105 DAS at 3 weeks intervals as per the treatments

Yield observations: The crop in net plot area of respective treatment was harvested separately at 120 DAS. After complete drying, weight of the total dry matter from net plot was recorded. After threshing, the produce was cleaned and weighed. Grain yield and straw yield per net plot area was enumerated on hectare basis and figured in kg ha⁻¹.

Economic observations: The economical parameters namely gross return (₹ ha⁻¹) was worked by grain yield and straw yield (kg ha⁻¹) with market price of wheat grain and university fixed price for straw yield (₹ kg⁻¹). Cost of cultivation was determined by summoned up all the cost incurred for the operations carried out during the study from land preparation to harvesting and inputs used with their market prices and preparation to market. Net returns (₹ ha⁻¹) by deducting cost of cultivation (₹ ha⁻¹) from gross returns and benefit cost ratio (B:C) by dividing gross returns (₹ ha⁻¹) by cost of cultivation (₹ ha⁻¹).

Statistical procedures: The recorded data subjected to analyze statistically by using split plot design with uneven control as per the procedure given by Gomez and Gomez, 1984.

Results

Yield:

Higher grain and straw yield were recorded in recommended package of practice (3670 and 7138 kg ha⁻¹) than organic farming practices (3012 and 5422 kg ha⁻¹) and all other natural farming treatment combinations. Among the natural farming practice, the treatment combination i.e., cow urine @ 50 % + jeevamrutha @ 100 % recorded significantly higher grain and straw yield (3066 and 3710 kg ha⁻¹) than all other combinations, whereas the organic farming practice was found on par with it (Table 1). The higher yield resulted in recommended package of practice was due to steady supply of nutrients in an integrated way through FYM @ 7.5 t ha⁻¹, biofertilizers and inorganic fertilizers and split application of nitrogen in the form of urea at critical growth stages of crop and supplementation of P and K along with micro nutrients.

Economics:

Among the three respective practices, it was observed that the lower cost of cultivation was imposed in case of natural farming treatments due to less cost associated with cow urine and jeevamrutha and other inputs required for raising the crop (Table 3). Whereas higher cost of cultivation was incurred in case of organic farming due to higher amount of bulky organic manures like FYM, vermicompost equivalent to 100 per cent RDN. RPP maintained an average cost of cultivation in between natural and organic farming which was a prime reason of getting higher profit (Table 2). When the natural farming treatments were compared with the recommended organic and conventional

-practices it was noticed that considerably higher gross return, net return and B:C ratio (₹ 104741 ha⁻¹, ₹ 41099 ha⁻¹ and 1.59) were recorded in recommended package of practice (RPP) than organic farming practice ((₹ 85481 ha⁻¹, ₹ 334 ha⁻¹ and 1.04) and best natural farming treatment combination (₹ 85006 ha⁻¹, ₹ 25768 ha⁻¹ and 1.41). This was mainly due to an average cost of cultivation, higher grain yield, straw yield and gross returns. The best treatment cow urine @ 50 % + jeevamrutha @ 100 % (CU₃JA₄) recorded 98 per cent higher net return than organic farming practice and 59 per cent lower net return than recommended package of practices due to reduced cost of inputs and producing grain yield equal to organic farming.

Table 2. Economics of wheat cultivation as influenced by foliar application of cow urine and jeevamrutha at different concentration

Treatments	Cost of cultivation (₹ ha ⁻¹)	Gross return (₹ ha ⁻¹)	Net return (₹ ha ⁻¹)	B:C ratio
Main plot: Foliar spray of cow urine (CU) at 3 weeks interval from 21 to 105 DAS				
CU ₁ : 10 %	51714	60857	7592	1.15
CU ₂ : 25 %	53928	67086	10207	1.20
CU ₃ : 50 %	54014	70704	15823	1.28
CU ₄ : 100 %	54167	76499	20142	1.34
S.Em. ±	-	1409.07	1276.73	0.02
CD at 5 %	-	4876.03	4418.07	0.08
Sub Plot: Foliar spray of Jeevamrutha (JA) at 3 weeks interval from 30 to 93 DAS				
JA ₁ : JA as per ZBNF recommendation (5 %, 7.5 %, 10 % at vegetative, flowering and panicle initiation stage)	51603	61816	8663	1.15
JA ₂ : 25 %	52869	66319	11947	1.22
JA ₃ : 50 %	54551	73358	15851	1.30
JA ₄ : 100 %	56299	73653	17304	1.31
S.Em. ±	-	1251.08	1191.18	0.02
CD at 5 %	-	3651.65	3476.79	0.06
Interactions: Cow urine (CU) x Jeevamrutha (JA)				
T ₁ - CU ₁ JA ₁	49940	44126	-5814	0.88
T ₂ - CU ₁ JA ₂	52189	57577	5388	1.09
T ₃ - CU ₁ JA ₃	54558	70406	15848	1.30
T ₄ - CU ₁ JA ₄	56373	71320	14947	1.34
T ₅ - CU ₂ JA ₁	54115	75837	21722	1.38
T ₆ - CU ₂ JA ₂	53752	66907	13155	1.20
T ₇ - CU ₂ JA ₃	54882	69325	14443	1.26
T ₈ - CU ₂ JA ₄	56774	70748	13973	1.29
	54202	69723	15521	1.29

T ₉ - CU ₃ JA ₁				
T ₁₀ - CU ₃ JA ₂	55328	73593	18265	1.32
T ₁₁ - CU ₃ JA ₃	56663	77676	21013	1.35
T ₁₂ - CU ₃ JA ₄	59238	85006	25768	1.41
T ₁₃ - CU ₄ JA ₁	54355	57580	3225	1.07
T ₁₄ - CU ₄ JA ₂	56220	67199	10979	1.26
T ₁₅ - CU ₄ JA ₃	58114	76025	17911	1.33
T ₁₆ - CU ₄ JA ₄	58824	67539	8715	1.14
S.Em. ±	-	2584.78	2426.26	0.04
CD at 5 %	-	7544.45	7081.75	0.12
To compare controls with other treatments (T₁ + T₁₆)				
C ₁ - OF	85147	85481	334	1.04
C ₂ - RPP	63642	104741	41099	1.59
S.Em. ±	-	2644.47	2510.26	0.04
CD at 5 %	-	7600.29	7214.55	0.12

Table 3. Cost of inputs and outputs for wheat cultivation

Sl. No.	Particulars	Unit	Quantity (ha ⁻¹)	Unit price (Rs.)
	(A) Labour and implements cost			
1	Land preparation			
	a. Labour	Labour ⁻¹ day ⁻¹	2	318
	b. Tractor (Ploughing)	Hour ⁻¹	5	700
	c. Bullock pair (Harrowing)	Pair ⁻¹ day ⁻¹	3	1000
2	Sowing operation			
	i) Labour	Labour ⁻¹ day ⁻¹	4	
	ii) Bullock pair	Pair ⁻¹ day ⁻¹	2	
3	Intercultural operation			
	i) Hand weeding (Once)	Labour ⁻¹ day ⁻¹	15	
	ii) Hoeing (Once)			
	a) Labour	Labour ⁻¹ day ⁻¹	2	
	b) Bullock pair	Pair ⁻¹ day ⁻¹	1	
	iii) Mulching (Once)	Labour ⁻¹ day ⁻¹	5	
	iv) Foliar and soil applications (9 times)	Labour ⁻¹ day ⁻¹	9	
4	Harvesting/threshing and winnowing			
	i) Labors	Labour ⁻¹ day ⁻¹	20	
	ii) Thresher	kg ⁻¹		1.2
	(B) INPUT COSTS			
5	a. Seeds	kg ⁻¹	150	38
6	Manures and fertilizers			
	a. Ghanajeevamrutha	kg ⁻¹	1000	4.5
	b. FYM	t ⁻¹	17.5 (OF)	1500
			7.5 (RPP)	

	c. Vermicompost	t ⁻¹	4	3250
	d. Biofertilizers			
	i) Azospirillum	kg ⁻¹	3 (OF)	80
			3 (RPP)	
	ii) PSB	kg ⁻¹	3	80
	e. Biopesticides			
	i) Trichoderma	kg ⁻¹	2.5	130
	ii) Pseudomonas	kg ⁻¹	2.5	150
	f. Liquid organic manures			
	i) Beejamrutha	l ⁻¹	30	0.32
	ii) Jeevamrutha	l ⁻¹		1.25
	iii) Cow urine	l ⁻¹		1
	g. Urea	kg ⁻¹	100	6
	h. DAP	kg ⁻¹	75	24
	i. MOP	kg ⁻¹	50	20
7	Plant protection chemicals			
	i) Pendimethalin	l ⁻¹	3.17	510
	ii) Tilt	l ⁻¹	0.5	3500
	iii) Acephate	kg ⁻¹	0.5	500
8	Organic botanicals			
	i) Neemastra	l ⁻¹	500	0.4
	ii) Brahmastra	l ⁻¹	10	10.6
	iii) Neem oil	l ⁻¹	1	600
9	Mulch materials	t ⁻¹	5	500
10	Transportation (Loading and unloading)	kg ⁻¹		2
	Wheat grain	Q		2640
	Wheat straw	t		1100

Discussion

The increased grain yield under recommended package of practices was 22 per cent higher than organic farming practices (3012 kg ha⁻¹). The best treatment from natural farming practice i.e., cow urine @ 50 % + *jeevamrutha* @ 100 % (3066 kg ha⁻¹) recorded 16 per cent lower yield than recommended package of practices, whereas the organic farming practice was on par with the best natural farming treatments. The higher yield resulted in recommended package of practice was due to steady supply of nutrients in an integrated way through FYM @ 7.5 t ha⁻¹, biofertilizers and inorganic fertilizers and split application of nitrogen in the form of urea at critical growth stages of crop and supplementation of P and K along with micro nutrients.

The best treatment cow urine @ 50 % + *jeevamrutha* @ 100 % (CU₃JA₄) recorded 98 per cent higher net return than organic farming practice and 59 per cent lower net return than recommended package of practices due to reduced cost of inputs and producing grain yield equivalent to organic farming and recommended package of practices.

Hence, the study indicates to follow the natural farming by meeting the nutrient requirements through foliar application. The foliar application of *jeevamrutha* and cow urine will be able to supply the required nutrients and can be reduce the huge cost imposed in conventional farming. Several researchers obtained good response of wheat to cow urine @ 10 % (Korade *et al.*, 2019 and Prasanna *et al.*, 2020), 50 % (Pradhan *et al.*, 2017) and 100 % (Sadhukhan *et al.*, 2018 and Vanita *et al.*, 2020). However, the information on combined application of cow urine and *jeevamrutha* and their concentration effect on irrigated wheat is very meagre and the concentration rate at which is to be applied is not known under natural farming condition.

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