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Evaluation of different components of natural farming in black gram (*Vigna mungo* L.) under mid hill conditions of Himachal Pradesh

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Abstract

Field experiments were conducted during *kharif* 2019 and 2020 at Holta Zero Budget Natural Farm (ZBNF), Department of Organic Agriculture and Natural Farming, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur to evaluate the comparative efficacy of different components of natural farming on crop production and economics of black gram. The results revealed that yield attributes and yield (seed and straw) of black gram increased significantly with application of natural farming components in totality. Application of *ghanjeevamrit* + *jeevamrit* + mulching (T_7) significantly increased the seed yield of black gram over T_8 (absolute control) by 61.4 and 233.1 per cent during 2019 and 2020, respectively and application of *ghanjeevamrit* + jeevamrit (T_4) recorded significantly higher net returns of Rs. 49265 ha^{-1} statistically at par with *ghanjeevamrit* + *jeevamrit* + mulching (T_7) in 2019. However, in 2020, application of *ghanjeevamrit* + *jeevamrit* + mulching (T_7) recorded higher net returns of Rs. 64206 ha^{-1} over other treatments.

Key words: Black gram, *jeevamrit*, ghanjeevamrit, mulching and natural farming.

Prior to green revolution, method of farming practiced in India was natural only. Reliance on inorganic sources of plant nutrients increased with adoption of intensive agriculture technologies in post green revolution period. Although the excessive use of inorganic fertilizers led to impressive gains in the food grain production, yet their indiscriminate use gave rise to concerns related to soil, water and environment. Consequently, the importance of natural farming in Indian agriculture has once again come to the fore.

Zero Budget Natural Farming (ZBNF) is a new concept introduced with an aim of sustainable development. Like organic farming, it replaces the use of synthetic chemicals and in addition to that, it also replaces use of huge quantity of farm yard manure and compost from organic farming with cover crops, green manure crops and use of preparations made from desi cow. It is a low-input, climate-resilient type of farming that encourages farmers to use low cost locally-sourced inputs, eliminating the use of artificial fertilizers and industrial pesticides.

In India, noted agriculturist Subhash Palekar has helped to popularize Zero Budget Natural Farming (ZBNF) practices throughout the country. He has recognized that application of *ghanjeevamrit* as basal soil application dose for nutrients and microbes along with main four aspects that are essential to ZBNF viz. *Beejamrit* is the microbial coating of seeds through the usage of cow dung and urine-based formulations. The useful microorganisms existing in *beejamrit* are known to defend the crop from hazardous soil-borne and seed-borne pathogens. The second component jeevamrit is a fermented microbial culture. It offers nutrients, however, most importantly, acts as a catalytic agent that promotes the activity of microorganisms in the soil, as well as enhances

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earthworm activity. The third aspect is acchadana - Mulching or applying a layer of organic material to the soil surface in order to forestall water evaporation and also to contribute to soil humus formation while fourth aspect whapasa – moisture is the condition where there are both air molecules and water molecules existing in the soil (Palekar, 2006).

Legumes are the main component of natural farming. Black gram (*Vigna mungo*) or urdbean is the third important pulse crop in India. This legume, one of the exceedingly most priced legumes, originated in India and has been under cultivation since ancient times. India produces around 2.2 million tonnes of black gram annually from about 4.02 million hectares of area, with average productivity of 547 kg per hectare. In Himachal Pradesh, black gram is grown in Shivalik hills and mid hill zones in an area of about 9000 hectares with a total production of 4320 tonnes and an average productivity of 480 kg/hectare (Anon. 2018). Keeping these points in view and the new concept of ZBNF, present study was conducted on the cultivation of black gram, a vital pulse crop of the region with an objective to study the effect of different components of natural farming on its production and economics.

Materials and Methods

Experiments were conducted at Holta Zero Budget Natural Farm (ZBNF), Department of Organic Agriculture and Natural Farming, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur during kharif 2019 & 2020 on the permanent plots. The experimental farm is situated at 32°4′ N latitude, 76°3′ E longitude and 1224 meters above mean sea level. The soil of the experimental field was silty clay loam in texture and acidic in reaction. The soil was rated as medium in organic carbon, available nitrogen, available phosphorus and high in available potassium. The experiment was laid out in Randomized Block Design (RBD) comprising of 8 treatments [T_1- *Ghanjeevamrit* @ 250 kg ha^{-1} + FYM @ 250 kg ha^{-1} before sowing. T_2- *Jeevamrit* (soil application at sowing @ 500 l ha^{-1}, foliar application @ 5% 10% and 10% after 21 days of sowing, 42 days of sowing and after 63 days of sowing respectively + foliar application of fermented butter milk @ 2.5% after 73 days of sowing). T_3- mulching @10 t ha^{-1} on dry weight basis. T_4 - *Ghanjeevamrit* + *jeevamrit*. T_5- *Ghanjeevamrit* + mulching. T_6- *Jeevamrit* + mulching. T_7- *Ghanjeevamrit* + *jeevamrit* + mulching. T_8 - Absolute control] and replicated thrice. Variety Him Mash-1 of black gram was sown in lines at a spacing of 30 cm at the seed rate of 25 kg ha^{-1}. Black gram seeds were treated with *beejamrit* @ 1 litres/10 kg of seeds irrespective of different treatments.

The necessary inputs *ghanjeevamrit*, *jeevamrit* and *beejamrit*, as mentioned in the table 1 were prepared after following the standard procedure of preparation as given by Subash Palekar (Palekar, 2006). *Beejamrit* was used for seed treatment on the very next day after preparation, *ghanjeevamrit* was used at the time of sowing and *jeevamrit* was used after five days of fermentation, at different times as per treatment. All the samples were analyzed on the day of their application and found to contain NPK content as given in table 1. The observations on different yield attributes and yield were recorded at harvest. The data generated from the field experiment was statistically analyzed for interpretation of the results (Gomez and Gomez, 1984).

Results and Discussion

Yield attributes and yield

A perusal of data on different yield attributes of black gram presented in table 2 revealed that during both the years (2019 and 2020) T_7 i.e. *Ghanjeevamrit* + *jeevamrit* + mulching produced significantly more number of pods per plant which was statistically at par with T_4 during 2019 and 2020. However, in 2019 it was also statistically at par with T_2 and T_5. This might be due to the fact that numbers of pod depends on number of branches and flowering nodes per plant. Their retention and photosynthesis is enhanced by more nutrient uptake resulting in more flowering buds which ultimately produced more pods per plant.

The data presented in table 2 revealed that number of seeds per pod was significantly influenced by different treatments. T_7 (*Ghanjeevamrit* + *jeevamrit* + mulching) resulted in significantly more number of seeds per pod during both the years of study. However, in 2019 it was also statistically at par with T_2. Similar results have also been obtained by Sutar *et al*. (2018) in

Table 1. Ingredients and composition of ZBNF/organic inputs

Sr. No	Input	Ingredients	Method of preparation	N (%)	P (%)	K (%)
1.	*Beejamrit*	Cow dung – 5 kg Cow urine – 5 L Lime – 50 g Water – 20 L Handful of soil	• Soaked cow dung for 12 hours • Squeezed in water tub • Added lime, soil, water & cow urine then stirred well	0.63	0.18	0.26
2.	*Jeevamrit*	Cow dung – 10 kg Cow urine – 10 L Jaggery – 2 kg Gram flour – 2 kg Water – 200 L Handful of soil	• In total water, added whole quantity of cow urine, cow dung, jaggery and gram flour • Mixed all the above materials with stirrer • Stirred 2 times daily in clockwise direction • Kept it for 48 hours under shade	0.28	0.08	0.10
3.	*Ghanjeevamrit*	Cow dung – 100 kg Cow urine – 10 L Jaggary – 100 g Besan – 100 g	• Took whole portion of cow dung, cow urine, jaggery and gram flour. Mixed all the contents, made balls with hand and dried under shade	1.33	0.84	0.73

Table 2. Effect of different treatments on yield attributes, yield and harvest index of black gram

T. No.	Treatment	No of pods per plant		No. of seeds per pod		Seed yield (kg ha^{-1})		Straw yield (kg ha^{-1})		Harvest index (%)	
		2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
T1	*Ghanjeevamrit* @ 250 kg ha^{-1} before sowing	19.43	22.47	6.85	6.83	720.7	807.2	1594.4	1751.6	31.2	31.7
T2	*Jeevamrit* (foliar application at 21 days interval)	23.50	22.93	7.00	6.93	740.7	733.0	1618.7	1473.3	31.4	30.1
T3	Mulching @10 t ha^{-1} dry leaves	18.23	17.90	6.89	6.67	764.5	581.4	1628.3	1325.5	32.0	32.8
T4	*Ghanjeevamrit*+ *jeevamrit*	24.07	24.93	6.92	6.98	867.6	955.0	1893.4	2101.0	31.4	32.0
T5	*Ghanjeevamrit* + mulching	22.83	22.87	6.91	6.97	817.6	850.0	1762.5	1836.0	31.7	31.6
T6	*Jeevamrit* + mulching	19.20	20.73	6.85	6.70	835.7	755.3	1795.3	1654.1	31.8	31.9
T7	*Ghanjeevamrit* + *jeevamrit* + mulching	25.43	26.87	7.33	7.37	933.4	1133.2	1993.7	2323.0	31.9	30.5
T8	Absolute control	17.83	15.13	6.81	6.47	578.4	340.2	1339.8	748.4	30.4	32.0
SEm±		0.87	1.20	0.11	0.10	20.1	37.7	41.3	40.10	0.8	0.9
CD (P=0.05)		2.65	3.59	0.35	0.31	60.9	113.0	125.2	120.4	NS	NS

cowpea, where application of *jeevamrit* @ 1000 l ha^{-1} resulted in significantly higher number of seeds per pod than the application of *jeevamrit* @ 500 l ha^{-1}. Siddappa (2015) also reported significantly higher number of seeds per pod with the application of *jeevamrit* @ 1500 l ha^{-1} followed by *jeevamrit* @ 1000 l ha^{-1} and *jeevamrit* @ 500 l ha^{-1} in field bean.

The data on the effect of different treatments on seed yield of black gram revealed that T_7 (*ghanjeevamrit* + *jeevamrit* + mulching) significantly increased the seed yield of black gram over T_8 (absolute control) by 61.4 and 233.1 per cent during 2019 and 2020. Improvement in the yield of T_7 treatment and reduction in the yield of T_8 treatment (absolute control) during 2nd year of experimentation resulted in a huge increase in yield (233.1%) as compared to first year of experiment. This might be due to the fact that combined application of solid and liquid organic manures resulted in fulfillment of nutritional needs of crop which provided better availability of nutrients throughout the crop growth that ultimately improved the growth and yield contributing characters of black gram and hence, resulted in higher seed yield. Similar findings were observed by Siddappa (2015) who had reported that in field bean, significantly higher grain yield was recorded with application of *jeevamrit* @ 1500 l ha^{-1}. Sutar *et al*. (2018) also recorded similar results with application of *jeevamrit* @ 1000 l ha^{-1}.

The pattern of effect of treatments on straw yield of black gram was also similar to that of seed yield. T_7 (*ghanjeevamrit* + *jeevamrit* + mulching) significantly increased the straw yield over other treatments. The increase in the straw yield with T_7 (*ghanjeevamrit* + *jeevamrit* + mulching) was to the tune of 48.8 and 210.3 per cent over T_8 (absolute control) in first year and second year, respectively. This might be due to the fact that adequate availability of nutrition improved the dry matter accumulation and hence resulted in increased straw yield.

Harvest index was not influenced significantly by any of the treatments though numerically highest harvest index was recorded in T_3 (mulching) during both the years of study.

Economics

It is evident from the data (Table 3) that during both the years, maximum cost of cultivation was incurred with application of *ghanjeevamrit* + *jeevamrit* + mulching (T_7) as compared to other treatments. The higher cost of cultivation in T_7 can be attributed to the use of multiple inputs like *ghanjeevamrit*, *jeevamrit* and mulching in this treatment. The least cost was recorded in T_8 (absolute control).

Table 3. Effect of different treatments on economics of black gram cultivation under natural farming

T. No.	Treatments	Cost of cultivation (Rs. ha^{-1})		Gross returns (Rs. ha^{-1})		Net returns (Rs. ha^{-1})		B:C ratio	
		2019	2020	2019	2020	2019	2020	2019	2020
T_1	*Ghanjeevamrit* @ 250 kg ha^{-1} before sowing	32262	36212	70440	78778	38177	42566	1.18	1.18
T_2	*Jeevamrit* (foliar application at 21 days interval)	29950	33912	72325	71126	42375	37214	1.39	1.10
T_3	Mulching @10 t ha^{-1} dry leaves	33262	37212	74506	56965	41243	19752	1.24	0.53
T_4	*Ghanjeevamrit*+ *jeevamrit*	35450	39412	84715	93303	49265	53891	1.41	1.37
T_5	*Ghanjeevamrit* + mulching	38762	42725	79756	82926	40993	40201	1.06	0.94
T_6	*Jeevamrit* + mulching	36450	40412	81500	73766	45050	33353	1.24	0.83
T_7	*Ghanjeevamrit* + *jeevamrit* + mulching	41950	45912	90985	110118	49035	64206	1.17	1.40
T_8	Absolute control	25250	29212	56749	33237	31499	4024	1.25	0.14
	SEm±			1858.3	1902.2	994.2	1000.3	0.03	0.03
	CD (P=0.05)			5636.5	5708.1	3015.6	3002.0	0.09	0.09

Application of *ghanjeevamrit* + *jeevamrit* + mulching (T_7), recorded significantly higher gross returns of Rs. 90985 ha^{-1} and Rs. 110118 ha^{-1} followed by T_4 (*Ghanjeevamrit* + *jeevamrit*) in 2019 and 2020, respectively. The significantly lowest gross returns were recorded in T_8 (absolute control) in both the years. The significant variation in the gross returns was mainly because of the difference in seed and straw yield due to treatment effect. Kasbe *et al*. (2009) have also reported application of *jeevamrit* to be cost effective treatment when used @ 2000 L ha^{-1} with combination of different organic manures than when *jeevamrit* was used alone. It was observed that application of *jeevamrit* is one of the cheapest and efficient organic substitutes along with other organic manures for high crop yield and profitability.

Application of *ghanjeevamrit* + *jeevamrit* (T_4) recorded significantly higher net returns of Rs. 49265 ha^{-1} but it was statistically at par with *ghanjeevamrit* + *jeevamrit* + mulching (T_7) in 2019. However, in 2020, application of *ghanjeevamrit* + *jeevamrit* + mulching (T_7) recorded higher net returns of Rs. 64206 ha^{-1} over other treatments. Statistically lower net returns were recorded with T_8 (control), as the seed yield and straw yield recorded from these plots were relatively lower and the cost of cultivation was higher.

Further, the data revealed that application of *ghanjeevamrit* + *jeevamrit* (T_4) recorded significantly higher benefit cost ratio which was statistically at par with T_2 (*jeevamrit*) in 2019 whereas in 2020, application of *ghanjeevamrit* + *jeevamrit* + mulching (T_7) recorded maximum benefit cost ratio and was statistically at par with *ghanjeevamrit*+ *jeevamrit* (T_4).

Conclusion

For higher productivity and profitability of black gram cultivation under natural farming application of all the components i.e. *ghanjeevamrit* + *jeevamrit* + mulching (T_7) is the most suitable option for silty clay-loam soils of mid-hill regions of Himachal Pradesh.

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