International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2020; 8(6): 2083-2087

Received: 02-08-2020
Accepted: 08-09-2020

Swati Singh
Department of Agronomy, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh, India

PK Singh
Department of Agronomy, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh, India

Shipra Yadav
Department of Agronomy, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh, India

Corresponding Author:
Swati Singh
Department of Agronomy, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh, India

Effect of different natural sources of nutrient supply on growth and yield of black gram (*Vigna mungo* L.) in Western U.P

Swati Singh, PK Singh and Shipra Yadav

DOI: https://doi.org/10.22271/chemi.2020.v8.i6ad.11076

Abstract
A field experiment was conducted during summer season of the year 2019 at the Technology Park, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, U.P. to study the effect of different natural farming treatments on growth, yield and economics of black gram (*Vigna mungo* L.) in Western Uttar Pradesh. The experiment was laid out in randomized block design with three replications having nine treatments *viz*. T_1- Control, T_2- RDF, T_3- Beejamrutha, T_4- Jeevamrutha, T_5- Mulching, T_6- Beejamrutha + Jeevamrutha, T_7- Beejamrutha + Mulching, T_8- Jeevamrutha + Mulching, T_9- Beejamrutha + Jeevamrutha + Mulching. The soil of the experimental site was sandy loam in texture having good drainage, low in available nitrogen, medium in available phosphorous and potassium with pH 7.92. Result revealed that the growth and yield of black gram was recorded under treatment T_3, Beejamrutha + Jeevamrutha + Mulching.

Keywords: Natural farming**,** Beejamrutha, jeevamrutha, mulching

1. Introduction
Pulses have occupied immense significance in recent years as an important component of Indian economy. Pulses are leguminous plants and belong to the family *Fabaceae*. Pulses are rich source of protein (22% to 26%) and thus form an important part of vegetarian diet supplying the major portion of the protein requirements for human nourishment. About 88 per cent of protein consumed in India is of vegetable origin. Pulses have 2-6% fats and can meet the essentiality of fatty acids (Kumar *et al*., 2018; Mahilane and Singh, 2018) [3, 4]. Black gram is a widely grown pulse assumes considerable importance from the point of food and nutritional security in the world. Black gram is a short duration pulse crop as it thrives better in *kharif* and summer seasons either as sole or as intercrop. India is the world's largest producer as well as consumer of black gram. It is consumed in the form of 'dal' (whole or split, husked and unhusked) or parched. It is the chief constituent of 'papad' and also of 'bari'
(spiced balls) which make a delicious curry. Black gram differs from other pulses in its peculiarity of covering the ground very fast with somewhat mucilaginous pasty character, giving additional body to the earth mass. In the south, the husked dal is grinded into a fine paste and allowed to ferment and is then mixed with equal quantity of rice flour to make 'dosa' and 'idli'. It is also fried to serve as savoury dish. Dal is also use in the preparation of 'halwa' and 'imarti'. It used as a nutritive fodder specially for milch cattle. It is also used as a green manuring crop. Black gram plant possesses deep root system which binds soil particles and thus prevent soil erosion. Black gram grain contains about 24% protein, 60% carbohydrates, 1.3% fat, and is the richest among the various pulses in phosphoric acid, being five to ten times more than others. Black gram contributes 17% in total pulses area and 13% in total production of India. Madhya Pradesh, Uttar Pradesh and Andhra Pradesh are major black gram growing states area-wise. Total area of black gram in India is 5.031 million hectares with an annual production of 3.06 million tonnes and productivity 652 kg ha^{-1} during year 2017-18. The highest yield is recorded in the state of Bihar (898 kg ha^{-1}) followed by Sikkim (895 kg ha^{-1}) and Jharkhand (890 kg ha^{-1}). The National yield average is 652 kg/ha. The lowest yield is recorded in the state of Chhattisgarh (309 kg ha^{-1}) followed by Odisha (326 kg ha^{-1}) and J&K (385 kg ha^{-1}).

Yield potential of black gram is very low because of the fact that the crop is mainly grown in rainfed condition with poor management practices and also due to various physiological, biochemical as well as inherent factors associated with the crop. Apart from the genetic makeup, the physiological factor *viz*., insufficient partitioning of assimilates, poor pod setting due to the flower abscission and lack of essential nutrients during critical stage of crop growth, coupled with infestation of disease and pest constitute the major constraints for the poor yield. Thus, the productivity of black gram is very low in our country. Cow is the backbone of Indian culture and rural economy and sustains our life; represent cattle wealth and bio-diversity. It is known as "*Kamdhenu*" and "*Gaumata*" because of its nourishing nature like mother, the giver of all providing riches to humanity and is a store of medicines.

2. Method and Material

The field experiment was conducted at Crop Research Center, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.), located at a latitude of 29^0 4' North and longitude of 77^0 46' East with an elevation of 237 meter above the mean sea level.

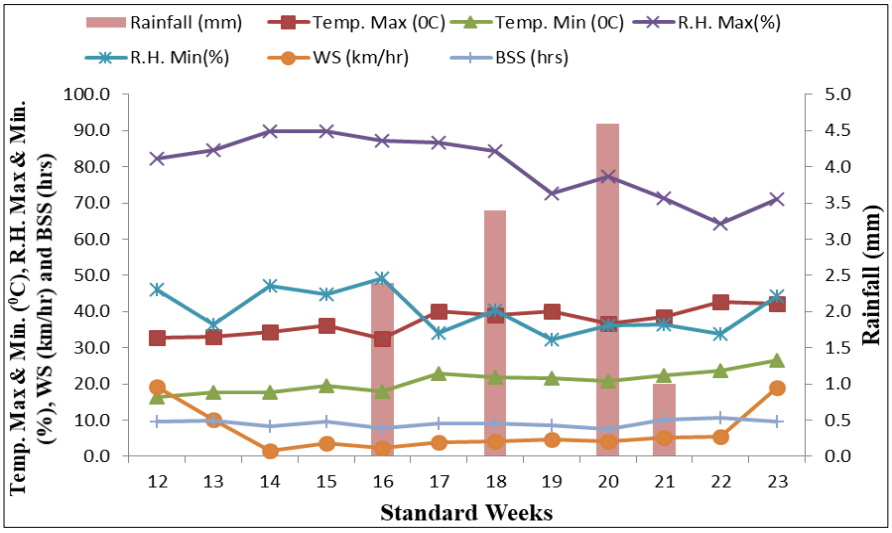

Fig 1: Mean weekly agro-meteorological data during the crop growing season (zaid - 2019)

The Meerut area lies in the heart of Western Utter Pradesh and has Sub-tropical climate. The mean annual rainfall of Meerut is 862 mm of which about 80-90 per cent is received from June to September. Winter season extended from November to March, where in frost occurs generally in the end of December and may continue up to the end of January. The mean minimum temperature reaches as low as 3 ^{0}C in winters, while during summer the mean maximum temperature varies from 43-45 ^{0}C in the month of May. Mean weekly data on mean temperature, relative humidity and total rainfall recorded during the crop season *i.e.*, summer season 2019. The experiment was layout in randomized block design with three replications having nine treatments *viz*. T_1- Control, T_2- RDF, T_3- Beejamrutha, T_4- Jeevamrutha, T_5- Mulching, T_6- Beejamrutha + Jeevamrutha, T_7- Beejamrutha + Mulching, T_8- Jeevamrutha + Mulching, T_9- Beejamrutha + Jeevamrutha + Mulching.

3. Result and Discussion

3.1 Growth parameters

Growth parameters (plant height, number of branches plant^{-1}, leaf area index, dry matter accumulation, number of nodules plant^{-1}, dry weight of nodules plant^{-1} and number of days taken to 50% flowering and maturity) as influenced by different natural farming treatments. Increase in growth attributes might be attributed to solubilization of nutrient in soil and proper absorption of nutrients and moisture due to soil application of jeevamrutha (Yogananda *et al.*, 2015, Siddappa 2015, Siddappa *et al.* 2016 and Boraiah 2013) [5, 6, 7]

3.1.1 Plant height

Plant height recorded at various growth stages (25, 50, 75 DAS and at harvest) of black gram as influenced by natural farming treatments. the plant height increased with advancement of crop age and reached to its maximum at maturity, irrespective of the treatments. It is evident from the data that plant height differ significantly with respect to different treatments levels at all the crop growth stages. The tallest plants were recorded with Beejamrutha + Jeevamrutha + Mulching treatments at all the stages of crop growth. At 25 DAS (17.65cm) treatment Beejamrutha + Jeevamrutha + Mulching resulted into significantly highest plant height than rest of the treatments, which was at par with Beejamrutha + Mulching treatment. The shortest plants (13.12, 17.89, 23.56 and 24.94 cm at 25, 50, 75 DAS and at harvest, respectively) were recorded in control treatment. On an average 25.66, 25.30, 20.67 and 23.61% increase over control treatment due to Beejamrutha + Jeevamrutha + Mulching was recorded at 25, 50, 75 and at harvest stage, respectively.

Table 1: Effect of different natural farming treatments on growth parameters of blackgram

Treatment	Growth Parameters					
	Plant height (cm)	Number of branches plant^{-1}	Leaf area index	Dry matter accumulation	Number of nodules (plant^{-1})	Dry weight of nodules plant^{-1}
Control	24.94	4.41	2.4	9.81	31.46	3.87
RDF	28.26	4.78	3.7	10.86	36.11	4.01
Beejamrutha	26.19	5.57	2.8	10.71	39.74	4.41
Jeevamrutha	28.76	5.69	4.0	11.75	38.71	4.08

Mulching	26.58	5.19	3.1	10.58	37.85	4.02
Beejamrutha + Jeevamrutha	29.16	5.82	3.8	12.15	42.39	5.14
Beejamrutha + Mulching	28.25	5.79	3.7	11.91	41.36	4.82
Jeevamrutha + Mulching	28.55	5.38	3.7	12.05	41.06	4.51
Beejamrutha + Jeevamrutha + Mulching	32.65	6.57	4.2	13.35	44.21	5.79
S.Em (±)	0.94	0.18	0.12	0.27	1.46	0.36
C.D. (P=0.05)	2.72	0.53	0.35	0.78	4.23	1.06

3.1.2 Number of branches plant^{-1}

Number of branches/plant at various stages of crop growth as influenced by natural farming treatments. the growth stages of crop remain natural farming treatments significantly increased the number of branches per plant at all the crop growth stages. Among the different natural farming treatments Beejamrutha + Jeevamrutha + Mulching had highest number of branches per plant at 25, 50, 75 DAS and at harvesting stages was 4.21, 5.44, 6.38 and 6.57, respectively followed by Beejamrutha + Jeevamrutha and Jeevamrutha + Mulching treatment. Less number of branches per plant at 25, 50, 75 DAS and at harvesting stages was 2.14, 3.25, 4.32 and4.41, respectively, in control plot. On an average 49.16, 40.25, 32.28 and 32.87% increase over control treatment due to Beejamrutha + Jeevamrutha + Mulching was recorded at 25, 50, 75 and at harvest stage, respectively.

3.1.3 Leaf area index

Leaf area index at various stages of crop growth as influenced by natural farming treatments. At 25 DAS, leaf area per plant under natural farming treatments resulted into significantly highest leaf area (4.1) was recorded with Beejamrutha + Jeevamrutha + Mulching, which was statistically at par with Beejamrutha + Jeevamrutha and Jeevamrutha + Mulching treatments. The lowest leaf area (2.1) was recorded with control treatment, respectively. At 50 DAS, significantly higher leaf area was noticed with a Beejamrutha + Jeevamrutha + Mulching (5.3), which was statistically at par with Beejamrutha + Jeevamrutha (4.9) and Jeevamrutha + Mulching (4.8) and lower leaf area (2.9) was noticed control treatment. At 75 DAS, significantly higher leaf area was noticed with a Jeevamrutha + Mulching (4.6), which was statistically at par with Beejamrutha + Jeevamrutha + Mulching (4.5), Beejamrutha + Jeevamrutha (4.5) and Beejamrutha + Mulching (4.4) and lower leaf area (2.6) was noticed control treatment. At harvest, significantly higher leaf area was noticed with a Beejamrutha + Jeevamrutha + Mulching (4.2), which was statistically at par with Beejamrutha + Jeevamrutha (3.8) and lower leaf area (2.4) was noticed control treatment. On an average 48.78, 45.28, 43.47 and 42.85% increase over control treatment due to Beejamrutha + Jeevamrutha + Mulching was recorded at 25, 50, 75 and at harvest stage, respectively.

3.1.4 Dry matter accumulation

Dry matter production and accumulation in leaves, stem and pods at 25, 50, 75 DAS and at harvest differed significantly due to the different natural farming treatments. At 25 DAS Among different natural farming treatments, Beejamrutha + Jeevamrutha + Mulching recorded higher dry matter accumulation (4.17g plant^{-1}), which was statistically at par with Jeevamrutha + Mulching (3.51 g plant^{-1}) significantly lower dry weight (2.06 g plant^{-1}) was registered with control treatment. At 50 DAS Beejamrutha + Jeevamrutha + Mulching recorded higher dry matter accumulation (8.90g plant^{-1}) followed by Jeevamrutha + Mulching (7.70 g plant^{-1}) and Beejamrutha + Jeevamrutha (7.35 g plant^{-1}) significantly lower dry weight (5.51 g plant^{-1}) was registered with control treatment, respectively. At 75 DAS Beejamrutha + Jeevamrutha + Mulching recorded higher dry matter accumulation (12.55 g plant^{-1}), which stood at par with the Beejamrutha + Jeevamrutha (11.86 g plant^{-1}), Jeevamrutha + Mulching (11.85 g plant^{-1}) and Beejamrutha + Mulching (11.60 g plant^{-1}) treatments. The lower dry weight (9.17 g plant^{-1}) was registered with control treatment, respectively. At harvest, significantly higher dry matter accumulation (13.35 g plant^{-1}) was noticed in Beejamrutha + Jeevamrutha + Mulching treatment followed by Beejamrutha + Jeevamrutha (12.15 g plant^{-1}) and Jeevamrutha + Mulching (12.05 g plant^{-1}) treatments. Significantly lower dry matter accumulation (9.81 g plant^{-1}) per plant was recorded with control treatment, respectively.

3.1.5 Number of nodules (plant^{-1})

Number of nodules at 25, 45 and 75 DAS differed significantly due to the different natural farming treatments. At 25 DAS Among different natural farming treatments, Beejamrutha + Jeevamrutha + Mulching recorded higher no. of nodules (39.68 plant^{-1}), which was statistically at par with Beejamrutha + Jeevamrutha (38.76 plant^{-1}) and Beejamrutha (36.47 plant^{-1}) treatments. Significantly lower no. of nodules (26.28 plant^{-1}) was recorded with control treatment, respectively. At 45 DAS Beejamrutha + Jeevamrutha + Mulching recorded higher no. of nodules (70.62 plant^{-1}), which stood at par with the Beejamrutha + Jeevamrutha (68.59 plant^{-1}) treatments. The lower no. of nodules (40.63plant^{-1}) was registered with control treatment, respectively. At 75 DAS Beejamrutha + Jeevamrutha + Mulching recorded higher no. of nodules (44.21 plant^{-1}), which was statistically at par with Beejamrutha + Jeevamrutha (42.39 plant^{-1}), Beejamrutha + Mulching (41.36 plant^{-1}) and Jeevamrutha + Mulching (41.06 plant^{-1}) treatments. The lowest no. of nodules (31.46 plant^{-1}) was recorded with control treatment, respectively.

3.1.6 Dry weight of nodules plant^{-1}

Dry weight of nodules at 25, 45 and 75 DAS differed significantly due to the different natural farming treatments the data pertaining to dry weight of nodules at various stages of crop growth as influenced by natural farming treatments. At 25 DAS Among different natural farming treatments, Beejamrutha + Jeevamrutha + Mulching recorded higher dry weight of nodules (4.62 plant^{-1}), which was statistically at par with Beejamrutha + Jeevamrutha (4.37 plant^{-1}) and Beejamrutha + Mulching (4.08 plant^{-1}) treatments. Significantly lower dry weight of nodules (2.66 plant^{-1}) was recorded with control treatment, respectively. At 50 DAS Beejamrutha + Jeevamrutha + Mulching recorded higher no. of nodules (8.62 plant^{-1}) followed by Beejamrutha + Jeevamrutha (8.20 plant^{-1}), Beejamrutha + Mulching (7.69 plant^{-1}) and Jeevamrutha + Mulching (7.38 plant^{-1}) treatments. The lower dry weight of nodules (4.69 plant^{-1}) was registered with control treatment, respectively. At 75 DAS Beejamrutha + Jeevamrutha + Mulching recorded higher dry weight of nodules (5.79 plant^{-1}), which was statistically at par with Beejamrutha + Jeevamrutha (5.14 plant^{-1}). The lowest dry

weight of nodules (3.87 plant^{-1}) was recorded with control treatment, respectively.

3.1.7 Days taken to flowering and maturity in blackgram

The days taken to flowering and maturity in blackgram did not differ significantly due to different natural farming treatments. However, numerically higher flowering 49 days in blackgram and maturity days 75 in blackgram was noticed with Beejamrutha + Jeevamrutha + Mulching. The lowest flowering 47 days in blackgram and maturity days 71 in blackgram was recorded with control treatment, respectively.

3.2 Yield

3.2.1 Grain yield

Conspicuous differences in the seed yield per hectare were noticed due to different natural farming treatments. Significantly higher seed yield of black gram (9.75 q ha^{-1}) was noticed with Beejamrutha + Jeevamrutha + Mulching followed by Beejamrutha + Jeevamrutha (8.65 q ha^{-1}), Jeevamrutha + Mulching (8.51q ha^{-1}), and Beejamrutha + Mulching (8.35q ha^{-1}). The lowest seed yield was recorded with control plot (4.94 q ha^{-1}). About 97.36(%) increases over control treatment was recorded by grain yield, respectively. Significantly higher grain yield recorded with Beejamrutha + Jeevamrutha + Mulching was due to better yield attributing characters like number of pods per plant, pod weight per plant, number of seeds per pod, seed weight per plant and test weight. The increase in grain and straw yield of blackgram due to natural farming treatments could be due to better availability of nutrients throughout the crop growth which was ensured further by improved microbial activity in the soil. These findings are in accordance with Kasbe *et al*. (2009) [2].

3.2.2 Straw yield

The impact of natural farming treatments on straw yield of black gram was found to be significant. Beejamrutha + Jeevamrutha + Mulching resulted in significantly higher straw yield (27.01 q ha^{-1}) as compared to all the other treatments, which was statistically at par with Beejamrutha + Jeevamrutha (26.18 q ha^{-1}), Jeevamrutha + Mulching (25.45 q ha^{-1}) and Beejamrutha + Mulching (24.68 q ha^{-1}). Significantly lower straw yield reported in control (15.88 q ha^{-1}). About 70.08 (%) increases over control treatment was recorded by straw yield, respectively.

3.2.3 Biological yield

A perusal of data revealed that natural farming practices markedly influenced the biological yield of black gram. Beejamrutha + Jeevamrutha + Mulching the highest biological yield (36.76 q ha^{-1}), Beejamrutha + Jeevamrutha (34.83 q ha^{-1}) and Jeevamrutha + Mulching (33.96 q ha^{-1}) being on par with each other and significantly with rest of the treatments including control. About 76.56 (%) increases over control treatment was recorded by biological yield, respectively.

3.2.4 Harvest index

The impact of natural farming treatments on harvest index was found to be non significant. However, numerically higher harvest index (26.52) was recorded with the Beejamrutha + Jeevamrutha + Mulching as compared to other treatments. The lowest harvest index was recorded in control plot (23.73).

Table 2: Effect of different natural farming treatments on grain, straw and biological yield and harvest index (%) of blackgram

Treatment	Yields (q ha^{-1})			Harvest Index (%)
	Grain	Straw	Biological	
Control	4.94	15.88	20.82	23.73
RDF	8.08	23.71	31.79	25.42
Beejamrutha	7.80	22.87	30.67	25.43
Jeevamrutha	8.15	23.36	31.51	25.86
Mulching	7.08	21.28	28.36	24.96
Beejamrutha + Jeevamrutha	8.65	26.18	34.83	24.83
Beejamrutha + Mulching	8.35	24.68	33.03	25.28
Jeevamrutha + Mulching	8.51	25.45	33.96	25.06
Beejamrutha + Jeevamrutha + Mulching	9.75	27.01	36.76	26.52
SEm (±)	0.28	0.79	1.07	0.86
C.D. (P=0.05)	0.80	2.30	3.10	NS

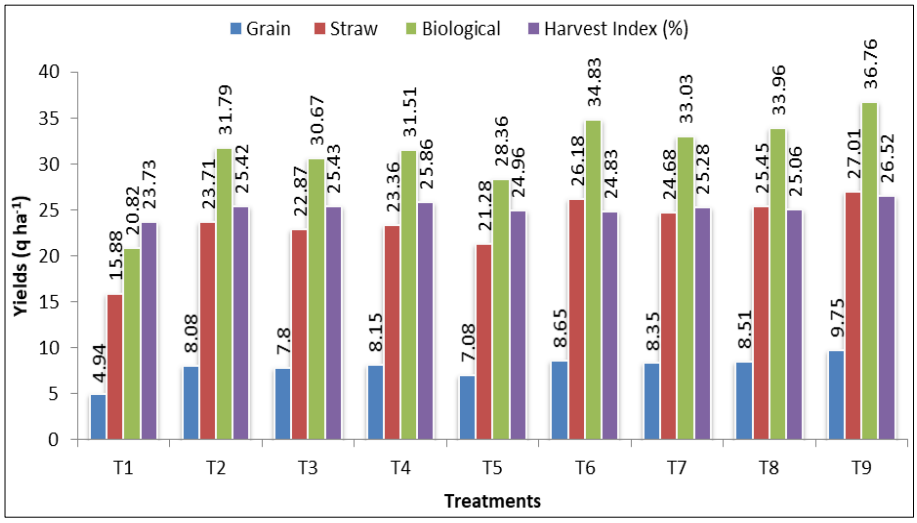

Fig 2: Effect of different natural farming treatments on grain, straw and biological yield and harvest index (%) of blackgram

4. Summery

Plant height differ significantly with respect to different treatments levels at all the crop growth stages. The tallest plants were recorded with Beejamrutha + Jeevamrutha + Mulching at all the stages of crop growth. Beejamrutha + Jeevamrutha + Mulching treatment resulted into significantly highest plant height than rest of the treatments followed by Beejamrutha + Jeevamrutha being at par with Jeevamrutha + Mulching. However, control and RDF remained on par to each other at both the stages of crop growth but statistically

inferior over higher treatments levels. Natural farming treatments significantly increased the number of branches per plant at all the crop growth stages. Among the different natural farming treatments Beejamrutha + Jeevamrutha + Mulching had highest number of branches per plant at 25, 50, 75 DAS and at harvesting stages was 4.21, 5.44, 6.38 and 6.57 respectively followed by Beejamrutha + Jeevamrutha and Jeevamrutha + Mulching. Less number of branches per plant at 25, 50, 75 DAS and at harvesting were 2.14, 3.25, 4.32 and 4.41 respectively in control plot. At 25 DAS, leaf area per plant under natural farming treatments did not cause any significant differences. However, numerically higher leaf area (4.1 plant^{-1}) was recorded with Beejamrutha + Jeevamrutha + Mulching and lower leaf area (2.1 plant^{-1}) in control. At 50 DAS, significantly higher leaf area was noticed with a Beejamrutha + Jeevamrutha + Mulching (5.3 plant^{-1}), which was on par with Beejamrutha + Jeevamrutha (4.9 plant^{-1}) and Jeevamrutha + Mulching (4.8 plant^{-1}) and significantly lower leaf area was noticed with the control (2.9 plant^{-1}). Among different natural farming treatments, Beejamrutha + Jeevamrutha + Mulching recorded higher dry matter accumulation and were on par with the Jeevamrutha + Mulching (4.17 and 3.51 g plant^{-1}, respectively). Significantly lower dry weight was registered (2.06 g plant^{-1}) with control at 25 DAS. Beejamrutha + Jeevamrutha + Mulching recorded higher dry matter accumulation and followed by Jeevamrutha + Mulching (8.90 and 7.70 g plant^{-1}, respectively) and significantly lower dry weight was registered (5.51 g plant^{-1}) with control at 50 DAS. Beejamrutha + Jeevamrutha + Mulching recorded higher dry matter accumulation and were on par with the Jeevamrutha + Mulching (12.55 and 11.86 g plant^{-1}, respectively) and significantly lower dry weight was registered (9.17 g plant^{-1}) with control at 75 DAS. At harvest, significantly higher dry matter accumulation was noticed in Beejamrutha + Jeevamrutha + Mulching (13.35 g plant^{-1}) followed by Beejamrutha + Jeevamrutha (12.15 g plant^{-1}). Significantly lower dry matter accumulation per plant was recorded with control (9.81 g plant^{-1}). Conspicuous differences in the seed yield per hectare were noticed due to different natural farming treatments. Significantly higher seed yield of black gram per hectare was noticed with Beejamrutha + Jeevamrutha + Mulching (9.75 q ha^{-1}) followed by Beejamrutha + Jeevamrutha (8.65 q ha^{-1}), Jeevamrutha + Mulching (8.51 q ha^{-1}), and Beejamrutha + Mulching (8.35 q ha^{-1}). Significantly lower seed yield was recorded with control (4.94 q ha^{-1}). The impact of natural farming treatments on straw yield of black gram was found to be significant. Beejamrutha + Jeevamrutha + Mulching resulted in significantly higher straw yield (27.01 q ha^{-1}) as compared to all the other treatments which was on par with Beejamrutha + Jeevamrutha (26.18 q ha^{-1}), Jeevamrutha + Mulching (25.45 q ha^{-1}) and Beejamrutha + Mulching (24.68 q ha^{-1}). Significantly lower straw yield reported in control (15.88 q ha^{-1}). The natural farming practices markedly influenced the biological yield of black gram. Beejamrutha + Jeevamrutha + Mulching (36.76 q ha^{-1}) and Beejamrutha + Jeevamrutha (34.83 q ha^{-1}) and Jeevamrutha + Mulching (33.96 q ha^{-1}), being on par produced significantly higher biological yield over control (20.82 q ha^{-1}). The impact of natural farming treatments on harvest index was found to be non significant. However, numerically higher harvest index (26.52%) was recorded with the Beejamrutha + Jeevamrutha + Mulching as compared to other treatments.

5. Conclusion

Findings of the experiment revealed that the growth and yield of black gram was found significantly higher with the application Beejamrutha + Jeevamrutha + Mulching treatment. Thus, on the basis of experimental results it can be concluded that for higher productivity of blackgram Beejamrutha + Jeevamrutha + Mulching is advisable.

6. References

1. Boraiah. Effect of organic liquid formulations and manures on growth and yield of capsicum. *Ph.D. Thesis* (*Unpub.*), Univ. Agric. Sci., Bangalore, Karnataka, India 2013.
2. Kasbe SS, Mukund Joshi, Bhaskar S. Characterization of farmer's jeevamrutha formulations with respect to Aerobic rice. Mysore J. Agric. Sci 2009;43(3):570-573.
3. Kumar R, Tomar GS, Kumawat N, Singh SP. Effect of varieties, plant density and molybdenum on yield and economics of black gram under rainfed condition of Chhattisgarh. International Journal of Chemical Studies 2018;6(1):1867-1870.
4. Mahilane C, Singh V. Effect of Zinc and Molybdenum on growth, yield attributes, yield and protein in Grain on Summer Black gram (*Vigna mungo* L.). International Journal of Current Microbiology and Applied Sciences 2018;7(1):1156-1162.
5. Siddappa, Use of jeevamrutha and farm yard manure on growth and yield of field bean (*Dolichos lablab* L.). *M.Sc. (Agri.) Thesis* submitted to University of Agricultural Sciences, Bangalore, Karnataka, India 2015.
6. Siddappa, Murali K, Devakumar N. Organically grown field bean (*Lablab purpureus V*ar. *lignosus*) using jeevamrutha and farm yard manure. *National. Conf. on Sust. And Self-Sufficient Production of Pulses through an Integrated Approach*, Bengaluru 2016, 105
7. Yogananda SB, Devakumar N, Shruti MK, Ningaraju. Growth and yield of cowpea as influenced by different sources of organic manures, *National. Symp.* Org. Agric. for Sust. Food Sec. Challenges and Opp., Tamil Nadu, India 2015, 113.