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SP Patel
Department of Agronomy, C. P. College of Agriculture, S.D.A.U., Sardarkrushinagar, Gujarat, India

SH Malve
Scientist, Krushi Vigyan Kendra, S.D.A.U., Deesa, Gujarat, India

MH Chavda
Department of Agronomy, C. P. College of Agriculture, S.D.A.U., Sardarkrushinagar, Gujarat, India

YB Vala
Young Professional-II, Krushi Vigyan Kendra, S.D.A.U., Deesa, Gujarat, India

Corresponding Author
SP Patel
Department of Agronomy, C. P. College of Agriculture, S.D.A.U., Sardarkrushinagar, Gujarat, India

Effect of *Panchagavya* and *Jeevamrut* on growth, yield attributes and yield of summer pearl millet

SP Patel, SH Malve, MH Chavda and YB Vala

Abstract
A field experiment was conducted during the summer season of 2020 at Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat to assess the effect of *panchagavya* and *jeevamrut* on growth, yield attributes and yield of summer pearl millet. The result of study revealed that, application of 75% RDN + foliar spray of *panchagavya* @ 4% + *jeevamrut* @ 500 liter/ha with irrigation at 30 & 45 DAS (T_{10}) registered significantly higher growth parameters like plant height, dry matter accumulation per plant at harvest, CGR, RGR; yield attributes like effective tiller per plant (10.27), length of earhead (25.08 cm), girth of earhead (10.27 cm), grain weight per earhead (12.98 g), 1000 grain weight (8.03 g) and grain yield (4393 kg/ha) and straw yield (7567 kg/ha) of summer pearl millet.

Keywords: pearl millet, *Panchagavya*, *Jeevamrut*, grain yield and straw yield

Introduction
Pearl millet (*Pennisetum glaucum* L.) is one of the major cereal crop grown in the arid and semi-arid regions of the world. Among the major food grain crops of India, pearl millet ranks fourth in the acreages, next to rice, wheat and sorghum. In India, pearl millet is popularly known as '*bajra*' or '*bajri*' is an important staple food. It is also grown in the Africa and Asia. It occupies an important place in the daily diet of many classes particularly middle and poor class families due to low priced grain in India, particularly Gujarat, Rajasthan, Madhya Pradesh, Haryana, Maharashtra and Uttar Pradesh where it is grown corporately on a large scale. It is an important drought hardy millet crop and adapted to production systems in region, characterized by drought, low soil fertility and high temperature.

The modern agriculture is dependent on heavily chemical fertilizer to meet the demands of ever-increasing population. Continuous use of inorganic fertilizers hazards the soil health in respect of physical, chemical and biological properties of soil. The population of beneficial organisms decrease and natural regeneration of nutrition in the soil cease causes soil becomes barren and unfertile. Therefore, it is necessary to minimize the application of inorganic fertilizers by substituting with organic inputs. It is well established that the improvement of quality and productivity of the crops either food grain, oilseed or fruit crop could be made possible with combined application of organic manure and balanced chemical fertilizers. This eventually, leads to high demand for integrated nutrient management (INM) which will be continuously improving soil productivity on long term basis through appropriate use of fertilizers along with liquid organic manure. Organic farming in recent years is gaining impetus due to realization of inherent advantages. It confers in sustaining crop production and also maintaining dynamic soil nutrient status and safe environment (Lokanath and Parameshwarappa, 2006) [7].

The use of fermented liquid organic manure or Bio-enhancer like *panchagavya* and *jeevamrut* are cheaper eco-friendly preparations made from cow products namely dung, urine, milk, curd and ghee. The *panchagavya* is an efficient plant growth stimulant that enhances the biological efficiency of crops. It is used to activate soil and to protect the plants from diseases and also increase the nutritional quality of fruits and vegetables. It is used as a foliar spray, as soil application along with irrigation water, seed or seedling treatment etc. Three per cent *panchagavya* is an ideal concentration for the foliar spray. Bio- chemical properties of *panchagavya* revealed that it possesses almost all the major nutrients like N, P, K and micro nutrients essential for plant and growth hormones like IAA and GA required for crop growth (Selvaraj *et al.*, 2007) [12].

Effect of *panchagavya* on seed germination, seedling length, seedling vigour index and significantly highest germination percentage (99%) was noticed in the seeds treated with bacterial culture which isolated from *panchagavya*. Likewise, *jeevamrut* also rich in various microorganisms like *Azospirillium*, PSM, pseudomonas, trichoderma, yeast and mould which promotes immense biological activity in soil and makes the nutrients available to crop (Devakumar *et al.*, 2008) [13]. Sreenivasa *et al.* (2010) [15] reported the presence of many beneficial microorganisms *viz*., nitrogen fixers, phosphorus solubilizers, actinomycetes and fungi in *panchagavya* and *jeevamruth*. Use of Liquid manures results in increase in soil microbial activity and microbial biomass. The application of liquid organic inputs like *panchagavya* and *jeevamrut* results in increase in number of beneficial microbes and also shows profound effect on soil enzymic activity. Thus, they enhance the growth of crop and can help in sustaining of safe environment and crop productivity.

Material and Methods

A field experiment was conducted at the Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar during summer season of the year 2020. The experiment was laid out in a randomised block design with 3 replication, consisted of ten treatments *viz.*, T_1: Control (100% RDN), T_2: 75% RDN + foliar spray of *panchagavya* @ 4% at 30 DAS, T_3: 75% RDN + foliar spray of *panchagavya* @ 4% at 45 DAS, T_4: 75% RDN + foliar spray of *panchagavya* @ 4% at 30 & 45 DAS, T_5: 75% RDN + *jeevamrut* @ 500 liter/ha with irrigation at 30 DAS, T_6: 75% RDN + *jeevamrut* @ 500 liter/ha with irrigation at 45 DAS, T_7: 75% RDN + *jeevamrut* @ 500 liter/ha with irrigation water at 30 & 45 DAS, T_8: 75% RDN + foliar spray of *panchagavya* @ 4% + *jeevamrut* @ 500 liter/ha with irrigation at 30 DAS, T_9: 75% RDN + foliar spray of *panchagavya* @ 4% + *jeevamrut* @ 500 liter/ha with irrigation at 45 DAS, T_{10}: 75% RDN + foliar spray of *panchagavya* @ 4% + *jeevamrut* @ 500 liter/ha with irrigation at 30 & 45 DAS. Soil was sandy loam in texture with low in nitrogen and medium in phosphorous and potash. Pearl millet variety GHB-732 was selected and sown on 20th February. The crop was sown manually at a spacing of 45 cm row to row using seed rate of 3.75 kg/ha. The recommended dose of fertilizers (N: P_2O_5: K_2O, 120: 60: 00). Full dose of phosphorus and half dose of nitrogen were applied before sowing and remaining half dose of the nitrogen was top dressed in two equal splits at 30 and 50 DAS. Foliar application of *panchagavya* @ 4% and soil application of *jeevamrut* @ 500 liter/ha along with irrigation was done at 30 and 45 DAS of pearl millet crop and chemical fertilizers were applied in furrows. Observation on plant growth, yield attributes and yield were recorded as per standard procedure. Economics was worked out on the basis of prevailing market prices of inputs and output obtained from each treatment. The data were statistically analyzed for various characters as described by Gomez and Gomez (1984) [3].

Results and Discussion

Growth parameters

It is evident from the data presented in Table 1.0 that the growth parameters like plant height and dry matter accumulation of pearl millet was significantly influenced by *panchagavya* and *jeevamrut* treatment. Significantly highest plant height (198.62 cm) and dry matter accumulation ((85.78 gm) at harvest was recorded with T_{10} treatment *i.e*., 75% RDF + foliar spray of *panchagavya* @ 4% + *jeevamrut* @ 500 liter/ha with irrigation at 30 & 45 DAS. However, it was found to be significantly at par with (T_1) 100% RDF (157.06 and 186.82 cm) and (T_7) 75% RDN + *jeevamrut* @ 500 liter/ha with irrigation at 30 & 45 DAS (151.52 and 184.08 cm), respectively.

Significant increase in plant height and dry matter accumulation of pearl millet might be due to the availability of small quantities of macronutrients, micronutrients and growth promoting substances in addition to huge beneficial microbial population in *panchgavya* and *jeevamrut*, thus when applied to the crop as foliar spray and through soil they trigger the necessary plant growth. Moreover, liquid bio-enhancer avail favourable influence of nitrogen to produce larger cells with thinner cell walls and its contribution in cell division and cell elongation, which promoted vegetative growth and ultimately increased plant height and improved the metabolic and photosynthetic activity for enhancing biological efficiency of plant which helps the roots to spread into deeper layer of soil so that it can uptake more nutrients from soil cause there by accumulation of more carbohydrates and higher dry matter (Upperi *et al.*, 2009) [16]. These results corroborate with the findings of Shubha *et al.* (2014) [13], Ramesh *et al.* (2015) [11], Siddappa *et al.* (2016) [14], Yadav *et al.* (2017) [18] and Gowda *et al.* (2018) [4].

In case of CGR, application of 75% RDN + foliar spray of *panchagavya* @ 4% + soil application of *jeevamrut* 30 & 45 DAS (T_{10}) recorded significantly highest CGR (36.62 g/m^2/day) and it was at par with treatment (T_1) 100% RDF (32.77 g/m/day). As CGR represents dry matter production/unit area over a period of time and it is considered as the most meaningful growth function. CGR of pearl millet crop has a significant relation with fertilization as in most plants nutrient was essential for healthy and vigorous growth which in turn help the plants to absorb water and light more efficiently resulted in taller plants, higher leaf area index ultimately to more number of tillers, higher dry matter production and higher CGR. Higher CGR in the in treatment in which liquid bio-enhancer (*panchagavya* and *jeevamrut*) applied at 30 and 45 DAS causes better growth of plant and higher production of dry matter. Addition of the *panchagavya* and *jeevamrut* improved the physical, chemical and biological properties of soil and this leads to improve the root growth and development of fresh leaves. Due to combined application of *panchagvya* as spray and *jeevamrut* through irrigation improved the metabolic and photosynthetic activity for enhancing biological efficiency of plant which helps the roots to spread into deeper layer of soil so that it can uptake more nutrients from soil cause there by accumulation of more carbohydrates and higher dry matter. Similar observations were made by Katyal *et al.* (2003) [5] and Upperi *et al.* (2009) [17]. Further, Highest RGR (0.0954 g/g/day) was recorded with 75% RDN + foliar spray of *panchagavya* @ 4% at 45 DAS (T_3) The decrease in RGR is being attributed for several reasons *viz.*, increase in non-photosynthetic biomass (roots and stems), the top leaves of a plant begin to shade lower leaves and soil nutrients can become limiting. Overall, respiration scales with total biomass, but photosynthesis only scales with photosynthetic biomass and as a result biomass accumulates more slowly as total biomass increases. Similar observations were made by Paine *et al.* (2012) [10].

Yield attributes

Yield attributes *viz*., effective tillers per plant (2.62), length of

earhead (25.08 cm), girth of earhead (10.27 cm), grain weight per earhead (12.98 g) and test weight (8.03 g) were significantly higher with 75% RDF + foliar spray of *panchagavya* @ 4% + *jeevamrut* @ 500 liter/ha with irrigation at 30 & 45 DAS spray (T_{10}). However, effective tillers per plant and length of earhead was significantly at par with T_1, T_7 and T_8 and girth of earhead, grain weight per earhead and test weight was significantly at par with T_1 and T_7, respectively. Significant increased in number of effective tiller/plant with T_{10} treatment due to increased in availability of all macro and micronutrients through *jeevamrut* coupled with foliar nutrition through *panchagavya* resulted better nutrient availability over a long period, have a positive effect on growth parameters like root growth, plant height, dry matter production and which might have resulted in better tillering. The *panchagavya* and *jeevamrut* is an efficient plant growth stimulant that enhances the biological efficiency of crops and promotes immense biological activity in soil and makes the nutrients available to crop. Application of these organic liquid formulations enhanced the soil microbial activity and population to a greater extent and helpful in phosphate solubilization, nitrogen fixation etc. This in turn has a positive effect on growth due to steady and continues supply of nutrient throughout the entire crop growth period cause higher length and girth of of earhead. Further *panchagavya* and *jeevamrut* also help in proper filling of grains and test weight with photosynthates likely to occur due to steady and continuous supply of N through bio-enhancer throughout the entire crop growth period due to gradual transformation and mineralization of organics, solubilization of water insoluble P compounds by organic acids released in greater extent and P availability to crop coupled with higher native K availability might have played a key role in ensuring superior yield attributes. These results corroborate the findings of Kumar *et al.* (2011) [6], Shubha *et al.* (2014) [13], Ramesh *et al.* (2015) [11] and Chongre *et al.* (2019) [2].

Grain and straw yield

Significantly highest grain (4393 kg/ha) and straw yield (7567 kg/ha) of pearl millet was recorded with T_{10} treatment *i.e.*, 75% RDF + foliar spray of *panchagavya* @ 4% + *jeevamrut* @ 500 liter/ha with irrigation at 30 & 45 DAS spray. However, it was found to be significantly at par with (T_1) 100% RDF and (T_7) 75% RDN + *jeevamrut* @ 500 liter/ha with irrigation at 30 & 45 DAS, respectively. Significantly higher grain and straw yield of pearl millet under T_{10} treatment could be traced due to the beneficial effect of *jeevamrut* cause more vigorous and extensive root system of crop leading to increased vegetative growth means for more efficient sink formation and greater sink size, greater carbohydrate translocation from vegetative plant parts to the grains and higher dry matter accumulation during grain filling period. It also increased biological efficiency of crop plants and enhanced the level of soil enzymes activities and promoted the recycling of soil nutrients in the ecosystem, improve the absorptive power of cations and anions present on soil particle and that may be released slowly during the crop growth and improvement in soil structure to existence of favourable nutritional environment under the influence of organic liquid manures which had a positive effect on vegetative and reproductive growth which ultimately led to realization of higher values for growth attributes leading to higher yield of crop. Moreover, the IAA and GA present in *panchagavya* when applied as foliar spray could have created stimuli in the plant system and increased the production of growth regulators in cell system and the action of growth regulators in plant system ultimately stimulated the necessary growth and development. Similar findings were also reported by Balakumbahan *et al.* (2010) [1] and Kumar *et al.* (2011) [6].

Economics

The economics parameters for pearl millet were calculated and presented in Table 3. Maximum gross realization value of ₹104609/ha was obtained with application of 75% RDN + foliar spray of *panchagavya* @ 4% + *jeevamrut* @ 500 liter/ha with irrigation at 30 & 45 DAS (T_{10}) closely followed by T_1 treatment (100% RDN) and T_7 treatment (75% RDN + *jeevamrut* @ 500 liter/ha with irrigation at 30 & 45 DAS). However, maximum net realization and BCR was achieved in 100% RDN (T_1) followed by 75% RDN + *jeevamrut* @ 500 liter/ha with irrigation at 30 & 45 DAS (T_7) and foliar spray of *panchagavya* @ 4% + *jeevamrut* @ 500 liter/ha with irrigation at 30 & 45 DAS (T_{10}). The higher value in these treatments might be due to higher production also registered highest gross realization of summer pearl millet with *panchagavya* and *jeevamrut* treatment. While in case of net realization, highest net realization was observed in treatment (T_1) 100% RDF due to optimum grain and straw yield of pearl millet crop and low cost of cultivation as compared to other treatments. These results corroborate the findings of Manjunatha *et al.* (2009) [8] and Siddappa (2016) [14].

Table 1: Effect of *panchagavya* and *jeevamrut* on growth parameters of summer pearl millet

Treatments	Plant height at harvest (cm)	Dry matter/plant at harvest (g)	CGR ($g/m^2/day$)	RGR (g/g/day)
T_1: Control (100% RDN)	186.82	78.03	32.77	0.0931
T_2: 75% RDN + foliar spray of *panchagavya* @ 4% at 30 DAS	159.46	66.83	22.26	0.0637
T_3: 75% RDN + foliar spray of *panchagavya* @ 4% at 45 DAS	156.44	67.13	21.98	0.0954
T_4: 75% RDN + foliar spray of *panchagavya* @ 4% at 30 & 45 DAS	160.58	67.73	26.27	0.0685
T_5: 75% RDN + *jeevamrut* @ 500 liter/ha with irrigation at 30 DAS	166.50	69.08	25.72	0.0742
T_6: 75% RDN + *jeevamrut* @ 500 liter/ha with irrigation at 45 DAS	162.53	68.36	24.36	0.0721
T_7: 75% RDN + *jeevamrut* @ 500 liter/ha with irrigation at 30 & 45 DAS	184.08	77.70	28.57	0.0874
T_8: 75% RDN + foliar spray of *panchagavya* @ 4% + *jeevamrut* @ 500 liter/ha with irrigation at 30 DAS	174.33	73.04	26.90	0.0783
T_9: 75% RDN + foliar spray of *panchagavya* @ 4% + *jeevamrut* @ 500 liter/ha with irrigation at 45 DAS	170.63	71.53	26.34	0.0780
T_{10}: 75% RDN + foliar spray of *panchagavya* @ 4% + *jeevamrut* @ 500 liter/ha with irrigation at 30 & 45 DAS	198.62	85.78	36.62	0.0607
S.Em.±	7.96	2.83	0.62	0.003
C.D.(P=0.05)	23.7	8.40	1.86	0.009
C.V.%	8.02	6.8	4.0	6.86

Table 2: Effect of *panchagavya* and *jeevamrut* on yield attributes, grain, straw yield and harvest index of summer pearl millet

Treatments	Effective tiller/ plant	Length of earhead (cm)	Girth of earhead (cm)	Grain weight /earhead (g)	Test weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest index (%)
T_1: Control (100% RDN)	10.10	24.02	10.10	12.86	7.75	4310	7486	36.54
T_2: 75% RDN + foliar spray of *panchagavya* @ 4% at 30 DAS	8.00	21.52	8.00	11.10	6.20	3533	6402	35.56
T_3: 75% RDN + foliar spray of *panchagavya* @ 4% at 45 DAS	7.80	20.99	7.80	11.06	6.00	3518	6313	35.78
T_4: 75% RDN + foliar spray of *panchagavya* @ 4% at 30 & 45 DAS	8.10	21.33	8.10	11.18	6.25	3550	6447	35.51
T_5: 75% RDN + *jeevamrut* @ 500 liter/ha with irrigation at 30 DAS	8.60	22.28	8.60	11.36	6.53	3640	6615	35.49
T_6: 75% RDN + *jeevamrut* @ 500 liter/ha with irrigation at 45 DAS	8.35	21.59	8.35	11.04	6.38	3635	6528	35.77
T_7: 75% RDN + *jeevamrut* @ 500 liter/ha with irrigation at 30 & 45 DAS	9.30	23.79	9.30	12.71	7.40	4265	7276	36.96
T_8: 75% RDN + foliar spray of *panchagavya* @ 4% + *jeevamrut* @ 500 liter/ha with irrigation at 30 DAS	9.00	23.41	9.00	11.44	7.00	3898	6643	36.98
T_9: 75% RDN + foliar spray of *panchagavya* @ 4% + *jeevamrut* @ 500 liter/ha with irrigation at 45 DAS	8.90	22.49	8.90	11.29	6.90	3753	6674	35.99
T_{10}: 75% RDN + foliar spray of *panchagavya* @ 4% + *jeevamrut* @ 500 liter/ha with irrigation at 30 & 45 DAS	10.27	25.08	10.27	12.98	8.03	4393	7567	36.73
S.Em.±	0.095	0.78	0.36	0.52	0.33	159	293	1.68
C.D.(P=0.05)	0.28	2.33	1.09	1.51	0.98	473	870	NS
C.V.%	7.1	6.0	7.2	7.6	8.4	7.17	7.5	8.1

Table 3: Economics of summer pearl millet as influence by *panchagavya* and *jeevamrut* treatments

Treatments	Gross realization (₹/ha)	Total cost of cultivation (₹/ha)	Net realization (₹/ha)	BCR
T_1: Control (100% RDN)	102942	38640	64302	2.66
T_2: 75% RDN + foliar spray of *panchagavya* @ 4% at 30 DAS	85712	39971	45741	2.14
T_3: 75% RDN + foliar spray of *panchagavya* @ 4% at 45 DAS	85039	39971	45068	2.13
T_4: 75% RDN + foliar spray of *panchagavya* @ 4% at 30 & 45 DAS	86195	41714	44481	2.07
T_5: 75% RDN + *jeevamrut* @ 500 liter/ha with irrigation at 30 DAS	88403	39044	49359	2.26
T_6: 75% RDN + *jeevamrut* @ 500 liter/ha with irrigation at 45 DAS	87892	39044	48848	2.25
T_7: 75% RDN + *jeevamrut* @ 500 liter/ha with irrigation at 30 & 45 DAS	101208	39859	61349	2.54
T_8: 75% RDN + foliar spray of *panchagavya* @ 4% + *jeevamrut* @ 500 liter/ha with irrigation at 30 DAS	92465	40787	51678	2.27
T_9: 75% RDN + foliar spray of *panchagavya* @ 4% + *jeevamrut* @ 500 liter/ha with irrigation at 45 DAS	90416	40787	49629	2.22
T_{10}:75% RDN + foliar spray of *panchagavya* @ 4% + *jeevamrut* @ 500 liter/ha with irrigation at 30 & 45 DAS	104609	42809	61800	2.44

Conclusion

In light of the results obtained from present investigation, It is concluded that summer pearl millet should be fertilized with 75% RDN along with apply *jeevamrut* @ 500 liter/ha with irrigation at 30 and 45 DAS or 75% RDN with foliar spray of *panchagavya* @ 4% and *jeevamrut* @ 500 liter/ha with irrigation at 30 & 45 DAS to obtain higher yield and net returns.

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