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Sayroj Lalani
Junagadh Agricultural
University, Junagadh, Gujarat,
India

Dr. VB Bhalu
Assistant Professor, Junagadh
Agricultural University,
Junagadh, Gujarat, India

Effect of various cow-based bio-enhancers and botanicals on yield, nutrient content, uptake and soil fertility after harvest in summer groundnut (*Arachis hypogaea* L.)

Sayroj Lalani and Dr. VB Bhalu

Abstract

A field experiment was conducted at Instructional Farm, Department of Agronomy, College of Agriculture, JAU, Junagadh to study the effect of various cow-based bio-enhancers (*Panchagavya*, *Jeevamrut*) and botanical (Banana Pseudostem sap, Seaweed extract) on summer groundnut (*Arachis hypogaea* L.) (Cv. TG-37A) in organic condition during summer season of 2019. The experiment results revealed that application *Panchagavya* as foliar spray @ 3% at 30 and 45 DAS + FYM 5 t/ha (T4) found superior in respect of the higher grain yield, straw yield, content and uptake of NPKS by pod & haulm, and total uptake of NPKS. It was found at par with treatment of FYM 10 t/ha + Biofertilizers (*Rhizobium*+ PSB + KSB) (T11), 100% RDF (T2). While higher organic carbon, bulk density and Available NPKS after harvest of the Summer Groundnut were recorded under the treatment of treatment (T12) FYM 10 t/ha but it was found statistically comparable with FYM 5 t/ha + Biofertilizers (*Rhizobium* + PSB + KSB) (T11), *Jeevamrut* @ 500 L/ha with irrigation at sowing, 30 and 45 DAS + FYM 5 t/ha (T6). However, significantly the lowest N, P, K and S content, uptake by pod and haulm, pod and haulm yield, organic carbon, bulk density and available NPKS after harvest was observed under control.

Keywords: Summer groundnut, cow-based bio-enhancers, botanicals, *Panchagavya*, *Jeevamrut*, bio-fertilizers banana pseudostem sap, Seaweed extract

Introduction

Organic farming is getting more popular nowadays, which accentuates shift from high volume production system to high value production system. Indiscriminate use of agro-chemicals during the last 5-6 decades has adversely affected the soil fertility, crop productivity, produce quality and particularly the environment. Organic farming in recent years is gaining impetus due to realization of inherent advantages as it confers in sustaining crop production and also in maintaining dynamic soil nutrient status and safe environment (Lokanath and Parameshwarappa, 2006) [10]. There is an urgent need to increase food production globally under shrinking land resources. Government of Gujarat declared “Gujarat Organic Farming Policy-2015” to support scientifically evolved organic farming practices for sustainable farming system along with the trustworthy marketing and supply chain of the produce with aim to promote technically sound, economically viable, environmentally non-degrading, and Socially acceptable use of natural resources in favour of organic agriculture.

Among the major groundnut growing states, Gujarat ranks first in area (1.76 M ha) and production (2.94 M tonne) with productivity of 1673 kg/ha (Anon., 2017) [2]. In the recent years, the area under summer groundnut (0.94 M ha) has increased due to assured higher profit and productivity as it is grown in area where assured irrigation water is available and less incidence of a biotic and abiotic stresses on the crop as compared to rainy season (Rana *et al.*, 2014) [14].

Cow is the backbone of Indian culture and rural economy also known as “*Kamdhenu*” and “*Gaumata*”. In India, organic farming was well developed during the past such as ‘*Vedas*’ which has specified use of ‘*Panchgavya*’ in agriculture. In Sanskrit, *Panchgavya* means the blend of five products obtained from cow namely dung, urine, milk, curd and ghee. Presence of naturally occurring, beneficial, effective microorganisms (EMO’s) in *Panchgavya* predominantly and lactic acid bacteria, yeast, actinomycetes photosynthetic bacteria and certain fungi besides beneficial and proven fertilizers such as *Acetobacter*, *Azospirillum* and *Phosphobacterium* were detected which have the beneficial effect especially in improving soil

Corresponding Author:
Sayroj Lalani
Junagadh Agricultural
University, Junagadh, Gujarat,
India

quality, growth and yield of crops (Selvaraj *et al.*, 2003) [19]. *Jeevamrut* is acidic (pH 4.92) in nature and good source of macro and micro nutrients i.e., N-2.38%, P-0.173%, K-0.280, Mg (ppm)-46, Cu (ppm)-51. *Jeevamrut* contain many vitamins, essential amino acid, growth promoting substances like indole acetic acid (IAA), gibberellins acid (GA) and beneficial microorganisms. Banana pseudostem sap and seaweed extract have been recommended by many agricultural universities. These products can be incorporated in organic farming module. Number of cow-based bio-enhancers like '*Bijamrut*', '*Jeevamrut*', '*Panchagavya*', '*Amrutpani*', '*Sanjivak*' etc. have been developed in different organic farming systems by innovative organic growers or associations and NGOs.

Very meagre scientific information is available regarding such use of such formulations especially for organic groundnut production in summer. Considering these points in view, the experiment was framed and conducted to test the efficacy of some cow-based bio-enhancers and botanicals for organic cultivation of summer groundnut.

Materials and Methods

A field experiment was conducted at Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh (Gujarat) in summer season of 2019. The soil of the experimental plot was clayey in texture and slightly alkaline in reaction with pH 8.19 and EC 0.34 ds/mand organic carbon 0.59%. The soil was low in available nitrogen (257.00 kg/ha), medium in available phosphorus (29.63 kg/ha), available potash (254.60 kg/ha) and available sulphur (17.5 mg/kg). The experiment comprising of 12 treatments viz., T₁-Absolute Control, T₂-100% RDF (25:50:50 NPK kg/ha), T₃-*Panchagavya* as foliar spray 3% at 30 and 45 DAS, T₄-*Panchagavya* as foliar spray 3% at 30 and 45 DAS + FYM 5 t/ha, T₅-*Jeevamrut* 500 L/ha with irrigation at sowing, 30 and 45 DAS, T₆-*Jeevamrut* 500 L/ha with irrigation at sowing, 30 and 45 DAS + FYM 5 t/ha, T₇- Banana pseudostem sap as foliar spray 1% at 30 and 45 DAS, T₈- Banana pseudostem sap as foliar spray 1% at 30 and 45 DAS + FYM 5 t/ha, T₉-Seaweed extract as foliar spray 3.5% at 30 and 45 DAS, T₁₀-Seaweed extract as foliar spray 3.5% at 30 and 45 DAS + FYM 5 t/ha, T₁₁-FYM 5 t/ha + Bio-fertilizers (*Rhizobium* + PSB + KSB), T₁₂-FYM 10 t/ha was laid out in randomized block design with three replications. The groundnut variety "TG-37A" was sown at 30 cm x 10 cm using seed rate of 120 kg/ha. The cow-based formulations were prepared on farm as per the procedure given by National Centre for Organic Farming, Ghaziabad (NCOF, 2006) [12]. Foliar spraying was done using knapsack sprayer with spray volume of 500 L/ha. The initially prepared and filtered solution of *Panchgavya* was sprayed on the crop foliage as per treatments. Similarly, *Jeevamrut* was applied on the soil 500 L/ha. The crop was raised as per organic standards in organically converted plot. Pest and disease protection measures were taken using organic or bio-pesticides.

***Panchagavya*:** Collect fresh cow dung (7 kg), mix it with ghee (1 kg) in the container using a wooden stick. Stirred it clockwise direction in a rhythmic motion. Left this mixture for three days. It was stirred twelve times in each direction once in the morning and once in the evening. After 3 days mix cow urine (10 litres) and water (10 litres) than kept it for 15 days with regular mixing both in morning and evening

hours. After 15 days mix cow milk (3 litres), cow curd (2 litres), tender coconut water (3 litres), jaggery (3 kg) and well ripened banana (12 no. without skin). Stir the contents with a wooden stick twice a day. After seven days, filter the product with a Khada or Terracot (TC) cloth and store it in closed containers (Pierce small holes in the cap of the containers to prevent bursting). This was diluted 300 ml/ 10 L water and sprayed.

Precaution: All the above items can be added to a wide mouthed earthen pot, concrete tank or plastic can as per the above order. Do not use a metal container. The container should be kept open under shade and it should not mix vigorously otherwise it will kill the beneficial microbes in cow dung. Care should be taken not to mix buffalo products. The products of local breeds of cow is said to have potency than exotic breeds. It should be covered with a wire mesh or plastic mosquito net to prevent houseflies from laying eggs and the formation of maggots in the solution. Store it in a place away from direct sun and rain.

***Jeevamrut*:** Take 200 liters capacity plastic drum and mix 10 kg of desi cow dung, 10 litres of cow urine, Mix well with the help of a wooden stick, add 2 kg of jaggery, 2 kg of pulse flour (gram, pigeon pea, greengram, cowpea or blackgram) and hand full of soil collected from rhizosphere of Banyan tree. The mixture was stirred well in clock wise direction and kept in shade covered with wet jute bag. Keep the solution aside for fermentation for two to seven days. Shake the solution regularly three times a day. The solution was regularly stirred clockwise in the morning, afternoon and evening for continuously 9 days and it was used for soil application.

Banana pseudostem sap: Banana *pseudostem* sap was acquired from Soil and Water Management Unit, Navsari Agricultural University, Navsari (Gujarat).

Seaweed extract: Seaweed extract (*Kappaphycus alvarezii*) was obtained from Fisheries Research Station, Junagadh Agricultural University, Okha (Devbhumi Dwarka). Foliar spraying was done using knapsack sprayer with spray volume of 500 L/ha.

Bio-fertilizers: *Rhizobium*, PSB and KSB were obtained from the Department of Plant Pathology, College of Agriculture, Junagadh Agricultural University, Junagadh. KSB was obtained from Navsari Agricultural University, Navsari.

Results and Discussion

Effect on crop yield

A close contemplation of data on pod yield and haulm yield revealed that different treatments significantly influenced the pod and haulm yields as given in (Table 1). Significantly the highest pod yield (1941 kg/ha) and haulm yield (2889 kg/ha) was recorded under application of *Panchagavya* as foliar spray 3% at 30 and 45 DAS + FYM 5 t/ha and it was statistically at par with FYM 10 t/ha, FYM 5 t/ha + Bio-fertilizers (*Rhizobium* + PSB + KSB), 100% RDF and *Jeevamrut* 500 L/ha with irrigation at sowing, 30 and 45 DAS + FYM 5 t/ha. However, significantly the lowest pod yield (1368 kg/ha) and haulm yield (2052 kg/ha) was observed under treatment control. Application of FYM with

Panchagavya increase the supply of easily assimilated major as well as micronutrients to plants, besides mobilizing unavailable nutrients into available form. Moreover, bio-fertilizers also perform better when soil is well supplied with nutrients particularly nitrogen and phosphorus. Enzymes present in cell leads to rapid growth and which turned out yield. The overall improvement of crop growth reflected into better source-sink relationship, which in turn to enhance the pod yield and haulm yield. The present findings are in close agreement with the results obtained by Sutar *et al.* (2018) [16] and Aher *et al.* (2019) [1].

Effect on content and uptake of nutrient by crop

A perusal of data (Table 1) showed that significantly the highest nitrogen content in pod (3.55%), phosphorus (0.29%), potassium (0.77%) and Sulphur (0.32%) was observed under the treatment *Panchagavya* as foliar spray @ 3% at 30 and 45 DAS + FYM 5 t/ha (T₄), which was found statistically at par with treatment FYM 10 t/ha + Biofertilizers (*Rhizobium* + PSB + KSB) (T₁₁), 100% RDF (T₂). Similarly, data revealed that different treatments imparted their significant influence on N, P, K & S content in haulm. Application of *Panchagavya* as foliar spray @ 3% at 30 and 45 DAS + FYM 5 t/ha (T₄) gave highest N content in haulm (1.47%), phosphorus (0.17%), potassium (0.81%) and Sulphur (0.26%). which was found statistically at par with treatment 100% RDF (T₂), FYM 10 t/ha + Biofertilizers (*Rhizobium* + PSB + KSB) (T₁₁), FYM 10 t/ha (T₁₂).

Nutrient accumulation in plant is function of nutrient concentration and dry matter accumulation. Application of plant nutrient through foliar application increases supply of plant nutrient in available form hence might be increased accumulation of dry matter by affecting root system. Dry matter which accumulates in above ground parts favours translocation of more carbohydrate towards developing roots which in enhanced the root volume and concomitantly increased content of more plant nutrients. Similar findings have been reported by Kanwar and Sharma (2014) [8] and Boraiah *et al.* (2015) [4].

An examination of data (Table 2) showed that significantly the highest nitrogen uptake by pod and haulm respectively (68.90 kg/ha, 42.46 g/ha), phosphorus (5.62 kg/ha, 4.91 kg/ha), potassium (14.94 kg/ha, 23.40 kg/ha) and Sulphur (6.21 kg/ha, 7.51 kg/ha) was observed under the treatment *Panchagavya* as foliar spray @ 3% at 30 and 45 DAS + FYM 5 t/ha (T₄), which was found statistically at par with treatment FYM 10 t/ha + Biofertilizers (*Rhizobium* + PSB + KSB) (T₁₁), 100% RDF (T₂) and *Jeevamrut* @ 500 L/ha with irrigation at sowing, 30 and 45 DAS + FYM 5 t/ha (T₆). On the contrary, the control (T₁) recorded significantly the lowest N, P, K & S content and uptake by pod and haulm. The combined application of *Panchagavya* along with enough bulk of FYM has always stimulated the uptake of nutrients partly because of stimulated microbes flush and improved root growth due to congenial soil physical condition. Cow urine rich in uric acid, a source of N was readily soluble in liquid form, one of the important compounds in *Panchagavya* directly influencing N content in leaves. Biofertilizer inoculations increase the numbers of such microorganisms in soil or rhizosphere and consequently improve the extent of microbiologically fixed nitrogen for plant growth. They are used either to fix nitrogen or to solubilize plant nutrients like phosphate. Phosphate solubilizing micro-organism (PSM) solubilizes the unavailable bound phosphate of the soil and makes them

available to plants which increase overall plant growth.

Among the different cow-based bio-enhancers, the highest total uptake of nitrogen (111.36 kg/ha), phosphorus (10.53 kg/ha), potassium (38.34 kg/ha) and sulphur (13.72 kg/ha) was observed under the treatment *Panchagavya* as foliar spray @ 3% at 30 and 45 DAS + FYM 5 t/ha (T₄) which was found statistically equivalent with treatment FYM 10 t/ha + Biofertilizers (*Rhizobium* + PSB + KSB) (T₁₁), 100% RDF (T₂) and *Jeevamrut* @ 500 L/ha with irrigation at sowing, 30 and 45 DAS + FYM 5 t/ha (T₆) among the botanicals, Seaweed extract as foliar spray @ 3.5% at 30 and 45 DAS + FYM 5 t/ha (T₁₀) and Banana sap as foliar spray @ 1% at 30 and 45 DAS + FYM 5 t/ha (T₈) recorded highest total uptake of N, P, K & S. On the opposite, significantly lowest total uptake of N (58.00 kg/ha), phosphorus (4.10 kg/ha), potassium (21.33kg/ha) and sulphur (5.80 kg/ha) was recorded with treatment control (T₁).

Application of N fixing biofertilizers enhances the soil N and PSB produces the organic acids which may partly be responsible for quick release of nutrients which resulted into more content of nutrients. Thus, improvement in uptake of N, P, K and S might be attributed to their respective higher concentration in pod and haulm and associated with higher pod and haulm yields. The increased uptake of the nutrients was due to added supply of nutrient and well developed root system resulting in better absorption of water and nutrients. This might also be attributed to better availability of nutrients in the soil under these treatments. Seaweed extract act as biostimulants mainly due to presence of plant hormones like auxin, cytokinins, gibberellins which ultimately helps in nutrient uptake by pod and haulm.

Nutrient status of soil after harvest of the crop

Post-harvest soil fertility analysis discovered that cow-based bio-enhancers and botanicals treatments significantly affected the available NPKS, organic carbon and bulk density of soil. (Table 3). Significantly the highest available nitrogen (280.0 kg/ha), phosphorus (40.31 kg/ha), potash (250.20 kg/ha), sulphur (30.62 mg/kg), organic carbon (0.73%) and lower bulk density(1.26 Mg/m³) were recorded with Application of *Jeevamrut* @ 500 L/ha with irrigation at sowing, 30 and 45 DAS + FYM 5 t/ha (T₆) Which was found statistically correspondent with treatment FYM 10 t/ha + Biofertilizers (*Rhizobium* + PSB + KSB) (T₁₁), 100% RDF (T₂) over the control. *Jeevamrut* contain effective microorganisms (EMO) are the mixed culture of naturally occurring beneficial microbes predominantly lactic acid bacteria (*Lactobacillus*), yeast (*Saccharomyces*), actinomycetes (*Streptomyces*), photosynthetic bacteria (*Rhodospirillum rubrum*) certain fungi (*Aspergillus*). Addition to this carbon dioxide and organic acids released during the process of decomposition of FYM which increase the availability of nutrients. This was possible because of enrichment of soil, ultimately reduced the bulk density and also, increased organic carbon by direct addition of organic matter through FYM. The results of present investigation are in close agreements with the findings of Choudhary *et al.* (2017) [5], Patel *et al.* (2018) [13] in respect of *Panchagavya*, Chandrakala (2008) [6], Laharia *et al.* (2013) [9] in respect of *Jeevamrut*, Mathukia *et al.* (2015) [11], respect of FYM, Zalate and Padmani (2010) [20] and Singh *et al.* (2013) [18] in respect of biofertilizer. Elumalai and Rengasamy, (2012) [7], Shankar *et al.* (2015) [17] and Singaravel *et al.* (2019) [15] in respect of seaweed extract.

Table 1: Effect of different treatments on yield and nutrient content in pod and haulm in summer groundnut

Treatments	Pod yield (kg/ha)	Haulm yield (kg/ha)	N content (%)		P content (%)		K content (%)		S content (%)	
			Pod	Haulm	Pod	Haulm	Pod	Haulm	Pod	Haulm
T ₁ : Control	1368	2052	2.53	1.14	0.18	0.08	0.63	0.62	0.20	0.15
T ₂ : 100% RDF	1830	2750	3.43	1.44	0.26	0.16	0.74	0.79	0.26	0.20
T ₃ : <i>Panchagavya</i> as foliar spray 3% at 30 and 45 DAS	1686	2535	2.90	1.27	0.21	0.11	0.68	0.70	0.25	0.19
T ₄ : <i>Panchagavya</i> as foliar spray 3% at 30 and 45 DAS + FYM 5 t/ha	1941	2889	3.55	1.47	0.29	0.17	0.77	0.81	0.32	0.26
T ₅ : <i>Jeevamrut</i> 500 L/ha with irrigation at sowing, 30 and 45 DAS	1733	2548	2.90	1.24	0.21	0.11	0.66	0.68	0.24	0.18
T ₆ : <i>Jeevamrut</i> 500 L/ha with irrigation at sowing, 30 and 45 DAS + FYM 5 t/ha	1801	2782	3.34	1.42	0.25	0.16	0.72	0.78	0.32	0.23
T ₇ : Banana sap as foliar spray 1% at 30 and 45 DAS	1669	2480	2.76	1.20	0.19	0.11	0.66	0.65	0.23	0.17
T ₈ : Banana sap as foliar spray 1% at 30 and 45 DAS + FYM 5 t/ha	1780	2724	3.15	1.32	0.24	0.15	0.68	0.75	0.28	0.23
T ₉ : Seaweed extract as foliar spray 3.5% at 30 and 45 DAS	1608	2427	2.61	1.19	0.19	0.10	0.65	0.65	0.21	0.16
T ₁₀ : Seaweed extract as foliar spray 3.5% at 30 and 45 DAS + FYM 5 t/ha	1753	2697	3.22	1.39	0.25	0.15	0.70	0.77	0.29	0.21
T ₁₁ : FYM 5 t/ha + Bio-fertilizers (<i>Rhizobium</i> + PSB + KSB)	1870	2804	3.50	1.44	0.28	0.17	0.75	0.80	0.31	0.25
T ₁₂ : FYM 10 t/ha	1735	2553	3.03	1.30	0.23	0.15	0.69	0.72	0.30	0.24
C.D. at 5%	206	338	0.31	0.18	0.05	0.02	0.084	0.114	0.04	0.03

Table 2: Effect of different treatments on total nutrient uptake of summer groundnut

Treatments	N uptake (%)		P uptake (%)		K uptake (%)		S uptake (%)		Total uptake of nutrient (kg/ha)			
	Pod	Haulm	Pod	Haulm	Pod	Haulm	Pod	Haulm	N	P	K	S
T ₁ : Control	34.61	23.39	2.46	1.64	8.61	12.72	3.48	3.45	58.00	4.10	21.33	5.80
T ₂ : 100% RDF	62.76	39.60	4.75	4.40	13.54	21.72	5.88	5.30	102.36	9.15	35.26	10.25
T ₃ : <i>Panchagavya</i> as foliar spray 3% at 30 and 45 DAS	48.89	32.19	3.54	2.78	11.46	17.74	5.57	5.00	81.08	6.32	29.20	9.02
T ₄ : <i>Panchagavya</i> as foliar spray 3% at 30 and 45 DAS + FYM 5 t/ha	68.90	42.46	5.62	4.91	14.94	23.40	7.37	8.00	111.36	10.53	38.34	13.72
T ₅ : <i>Jeevamrut</i> 500 L/ha with irrigation at sowing, 30 and 45 DAS	50.25	31.59	3.63	2.80	11.43	17.32	5.42	4.65	81.84	6.43	28.75	8.73
T ₆ : <i>Jeevamrut</i> 500 L/ha with irrigation at sowing, 30 and 45 DAS + FYM 5 t/ha	60.15	39.50	4.50	4.45	12.96	21.69	6.60	7.17	99.65	8.95	34.65	12.15
T ₇ : Banana sap as foliar spray 1% at 30 and 45 DAS	46.06	29.76	3.17	2.72	11.01	16.12	5.20	4.18	75.82	6.43	27.13	8.04
T ₈ : Banana sap as foliar spray 1% at 30 and 45 DAS + FYM 5 t/ha	56.07	35.95	4.27	4.08	12.10	20.43	6.45	7.10	92.02	8.35	32.53	11.24
T ₉ : Seaweed extract as foliar spray 3.5% at 30 and 45 DAS	41.96	28.88	3.05	2.42	10.45	15.77	4.21	4.06	70.84	5.47	26.22	7.25
T ₁₀ : Seaweed extract as foliar spray 3.5% at 30 and 45 DAS + FYM 5 t/ha	56.44	37.48	4.38	4.04	12.27	20.76	6.09	5.46	93.92	8.42	33.03	10.74
T ₁₁ : FYM 5 t/ha + Bio-fertilizers (<i>Rhizobium</i> + PSB + KSB)	65.45	40.37	5.23	4.76	14.02	22.43	7.01	7.87	105.82	9.99	36.45	12.89
T ₁₂ : FYM 10 t/ha	52.57	33.18	3.99	3.82	11.97	18.38	6.89	7.21	85.75	7.81	30.35	11.32
C.D. at 5%	12.68	8.23	0.73	0.84	3.00	5.15	1.05	0.99	20.18	1.64	6.43	2.64

Table 3: Effect of different treatments on available NPK, organic carbon and bulk density of soil after harvest of crop in summer groundnut

Treatments	Available nutrients (kg/ha)			S (mg/kg)	Bulk density (Mg/m ³)	OC (%)
	N	P ₂ O ₅	K ₂ O			
T ₁ : Control	185.40	26.71	202.40	17.01	1.49	0.62
T ₂ : 100% RDF	266.50	37.10	235.30	23.20	1.48	0.69
T ₃ : <i>Panchagavya</i> as foliar spray 3% at 30 and 45 DAS	250.90	34.57	221.20	25.15	1.46	0.63
T ₄ : <i>Panchagavya</i> as foliar spray 3% at 30 and 45 DAS + FYM 5 t/ha	262.00	35.91	207.80	28.57	1.34	0.68
T ₅ : <i>Jeevamrut</i> 500 L/ha with irrigation at sowing, 30 and 45 DAS	234.80	29.11	236.70	22.20	1.33	0.60
T ₆ : <i>Jeevamrut</i> 500 L/ha with irrigation at sowing, 30 and 45 DAS + FYM 5 t/ha	280.00	40.31	250.20	30.62	1.31	0.66
T ₇ : Banana sap as foliar spray 1% at 30 and 45 DAS	253.20	31.83	220.70	24.43	1.47	0.63
T ₈ : Banana sap as foliar spray 1% at 30 and 45 DAS + FYM 5 t/ha	262.00	35.21	233.80	24.74	1.35	0.68
T ₉ : Seaweed extract as foliar spray 3.5% at 30 and 45 DAS	213.00	30.00	223.10	23.90	1.46	0.63
T ₁₀ : Seaweed extract as foliar spray 3.5% at 30 and 45 DAS + FYM 5 t/ha	252.10	33.28	229.40	25.30	1.42	0.64
T ₁₁ : FYM 5 t/ha + Bio-fertilizers (<i>Rhizobium</i> + PSB + KSB)	271.70	38.50	244.60	30.33	1.27	0.70
T ₁₂ : FYM 10 t/ha	251.60	36.71	214.40	28.03	1.26	0.73
C.D. at 5%	25.89	3.98	26.94	5.32	0.11	0.062

Conclusion

Based on one year field experimentation, it can be concluded that higher yield with nutrient content and uptake by summer groundnut (Cv. TG-37A) could be obtained with application of *Panchagavya* as foliar spray 3% at 30 and 45 DAS + FYM 5 t/ha or FYM 5 t/ha + Bio-fertilizers (*Rhizobium* + PSB +

KSB). While post harvest soil fertility i.e., highest available NPK, organic carbon and low bulk density of the soil after harvest recorded under Application of *Jeevamrut* @ 500 L/ha with irrigation at sowing, 30 and 45 DAS + FYM 5 t/ha under medium black calcareous clayey soil of South Saurashtra Agro-climatic Zone.

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