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Effect of various cow-based bio-enhancers and botanicals on quality, micro-nutrient content and microbial population in soil after harvesting of summer groundnut (*Arachis hypogaea* L.)

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Abstract

An experiment was carried out at certified organic plot, Instructional Farm, Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh during summer season of 2019 on medium black calcareous soil to study effect of various cow-based bio-enhancers and botanicals for organic cultivation of Summer Groundnut (*Arachis hypogaea* L.) (Cv. TG-37A). The experiment containing twelve treatments was arranged in randomized block design with three replications. The experimental results revealed that quality characters viz., 100 kernel weight, shelling percent, oil content and protein content significantly increased with application of *Panchagavya* as foliar spray @ 3% at 30 and 45 DAS + FYM 5 t/ha, it was statistically at par with 100% RDF, FYM 5 t/ha + Biofertilizers (*Rhizobium* + PSB + KSB), *Jeevamrut* @ 500 L/ha with irrigation at sowing, 30 and 45 DAS + FYM 5 t/ha. However, Micronutrients content, highest fungal, bacterial and actinomycetes population in soil noted under the treatment of FYM 5 t/ha + Biofertilizers (*Rhizobium* + PSB + KSB) which was found at par with *Jeevamrut* @ 500 L/ha with irrigation at sowing, 30 and 45 DAS + FYM 5 t/ha over control.

Keywords: *Arachis hypogaea* L., *Panchagavya*, *Jeevamrut*, banana pseudostem sap, Seaweed extract, microbial population

Introduction

The oilseeds sector has been one of the most dynamic components of world agriculture. Oilseeds are the second largest agricultural product after cereals in India. Groundnut is the 13th most important food crop and 4th most important oilseeds crop of the world. Multiple uses of groundnut make it an excellent cash crop for domestic markets as well as for foreign trade in several developing and developed countries. It is grown in about 24 M ha area with a total production of 35 M tonne under different agro-climatic zones between 40°S and 40°N (Anon., 2013) [1]. In India, it is cultivated on area of 5.33 M ha with production of 7.46 M tonne and productivity of 1398 kg/ha (Anon., 2017a) [2]. In India, about 75% of the groundnut area lies in a low to moderate rainfall zone (parts of peninsular region and western and central region) with a short period of distribution (90-120 days). Based on rainfall pattern, soil factors, diseases and pest situations, groundnut growing area in India has been divided into five zones. Currently six states viz., Gujarat, Andhra Pradesh, Karnataka, Tamil Nadu, Maharashtra and Rajasthan account for more than 90% of the total groundnut area and 89.3% of total groundnut production. Madhya Pradesh, Uttar Pradesh, Odisha and West Bengal are the other states having substantial area under this crop. 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., 2017b) [3]. 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) [11]. There is an ardent awareness worldwide in recent years on the excess use of inorganic fertilizers and other chemicals leading to environmental pollution and pest outbreaks. Principle of organic farming is to allow Mother Nature to provide us food the nature intended. Organic farming is all about producing healthy food and fiber without the use of synthetic agrochemicals while ensuring animal welfare and environment sustainability. *Panchgavya* had reverence in the scripts of Vedas (divine scripts of Indian wisdom) and Vrkshyurveda (Vrksha means plants and Ayurveda means health system). (Naresh *et al.*, 2018) [7].

Cow-based bio-enhancers, botanicals, organic manure and bio-fertilizer play important role in crop production. It acts on the soil physical properties, organic matter promotes formation of soil crumb, thus makes the soil friable and thereby, facilitates the proper movement of air and water as well as absorption of rain water. The *Panchagavya*, *Jeevamrut* and *Beejamrut* are cheaper ecofriendly organic preparations made by cow products namely dung, urine, milk, curd and ghee. The situation has been changed with depletion of fossil fuel, resulting in exorbitant cost of chemical fertilizers. The reduction in use of NPK fertilizers can be fulfilled by alternate options like bio-fertilizers. It is aimed to promote technically sound, economically viable, environmentally non-degrading and socially acceptable use of natural resources in favor of organic agriculture. In view of the above considerations and paucity of adequate research evidence, the present study was undertaken during summer season 2019 to determine the "Evaluation of some cow-based bio-enhancers and botanicals for organic cultivation of summer groundnut (*Arachis hypogaea* L.) Cv. TG- 37A at the Instructional Organic Farm, Department of Agronomy, Junagadh Agricultural University, Junagadh.

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. Geographically, Junagadh is situated at 21.5 °N latitude and 70.5° E longitude with an altitude of 60 m above the mean sea level. 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 x10 cm using seed rate of 120 kg/ha. The cow-based formulations were prepared on farm as per the modus operandi given by National Centre for Organic Farming, Ghaziabad (NCOF, 2006) [8]. 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*:** *Panchgavya* can be loosely translated as "Five products of cow". As the name suggests it uses five products

from cow and a few more natural ingredients for the fermentation process. 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 (Fig.1)



Fig 1: Preparation of *Jeevamrutha*

Banana pseudostem sap: Banana *pseudostem* sap was acquired from Soil and Water Management Unit, Navsari Agricultural University, Navsari (Gujarat) (Fig.2)

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 (Fig. 2).

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 (Fig. 2).



Fig 2: Botanicals and Biofertilizers used in experiment

Results and Discussion

Effect on quality

A close persual of data (Table: 1) on Significantly the highest 100 kernal weight (46.07 g), shelling percent (70.09%), oil content (49.20%) and protein content (22.18%) was recorded in treatment of *Panchagavya* as foliar spray @ 3% at 30 and 45 DAS + FYM 5 t/ha (T_4), which was found statistically at par with treatment 100% RDF (T_2), FYM 10 t/ha + Biofertilizers (*Rhizobium* + PSB + KSB) (T_{11}), *Jeevamrut* @ 500 L/ha with irrigation at sowing, 30 and 45 DAS + FYM 5 t/ha (T_6) and Banana sap as foliar spray @ 1% at 30 and 45 DAS + FYM 5 t/ha (T_8). In contrast, significantly the minimum was noted under control (T_1). The increased in kernel weight and shelling percent, this might be due to improvement in nutritional environment due to effect of treatment which might have favourably influenced carbohydrate metabolism which in turn increased the uptake of nutrients and ultimately resulted in increased kernel weight and shelling percent (Choudhary *et al.* 2017)^[4].

Effect on Micronutrient content in soil after harvesting of crop:

The data pertaining to DTPA-extractable zinc, iron, manganese and copper content of soil after harvest are presented in Table 1. Significantly the highest zinc content of (1.65 ppm), iron content (4.00 ppm), manganese content (3.20 ppm), copper content (0.357 ppm) was registered under the treatment of FYM 5 t/ha + Biofertilizers (*Rhizobium* + PSB + KSB) (T_{11}) which was statistically equivalence with *Jeevamrut* @ 500 L/ha with irrigation at sowing, 30 and 45 DAS + FYM 5 t/ha (T_6), *Jeevamrut* @ 500 L/ha with irrigation at sowing, 30 and 45 DAS (T_5), FYM 10 t/ha (T_{12}), Seaweed extract as foliar spray @ 3.5% at 30 and 45 DAS + FYM 5 t/ha (T_{10}). In respect to the organics, among the cow-

based bio-enhancers, the highest micronutrient content was observed under *Jeevamrut* @ 500 L/ha with irrigation at sowing, 30 and 45 DAS + FYM 5 t/ha (T_6) among the botanicals, Seaweed extract as foliar spray @ 3.5% at 30 and 45 DAS + FYM 5 t/ha (T_{10}) recorded the highest micronutrient content. Addition to this carbon dioxide and organic acids released during the process of decomposition of FYM which increase the availability of nutrients. These all might have contributed towards increased available status of soil with respect to these nutrients. The results of present investigation strongly support the findings of Palekar (2006)^[10].

Effect on Microbial population of soil

The data regarding fungal count, bacterial count and actinomycetes after harvest of the crop under the influence of different treatments are presented in Table 2. Significantly the highest fungal count $35.33 \text{ CFU} \times 10^{-4}$, bacterial count $96.00 \text{ CFU} \times 10^{-6}$, actinomycetes count $68.33 \text{ CFU} \times 10^{-5}$ was noted under the treatment of FYM 5 t/ha + Biofertilizers (*Rhizobium* + PSB + KSB) (T_{11}) which was found at par with *Jeevamrut* @ 500 L/ha with irrigation at sowing, 30 and 45 DAS + FYM 5 t/ha (T_6), FYM 10 t/ha (T_{12}). On the other hand, the treatment (T_{12}) control registered the lowest count. This results reflects that microbial population was higher in the treatment which received FYM and Biofertilizers, because the organic matter is the food of microbes and *Jeevamrut* it self contains large number of microbes and easily available food i.e. sugar, which is important for faster multiplication of microorganisms. The results are akin to those reported earlier by Deshpande *et al.* (2010)^[5] and Pareek and Yadav (2011)^[9] in respect to biofertilizer. Vasanthkumar (2006)^[12] and Manjunatha *et al.* (2007)^[6] in respect to *Jeevamrut*.

Table 1: Effect of different treatments on Quality parameters in summer groundnut.

Treatments	Test weight (g)	Shelling %	Oil content (%)	Protein content (%)	DTPA-extractable zinc (ppm)	DTPA-extractable iron (ppm)	DTPA-extractable manganese (ppm)	DTPA-extractable copper (ppm)
T ₁ : Control	39.39	61.35	43.73	15.48	1.20	2.63	2.62	0.183
T ₂ : 100% RDF	44.22	69.90	48.53	21.63	1.21	2.66	2.75	0.217
T ₃ : <i>Panchagavya</i> as foliar spray 3% at 30 and 45 DAS	41.64	65.63	45.23	18.12	1.41	3.00	2.75	0.256
T ₄ : <i>Panchagavya</i> as foliar spray 3% at 30 and 45 DAS + FYM 5 t/ha	46.07	70.09	49.20	22.18	1.46	3.07	2.94	0.283
T ₅ : <i>Jeevamrut</i> 500 L/ha with irrigation at sowing, 30 and 45 DAS	41.98	67.86	45.20	18.12	1.60	3.29	3.11	0.320
T ₆ : <i>Jeevamrut</i> 500 L/ha with irrigation at sowing, 30 and 45 DAS + FYM 5 t/ha	43.00	69.88	46.33	20.90	1.61	3.47	3.13	0.333
T ₇ : Banana sap as foliar spray 1% at 30 and 45 DAS	41.09	64.02	45.18	17.33	1.40	2.92	2.83	0.232
T ₈ : Banana sap as foliar spray 1% at 30 and 45 DAS + FYM 5 t/ha	42.79	69.02	47.53	18.93	1.43	3.00	2.90	0.266
T ₉ : Seaweed extract as foliar spray 3.5% at 30 and 45 DAS	40.84	62.35	44.30	17.47	1.33	2.70	2.89	0.222
T ₁₀ : Seaweed extract as foliar spray 3.5% at 30 and 45 DAS + FYM 5 t/ha	42.47	68.34	44.67	19.60	1.56	3.14	2.90	0.303
T ₁₁ : FYM 5 t/ha + Bio-fertilizers (<i>Rhizobium</i> + PSB + KSB)	43.55	69.82	48.33	21.90	1.65	4.00	3.20	0.357
T ₁₂ : FYM 10 t/ha	41.54	67.00	46.00	20.19	1.59	3.23	3.08	0.309
C.D. at 5%	3.28	5.98	3.51	2.00	0.20	0.54	0.24	0.051

Table 2: Effect of different treatments on total microbial count of soil after harvest of crop in summer groundnut

Treatments	Total fungal count (CFU x 10 ⁻⁴)	Total bacterial count (CFU x 10 ⁻⁶)	Total actinomycetes count (CFU x 10 ⁻⁵)
T ₁ : Control	24.00	63.67	52.00
T ₂ : 100% RDF	27.33	73.33	54.67
T ₃ : <i>Panchagavya</i> as foliar spray 3% at 30 and 45 DAS	26.00	69.33	54.00
T ₄ : <i>Panchagavya</i> as foliar spray 3% at 30 and 45 DAS + FYM 5 t/ha	31.67	91.00	60.00
T ₅ : <i>Jeevamrut</i> 500 L/ha with irrigation at sowing, 30 and 45 DAS	34.00	95.00	64.33
T ₆ : <i>Jeevamrut</i> 500 L/ha with irrigation at sowing, 30 and 45 DAS + FYM 5 t/ha	35.00	96.00	66.33
T ₇ : Banana sap as foliar spray 1% at 30 and 45 DAS	26.33	70.00	54.33
T ₈ : Banana sap as foliar spray 1% at 30 and 45 DAS + FYM 5 t/ha	30.67	86.00	59.33
T ₉ : Seaweed extract as foliar spray 3.5% at 30 and 45 DAS	25.00	67.67	53.67
T ₁₀ : Seaweed extract as foliar spray 3.5% at 30 and 45 DAS + FYM 5 t/ha	29.00	85.00	57.67
T ₁₁ : FYM 5 t/ha + Bio-fertilizers (<i>Rhizobium</i> + PSB + KSB)	35.33	96.33	68.33
T ₁₂ : FYM 10 t/ha	32.67	92.33	61.67
C.D. at 5%	4.75	11.40	8.66

Conclusion

Based on the experimental results, it seems quite analytical to conclude that higher quality characters along with improved micronutrient content and microbial population in Summer Groundnut (*Cv. TG-37A*) under organic farming can be secured by application of FYM 5 t/ha + Biofertilizers (*Rhizobium* + PSB + KSB) (T₁₁) which was found equivalence with *Jeevamrut* @ 500 L/ha with irrigation at sowing, 30 and 45 DAS + FYM 5 t/ha (T₆) and *Panchagavya* as foliar spray @ 3% at 30 and 45 DAS + FYM 5 t/ha on medium black calcareous clayey soil under South Saurashtra Agro-Climatic Zone.

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