International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2017; 5(6): 822-825
© 2017 IJCS
Received: 12-09-2017
Accepted: 15-10-2017

K Akhila
Department of Soil Science and Agricultural Chemistry, Navsari Agriculture University, Navsari, Gujarat, India

AR Kaswala
Department of Soil Science and Agricultural Chemistry, Navsari Agriculture University, Navsari, Gujarat, India

PK Dubey
Department of Soil Science and Agricultural Chemistry, Navsari Agriculture University, Navsari, Gujarat, India

Correspondence
K Akhila
Department of Soil Science and Agricultural Chemistry, Navsari Agriculture University, Navsari, Gujarat, India

Effect of liquid fertilizers on nutritional and cooking quality of organically grown green gram (*Vigna radiata*)

K Akhila, AR Kaswala and PK Dubey

Abstract
A field experiment on green gram consisting of twelve treatment combinations involving two varieties of green gram and different levels of liquid fertilizer in FRBD with three replications at Organic farm, NAU, Navsari was conducted during *Rabi* season of 2015-16. The significant variation was observed. Among the liquid fertilizer treatment L_2 (2% *Kappaphycus alverezii* seaweed sap) recorded significantly highest value of protein (19.01%) and carbohydrate (62.70%)in seed, P (0.28%), Fe (142.50mg/kg), Mn (16.83 mg/kg), Zn(40.50 mg/kg) content in stover and P(0.13%), K(0.97%), Fe(59.59 mg/kg), Mn(19.35 mg/kg) and Cu(6.83 mg/kg) content in green gram seed, and all these parameters are significantly at par with L_5 (1% enriched banana pseudostem) treatment. Variety V_1 (CO-4) recorded the significantly highest value of Mn content in stover (15.11 mg/kg) and seed (16.51 mg/kg). With respect to cooking quality the L_2 treatment secured highest swelling capacity (0.606 mL seed^{-1}) and least hydration index (6.089) with less cooking time (16.75 minutes) compared to other treatments.

Keywords: Organic farming, liquid fertilizers, nutritional quality and cooking quality of the crop

Introduction

Organic farming is a form of agriculture that developed from a desire to improve soil quality and the environment, which proving as remedy to cure the ills of modern agriculture. The demand of organic products increased day by day. Therefore, application of organic fertilizer has received great attention. Seaweeds are the several species of macroscopic multicellular marine algae with no true roots, stems and leaves, and they are one of the important marine living resources with tremendous commercial importance. The use of seaweed as fertilizer is important in the present day world as the seaweed fertilizers are often found to be more successful than the chemical fertilizers (Bokil *et al*., 1972) [3]. Liquid fertilizer, obtained from seaweed contains polysaccharide content, which is already broken down, becomes effective at once (Stephenson, 1974) [8]. The state-run Gujarat Livelihood Promotion Company (GPLC) has joined hands with Central Marine Research Institute (CSMCRI) to encourage seaweed cultivation along the state coast, which can be a source of livelihood for the local residence. Council for Scientific Research and CSMCRI has introduced the seaweed '*Kappaphycus alvarezii'* in India. Extract of seaweed *Kappaphycus alvarezii* has been found rich in micro & macronutrients and plant growth regulators like auxins and cytokinins which showed positive responses in different crops. In addition to seaweed, the sap extracted from banana pseudostem is also emerging liquid fertilizer. The Enriched Banana Pseudostem Sap (EBPS) is the value added product prepared from the pseudostem. EBPS contains several major & micro nutrients, plant growth regulators & this mixture is inoculated with different microbes like *Rhizobium*, *Azotobacter etc*., which play an important role in enhancing the crop yield. The green gram (*Vigna radiata*) is an important pulse crop in India after bengal gram & red gram, which is grown and consumed in India & it is the richest source of protein & it supplies part of protein requirement of vegetarian population in India. This study presents the foliar application of liquid fertilizer to determine improvement in quality of greengram.

Materials and Methods

The present study was conducted at Organic Farm, Navsari Agricultural University, Navsari during *Rabi* season 2015-16. The farm was converted in to organic during 2005, since then organic management practices are adopted to raise the crops. According to the soil taxonomy, the soil of the experiment field is classified under the order of 'Inceptisol', family of Vertic

Ustochrepts belong to Jalalpore series. The soil type was clayey, pH of the soil was 8.01, available N, P_2O_5 and K_2O were 172.48 kg/ha (low), 29.27kg/ha (medium) and 336.33 kg/ha (high), respectively and has sufficient cationic micronutrients content (DTPA extractable Fe, Mn, Zn and Cu). The experiment was laid out in a Factorial Randomized Block Design with 12 treatments replicated 3 times. Crop was fertilized @ 20 kg N ha^{-1} through NADEP compost as basal dose. Three replications were laid out, each of containing 12 plots. The treatments consisting 6 levels of liquid fertilizers *viz*. without any liquid fertilizers (control) (L_1), 2% *Kappaphycus alverezii* seaweed sap (L_2), 4% *Kappaphycus alverezii* seaweed sap (L_3), 6% *Kappaphycus alverezii* seaweed sap (L_4), 1% enriched banana pseudostem sap (EBPS) (L_5) and 2% enriched banana pseudostem sap (EBPS) (L_6) applied on two varieties of green gram *viz.* Co-4 and GBM-1. Three sprays of liquid fertilizer were applied at 27, 45 and 60 DAS. The total nitrogen content from seed was determined by Chromic acid method as described by Jackson (1973) [6]. The protein content of seed was computed by multiplying the total nitrogen content (%) in seed with the factor 6.25 for each treatment (Bhuiya and Chowdhary, 1974) [4]. Carbohydrate content (%) of dried and powdered seed samples was estimated in Autoanalyzer using Anthrone reagent method. Cooking quality Swelling capacity and swelling index the volume of 100 g of seeds was predetermined using a graduated cylinder and they were subsequently soaked overnight in distilled water. The volume of the seeds after soaking was then measured. Swelling capacity and the swelling index were determined. Seeds (100 g) were soaked in 100 mL of distilled water in a measuring cylinder and covered with an aluminum foil. The seeds were left to soak for 24 h in room temperature, drained and excess water was removed using a tissue paper. The weight of the swollen seeds was measured. Hydration capacity and hydration index were calculated. Distilled water was brought to boil in 500 mL spout less beakers fitted with bulb condenser to prevent loss of water during cooking. 20 g of seeds from each cultivar was separately added to them. Boiling was continued, and samples (4–5 seeds) were withdrawn using a spatula at 5 min intervals up to 30 min and thereafter after every 2 min and tested for softness by pressing between finger and thumb. The time from addition of seeds till achievement of the desirable softness was recorded as the cooking time (Adebowale *et al*., 2005) [2]. Seed and haulm samples were collected at the time of threshing and were oven dried at 65 °C for chemical analysis of plant. Dried haulm and seed samples were powdered with the help of stainless steel grinder mixture. After grinding, the haulm and seed samples were analyzed for total N, P, K, Fe, Mn, Zn, and Cu content by following standard procedures (Table 2).

Table 1: Equation used to calculate cooking quality of green gram

Cooking quality		
Swelling capacity (mL $seeds^{-1}$)	=	((Volume after soaking) – (Volume before soaking)) /Number of seeds
Swelling index	=	Swelling capacity of seeds / Volume of one seed
Hydration capacity (g $seed^{-1}$)	=	(Weight after soaking) – (Weight before soaking) /Number of seeds
Hydration index	=	Hydration capacity of seeds /Weight of one seed

Table 2: Chemical analysis of plant samples

Plant analysis			
1	Total N	Wet digestion (Chromic acid)	Trivedi *et al.* (1999) [9]
2	Total P, K, Fe, Mn, Zn, Cu	Wet digestion (di-acid) **P:**Vanedomolybdo yellow color method **K:** Flame photometry **Fe, Zn, Mn, Cu:** Atomic absorption Spectrophotometer method	Jackson (1973) [6]

Table 3: Effect of different treatments on protein (%) and carbohydrate (%) in seed

	Contents (%)	
Treatment	**Protein**	**Carbohydrate**
Variety		
V1	17.90	59.04
V2	17.45	57.50
S.Em. (±)	0.21	0.91
CD at 5%	NS	NS
L.F		
L1	17.15	56.65
L2	19.01	62.70
L3	17.60	58.72
L4	17.00	55.12
L5	18.51	60.84
L6	16.80	55.60
S.Em. (±)	0.37	1.57
CD at 5%	1.07	4.60
V*L		
S.Em. (±)	0.52	2.22
CD at 5%	NS	NS
CV %	5.06	6.59

Results and Discussion

Protein and Carbohydrate: Foliar application of SWS and EBPS improved the protein and carbohydrate. Significant variation in quality parameters due to liquid fertilizer treatments was observed. The significantly highest value of protein (19.01%) and carbohydrate (62.70%) in green gram was linked with the application of 2% seaweed sap (L_2) and which was at par with the application of 1% EBPS (L_5). The lowest protein content of 16.80 % and was obtained with the treatment L_6 which remained at par with L_1 (17.15%), L_3 (17.60%) and L_4 (17.00%). Lowest value of carbohydrate observed in L_4.Compared to control L_1 protein content had increased 10.8 % while carbohydrate by 10.7% with foliar application of 2% of seaweed sap (L_2) *i.e.* at lowest level of SWS. These findings are in agreement with the findings of Zodape *et al.*, 2010 [13] for green gram. Erulan *et al*., 2009 [5] in *Cajanus cajan*, Zodape *et al.*, 2008 [11] in okra and Zodape *et al*., 2009 in wheat. Kumar *et al*., 2015 [7] reported total protein and total lipid content more at 1% concentration whereas the carbohydrate content more at 2% concentration in green gram when treated with different concentrations of foliar application of SWS. Beneficial effects of seaweed extract may be due to presence of some growth promoting substances like IAA, ABA, Gibberellins, cytokinins, micro-nutrients, vitamins and amino acid.

Cooking Quality: Cooking quality of the green gram seed is important for consumer acceptance. Cooking is the common processing method required to remove antinutritional factors and to ensure acceptable sensory quality of pulses. The observation regarding cooking quality parameters presented in Table 4. The treatment L_2 showed significant superiority in cooking quality with high swelling capacity (0.606 mL seed^{-1}) and less hydration index (6.089) with minimum cooking time (16.75 minutes) compared to other treatments of liquid fertilizer. From the varietal difference point of view variety V_2 (GBM-1) possessed significantly high swelling capacity (0.620 mL seed^{-1}) and swelling index (3.718) with minimum hydration index (6.540), this might be due to the boldness of the seeds of V_2 variety, but the cooking time is less in variety V_1 (CO-4). Higher swelling capacity low hydration index with least cooking time of green gram seeds indicates its better cooking quality. The similar findings were reported by Wani *et al.* (2014).

Nutrient Content: The result revealed that, the individual treatments significantly influence the nutrient content in seed and stover. The variety V_1 (CO-4) showed significantly higher Mn content 15.11 mg kg^{-1} and 16.51 mg kg^{-1} in both the seed and stover respectively as compared to V_2 (GBM-1). Among the liquid fertilizer treatment L_2 (2% seaweed sap) showed significantly higher value of P (0.28%), Fe (142.50 mg kg^{-1}), Mn (16.83 mg kg^{-1}) and Zn (40.50 mg kg^{-1}) in stover and P (0.13%), K (0.97%), Fe (59.59 mg kg^{-1}), Mn (19.35 mg kg^{-1}) and Cu (6.83 mg kg^{-1}) in seed. Minimum value of all these nutrients observed in L_6 (2% of EBPS). The decrease in concentration of various nutrient elements was observed with increase in SWS as well as EBPS treatment. The result of present study regarding nutrient concentration in straw and seed are in accordance with those obtained by many workers with use of seaweed extract. Seaweed extract are reported effective fertilizer in many crops including vegetables, trees, flowering plants and grain crop (Abetz, 1980) [1]. Zodape *et al.*, 2009 reported increase in macro and micro-nutrients content in wheat in the range of 15.86% to 75.02% and 1.28% to 20% respectively under the influence of *K. alvarezii* extract treatment.

Table 4: Effects of different treatments on swelling capacity, swelling index, hydration capacity, hydration index and cooking time

Treatment	Swelling capacity (mL seed^{-1})	Swelling index	Hydration capacity (g seed^{-1})	Hydration index	Cooking time (minutes)
Variety					
V1	0.545	3.282	0.281	7.244	16.69
V2	0.620	3.718	0.288	6.540	19.04
S.Em. (±)	0.006	0.038	0.004	0.145	0.26
CD at 5%	0.019	0.111	NS	0.426	0.78
L.F					
L1	0.582	3.525	0.287	7.273	18.50
L2	0.606	3.475	0.292	6.089	16.75
L3	0.592	3.537	0.295	6.969	17.21
L4	0.561	3.463	0.277	7.413	18.65
L5	0.599	3.527	0.288	6.152	17.26
L6	0.554	3.475	0.270	7.458	18.82
S.Em. (±)	0.011	0.066	0.007	0.251	0.47
CD at 5%	0.032	NS	NS	0.737	1.36
V*L					
S.Em. (±)	0.016	0.093	0.010	0.356	0.66
CD at 5%	NS	NS	NS	NS	NS
CV %	4.610	4.590	5.960	8.930	6.37

Table 5: Effect of different treatments on major and micro nutrient content in green gram stover

Treatment	Content of major nutrients (%)			Content of micro-nutrient (mg kg^{-1})			
	N	P	K	Fe	Mn	Zn	Cu
Variety							
V1	1.01	0.24	1.32	138.90	15.11	38.50	5.29
V2	0.98	0.23	1.28	136.33	14.57	37.67	5.23
S.Em. (±)	0.01	0.01	0.03	1.06	0.18	0.49	0.08
CD at 5%	NS	NS	NS	NS	0.52	NS	NS
L.F							
L1	0.99	0.23	1.26	138.50	14.50	37.50	5.12
L2	1.05	0.28	1.42	142.50	16.83	40.50	5.60
L3	1.01	0.25	1.32	140.50	15.50	39.00	5.27
L4	0.97	0.22	1.27	133.67	14.00	37.50	5.18
L5	1.01	0.24	1.29	141.00	15.50	38.50	5.35
L6	0.96	0.21	1.23	129.53	12.70	35.50	5.05
S.Em. (±)	0.02	0.01	0.05	1.83	0.31	0.84	0.14
CD at 5%	NS	0.02	NS	5.36	0.90	2.47	NS
V*L							
S.Em. (±)	0.03	0.01	0.07	2.59	0.43	1.19	0.20
CD at 5%	NS	NS	NS	NS	NS	NS	NS
CV %	15.80	8.13	8.71	13.25	15.07	15.42	16.56

Table 6: Effect of different treatments on major and micro nutrient content in green gram seed

Treatment	Content of major nutrients (%)			Content of micro-nutrient (mg kg^{-1})			
	N	P	K	Fe	Mn	Zn	Cu
Variety							
V1	2.86	0.42	0.93	53.88	16.51	32.65	6.35
V2	2.74	0.41	0.91	53.16	15.61	33.15	6.04
S.Em. (±)	0.05	0.01	0.01	0.82	0.26	0.83	0.17
CD at 5%	NS	NS	NS	NS	0.75	NS	NS
L.F							
L1	2.75	0.41	0.93	49.85	13.81	32.03	5.80
L2	3.04	0.43	0.97	59.59	19.35	33.57	6.83
L3	2.82	0.42	0.95	52.90	15.64	33.16	6.51
L4	2.72	0.41	0.88	49.37	14.82	31.28	5.64
L5	2.80	0.42	0.96	58.97	18.55	33.43	6.52
L6	2.69	0.37	0.86	50.43	14.19	33.91	5.89
S.Em. (±)	0.09	0.01	0.02	1.42	0.44	1.44	0.29
CD at 5%	NS	0.04	0.05	4.17	1.30	NS	0.85
V*L							
S.Em. (±)	0.12	0.02	0.02	2.01	0.63	2.03	0.41
CD at 5%	NS	NS	NS	NS	NS	NS	NS
CV %	7.62	7.18	10.08	16.50	16.74	10.70	11.49

Reference

1. Abetz P. Seaweed extract: Have they a place in Australian agriculture or horticulture. J Aust Inst Agric Sci. 1980; 46:23-29.
2. Adebowale YA, Adeyemi A, Oshodi A. Variability in the physicochemical, nutritional and antinutritional attributes of six Mucuna species. Food Chem. 2005; 89:37-48.
3. Bokil KK, Mehta VC, Datar DS. Seaweed as manure, field manurial trials on *Pennisetum typhoids* S.H. (pearl Millets) and *Arachis hypogea* (Ground nut). Bot. Mar. 1972; 15:148-150.
4. Bhuiya ZH, Chowdhary SU. Effect of N, P, K, and S on protein oil content of groundnut grown in Brahamputra flood plain soil. Indian Journal of Agricultural Sciences. 1974; 44(11):751-754.
5. Erulan V, Soundarapandian P, Thirumaran G, Ananthan G. Studies on the Effect of *Sargassum polycystum* (C.Agardh, 1824) Extract on the Growth and Biochemical Composition of *Cajanus cajan (*L.) Mill sp. *American-Eurasian.* J. Agric. & Environ. Sci. 2009; 6(4):392-399.
6. Jackson ML. Soil chemical analysis. Prentice Hall of India Pvt. Ltd., New Delhi, 1973, 183-192.
7. Kumar GP, Desai SE, Amalraj LD, Pinisetty S. Impact of seed bacterization with PGPR on growth and nutrient uptake in different cultivable varieties of green gram. Asian Journal of Agricultural Research. 2015; 9(3):113-122.
8. Stephenson WA. Seaweeds in agriculture and horticulture. Ratequer, peruma valley 3rd edition, California, 1974, 241.
9. Trivedi BS, Patel GG, Desai RM, Padhiyar GM. Comparison of Kjeldahl's and Chromic acid methods of nitrogen determination. GAU Res. J 1999; 25(1):9-14.
10. Wani IA, Sogi DS, Wani AA, Gill BS. Physical and cooking characteristics of some Indian kidney bean (*Phaseolus vulgaris* L.) cultivars. Journal of the Saudi Society of Agricultural Sciences. 2015; 10:1016.
11. Zodape ST, Kawarkhe VJ, Patolia JS, Warade AD. Effect of VIII liquid fertilizer on yield and quality of Okra (*Abelmoschus esculentus* L.). Journal of scientific industrial research. 2008; 67:1115-1117.
12. Zodape ST, Mukherjee S, Reddy MP, Chaudhary DR. Effect of *Kappaphycus alvarezii* (Doty) Doty ex silva. extract on grain quality, yield and some yield components of wheat (*Triticum aestivum* L.). International Journal of Plant Production. 2009; 3(2):1735-6814.
13. Zodape ST, Soumita M, Eswaran K, Reddy MP, Chikara J. Enhanced yield and nutritional quality in green gram (*Phaseolus radiate* L) treated with seaweed (*Kappaphycus alvarezii*) extract. Journal of scientific and industrial research. 2010; 69:468-471