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Effect of panchagavya on quality, nutrient content and nutrient uptake of organic blackgram [*Vigna mungo* (L.) Hepper]

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Abstract
A field experiment was conducted at the instructional farm of Rajasthan College of Agriculture, Udaipur, Rajasthan during *kharif* season of 2015 to study the effect of panchagavya on yield, quality, nutrient content and nutrient uptake of organic blackgram. A significant increase in seed yield, straw yield, biological yield and maximum nitrogen, phosphorus, potassium, sulphur, zinc and iron content in seed and straw and their uptake and protein content in seed was observed with the application of panchagavya 4% over control, panchagavya 2%, panchagavya 6%, panchagavya 8%, panchagavya 10% and indigenous panchagavya 2%. Application of panchagavya at branching + flowering stages significantly increased seed yield, straw yield, biological yield and maximum nitrogen, phosphorus, potassium, sulphur, zinc and iron content in seed and straw and their uptake and protein content in seed of blackgram over the application of panchagavya at branching alone and flowering stage alone.

Keywords: Organic Blackgram, Yield, Quality, Nutrient uptake, Zinc, Iron

Introduction
Interest in food production without chemical fertilizer and pesticides practices is increasing. Such food is commonly referred as organic (Ramesh *et al.*, 2009) [10]. Blackgram is a rainfed crop predominantly grown in *kharif* in the Rajasthan. It is a short day plant. Flowering is both photoperiod and temperature sensitive. Blackgram is utilized in making *dal*, curries, soup, sweets and snacks. In South India, the most popular *idli* and *dosa* are prepared by mixing rice and blackgram flour. The food values of blackgram lie in its high and easily digestible protein. Its seed contains approximately 26 per cent protein, 1.2 per cent oil and 62 – 65 per cent carbohydrates on dry weight basis. (Sharma *et al*., 2011) [13]. Pulses are important components of organic farming systems in the India. In recent years, the use of fermented cow dung, cow urine, cow ghee, cow curd and milk with the name of panchgavya is getting adaptive popularity in Indian agriculture largely through the efforts of small groups of farmers. Panchagavya is an organic product recommended for crop improvement in organic agriculture (Sangeetha and Thevanathan, 2010) [12]. Panchagavya has resulted in positive effect on growth and productivity of crops (Somasundaram *et al.*, 2007) [16]. It is used as a foliar spray, soil application along with irrigation, as well as seed treatment (Natarajan, 2002) [8]. Farmers in South India practice panchagavya for sustainable agriculture (Nayagam, 2001) [9]. Panchagavya is known to contain biofertilizers such as *Azospirillum*, *Azotobactor*, *Phosphobacteria* and *Pseudomonas* besides *Lactobacillus* (Yadav and Lourduraj, 2006) [20].

Materials and Methods
A field experiments was conducted during *kharif*, 2015 at Instructional Farm (Agronomy), Rajasthan College of Agriculture, Udaipur which is situated at South-Eastern part of Rajasthan at an altitude of 579.5 metre above mean sea level and at 24º 35′ N latitude and 74º 42′ E longitude. The region falls under agro-climatic zone IV a (Sub- humid Southern Plain and Aravalli Hills) of Rajasthan. The soil of the experimental site was clay loam in texture with pH 7.6 and 0.58 per cent organic carbon. The experiment of was laid out in factorial randomized block design with three replications and assigning 21 treatment combinations consisting of control, comprising six doses of panchagavya (panchagavya 2%, panchagavya 4%, panchagavya 6%, panchagavya 8%, panchagavya 10% and indigenous panchagavya 2%) as growth promoter and three stages of application of panchagavya (branching, flowering and branching + flowering). The blackgram variety PU-31 was sown on 9th July 2015 at 30 cm row

to row spacing by using recommended seed rate of 16 kg ha^{-1}. All other agronomic practices were adopted as per need of the crop. Seed and stover yield were recorded plot^{-1} and converted in to kg ha^{-1} and protein content was determined by multiplying the nitrogen percentage with factor 6.25 as described by AOAC (1960) [1]. Nutrient content in seed and stover samples were determined as Nitrogen by Colorimetric method (Snell and Snell, 1959) [17], P by Vandomolybdo phosphoric acid yellow colour method, K by Flame Photometer method (Jackson, 1973) [4], S by Turbidimetric method (Tabatabai and Bremner, 1970) [19], Zn and Fe estimation on AAS (Lindsay and Norvell, 1978) [6].

Results and Discussion

Effect on yield

Application of panchagavya 4% gave higher seed yield (801 kg ha^{-1}), straw yield (1735 kg ha^{-1}), biological yield (2536 kg ha^{-1}) of blackgram over the control, 2%, 6%, 8% and 10% panchagavya and indigenous panchagavya 2%. Further, The data indicate that application of panchagavya at branching + flowering stages recorded the highest seed yield (751 kg ha^{-1}), straw yield (1617 kg ha^{-1}), biological yield (2368 kg ha^{-1}) of blackgram over the application of panchagavya at branching and flowering (Table 1).

The easy transfer of nutrients and growth stimulants to plants through foliar spray of optimum dose of panchagavya might be the reason for enhancement in yield attributes. There are several reasons for increased yield in blackgram due to spray of panchagavya. Smaller quantities of IAA and GA present in panchagavya when foliar sprayed could have created stimuli in the plant system which in turn increased the production of growth regulator in cell system and the action of growth regulators in plant system stimulated the necessary growth and development, leading to better yield.

Application of panchagavya on vegetative growth viz., number of branches plant^{-1} and reproductive growth viz., pods plant^{-1}, seeds pod^{-1} and test weight, which were the important yield attributes having significant positive correlation with seed & straw yield. Similarly findings have been reported by Somasundaram *et al.* (2007) [16], Kumawat *et al.* (2009) [5] and Mudigoudra *et al.* (2009) [7]. The pronounced increase in yield might be due to sustained availability of nutrients (N, P, K, S, Zn and Fe) at growth phases of blackgram and also due to enhanced carbohydrate synthesis and effective translocation of photosynthates to the developing sink. Panchagavya increased synthesis of growth promoting substances which is turn helped in increased growth and yield attributes and finally grain yield. Similarly findings have been reported by Swaminathan *et al.* (2007) [18] and Choudhary *et al.* (2014) [3].

Effect on nutrient content, uptake and quality

Maximum N, P, K, S, Zn and Fe content and their uptake in seed and straw and protein content in seed of blackgram was noticed with use of panchagavya spray 4% as compared to control, 2%, 6%, 8% and 10% panchagavya and indigenous panchagavya 2% (Table 2). Results further reveal that maximum N, P, K, S, Zn and Fe content and uptake in seed and straw and protein content in seed of blackgram was observed with the application of panchagavya at both branching + flowering stages as compared application of panchagavya at either stage of branching or flowering stage alone (Table 2).

Maximum N, P, K, S, Zn and Fe content and their uptake in seed and straw and protein content in seed with use of panchagavya spray 4% might be due to optimum dose of bio regulator panchagavya which provide more macro and micro nutrients as well as growth regulators like auxins and GA which helped in producing higher bio mass and also in better recovery of N, P, K, S, Zn and Fe in plant. Similar effects have also been observed by Beaulah (2002) [2] and Kumawat *et al.* (2009) [5].

Maximum N, P, K, S, Zn and Fe content and uptake in seed and straw and protein content in seed at both branching + flowering stages as compared application of panchagavya at either stage of branching or flowering stage alone might be due to adequate and balanced nutrient supply to crop at the right time (both at branching and flowering stages) of requirement. Blackgram crop could accrue high quantity of biomass and partitioned a higher fraction of assimilates to the sink thus resulting in better yield as displayed by improvement in overall yield attributes and improvement in quality parameters. Similar findings were reported by Rao *et al.* (2010) [11]. Higher N, P, K, S, Zn and Fe uptake by blackgram crop might be ascribed to higher N, P, K, S, Zn and Fe content in seed and straw (Table 2) which resulted higher seed and straw yield (Table 1) with application of panchagavya. The regulation of stomata was favourably influenced by the bioactive substances produced by beneficial microorganisms present in panchagavya, which also enhanced the uptake of nutrients of the blackgram. Similar findings were also reported by Shwetha *et al.* (2009) [15] and Shivakumar and Ponnusami (2011) [14].

Table 1: Effect of doses of panchagavya and its stage of application on yield and quality of organic blackgram

Treatments	Yield (kg ha^{-1})			Protein content in seed (%)
	Seed	Straw	Biological	
Doses of panchagavya				
Control	519	1272	1791	20.63
Panchagavya 2%	686	1512	2198	21.17
Panchagavya 4%	801	1735	2536	22.36
Panchagavya 6%	715	1534	2249	21.52
Panchagavya 8%	697	1519	2217	21.45
Panchagavya 10%	690	1505	2195	21.31
Indigenous panchagavya 2%	681	1512	2193	21.18
SEm±	20	59	68	0.30
C.D.5%	57	168	193	0.84
Stage of panchagavya application				
Branching	635	1470	2105	20.75
Flowering	667	1451	2118	20.99
Branching + Flowering	751	1617	2368	22.37
SEm±	13	38	44	0.19
C.D.5%	37	110	127	0.55

Table 2: Effect of doses of panchagavya and its stage of application on N, P and K content and their uptake in seed and straw of organic blackgram

Treatments	Nitrogen content (%)		Total N uptake (kg ha^{-1})	Phosphorus content (%)		Total P uptake (kg ha^{-1})	Potassium content (%)		Total K uptake (kg ha^{-1})
	Seed	Straw		Seed	Straw		Seed	Straw	
Doses of panchagavya									
Control	3.30	2.28	46.14	0.346	0.207	4.42	1.218	2.067	32.62
Panchagavya 2%	3.39	2.43	59.62	0.360	0.211	5.67	1.275	2.111	40.66
Panchagavya 4%	3.58	2.55	73.32	0.400	0.229	7.23	1.319	2.187	48.68
Panchagavya 6%	3.44	2.46	62.55	0.372	0.221	6.07	1.316	2.171	42.77
Panchagavya 8%	3.43	2.45	61.23	0.369	0.219	5.90	1.312	2.166	42.09
Panchagavya 10%	3.41	2.43	60.33	0.365	0.217	5.80	1.309	2.159	41.62
Indigenous panchagavya 2%	3.39	2.41	59.68	0.359	0.210	5.64	1.283	2.109	40.67
SEm±	0.05	0.04	1.98	0.008	0.003	0.21	0.011	0.015	1.47
C.D.5%	0.14	0.13	5.65	0.022	0.008	0.59	0.030	0.043	4.21
Stage of panchagavya application									
Branching	3.32	2.42	56.91	0.366	0.214	5.49	1.281	2.130	39.54
Flowering	3.36	2.35	56.55	0.355	0.211	5.44	1.280	2.110	39.18
Branching + Flowering	3.58	2.51	67.78	0.381	0.223	6.53	1.310	2.176	45.18
SEm±	0.03	0.03	1.29	0.005	0.002	0.13	0.007	0.010	0.96
C.D.5%	0.09	0.08	3.70	0.014	0.005	0.38	0.020	0.028	2.76

Table 3: Effect of doses of panchagavya and its stage of application on S, Zn and Fe content and their uptake in seed and straw of organic blackgram

Treatments	Sulphur content (%)		Total S uptake (kg ha^{-1})	Zinc content (mg kg^{-1})		Total Zn uptake (g ha^{-1})	Iron content (mg kg^{-1})		Total Fe uptake (g ha^{-1})
	Seed	Straw		Seed	Straw		Seed	Straw	
Doses of panchagavya									
Control	0.178	0.098	2.17	8.82	17.17	26.41	44.10	201.04	278.38
Panchagavya 2%	0.188	0.104	2.87	9.89	18.29	34.42	46.47	206.00	342.89
Panchagavya 4%	0.222	0.117	3.83	10.61	19.86	43.08	49.84	225.31	431.40
Panchagavya 6%	0.218	0.116	3.35	10.42	19.73	37.72	49.81	223.77	378.53
Panchagavya 8%	0.213	0.114	3.23	10.17	19.65	36.98	49.75	220.44	369.49
Panchagavya 10%	0.210	0.112	3.15	9.90	19.51	36.19	49.26	217.72	362.63
Indigenous panchagavya 2%	0.182	0.103	2.80	9.84	18.21	34.18	46.97	205.92	343.48
SEm±	0.006	0.002	0.12	0.17	0.42	1.23	0.90	3.52	13.21
C.D.5%	0.018	0.007	0.33	0.48	1.20	3.52	2.56	10.07	37.76
Stage of panchagavya application									
Branching	0.198	0.108	2.86	9.84	18.77	33.89	47.51	212.09	342.01
Flowering	0.191	0.104	2.79	9.70	18.33	33.07	47.28	211.34	338.50
Branching + Flowering	0.215	0.116	3.52	10.31	19.65	39.74	49.30	219.35	393.83
SEm±	0.004	0.002	0.08	0.11	0.27	0.81	0.59	2.31	8.65
C.D.5%	0.012	0.005	0.22	0.31	0.78	2.31	1.68	6.59	24.72

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