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PB Tapkeer
Department of Soil Science and Agricultural Chemistry, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra, India

MC Kasture
Department of Soil Science and Agricultural Chemistry, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra, India

JB Kadu
Department of Soil Science and Agricultural Chemistry, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra, India

Correspondence
PB Tapkeer
Department of Soil Science and Agricultural Chemistry, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra, India

Effect of different fertilizer briquettes on yield, nutrient uptake and soil fertility status of Dolichos bean (*Dolichos lablab* L.) in lateritic soils of Konkan

PB Tapkeer, MC Kasture and JB Kadu

Abstract
The field experiment was conducted at Vegetable Improvement Scheme, Central Experimental Station, Wakawali during *Rabi* season 2013-2014 to study the "Effect of different fertilizer briquettes on yield, nutrient uptake and soil fertility status of Dolichos bean (*Dolichos lablab* L.) In lateritic soils of Konkan" The field experiment was laid out in randomized block design comprising of eight treatments replicated thrice. The present study was formulated to reduce the fertilizer use by using briquette form. Amongst all fertilizer briquettes, UB-10:26:26 briquettes found significant in term of growth attributing characters and yield of Dolichos bean. It was observed that the application of one UB-10:26:26 briquette in between two plants at sowing was found significant in respect of yield and recorded higher plant height and number of pods per plants as well as higher total N, P and K uptake. The available nutrient status such as organic carbon, (N, P and K) in soil after harvest was found to be improved due to application of UB-10:26:26 briquettes one in between two plants as compared to other treatments. In general, it is concluded that the application of UB-10:26:26 briquettes @ one briquette in between two plants was found promising in enhancing the green pod yield of *Konkan bhushan* variety in lateritic soils of Konkan. 50 per cent recommended dose of NPK fertilizer was reducing by the application of nutrients in the form of UB-10:26:26 briquettes.

Keywords: dolichos bean, fertilizer briquettes, yield, available nutrients and uptake

Introduction
Dolichos Bean (*Dolichos lablab L.*) is an important leguminous vegetable of India and is mainly grown for its tender pods which are cooked and consumed as vegetable. Being leguminous vegetable, the immature green pods of dolichos bean is a good source of protein, minerals and vitamins (Basu *et al*., 1999) [3]. It is one of the most ancient crops among the cultivated plants grown as either pure or mixed with other crops, such as finger millet, groundnut, castor, corn or sorghum. Field bean is a drought tolerant crop grown in dry lands with limited rainfall. It is one of the popular leguminous vegetables grown in different regions of Maharashtra State. Application of chemical fertilizers leads to the loss of soil fertility due to imbalanced use of fertilizers which have adversely affected agricultural productivity and caused soil degradation. For sustainable agriculture Scientific and efficient use of fertilizers is important. Number of investigators has shown that there is a definite and nearly constant requirement of NPK for production of high yielding varieties of crop. The low use efficiency of N and P is because of various reasons such as volatilization, denitrification, surface runoff, leaching losses for nitrogen and fixation of phosphorus in soil. Deep placement of fertilizers Urea Super Granules (USG) and NPK briquette into the anaerobic soil zone is an effective method to reduce volatilization loss (Mikkelsen *et al*., 1978) [14]. Deep placement of urea super granule (USG) at 8-10 cm depth of soil can save 30% N compared to Prilled Urea (PU), increases absorption rate, improves soil health and ultimately increases rice yield (Savant *et al.*, 1991) [17]. Moreover, deep placement method of fertilizer application is environment-friendly and will not decrease the normal fertility of land (BRRI, 2010) [6]. Urea briquette/USG/UB-DAP briquette has less surface area as compared to prilled urea, therefore it dissolved slowly and maintains higher level of NO^-_3-N in soil up to maximum period of crop growth and found beneficial in transplanted rice crop under anaerobic condition (Prasad and De Datta, 1979) [14].

Hence, the present investigation was carried out with view to study the effect of different formulations of briquettes on growth, yield, quality and nutrient uptake of Dolichos bean.

Materials and methods

The field experiment was conducted during *Rabi season* 2013-2014 at vegetable improvement scheme central experimental stations, wakawali. The experiment was laid out in randomized block design with eight treatments replicated thrice. The treatment comprised *viz.* T_1 (control), T_2 (Recommended Dose of Fertilizer), T_3 (Konkan Annapurna Briquettes @ 1 briquette plant^{-1}), T_4 (KAB @1 briquette in between two plants), T_5 (Urea Briquettes-10:26:26 @1 briquette plant^{-1}), T_6 (UB-10:26:26 @1 briquette in between two plants), T_7 (Urea Briquettes -DAP @ 1 briquette plant^{-1}), T_8 (UB-DAP @ 1 briquette in between two plants). Application of briquettes was takes place at 5 to 7 cm deep manually in respective treatments. In case of treatment T_2 application of NPK (60:60:60 kg ha^{-1}) was applied at the time of sowing. The fertilizer dose of NPK and FYM (except control) was incorporated at the time of sowing and application of briquettes at deep point placement at the depth 5 to 7 cm after leaf initiation. Dolichos bean cv. *Konkan bhushan* was sown during 29th December, 2013 with the spacing 45x30 cm. The soil of experimental field was clay loam in texture, strongly acidic in reaction, low in available nitrogen (360 kg ha^{-1}), medium in available P_2O_5 (11.87 kg ha^{-1}) and high in available K_2O (157.24 kg ha^{-1}) with organic carbon (15.6 g kg^{-1}). The nutrient content in soil sample was determined by following standard procedure. The treatment wise soil samples were collected, air dried and sieved through 2 mm sieve. The soils sample were analyzed for its chemical properties by employing the methods, pH and EC (Jackson, 1973) [9], organic carbon (Black, 1965) [4], available nutrients viz. N, P_2O_5 and K_2O method given by (Subbiah and Asija 1956) [20], (Brays and Kurtz, 1945) [5] and (Jackson, 1973) [9]. The data were subjected to statistical analysis following Panse and Sukhatme (2000) [15].

Result and discussion

Effect on Green Pod and Stover Yield

A glance look of table 1 revealed that the application of different fertilizer briquettes has significantly influenced the yield of green pod and stover over control. The highest green pod (75.69 q ha^{-1}) yield of Dolichos bean was recorded in the treatment T_6 receiving UB-10:26:26 briquettes @ 1 briquette in between two plants, which was significantly superior over the T_1 (control) and T_2 (RDF) treatments and the highest stover (25.08 q ha^{-1}) yield was received by T_6 treatment i.e. UB-10:26:26 briquettes @ 1 briquette in between two plants which was at par with RDF and UB-10:26:26 briquettes @ 1 plant^{-1}. Therefore signifying the role of UB-10:26:26 briquettes in better nutrition of Dolichos bean crop. From the results of green pod and stover yield of Dolichos bean, it is inferred that the crop of Dolichos bean responded well to UB-10:26:26 briquette. The interaction between lateritic soil and UB-10:26:26 briquettes were better than that of Urea-DAP and KAB briquettes. This might be due to better extraction of nutrients from the soil treated with UB-10:26:26 briquettes. The deep placement of these briquette resulted into lower losses of nutrient owing to low fixation, low leaching and less loss through runoff followed by the better retention and release of macro as well as micro nutrients. The briquette form of fertilizer recorded maximum yield of tomato than non –briquette form, reported by Kadam *et al.* (2005) [11] and Talpade *et al.* (2011) [21].

Effect on Growth and Yield Attributing Characters

The perusal of the data indicated that the plant height of dolichos bean increased gradually within the treatments of various stages of crop i.e. 13.64 to 17.41 cm at 30 DAS, 35.10 to 53.67 cm at 60 DAS and 38.73 to 61.67 cm at harvest stage. At 30 DAS, plants recorded maximum plant height (17.41 cm), at 60 DAS the highest plant height (53.67 cm) was observed in the treatment T_6 receiving UB-10:26:26 one briquette in between two plants but found statistically non-significant. Similar results were obtained at harvest i.e. the treatment variation found non-significant. The enhancement in growth parameters could be due to the better and proper nourishment of the crop when fertilized through the briquette (Bulbule *et al*., 2005) [8].

The effect of different fertilizer briquette, showed the significant results with respect to number of branches per plant at various stages except 30 DAS. The increase in the number of branches per plant may due to the better uptake of plant nutrients due to application in briquette form. This supplied balance nutrients. Similar observation was recorded by Krishna *et al*. (1995) [13].

The data pertaining to the yield contributing characters i.e. number of pods per plant was significantly influenced due to application of various sources of fertilizers including briquettes. The treatment T_6 receiving one UB-10:26:26 briquettes in between two plants recorded highest number of pods (41.49) which was found significantly superior over rest of the treatments, these treatments also observed to maximum pods per plant due to placement of N, P and K nutrients through UB- 10:26:26 briquettes, which supplied the nutrients to the crop for long period.

Effect on Uptake of Nutrients by Dolichos bean

The data pertaining to the uptake of nutrients by green pod, stover and total nutrient uptake by Dolichos bean crop as influenced by different treatments i.e. applications of different fertilizers on Dolichos bean are presented in Table 2.

It was observed from the data the uptake of nitrogen in the stover was increased from 6.55 to 18.09 kg ha^{-1} due to effect of various treatments it was statistically significant. The significantly higher uptake of nitrogen by the pod (47.17 kg ha^{-1}) and total uptake (65.26 kg ha^{-1}) in dolichos bean crop were recorded with treatment T_6 i.e. application of UB-10:26:26 briquettes @ one briquette in between two plants which was significantly superior over rest of the treatment. From the perusal of the data on the maximum P uptake in stover (1.61 kg ha^{-1}) recorded in T_6 treatment by receiving UB-10:26:26 briquettes @ one briquette in between two plants but it was at par with RDF, KAB @1 briquette in between two plants and UB-10:26:26 briquettes @ 1 plant^{-1}. The maximum pod (4.92 kg ha^{-1}) and total uptake (6.52 kg ha^{-1}) in dolichos bean crop were recorded in the treatment T_6 which was significantly superior over rest of all the treatments. Ranges of total nitrogen uptake by tomato at harvest coated here was agreed with Kadam *et al.* (2005) [11] in tomato and Kokare (2013) in chilli. Similarly Shinde (2011) [18] reported that there was significant increase in nitrogen uptake by groundnut in the treatment receiving fertilizers in the form of briquettes over treatment receiving 100 per cent RDF. The increased uptake of P might be ascribe to more availability of nutrients from added fertilizers and to the solubility action of organic acids produced during the

degradation of organic materials. Bagal (2009); Bulbule *et al.* (2008) [7] and Kokare (2013) showed increase in phosphorus uptake due to deep placement of briquettes containing NPK in different levels. Whereas the significantly highest uptake of K by stover (3.86 kg ha^{-1}) was recorded to the tune of in the treatment T_6 by receiving UB-10:26:26 briquettes @ one briquette in between two plants which was found at par with RDF, KAB @1 briquette in between two plants and UB-10:26:26 briquettes @ 1 $plant^{-1}$. Application of UB-10:26:26 briquettes @ 1 briquette in between two plants significantly increased K uptake in pod (8.40 kg ha^{-1}) and total uptake (12.26 kg ha^{-1}) in dolichos bean which was statistically significant to over rest of all the treatment. The briquette form of fertilizers recorded significantly higher potassium uptake by fruits of tomato than non-briquette form which was opined by Kadam (2000) [10] and Kokare (2013) in chilli.

Effect on Chemical Properties of Soil

The maximum pH (5.44, 5.51, and 5.29) at all stages was recorded by T_6 treatment i.e. application of UB-10:26:26 briquettes @ 1 briquette in between two plants (Table 2). Although the reduction in soil pH in the treatments receiving inorganic fertilizer in straight as well as all three types of briquettes form as compared to other treatment. The behavior of soil reaction was found similar in the studies conducted on lateritic soil by Kokare (2013) in chilli and Torane (2014) in cucumber. There was no significant change in Electrical Conductivity. values due to the application of RDF and different types of briquettes through the trial. The organic carbon content was decreased with application of inorganic fertilizers. The significantly highest values of organic carbon were observed in treatment T_6 by receiving UB-10:26:26 briquettes @ 1 briquette in between two plants (18.30 g kg^{-1}), (14.30 g kg^{-1}) and (14.40 g kg^{-1}) at 30, 60 and after harvest stage, respectively. Singh *et al.* (2006) [19] concluded that application of chemical fertilizers decreased the organic carbon content due to deterioration of soil structure.

Effect on Available N, P_2O_5 and K_2O

The perusal of data revealed that all the treatments showed increase in available N and P_2O_5 status of soil over absolute control at all the stages of crop growth (table 3). The significantly highest available N (450.53, 365.86, and 334.50 kg ha^{-1}) and P_2O_5 (18.26, 20.52 and 17.50kg ha^{-1}) were observed in the treatment T_6 by receiving UB-10:26:26 briquettes @ 1 briquette in between two plants. Similar results were found by Shinde (2011) [18], Kokare (2013) and Torane (2014). Application of KAB briquettes, Urea-DAP briquettes and Urea-SSP-Suphala briquettes significantly enhanced available nitrogen content of soil over the treatment receiving RDF alone. An increase in available phosphorus with the application of briquettes to rice crop was reported by Pillai (2004) [16] and Bulbule *et al.* (2008) [7]. It is observed from the data that the available K_2O content at 30, 60, DAS and at harvest ranged from 161.72 to 197.12 kg ha^{-1}, 172.03 to 246.26 kg ha^{-1} and 167.55 to 190.40 kg ha^{-1},respectively (Table 4). The available potassium content observed in soil was significantly higher in treatment T_6 by applied dose of UB-10:26:26 briquettes @1 briquette in between two plants which were at par with RDF, T_3 (Konkan Annapurna Briquettes @ 1 briquette $plant^{-1}$), T_4 (KAB @1 briquette in between two plants), T_5 (Urea Briquettes-10:26:26 @1 briquette $plant^{-1}$), T_7 (Urea Briquettes -DAP @ 1 briquette $plant^{-1}$), at 30 DAS, significantly superior over rest of all treatments at 60 DAS and also non-significant at harvest stages. At harvest, of Dolichos bean available potassium content of soil decreased as compared to the 60 DAS stages. This might be due to the utilization of potassium by Dolichos bean plant. Agate (1997) [1] also observed depletion of potash in lateritic soil even after application of potassic fertilizers; Shined (2011) [18] showed superiority of Urea-Suphala briquettes and Urea-Godavari briquettes to other organic and inorganic sources of nutrients in enhancing available potassium status of soil. Similarly Kokare (2013) found the application of briquettes along with organic manures retains the potassium in soil during in chili crop.

Table 1: Effect of different fertilizer briquettes on yield and yield attributing character

Treatment No.	Yield (q ha^{-1})		Plant height (cm)			Number of branches $plant^{-1}$			Number of pods $plant^{-1}$
	Green pod	Stover	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest	
T_1	34.85	12.80	13.64	35.10	38.73	5.00	6.67	6.33	20.79
T_2	57.96	24.04	15.52	42.16	45.42	5.67	8.67	8.67	29.94
T_3	58.51	21.05	15.42	41.53	47.53	5.67	6.67	6.67	29.40
T_4	70.68	22.72	15.80	45.63	51.40	5.67	6.67	6.67	32.75
T_5	63.31	23.63	16.90	40.93	47.67	5.67	6.33	7.67	29.87
T_6	75.69	25.08	17.41	53.67	61.67	6.00	9.00	9.00	41.49
T_7	65.19	20.46	15.10	44.33	39.47	5.00	8.00	8.00	36.22
T_8	61.27	20.42	16.10	51.67	53.27	5.67	6.67	6.67	32.60
S.E. ±	4.00	0.72	0.55	6.25	7.17	0.33	0.57	0.52	1.17
C.D(P=0.05)	12.16	2.20	1.69	NS	NS	NS	1.74	1.59	3.57

* DAS: Days after sowing

Table 2: Effect of different fertilizer briquette on Uptake of N, P and K of Dolichos bean

Treatment No.	Nitrogen (kg ha^{-1})			Phosphorus (kg ha^{-1})			Potassium (kg ha^{-1})		
	Stover	Pod	Total	Stover	Pod	Total	Stover	Pod	Total
T_1	6.55	14.10	20.64	0.60	1.32	1.92	1.30	2.28	3.58
T_2	14.51	25.36	39.87	1.41	2.59	4.00	3.25	4.83	8.08
T_3	12.99	25.16	38.15	1.07	2.62	3.69	2.72	4.23	6.95
T_4	15.73	32.63	48.37	1.30	3.53	4.83	3.10	5.07	8.17
T_5	13.07	31.09	44.16	1.39	2.95	4.35	3.23	4.96	8.18
T_6	18.09	47.17	65.26	1.61	4.92	6.52	3.86	8.40	12.26
T_7	13.84	32.82	46.65	1.13	3.36	4.49	2.47	5.24	7.71
T_8	12.61	35.52	48.13	1.08	3.25	4.33	2.25	5.99	8.24
S.E. ±	0.86	2.81	2.61	0.12	0.19	0.20	0.26	0.32	0.43
C.D. (P=0.05)	2.62	8.53	7.94	0.37	0.58	0.62	0.80	0.99	1.32

*DAS: Days after Sowing

Table 3: Effect of different fertilizer briquette on pH, Electrical Conductivity and Organic Carbon of soil

Treatment No.	Soil pH (1:2.5)			Electrical conductivity (dSm^{-1})			Organic Carbon (g kg^{-1})		
	30 DAS	60 DAS	AH	30 DAS	60 DAS	AH	30 DAS	60 DAS	AH
T_1	5.06	5.26	5.12	0.16	0.30	0.40	6.00	10.00	12.47
T_2	5.08	5.16	5.14	0.19	0.38	0.57	17.00	13.10	13.50
T_3	5.23	5.41	5.10	0.22	0.27	0.47	16.70	10.27	12.90
T_4	5.19	5.29	5.11	0.27	0.29	0.39	15.70	10.20	12.60
T_5	5.14	5.29	5.15	0.25	0.20	0.41	16.20	14.00	14.00
T_6	5.44	5.51	5.29	0.38	0.28	0.42	18.30	14.30	14.40
T_7	5.12	5.27	5.17	0.27	0.22	0.33	17.70	14.10	12.80
T_8	5.07	5.25	5.20	0.22	0.27	0.31	17.20	14.20	12.80
S.E. ±	0.033	0.041	0.023	0.058	0.1	0.079	0.82	0.57	0.37
C.D.(P=0.05)	0.10	0.12	0.07	NS	NS	NS	2.49	1.73	1.13

* DAS: Days after sowing

Table 4: Effect of different fertilizer briquette on Available Nitrogen, Phosphorus and Potassium in soil

Treatment No.	Available N (kg ha^{-1})			Available P (kg ha^{-1})			Available K (kg ha^{-1})		
	30 DAS	60 DAS	AH	30 DAS	60 DAS	AH	30 DAS	60 DAS	AH
T_1	371.09	308.37	296.94	12.39	13.82	10.03	161.72	172.03	167.55
T_2	402.45	359.59	310.46	15.32	18.76	16.41	184.04	177.13	179.64
T_3	414.99	321.96	303.09	16.67	17.17	13.73	187.04	176.96	178.30
T_4	412.90	358.54	330.32	15.74	19.51	12.25	180.88	192.19	175.05
T_5	415.87	351.23	304.19	15.91	20.43	14.66	185.02	186.87	183.68
T_6	450.53	365.86	334.50	18.26	20.52	17.50	197.12	246.26	190.40
T_7	395.13	351.23	327.18	15.66	17.50	13.05	179.64	212.17	182.33
T_8	377.36	333.46	316.73	17.25	19.60	12.97	168.44	211.90	169.34
S.E. ±	19.2	9.66	5.97	2.6	1.88	1.14	6.11	10.16	9.13
C.D.(P=0.05)	NS	29.3	18.13	NS	NS	3.47	18.53	30.82	NS

* DAS: Days after sowing

Conclusions

The results showed that application of KAB, UB-DAP and UB-10:26:26 forms of briquettes are promising source of NPK fertilizers as compared to straight fertilizers for enhancing yield and yield attributing characters as well as nutrient uptake and soil properties of lateritic soil. Amongst the three types of briquettes, UB-10:26:26 was found to be superior for increasing green pod yield applied @ 1 briquette in between two plants at leaf initiation stage. While, higher uptake and available nutrient status of soil in respect to N, P and K found to be improved due to incorporation of briquettes. The application of nutrients in the form of UB-10:26:26 briquettes can reduce the recommended dose of NPK fertilizer to the extent of 50 per cent.

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