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Studies on influence of multinutrient briquettes on movement of nitrogen, phosphorus, potassium and zinc in soil of bt-cotton

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Abstract
An experiment was conducted during *kharif* season during the year 2015-16 to evaluate the studies on influence of multinutrient briquettes on movement of nitrogen, phosphorus, potassium and zinc in soil of Bt-cotton. The soil sampling was done at 15 cm away from cotton plant at 15 cm and 30 cm depth and at 30 cm away from cotton plant and at 15 cm and 30 cm depth. The results out came clearly showed that available nutrient status significantly decreased with increasing soil depths (15-15 cm, 15-30 cm, 30-15 cm and 30-30 cm). The maximum nitrogen was retained by treatment fertigation at all depths followed by application of briquette in root rhizoshere. The movement of nutrient P was observed at lower magnitude. It was non-significantly, however the P movement was maximum in briquettes and soluble fertilizers. The mobility rate of K is high if may leached faster than P and Zn but in present research mobility of K was reduced due to synergetic effect of slow release of N and Zn. The zinc content was more at 15 and 30 cm depth as compared to 30 cm away from the plant. The movement of zinc was found to be maximum in treatment receiving NPKZn briquette through drip irrigation. The DTPA zinc decreased with depth of sampling.

Keywords: Briquettes, movement, NPKZn, Soil, Bt-Cotton

Introduction
Cotton (*Gossypium spp*.) is one of the most important commercial, non-edible commodity, produced on India's farms playing a key role in the economical and social status of world. A premier cash crop popularly known as `White Gold`, is good source of natural fibre and to some extent a supplementary source of edible oil. It contributes 29.8 per cent of the Indian agricultural gross domestic product (Sreenivasan and Ravindran, 2010) [2]. The essential plant nutrient therefore must supplied in balance form and its proper concentration in soil solution which can show its maximum capacity to produce the economic yield. The nutrient for plant growth needs to be supplied in right time and in right quantities.

Nitrogen being a highly leachable nutrient its application by split application becomes important as it is supplied ideally in a time when crop critically needs it. Bt-cotton differs in its requirement either by total or part of it in the different stages of crop. Phosphorus is another important nutrient in cotton production. It is essential for vigorous root and shoot growth, promotes early boll development, hastens maturity, helps to overcome the effects of compaction, increases water use efficiency, and is necessary for energy storage and transfer in plants. The function of potassium in plant is to increase root growth and improve drought resistance. Zinc functions generally as a metal activator of enzymes. Zinc deficiency is wide spread in Marathwada region, it varies between 62 to 89 % (Patil, 2013) [1]. Besides increasing crop yield Zn application increases the crude protein content, amino acids, energy value and total lipid.

Urea briquette which is used now-a-days supply only N as in few cases urea-DAP briquette supply N and P. It would be beneficial if all three viz. P and K with deficient micronutrient Zn nutrient are supplied in the form of briquette. It is also essential to test this type of product i.e. multi-nutrient briquette having N, P, K and Zn. The basic information on pattern of N, P, K and Zn flux to plant root at the placement of such briquette in not available. It was noticed that almost no work was reported on production and application of multinutrient briquettes supplying N, P, K and Zn in cotton crop.

Hence present investigation on **"**studies on influence of multinutrient briquettes on movement of nitrogen, phosphorus, potassium and zinc in soil of Bt-cotton**"** was planned and conducted.

Materials and Methods

The field experiments were conducted during 2015-16 at experimental farm of Department of Soil Science and Agricultural Chemistry, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani during *kharif* seasons on Typic *Haplusterts*. The field experiments were laid out in a Randomized Block Design with five treatments T_1: Absolute Control, T_2: 120:60:60 by N, P_2O_5, and K_2O kg ha^{-1} with Drip irrigation, T_3: RDF through fertigation (soluble fertilizer: 80:40:40 NPK kg ha^{-1} in six splits, T_4: 120: 60: 60 kg NPK ha^{-1} through briquettes with drip irrigation, T_5**:** Application of NPK + micronutrient briquettes (120:60: 60 NPK kg ha^{-1} + 20 $ZnSO_4$ kg ha^{-1}) and replicated four times.

Soil of experimental field was well drained, clayey in texture, alkaline in nature, within safe limit of electrical conductivity. The soil was medium in organic carbon content and non calcareous in nature. The soil fertility showed low nitrogen and phosphorus availability and very high availability of potassium. Further, the soil was low in DTPA Zn, Fe and sufficient in DTPA Mn and Cu. Soil samples were collected before sowing, at square formation, at boll formation and boll bursting stage of crop from two depths i.e. 15 cm and 30 cm deep with 15 cm and 30 cm distance away from plant from each treated plots of the layout. Soils were air dried, ground with wooden mortar and pestle and passed through 2 mm sieve. The sieved samples were stored in polythene bags with proper labelling for further analysis. All the data were subjected to analysis of variance.

Results and Discussion

Effect of multinutrient briquettes (NPKZn) on movement of Nitrogen, Phosphorus, Potassium and Zinc in soil

Effect on Available Nitrogen

The data presented in Table 1 revealed that application of multinutrient briquettes (NPKZn) caused significant changes in available nitrogen at 15 cm away from cotton plant at 15 cm and 30 cm depth the N concentration was 163.99,160.29,151.61 and 140.39 kg ha^{-1} respectively, showing it was maximum at 15 cm away at 15 and 30 cm depth in treatment T_5, T_4 and T_3 and lowest in absolute control. This indicates that the distance increases the movement of available N was also decreased with depth. Similar trend was observed at 30 cm away from cotton plant and at 15 cm and 30 cm depth. However, the available N concentration was lower than at 15 cm lateral distance. The data interpreted above clearly indicates that movement of available N was decreased with distance. The results performed to law of diffusion which states that concentration of any solute decreases with increase in distance. Movement of ammonium at the placement of USG was attributed by Gaudin (1987) mainly due to diffusion process influenced by the ion exchange.

Effect on Available Phosphorus

The available phosphorus contents in different soil layers of the profile as influenced by imposition of different treatments are given in Table 1. The P content got reduced significantly with increase in soil depth. The highest available P concentration at 15 and 30 cm away from plant and 15 and 30 cm depth was 9.57, 9.13,8.51 and 8.15 kg ha^{-1}. The Table 1 further showed that the P applied through NPK +Zn briquette left higher amount of P in soil even after the harvesting of crop. The second best treatment in respect of balanced P was T4 i.e. NPK briquettes only followed by application of soluble fertilizers through irrigation. The results were in confirmation with Sawant *et al.*, (1982) and Krishankumari *et al.*, (1993),Swarup and Yaduvanshi (2000).

Effect on Available Potassium

Results presented in Table 2 revealed that in cotton crop, available K status influenced significantly. Available-K significantly decreases with increasing soil depths and distance from the plant (15-15 cm, 15-30 cm 30-15 cm and 30-30 cm). The value of available K at 15-15 cm was (734.12 kg ha-1) and at 15-30 cm was (746.61 kg ha-1), 30-15 cm (726.87 kg ha-1) and 30-30 cm (718.87 kg ha^{-1}) with NPKZn briquettes (T_5)application followed by NPK briquettes (T_4) at 15-15 cm (729.64kg ha-1) and 15-30 cm (738.71 kg ha-1), 30-15 cm (696.90 kg ha-1) and 30-30 cm (699.40 kg ha^{-1}) which was found to be at par with T_5.In general values of soil available K were highest at 15 cm away and 15 cm deep from plant and lowest at 30 cm away and 30 cm deep from the plant. The highest value of available K in NPKZn briquettes from all soil layers was attributed to better conservation and use efficiency of this nutrient dissolvation from briquettes. Similar findings were collaborated with Kauraw (1982) [3]; Sahu (2004) and Thakur *et al.*, (2010) and Kadam, *et al.*, (2005).

Effect on Available Zinc

Data presented in Table 2 showed that available Zn differed significantly by application of fertilizers with respect to two soil depths. In surface soil i.e. at 15 cm away and 15 cm deep from the plant the highest value of available Zn was recorded in NPKZn briquettes (0.98 mg kg^{-1}) followed by NPK briquettes (0.94 mg kg^{-1}) and soluble fertilizers through drip irrigation (0.86 mg kg^{-1}) and lowest value in absolute control (0.80 mg kg^{-1}). NPKZn fertilizer dose through briquettes was at par with NPK briquettes and found to be significantly superior over rest of the treatments. The highest concentration was observed at placement site which decreased as horizontal or vertical distances increased indicating the development of concentration gradient horizontally. Similar observations were also reported by Savant *et al.*, (1982) [3].

Table 1: Effect of multinutrient briquettes on movement of available nitrogen and available Phosphorus in soil of Bt-Cotton

Treatments	Available Nitrogen (kg ha^{-1})				Available Phosphorus (kg ha^{-1})			
	15 cm away		30 cm away		15 cm away		30 cm away	
	(15 cm depth)	(30 cm depth)	(15 cm depth)	(30 cm depth)	(15 cm depth)	(30 cm depth)	(15 cm depth)	(30 cm depth)
Absolute Control (Drip irrigation)	140.39	133.08	126.37	118.59	6.53	6.44	6.51	5.60
RDF (Soil)	142.64	134.64	132.45	125.28	7.26	7.40	7.06	6.69
Soluble Fertilizers (fertigation)	151.61	149.53	144.83	129.00	8.42	8.37	7.23	7.50
NPK Briquetes with Drip	160.29	153.49	151.03	139.79	9.01	8.56	8.13	7.60
NPKZn Briquettes with Drip	163.99	156.42	159.58	148.29	9.57	9.13	8.51	8.15
S.Em (±)	2.39	1.79	3.14	1.67	0.52	0.39	0.23	0.44
CD at 5%	7.38	5.50	9.6.7	5.14	1.60	1.22	0.70	1.36

Table 2: Effect of multinutrient briquettes on movement of available potassium and DTPA zinc in soil of Bt-Cotton

Treatments	Available Potassium(kg ha^{-1})				DTPA zinc (mg kg^{-1})			
	15 cm away		30 cm away		15 cm away		30 cm away	
	(15 cm depth)	(30 cm depth)	(15 cm depth)	(30 cm depth)	(15 cm depth)	(30 cm depth)	(15 cm depth)	(30 cm depth)
Absolute Control (Drip irrigation)	620.68	625.78	658.31	663.31	0.80	0.76	0.61	0.66
RDF (Soil)	648.48	654.81	681.08	686.08	0.85	0.85	0.64	0.71
Soluble Fertilizers (fertigation)	703.52	703.49	687.97	692.97	0.86	0.85	0.69	0.73
NPK Briquetes with Drip	729.64	738.71	696.90	699.40	0.94	0.89	0.85	0.81
NPKZn Briquettes with Drip	734.12	746.61	726.87	718.87	0.98	0.92	0.90	0.89
S.Em (±)	7.69	7.72	6.08	6.36	0.03	0.03	0.03	0.04
CD at 5%	23.69	23.80	18.75	19.60	0.09	0.09	0.09	0.13

Conclusion

The maximum nitrogen was retained by treatment fertigation at all depths followed by application of briquette in root rhizoshere. The movement of nutrient P was observed at lower magnitude. It was non-significantly, however the P movement was maximum in briquettes and soluble fertilizers. The mobility rate of K is high if may leached faster than P and Zn but in present research mobility of K was reduced due to synergetic effect of slow release of N and Zn. The zinc content was more at 15 and 30 cm depth as compared to 30 cm away from the plant. The movement of zinc was found to be maximum in treatment receiving NPKZn briquette through drip irrigation. Thus, Soil fertility status i.e. available N, P, K and Zn was higher in the treatment receiving NPKZn through drip irrigation.

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