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Utilization of biomass briquette ash as source of potassium to sunflower and its effect on soil properties

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Abstract
The experiment was conducted during the Rabi season at Research Farm, Shankar Nagar, College of Agriculture, Nagpur during 2021-2022. It was laid out in Randomized Block Design with eight treatments and three replications, which comprised of recommended NP fertilizers along with water soluble potassium (WSK) and total potassium (TP) basis through biomass briquette ash (BBA) from 50-100 percent compared over recommended NPK fertilizers and absolute control. The Slight improvement in organic carbon content (4.32 - 4.84 g kg^{-1}) were recorded with its incremental effects on soil available nitrogen, phosphorus, potassium and sulphur (283.13, 14.62, 354.20 and 10.62 kg ha^{-1} and Fe, Zn, Cu and Mn (4.18, 0.76, 1.67 and 2.34 mg kg^{-1}) due to application of 100 percent of recommended NP fertilizer along with 100 percent water soluble potassium through BBA.

Keywords: Biomass briquette ash, water soluble potassium, total potassium

Introduction

The world agriculture in the last few decades has been heavily dependent on chemical fertilizers as source of plant nutrients to meet the increasing demand for food. However, in the recent years, the environmentalists and agricultural scientists have realized that continued and unbalanced use of chemical fertilizers deteriorate the soil fertility, cause environmental pollution and affect the soil microbial activity. Thus, increasing awareness is being created on the use of organics including biomass ash to sustain the soil fertility and plant productivity.

Ash from plant biomass can be used as a fertilizer in the cultivation of energy crops. Biochar and biomass ash, if applied in proper doses, have a beneficial effect on the chemical properties of soil, leading to increased crop yields. Earlier studies showed that wood ash/biomass ash is alkaline in nature and can be good conditioner for raising the soil pH for making the soil less acidic. However, use of biomass ash in alkaline soils may further increase the alkalinity of soil. Biomass ash is a good source of nutrients like calcium, magnesium, potassium and phosphorus with some trace elements require for plant growth. However, it also contents traces of heavy metals which may threatens soil environment thus caution against its use. Therefore, before going to use of biomass ash in agriculture, the detailed study to understand its effect on various soils and crops is needed.

Sunflower (*Helianthus annus* L.) is an important oilseed crop. The name "Helianthus" is derived from 'Helios' meaning 'sun' and 'anthos' meaning 'flower'. It belongs to the family Compositae. It is one of the fastest growing oilseeds crops in India. It ranks 3rd next to groundnut and soybean in the total production of oilseed in the world. It is cultivated on an area of 18.22 million hectares with an annual production and productivity of 22.03 million tones and 1216 kg ha^{-1} respectively in the world (Anonymous, 2015) [1]. Currently sunflower is grown in India on an area of 0.228 million ha with a production of 0.212 million tones and productivity of 0.93 t/ha (Indiastatagri, 2020) [7]. India shares 1.25 percent of total area and contributes 0.58 percent production of sunflower in the world.

The purpose of study is to observe the rational ways of biomass ash utilization, in particular, to analyse the possibilities and summarise the experience of its use as potassic fertilizer in agriculture. Therefore, present investigation is proposed with following objectives.

Materials and Methods

The experiment was conducted during the Rabi season at Research Farm, Shankar Nagar, College of Agriculture, Nagpur during 2021-2022. It was laid out in Randomized Block Design with eight treatments and three replications. The treatment comprises which comprised of T_1 - 100% NP + 100% WSK through BBA, T_2 - 100% NP + 75% WSK through BBA, T_3- 100% NP + 50% WSK through BBA, T_4 - 100% NP + 100% TK through BBA, T_5 -100% NP + 75% TK through BBA, T_6 -100% NP + 50% TK through BBA, T_7 - 100% RDF (80:60:30), T_8 - Absolute control. Here RDF recommended dose of fertilizer 80:60:30NPK (kg ha^{-1}). The soil samples were collected as per treatment. The observation recorded during the investigation were tabulated and subjected to statistical analysis. The result was analyzed and interpreted in accordance with the methods outlined in statistical methods for Agricultural Workers by Gomez and Gomez (1983) [5]. The physical properties viz. The bulk density of soil was determined by clod coating method (Blake and Hertz, 1986) [3] and hydraulic conductivity of soil was determined by constant head method as described by Richard (1954) [15]. The chemical properties viz. pH determined in 1:2.5 soil water suspension with the help of glass electrode using pH meter (Jackson, 1967) [8], Electrical conductivity (EC) of the soil was determined in 1:2.5 soil water suspension using conductivity bridge (Richards, 1954) [15], Organic carbon was estimated by Walkley and Black's (1934) [16] Wet Oxidation method and calcium carbonate determined by Rapid titration method as suggested by Piper (1966) [13]. Nitrogen content was determined as described by Piper (1966) [13], While phosphorus and potassium content as described by Jackson (1967) [8] and sulphur content determined by turbidity method given by Chesnin and Yien (1951) [4]. Fe, Mn, Zn and Cu content were determined by using atomic absorption spectrophotometer method given by Lindsay and Norvell (1978) [9].

Result and Discussion

Table 1: Effect of fertilizers and biomass briquette ash on physical properties of soil

Treatments	HC (cm hr^{-1})	BD (Mg m^{-3})
T_1 -100% NP + 100% WSK through BBA	0.95	1.32
T_2 -100% NP + 75% WSK through BBA	0.94	1.34
T_3 -100% NP + 50% WSK through BBA	0.94	1.34
T_4 -100% NP + 100% TK through BBA	0.94	1.34
T_5 -100% NP + 75% TK through BBA	0.94	1.35
T_6 -100% NP + 50% TK through BBA	0.94	1.35
T_7 - 100% RDF (80:60:30)	0.94	1.37
T_8 - Absolute control	0.93	1.37
S. E. (m±)	0.01	0.02
C. D. @ 5%	NS	NS

Table 2: Effect of fertilizers and biomass briquette ash on chemical properties of soil

Treatments	Soil pH	EC (dSm^{-1})	$CaCO_3$ (%)	OC (g kg^{-1})
T_1 -100% NP + 100% WSK through BBA	7.98	0.31	1.85	4.84
T_2 -100% NP + 75% WSK through BBA	7.94	0.31	1.87	4.72
T_3 -100% NP + 50% WSK through BBA	7.94	0.29	1.88	4.62
T_4 -100% NP + 100% TK through BBA	7.96	0.31	1.89	4.62
T_5 -100% NP + 75% TK through BBA	7.96	0.31	1.89	4.51
T_6 -100% NP + 50% TK through BBA	7.97	0.28	1.89	4.50
T_7 - 100% RDF (80:60:30)	7.98	0.29	1.87	4.61
T_8 - Absolute control	8.00	0.28	1.90	4.32
S. E. (m±)	0.019	0.008	0.005	0.007
C. D. @ 5%	NS	NS	NS	0.46

Table 3: The effect of fertilizers and biomass briquette ash on available nutrients status of soil

Treatments	Available nutrients (kg ha^{-1})			
	N	P	K	S
T_1 -100% NP + 100% WSK through BBA	283.13	14.62	354.20	10.62
T_2 -100% NP + 75% WSK through BBA	278.00	14.01	345.73	10.55
T_3 -100% NP + 50% WSK through BBA	275.97	14.43	343.05	10.52
T_4 -100% NP + 100% TK through BBA	274.23	14.21	329.00	10.45
T_5 -100% NP + 75% TK through BBA	275.80	14.23	324.60	10.36
T_6 -100% NP + 50% TK through BBA	275.50	14.08	324.77	10.54
T_7 - 100% RDF (80:60:30)	281.49	14.17	348.48	10.30
T_8 - Absolute control	263.61	13.66	293.80	9.72
S. E. (m±)	2.04	0.19	3.12	0.19
C. D. @ 5%	6.19	NS	9.47	NS

Table 4: The effect of fertilizers and biomass briquette ash on micronutrient status of soil

Treatments	Micronutrients (mg kg^{-1})			
	Fe	Zn	Cu	Mn
T_1 -100% NP + 100% WSK through BBA	4.18	0.76	1.67	2.34
T_2 -100% NP + 75% WSK through BBA	3.92	0.71	1.56	2.31
T_3 -100% NP + 50% WSK through BBA	3.77	0.69	1.56	2.19
T_4 -100% NP + 100% TK through BBA	3.63	0.58	1.34	2.09
T_5 -100% NP + 75% TK through BBA	3.52	0.57	1.11	2.07
T_6 -100% NP + 50% TK through BBA	3.14	0.44	0.78	1.75
T_7 - 100% RDF (80:60:30)	3.23	0.45	0.71	1.51
T_8 - Absolute control	3.04	0.42	0.64	1.69
S. E. (m±)	0.10	0.02	0.05	0.06
C. D. @ 5%	0.32	0.08	0.16	0.18

Effect of fertilizers and biomass briquette ash on physical properties of soil

The hydraulic conductivity generally shows the drainable status of the soil and gives a measure of the overall structural condition of the soil. The data regarding hydraulic conductivity of the soil revealed that, incorporation of biomass briquette ash as a source of plant nutrient improved the drain ability and also improved the physical condition of the experimental soil. The data also revealed that, the maximum hydraulic conductivity (0.95 cm hr^{-1}) was recorded by treatment which received 100% of NP fertilizers along with 100% WSK through BBA (T_1). Iderawumi (2020) [6] recorded beneficial effects plant derived ash on soil structure and physical properties, further it was found improvement in hydraulic properties of soil and this was attributed to the presence of cations, especially Ca. Ash applied to unburnt soils contained some organic matter, which helped to improve soil structure and reduced bulk density and penetrometer resistance. The lowest bulk density of soil was recorded by the treatment received 100% of NP fertilizers along with 100% WSK through BBA (T_1- 1.32 Mg m^{-3}) and high bulk density (1.37 Mg m^{-3}) was observed where recommended NPK fertilizers applied (T_7) and absolute control (T_8). The reduction in bulk density might be due to the presence of ash which might have improved the structure of the soil and made the structure crumb and also increased the porosity of the soil which is essential for the growth and development of the crop. Addition of only NPK fertilizers and no fertilizers and ash or any other organic manure found increased in bulk density of soil. These findings are in conformity with those earlier reported by Zakari *et al.*, (2019) [17] who stated impact of ash decreased bulk density.

Effect of fertilizers and biomass briquette ash on chemical properties of soil

The chemical properties of soil are as influenced by application of fertilizers and biomass briquette ash presented in table 2. It revealed that due to application 100% recommended NP fertilizers along with biomass briquette ash not influenced the soil pH, EC, $CaCO_3$ and results were non-significant. It varied in soil from 7.94 to 8.00, 0.28 to 0.31 dS m^{-1}, 1.85 to 1.90 percent respectively. However, organic carbon content was significantly influenced and recorded significantly maximum organic carbon (4.84 g kg^{-1}) due to application of 100% of NP fertilizers along with 100% WSK through BBA (T_1) over absolute control (4.32 g kg^{-1}) and it was at par with all other treatments (T_2 to T_7). Nwite *et al.*, (2011) [10] recorded after application of three different ash (rice husk ash, wood ash, and leaf ash) to soil @ 3 tons ha^{-1}, improved soil properties under maize crop. The soil organic carbon was significantly improved (0.49 to 0.57%) in all the ash-amended plots compared to the control. Alzamel *et al.*, (2022) [2] recorded use of two organic fertilizers from various sources and comparing them to conventional inorganic fertilizers were found improved soil properties and mainly soil organic carbon content in soil.

Effect of fertilizers and biomass briquette ash on available nutrient status of soil

The available nutrient status of soil are influenced by application of fertilizers and biomass briquette ash presented in table 3. It has been revealed the significant changes in soil for available nitrogen (283.13 kg ha^{-1}) and potassium (354.20 kg ha^{-1}) were recorded with the application of 100% nitrogen and phosphorus fertilizer along with 100% water soluble potassium through biomass briquette ash (T_1) over all other levels accept application of 100% nitrogen and phosphorus fertilizer along with 75% water soluble potassium through biomass briquette ash (T_2) and recommended NPK fertilizers level (T_7). It indicates, the role of biomass briquette ash as it's a source of potassium. Whereas, soil available phosphorus and sulphur were found non-significant. The results are in conformity with those earlier recorded by Ojeniyi *et al.*, (2017) [11] they reported that, there were increase in available nitrogen and potassium by the use of different rates of wood ash @ 0 to 6 t ha^{-1} in cowpea crop. They further observed soil potassium increased with rate of ash. Similarly Piekarczyk *et al.*, (2017) [12] reported use of ash from cereal crop and oilseed rape straw can be used for soil, since it is a source of elements available to plants. The use of straw ash in a dose of 2.68 g kg^{-1} of soil significantly increased the content of available potassium and magnesium by 48.3% and 93.3%, respectively.

Effect of fertilizers and biomass briquette ash on micronutrient status of soil

The micronutrient status of soil are influenced by application of fertilizers and biomass briquette ash presented in table 4. Maximum Fe, Zn, Cu and Mn (4.18, 0.76, 1.67 and 2.34 mg kg^{-1}) was recorded with application of 100% of nitrogen, phosphorus fertilizer along with 100% water soluble potassium through biomass briquette ash (T_1), over all other lower level except application of 100 of nitrogen phosphorus fertilizer and 50 to 100% water soluble potassium through biomass briquette ash (T_2 and T_3). While Low Fe, Zn, Cu and Mn (3.04, 0.42, 0.64 and 1.69 mg kg^{-1}) was recorded in absolute control. These results are in conformity with the findings of Ramamurthy *et al.*, (2019) [14] application of application of 5 tons FYM / ha on sunflower field resulted micronutrients Fe, Mn, Zn and Cu range varied from 2.33-15.59, 18.3-59.39, 0.09-14.66 and 0.79 -2.45 (mg kg^{-1}) were found. Piekarczyk *et al.*, (2017) [12] reported use of ash from cereal crop and oilseed rape straw can be used for soil fertilization since it is a source of elements available to plants. The use of straw ash in a dose of 2.68 g kg^{-1} of soil significantly increased the content of available magnesium by 93.3%, respectively.

Conclusion

The application biomass briquette ash as source of potassium to soil, increase the organic-C content of soil and improved the available nitrogen and potassium in soil.

References

1. Anonymous. Annual Group Meeting on Sunflower, Project Director's Report, Indian Institute of Oilseed Research, Hyderabad; c2015.
2. Alzamel NM, Taha EMM, Bakr AAA, Loutfy N. Effect of organic and inorganic fertilizers on soil properties, growth yield, and physiochemical properties of sunflower seeds and oils. Sustainability. 2022;14:12928.
3. Blake GR, Hartz KH. Methods of soil analysis part-I, Klute, A. (Ed.). American Society of Agronomy Inc. and Soil Science Society of America Inc. Madison, Wisconsin, USA, pp. 371-373. ies. Agropedology. 1986;17:1-15.
4. Chesnin L, Yien CH. Turbidimetric determination of available sulphur in soil. Soil Sci. Soc. Of America Proceed. 1951;15:149-151.
5. Gomez KA, Gomez AA. Statistical procedures for agriculture research. John Wiely and Sons, New York; c1983.
6. Iderawumi MA. Effects of ash on soil properties and yield of crops. Agriculture Observer. 2020;1:3.
7. Indiastatagri; c2021. https://www.indiastatagri.com/.
8. Jackson ML. 'Soil Chemical Analysis'. Prentice Hall of India Pvt. Ltd: New Delhi; c1967.
9. Lindsay WL, Norvell WA. Development of DTPA soil test for Zinc, Iron, Manganese and Copper. Soil Sci. So.Am. J. 1978;42:421-428.
10. Nwite JC, Igwe CA, Obalum SE. The contributions of different ash sources to the improvement in properties of a degraded ultisol and maize production in southeastern Nigeria. Am-Eu. J Sustain. Agric. 2011;5:34-41.
11. Ojeniyi SO, Oyatoye A, Iderawumi MA. Use of Ash for Soil Fertility Improvement and effect on Cowpea. Nigeria Journal of Soil Science. 2017;27:216-222.
12. Piekarczyk M, Kobierski M, Gałęzewski L. The influence of the application of barley, wheat and rape straw ash into sandy soil on the changes of soil reaction and the content of available phosphorus, potassium and magnesium. Acta Sci. Pol. Agricultura. 2017;16(3):139-146.
13. Piper CS. Soil and Plant Analysis. Hans Publishers, Bombay; c1966. p. 368.
14. Ramamurthy V, Satish Kumar GD, Aziz Qureshi MA, Bhaskar BP. Performance of Sunflower in Relation to Soil Types and Management Levels. International Journal of Current Microbiology and Applied Sciences. 2019;10:1186-1195.
15. Richard LA. Diagnosis and Improvement of Saline and Alkali Soils. Agricultural Handbook 60, US Department, Washington DC; c1954. p. 160.
16. Walkley AJ, Black AI. Estimation of organic carbon by chromic acid titration method. Soil Science. 1934;25:255-259.
17. Zakari MD, Babangida I, Ibrahim A, Nasidi NM, Shanono NJ, Mohammed D, *et al*. Effect of Rice Straw Ash on Soil Properties and Yield of Cucumber. Algerian Journal of Engineering and Technology. 2019;1(1):025-031.