The Pharma Innovation Journal 2022; 11(8): 604-609

www.ThePharmaJournal.com

The Pharma Innovation

**ISSN (E): 2277-7695**
**ISSN (P): 2349-8242**
**NAAS Rating: 5.23**
TPI 2022; 11(8): 604-609

www.thepharmajournal.com
Received: 06-05-2022
Accepted: 15-06-2022

**MVVI Annapurna**
Department of Soil Science and Agricultural Chemistry, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

**AL Pharande**
Department of Soil Science and Agricultural Chemistry, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

**AD Kadlag**
Department of Soil Science and Agricultural Chemistry, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

**AG Durgude**
Department of Soil Science and Agricultural Chemistry, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

**Corresponding Author:**
**MVVI Annapurna**
Department of Soil Science and Agricultural Chemistry, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

# Effect of cogenerated bagasse ash on growth, yield and quality of sugarcane

**MVVI Annapurna, AL Pharande, AD Kadlag and AG Durgude**

## Abstract
The present investigation was conducted during 2016-18 on an Inceptisol of Rahuri, Maharashtra to evaluate the effect of cogenerated bagasse ash on growth, yield and quality of sugarcane. The experiment laid out in randomized block design with 3 replications and comprised of 9 treatments. The results showed that growth parameters and yield of sugarcane increased significantly with increasing rates of potassium through cogenerated bagasse ash over the control. The application of 6.62 t ha$^{-1}$ cogenerated bagasse ash along with recommended dose of N, $P_2O_5$ (340 and 170kg ha$^{-1}$) through chemical fertilizers and 20 t ha$^{-1}$ FYM is recommended for getting higher number of millable canes (86.41 x 10$^3$ ha$^{-1}$), cane yield (146.71 t ha$^{-1}$) and commercial cane sugar yield (19.58 t ha$^{-1}$). These results clearly indicated that the cogenerated bagasse ash can be used as a substitute for potash fertilizer in particular and as a source of carbon as well as other source of plant nutrients in general. The addition of 150% recommended dose of potassium through cogenerated bagasse ash (6.62 t ha$^{-1}$) has substituted 100% recommended dose of potassium through inorganic fertilizer (Muriate of Potash) requirement of sugarcane crop.

**Keywords:** Cogenerated bagasse ash, sugarcane yield, recommended dose, potassium

## Introduction
Bagasse ash is one of the industrial wastes obtained from sugar industries during the process of sugar manufacturing. After crushing and extracting juice from sugarcane, the remaining straw is called bagasse and this bagasse is often used as a primary fuel source for sugar mills. When it burned in bulk quantity, it produces sufficient heat energy to supply all the needs of a typical sugar mill. The ash produced after cogeneration is called as "cogenerated bagasse ash" (CBA). The dumping of this industrial waste in open land poses a serious threats to the environment by polluting the air and water bodies. This also reduce the availability of land for public use. The extraction of all economical cane sugar from sugarcane, 40-45% fibrous residue was obtained, which is reused in the same industry as fuel in boilers for heat generation leaving behind 8-10% ash as waste, known as sugarcane bagasse ash (SCBA). The huge amount of bagasse ash always created disposal problems for the sugar mills owners, municipal administration and environmental organizations. Keeping in view the nutritive importance of this industrial waste and its positive effects on the yield of cereal crops (Sharma *et al*., 2001; Kumar *et al*., 1999) [1, 2], its utilization in agriculture field will solve the disposal problem of this waste. Bagasse ash contains significant amount of plant nutrients and organic matter which helps in the improvement of soil properties (Jamil *et al*., 2004) [3]. So, its ecofriendly use in agriculture as a source of nutrients for crop production is a good alternative for disposal. Anguissola *et al*., (1999) [4] consider bagasse ash as a good source of micronutrients like, Fe, Mn, Zn and Cu. It can also be used as soil additive due to its capacity to supply the plants with nutrients (Carlson and Adriano, 1993) [5]. Bagasse ash not contains nitrogen, but there are commonly high concentrations of potash and phosphorus (Page *et al*., 1979) [6]. Along with positive effect on soil nutrient status, bagasse ash also has produced increased yield of wheat crop (Mlynkowiak, 2001) [7] and sugar cane (Hallmark *et al*., 1998) [8]. Therefore, its use in agriculture for crop production will be proved more beneficial.

Sugarcane industries are age old industrial practice in India which contribute a significant amount of byproducts as waste. One ton of sugarcane can generate approximately 26 per cent of bagasse and 0.62 per cent of residual ash. Bagasse ash is a solid waste of economic importance which is produced as a byproduct from the sugar manufacturing industry in huge quantities. India is one of the leading producers of sugar, this waste is generated in huge quantities leading to potential disposal problems without effective management techniques. Handling and management of these byproducts are huge task, because those require lot of space for storage. However, it provides opportunity to utilize these by-products in agricultural crop production as nutrient source. Neither chemical fertilizers nor organic manures alone, but their integrated use has been observed to be highly beneficial for the sustainable sugarcane production. Integrated nutrient management (INM), involves the integrated use of mineral fertilizer together with organic manures/industrial agricultural wastes in suitable combination complementing each other to optimize input use and maximize production with reducing cost of production and sustain the same without impairing the crop quality and soil health. It enables gainful utilization of wastes or underutilized renewable resources.

Sugarcane is a long duration and nutrient exhaustive crop which removes about 2.05, 0.24 and 2.28kg NPK/tonne of cane produced (Singh *et al.*, 2007) [9]. Balanced nutrition is one of the critical components in augmenting crop production. Among the nutrients, potassium is an important nutrient contributing to production and quality of sugarcane. Potassium plays an essential role in numerous physiological processes in the crop and adequate supplies of K are crucial for sustainable and profitable sugarcane production. Potassium fulfils a number of important roles in plant growth (Anderson and Bowen, 1990 and Calcino, 1994) [10, 11], while K deficiency can result in reduced cane yields and lower commercial cane sugar values. It is required for cells structure, carbon assimilation, photosynthesis, protein synthesis, starch formation, translocation of proteins and sugars and entry of water into plants. More than 60 enzymes are activated by potassium and it is basic to sugarcane for synthesis and accumulation of sugar (Clements, 1980) [12]. Potassium helps sugarcane under moisture stress by maintaining cell turgidity. The most important function of K in sugarcane is improvement in cane quality by converting reducing sugars to recoverable sugars. Potassium is directly associated with the quality of canes as it improves pol (%) in cane.

## Materials and Methods

Field investigation was conductrd to study the effect of cogenerated bagasse ash on growth, yield and quality of sugarcane during 2016-18 at Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, (Maharashtra). The soil of the experimental area was clay in texture and belonging to order Inceptisol. The surface soil (0-15cm depth) was low in available N (190kg ha$^{-1}$), medium in organic carbon (0.56%) and available P (15.68kg ha$^{-1}$) and high in available K (537kg ha$^{-1}$), having pH 8.06 and an EC of 0.32 DS m$^{-1}$. The experiment was laid out in randomized block design with nine treatments and three replications consisting of different levels of recommended dose of potassium through cogenerated bagasse ash. The treatment details were: $T_1$: Absolute control, $T_2$: GRDF - N:$P_2O_5$:$K_2$0 (340:170:170kg ha$^{-1}$) + FYM 20 t ha$^{-1}$ (K through MOP), $T_3$: 0% RDK through cogenerated bagasse ash, $T_4$: 25% RDK through cogenerated bagasse ash i.e. 1.10 t ha$^{-1}$, $T_5$: 50% RDK through cogenerated bagasse ash i.e. 2.20 t ha$^{-1}$, $T_6$: 75% RDK through cogenerated bagasse ash i.e. 3.31 t ha$^{-1}$, $T_7$: 100% RDK through cogenerated bagasse ash i.e. 4.42 t ha$^{-1}$, $T_8$: 125% RDK through cogenerated bagasse ash i.e. 5.52 t ha$^{-1}$ and $T_9$: 150% RDK through cogenerated bagasse ash i.e. 6.62 t ha$^{-1}$. For treatments $T_3$ to $T_9$ the recommended dose of N, $P_2O_5$ (340:170kg ha$^{-1}$) and FYM 20 t ha$^{-1}$ were applied are common.

Cogenearated bagasse ash was collected from the dumping sites of Padmashri Dr. Vitthalrao Vikhe Patil Cooperative Sugar Factory Ltd., Pravaranagar, Tal. Rahata, Dist. Ahmednagar (Maharashtra) to use in the present investigation. The cogenerated bagasse ash was analyzed for its physico-chemical properties as described by Lim and Jackson (1982) [13], which are presented in Table 1. The cogenearated bagasse ash was applied to the soil before planting as per the treatments. The crop was managed by adopting standard package of practices. The various growth, yield and quality parameters were recorded at appropriate stages of the sugarcane crop.

**Table 1:** Physico-chemical characteristics of soil

| Sr. No. | Characteristics | Value |
|---|---|---|
| 1 | pH (1:2.5) | 8.06 |
| 2 | EC (DS m$^{-1}$) | 0.32 |
| 3 | Organic carbon (%) | 0.56 |
| 4 | $CaCO_3$ (%) | 6.00 |
| 5 | Available Nitrogen (kg ha$^{-1}$) | 190 |
| 6 | Available Phosphorus (kg ha$^{-1}$) | 15.68 |
| 7 | Available Potassium (kg ha$^{-1}$) | 537 |
| 8 | Available Sulphur (kg ha$^{-1}$) | 19.64 |
| 9 | Fe (mgkg$^{-1}$) | 7.37 |
| 10 | Mn (mgkg$^{-1}$) | 15.31 |
| 11 | Zn (mgkg$^{-1}$) | 0.71 |
| 13 | Cu (mgkg$^{-1}$) | 2.83 |
| 14 | Cd (mgkg$^{-1}$) | 0.045 |
| 15 | Cr (mgkg$^{-1}$) | 0.81 |
| 16 | Ni (mgkg$^{-1}$) | 0.89 |
| 17 | PB (mgkg$^{-1}$) | 0.71 |

**Table 2:** Characterization of cogenerated bagasse ash

| Sr. No. | Characteristics | Value |
|---|---|---|
| 1 | pH (1:10) | 9.51 |
| 2 | EC (1:10) (DS m$^{-1}$) | 4.57 |
| 3 | Total organic carbon (%) | 10.56 |
| 4 | Total N (%) | 0.35 |
| 5 | Total $P_2O_5$ (%) | 1.22 |
| 6 | Total $K_2O$ (%) | 3.85 |
| 7 | Ca (%) | 0.52 |
| 8 | Mg (%) | 0.55 |
| 9 | Na (%) | 0.13 |
| 10 | Fe (μg g$^{-1}$) | 2400 |
| 11 | Mn (μg g$^{-1}$) | 303 |
| 13 | Zn (μg g$^{-1}$) | 116 |
| 14 | Cu (μg g$^{-1}$) | 67 |
| 15 | Cd (μg g$^{-1}$) | 20 |
| 16 | Cr (μg g$^{-1}$) | 220 |
| 17 | Ni (μg g$^{-1}$) | 29 |
| 18 | PB (μg g$^{-1}$) | 250 |
| 19 | C:N | 30:1 |

## Results and Discussion

### Germination

The germination percentage of sugarcane was not influenced due to treatments at 45 DAP which are reported in Table 3. The germination essentially depends upon the sett moisture and total sugar content of the sett (Hunsigi, 1993) [14].

### Tillering ratio

Addition of cogenerated bagasse ash (CBA) in general showed significant improvement in tillering ratio (Table 3). The treatment T9 receiving 150% RDK through CBA significantly recorded the higher tillering ratio at 120 DAP (13.73) and the treatment T1 (absolute control) significantly recorded the lower tillering ratio at 120 DAP (5.20). Singh *et al*., (1992) [15] and Jamil and Qasim (2008) [16] also reported increase in the number of tillers could be attributed due to improvement in soil physical and chemical properties and abundance of different nutrients by the addition of bagasse ash and mineral fertilizers.

**Table 3:** Effect of cogenerated bagasse ash on germination and tillering ratio of sugarcane

| Treatments | Germination (%) 45 DAP | Tillering ratio 120 DAP |
|---|---|---|
| T1- Absolute control | 68 | 5.20 |
| T2- GRDF (340:170:170kg $ha^{-1}$ N:$P_2O_5$:$K_2O$ + 20 t $ha^{-1}$ FYM) (K through MOP) | 62 | 10.27 |
| T3- 0% RDK through CBA | 71 | 7.77 |
| T4- 25% RDK through CBA | 65 | 8.67 |
| T5- 50% RDK through CBA | 66 | 9.23 |
| T6- 75% RDK through CBA | 77 | 9.77 |
| T7- 100% RDK through CBA | 68 | 11.23 |
| T8- 125% RDK through CBA | 70 | 11.83 |
| T9- 150% RDK through CBA | 73 | 13.73 |
| S.Em. ± | 4.36 | 0.19 |
| CD (P= 0.05%) | NS | 0.58 |

**Growth parameters**

The growth parameters of sugarcane *viz*. total plant height, mill able cane height, length of internode, girth of internode and number of internodes at harvest were significantly influenced by the application of different levels of RDK through cogenerated bagasse ash over control are reported in Table 4. The highest total plant height (391.13cm), millable cane height (351.93cm), length of internode (15.60cm), girth of internode (12.10cm) and number of internodes (26) were recorded in the treatment T9 receiving 150% RDK through CBA (6.62 t $ha^{-1}$) along with recommended dose of N, $P_2O_5$ (340 and 170kg $ha^{-1}$) through inorganic fertilizers and 20 t $ha^{-1}$ FYM. The plant height might have increased due to abundant supply of S, K and micronutrients by cogenerated bagasse ash which in turn improved soil physical conditions was also reported by Jamil and Qasim (2008) [16]. The increase in growth attributing characters might be due to the pronounced effect of cogenerated bagasse ash on growth, dry matter production, chlorophyll content and increased uptake of nutrients (Patil and Shinde, 1995 and Ramana *et al.* 2002) [17, 18] and better soil physical properties (Hati *et al*. 2004) [19].

**Table 4:** Effect of cogenerated bagasse ash on growth parameters of sugarcane at harvest

| Treatments | Total plant height (cm) | Mill able cane height (cm) | Length of internode (cm) | Girth of internode (cm) | No. of internodes |
|---|---|---|---|---|---|
| T1- Absolute control | 303.07 | 251.60 | 10.27 | 8.77 | 16 |
| T2- GRDF (340:170:170kg $ha^{-1}$ N:$P_2O_5$:$K_2O$ + 20 t $ha^{-1}$ FYM) (K through MOP) | 362.07 | 308.93 | 13.40 | 11.10 | 23 |
| T3- 0% RDK through CBA | 318.93 | 259.73 | 10.77 | 9.10 | 17 |
| T4- 25% RDK through CBA | 332.40 | 268.87 | 11.30 | 9.83 | 19 |
| T5- 50% RDK through CBA | 345.67 | 278.13 | 11.83 | 10.53 | 20 |
| T6- 75% RDK through CBA | 353.73 | 290.27 | 12.67 | 10.93 | 22 |
| T7- 100% RDK through CBA | 369.80 | 326.00 | 13.87 | 11.20 | 24 |
| T8- 125% RDK through CBA | 378.93 | 338.13 | 14.63 | 11.33 | 25 |
| T9- 150% RDK through CBA | 391.13 | 351.93 | 15.60 | 12.10 | 26 |
| S.Em. ± | 2.57 | 3.80 | 0.24 | 0.23 | 0.41 |
| CD (P= 0.05%) | 7.71 | 11.40 | 0.72 | 0.68 | 1.24 |

**Effect of cogenerated bagasse ash on yield of sugarcane**

**Number of millable canes**

The number of millable canes of sugarcane at harvest was increased significantly with the increasing levels of RDK through cogenerated bagasse ash over control (Table 5). Application of 150% RDK through CBA along with recommended dose of N,$P_2O_5$ and 20 t $ha^{-1}$ FYM significantly recorded the highest number of millable canes at harvest (86.41 x $10^3$ $ha^{-1}$) than GRDF-100% RDK through MOP (79.29 x $10^3$ $ha^{-1}$). However, it was statistically on par with the treatment 125% RDK through CBA (83.43 x $10^3$ $ha^{-1}$). The treatment absolute control significantly recorded the lowest number of millable canes at harvest of sugarcane (67.15 x $10^3$ $ha^{-1}$). The significant increase in number of millable canes of sugarcane with the application of increased level of cogenerated bagasse ash might be attributed to the increased availability of nutrients and its favourable effect on soil physical and biological conditions and favourable soil processes. These results corroborate with the findings of Das *et al*. (2015) [20] and Hamsa *et al*. (2017) [21].

**Cane yield**

The cane yield is mainly a function of supply of nutrients from soil in large quantities and their timely utilization in metabolic processes, which results in buildup of sugarcane (Joshi and Pawar, 2005) [22]. The cane yield of sugarcane ranged between 85.33 t $ha^{-1}$ and 146.71 t $ha^{-1}$ in control and treatment respectively (Table 5). The effect of various levels of RDK through cogenerated bagasse ash on cane yield at harvest was increased significantly (Table 6). Among the treatments, the highest cane yield of 146.71 t $ha^{-1}$ was obtained with T9 receiving 150% RDK through CBA along with recommended dose of N, $P_2O_5$ (340 and 170kg $ha^{-1}$) and 20 t $ha^{-1}$ FYM. It is interesting to observe that, the treatment

T9 recorded the highest cane yield where K fertilizer (MOP) was substituted by cogenerated bagasse ash. From the results it was evident that increasing levels of RDK through CBA increased the cane yield of sugarcane which might be due to improved physical properties and availability of nutrients in the soil.

## Top yield

The top yield of sugarcane at harvest varied significantly with the increasing levels of RDK through cogenerated bagasse ash over control are reported in Table 5. The treatment 150% RDK through CBA significantly recorded the highest top yield (16 t $ha^{-1}$) and the treatment absolute control significantly recorded the lowest top yield at harvest (9.74 t $ha^{-1}$).

Application of 150% RDK through CBA along with recommended dose of N, $P_2O_5$ (340 and 170kg $ha^{-1}$) and 20 t $ha^{-1}$ FYM significantly recorded the highest cane and top yield of sugarcane at harvest compared to GRDF-100% RDK through MOP. This might be due to supply of nutrients, conducive physical and biological environment leading to better aeration, increase in soil moisture holding capacity, root activity and nutrient absorption and the consequent complementary effect of CBA have resulted in higher top and cane yield of sugarcane. Selvakumari *et al*. (2000) [23] and Yeledhalli *et al*. (2008) [24] were also reported similar observations of increase in yield due to addition of fly ash in rice and sunflower crops.

## Commercial cane sugar yield

The application of cogenerated bagasse ash significantly increased commercial cane sugar yield over the control. The effect of different levels of RDK through cogenerated bagasse ash on commercial cane sugar yield of sugarcane at harvest was given in Table 5. Though there is gradual increase in commercial cane sugar yield with the increasing levels of RDK through cogenerated bagasse ash, the highest commercial cane sugar yield was significantly recorded in T9 i.e., 150% RDK through CBA along with recommended dose of N, $P_2O_5$ and 20 t $ha^{-1}$ FYM (19.58 t $ha^{-1}$) compared to T2 GRDF-100% RDK through MOP (16.85 t $ha^{-1}$). This was statistically on par with the treatment 125% RDK through CBA along with recommended dose of N, $P_2O_5$ and 20 t $ha^{-1}$ FYM (19.06 t $ha^{-1}$). The treatment T1, absolute control significantly recorded the lowest commercial cane sugar yield (11.60 t $ha^{-1}$). The significant increase in commercial cane sugar yield of sugarcane might be due to presence of essential nutrients in cogenerated bagasse ash and it is a source of major and micronutrients. These results are in conformity with the earlier findings of Kumar *et al.* (1999) [2], Jamil and Qasim (2008) [16], Thind *et al.* (2012) [25] and Sinha *et al.* (2014) [26].

**Table 5:** Effect of cogenerated bagasse ash on number of millable canes, cane, top and CCS yield of sugarcane

| Treatments | No. of millable canes (‘000’ $ha^{-1}$) | Cane (t $ha^{-1}$) | Top (t $ha^{-1}$) | CCS (t $ha^{-1}$) |
|---|---|---|---|---|
| T1- Absolute control | 67.15 | 85.33 | 9.74 | 11.60 |
| T2- GRDF (340:170:170kg $ha^{-1}$ N:$P_2O_5$:$K_2O$ + 20 t $ha^{-1}$ FYM) (K through MOP) | 79.29 | 128.67 | 13.56 | 16.85 |
| T3- 0% RDK through CBA | 72.22 | 108.28 | 10.60 | 14.81 |
| T4- 25% RDK through CBA | 73.64 | 112.26 | 11.74 | 15.28 |
| T5- 50% RDK through CBA | 75.37 | 117.02 | 12.13 | 15.76 |
| T6- 75% RDK through CBA | 77.26 | 123.58 | 12.47 | 16.57 |
| T7- 100% RDK through CBA | 80.56 | 135.39 | 14.08 | 18.38 |
| T8- 125% RDK through CBA | 83.43 | 141.16 | 14.74 | 19.06 |
| T9- 150% RDK through CBA | 86.41 | 146.71 | 16.00 | 19.58 |
| S.Em. ± | 1.11 | 1.33 | 0.39 | 0.37 |
| CD (P= 0.05%) | 3.32 | 3.99 | 1.18 | 1.12 |

## Juice quality of sugarcane

The juice quality parameters *viz* brix, sucrose, purity, reducing sugars per cent and CCS per cent of sugarcane at harvest were not influenced by different levels of RDK through cogenerated bagasse ash (CBA) are reported in Table 6. Moreover, the different levels of K failed to influence the juice quality parameters *viz*., brix, sucrose, purity, reducing sugars per cent and CCS per cent. Similar findings were also reported by Ramesh and Sumansusan (2000) [27], Singh *et al*. (2007) [9] and Sinha *et al*. (2014) [26].

**Table 6:** Effect of cogenerated bagasse ash on juice quality of sugarcane at harvest

| Treatments | Brix ($^0$C) | Sucrose (%) | Purity (%) | Reducing sugars (%) | CCS (%) |
|---|---|---|---|---|---|
| T1- Absolute control | 19.92 | 18.99 | 95.32 | 0.27 | 13.59 |
| T2- GRDF (340:170:170kg $ha^{-1}$ N:$P_2O_5$:$K_2O$ + 20 t $ha^{-1}$ FYM) (K through MOP) | 19.75 | 18.45 | 93.37 | 0.29 | 13.09 |
| T3- 0% RDK through CBA | 20.25 | 19.16 | 94.62 | 0.26 | 13.67 |
| T4- 25% RDK through CBA | 19.42 | 18.87 | 97.18 | 0.29 | 13.61 |
| T5- 50% RDK through CBA | 19.59 | 18.78 | 95.90 | 0.30 | 13.47 |
| T6- 75% RDK through CBA | 19.75 | 18.76 | 94.96 | 0.25 | 13.41 |
| T7- 100% RDK through CBA | 19.59 | 18.92 | 95.84 | 0.30 | 13.57 |
| T8- 125% RDK through CBA | 19.92 | 18.91 | 94.91 | 0.32 | 13.51 |
| T9- 150% RDK through CBA | 19.25 | 18.56 | 96.44 | 0.29 | 13.34 |
| S.Em. ± | 0.36 | 0.33 | 1.21 | 0.072 | 0.26 |
| CD (P= 0.05%) | NS | NS | NS | NS | NS |

**Residual soil fertility**

The residual soil macro and micronutrients at harvest showed enhanced availability with application of cogenerated bagasse ash and the effect was more pronounced by addition of 150% RDK through CBA (6.62 t $ha^{-1}$) along with recommended dose of N, $P_2O_5$ (340 and 170kg $ha^{-1}$) through inorganic fertilizers and 20 t $ha^{-1}$ FYM. The higher soil macro and micronutrients values were recorded in the treatment T9 receiving 150% RDK through CBA compared to T2 (GRDF-K through MOP) (Data not shown). The increased availability is an indication of increased growth and yield of sugarcane.

**Conclusion**

From the present study it can be concluded that the integrated use of cogenerated bagasse ash @ 150% RDK (6.62 t $ha^{-1}$) along with recommended dose of N, $P_2O_5$ (340 and 170kg $ha^{-1}$) through inorganic fertilizers and 20 t $ha^{-1}$ FYM not only increased the cane and sugar yield but has also influenced favourably the various growth and yield parameters of sugarcane such as tillering ratio, total plant height, millable cane height, length of internode, girth of internode and number of internodes at harvest. Further, the data revealed application of 150% RDK through cogenerated bagasse ash (6.62 t $ha^{-1}$) has substituted 100% of K fertilizer requirement of sugarcane crop and thereby reducing the cost of fertilizer. Thus tapping the nutrient potential of cogenerated bagasse ash could augment and sustain the sugarcane production and as well as a viable option for safe disposal of this industrial waste.

**Acknowledgement**

The authors are grateful to the Department of Science and Technology INSPIRE for their financial assistance and Padmashri Dr. Vitthalrao Vikhe Patil Cooperative Sugar Factory Ltd., for providing the cogenerated bagasse ash.

**References**

1. Sharma SK, Karla N, Singh GR. Impact of coal burnt ash on environment and crop productivity. Journal of Scientific and Industrial Research. 2001;60:580-585.
2. Kumar A, Sarkar AK, Singh RP, Sharma VN. Effect of fly ash and fertilizer levels on yield and trace metal uptake by soybean and wheat crops. Journal of the Indian Society of Soil Science. 1999;47:744–8.
3. Jamil M, Qasim M, Umar M, Subhan A. Impact of organic wastes (bagasse ash) on the yield of wheat (Triticum aestivum L.) in a calcareous soil. International Journal of Agriculture and Biology. 2004;3:468-470.
4. Anguissola S, Silva S, Botteschi G. Effect of fly ash on the availability of Zn, Cu, Ni and Cd to chicory. Agriculture Ecosystems and Environment. 1999;72:159-163.
5. Carlson CL, Adriano DC. Environmental impacts of coal combustion on residues. Journal of Environment Quality. 1993;22:227-247.
6. Page AL, Elseewi AA, Straughan IR. Physical and chemical properties of fly ash from coal–fired power plants with reference to environmental impact. Residue Reviews. 1979;71:83-120.
7. Mlynkowiak W, Snieg M, Tomaszewicz T, Dawidowski JB. Impact of fly ash from the Dolna Odra power plant on firmness and physico-chemical properties of light silty loam. Inzynieria Rolnicz. 2001;5:237-243.
8. Hallmark WB, Brown LP, Hawkins GL, Judice J. Effect of municipal, fish and sugarmill wastes on sugarcane yields. Louisiana Agriculture. 1998;41:9-10.
9. Singh, Shalini, Munna Singh, Rao GP, Solomon S. Application of distillery spent wash and its effect on sucrose content in sugarcane. Sugar Tech. 2007;9:61-66.
10. Anderson DL, Bowen JE. Sugarcane Nutrition. Potash and Phosphate Institute, Narcross, Georgia, USA. 1990.
11. Calcino DV. Australian Sugarcane Nutrition Manual. BSES/SRDC, Brisbane, Australia, 1994.
12. Clements HF. Sugarcane crop logging and crop control: Principles and practices. The University Press of Hawaii, Honolulu, 1980, 520.
13. Lim CH, Jackson ML. Dissolution for total elemental analysis. In Methods of Soil Analysis, Part-2, Chemical and Microbiological Properties. AL (Ed), II Edition, American Society of Agronomy, Inc. and Soil Science Society of America, Madison, Wisconsin, USA, 1982.
14. Hunsigi G. Fertilizer management in commercial crops. Ed. Tandon, HLS, FDCO, New Delhi, 1993, 1-25.
15. Singh S. Ecological studies on natural vegetation around thermal power plant with special reference to the impact of fly ash and afforestation prospects of fly ash dumps. Ph.D. Thesis submitted to Hari Singh Gour University, Sagar, Madya Pradesh, India, 1992.
16. Jamil KM, Qasim M. Integrated use of boiler ash as organic fertilizer and soil conditioner with NPK in calcareous soil. Songklanakarin Journal of Science and Technology. 2008;30:281-289.
17. Patil GD, Shinde BN. Effect of spent wash (distillery effluent), spent slurry and press mud composts on maize. Journal of the Indian Society of Soil Science. 1995;43:700-702.
18. Ramana S, Biswas AK, Singh AB, Yadava RBR. Relative efficacy of different distillery effluents on growth, nitrogen fixation and yield of groundnut. Bio resource Technology. 2002;81:117-121.
19. Hati KM, Biswas AK, Bandyopadyay K, Misra AK. Effect of post machination effluent on soil properties under a soybean-wheat system in a vertisol. Journal of Plant Nutrition and Soil Science. 2004;167:584-590.
20. Das KN, Patgiri DK, Basumatary A, Das K, Sharma A, Das B. Effect of fly ash on soil properties and rice productivity in an Inceptisol of Assam. Journal of the Indian Society of Soil Science. 2015;63:100-106.
21. Hamsa N, Srinivasamurthy CA, Bhaskar S, Varalakshmi LR. Utilization of cogent ash for enhancing growth and yield of paddy. International Journal of Current Microbiology and Applied Sciences. 2017;6:779-785.
22. Joshi S, Pawar MW. Effect of foliar application of phosphorous a micronutrients on cane and sugar yield. Proceedings of the 8th Joint Convention of STAI, DSTA, SISSTA, on 13-15 August at Hyderabad, 2005, 112-121.
23. Selvakumari G, Baskar M, Jayanthi D, Mathan KK. Effect of integration of fly ash with fertilizers and organic manures on nutrient availability, yield and nutrient uptake of rice in Alfisols. Journal of the Indian Society of Soil Science. 2000;48:268-278.
24. Yeledhalli NA, Prakash SS, Ravi MV, Rao KN. Long-term effect of fly ash on crop yield and soil properties. Karnataka Journal of Agricultural Sciences. 2008;21:507-512.
25. Thind HS, Singha Y, Singh B, Singh V, Sharma S,

Vashisthab M, *et al.* Land application of rice husk ash, bagasse ash and coal fly ash: Effects on crop productivity and nutrient uptake in rice-wheat system on an alkaline loamy sand. Field Crops Research. 2012;135:137-144.

26. Sinha SK, Jha CK, Kumar V, Kumari G, Alam M. Integrated effect of bio-methanated distillery effluent and bio-compost on soil properties, juice quality and yield of sugarcane in Entisol. Sugar Tech. 2014;16(1):75-79.
27. Ramesh V, Sumansusan V. Effect of fertilizer levels of N, P and K on the yield and juice quality of sugarcane. Indian Sugar. 2000;50:301-302.