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Impact of Stone Crusher Dust on Soil Properties in Perecherla, Guntur District, Andhra Pradesh

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ABSTRACT

A study was conducted on the impact of dust on properties of soil close to the stone crushing activity in comparison with soils at a (more than1km) distance. It was found that there was significant increase in pH close (less than1km) to the stone crushing activity. In general available N, P, K and S values were lower in soils close (less than1km) to the stone crushing activity as compared to that of soils away from crushing (more than1km) zone. This could be due to cumulative effect of dust fall due to stone crushing activity over a period of time. pH and EC decreased with increase in distance from the blasting and crushing area. The increase in values of these parameters of the soils close to the mining activity was due to the cumulative accumulation of dust from the nearby stone slab quarries and mining activities of the stone crusher clusters. N, P, K and S increased with increase in distance from the blasting and crushing area.

Key words: *Stone dust, Contamination and Soil properties.*

Pollution is increasing day by day because of ever increasing population and one of the major causes of the increased pollution is industrialization. Stone quarrying and crushing industries are important class of "essential industry" that supplies the raw material for many large scale constructions and transport related projects. Dust emanated from the stone crushing activity gets deposited on the soil surface over a period of time in the vicinity of stone crushing activity (Gottesfeld *et al* 2008). During the stone crushing process, large size boulders in the range between 200-300 mm are taken from the mine and are unloaded from almost 25 feet height into the mount of primary crusher machine of the unit where these are broken into smaller pieces. These pieces are taken through a conveyor belt to disintegrator which produces powder out of these small granules followed by size-wise separation through vibrator. Finally, different sized chips are carried to different product sites and a hoper is served as the dust collector. Generally, final products are of three different size granules, e.g., 6, 12 and 20 mm.

Generally, stone crushing industries are located adjacent to the highways and nearby communities for the sake of convenient transport facilities. Particulate matter such as stone dust, limestone dust and cement dust deposited on vegetation causes stomatal clogging and inhibits the normal respiration and photosynthetic mechanisms of the leaf and thereby affect the growth and yield of crops. In addition, accumulation of alkaline dusts in the soil increases, there by affect the crop growth. Dust deposited on the ground produce changes in chemical properties of the soil, which on the longer-term brings changes in plant chemistry.

MATERIAL AND METHODS

A study was conducted in stone crushing area of Perecherla village, Medikonduru mandal, Guntur district, Andhra Pradesh to find out the effect of stone crusher dust on soil properties. The soil samples were collected at crop growing sites from a depth of 20 cm from 9 different locations. Locations 1, 2, 3 and 4 were close to the stone crushing activity (1 km zone) as one set and 6, 7, 8 and 9 locations, away from the stone crushing activity (1km+ zone) as one set. Soil samples after processing were analyzed for physical properties *viz*., mechanical composition, bulk density, water holding capacity and porosity; physico-chemical properties *viz.,* soil reaction (pH) and electrical conductivity (EC) and chemical properties *viz.,* available N, P_2O_5, K_2O and S. Standard methods were followed to analyze all these parameters (Jackson, 1973).

RESULTS AND DISCUSSION

Impact on soil physical properties

Mechanical composition

The results presented in Table1 showed that mechanical composition of soils which were close and beyond 1 km distance from the stone crushing activity**.** During pre monsoon season the average content of sand, silt and clay was 15.02, 34.73 and 50.62 percent in soils within 1 km distance from the stone crushing activity and 14.74, 34.50 and 50.75 percent in soils in 1 km+ zone from the stone crushing activity. During post monsoon season the average content of sand, silt and clay was 15.01, 34.70 and 50.53 percent in soils within 1 km distance from the stone crushing activity and 14.74, 34.49 and 50.75percent in soils in 1 km+ zone from the stone crushing activity. Soils from all locations both within and beyond 1 km distance from the stone crushing activity fall under the group of clay loam texture. (Khan *et al.,* 2008) There was no significant change in mechanical composition of soil close to and away from the stone crushing activity.

Bulk density

During pre monsoon the average content of bulk density was 1.49 Mg m^{-3} in soils within 1 km distance from the stone crushing activity and 1.41 Mg m^{-3} in soils in 1 km+ zone from the stone crushing activity. During post monsoon the average content of bulk density was 1.49 Mg m^{-3} in soils within 1 km distance from the stone crushing activity and 1.40 Mg m^{-3} in soils of 1 km+ zone from the stone crushing activity as shown in Table 2. The Bulk density content was significantly higher in soils within 1 km as compared to those in 1 km+ zone from the stone crushing activity. The bulk density of the soil at the mining area was 1.68 ± 0.12 mg m^{-3} and decreased progressively to 1.05 ± 0.15 mg m^{-3}, 10,000 m away and heavy traffic on top soil within the vicinity of mining may have contributed to the high bulk density within the mining area (Adewole and Adesina, 2011).

Porosity

During pre monsoon the average content of porosity was 42.45 in soils within 1 km distance from the stone crushing activity and 45.52 in soils in 1 km+ zone from the stone crushing activity (Table 3). During post monsoon the average content of porosity was 42.50 in soils within 1 km distance from the stone crushing activity and 45.56 in soils of 1 km+ zone from the stone crushing activity. There was no significant change in porosity values of soils close to the stone crushing activity as compared to the soils of 1 km+ zone from the stone crushing activity (Ibanga *et al*., 2005).

Moisture holding capacity

During pre monsoon, the average content of moisture holding capacity was 54.64 in soils within 1 km distance from the stone crushing activity and 54.83 in soils in 1 km+ zone from the stone crushing activity. During post monsoon the average content of moisture holding capacity was 55.41 percent in soils within 1 km distance from the stone crushing activity (Table 4) and 56.16 percent in soils of 1 km+ zone from the stone crushing activity. The physical properties of soil, *i.e.* water-holding capacity (WHC) represented poor soil health in mining area (29.8 %) and they improved with increasing distance of 1km (38.3 %) (Kumar *et al.,* 2007).

Impact on soil physico-chemical properties

Soil reaction (pH)

The soil reaction was recorded in terms of pH (Table 5) and is affected by stone crusher dust at Perecherla region. During pre monsoon the pH ranges from 8.06 to 8.31 in soils within 1 km distance from the stone crushing activity and 7.99 to 8.08 in soils in 1 km+ zone from the stone crushing activity. During post monsoon the pH ranges from 8.08 to 8.31 in soils within 1 km distance from the stone crushing activity and 7.98 to 8.06 in soils of 1 km+ zone from the stone crushing activity. The pH values indicated that the soils within 1km distance and beyond 1 km distance were moderately alkaline (7.81 to 8.50). There was significant increase in pH values of soils close to the stone crushing activity as compared to the soils 1 km+ zone from the stone crushing activity. (Khan *et al.,* 2008).

Electrical conductivity (EC)

The soil EC was affected by stone crusher dust at Perecherla region (Table 6). During pre monsoon the average content of electrical conductivity values recorded were 0.19 and 0.15 dS m^{-1}whereas during post monsoon the average content of electrical conductivity values recorded were 0.19 and 0.15 dS m^{-1}. The average EC values indicated that the soils within 1 km distance and beyond 1 km distance were low (0 to 0.25 dS m^{-1}). There was no significant difference in EC between soils of two seasons.

Chemical properties of soil

Nitrogen

The mean available N content of soils within 1 km (Table 7) and beyond 1 km distance from the stone crushing activity during pre monsoon were 319 and 404 kg ha^{-1} and during post monsoon were 319 and 402 kg ha^{-1}. Available N content was significantly low in soils close to the mining activity (Khan *et al*., 2008). The decrease in total N content was due to decreased mineralization of peptone nitrogen in dust polluted soils (Shanthi *et al.,* 2004).

Phosphorus

The mean available P_2O_5 content of soils during pre monsoon season were 21.45 and 33.23 kg ha^{-1} within 1 km and beyond 1 km distance from the stone crushing activity, during post monsoon season were 21.83 and 28.33 kg ha^{-1} as shown in Table 7. The available phosphorus content was significantly lower in soils within 1 km as compared to those in 1 km+ zone from the stone crushing activity. Phosphorus in terms of available P_2O_5 within 1km from the mining activity were slightly lower *i.e.,* 26.2, 22.5 and 29.6 kg ha^{-1} as compared to those recorded away (1 km

Table 1. Effect of dust from stone crushers on soil mechanical composition

Soil mechanical composition						
Location no.	Pre monsoon			Post monsoon		
	Sand %	Silt %	Clay %	Sand %	Silt %	Clay %
Close to the site (1 km)						
1.00	15.50	34.34	50.16	15.48	34.31	50.21
2.00	14.67	35.00	50.33	14.67	34.98	49.92
3.00	14.60	36.00	51.00	14.60	36.00	51.00
4.00	15.31	33.60	51.00	15.31	33.52	51.02
Mean	15.02	34.73	50.62	15.01	34.70	50.53
Away from the site (1 km+)						
5.00	15.00	34.34	50.66	15.31	34.31	50.66
6.00	14.34	34.66	51.00	14.34	34.65	51.01
7.00	15.66	34.00	50.34	15.31	34.00	50.34
8.00	14.00	35.00	51.00	14.00	35.00	51.00
Mean	14.75	34.50	50.75	14.74	34.49	50.75

Table 2. Effect of dust from stone crushers on bulk density (Mg m^{-3})

Bulk Density Mg m^{-3}		
Location No	Pre monsoon	Post monsoon
Close to the site(<1km)		
1	1.53	1.54
2	1.52	1.52
3	1.48	1.47
4	1.46	1.46
Mean	1.49	1.49
Away from the site (1 km+)		
5	1.45	1.45
6	1.42	1.41
7	1.39	1.39
8	1.38	1.38
Mean	1.41	1.4

Table 3. Effect of dust from stone crushers on Pore Space (percent)

Pore space (%)		
Location no	Pre monsoon	Post monsoon
Close to the site(<1km)		
1	41.2	41
2	41.6	41.6
3	43.1	43.5
4	43.9	43.9
Mean	42.45	42.5
Away from the site (1 km+)		
5	44.3	44.3
6	45.3	45.7
7	46.5	46.5
8	46.0	46.0
Mean	45.52	45.56

Table 4. Effect of dust from stone crushers on water holding capacity (%)

Water Holding Capacity (%)		
Location no	Pre monsoon	Post monsoon
Close to the site(<1km)		
1.00	53.45	54.67
2.00	54.79	55.00
3.00	56.33	57.33
4.00	54.00	54.67
Mean	54.64	55.41
Away from the site (1 km+)		
5.00	56.67	59.67
6.00	54.00	55.33
7.00	54.27	54.67
8.00	54.40	55.00
Mean	54.83	56.16

Table 5. Effect of dust from stone crushers on pH

Location no	pH	
	Pre monsoon	Post monsoon
Close to the site (<1km)		
1	8.31	8.31
2	8.28	8.21
3	8.25	8.22
4	8.06	8.08
Away from the site (1 km+)		
5	8.06	8.06
6	7.99	7.98
7	8.08	7.98
8	8.07	8.00

Table 6. Effect of dust from stone crushers on EC

Location no	EC	
	Pre monsoon	Post monsoon
Close to the site (<1km)		
1	0.18	0.15
2	0.17	0.18
3	0.19	0.18
4	0.23	0.24
Mean	0.19	0.19
Away from the site (1 km+)		
5	0.14	0.15
6	0.18	0.18
7	0.14	0.15
8	0.16	0.15
Mean	0.15	0.15

Table 7. Effect of stone crushing activity available N, P, K and S content of soils

Location no	Nitrogen ($kg\ ha^{-1}$)		Phosphorus ($kg\ ha^{-1}$)		Potassium ($kgha^{-1}$)		Sulphur ($kg\ ha^{-1}$)	
	Pre monsoon	Post monsoon	Pre monsoon	Post monsoon	Pre monsoon	Post monsoon	Pre monsoon	Post monsoon
Close to the site(<1km)								
1	305	308	19.2	19.5	258	247	5.25	5.19
2	320	317	20.1	19.8	290	277	6.19	6.21
3	323	321	22.6	23.2	268	256	6.32	6.22
4	330	330	23.9	24.8	275	253	6.33	5.72
Mean	319	319	21.45	21.83	272	258	6.02	5.83
Away from the site (1 km+)								
5	398	394	27.7	26.3	291	290	6.28	5.68
6	407	402	35.4	22.1	286	285	6.16	6.14
7	399	404	38.5	33.4	283	289	6.45	6.13
8	412	408	31.3	31.5	346	286	7.48	7.69
Mean	404	402	33.23	28.33	301	287	6.6	6.41

distance) from mining activity *i.e.*, 35.8, 25.7 and 42.4 $kg\ ha^{-1}$ at vegetative, flowering and harvesting stages of crop (Khan *et al.*, 2008).

Potassium

The mean available K_2O content of soils within 1 km and beyond 1 km distance from the stone crushing activity during pre monsoon were 272 and 301 $kg\ ha^{-1}$ and during post monsoon were 258 and 287 respectively. The available K_2O content was significantly (Table 7) lower in soils within 1 km as compared to those in 1 km+ zone from the stone crushing activity. Potassium content in soils within 1km from the mining activity were 273, 259 and 253 $kg\ ha^{-1}$ as compared to those recorded at away (1 km distance) from the mining activity *i.e.*, 315, 262 and 288 $kg\ ha^{-1}$ at vegetative, flowering and harvesting stages of crop. K content was significantly low in soils close to the mining activity (Khan *et al.*, 2008). Potassium content increased with increase in distance from the blasting and crushing area. (Adewole and Adesina, 2011).

Sulphur

The mean available sulphur content of soils during pre monsoon season within 1 km and beyond 1 km distance from the stone crushing activity were 6.02 and 6.60 $kg\ ha^{-1}$ (Table 7) respectively. The mean available sulphur content of soils during post monsoon season within 1 km and beyond 1 km distance from the stone crushing activity were 5.83 and 6.41($kg\ ha^{-1}$) respectively. It showed an increasing trend with increase in distance from the mining area.

CONCLUSION

The dust from stone crushing activity caused changes in the physico-chemical and chemical properties of soils close (within one kilometer) to the site. There was no significant change in physical properties of soil within and beyond 1 km distance from the stone crushing activity. However, it did not show any deleterious effect on the soils around the activity but over a period of time increase in pH may alter the soil quality. pH and EC decreased with increase in distance from the blasting and crushing area. The increase in values of these parameters of the soils close to the mining activity was due to the cumulative accumulation of dust from the nearby stone slab quarries and mining activities of the stone crusher clusters. Nitrogen, phosphorus, potassium and sulphur increased with increase in distance from the blasting and crushing area. The observed reduction in available N, P, K and S content of soils close to (1 km zone) the stone crushing activity could be due to poor mineralization in dust effected fields and also due to the poor management practices adopted by the farmers.

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