IOSR Journal Of Pharmacy And Biological Sciences (IOSR-JPBS)
e-ISSN:2278-3008, p-ISSN:2319-7676. Volume 16, Issue 5 Ser. III (Sep. –Oct. 2021), PP 67-70
www.Iosrjournals.Org

A Case Study of the Influence of Gypsum Mining on selected Morphological characters of Bajara (*Pennisetum Typhoides*) in Nagaur District of Rajasthan

Vaibhav Saraswat[1] and Manoj Kumar Yadav
Department of Botany, Samrat Prithviraj Chouhan Government College, Ajmer

Abstract
The study is focused on the effect of gypsum ($CaSO_4.H_2O$) mining on the morphology of Bajara (Pennisetum typhoides). The experiments and observation were done in the agriculture area nearby villages of Bhadwasi Mining area in Nagaur district during the Kharif season of 2018. Primary Data was collected by sample survey and observation scheduled method. All data were recorded and observed on the basis of the height of the plant, number of leaves per plant, size of panicle and shape of the panicle. In many past studies concluded that ecology and crops mostly suffer from mining activities. However, this case study shows gypsum mining effects positively on selected crops apart from some core areas of mining. The present case study also deals with the influence of the application of gypsum on Pennisetum typhoides and it also suggest the best uses of post-mining areas of gypsum in agriculture because gypsum mining helps in improving and maintaining soil fertility.

I. Introduction

Pearl millet (*Pennisetum typhoides*) is one of the important cereal crops in arid areas of Rajasthan, India. It belongs to the family Poaceae. The local name of pearl millet is Bajara. It includes the high content of carbohydrate and protein. It's grain mostly used as food and its plant is used as fodder in arid areas. Pearl millet grows in different types of soil and shows a wide variation in all developing stages. It can grow in low soil fertility, high temperature by managing stress tolerance. Pearl millet is a good plant for bioaccumulation and translocation of heavy metals like Mn, Cd, Fe, Cu, Zn and Pb. (Toma Buba et al. 2021).

It has a typical monocotyledonous type of root system and the shape of main stem is generally round to oval with a height of 2-4 meter. Nodes and internodes are found on the stem and single linear shape leaf with 20-80 cm long appears on each node in alternative orientation. Inflorescence of *Pennisetum* is compound terminal spike known as panicle. Length of panicle normally varies between 20-35 cm. It's panicle also found in various shapes like a cylindrical, candle, conical, spindle, etc. Fruit type of *Pennisetum* is caryopsis.

Nagaur district situated in the central part Rajasthan covering an area of 17,718 sq.km. The district is located between the latitudes 26°02'12" to 27°37'39" and longitudes 73°05'20" to 75°24'. The climate of the district is arid to semi-arid type. Nagaur district is very rich in gypsum and some deposits are found in Golsar, Bhadana, Kherat Manglod, Bhadawasi, Makodi and Pilanvasi villages. The reserves were estimated to be 952 million tones by the geographical survey of India. Bhadwasi gypsum mine is most important gypsum mine in Rajasthan.

Mining is a compulsory developmental activity for the economy but on the other side, it is harmful to the environment and ecology. Gypsum has been proved as a kick starter for plants and it improves in soil when it is used for a longer time. Alva and Sumner (1990) concluded that gypsum applications to acid soils have many times resulted in positive crop growth but sometimes it has shown either no response or negative response. Van Alphen and de Los Rios Romero (1971) noted that up to 2 percent gypsum in the soil helps in plant growth, while if gypsum is in powdery form between 2% - 25% it has little or no negative effect but if gypsum is more than 25 percent in soil it can be notable reduction in productivity. Similar results were also observed by Hernando et al. (1965) and they studied the effect on the growth of wheat and corn by various level of gypsum in the soil up to 75 percent and they concluded that high levels of gypsum effect and poor growth of corn, while the soil moisture was maintained at 80 percent. In selected gypsum mining area, gypsum content is not available for every time and availability is also not similar in whole selected area. It mixed up in the soil in dust form. Gypsum has long-term effect after many years of application and increase exchangeable Calcium, sulphate and electrical conductivity whereas it decreases Mg and toxic content like Al in soil (M. Toma et al.1999) *Pennisetum typhoides* and *Vigna radiata* are most cultivated crops as a seasonal crop in Kharif season near the mining area and post- mining area. The study characterized the effect of gypsum ($CaSO_4.2H_2O$) mining on the morphology of Bajara (*Pennisetum typhoides*) in various selected blocks in the agriculture area near Bhadwasi mining area.

II. Materials And Methods

The case study was conducted during 'Kharif" season in 2018 at Bhadwasi mining area in Nagaur district, Rajasthan. The experimental site is located at 27º20"14' N latitude, 73º41"11' E longitude. This is arid zone and the average temperature is very high about 40 degrees during the seed emergence period. No source of irrigation is available so rainfall is the only source of water. Any type of Biofertilizer was never used there at any block of the experimental site. mostly variety of hybrid seeds of *Pennisetum* are used in Nagaur but in this area only traditional desi seed which was collected from last year were used in cultivation. The experimental area was divided into five blocks A, B, C, D, and E.

Block A- core mining area where the quantity of gypsum is higher in soil **Block B** - non-gypsum mining area which is far away from the mining site **Block C** and **D** - post-mining area of gypsum

Block E - this block was selected where gypsum dust and particles of gypsum produced in air by gypsum industry near the mining site.

The block was selected just after sowing the seed. Random sampling technique was used in selection of each block to assure the maximum chance to represent the entire population. Size of each block is 20×20 meter^2. Frequently survey was conducted during this case study from the vegetative phase to grain filling phase. The observations and data were recorded during 40-60 days after emergence to Grain filling phase. Primary data was collected by a sample survey and observation scheduled method. The parameters like Height of plant, number of leaves, length of panicle and shape of panicle were selected for morphological study. Height of plants was observed between the interval of 50 cm and length of panicle were observed between the interval of 5 cm by measurement scale as shown in fig. (a). Soil samples were collected from post-mining areas at 40-90 cm depth for soil analysis. Mostly observations and data collection were done at the experimental site.

III. Results And Discussion

To understand the effect of gypsum mining on the growth of *Pennisetum typhoides* different tests and observations are preformed such as soil test to understand the soil property, plant size and height in each block under the influence of gypsum mining etc. and discussed as follow-

a. Soil test

According the soil test report, the soil properties of the experimental site is sandy in texture, alkaline in soil reaction (pH 8.10) low in organic carbon 0.15%, EC (0.63 Ds/meter), available P (56.00 Kg/Hac.), S (11.74 ppm) Zinc (0.49 ppm) Fe
(1.38 ppm) Cu (0.38 ppm) And Mn (0.91 ppm).

b. The number of plants

In each block, the number of plants is not similar. Plants in Block A are less than another all blocks because some seeds couldn't germinate in higher alkalinity and the highest number of the plant were observed in Block E because gypsum dust helps in improving soil fertility so all observed data are showing a variation on the basis of percentage.

c. Morphological study

In the comparative study between the gypsum mining area and non-gypsum mining area, there are no significant effect or difference were observed in the number of leaves on a stem and shape of the panicle. while a variation in size of panicle and height of plant were observed among the selected blocks. The results of the size of the panicle are shown in **Table 1** and the result of the height of the plant is shown in **Table 2.**

Fig.(A) Measurement of length of panicle

Fig. (B) *Pennisetum typhoides* in block A

Table 1: Observation of panicle size of *Pennisetum typhoides* in different Blocks

S.No	Size of panicle	Block A	Block B	Block C	Block D	Block E	Total
1.	20-25 cm	18 (28.57%)	23 (11.00%)	14 (6.08%)	8 (3.66%)	12 (4.31%)	75 (7.51%)
2.	25-30 cm	29 (46.03%)	32 (15.31%)	23 (10.00%)	19 (8.71%)	31 (11.15%)	134 (13.42%)
3.	30-35 cm	11 (17.46%)	58 (27.75%)	52 (22.60%)	63 (28.89%)	67 (24.10%)	251 (25.15%)
4.	35-40 cm	5 (7.93%)	89 (42.58%)	112 (48.69%)	95 (43.57%)	142 (51.07%)	443 (44.38%)
5.	40-45 cm	0 (0.00 %)	7 (3.34%)	29 (12.60%)	33 (15.13%)	26 (9.35%)	95 (9.51%)
	Total	63 (100%)	209 (100%)	230 (100%)	218 (100%)	278 (100%)	998 (100%)

The results related to the size of panicle is showing variation block wise by distance from the mining site and quantity of gypsum in the soil. As shown in **Table 1**, there was a variation observed in size of panicle in each block in 20-25 cm from 8 (3.66%) to 18 (28.57%), in 25 -30 cm from 19 (8.71%) to 29 (46.03%), in 30-35 cm from 11 (17.46%) to 63 (28.89%), 35-40 cm from 5 (7.93%) to 142 (51.07%), and in 40-45 cm from 0 (0.00%) to 33 (15.13%). it indicates that growth of panicle was reduced in Block A which is core gypsum mining area while in the remaining blocks size of panicle is more than Block A as shown in fig.(b). growth of panicle in Blocks C, D, and E indicates that post mining areas and the area near gypsum industry where only gypsum dust produced is impacts positively on morphology. Along with this, size of panicle also effects productivity of total grain so the productivity of all blocks was higher apart from block A.

Table 2: Observation of height of *Pennisetum typhoides* in different Blocks

S.No	Height of plant	Block A	Block B	Block C	Block D	Block E	Total
1.	0-50 cm	2 (3.17%)	4 (1.91%)	7 (3.04%)	5 (2.29%)	3 (1.07%)	21 (2.10%)
2.	50-100 cm	8 (12.69%)	19 (9.09%)	22 (9.56%)	26 (11.92%)	18 (6.47%)	93 (9.31%)
3.	100-150 cm	43 (68.25%)	84 (40.19%)	48 (20.86%)	62 (28.44%)	38 (13.66%)	275 (27.55%)
4.	150-200 cm	10 (15.87%)	91 (43.54%)	129 (56.08%)	96 (44.03%)	121 (43.52%)	447 (44.78%)
5.	200-250 cm	0 (0.00%)	11 (5.26%)	24 (10.43%)	29 (13.30%)	98 (35.25%)	162 (16.23%)
	Total	63 (100%)	209 (100%)	230 (100%)	218 (100%)	278 (100%)	998 (100%)

The results related to the height of plants (with panicle) effected and show variation block wise due to distance from mining site and quantity of gypsum in soil is presented in **Table**

2. As shown in **Table** 2, there was a variation was observed in height of plant in each block in 0-50 cm from 3 (1.07%) to 2 (3.04%), in 50-100 cm from 18 (6.47%) to 8 (12.69%) in 100-150 cm from 38(13.66%) to 43 (68.25%) inn 150-200 cm from 10 (15.87%) to 129 (56.08%) and in 200-205 cm from 0 (0.00%) to 98 (35.25%). Negative effect of gypsum was observed in block A while the minimum growth was recorded in block B. it indicates that height of plant varies in each block and height of plant is reduced in Block A which is core gypsum mining area while in the remaining blocks height of plant is more than Block A. it is due to increasing in sulphur content in soil. Sulphur effect positively on growth of plant but after optimum value, it impacts negatively. The result is similar to finding of Anuj Kumar et. al. (2010). Growth of plant in Blocks C, D, and E indicates that post mining areas and the area near gypsum industry where only gypsum dust produced is impacts positively on morphology. Gypsum works as source of calcium and sulphur content for soil. Variance in gypsum is represented by presence of variance in calcium and sulphur in soil. Along with this, height of plant also effects productivity of plant material which is used in fodder. So, the impact of gypsum mining is showing negatively in Block A so the productivity of Block A is less than other blocks

IV. Conclusions

In many past studies and observations related to the effect of mining on ecology and crops, it shows that ecology and crops mostly suffer from mining activities. However, this case study shows gypsum mining effects positively on selected crops apart from some core area of mining. Same crops developed under the same environmental factors responded differently to the excess of gypsum. The effect of gypsum mining and particles of gypsum dust on the growth and morphology of *Pennisetum typhoides* were observed and the result of this study suggests a great role of gypsum mining in effecting of morphological characters and productivity of *Pennisetum typhoides.* The present case study also deals with the influence of the application of gypsum on *Pennisetum typhoides* and it also explores the best uses of post-mining areas of gypsum in agriculture because gypsum mining helps in improving and maintaining soil fertility.

References

[1]. Buba, T., Jalam, M.A., Abubakar, M.I., (2021) Bioaccumulation and translocation of heavy metals in pearl millet (Pennisetum glaucam) depends on ectomycorrhiza pisolithus arhizus and soil type. Soil Environ, Vol. 40, No. 1, pp. 59-68.

[2]. Valzano F. P., Greene R. S. B., Murphy B. W., Rengasamy P. Jarwal S. D. (2001) Effects of gypsum and stubble retention on the chemical and physical properties of a sodic grey Vertosol in western Victoria. *Soil Research*, Vol. **39**, pp. 1333-1347.

[3]. Tripathi, B.N., Mishra U.C., Maurya K.K. (2014), Effect of gypsum alone and in conjuction with green manure and zinc on the rice in sodic soils, Annals of Plant and soil Research 16(3) : 198-202 (2014).

[4]. A., Shyam Kumar, K.V., Reddy M., Ashok (2014). Identification of variations in plant morphology through different methods of gypsum application in tulsi (*Ocimum basilicum*). International Journal of Scientific & Technology Research Vol 3, No. 11, pp. 190-195

[5]. Toma, M., Sumner, M. E., Weeks, G. and Saigusa, M., (1999). Long term effects of gypsum on crop yield and subsoil chemical properties, Soil Sci. Soc. Am J Vol. 39, pp. 891-895.

[6]. Kumar, Anuj, Kumar, Devendra and Arya, K.P.S. (2010). Effect of calcium and sulphur on the growth and yield of mungbean [*vigna radiata*(L) wilzek], International journal of plant sciences, Vol. 5, No. 1, pp. 162-164.

[7]. Vyas, Ashutosh and Pancholi, Archana (2009). Environmental degradation due to mining in south rajasthan: a case study of nimbahera, chittorgarh (India). Journal of environmental research and development, Vol.4, No.2.

[8]. Alva, A.K., M. E. Sumner, and W. P. Miller. (1990) Reactions of Gypsum or Phosphogypsum in Highly Weathered Acid Subsoils. Soil Sci. Soc. Am. J. Vol. 54, pp. 993- 998

[9]. Hernando, V., Sanchez Conde, M.P. and Contreras, J.G. (1965), Study of the mineral nutrition of maize on soils rich in gypsum. *Zolfo in Agricoltura, Palermo, pp*. 398-411.

[10]. Van Alphen, J.G. and de los Rios Romero, F. (1971), Gypsiferous soils. Notes on characteristics and managem*ent.* International Institute of Land Reclamation and Improvement Bulletin, Vol. 12.

[11]. Sinha, Rajiv Kumar, Pandey, Dharmendr K, Sinha, Ambuj K. (2000). Minning and environment: A case study from Bijolia quarrying site in Rajasthan, India. The environmentalist, Vol. 20, No. 3, pp. 195-203.

[12]. Choudhary D. R., Singh A., Panghal VPS., (2019) Effect of FYM and gypsum with high RSC water application on growth and phenological characters of radish (Raphanus sativus L.), vegetable science (2019) 46(1&2):56-59

[13]. Bera M., and Ghosh G. K., (2015) Efficacy of sulphur sources on green gram (Vigna radiata L.) in red and lateritic soil of west Bengal. International journal of plant, animal and environmental sciences volume 5 issue 2 109-115

[14]. *Zhao, F., Tausz, M., & Kok, L.J. (2008). Role of Sulfur for Plant Production in Agricultural and Natural Ecosystems.*