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A Case Study of the Effect of Gypsum Mining on the Morphology of Mungbean *(Vigna radiata L.*) in Nagaur District of Rajasthan

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ABSTRACT
This case study is an attempt to know the effect of gypsum mining on the morphology of mungbean (Vigna radiata). The experiments and observation were done in the Goth Manglod gypsum Mining area in Nagaur district during the Kharif season of 2019. All data were recorded and observed on the basis of height of plant, number of leaves per plant, number of pods per plant, number of root nodules per plant etc. Result of this study reveals that average root nodule/plant RNA =23.42 height of plant HPE =58.85 cm and average number of pods per plant NPE = 24.71 pod/plant were in gypsum mining area. While a minimum value of RNB=16.14 HPB =50.57 cm and NPB =18.57 pod/plant were noted in non-gypsum mining area. Results of this case study shows that due to the availability of sulphur and calcium content in soil by gypsum, numbers of pods/plant, number of root nodules/plant and height of Vigna radiata were found higher than non- gypsum areas. Many past studies concluded that ecology and crops mostly suffer from mining activities but this case study indicates that gypsum mining effects positively on Vigna radiata.
Keywords *– Gypsum, Mining, Sulphur, Vigna radiata, Nagaur*

I. Introduction

Mungbean (*Vigna radiata L.*) is one of the important pulse crops in arid areas of Rajasthan, India and belongs to the family fabaceae. The local name of *Vigna radiata* is 'moong'. It is highly rich with carbohydrate, protein and mineral contents in seed grain, mungbean is consumed as food in the form of various recipe. *Vigna radiata* grows in different types of soil and shows a wide stress tolerance. mostly cultivated as crop rotation for maintaining soil quality. *Vigna radiata* has a typical dicotyledonous type of root system with some specific structure like root nodule. Stem of plant is cylindrical, branched and height of plant found differ in different varieties and varies between 25 cm

-110 cm. Inflorescence of mungbean is axillary receme and known as pod at maturation stage. Mature pod is commonly called 'PHAAL' or 'BHAGAR' in local language of Nagaur district. Length of pod normally varies between 6-14 cm. Nagaur district is leading producer of mungbean and produces 1/3 part of total production of Rajasthan.

Nagaur district situated in the central western part of Rajasthan covering an area of 17,718 sq.km. The district is located between the latitudes 26°02'12" N to 27°37'39" N and longitudes 73°05'20" E to 75°24' E. The district experience arid to semi-arid climate. Nagaur district is very rich in gypsum and total deposits are found in only two blocks Nagaur and Jayal. Villages of both blocks viz. Golsar, Bhadana, Kherat, Goth Manglod,

Bhadawasi, Makodi and Pilanvasi have some important gypsum mines. Bhadwasi gypsum mine is the most important gypsum mine in Rajasthan. Nagaur district is sole producer of good quality gypsum. This gypsum is supplied for use in building material, chalk production, fertilizer etc. across the country.

Mining is a compulsory developmental activity for the economic growth and fulfilling the human needs but on the other side, it is harmful to the environment and ecology. Mining impacts negatively on environment (Ashutosh Vyas and A. Pancholi 2009). Gypsum mining is being done by open cast method. Gypsum has been proved as a kick starter for plants and it improves in soil when it is used for a longer time. N.C. Banik et al. (2012) observed the influence of Phospho-gypsum on the seed yield and plant height in *Vigna radiata L.* Morphological characters viz. height of plant, leaf area and quantitative characters of plant viz. number of pods per plant, seed yield per plant, dry weight per plant and number of leaves per plant is influenced by treatment with different level of calcium and sulphur in *Vigna radiata* L. (Anuj Kumar et al. 2010). In selected gypsum mining area, gypsum content is not available for every time and availability is also not similar in entire 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 mungbean (*Vigna radiata*) in

various selected blocks in the agriculture area near Goth Manglod mining area.

II. Materials And Methods

The case study was carried out during 'Kharif" season in 2019 at Goth Manglod (Jayal) mining area in Nagaur district, Rajasthan. The experimental site is located at 27º13'22" N latitude, 74º3'24.4" E longitude. As shown in **fig.1**. The experimental site located in arid zone. Rainfall is the only source of water due to lack of resources of irrigation. Any type of chemical fertilizer was not used there during experiment at any block of the experimental site. Traditional desi seed which was collected from last year were used in cultivation. The maps and spatial data of following are provided by GADM and a python code was used for plotting.[13]

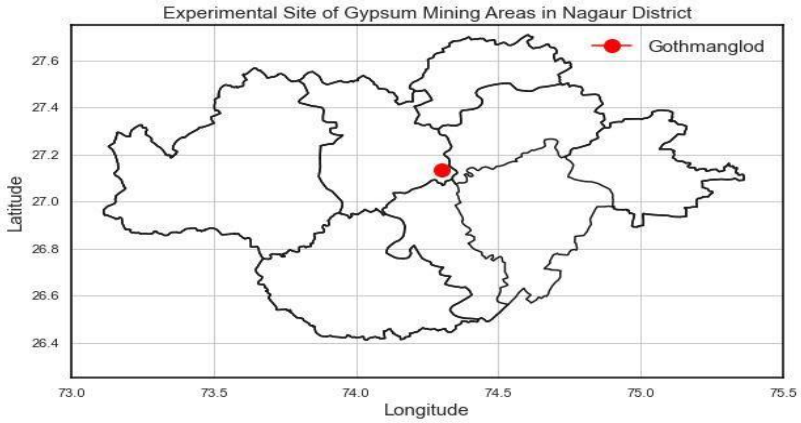

Figure 1. Location of experimental gypsum mining site

Distribution of gypsum deposit is found in very large area and it is very difficult to study the entire area with entire population in a limited period. Sampling method is used in the present case study, Five blocks were selected on the basis of distance with the gypsum mining area. Size of each block is 20×20 meter$^{2.}$ All blocks were marked before sowing the seed. Random sampling technique was used in selection of each block to assure the maximum chance to represent the entire population. Seven plants viz.

PT_1, PT_2, PT_3, PT_4, PT_5, PT_6, PT_7 from each block were randomly selected for morphological study. The experimental area was divided into five blocks viz. A, B, C, D, and E. Block A is Core mining area where the quantity of gypsum is higher in soil. Block B is Non-gypsum mining area which is far away from the mining site. Block C & D are Post-mining area of gypsum, where gypsum has been mined and now it is used in agriculture. Block E is the selected area situated adjacent gypsum industry near mining sites where gypsum dust and particles of gypsum are found in air. Frequently survey was conducted during this case study from the seed germination to cutting phase. The observations and data were recorded during maturation of pods. Primary data was collected by a sample survey and observation scheduled method at the experimental site. The parameters like Height of plant, number of leaves, Number of branches, Number of pods per plant and number of nodules per plant were selected for morphological study. Soil samples were collected from each selected block at 40-90 cm depth for soil analysis.

III. Results And Discussion

The effect of gypsum mining on the growth of *Vigna radiata L.* were studied deeply and different tests and observations were preformed such as soil test to understand the soil property. Height of plant was measured and nodules per plant and number of pods per plant were counted in five randomly selected plant of each block. Result of the study is discussed as follow-

a. Soil analysis

The soil is sandy in texture and soil properties of each block is presented in **table**

1. The quantity of gypsum is not similar in all blocks and this is shown by presence of variation in sulphur content in each block. Value of sulphur in **table** 1 indicates that distribution of sulphur is not similar in all block. Available sulphur in soil samples can be shown as $S_A > S_E > S_{CD} > S_B$

Table 1. soil analysis of each block

	Block A	Block B	Block C&D	Bloack E
pH	6.4	8.3	8.1	7.9
Electric conductivity	1.65	0.15	0.63	1.43
Organic Carbon (%)	0.12	0.19	0.15	0.16
Phosphorus (Kg/Hec.)	36	12	56	21
Sulphur (mg/kg)	21.3	9.42	11.74	14.11
Zinc (mg/kg)	0.34	0.44	0.49	0.19
Fe (mg/kg)	1.31	1.28	1.38	1.41
Cu (mg/kg)	0.42	0.63	0.38	0.64
Mn (mg/kg)	1.21	2.57	0.91	1.39

b. The number of plants

In each block, the distribution of plant is not similar because blocks were randomly selected before sowing. Plants in Block A are less than other all blocks it is due to 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 distribution of plants.

c. Morphological study

In the comparative study between each block, there are no significant effect or difference were observed in the number of leaves on a stem and shape or size of the pod but the leaves of block A, C, D and E looks fresh and green than the leaves of block B. It was little pale, spotted and some leaves were wrinkled. In all above four blocks A, C, D, and E, gypsum works as a source of sulphur and it effects the leaves due to presence of Sulphur. A considerable variation in number of pods per plant, height of plant and number of nodules per plant were observed among the selected five plants of each blocks. The results of the number of Pod per plant are shown in **Table 2** and the result of the height of the plant is shown in **Table 3** and result of number of nodules per plant is presented in **Table 4.**

Table 2: Observation of Number of pods of *Vigna radiata* in different Blocks

S.No		PT_1	PT_2	PT_3	PT_4	PT_5	PT_6	PT_7	NP_{AVR}
1.	NP_A	24	15	24	27	28	23	26	23.85
2.	NP_B	13	21	22	16	22	19	17	18.57
3.	NP_C	18	16	21	26	22	21	15	19.85
4.	NP_D	24	14	19	21	17	22	19	19.42
5.	NP_E	28	21	18	29	25	28	24	24.71

***NPA,NPB*, *NPC*, *NPD*, *NPE* are respectively Number of pods per plant in Block A, Block B, Block C, Block D and Block E**

As data shown in **table 2**. maximum average NPE = 24.71 pod/ plant were observed in block E while minimum average NPB =18.57 pod/plant were observed in block B as shown in **fig.2(a).** The data presented in **table 2**, Block D have numbers of pod/plant more than block B, as shown in fig.2(b). It clearly indicates the role of mined gypsum in increasing numbers of pod/plant in *Vigna radiata*. Average numbers of pod/plant of all blocks are presented as $NP_E > NP_A > NP_{CD} > NP_B$ Sulphur content increased with the increase in gypsum. Manju Rani et. al. (2016) finds the same effect of sulphur on number of pods per plant in an experiment. Increase in number of pods per plant also increase the seed yield and production. Hence gypsum mining considerably increased in seed production.

(a) (b)

Fig. 2(a) plants of *Vigna radiata* in Block B (b) mature pods in *Vigna radiata* in Block D

Table 3: Observation of Height of *Vigna radiata* in different Blocks

S.No		PT_1	PT_2	PT_3	PT_4	PT_5	PT_6	PT_7	HP_{Avr}
1.	HP_A	53 cm	49cm	56cm	52cm	59cm	57 cm	52cm	54cm
2.	HP_B	51cm	54cm	53cm	49cm	46cm	48cm	53cm	50.57cm
3.	HP_C	56cm	56cm	54cm	53cm	57cm	55cm	46cm	53.85cm
4.	HP_D	51cm	41cm	48cm	57cm	59cm	54cm	57cm	52.42cm
5.	HP_E	58cm	54cm	62cm	56cm	59cm	60cm	63cm	58.85cm

***HPA*, *HPB* ,*HPC HPD HPE* are respectively height of plant in Block A, Block B, Block C, Block D and Block E**

As data presented in **table 3.** A variation in height of *Vigna radiata* were also noted during experiment. Maximum average height HPE -=58.85 cm was seen in Block E and adversely minimum average height HPB = 50.57 cm were seen in Block B. In block C and D, average height of plant was noted respectively 53.85 cm and 52.42 cm. Block-wise result of plant height is shown as $HPE > HPA > HPC > HPD > HPB$. It shows that a medium effect of gypsum was also found in post mining sites. This result reveals that calcium content of gypsum helps in increasing the height of *Vigna radiata*. The effect of calcium on plant height is just similar to Anuj Kumar et al. (2010).

Table 4: Observation of Number of root nodule per plant in *Vigna radiata* in different Blocks

S.No		PT_1	PT_2	PT_3	PT_4	PT_5	PT_6	PT_7	RN_{AVR}
1.	RN_A	24	26	27	19	21	18	29	23.42
2.	RN_B	13	04	19	7	15	17	21	.16.14
3.	RN_C	14	17	19	10	21	16	22	17
4.	RN_D	19	16	14	24	23	11	20	18.14
5.	RN_E	21	18	26	22	23	27	16	21.85

***RNARNBRNCRNDRNE* are respectively number of root nodule per plant in Block A, Block B, Block C, Block D and Block E**

Root nodule formation is also influenced by presence of gypsum in soil. Average number of root nodule is maximum RNA =23.42 in block A while the same result repeated like plant height and number of pods per plant, block B holds only RNB=16.14 the minimum number of root nodules per plant. Result of average number of root nodules per plant in block C and block D are RNC = 17 and RND =18.14 respectively are almost similar. Sulphur concentration $S_A = 21.3\ mg/kg$ is much higher in Block A than others so number of root nodule is also higher than other blocks. Average root nodule per plant of each block can be presented as $RNA > RNE > RNCD > RNB$. Comparison of value of RNE and RNC *and* RND reveals that effect of gypsum dust and particles are higher than post mining areas of gypsum. Sulphur content in soil increased with the increase of gypsum in soil, it provides favourable conditions by decreasing soil pH for root nodulation. The result of effect of sulphur confirms the conclusion of Dharmik Solanki et al (2017).

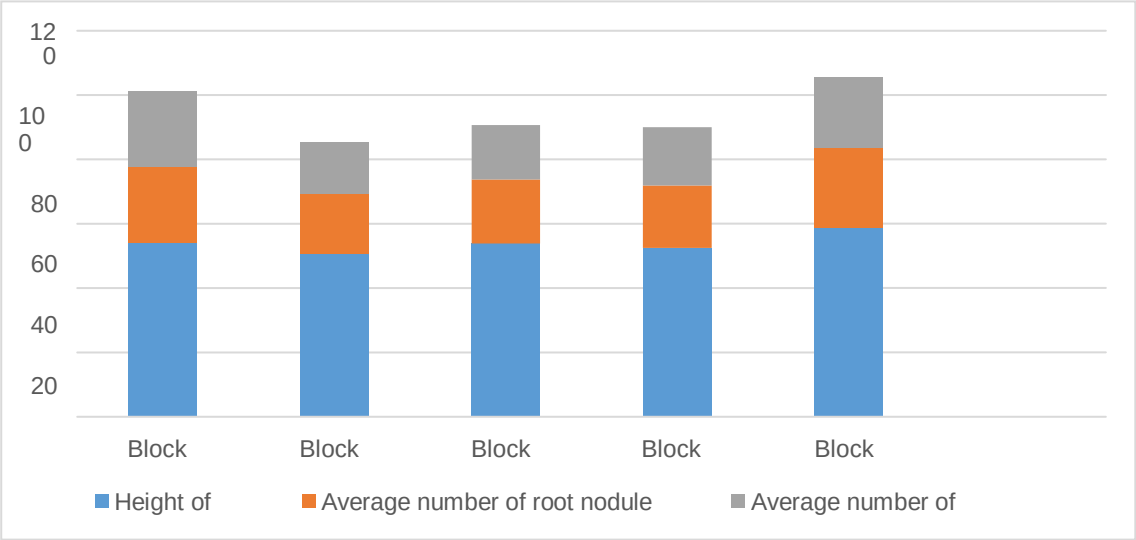

Figure 3. Block wise representation of average height of Vigna radiata ($HPAvr$), average numbers of pods/plant ($NPAVR$) and average number of root nodules/plant ($RNAVR$)

IV. Conclusions

Nagaur district is sole producer of both gypsum and mungbean in Rajasthan. Result of average root nodule/plant RNA =23.42 height of plant HPE -=58.85 cm and numbers of pods/plant NPE = 24.71 pod/plant were noted in gypsum mining area. While a minimum value of RNB =16.14 HPB = 50.57 cm and NPB =18.57 pod/plant were observed in non-gypsum mining area. A significant difference is found between values of selected parameters in gypsum mining area and values of non-gypsum mining area. This case study concluded that due to the availability of sulphur and calcium content in soil by gypsum, numbers of pods/plant, number of root nodules/plant and height of *Vigna radiata* were found higher than non-gypsum areas, as shown in Fig.3. Seed yield increase with increase in numbers of pods/plant and increase in root nodules/plant improves soil fertility. Gypsum mining indirectly resulted as increase in productivity in *Vigna radiata*. Result of this study suggests a great role of gypsum mining in positively effecting of morphological characters and productivity of *Vigna radiata.* Hence it can be concluded that mining is undoubtedly harmful activity for the environment and crops, exception gypsum mining. The present case study also recommends the best uses of post-mining areas of gypsum in cultivation of *Vigna radiata* because both gypsum mining and cultivation of *Vigna radiata* helps in improving and maintaining soil fertility.

References

[1]. 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).
[2]. Vyas, A., & Pancholi, A. (2009). ENVIRONMENTAL DEGRADATION DUE TO MINING IN SOUTH RAJASTHAN: A CASE STUDY OF NIMBAHERA, CHITTORGARH (INDIA). Journal of Environmental Research and Development, 4, 405-412.
[3]. Kumar, A., Kumar, D., & Arya, K.P. (2010). Effect of calcium and sulphur on the growth and yield of mungbean [Vigna radiata (L.) Wilczek].
[4]. Sinha, R.K., Pandey, D.K., & Sinha, A.K. (2000). Mining and the environment: a case study from Bijolia quarrying site in Rajasthan, India. Environmentalist, 20, 195- 203.
[5]. Alva, A.K., Sumner, M.E., & Miller, W.P. (1990). Reactions of gypsum or phosphogypsum in highly weathered acid subsoils. Soil Science Society of America Journal, 54, 993-998.
[6]. Banik, N.C., & Sengupta, K. (2012). Effect of sulphur on growth and yield of green gram (Vigna radiata (L.) Wilczek). Journal of Crop and Weed, 8, 109-110.

[7]. Kumar, A., Reddy, K., & M.Ashok (2014). Identification Of Variations In Plant Morphology Through Different Methods Of Gypsum Application In Tulsi (Ocimumbasilicum). International Journal of Scientific & Technology Research, 3, 190-195.
[8]. et.al., D.S. (2017). Growth, Yield and Yield Attributes of Summer Green Gram (Vigna Radiata L.Wilezeck) under Medium Black Calcareous Soils as Influenced by Application of Sulphur and Zinc Levels. International Journal of Agricultural Science and Research, 7, 663-668.
[9]. Rani, M.A., Prakash, V., & Khan, K. (2016). Response of Mungbean [Vigna radiata (L.) Wilczek] to Phosphorus, Sulphur and PSB during Summer Season. Agricultural Science Digest – A Research Journal, 36, 146-148.
[10]. Valzano, F., Greene, R., 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, 39, 1333-1347.
[11]. Van Alphen, J.G. and de los Rios Romero, F. (1971), Gypsiferous soils. Notes on characteristics and management. International Institute of Land Reclamation and Improvement Bulletin, Vol. 12.
[12]. Toma, M., Sumner, M.E., Weeks, G., & Saigusa, M. (1999). Long- term Effects ofGypsum on Crop Yield and Subsoil Chemical Properties. Soil Science Society of America Journal, 63, 891-895.
[13]. https://gadm.org/maps/IN/rajasthan/nagaur.html
[14]. Kumar, A., Batra, V.K., Panghal, V., Bhuker, A., & Kumar, R. (2019). Influence of FYM and Gypsum on Growth and Seed Yield in Carrot (Daucus carota L.)Irrigated with High RSC Water. International Journal of Current Microbiology and Applied Sciences.