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EFFECT OF STEEL PLANT WASTE SLAG ON BIOMASS, CROP PRODUCTIVITY AND ITS BIOCHEMICAL NATURE ON *Vigna radiata*

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ABSTRACT

Among the seven integrated steel Plants in India, one major public sector plant is located at Rourkela. It was collaboration of Federal Republic of Germany in October 1956. Rourkela Steel Plant generate Blast Furnace Slag, Steel making slag, fly ash, BF sludge dust. Industrial wastes and agricultural byproducts are increasingly used in crop production as fertilizers, but their impacts on soil carbon C sequestration remain poorly understood. slag based silicate fertilizer has been widely used to improve soil silicon availability and crop productivity. Silicon is the second most abundant element in soil after oxygen. Steel slag was considered as an adequate source of Si and registered in 1995 in Japan as a fertilizer. As steel slag also contains trace amounts of heavy metals, certain oxidative parameters were evaluated as well. Steel slags can be used in several activities such as construction and paving and also in the agricultural sector due to its ability to correct soil acidity, as it contains some nutrients for the plants and also as silicate fertilizer that is capable of providing silicon to the plants. The present work is to study the effect of Steel Plant waste slag on Biomass and crop productivity of Moong plant. Slag fertilizer was first used in rice cultivation ,wheat cultivation, maize cultivation. Our aim is to check the effect of steel plant waste slag on biomass and crop productivity of Moong plant. To maintain our ecological balance, this waste material can be used or recycled back to the environment in a positive way. The present work was to study the effect of steel plant waste slag on the shoot region i.e; leaves, flowers and fruit in different concentration of slag treatment resulted variable impact in green gram plant but it is insignificant.

Keywords: Rourkela Steel Plant, Steel Slag, Slag cement, *Vigna radiata* (Green Gram), Crop productivity, Biomass, Shoot region.

INTRODUCTION

Slag is the byproduct generated during manufacture of pig iron and steel. It is produced by action of various fluxes upon gangue materials within the iron ore during the process of pig

iron making in blast furnace and steel manufacturing in steel melting shop. As Silicon helps in the promotion of nodule formation which is essential for nitrogen fixation. Nodulation and Nitrogen fixation depend on sufficient supply of both macro and micro nutrients (Smith, 1982). Iron which is a micro nutrient it has an important role in nodule formation. A legume is a plant in the family Fabaceae or the fruit or seed of such plant. This Plant has close link with Nitrogen fixing microorganism known as Rhizobium. Leguminous plants are important in agriculture because they are resistance to disease, they are rich in proteins so they require less amount of Nitrogen for growth. Nitrogen fixing bacteria are symbiotically associated in them. These plants are used with food crops to enrich the soil with natural fertilisers are in fact produced by bacteria found in the roots or Rhizosphere of leguminous plant. In different concentration of slags the nodule formation also differs. It is also regulated by internal factors or we can termed it as autoregulation. Environmental factors which affects the number of nodules and nitrate concentration in the growing pot. Many research work has been done related to leguminous plant like Pigeon pea economic analysis, in human nutrition productivity and nutrient uptake comparative plant morphology of three wild relatives of Pigeon pea, Pigeon pea perspective in India but in Green Gram i.e; *Vigna radiata* treated in different concentration of Steel slag is not yet known. The objective of this work is to check the effects of Steel Plant waste slag on growth and productivity of *Vigna radiata (*Green Gram) plant. Mung Bean is the main source of human food and animal feeds, it has a very important role in maintaining the soil fertility by enhancing the physical properties and fixing atmospheric Nitrogen. This crop is cultivated in several countries of Asia, Africa and South America. In the U.S most Mung Beans are grown in Oklahoma. Mung Bean has special features such as it matures early, supply of good yield, drought resistance property. This property makes it very highly responsive in the time of scarcity of rainfall. Pulses generally fix atmospheric Nitrogen which boost crop yield. This Plant is an annual, erect or semi- erect, reaching a height of 0.5-1.25m. It is slightly hairy and has a well developed root system. The Beans are small, ovoid in shape and green in colour. The stems are many branched, sometimes, trifoliate with elliptical to ovate leaflets 6-16cm long x 4-14cm broad. The flowers are papillonaceous greenish or pale yellow in colour. The pods are long, cylindrical, hairy. They contain 7-15 small, cube shaped seeds. This plants have a growth period of 90 to 120 days.

STUDY SITE

This research was conducted in the Garden of Muncipal College, Uditnagar Rourkela. (22°13′30″N and 84°51′50.76″E) Odisha, India.

METHODOLOGY

To study the effects of Steel Plant waste slag on biomass and crop productivity of plant Vigna radiata in garden soil “Pot Experiment” was conducted. The experiment was carried using rounded design six pots. Six earthern pots (size r.23cm and h.28.5cm) were taken each containing 7 kg of dried garden soil. The experiment was started on 27th. April,2022, and it was considered as the day zero. After the addition of garden soil in the pot, the waste steel slag was added in each pot (except the control pot) separately slag at the rate of 125g,250g,500g,750g and 1000g per pot i.e; 5% slag, 10% slag, 20% slag, 30% slag and 50% slag. One untreated pot was kept as control. On the next day 10 Green Gram (*Vigna radiata*) seeds were sown in each pot and on the next day plumule and radicle was risen and after one week thin plants were grown in the pot. Throughout at an uniform level by watering at every alternative day. Ten seeds were sown in each pot and in the control pot 8 plants grown and 2 halt, 5% steel slag 9

plants grown and 1 halt, 10% steel slag 7 plants grown and 3 halt, 20% steel slag 8 plants grown and 2 halt, 30% steel slag 10 plants grown, 50% steel slag 8 plants grown and 2 halt.

Few pictures during different time interval of the experiment

TABLE – 1

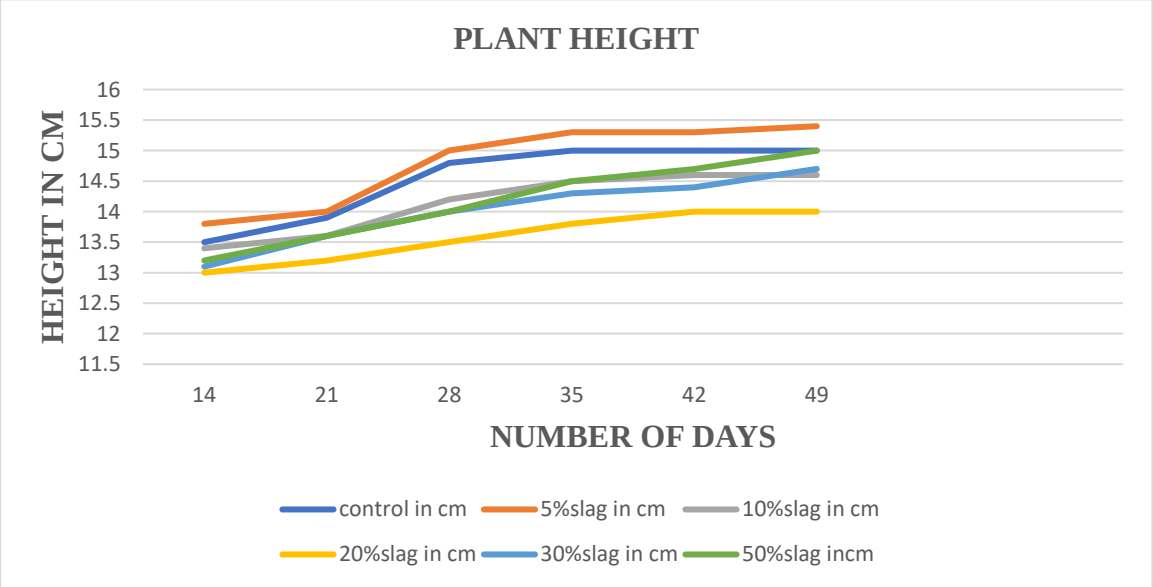
PLANT HEIGHT

POT EXPERIMENT						
DAYS	**CONTROL IN CM**	**5% SLAG IN CM**	**10% SLAG IN CM**	**20% SLAG IN CM**	**30% SLAG IN CM**	**50% SLAG IN CM**
14	13.5	13.8	13.4	13	13.1	13.2
21	13.9	14	13.6	13.2	13.6	13.6
28	14.8	15	14.2	13.5	14	14
35	15	15.3	14.5	13.8	14.4	14.5
42	15	15.3	14.6	14	14.4	14.7
49	15	15.4	14.6	14	14.7	14.7

TABLE-2

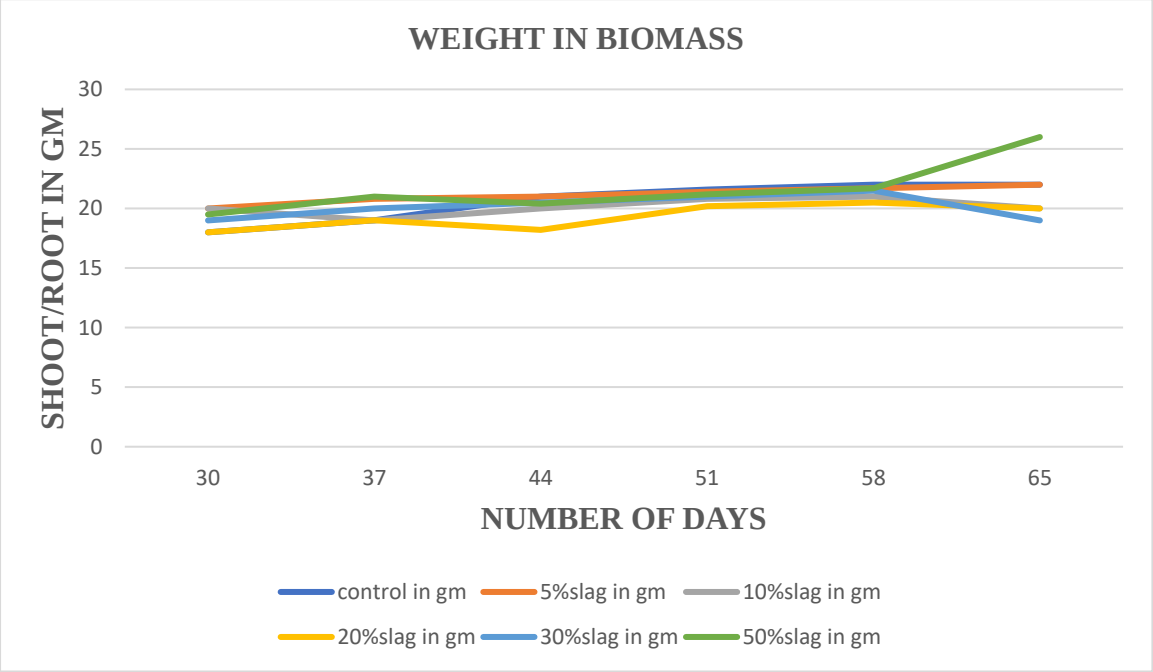
TOTAL BIOMASS

POT EXPERIMENT						
DAYS	**CONTROL IN GM**	**5% SLAG IN GM**	**10% SLAG IN GM**	**20% SLAG IN GM**	**30% SLAG IN GM**	**50% SLAG IN GM**
30	18	20	20	18	19	19.5
37	19	20.8	19	19	20	20
44	21	21	20	18.2	20.5	20.4
51	21.6	21.4	20.8	20.2	21	21.2
58	22	21.7	21	20.5	21.5	21.7
65	22	22	20	20	19	20



Plant Height of *Vigna radiata* data were collected from six randomly distributed pots at seven days interval. In 5% slag concentration, we observed that the plant height increased due to

stimulatory effect. In 10% slag concentration there is slight decrease in plant height because there might be some toxicant substance present in the slag. In 20% slag concentration there is also slight decrease in plant height there might be some toxic materials present in the slag. In 30% slag concentration there is sudden increase in plant height in the 21 days of interval and after that the rest days the plant height remains constant as the plant has attained the stage of maturity. In 50% slag concentration there is also the height remains constant because of maturity of plant. This result indicates unfavourable soil condition in slag treated in pots for plant height is quite insignificant (F=0.129).



In case of Plant Biomass, there is slight increase in biomass of plant in 5% slag concentration because of the stimulatory effect. In 10% slag concentration there is slight decrease in the biomass of plant because of the reduction in the plant height. In 20% slag concentration there is also decrease in plant biomass because of its variation in the plant height. In 30% slag concentration the biomass suddenly increased and after 51 days of interval it remains constant due to senescence of leaves. In 50% slag concentration the biomass almost remains constant because of the maturation of the plant and senescence of leaves. This result indicates the unfavourable soil condition in slag treated pots for biomass of the plant it was insignificant (F=0.131).

PRIMARY PRODUCTIVITY OF MOONG PLANT (*Vigna radiata)* GROWN IN POTS IN SOIL TREATED WITH DIFFERENT CONCENTRATION OF SLAG.

CONCENTRATION	PRIMARY PRODUCTIVITY
CONTROL	22.2%
5%	7.5%
10%	9.0%
20%	19.4%
30%	21%
50%	15.4%

The Primary Production in control pot was more than the treated pots. The treated pot of 5% slag concentration was lower than control pot. As the slag concentration rate increases i.e; 10%,20%,30% the primary productivity rate increases but in 50% the productivity rate decreases due to unfavourable condition or might be some toxic material present in the slag which retards the growth rate.

RESULT AND DISCUSSION OF BIOCHEMICAL EFFECT

TABLE – 1

MEAN (NUMBER OF LEAVES)

POT EXPERIMENT						
DAYS	**CONTROL**	**5% SLAG**	**10% SLAG**	**20% SLAG**	**30% SLAG**	**50% SLAG**
14	5	5	5	5	5	4.25
21	8.25	8.42	8.57	8.37	8.7	8.42
28	12	12.14	12	11.75	11.8	11.42
35	16.87	17	16.57	17.5	18.7	16.1
42	20.37	20.37	19.87	18.7	20.1	20
49	20	21	19	18	19	19

TABLE – 2

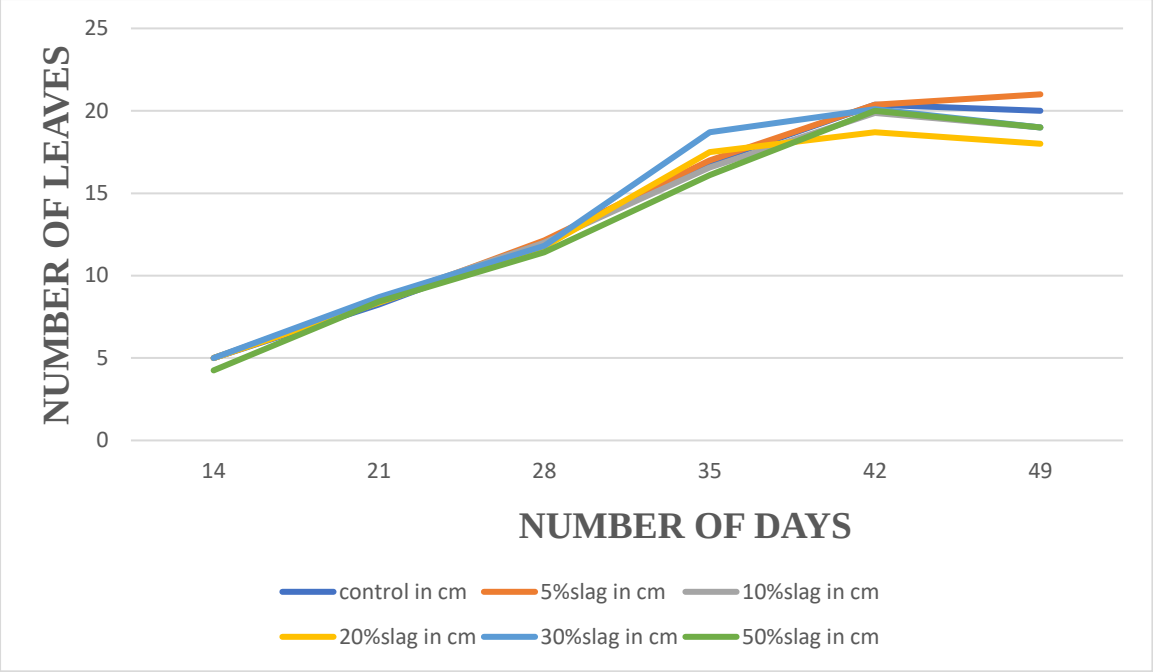
MEAN (NUMBER OF FLOWERS)

POT EXPERIMENT						
DAYS	**CONTROL**	**5% SLAG**	**10% SLAG**	**20% SLAG**	**30% SLAG**	**50% SLAG**
30	4.5	5.1	3.6	4.1	2.8	4.5
37	5	5.3	4	4.5	3	5
44	6.2	6.5	5.3	6.2	4.4	6.5
51	8.1	7.5	8	8.5	8.3	8
58	5.2	5.5	6.2	6.5	7.1	8
65	4	4.5	5	4.3	4.2	5

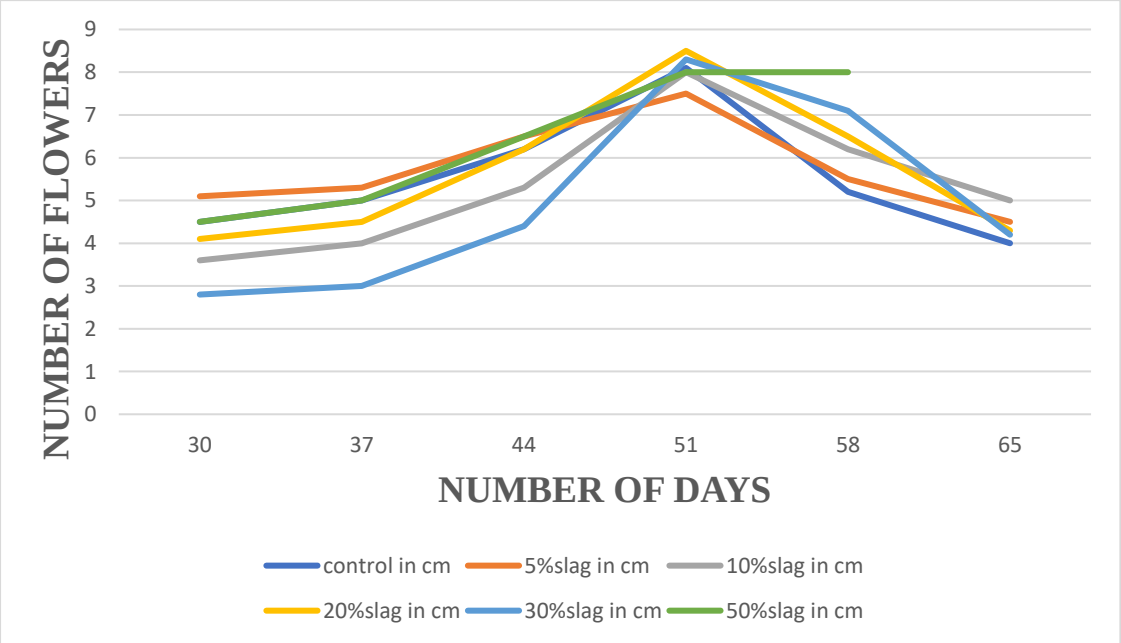
TABLE – 3

MEAN (NUMBER OF FRUIT)

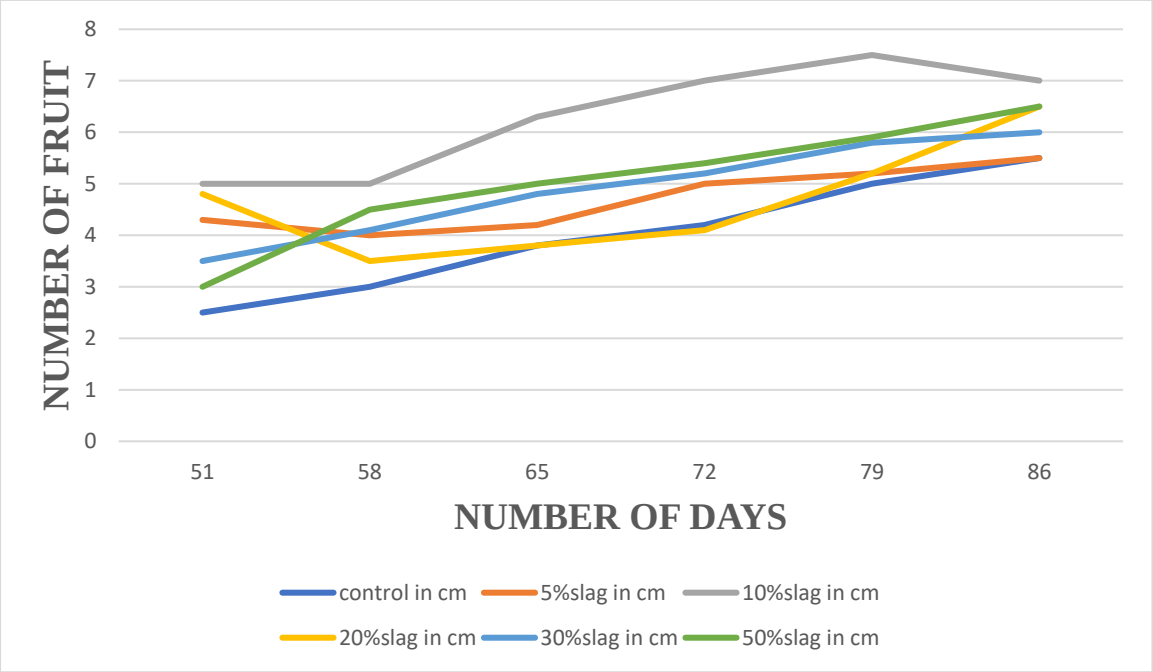
POT EXPERIMENT						
DAYS	**CONTROL**	**5% SLAG**	**10% SLAG**	**20% SLAG**	**30% SLAG**	**50% SLAG**
51	2.5	4.3	5	4.8	3.5	3
58	3	4	5	3.5	4.1	4.5
65	3.8	4.2	6.3	3.8	4.8	5
72	4.2	5	7	4.1	5.2	5.4
79	5	5.2	7.5	5.2	5.8	5.9
86	5.5	5.5	7	6.5	6	6.5



Number of leaves of *Vigna radiata* plant data were collected from six randomly distributed pots at seven days interval. In 5% slag concentration, we observed that the number of leaves were quite increased in 10% slag concentration there is also slight increase in number of leaves due to stimulatory effect.. In 20% slag concentration there is sudden decrease in the number of leaves due to presence of some toxicant might have affected the growth of the leaves. In 30% slag concentration there is sudden increase in the number of leaves . In 50% slag concentration there is again sudden decrease in the number of leaves due to senescence of leaves or due to presence of some toxicant material. This result indicates unfavourable soil condition in slag treated in pots for plant leaves and senescence of leaves. The result is quite insignificant (F=0.208).



Number of flowers of *Vigna radiata* plant data were collected from six randomly distributed pots at seven days interval. In 5% slag concentration, we observed that the number of flowers were quite increased in 10% slag concentration there is slight decrease in number of flower. In 20% slag concentration there is sudden increase in the number of flowers due to stimulatory effect. In 30% slag concentration there is sudden increase in the number of leaves because there might be inadequate temperature, moisture or some toxicant present in the soil. . In 50% slag concentration there is sudden increase in the number of flowers. This result indicates unfavourable soil condition in slag treated in pots for plant flower and the result is quite insignificant (F=0.431).



Number of fruit of *Vigna radiata* plant data were collected from six randomly distributed pots at seven days interval. In 5% slag concentration, we observed that the number of fruit were quite less in 10% slag concentration there is slight increase in number of fruit. In 20% slag concentration there is sudden decrease in the number of fruit due to light, temperature, soil. In 30% slag concentration there is sudden increase in the number of fruit. In 50% slag concentration there is increase in the number of fruit. This result indicates that it affected soil condition in slag treated in pots for plant fruit and the result is quite insignificant (F=0.106).

CONCLUSION

The present study indicates that Rourkela Steel Plant waste slag has Positive Effect (Stimulatory Effect) on growth, Biomass and Primary Productivity of Moong Plant at lower concentration (5%) but at higher concentration it has Negative Effect. But variation is insignificant.

The present study indicates that Rourkela Steel Plant waste slag has Positive Effect (Stimulatory Effect) on the number of leaves, flowers and fruit of Moong Plant at lower

concentration (5%) but at higher concentration (10,20%,30%,50%) it has adverse effect on the plant. Though it is insignificant. This may be due to presence of some heavy metal (Cd, Ni, Pb) in slag which may have inhibitory effect.

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