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Influence of Chemical Fertilizers and Biofertilizers on Growth of *Vigna radiata*

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Abstract: **Green gram is of short duration crop, requires low investment, yields higher income and serves as an excellent protein source as seed. The area under cultivation now increases because of its cultivation as a rotation crop after rice and groundnut. Aim of this study was to find the highest yielding capacity of plant with the application of various combination and doses of chemical fertilizers and biofertilizers. Different combination of N, P, K, Ca, Mg, Fe, Mn, Zn, Cu were selected as a chemical fertilizers and *Rhizobium fredii* and Phosphate solubilizing bacteria selected as a biofertilizers. The experiments were conducted in field of Sembal Village, Dist- Chandrapur. Results showed that treatment T_6P_7 was highest yield as compared to other treatments of lower, higher and Control. From this investigation it may concluded that not only primary nutrients are sufficient but secondary nutrients are also essential for growth of plant.**

Index Terms: **Biofertilizers, Chemical fertilizers, Nutrients, Phosphate Solubilizing Bacteria (P.S.B), Rhizobium fredii**/.

I. INTRODUCTION

Pulses have been grown since millennia and a vital ingredient of the human diet in India. Even "balanced food" as defined over 1000 years ago consisted of pulses, besides cereals, vegetables, fruits and milk products (Ayachit, 2002). It occupies a large part of the area under cultivation in India but their production is low. The growth rate in total area under pulses was negative in 1980s and 1990s, while it was positive during 2001-2008 because of the wider adoption of long duration varieties. They have serve as a poor man's meat and it provide energy, essential minerals, vitamins and several compounds considered beneficial for good health. Legumes contained the root nodules with symbiotic nitrogen fixing bacteria therefore it play a key role in crop rotation. The isoflavone content of pulses has been shown to increase two to three times more after germination thus dry green legumes and germinated pulses are good source of antioxidants (Sharma,1981).

Green gram is an important traditional crop cultivated all over the world. It is popularly known as 'Moong dal' in India and is basically a tiny circular shaped bean, green in color which is one of the main pulse crops in India. Because of to cross fertilization it has been distributed from Southern China through the north of Vietnam, Laos and Thailand into Myanmar and India. But now India has been universally accepted as the original home of green gram. It is spread too many countries, especially in tropical and subtropical Asia (Nene, 2006). Green, yellow, red and black seeded varieties of green gram have many health benefits and especially green gram flour is an excellent substitute for soap and it makes the skin soft and smooths (Watt, 1889). Mung beans contain higher amounts of protein with globulin and albumin as main storage proteins in the seeds (Kirchhoff, 2002). Medicinally, it helps to reduce weight, lower blood pressure, control cholesterol, heart disease risk, fight cancer, boost immunity & Protect against infection, improve skin health and antitoxic benefits. According to Krishnamurthy (1991) green gram soup was recommended during convalescence. Mung beans contain many healthy antioxidants, including phenolic acids, flavonoids, caffeic acid, cinnamic acid and more (Anwar, et. al., 2007). Sprouted mung beans appear to have a more impressive antioxidant profile and may contain as much as six times more antioxidants than regular mung beans (Kumar Ganesan, 2017).

Plants are able to received nutrients from the soil, fertilizers and through individual nutrient application. Elements are essential to the nourishment of plant health and have performs a crucial role in plant growth and development. Sulphur deficiency symptoms usually appear first on the youngest leaves and persist even after nitrogen application. Sulphur functions in plants have been reviewed by Duke and Reisenauer (1986), Dekok et. al. (1993) and Marchner (1995).The chemical and physical properties of the soil determine which methods of application

and soil management practices are best suited for a given soil. Gilbert (1952) produces super phosphate by chemical treatment of crushed bones with sulphuric acid. The experiments conducted in the 20th century and showed the distinction between major and minor nutrients.

Biofertilizers are substances which contain living microorganisms which applied to seeds, plant surfaces, soil colonize the rhizosphere and promotes growth by increasing the supply of primary nutrients to the host plant, it add nutrients through the natural processes of nitrogen fixation, solubilizing phosphorus and stimulating plant growth. The objects behind the application of biofertilizers to seed, soil is to increase the number of biological metabolic activity of useful microorganisms that accelerate certain microbial processes to augment the extent of availability of nutrients in the available form which can be easily assimilated by plants. The concentration of soluble Phosphorus in soil is usually very low, normally at levels of 1ppm or less than 1ppm (Goldstein, 1994). The first nitrogen fixing bacteria isolated from root nodules of legumes was Bacillus radicicola (Rhizobium sp.,) by Beijerinck (1888), Azotobactor sp., and Azospirillum sp., by Beijerinck (1925) and made a pure culture in liquid media. The biofertilizers inoculation technique and first commercial inoculants production was started in 1887 and sold in the market in 1895, under the brand name "Nitragin" in USA (Dalal, 2004).

II. MATERIALS AND METHODS

The experiments were conducted in the field of Sembal Village at Tahsil Warora, Chandrapur District, Maharashtra, during the session 2016 - 2018. *Vigna radiata* (variety – Mahabij) were chosen to study. Total seven treatments were taken, out of these, one are control and other seven treatments were given to seedling plants with inoculation of individuals and combination of biofertilizers, rhizobium and P.S.B. and treatments to seedling plants with different combination of chemical fertilizers N, P, K, Ca, Mg, Fe, Mn, Zn and Cu. The macro and micronutrients concentration to each selected crop as per recommendation of ICAR and PKV Akola. Biofertilizers were applied to plants by seed treatment method at the time of seed sowing. Phosphate solubilizing bacteria were collected from Anand Niketan College of Agriculture', Anandwan, Warora. *Baciilus megaterium variety- phosphoticum* was used as a P.S.B. *Rhizobium fredii* was the strains of Rhizobium cultured in department of microbiology, Janata College, Chandrapur.

A. APPLICATION OF CHEMICAL FERTILIZERS

The individual element was applied to field after 15 days from seed sowing and 10-15 days of interval in stepwise manner to study its effect on growth and development of crops.

B. APPLICATION OF BIOFERTILIZERS AND SEED TREATMENT

15-25 gm of biofertilizers were mixed with 20 ml solution of jaggery. The slurry was then poured over the 1kg of seeds spread on a cemented floor and mixed properly in such a way that a thin layer was formed around the seeds. The treated seeds were dried in the shade overnight and then they were ready to use for seed sowing in the cultivated field.

Table I. Level of Chemical Fertilizers in *Vigna radiata*

	N	P	K	Ca	Mg	Fe	Mn	Zn	Cu
P_0	0	0	0	0	0	0	0	0	0
P_1	25	10	5	10	5	2.5	3	2.5	2.5
P_2	30	20	10	15	10	5	6	5	5
P_3	35	30	15	20	15	7.5	9	7.5	7.5
P_4	40	40	20	25	20	10	12	10	10
P_5	45	50	25	30	25	12.5	15	12.5	12.5
P_6	50	60	30	35	30	15	18	15	15
P_7	55	70	35	40	35	17.5	21	17.5	17.5

*P_0-P_7 = Plants number., Treatment = chemical fertilizers in kg/ha.

Table II. Different Treatments of Chemical Fertilizers applied in the field for *Vigna radiata*

Treatments	Chemical Fertilizers & Biofertilizers
T_0	Control
T_1	N + P + K
T_2	T_1 + Ca + Mg
T_3	T_1 + Rhizobium
T_4	T_3 + Ca + Mg
T_5	Fe + Mn +Zn + Cu
T_6	T_5 + Rhizobium
T_7	Rhizobium + P.S.B.

III. OBSERVATIONS

Biofertilizers with balanced macronutrients and micronutrients supply to the plant were shown more outstanding response of yield attributing character like no. of pod / plant, wt. of pods/ plant and wt. of dry seeds /plant ("Table I" to "Table V").

Table III. Effect of chemical fertilizers and biofertilizers on number of pods (gm) per plant in *Vigna*

	T_0	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**	**T_7**
P_0	57	46	48	40	56	58	77	49
P_1	60	50	49	39	60	60	79	53
P_2	63	54	54	35	60	61	80	53
P_3	68	57	63	28	62	69	83	57
P_4	68	61	68	32	64	72	82	63
P_5	61	63	61	40	69	79	83	62
P_6	62	67	59	44	72	79	84	64
P_7	59	69	53	44	72	74	89	59

T_0-T_7 = Treatments, P_0-P_7 = Plants number

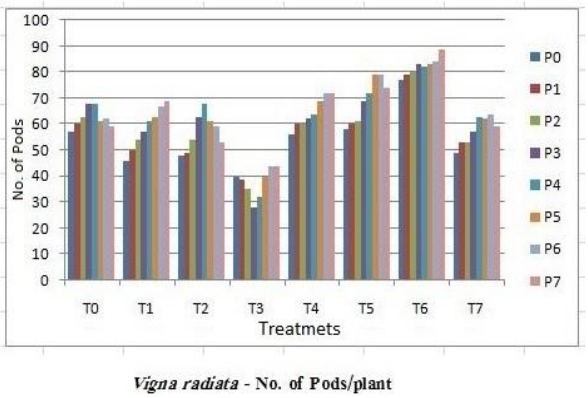

Figure 1: Bar diagram representing number of pod per plant in the cultivated study area of Sembal Village

Table IV. Effect of chemical fertilizers and biofertilizers on weight of pod (gm) per plant *in Vigna radiata*

	T_0	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**	**T_7**
P_0	29	20	24	30	24	31	38	27
P_1	30	23	25	28	27	32	41	29
P_2	31	27	27	22	27	34	43	29
P_3	34	29	29	18	28	35	44	30
P_4	32	30	33	22	29	35	46	32
P_5	30	31	30	26	32	41	46	31
P_6	31	34	30	27	33	40	47	33
P_7	30	34	26	29	35	37	48	30

T_0-T_7 = Treatments, P_0-P_7 = Plants number

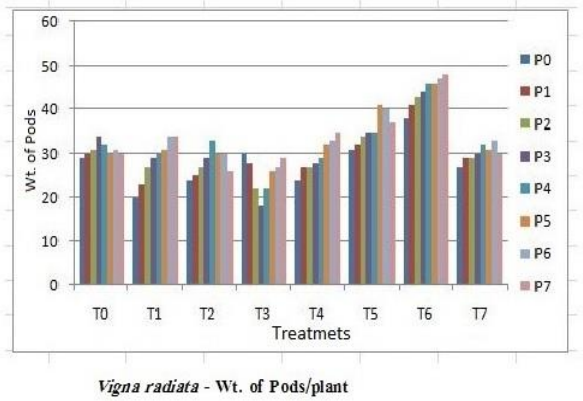

Figure 2: Bar diagram representing weight of pod per plant in the cultivated study area of Sembal Village

Table V. Effect of chemical fertilizers and biofertilizers on weight of seeds (gm) per plant in *Vigna radiata*

	T_0	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**	**T_7**
P_0	21	21	20	18	16	12	21	14
P_1	22	22	20	17	17	13	21	14
P_2	24	22	21	15	17	15	22	15
P_3	24	22	24	10	19	16	23	16
P_4	23	23	26	14	20	15	25	18
P_5	21	24	22	19	25	21	25	22
P_6	21	25	21	20	24	20	28	17
P_7	20	25	19	20	21	20	29	18

*T_0-T_7 = Treatments, P_0-P_7 = Plants number

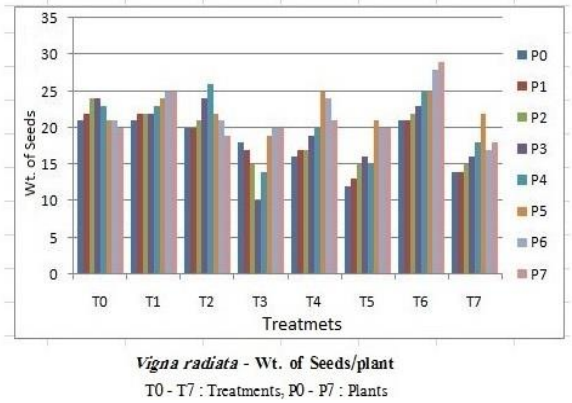

Figure 3: Bar diagram representing weight of seed per plant in the cultivated study area of Sembal Village

IV. RESULT

In our study, we found in graph Fig.1, 2, & 3 of experimental field of *Vigna radiata* were showed that the treatment T_6P_7 (17.5 kg Fe: 21 kg Mn : 17.5 kg Zn : 17.5 kg Cu/ha + Rhizobium) 89 pods, 48 gm. pod and 29 gm. seeds/ plant respectively. T_6P_7 was the best suited treatment, which increases yielding capacity of *Vigna radiata* while treatment T_3 was showed least yield as compared with control In T_3P_3 treatment (35 kg N: 30 kg P: 15 kg K/ha + Rhizobium) 28 pods, 18 gm. pods and 10 gm. seeds / plant was recorded. Treatment T_3 was only N, P, K + Rhizobium, treatment T_4 was N, P, K + Rhizobium in combination with secondary macronutrients Ca + Mg gave good results and more productive as compared with T_3. 25 gm seeds/ plant was obtained in T_4P_5 (45 kg N: 50 kg P: 25 kg K: 30 kg Ca: 25 kg Mg/ha + Rhizobium). 17 – 22 gm. of seeds/plant was obtained from treatment of biofertilizers (*Rhizobium fredii* + *Bacillus megaterium* var. *phosphoticum*) compared with control near about same results were observed. About 100gm of matured green gram seeds contain 1,453 KJ of energy, 62.62gm of carbohydrates, 6.60gm of sugar, 16.3gm of dietary fiber, 1.15gm of fat, 23.9gm of protein, 4.8 gm of vitamin C, 132mg of calcium, 189mg of magnesium, 367mg of phosphorus, 1246mg of potassium and 15mg of sodium, 6.7mg of iron, 2.7mg of zinc, 2.3mg of niacin (USDA Report, 2004).

V. DISCUSSION

From this study we were observed that not only primary nutrients are sufficient but secondary nutrients are also essential for growth of plant. If the nutrients deficiency occurred in plant, growth was stunted in *Vigna radiata*. Mung bean respond well to application of micronutrients like Zinc (Zn), iron (Fe) and Boron (B) under deficient condition (Masood Ali, 2000). From this study the above results are somewhat similar with Masood Ali. Mahodkar and Saraf (1988) observed that application of nitrogen as starter dose was found to be more beneficial as compared to N applied at other stage of crop growth in Mung bean. Dual inoculation with Rhizobium and VAM in organic matter and lime amended acid lateritic soil receiving phosphate from a cheaper unavailable source like rock phosphate improve the growth and yield of green gram (Das et. al., 1999). The effect of phosphate manures on crop yield in green gram an increase in growth, dry matter and yield (18.23q/ha) in 60 kg P_2O_5/ha through phosphocompost, phosphoFYM, phospho vermicompost, phosphopoultry manure, phosphocitycompost and single super phosphate. Involvement of N and P in the establishment of effective Bradyrhizobium and Glomus fasciculatum which consequently increase the N_2 fixation and yield of green gram plants (Saber et. al., 2005).

Figure :4 *Vigna radiata* plants representing A- Control, B- Treated & C- Biofertilizers in the cultivated study area of Sembal Village

VI. CONCLUSIONS

In the present study, it was concluded that effect of micronutrients, macronutrient with inoculation of Rhizobium species of T_6 treatment were highest growth of plants height, pod /plant & weight of seed /plants of *Vigna radiata*. Therefore this treatment was more favorable and superior as compared to the other treatments of highest, lowest and control. It mean from our own experiment we can concluded that not only primary nutrients are sufficient but secondary nutrients are also essential for growth of plant and because of deficiency of Ca and Mg the plant growth was stunted in *Vigna radiata.* This treatment was very useful for growth and development of crop. From this study, we also support the fact that it will beneficial for society from nutrients point of view. Moreover, this work will play an important role in establishing its utility for crop cultivation for farmers.

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