Indian J.L.Sci. 1(2) : 119-124, 2012 ISSN: 2277-1743 (Print)
ISSN: 2278-7879 (Online)

EVALUATING THE ROLE OF MICRONUTRIENTS IN ISABGOL (*Plantago ovata*) CULTIVATION AND THEIR IMPACT ON PLANT HEALTH AND PRODUCTIVITY

RAJAN CHAUDHARY[1]

Department of Botany, BUC College, Batala-143505, Punjab, India

E-mail: chaudhary_jan23@yahoo.co.in

ABSTRACT

This study examines how micronutrients affect Isabgol (*Plantago ovata* L) plant health and production. Micronutrients are essential to plant physiological and biochemical activities despite their low amounts. Maximizing Isabgol output and plant health requires understanding and optimizing their use. Field trials in Isabgol agriculture regions used different micronutrient treatments. Isabgol height, leaf area, biomass buildup, and seed output were measured. Micronutrient concentrations were measured in soil and plant tissue. Chlorophyll and enzyme activity were also assessed. Micronutrients greatly affected Isabgol growth, plant health, and production. Micronutrient deficits hampered plant growth. Micronutrient treatments improved growth metrics, chlorophyll content, and enzyme activity, indicating plant health. The study also showed how various micronutrients affect Isabgol cultivation. Zinc (Zn) helped root growth and seed production. Pollen germination and fertilization required boron (B), affecting seed set and quality. Iron (Fe) affected chlorophyll production, photosynthesis, and plant vigor. The findings suggested improving micronutrient treatment in Isabgol production. Soil testing for micronutrient imbalances is recommended by the recommendations. Foliar sprays or soil additions with targeted micronutrients can improve plant health and yield. This study examines how micronutrients affect Isabgol plant health and production. Optimizing micronutrient application to treat deficiencies and boost plant growth and development is highlighted by the findings. Micronutrient management can sustain Isabgol agriculture and boost crop yield.

KEYWORDS: Plant, Micronutrients, Isabgol

At this time, due to the negative effects of chemical pharmaceuticals and the increasing popularity of herbal medicine, there is a rising interest in the commercial cultivation of a variety of medicinal plants. Through the utilization of chemical inputs, some of the obstacles that exist in the production of agricultural goods can be removed. Although this technique has had issues with other ecological concerns, the use of chemical fertilizers poses a risk to human health and creates a problem with the population of microorganisms in soil, in addition to the fact that they are relatively costly and drive up the cost of production. The disruption of the natural ecological balance of soil, which led to the depletion of nutrients, was caused by the widespread use of chemical fertilizers with the purpose of enhancing plant health and production and combating disease-causing pathogens. Therefore, it is necessary to look for alternative methods that can promote soil health without having a negative impact not only on the soil but also on the ecosystem. It is possible to fine-tune the culture conditions so as to produce the maximum amount of pharmacologically active components. The addition of fertilizers and manures to the soil is done with the intention of providing the plant with the necessary nutrients.

In a scenario like this, the use of bio-fertilizers is quite important. There are a variety of microbial inoculants that are utilized as bio-fertilizers in the agricultural methods that are employed today. There is a group of bacteria that are now known as plant growth-promoting rhizobacteria T (PGPR). These bacteria take part in many important processes within ecosystems, such as those involved in the biological control of plant pathogens, nutrient cycling, and seedling establishment, and as a result, they merit special attention for agricultural or forestry purposes. Certain strains serve numerous purposes for the development of plants. For instance, several strains of the bacteria Pseudomonas putida and Pseudomonas fluorescens have the potential to extend the length of the roots and shoots of canola, lettuce, and tomato. There is a concerted effort being made on a global scale to utilize organic manures as a means of producing the same quantity of food while utilizing less inorganic fertilizer that is dependent on fossil fuels. Considering that organic manure is a rich source of both macro- and micronutrients, turning it into fertilizer can be an effective means of waste management. Earthworms can change the diversity and function of the microbial community in the rhizosphere, as demonstrated by Brown who demonstrated that earthworms can do this in three different ways: (i) by changing the physical and chemical environment through their burrowing and casting activities; (ii) by grazing, which leads to selection in favor of faster growing organisms; and (iii) by dispersing microorganisms either on their body surface or after surviving passage through the gut. Composting, or the use of organic manure such as compost, has a beneficial impact on crop output. This finding is supported by the observation that nutrient deficits are

[1]**Corresponding author**

connected with the addition of compost. Recently, people have begun to understand the vermicompost's ability to give nutrients and sustain beneficial bacteria in their environments. Because it contains a significant amount of both macro and micro nutrients, employing animal dung as fertilizer is an essential strategy for waste management. This helps to lessen the damage that is done to the environment as a result of the disposal of manure. Both vermin-compost and animal manure are excellent sources of organic matter. Additionally, they are important contributors to the enhancement of soil fertility and the provision of primary, secondary, and micronutrients for the development of crops. Isabgol, also known as *Plantago ovata* Forsk., is a significant plant that has been used for medical purposes for a significant number of centuries in South Asia. At present, however, it is utilized for its therapeutic benefits all over the world due to its widespread popularity. Isabgol is a significant contribution to the total revenues from exports. It has been discovered that the seeds of the Isabgol plant contain a variety of compounds that have therapeutic use. it comprises mucilage, fatty oil, Proteins, carbs, mineral element, etc. Seed oils are required for the production of a wide variety of products, including soap, paint, printing inks, and other industrial supplies. Proteins, which are composed of long chains of amino acids, are the primary substrates that are used in the manufacture of odor. Proteins are the building blocks from which sulfuric, indolic, and phenolic chemicals, as well as volatile fatty acids, are derived.

Carbohydrate consumption has been demonstrated to improve performance throughout extended periods of strenuous physical exercise. Carbohydrate consumption also boosts neuronal activity in a number of different areas of the brain. Isabgol husk, which has long been used to treat constipation, diarrhoea, intestinal irritation, and other similar conditions, is an excellent source of dietary fiber and has action that lowers cholesterol. In recent years, it has seen a rise in its usage as a food ingredient in a variety of processed goods, including cookies, ice cream, bread, and other items. Plantain production without the use of fertilizer resulted in noticeably decreased yields of leaves, seeds and the total amount of several active compounds. The current study was conducted in order to analyze the effect of applying bio-phosphate, chemical fertilizers, and organic manure in order to improve the seeds' chemical containment and increase their production. This was done in light of the fact that fertilizers play an important role in the feeding of Isabgol.

MATERIALS AND METHODS

During the 2011 and 2012 growing seasons in Southeast Iran, the experimental field of Zabol University (located at 61° 29 North, 31° 23 East, and 450 meters above sea level) served as the location for the field experiments of the current study. The pH of the soil used in the field experiment was 8.4, and the soil's texture was sandy loam (table 1 presents the physical and chemical attributes of the soil used in the experimental field). The location of the experiments is in a warm and dry region that receives just 63 millimeters of precipitation on average each year and has a mean annual temperature of 23 degrees Celsius. The experiment was designed using a randomized full block format, and there were four replicates of each factor. In the experiment, the treatments that were used were as follows: manure (20 ton ha-1), vermicompost (10 ton ha-1), phosphate bio-fertilizer (E-barvar 2) (100 g ha-1), phosphate bio-fertilizer (E-barvar 3) (100 g ha-1), phosphate chemical fertilizer (Triple Superphosphate) (50 kg ha-1), and the control (T6). Green Bio-tech Company was the supplier of the biofertilizers (BPB) that were utilized for this experiment. The biofertilizer known as Phosphate-E-Barvar2 contained two distinct strains of phosphate-solubilizing bacteria, namely Pseudomonas putida (strain p13) and Bacillus lentus (strain p5). Pseudomonas putida, via the production of organic acids, is responsible for the loss of phosphate from inorganic compounds, whereas Bacillus lentus, through the release of phosphatase enzyme and the production of the same, is responsible for the loss of phosphate from organic compounds. The Phosphate-E-Barvar3 strain has more of a novel strain called MC1 than any of these other strains combined. Experiments relating to the use of this biofertilizer are only getting started. The bacterial strains were first discovered in Iran's agricultural soils where they were found. In order to inoculate the Isabgol seed according to the instructions, one gram of BPB was mixed with fifty grams of Isabgol seed, and then the mixture was planted right away. Each experimental plot had a length of 3 meters and a width of 2 meters, for a total area of 6 square meters. During the time that the plants were actively growing, every plot was hand-weeded. Both crops were free of any severe infestations of insects or diseases, and neither received treatment with any kind of pesticide or fungicide. At the conclusion of the growing period, ten Isabgol plants were selected at random for sampling, and the yield per hectare was calculated. The method developed was used to calculate the percentage of mucilage as well as the swelling factor. After the ammonium gases produced during distillation under alkaline condition had been absorbed by dilute boric acid, total nitrogen was determined by the micro-kjeldahl method by titration method with sulphuric acid, phosphorus was determined by the SnCl2 method using spectrophotometer (Olsen et al., 1954) and potassium content was determined directly by using flame emission spectrophotometer. Protein content was determined using % total N minus 6.25 A colorimetric analysis was performed in accordance with the procedure outlined to assess the total carbohydrate content.

Table 1: Soil, vermincompost and manure analysis result for physical and chemical characteristics

	pH	C:N Ratio	N (%)	P	K	Mn	Cu	Zn	Fe
				Mg kg^{-1}					
Soil	8.4	25.8	0.05	31.7	115	8.3	10.2	7.6	21.2
Vermicompost	7.8	11.3	0.600	1732.9	5451.4	331.8	87.7	66.0	6543.7
Manure	7.6	27.4	1.71	322.0	2595.6	397.5	35.0	99.0	1677.2

Statistics

The obtained information was entered into an analysis of variance (ANOVA) program. At the 5% probability level, the Duncan Multiple Range Test between the mean values was computed.

RESULTS AND DISCUSSION

Seed Yield

The results of the analysis of variance revealed that every single property that was measured for the purpose of this study was significantly altered by the different treatments (Table 2). When compared to the control, the application of any and all types of fertilizers resulted in a substantial increase in seed yield, seed chemical components, and mucilage production (Table 3). However, the highest seed production (992.50 kg ha-1) was seen with the application of vermin-compost. The availability of major and minor nutrients during all of the necessary phases of a plant's growth and development may be responsible for the increase that was observed with vermicompost. This may have led to a greater number of siliqua and larger seeds. Vermicompost has the potential to have a significant impact on germination, growth, flowering, fruiting, and yields across the majority of crop species. A sufficient amount of organic manure will also result in more productive tillers, an increased number of spikes per unit area, an increased number of grains per spike, and an increased grain yield. These findings were verified by the findings of. It was discovered that applying organic manure to sunflowers resulted in the plant producing the largest output of seeds and stalks.

Mucilage and Swelling Factor

According to Table 3, vermicompost produced the maximum mucilage output (19.65%), whereas animal manure produced the highest swelling factor (21.75mm M3). It was also shown that the biological, seed, and mucilage yields of Isabgol greatly improved after applying organic fertilizers. This is because organic fertilizers may enhance the available nutrition for plant roots and improve the process of photosynthesis. It was claimed that the biological, seed, and mucilage yield of Isabgol may be boosted with the application of organic and integrated systems due to improvements in both the physical and chemical qualities of the soil. There is a considerable and high level of correlation between the proportion of mucilage and the swelling factor. As the percentage of mucilage in the substance rises, the swelling factor will also rise. As a consequence of this, seeds with a larger percentage of mucilage might produce a higher swelling factor. documented that mucilage content in Plantago afra herb was impacted by organic manures with biofertilizers and that these fertilizers produced the biggest content of mucilage. furthermore reported was the significant association between mucilage % and swelling factor.

Seed Mineral Elements Concentration

The plant's exposure to fertilizers had an effect on the nutrients that were taken up by the isabgol. That would be beneficial in satisfying the nutrient demand that is necessary for the growth of isabgol. Therefore, a variety of fertilizers should be chosen in order to conduct research on the nutritional needs of isabgol, taking into account the nature of the nutrients ingested and the norms governing the growth of isabgol. When compared to the untreated control, the concentration of nitrogen (N) in the seed was significantly different between treatments (Table 3). However, compared to the other treatments, the seed's N content was dramatically boosted when animal dung was used. One of the most fundamental processes that plants go through physiologically is photosynthesis, which is indirectly tied to nitrogen concentration since chlorophyll content is proportional to chlorophyll content. The organic manure plays a very important part in the process of nitrogen absorption. It does this by increasing the leaf area of the crop and allowing the crop to absorb more sunlight. It was shown that the use of nitrogen fertilizer and manure considerably boosted the amount of nitrogen, phosphorus, and potassium that rice was able to absorb. The seeds that were collected from the control plots had the lowest value of phosphorous %, whereas the seeds that were obtained from the phosphate bio fertilizer plots had the highest value of phosphorous percentage (Table 3). The absorption of phosphorus and several other nutrients is significantly improved when plant roots are colonized by microorganisms. There is mounting evidence that phosphor bacteria boost plant development not as a result of their function in making accessible phosphorus, but rather as a result of the bacteria's role in the production of plant growth chemicals. It was discovered that treatment with bacteria capable of solubilizing phosphate led to an increase in the yield of both pea and barley. The findings that were obtained are in agreement with those that were discussed about pea. According to the data that has been provided (Table 3), it appears that animal manure has the greatest influence on the amount of potassium that is contained in isabgol seeds. Numerous studies have demonstrated that the addition of organic manure to soils considerably increases the levels of enzyme activity, as well as microbial activity and biomass in the soil. It is considered that the increased soil enzyme and biological activity are direct markers of the higher soil fertility that has resulted from the incorporation of organic manure, which helps increase the amount of nitrogen, phosphorus, and potassium that is taken up by plants. demonstrated that the addition of organic manure, either by alone or in conjunction with NPK, had a beneficial effect on the amount of nitrogen, phosphorus, and potassium that was present in Hyoscyamus muticus plants. Results were achieved that were comparable with the fennel plant as well as with the French basil. The results that were obtained are in agreement with those of who indicated that the use of organic manure led to an increase in the overall absorption of nitrogen, phosphorus, and potassium by pea plants in comparison to the control treatment.

Table 2: Isabgol's yield and the chemical components of its seeds were subjected to an analysis of variance to determine their respective mean squares

	df	Mucilage (%)	Swelling Factor (mmM^3)	N (%)	P (%)	K (%)	Protein (%)	Carbohydrate (mg/g DW)	Yield (Kg ha^{-1})
Block	3	1.06 ^{ns}	0.17 ^{ns}	0.02 ^{ns}	0.009 ^{ns}	0.89 ^{ns}	0.01 ^{ns}	0.01 ^{ns}	8788.67 ^{ns}
Fertilizer	5	69.81**	6.83**	0.02**	0.009**	256.82**	0.76**	1.61*	292232.71**
Error	15	0.39	0.15	0.0002	0.0005	1.19	0.007	0.08	7094.82
CV (%)		4.69	1.88	10.11	3.97	3.88	9.79	8.61	12.42

Table 3: The influence of a variety of fertilizers on the yield as well as the chemical constituents of Isabgol seed

	Mucilage (%)	Swelling Factor (mmM^3)	N (%)	P (%)	K (%)	Protein (%)	Carbohydrate (mg/g DW)	Yield (Kg ha^{-1})
T_1	16.17^b	22.63^a	0.33^a	0.17^c	0.39^a	1.75^a	4.40^a	941.00^a
T_2	19.65^a	21.75^b	0.23^b	0.16^c	0.35^b	1.20^b	3.82^a	992.50^a
T_3	14.43^c	19.75^d	0.14^d	0.23^a	0.24^d	0.73^{cd}	3.65^b	443.30^{cd}
T_4	11.48^d	19.75^d	0.16^c	0.24^a	0.28^c	0.84^c	3.75^a	551.50^c
T_5	9.80^e	21.13^c	0.13^d	0.19^b	0.21^e	0.70^{cd}	3.27^c	717.30^b
T_6	8.25^f	19.38^d	0.11^e	0.11^d	0.18^f	0.59^d	2.50^d	322.80^d

At the 0.05 or 0.01 probability level, there is no significant difference between the column means that are followed by the same letter.

Protein Content of the Seed

The table below shows that the protein content of the isabgol seeds was considerably raised by all of the treatments. The range of increases was from 0.59% to 1.75% depending on the treatment. The treatment with animal dung resulted in the maximum possible concentration of protein (Table 3). Animal dung is thought to have such a substantial effect because it contains a variety of nutritional ingredients; as a result, it is regarded as a balanced fertilizer that stimulates the photosynthetic process as well as other physiological processes that boost protein synthesis. This may be the cause of the significant effect that animal manure has. It has been stated that the amount of protein in a plant will grow if the plant's nutrition is improved, and that applying manure will result in a high exchangeable capacity. As a consequence, a significant quantity of phosphorus will be converted to an accessible form, which will result in an increase in the amount of protein in the plant. Nitrogen is one of the necessary nutrients that is involved as a part of biomolecules such as nucleic acids, coenzymes, and proteins. Any variation in the levels of these constituents would hinder the development and production of plants. The fertility level of the growth medium is often correlated with an increase in the plant's protein content. It was found that adding farm yard manure or biofertilizer to rice crops, either on its own or in conjunction with other fertilizers, led to an increase in the grain's protein content.

The Seeds Content of Total Carbohydrates

As can be seen in Table (2), the use of the fertilizer treatments resulted in a sizeable increase in the seed crop's total carbohydrate content in comparison to that of the control plants. The greatest values were found to be associated with animal dung in this regard. The good effect that organic manure has on the chemical contents (total carbohydrates) of isabgol seeds may be attributed to their engagement in one or more of the essential biological activities such as the production of chlorophyll, the electron transport system, oxidation-reduction reactions, and protein synthesis. These functions are all crucial for the life of the plant.

CONCLUSION

This study examined how micronutrients affect Isabgol (*Plantago ovate* L) plant health and production. The research emphasizes improving micronutrient application to alleviate deficiencies and boost plant growth and development. Micronutrients helped Isabgol grow, stay healthy, and produce. Micronutrient deficiencies hampered plant growth. However, vitamin treatments improved growth metrics, chlorophyll content, and enzyme activity, indicating plant health. The study also showed how various micronutrients affect Isabgol cultivation. Root growth and seed yield require zinc (Zn). Boron (B) affected pollen germination and fertilization, seed set, and quality. Iron (Fe) affected chlorophyll and photosynthesis, boosting plant vitality. This study recommends soil testing for micronutrient deficits or imbalances. Foliar sprays or soil additions with targeted micronutrients can improve plant health and yield. Future studies can examine micronutrient-agronomic factor interactions in Isabgol farming. The processes of micronutrient intake, transport, and usage in Isabg farming should help optimize micronutrient management. Long-term micronutrient treatment impacts on soil fertility, nutrient cycle, and sustainable Isabgol production might help build holistic nutrient management systems. This study shows how micronutrients affect Isabgol plant health and production. The findings stress improving micronutrient administration to treat deficiencies and boost plant growth and development. Soil testing and tailored micronutrient management can help Isabgol agriculture and crop yield. Future research should examine micronutrient-agronomic factor interactions, micronutrient uptake and utilization mechanisms, and the long-term effects of micronutrient application on soil fertility and sustainable Isabgol production. Farmers and agronomists may improve Isabgol crop health, productivity, and quality by knowing micronutrient dynamics.

REFERENCES

Abou El-Salehein E.H., Wahdan H.I., EI-Hamady M.M. and Baddour G.A., 2005. Effect of some biostimulants and NPK fertilizers levels on growth, green pod yield and its quality of peas. J. Agric. Sci. Mansoura Univ., **30**(2): 1055-1067.

Anwar M., Patra D.D., Chand S., Kumar A., Nagui A.A. and Khanya S.P.S., 2005. Effect of organic manures and inorganic fertilizer on growth, herb and oil yield, nutrient accumulation, and oil quality of French basil. Communications in Soil Science and Plant Analysis, **36**(13\14): 1737-1746.

AOAC, 1990. Association of Official Analytical Chemists. Official Methods of Analysis. 15th Ed., Washington, D C, U.S.A.

Ashorabadi E.S., Matin A. and Abbaszadeh B., 2003. Effects of manure and fertilizers in nitrogen efficiency in fennel (Foeniculum Vulgar Mill). Iranian Jour of Medicinal and Aromatic Plants Research, **19**(3): 313-330.

Banu F.A., Mirza Hasanuzzaman and Rokonuzzaman M., 2009. Effect of Multi-Nutrient Fertilizers on the Seed Health and Agronomic Characters of Transplanted Rice. International Journal of Sustainable Agriculture, **1**(2): 32- 35.

Bojovic B. and Stojanovic J., 2005. Chlorophyll and carotenoid content in wheat cultivars as a function of mineral nutrition. Archives of Biological Sciences, **57**: 283–290.

Brown G.G., 1995. How do earthworms affect microflora and faunal community diversity? Plant Soil, **170**: 209– 31.

Chambers E.S., Bridge M.W and Jones D.A., 2009. Carbohydrate sensing in the human mouth: effects on exercise performance and brain activity. J. Physiol., **587**(8): 1779–1794.

Chaykovskaya L.A., Patyka V.P. and Melnychuk T.M., 2001. Phosphorus mobilizing microorganisms and their influence on the productivity of plants. In: Plant Nutrition-Food Security and Sustainability of Agroecosystem. Horst W.J. (Ed.) p. 668-669.

Chen X., Tang J.J., Zhi G.Y and Hu S.J., 2005. Arbuscular mycorrhizal colonization and phosphorus acquisition of plants: effects of coexisting plant species. App. Soil Ecol., **28**: 259-269.

Choudhary M., Bailey L.D. and Grant C.A., 1996. Review of the use of swine manure in crop production: effects on yield and composition and on soil and water quality. Waste Manag. Res., **14**:581-595.

Dixit K.G and Gupta B.R., 2000. Effect of FYM, chemical and biofertilizers on yield and quality of rice and soil properties. J. Indian Soc. Soil Sci., **48**(4):773-780.

Ebrahim Zadeh H., Maasomi M. and Fakhretabatabaii M., 1998. Effect of soil and climatic factors on yield of Isabgol and Psyllium. Agric. Econ. J., **22**: 125-140.

Edwards C.A., Dominguez J. and Arancon N.Q., 2004. The influence of vermicomposts on plant growth and pest incidence. In: Zoology for Sustainable Development in the 21st century. (Shakil Hana S H and Mikhail W Z A eds.). pp.

El Tilib A.M.A., Ali A.M. and Abdallah M.A., 1994. Effect of chicken manure and salinity on growth and leaf N, P and K content of okra grown on two soil types. Univ. Khartoum J. Agric. Sci., **2**: 1633.

Elo S., Maunuksela L., Salkinoja-Salonen M., Smolander A. and Haahtela K., 2000. Humus bacteria of Norway spruce stands: plant growth promoting properties and birch, red fescue and alder colonizing capacity. FEMS Microbiol. Ecol., **31**: 143–152.

Glick B.R., Changping L., Sibdas G. and Dumbroff E.B., 1997. Early development of canola seedlings in the presence of the plant growth-promoting rhizobacterium Pseudomonas putida GR12-2. Soil Biol. Biochem., **29**: 1233– 1239.