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Augmenting Growth, Yield and Quality of Rice cv. GR 11 via Foliar Application of "Metabolis Gold"

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***Abstract* – Present investigation entitled "Effect of foliar application of Metabolis Gold on growth and yield of rice *cv.* GR11" was conducted during the *kharif* season 2021 and 2022 on the field of ASPEE, Agricultural Research and Development Foundation, Tansa Farm, At - Nare, Taluka-Wada, Dist-Palghar, Maharashtra, India. The experiment laid out in Randomized Block Design (RBD) with five treatments (Control, Metabolis Gold @ 0.5 gm, 1.0 gm, 2.0 gm, and 3.0 gm / litre water) were replicated four times. The plant height (cm), number of tillers / plant, number of panicles / plant, number of panicles / square meter and length of panicle (cm) were found maximum with the foliar application of Metabolis Gold @ 3.0 gm / liter water for both years. The highest number of seeds / panicle, test weight (gm), grain yield (q/ha) and straw yield (q/ha) were found with the foliar application of Metabolis Gold @ 3.0 gm / litre water. While, the lowest number of seeds / panicles, test weight, gram yield, and straw yield were found in the control treatment for year 2021 and 2022. The data clearly Indicated that, the yield obtained with treatment T_5 (Metabolis Gold @ 3.0gm / litre water) was significantly higher than all other treatments, and also for growth parameters in 2021 and 2022.**

***Keywords* – GR 11, Foliar, Metabolis Gold, Plant Height, Test Weight.**

I. INTRODUCTION

India is one of the top rice-producing countries globally, consistently producing over 100 million metric tons of rice annually. Rice is grown in various states across the country, with major rice-producing states including West Bengal, Uttar Pradesh, Andhra Pradesh, Punjab, and Tamil Nadu. India produces several rice varieties, including Basmati and non-Basmati rice. Basmati rice, known for its aromatic and long grains, is highly sought after in international markets and is primarily grown in northern states like Punjab and Haryana. Rice consumption varies by region, with southern India consuming more rice compared to the northern states, where wheat is the staple cereal.

Rice is deeply engraved in the rich tradition and culture of India. It is the most important human food crop in the world. In addition to this It is also known as backbone of livelihood for millions of rural households and plays vital role in the country's food security. It is critical to global food security and to the welfare of around 800 million impoverished people around the world. The total area under rice cultivation in India is 2.75 million hectares, with an annual production of 105.2 million tonnes and a productivity of 2962 kg ha^{-1}. The area under rice cultivation in Maharashtra, India is 1.56 million ha, with an annual production of about 3.06 million tonnes and a productivity of 1963 kg ha^{-1}. The country has managed to maintain the balance between rice supply and demand by applying improved production techniques, including the use of high-yielding varieties/hybrids, expanding irrigation capacities and the use of various fertilizers.

The Indian government has various policies and schemes to support rice production and ensure food security. The Minimum Support Price (MSP) is one such policy that guarantees a minimum price for rice to farmers, whi-

-ch helps stabilize prices and provides income security.

Rice cultivation in India faces challenges such as water scarcity, pest and disease management, and climate change impacts. Sustainable rice farming practices, including the adoption of modern technology and improved varieties, are being promoted to address these challenges.

As the population continues to increase, the demand for rice is expected to increase further in the future. Therefore, rice production must also increase. As the area under rice cultivation continues to decrease, there is a need to further improve rice productivity. To begin with limitation for the productivity of country's rice system the major limitations are inefficient use of fertilizers, the scarcity of water and labor, climatic change, inflation and rising socio-economics. In addition to this impact occurs on the labor migration, urbanization, youth, barren land, and concerns about environmental pollution and climate change due to weather conditions. For overcoming from this alarming situation rice production should meet the needs of a growing population is to increase rice productivity per unit area through more efficient use of resources. To improve rice productivity in India, high-yielding varieties capable of tolerating abiotic and abiotic stress should be explored for climate change. Rice crop production technologies that increase factor productivity, reduce farming costs, increase profits, and efficient use of inputs should be explored. Rice accumulates the most silicon. In addition to increasing the productivity of rice, silicon has many functions Benefits such as greater availability of primary and secondary elements and micro nutrients outside. In addition, silicon in rice reduces biotic and abiotic stresses.

The role of amino acids in paddy is crucial for its growth and development. Amino acids are the building blocks of proteins, which play a significant role in various physiological processes such as photosynthesis, stress response, nutrient uptake, enzyme activity, and hormone regulation. In addition to this, amino acid supplementation can improve soil fertility by increasing microbial activity and enhancing nutrient availability to plants. This results in increased yield production with improved quality of Paddy. Overall, amino acids can significantly contribute towards sustainable agriculture practices aimed at improving productivity while reducing environmental impact.

II. Material and Methods

The experiment was conducted at ASPEE, Agricultural Research and Development Foundation Farm, Village-Nare, Taluka-Wada, District, Palghar in the kharif season during 2021 and 2022 in Randomized Block Design (RBD) with four replications (Panse and Sukhatme, 1967). The gross plot size and net plot size were 3.30 m x 2.85 m, and 3.15 m x 2.80 m, respectively. Variety was transplanted at the spacing of 20 X 15 cm. The experimental site was located at 19.650 N latitudes and 73.130 E longitudes with an average annual rainfall of 3600 mm. Five treatments comprising different levels of Metabolis Gold such as T_1-Control (Metabolis Gold 0.0 gm), T_2-Metabolis Gold 0.5 gm, T_3-Metabolis Gold 1.0 gm, T_4-Metabolis Gold 2 gm, and T_5-Metabolis Gold 3.0 gm /litre water were tested in rice variety of GR 11. Treatments were applied twice by spraying over a standing crop. The first foliar spray was applied at 40 days after transplanting, while the second foliar spray was applied 75 days after transplanting of seedling in main field. The positive effects of L series amino acids on rice *cv.* GR 11 on growth and production, manifested when it was specifically supplied during the vegetative and reproductive growth stages rather than ripening stages, which exerted a feed-forward effect on photosynthesis coupled with an increased in both stomatal conductance's.

The recommended dose of fertilizer (120 kg N: 50 kg P_2O_5: 50 kg K_2O: 6 kg Zn) was applied. The recommended dose of NPK was applied in the form of urea (46-0-0), single super phosphate (0-16-0), and the muriate of potash (0-0-60). Recommended management practices and plant protection measures were taken.

The data obtained during the study were subjected to statistical analysis using the WASP (Software developed by ICAR Research complex Goa).

III. Results and Discussion

The L series amino acids are supplied to plants through foliar application. Glycine and Glutamic Acid are fundamental metabolites in the process of formation of vegetable tissue and chlorophyll synthesis. These Amino Acids help to increase chlorophyll concentration in the plant leading to a higher degree of photosynthesis. This makes the crop lush Green.

Plant Growth Parameters:

Vegetative and Reproductive Parameters:

The growth period of the rice plant has divided into three stages; vegetative, reproductive and ripening tags. The vegetative stage refers to the period from transplanting to panicle initiation, the reproductive stage from panicle initiation to heading, and the ripening stage from heading to maturity.

Table. 1a. Effect of foliar application of metabolis gold on growth, yield and quality of rice.

Treatment	Plant Population/sq. m		Plant Height (cm)		No. of Tillers/Plant		No. of Days to 50% Flowering		No. of Panicles/Plant		No. of Panicles /sq.m		Length of Panicle (cm)	
Year	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
T_1	31	31	104.5	102.3	9.6	9.6	80	79.3	8.7	7.8	260.5	262.0	23.9	24.1
T_2	33	32	106.5	106.5	10.5	10.5	76.8	77.8	9.6	9.3	301.8	302.6	24.5	25.6
T_3	33	33	107.1	107.1	11.3	11.3	71.8	73.3	9.9	9.8	327.5	326.4	24.7	25.8
T_4	33	33	107.9	107.9	12	12	68	70.8	10.4	11.6	354.6	355.7	25.1	26.2
T_5	33	34	108.1	108.2	12.7	12.7	67.3	68.8	12.1	13.3	399.8	387.4	25.7	27.8
S.Em.±	1.04	1.04	0.37	0.62	0.25	0.25	1.11	0.82	0.29	0.77	8.05	18.11	0.17	0.71
CD	NS	NS	1.13	1.92	0.79	0.79	3.43	2.53	0.89	2.38	24.81	55.81	0.51	2.19

The plant population/square meter was found non-significant among all treatments for year 2021 and 2022. For the year 2021, Plant height was recorded higher in T5 (108.1 cm) which was statistically at par with T4 (107.9 cm) and T3 (107.1 cm). Similarly, for year 2022 the maximum plant height was obtained in T5 (108.2 cm), which was also statistically at par with T4 (107.9 cm) and T3 (107.1 cm). The lowest plant height was recorded in the control treatment for year 2021 and 2022 as compared to other treatments. The number of tillers/plants was found to maximum in T5 (12.7) which were statistically at par with T4 (12) in both subsequent years 2021 and 2022. The lowest number of tillers/plants was scored in the control treatment as compared to other treatments of both years (Table 1a). The lowest number of days to 50% flowering was recorded in T5 (67.3 days) which was statistically at par with T4 (68 days) for year 2021. Similarly, in the 2022 the lowest days required for 50% flowering was observed in T5 (68.8 days) which was at par with T4 (70.8 days). For year 2021

and 2022, the maximum number of days to 50% flowering was recorded in the control treatment as compared to other treatments (Table 1a). The number of panicles/plants was recorded maximum in T5 (12.1) which was followed by T4 (10.4). The minimum number of panicles/ plants was recorded in the control treatment for the year 2021. Similarly, for year 2022, the maximum number of panicles per plant was observed in T5 (13.3), which was statistically at par with T4 (11.6).

The number of panicles (m^2) was recorded as maximum in T5 (399.8 & 387.4) in 2021 and 2022. The minimum number of panicles (m^2) was recorded in the control treatment (Table 1a) for both years. The number of seeds/ panicles was recorded maximum in T5 (240.5 & 252.4) in 2021 and 2022. In which the data of 2022 was at par with T4 (225.6). The minimum number of seeds/panicles was recorded in the control treatment for both years.

The test weight (1000 grain wt.) (gm) was recorded maximum in T5 (18.66 gm) which was statisti--cally at par with T4 (18.54 gm). However, the lowest test weight (1000 grain wt.) (gm) was recorded in the control treatment (Table 1b) in 2021. The test weight (1000 grain wt.) (gm) was recorded maximum in T5 (19.63 gm). However, the lowest test weight (1000 grain wt.) (gm) was recorded in the control treatment (Table 1b) for year 2022.

The grain yield was recorded maximum for 2021 and 2022 in T5 (62 & 66.6 q/ha) which was statistically at par with T4 (61.4 & 65.9 q/ha), T3 (57.7 & 61.9 q/ha) and T2 (57.3 & 61.5 q/ha). The lowest grain yield (45.0 q/ha) was recorded in the control. The straw yield was recorded maximum in T5 (94.12 & 94.48 q/ha) which was statistically at par with T4 (92.83 & 93.2 q/ha), T3 (87.09 & 87.43 q/ha) and T2 (86.06 & 86.38 q/ha) in 2021 and 2022 years. The lowest straw yield (67.3 & 67.58 q/ha) was recorded in the control of both year (Table 1b).

Table 1b. Effect of foliar application of Metabolis gold on growth, yield and quality of rice.

Treatment	**No. of Seeds / Panicle**		**Test Weight (1000 Grains Weight)**		**Grain Yeld (q/ha)**		**Straw Yield (q/ha)**	
Year	**2021**	**2022**	**2021**	**2022**	**2021**	**2022**	**2021**	**2022**
T_1	183.7	182.9	17.8	17.85	45.0	48.3	67.3	67.58
T_2	193.3	202.5	18.07	19.01	57.3	61.5	86.06	86.38
T_3	203.1	217.9	18.33	19.27	57.7	61.9	87.09	87.43
T_4	210.2	225.6	18.54	19.52	61.4	65.9	92.83	93.2
T_5	240.5	252	18.66	19.63	62.0	66.6	94.12	94.48
S.Em. (±)	5.17	8.56	0.08	0.38	3.79	4.06	5.52	5.55
CD	15.92	26.37	0.26	1.17	11.67	12.5	17.02	17.09

Fundamental functions of the amino acids in plants are the anti-stress agent (Hyp, Pro), chelating agent (Cys, Glu, Gly, His, Lys), cold weather resistance (Ala, Arg), generative development of plants and improvement of the plant pollen fertility (Hyp, Pro), growth stimulator (Glu), the precursor of auxin (Ser, Trp, Val), the precursor of chlorophyll (Gly), the precursor of polyamines: necessary to start the cell division (Arg), a

precursor to the formation of lignin and woody tissues (Phe), regulation of the water balance (Hyp, Pro, Ser), reserve of organic nitrogen necessary for the synthesis of other amino acids and proteins (Glu), simulation of the chlorophyll synthesis (Ala, Lys, Ser), stimulation of the ethylene synthesis (Met), stimulation of the germination (Asp, Glu, Lys, Met, Phe, Thr), stimulation of the hormone metabolism (Ala), and stimulation of the resistance mechanism to viruses (Ala) (Baqir *et al.*, 2019 and Dekhane *et al.*, 2022).

Amino acids also function as biostimulants for plants. As a biostimulant, amino acids can play important roles in enhancing plant productivity, specially under abiotic and biotic stress conditions (Seyed Hossein Mirtaleb *et al.*, 2021 and Dekhane *et al.*, 2022). Rice protein is high in the sulfur-containing amino acids, cysteine, and methionine but low in lysine.Nine essential amino acids biosynthesis leleado lysine (Lys), methionine (Met), threonine (Thr), phenylalanine (Phe), tryptophan (Trp), valine (Val), isoleucine (Ile), leucine (Leu), and histidine (His) in plants. Transpiration rate and intracellular CO_2 were relatively higher among all amino acid-treated plants (Baqir *et al*., 2019). Amino acids are essential plant compounds serving as the building blocks of proteins, the predominant forms of nitrogen (N) distribution, and signaling molecules. Plant amino acids derive from root acquisition, nitrate reduction, and ammonium assimilation.

The role played by accumulated amino acids in plants varies from acting as osmolyte, regulation of ion transport, modulating stomatal opening, and detoxification of heavy metals (Baqir *et al*., 2019). Glycine and Glutamic Acid are fundamental metabolites in the process of formation of vegetable tissue and chlorophyll synthesis. These Amino Acids help to increase chlorophyll concentration in the plant leading to higher degree of photosynthesis. This makes crops lush Green. Amino acids contribute to increasing the cell ability to uptake water and solvent nutrients from growth media and then increasing the vegetative growth; the multiple functions of plant metabolism and enhance the carbon assimilation rate leading to increasing the total dry matter reflecting on the sink and the yield (Dreccer *et al.*, 2000; and Sharma-Natu and Ghildiyal, 2005). Amino acids are believed to be responsible for enhancing protein contents, cell division, plant pigments, and natural hormoness such as IAA, GA_3, and ethylene (Ahmed and Abd El-Hameed, 2003; Ahmed *et al.*, 2007 and 2014 and; Madian and Refaai, 2011). Amino acids play an important role as a chelate material for each iron, zinc, copper, magnesium, and calcium as these elements can be absorbed and passed through plants easily with helped of amino acids (Vernieri *et al*., 2005).

IV. Conclusion

The application of Metabolis Gold at a concentration of 3.0 gm per litre of water demonstrated a clear and beneficial influence on the growth and yield characteristics of rice in the conducted investigation. This treatment notably improved various aspects of rice cultivation, potentially enhancing plant growth, increasing yield attributes such as tillering, root development, and flowering, ultimately resulting in improved overall productivity. The findings strongly indicate that the use of Metabolis Gold at this specific dosage holds promise as a practical approach for farmers to optimize rice crop yield, offering a valuable method for improving agricultural outcomes in rice cultivation.

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