



Applications of New World PGRs on Pomegranate (*Punica granatum* L.) to Improve Resistance against Pests, Airborne Pathogens and Improve Plant Physiology, Yield

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Abstract

The present research study deals with application activity, physiological impacts, and observations interaction between new world Plant Growth Regulators PGRs like amino acids, sea weed extracts, humic acids and Plant Physiology of Pomegranate (*Punica granatum* L.) Practically it has proved that use of PGRs in the Pomegranate fields found helpful improve resistance against air borne/ soil borne pathogens/diseases and improve crop yield.

Agriculture practices like pesticide, chemical fertilizer applications consequences of variety pollutions. It's time to emerge, evolve and establish organic farming methods in Agriculture to make sure we've started journey towards saving our planet from pollution and conveying clean environment future generations.

Present study was carried out during various seasons of 2021-2022 and all observations were noted during flowering to harvesting periods. Matter in this paper is defining the importance of soil and foliar applications of PGRs like Amino acids, Humic acid on Pomegranate (*Punica granatum* L.) fa-Punicaceae. Such study is vital to understand application PGRs to higher plants and their positive effects on plant physiology.

Also this is useful for increasing awareness towards better agriculture and useful to open new window explaining, exploring Aerobiology, Soil biology-Soil carbon for sustainable organic farming.

Keywords: PGRs; Pollution; Organic Farming; Plant Physiology; Sustainable Organic Farming

Introduction

Pomegranate fruit crop is has most ancient identity with impressive discussions and evidences as per historic data in various religious books. It is having tremendous beneficial medicinal health values [4]. Trees of Pomegranate; more technically deciduous shrub (characteristic periodical leaf fall naturally) shows luxurious growth, flowering, fruit setting in various seasons, in other words Pomegranate fruits are available throughout year.

Iraq is considered as its origin as per evidences provided in ancient literatures. Human practices like domestication,

hybridization, irrigation, fertilizers application, pest and disease management are the additional activities made it famous worldwide [4,8]. As per authentic data from the ancient Indian medicinal system, i.e., in Ayurveda Pomegranates shares handsome role in curing various diseases [8]. Pomegranates highly nutritious in calories due to having sugars like sucrose, glucose and fructose; high content of vit-C helpful iron metabolism increases hemoglobin levels (RBCs i.e. Blood) in other words supportive in the process of blood formation. Source of antioxidants and flavonoids prevents accumulation of 'Bad' cholesterol and consequently lowers the heart related risks. Again it is beneficial to improve immunity,

healthy skin, to be effective assistance in preventing cancers belongs prostate, breast, lung, and colon [8].

Agro-climatic conditions of Maharashtra (Geographically part of Deccan Plateau) are favorable for Pomegranate growth and development, so farmers can grow it throughout the year. Pomegranate (*Punica granatum L.*) Family Punicaceae is the major horticulture crop cultivated in Malshiras, Dist. Solapur and nearby areas of Pune district.

Pomegranate gives assurance for economic profits so it is necessary to adopt some innovative ideas in agriculture. Out of three flowering seasons, viz., January-February (ambia bahar) June-July (mrig bahar) and September-October (hasta bahar) farmers prefer mrig and amba bahar to attain maximum yield.

Materials and Methods

We conducted several types of experiments in work in the Pomegranate fields of Mr. Punjab Rao Pisal A/PShipur, Tal Malshiras. Visits were practiced in every week during Jan 2022-June 2022 (ambia bahar) and every minute details noted. Samplings like root, stem, leaves, flowers, fruits collected from trial plot analyzed in laboratory.

This research study is totally agriculture centric and tried to focus on valuable inputs in this industry along with improving Agro economy. To emphasize an importance organic (residue free) farming for future generations. Plant growth regulators (PGRs) Humic acid, Amino Acids (AA) and Sea weeds were taken into consideration to find out they are acting as growth and physiological parameters by increasing Organic Carbon* in soil. Now a days major problems threatening agriculture industry for reducing crop yield low organic carbon and air borne bacterial, fungal diseases.

Presented work in this paper has been carried out during various seasons of 2021-2022 in mrig bahar and amba bahar seasons. All the activities conducted under technical guidance and supervision of expert Mr. Tushar Kumbhar possessor of various Agribusiness industries and working in this field since last one and half decade. Laboratory works conducted in well esteemed laboratories of Shankarrao Mohite Mahavidyalaya Akhuj, Post Graduate department of Agrochemicals and Pest Management.

During this project every minute details were noted and applied for further investigations.

Along with water-fertilizers management another challenging task for farmers is to fight and prevent orchards from attack of pest and diseases. Airborne diseases causes severe losses during every year one can't avoid it easily. Especially airborne Oil spot (Duo of fungal + bacterial spores) fungal pathogens like *Alternaria* sp. arrives with air blow and infect orchard leaves thriving as parasite, *Fusarium oxysporum* root fungi causing wilt disease [7].

To bring about normal metabolic body functions i.e. Physiology of plants needed good soil, water, healthy environmental conditions along with nutrients sources. Of course soil is the medium/reservoir for plant nutrients (macronutrients and micronutrients) although soil microbes matter for uptake the same [6].

Humic acids are organic compounds that are important components of humus useful for luxurious growth of soil bacteria, fungi Mycorrhizae, earthworms which bring about conversion of nutrients available forms to plants. Soil carbon i.e. organic carbon-organic substances humic acid is highly beneficial to both plant and soil. It is important for increasing microbial activities like breakdown of nutrients Urea→Amides→Nitrite→Nitrate (only suitable form of N for plants) otherwise the process for nutrient uptake is totally impossible. Humic acid as a plant growth bio-stimulant, an effective soil enhancer; it promotes nutrient uptake as chelating agent and improves vegetative characteristics white roots development, leaf greenery, and nutritional status and leaf chlorophyll pigments [2].

For better results and plant nutrient balance in terms of yield along with maintenance of proper physiological plant health i.e. Pest and Disease management. Farmers have to face several challenges like drought, irregular rainfall, pest attack, various diseases and fluctuating market rates for product etc.

It's too important and only choice to maintain plant health to fight against pests and diseases. As per school of thoughts plant physiology it is possible to improve plant health by applying proper nutrient management systems. Amino acids (AA) are most important to bring about protein synthesis. Actually AA are building blocks for proteins and the base of next interesting story

in plant physiology is protein synthesis gives rise to structural and functional proteins e.g. Cell structures, Enzymes, hormones etc.

Humic acid, Amino Acids (AA) and Sea weeds were used to treat Pomegranate plants in trial plots. Above mentioned PGRs were used on an individual basis as well as in combinations. Various types of aqueous solutions were prepared using PGR with different concentrations, on account of purity percentage of particular ingredient in PGR.

Fertilizer applications and irrigation practices kept constant for treated and controlled plants. PGRs applied only to trial plants to compare physical and physiological results.

Nathan Cobb method (standard area diagram for leaf) used to determine Percent Disease Index (PDI). This method was used to determine fungal, bacterial disease severity.

Sr. NO.	Type of PGR	Technical Purity	Type of application	
			Soil/Plant	Foliar/Lit
1	Humic Acid powder	60%	10-20gm	2gm/lit
2	Amino Acids	80%	5-10gm	2gm/lit
3	Sea Weeds extracts	95%	10-20gm	2gm/lit

Table 1: Preparations of required formulations for Soil application and foliar spray.

Sr. No.	Type of PGR	Technical Purity	Weight inkg.	Solution preparation	Type of application	
					Soil Drenching/Plant	Foliar/Lit
1	Humic Acid powder	60%	06.66	1+2+3 Dissolved in 100lit of water	5ml	2ml/lit
2	Amino Acids	80%	10.00			
3	Sea Weeds extracts	95%	4.21			

Table 2: Preparations of required formulations for Soil application Drenching and foliar spray(Combination).

Formulae and Calculations -

Humic Acid powder (Technical Purity 60%)

$4/60 \times 100 = 6.66$ kg (required for 4% solution)

Amino Acids (Technical Purity 80%)

$8/80 \times 100 = 10.00$ kg (required for 8% solution)

Sea Weeds extracts (Technical Purity 95%)

$4/95 \times 100 = 4.21$ kg (required for 4% solution)

[Humic Acid 06.66 kg+ Amino Acids 10.00 kg+ Sea Weeds extracts 04.21 kg (powder forms) = 20.87 kg used to prepare solution in 100 lit Water] Prepared solution to be used for soil/ foliar application.

Sr. No.	Parameters (Physical)	Treated Plants/Rows	Controlled Plats/Rows
1	Number of Fruits/tree till harvest	100-130	85-115
2	Yield (gram/kg/fruit)	35 % increased	NA
	Yield (Per tree)	19-24 kg	17-21 kg
3	Bud/Flowers Drop Percentage	10-18%	10- 21%
4	Fruit Drop Percentage	15%	25-30%
5	Leaf Area	5-7 cm ²	3-5 cm ²
6	Pest-Sucking pest like thrips incidence (To find Resistance)	22%	35%
7	Disease Incidence intensity ¹ (To find Resistance)	Leaves	15%
		Stem	8-10%
		Fruits	10-15%

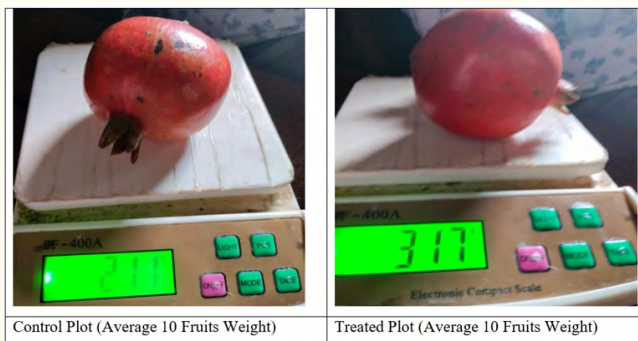
Table 3: Results showing various vegetative/physical parameters found in Pomegranate (*Punica granatum L.*) from treated and non-treated (control) from trial plot.

*Values/figures in table are product of observed values of samples of randomly collected leaves, flowers, fruits, insects, leaf spots (10-100 nos.) from the trial plots converted in percentage.

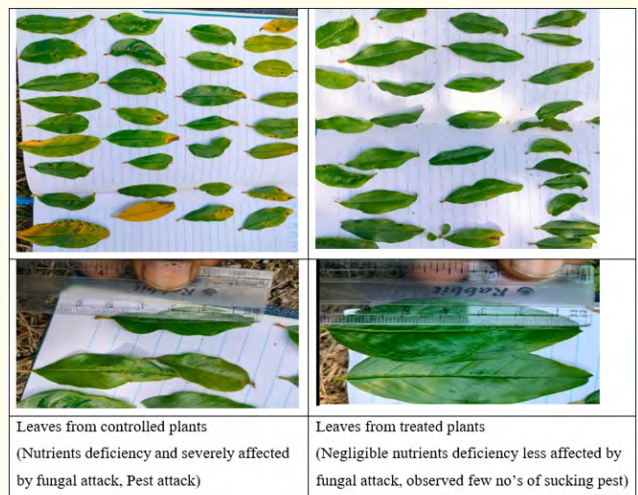
¹ Disease intensity calculated using Nathan Cobb method.



Photograph Slide 1: (Plants) showing difference between before and after treatment.



Photograph Slide 2: (Fruits) showing difference between control and treated fruits.



Photograph Slide 3: (Leaves) showing difference between control and treated leaves.

Results and Discussion

Improvement in vegetative growth/vigor

Overall plant growth observed vigorously so it is defining property to maintain physiology and consequently helpful for desired yield. Physiological improvement in plant found increase disease resistance, pest incidence (attack) in size and weight of fruits (Table 3) (Slides 1, 2 and 3).

Improvement in physiology/Leaf Area

Leaf area increased significantly after application of PGRs and physiology improvement (Table 3). The addition of some soil conditioner to improve the soil water holding capacity increased significantly leaf area. No significant improvement was detected between the control plants.

Less attack of insect pests

Insects like Thrips (*Thysanoptera*), Aphids (*Aphis gossypii*) and Stem-Fruit borers belongs order Lepidoptera frequently found on orchards which noxious one lowering quantity as well as quality of agricultural products. Due to healthy vigor of plants these insect pest incidence was less as compare to control trees/leaves/fruits.

Improvement in soil flora and fauna

Quality of soil can be determined by what it retains rather than whatever nutrients (in the form of fertilizers) that have been added in it. Macronutrients N,P,K Secondary nutrients Ca, Mg, S and Micronutrients Zn, Fe, Cu, B, Mn and Mo are playing crucial role to growth and development of plant [5,6]. It's not important to add these nutrients in soil but it matters what type of flora and fauna present in it required for conversion these nutrients in available forms. Plants cant uptake applied forms of fertilizers directly, needful process of nutrients conversion to suitable forms major role is played by soil microorganisms.

Soil microorganisms (required for plant growth not pathogens) further classified as Bacterial (free living/symbiotic), Nitrogen fixing bacteria, Phosphate solubilizing bacteria, Potash solubilizing bacteria Fungal, Algal (Blue green algae) etc. Soil microbes feeding on Soil carbon i.e. Organic Carbon* which is most important factor.

As per an authentic data Govt. Agriculture department says required Organic Carbon* in soil must be 5% but unfortunately analysis of soils in all over Maharashtra are showing below 1% i.e. 0.25-0.37%.

Useful bacteria, fungi can grow impressively if Organic Carbon* is available in required quantity, but it's not matching required values. Thus cascade effect is being observed availability of nutrients.

This study reveals importance of Organic Carbon* and figures are proving that Organic Carbon* can be increased by applying PGRs Amino acids, Humic acids, Sea weed extracts are improving soil Organic Carbon* (Table 4).

Sr. No	Parameter	Unit	Leaf		Fruit	
			Before treatment	After treatment	Before treatment	After treatment
1	pH	-	7.1	7.0	6.8	7.0
2	Electrical conductivity (EC)	Mhos/cm	1.2	1.4	1.6	1.1
3	Organic Carbon (OC)	%	0.42	0.47*	0.43	0.50*
4	Nitrogen (N)	Kg/ha	195	222	190	286
5	Phosphorous (P)	Kg/ha	17.1	20.1	16.1	22.1
6	Potash (K)	Kg/ha	210	240	201	252
7	Calcium (Ca)	%	7.5	8.2	7.5	8.7
8	Magnesium (Mg)	%	0.43	0.39	0.41	0.51
9	Sulphur (S)	%	1.10	1.20	1.0	1.53
10	Zinc (Zn)	ppm	0.37	0.40	0.32	0.45
11	Ferrous (Fe)	ppm	1.7	2.0	1.1	2.7
12	Copper (Cu)	ppm	0.09	0.11	0.09	0.18
13	Manganese (Mn)	ppm	0.82	0.12	0.81	1.15
14	Boron (B)	ppm	0.09	0.13	0.10	0.16

Table 4: Analysis Values of nutrients found after technical investigations in plant (Leaf and Fruit) made using lab techniques.

Instruments used for analysis of NPK, Nutrients, Soil Organic carbon

- Atomic Absorption Spectrophotometer (AAS) made CHEM BIOTECK.
- UV visible spectrophotometer made CHEM BIOTECK for micronutrients.
- Kjeldahl method Nitrogen (N) Determination Digestion and Distillation Apparatus.
- A Muffle Furnace to detect Phosphorous (P).
- Digital Flame Photometer for Potash (K) determination.

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