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BIO-REGULATORS AND ITS APPLICATIONS IN ENHANCING FLOWERING AND FRUIT CHARACTERS OF POMEGRANATE (*Punica granatum* L. Var. BHAGWA)

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ABSTRACT

The experiment entitled "effect of foliar application of bio-regulators on flowering and fruiting characters of pomegranate" was conducted at Rasingapuram village of Theni district of Tamil Nadu. The treatments significantly influenced the flowering and fruiting of pomegranate (*Punica granatum* L. Var. BHAGWA) over the control. The flowering characters viz., days taken for flower initiation (51.23), no of flowers per tree (171.47), fruit set percent (84.10) and flower drop (15.90) were found to be the best in T6 which received three doses of humic acid at 1 percent. The fruiting characters viz., no of fruits per tree was observed and the highest (143.49) was recorded in the T6 which received the application of humic acid as1 percent whereas control is recorded as lower value 99.54. Though all the bio-regulators significantly enhanced the flowering characters of pomegranate the humic acid excelled the panchakavya, seaweed extract and vermi wash. Vermi wash stood next to humic acid. The maximum fruit (12.74 cm), fruit diameter (10.46 cm), fruit volume (179.05 ml) and fruit weight (252.39g per tree) were recorded in the treatment T6. Different treatments significantly influenced the fruit yield per tree. Among the treatments T6 recorded the highest fruit yield. Hence from the above concluded results the foliar application of humic acid @ 1 percent in 3 doses can be adopted to get higher yield of good quality pomegranate fruits.

Keywords : Pomegranate var BHAGWA, foliar application, bio-regulators.

INTRODUCTION

Pomegranate (*Punica granatum* L.) belongs to the family punicaceae is the most delicious fruit crop. The name pomegranate is derived from two latin words pomum (apple) and granatus (seeded). Pomegranate plant grows as a bushy shrub with cylindrical thorny branches. Three types of flowers ranging from bright red to orange in colour are commonly on available and both self and cross pollination take place in them. Fruits are large, round (or) globose and berries called as "Balusta" symbolizes fullness (Bhosale *et al*., 2014).

Fruit and its different parts contain several phytochemicals like ellagic acid, catechin and procyanidins, fatty acids and triglycerides (linoleic acid, palmitic acid, punicic acid, tri-o-punicylglyceriol) sterols and terpenoids (betulinic acid, estrone, stigmasterol, testosterone), flavonols etc. that have been associated with a reduced risk of chronic human diseases (Gil *et al.,* 2000, Seeram *et al.*, 2006). Because of these properties, it is recognized as a strong therapeutic agent and considered as an important medicinal fruit crops.

Pomegranate is tolerant to drought, salinity, iron chlorosis and active lime stone (Melgarejo, 1993). It thrives well under semi-arid and arid regions. It has wide climatic and solid adaptability, but best quality fruits are produced in the areas of cool winter and hot dry summer. The area under pomegranate production has been on increase due to its versatile adaptability, hardy nature; low maintenance cost, steady and high yield and better keeping quality and possibilities to thrive in the rest period when irrigation potential is generally low. The quality and yield of this fruit crop depends on the irrigation regime, manuring and growth regulation. Among the horticultural technologies adopted in pomegranate cultivation growth regulation and supplemental nutrient management are considered as the top priority practices to enhance yield and quality of fruits.

Application of plant bio-regulators has been reported to increase the growth and yield in pomegranate. (Vidya *et al.,* 2016). Growth regulators are organic compounds, which modify or regulate physiological processes in plants in appreciable measures when are used in low concentrations. They are also known as magic chemicals as they can exert miracle in the growth, development and yield of crop plants. Various bio- regulators are available in two types, one as promoters and other as retardants, but both enhance the production and quality of a particular crop. However, their concentration may vary according to the climate, crop and season (Phookan *et al.*, 1991). Further growth regulator application need to be supplemented with foliar nutrition in order to meet the physiological nutrient requirement of the crop augmented by the PGRs. Hence, the bio regulators like Panchakavya, Seaweed extract, Humic acid and Vermiwash are used as they possess both PGR activity as well as nutrition.

The liquid organic solution panchakavya is prepared from cowdung, urine, milk, curd, ghee, legume flour and jaggery, contains macro nutrients, essential micro nutrients, many vitamins, essential amino acids, growth promoting factors like IAA, GA and beneficial microorganisms.

Organic seaweed extract is obtained from well selected naturally grown and cultured marine and is a common practice in coastal area throughout the world. The marine weed manures are applied either directly or in the form of compost and the seaweed extract is applied through the foliar application.

Humic acid (HAs) are the main fractions of humic substances and the most active components of soil and compost organic matter. They exert indirect and direct effects on plants, and this action of Humic acid and high concentrations of Humic acid are inhibitory for nutrient accumulation (Chen and Aviad, 1990).

Vermi wash contains various enzymes and microbes. Those are beneficial for growth and development of plant. The vermi wash also possess beneficial enzymes like of protease, amylase, urease and phosphatase and secretions of earthworms and these would stimulate the growth and yield of crops (Zambare *et al.,* 2008). Microbial study of vermiwash revealed the presence of nitrogen fixing bacteria like *Azotobacter* sp., *Agrobacterium* sp., and *Rhizobium* sp., and some phosphate solubilizing bacteria. There is a wide scope in using these of bio- regulators for yield enhancement of pomegranate.

MATERIALS AND METHODS

The present investigation on the effect of foliar application of bio-regulators on flowering and fruit yield of pomegranate (*Punica granatum* L. Var. Bhagwa) was conducted in a farmer's field. Theni district is situated at between 9° 39 and 10° 30' North latitude and between 77° 00' and 78° 30 of East longitude with an elevation of about 100 m above mean sea level. The mean maximum temperature is 40.5°C and average winter temperature is 15°C. The average annual rainfall is 880 mm. The mean relative humidity is 74 percent. The soil in the experimental field, where pomegranate varieties are being cultivated is Red soil and with a pH of 7.0.This study involves the fruit crop pomegranate i.e.) variety bhagwa which is grown well during End-July, Mid-August and Mid-September which is designed in RBD (randomized block design) involving three replications with 9 treatments. Total number of plants involved in this study is 270.There were nine treatments comprising of four bio regulators at two concentrations each.(table-1)

Table 1: Treatment Plan

Treatment	Treatment details	Concentration
T1	Panchakavya	0.5%
T2	Panchakavya	1%
T3	Seaweed extract	0.5%
T4	Seaweed extract	1%
T5	Humic acid	0.5%
T6	Humic acid	1%
T7	Vermiwash	0.5%
T8	Vermiwash	1%
T9	Control	Water spray

The bio-regulators were diluted with the required amount of water for foliar application. The spraying was done thrice at 30 days interval from pre flowering stage(45th day) and fruit development stage. The fruits of Bhagwa variety are glossy red in colour with soft seeds. Fruits weighed between 250-500 gms. Fruits are medium sized. This variety is otherwise called as Kcsar. It is well suited variety for export. It is recommended for cultivation by the Mahatma Phule Krishi Vidyapath, Rahuri. Healthy trees of pomegranate variety Bhagwa grown in the field, aged about 12 years were selected. For each replication and treatment ten trees planted adjacent in a row were selected. Selected trees were given with light pruning between two seasons application of treatment. Then 5 kg of FYM tree and recommended dose of NPK were applied in rhizosphere region of the tree. Then irrigation was practiced as and when required based on soil moisture content. The other crop management practices like weeding, earthing up and spraying of plant protection chemicals was done as per requirement. Five trees were randomly selected and tagged for taking readings. These observations were taken periodically up to the end of the fruiting season, This was recorded by counting the days from the date of foliar application of bio-regulator to the day at which flower bud initiation was took place at each treatment. The first five flower buds that were initiated in each plant were noted and the average was expressed in days. Number of flowers per tree was recorded by counting all the flowers that occurred during the entire flowering season and the average was expressed in numbers. Total number of fruits set in each treatment were counted and expressed as percentage of fruits set over total number of flowers produced. The following formula was used.

Fruit set percent = Number of fruits per tree / Number of flower per tree x 100

The percent flower/fruit drop was calculated by subtracting the percent fruit set value from hundred. The number of fruits per tree was counted at each picking and up to the end of the season to arrive the total number of fruits per plant. The length of each fruit was measured from the stalk end to the apex and the mean was worked out and expressed in centimcters. The fruit diameter of each fruit was measured at the broadest point after cutting the fruit into two equal halves. The mean value of five fruits was expressed in centimetres. The volume of each fruit was determined by water displacement method using a measuring cylinder and the man was expressed in milli litres. From the harvested lot of fruits in a tree five individual fruit were weighed and the mean of five fruits was expressed in grams. The yield of the fruits per plant was recorded at the time of harvest and expressed in kilograms (kg/plant). The following formula was used.

Benefit cost ratio = Net income / Cost of cultivation. The data were statistically analyzed as applicable to Randomized Block design (Panse and Sukhatme, 1978). Wherever the results were found significant, the critical differences were computed at 5 percent level of probability to arrive statistical conclusions.

RESULTS AND DISCUSSION

The data pertaining to the flowering characters given below in Table 2 viz., days taken for flower Initiation, number of flowers per tree, fruit set percent and flower drop (percent) showed significant variations among the treatments.

The earliness in flowering was noticed under the treatment To (Humic acid 1percent) with 51.23 days. However, the treatment T9 (Control) took a maximum of 85.31 days to initiate flowering. Earliness in flowering observed in plants treated with humic acid might be contributed due to the increased level of plant hormones and which ultimately might have altered the flowering physiology resulting in early flowering as reported by Shukla *et al*. (2014) and Das *et al*. (2015) in guava. Further earlier reports by Sunder *et al*. (2010) resulted that drip fertigation with123% recommended dose of fertilizer in combination with foliar spray of humid (0.4%) and panchakavya (3%) recorded least number of days taken for first flower bud emergence in jasmine. Further, humic acid has the ability to alter CN ratio of crop immediately after the foliar application. Alteration in C:N might have also triggered flowering earlier. Though all the bio -regulators significantly enhance the flowering characters of pomegranate, the humic acid excelled the panchakavya, seaweed extract and vermi wash. Vermi wash stood next to humic acid.

The data pertaining to the fruiting characters given below in Table 3 viz., number of fruits tree, fruit length (cm), fruit diameter (cm), fruit volume (ml), fruit weight (g fruit") and fruit yield (kg tree') showed significant variations among the treatments. The result of the present study indicated that the maximum number of fruits tree' was obtained (143.49) in T. (Humic acid 1 percent), while the least number of fruits tree;" was observed (99.54) in T, (control). Earlier reports by Chen et al. (2004) and Varanini and Pinton, (2000) in grapes indicated that humic acid could help in enrichment of soil nutrients, increase of microbial population and higher cation exchange capacity (CEC) which resulted in the increase of number of berries bunch". Similar observations on increased number of fruits tree due to humic acid application has been reported by Fatma *et al*. (2015) in *Canino apricot* fruits. Enhancement in number of fruits might be due to the enhancement in number of flowers and fruit set percent observed in humic acid treatments.

Table 2: Effects of Bio-regulators on Flowering Characters

T.No.	Treatments	Days taken for flower initiation	No of flowers per tree	Fruit set percent	Flower drop (percent)	No of fruits per tree
T1	Panchakavya 0.5%	81.05	147.52	73.64	26.36	108.64
T2	Panchakavya 1%	75.69	152.43	75.66	24.34	115.34
T3	Seaweed extract 0.5%	75.41	152.38	75.65	24.34	115.28
T4	Seaweed extract 1%	68.02	156.62	78.35	21.65	122.42
T5	Humic acid 0.5%	57.32	163.85	80.39	19.61	131.72
T6	Humic acid 1%	51.23	171.47	84.10	15.90	143.49
T7	Vermiwash 0.5%	68.27	157.63	78.40	21.60	123.59
T8	Vermiwash 1%	55.70	169.42	82.15	17.85	138.60
T9	Control	85.31	141.29	70.45	29.55	99.54
S.Ed		0.55	0.97	0.77	0.02	1.05
CD (P=0.05)		1.11	1.95	1.55	0.05	2.10

Table 3: Effects of Bio-regulators on fruiting characters

T.No	TREATMENT	Fruit length	Fruit Diameter (cm)	Fruit volume (ml)	Fruit weight (g/fruit)	Fruit yield kg per tree
T1	Panchakavya 0.5%	7.84	6.95	106.93	189.34	20.56
T2	Panchakavya 1%	9.32	7.86	123.45	204.65	23.60
T3	Seaweed extract 0.5%	8.64	7.52	122.86	203.74	23.48
T4	Seaweed extract 1%	10.27	8.78	138.24	217.63	26.64
T5	Humic acid 0.5%	11.72	9.42	150.24	227.65	29.98
T6	Humic acid 1%	12,74	10.46	179.05	252.39	36.21
T7	Vermi wash 0.5%	10.48	8.83	138.32	217.78	26.91
T8	Vermi wash 1%	11.99	9.90	165.15	240.58	33.33
T9	Control	7.09	5.98	94.07	175.47	17.46
	S.Ed	0.12	0.08	0.98	1.47	0.44
	CD (p=0.05)	0.24	0.16	1.97	2.95	0.89

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