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Effect of integrated nutrient management on growth and flowering of Pomegranate cv. Bhagwa

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ABSTRACT

The present research work on the topic entitled "Studies on Integrated Nutrient management on growth and flowering in Pomegranate (*Punica granatum* L.) cv. Bhagwa" was conducted at the research plot, College of Horticulture, Chiplima during the year 2021-2022 by using Randomized Block Design with nine treatments replicated thrice. The treatment details were T_1 : RDF (500 g N: 125g P_2O_5: 250 g K_2O) / Plant, T_2 : Half of the RDF, T_3 : 75 % of 'N' of RDF + Full 'P' + Full 'K' + 25 % N through FYM, T_4 : 75 % of 'N' of RDF + Full 'P' + Full 'K' + 25 % N through FYM + *Azotobacter* + PSB, T_5 : 75 % of 'N' of RDF + Full 'P' + Full 'K' + 25 % N through Vermicompost, T_6 : 75 % of 'N' of RDF + Full 'P' + Full 'K' + 25 % N through Vermicompost + *Azotobacter* + PSB, T_7 : 75 % of 'N' of RDF + Full 'P' + Full 'K' + 25 % N through Poultry manure, T_8 : 75 % of 'N' of RDF + Full 'P' + Full 'K' + 25 % N through Poultry manure + *Azotobacter* + PSB and T_9 : Control (No manures and fertilizers or biofertilizers). The observations on vegetative growth parameters and reproductive parameters were taken both initial (1 MAT) and advanced growth (3 MAT) stages. The results revealed that T_8 recorded maximum plant height (2.21 m at 1 MAT & 2.65 m at 3 MAT), stem girth (12.50 cm at 1 MAT and 14.78 cm at 3 MAT), canopy volume (3.48 m^3 at 1 MAT and 5.50 m^3 at 1 MAT), leaf area (74.80 cm^2 at 1 MAT, 76.25 cm^2 at 3 MAT) and significantly superior to control (T_9) plants. The treatment T), recorded significantly higher number of total flowers (174 in T_8 and 152 in T_7) whereas the control plants (T_9) recorded lowest number of total flowers (41.67). From the present study, it may be inferred that plants treated with 75 % N of RDF + full P + full K + poultry manure + *Azotobacter* + PSB is superior than the other treatments with respect to improvement in growth and flowering parameters in Mrig bahar crop of pomegranate cv. Bhagwa under Western Odisha condition of Odisha.

Key words : *Integrated nutrient management, Pomegranate, Flowering, Growth*

Introduction

Pomegranate (*Punica granatum* L.) belonging to family Punicaceae is a delicious and desert table fruit of tropical and subtropical regions of the world. It is native to Iran but extensively cultivated in Mediterranean region especially in Spain, Morocco, Egypt and Afghanistan. The versatile adaptability, hardy nature, low maintenance cost, steady and high yield, fine table and therapeutic values, better keeping quality and possibilities to thrive in the rest period when the irrigation potential is generally low are the main features responsible for its spread on a wide scale (Khodade *et al*., 1990). Owing to these medicinal properties and health benefits of the pomegranate, it is known as "Super food" (Hertog *et al*., 1997). Among the cultivars, Bhagwa is the predominant ruling variety of India owing to its dark red arils and

attractive red colour rind. Nutrients influence plant growth, flowering, yield and quality of pomegranate. With each harvest of fruit substantial amounts of macro and micronutrients are being depleted which need to be replenished regularly (Saroj and Kumar, 2019). The combined use of different sources of plant nutrients i.e. organic, inorganic and biological amendments for the maintenance and improvement of soil fertility and plant nutrient supply at an optimum level for desired crop productivity may be termed as integrated nutrient management. The reports from a number of experiments revealed that neither chemical fertilizer alone, nor organic fertilizers when applied exclusively as nutrient sources can maintain fertility of soil as well as crop production under highly intensive cropping systems. Thus, it is possible through integration of organic and inorganic sources of nutrients (Nambiar and Ghosh, 1984). The INM have been recognized to influence growth, yield and fruit quality of pomegranate. The information about effect of integrated nutrient management in Pomegranate cv. Bhagwa in West Central Table Land Zone of Odisha is meagre. Looking at all the above aspects, the present investigation was taken up to Effect of Integrated Nutrient Management on growth and flowering of pomegranate (*Punica granatum L.*) cv. Bhagwa

Materials and Methods

The experiment was conducted at the Research plot, College of Horticulture, Chiplima, Sambalpur, Odisha University of Agriculture and Technology during the year 2021-202. It is 20 km away from famous Hirakud Dam. The soil of the experiment plot was sandy loam with available N (135 kg/ha), available P_2O_5 (18 kg/ha), available K (101 kg/ha) having acidic pH (5.29), Ec (0.048 dS/m) and organic carbon content of 0.36 %. The experiment was imposed in Pomegranate var. Bhagwa with following 8 treatments replicated thrice. The age of the plants is 4 years.

The recommended dose of fertilizer (500 :125: 250 g each of N: P2O5: K2O) per plant was adopted to carry out the experiment. Half quantity of nitrogen and potash and whole quantity of phosphorus, and FYM, vermicompost and poultry manures according to each treatment were applied as basal application (4th week of May), whereas remaining nitrogen and potash was given during fruit development stage in two equal split doses at 1 month interval. Sources of inorganic fertilizers used were urea (46 % N), Diammonium phosphate (18-46-0) and muriate of potash (60 % K_2O). Bio-fertilizers were given 21 days after basal application. Intercultural operations were carried out during field preparation. All weeds around the plant were cleared by hand weeding and shallow hoeing as and when seen. The plants were irrigated during fruit development stage at regular interval. The effect of integrated nutrient management in pomegranate was studied by observing various vegetative growth parameters (Plant height, stem girth, plant spread in East-West and North-South direction, canopy volume, shoot length, leaf area, chlorophyll content, fresh weight and dry weight of leaves) at 1 month and 3 months after application of manures, fertilizers and biofertilizers in pomegranate. Four branches of one meter length were selected on each tree in all the directions. The numbers of flowers present on these branches were counted 20 days after full bloom. The number of male and hermaphrodite in each plant was counted and average was computed. The size of the both the staminate and hermaphrodite flowers were taken

Treatment details

Sl. No.	Treatments	Notations
1	RDF (500 g N: 125g P_2O_5: 250 g K_2O) / Plant	T_1
2	Half of the RDF	T_2
3	75 % of 'N' of RDF + Full 'P' + Full 'K' + 25 % N through FYM	T_3
4	75 % of 'N' of RDF + Full 'P' + Full 'K' + 25 % N through FYM + *Azotobactor* + PSB	T_4
5	75 % of 'N' of RDF + Full 'P' + Full 'K' + 25 % N through Vermicompost	T_5
6	75 % of 'N' of RDF + Full 'P' + Full 'K' + 25 % N through Vermicompost + *Azotobactor* + PSB	T_6
7	75 % of 'N' of RDF + Full 'P' + Full 'K' + 25 % N through Poultry manure	T_7
8	75 % of 'N' of RDF + Full 'P' + Full 'K' + 25 % N through Poultry manure + *Azotobactor* + PSB	T_8
9	Control (No manures and fertilizers or biofertilizers)	T_9

RDF- Recommended Dose of Fertilizer

with the help of slide caliper and expressed in cm. The number of stamens present in the flowers was counted and average value was presented. Three plants were randomly selected from each treatment in order to get representative sample. The datas were statistically analysed following standard procedure (Panse and Sukhatme, 1989).

Results and Discussion

From the data presented in the Tables 1- 2 and 3, it was inferred that maximum plant height (2.21 m at 1 MAT & 2.65 m at 3 MAT), stem girth(12.50 at 1 MAT and 14.78 cm at 3 MAT), plant spread in East-West direction (2.10 m at 1 MAT and 2.32 m at 3 MAT), plant spread in North-South direction (2.19 m at 1 MAT and 2.39 m at 3 MAT), canopy volume (3.48 m3 at 1 MAT and 5.50 m3 at 1 MAT) and shoot length (39.48 cm at 1 MAT and 67.33 cm at 3 MAT)were recorded in plants received with 75% of 'N' of RDF + Full 'P' + Full 'K' + 25% N through poultry manure + *Azotobacter* + PSB (T8). The control plants receiving no manures, fertilizers and biofertilizers had recorded minimum values for plant height (1.24 m at 1 MAT m and 1.31 m at 3 MAT), stem girth (10.23 at 1 MAT and 11.96 cm at 3 MAT), plant spread in East-West direction (1.53 m at 1 MAT and 1.71 m at 3 MAT), plant spread in North-South direction (1.55 m at 1 MAT and 1.66 m at 3 MAT), canopy volume (0.79 m3 at 1 MAT and 0.95 m3 at 1 MAT) and shoot length (24.32 cm at 1 MAT and 31.16 cm at 3 MAT).

The probable reason for the increase in above vegetative growth parameter may be attributed due to the combined application of balanced dose of inorganic fertilizers along with organic manures and biofertilizers, that might have contributed in improvement of the physical, chemical and biological

Table 1. Effect of INM on plant height and stem girth in pomegranate cv. Bhagwa

Treatments	Plant height (m)			Stem girth (cm)		
	Initial	Final	Net increase	Initial	Final	Net increase
T_1	1.60	1.81	0.21	12.33	13.65	1.32
T_2	1.67	1.69	0.02	12.21	13.22	1.01
T_3	1.62	1.96	0.34	11.67	13.81	2.14
T_4	1.81	2.16	0.35	12.50	14.14	1.64
T_5	1.74	2.08	0.34	11.67	13.45	1.78
T_6	1.84	1.96	0.12	12.33	13.51	1.18
T_7	2.06	2.47	0.41	11.76	14.44	2.68
T_8	2.21	2.65	0.44	12.33	14.78	2.45
T_9	1.24	1.31	0.07	10.23	11.96	1.73
SE(m)+	0.19	0.17	0.04	0.50	0.43	0.13
CD(P=0.05)	0.56	0.52	0.13	NS	1.29	0.40

Note: Initial (1 MAT-1 month after treatment), Final (3 MAT-3 months after treatment)

Table 2. Effect of integrated nutrient management on plant spread in Pomegranate cv. Bhagwa

Treatments	Plant spread in East-West (m)			Plant spread in North-South (m)		
	Initial	Final	Net increase	Initial	Final	Net increase
T_1	1.71	1.77	0.06	1.62	1.89	0.27
T_2	1.89	1.97	0.08	1.94	2.13	0.19
T_3	1.81	2.03	0.22	1.75	1.99	0.24
T_4	1.97	2.07	0.10	1.78	2.14	0.36
T_5	1.77	1.80	0.03	1.62	1.88	0.26
T_6	1.74	1.84	0.10	1.80	2.11	0.31
T_7	1.97	2.21	0.24	1.87	2.13	0.26
T_8	2.10	2.32	0.22	2.19	2.39	0.20
T_9	1.53	1.71	0.18	1.55	1.61	0.06
SE(m)+	0.11	0.12	0.03	0.08	0.12	0.04
C.D. (P =0.05)	0.33	0.36	0.09	0.24	0.36	0.12

Note: Initial (1 MAT-1 month after treatment), Final (3 MAT-3 months after treatment)

properties of soil by increasing the soil microbial activity. Improvement in soil parameters might have also helped in increasing the absorption of nutrients from the soil at optimum level and enhanced better assimilation of carbohydrates within the plants. The results are in conformity with Kurer *et al*. (2017), and Kumar *et al*. (2020) in pomegranate.

The plants under treatment T_8 (75% of 'N' of RDF + Full 'P' + Full 'K' + 25% N through poultry manure + *Azotobacter* + PSB) produced the highest (11.40 g) fresh leaf weight, dry leaf weight (6.40 g) and leaf area (74.8 m^2) which was from the data presented in the Table 4. This might be due to supply of optimum levels of nitrogen, phosphorous and potassium along with manures and biofertilizers. The addition of biofertilizers like *Azospirillum*, PSB helps in higher uptake and accumulation of nutrients in leaf tissues which in turn ensure photosynthetic efficiency causing greater synthesis, translocation and accumulation of carbohydrates. This is consonance with the findings of Gogoi *et al.* (2004) who reported that integrated application of biofertilizers along with inorganic fertilizers and organic manures have considerably increased the leaf production with increased leaf area. The maximum leaf area under the treatment which has received the inorganic fertilizers along with organic manures and biofertilizers could have secreted certain growth promoting substances besides increasing the availability of atmospheric nitrogen and soil phosphorus that might have led the more leaf area. These findings are in agreement with Sheikh and Rao (2005) in pomegranate, Athani *et al*. (2005) in guava.

From the data depicted in the Table 5, it was found that the leaf Chlorophyll (Chlorophyll-a, Chlorophyll-b and total Chlorophyll) content were

Table 3. Effect of integrated nutrient management on Canopy volume and shoot length in pomegranate cv. Bhagwa

Treatments	Canopy Volume (m^3)			Shoot length (cm)		
	Initial	Final	Net increment	Initial	Final	Net increment
T_1	1.42	1.99	0.57	23.47	37.33	13.86
T_2	1.78	1.95	0.17	24.03	39.20	15.17
T_3	1.55	2.57	1.02	28.66	47.25	18.59
T_4	2.04	3.27	1.23	30.14	52.37	22.23
T_5	1.71	2.65	0.94	27.61	42.23	14.62
T_6	1.99	2.52	0.53	28.01	53.06	25.05
T_7	2.71	4.40	1.69	34.62	57.53	22.91
T_8	3.48	5.50	2.02	39.48	67.33	27.85
T_9	0.79	0.95	0.16	24.32	31.16	6.84
SE(m)+	0.17	0.21	0.21	3.05	6.17	0.70
CD(P =0.05)	0.52	0.63	0.62	9.15	18.49	2.10

Note: Initial (1 MAT-1 month after treatment), Final (3 MAT-3 months after treatment)

Table 4. Effect of integrated nutrient management on fresh weight, dry weight and leaf area of Pomegranate cv. Bhagwa

Treatments	Fresh Weight (g) Initial	Fresh Weight (g) Final	Dry Weight (g) Initial	Dry Weight (g) Final	Leaf Area (cm^2) Initial	Leaf Area (cm^2) Final
T_1	9.80	10.20	5.00	5.25	62.50	63.55
T_2	11.20	11.35	6.00	6.15	72.10	73.25
T_3	9.20	9.30	4.80	5.25	62.70	63.15
T_4	10.80	11.40	5.80	6.15	60.50	61.25
T_5	9.70	9.85	5.10	5.25	68.50	69.25
T_6	9.30	9.48	5.30	5.65	62.80	63.75
T_7	10.50	11.30	5.60	5.85	70.00	71.15
T_8	11.40	12.60	6.40	6.75	74.80	76.25
T_9	7.60	7.85	4.00	4.12	57.90	58.00
SE(m)+	0.45	0.37	0.21	0.17	1.11	1.65
CD(P=0.05)	1.34	1.11	0.64	0.50	3.31	4.65

Note: Initial (1 MAT-1 month after treatment), Final (3 MAT-3 months after treatment)

highest in plants receiving 75% of 'N' of RDF + Full 'P' + Full 'K' + 25% N through poultry manure + Azotobactor + PSB (T8) (0.336, 0.718, 1.054 mg/g at 1 MAT and 0.801, 1.770, 2.585 mg/g at 3 MAT) respectively. In both stages the control plants (T9) were found to be significantly inferior to the rest of treatments (0.123, 0.187, 0.319 mg/g at 1 MAT and 0.267, 0.863, 1.031 mg/g at 3 MAT for Chlorophyll-a, Chlorophyll-b and Total chlorophyll respectively). The increase in chlorophyll content may be due to supply of optimum levels of N, P and K as 100% recommended dose. The role of nitrogen and potassium in the functioning of chlorophyll is well established. Nitrogen is the chief constituent of chlorophyll, proteins and amino acids. The synthesis of which is accelerated through increased supply of nitrogen. The results are in confirmation with Singh and Singh (2009) and Wang and Lin (2002) in strawberry.

Application of different INM treatments resulted significant variation with respect to number of staminate and hermaphrodite flowers (Table 6). Treatments receiving 75% of 'N' of RDF + Full 'P' + Full 'K' + 25% N through poultry manure (T_7) and 75% of 'N' of RDF + Full 'P' + Full 'K' + 25% N through poultry manure + *Azotobacter* + PSB (T_8) ,recorded significantly higher number of total flowers (174 in T_8 and 152 in T_7) whereas the control plants (T_9) recorded lowest number of total flowers (41.67) and was found significantly different from other treatments.

The profuse flowering in T_7 and T_8 might be due to higher C: N ratio as compared to control plants. Phosphorous is a vital nutrient involved in stimulating and enhancing bud development, blooming and fruit set. Highest phosphorous content in poultry manure might have benefitted the plants to produce more flowers and fruits. The treatments were statistically non-significant with respect to flower size and number of stamens in staminate and hermaphrodite flower. However, since flowering depends upon genetic pool of the plant and variety as well as the plant growth regulators, the nutrient application may not be considered to influence flowering in pomegranate.

Table 6. Effect of INM on number of male and hermaphrodite flowers in pomegranate cv. Bhagwa

Treatments	Number of male flowers	Number of Hermaphrodite flowers	Total number of flowers
T_1	14.00	31.97	45.97
T_2	26.33	53.00	79.33
T_3	19.50	61.67	81.17
T_4	46.33	74.00	120.33
T_5	30.00	50.00	80.00
T_6	32.00	68.00	100.00
T_7	53.00	99.00	152.00
T_8	66.00	108.00	174.00
T_9	13.00	28.67	41.67
SE(m)+	3.69	3.30	12.64
CD(P=0.05)	11.05	9.91	37.89

Note: Initial (1 MAT-1 month after treatment), Final (3MAT-3 months after treatment)

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Table 5. Effect of integrated nutrient management on Chlorophyll content of Pomegranate cv. Bhagwa

Treatments	Chlorophyll-a (mg/g) of fresh leaf		Chlorophyll-b (mg/g) of fresh leaf		Total chlorophyll (mg/g) of fresh leaf	
	Initial	Final	Initial	Final	Initial	Final
T_1	0.275	0.495	0.507	1.268	0.782	1.735
T_2	0.161	0.481	0.403	1.180	0.564	1.543
T_3	0.197	0.666	0.474	1.658	0.671	2.174
T_4	0.123	0.434	0.297	1.310	0.420	1.681
T_5	0.237	0.573	0.294	1.420	0.531	2.116
T_6	0.254	0.564	0.491	1.720	0.745	2.279
T_7	0.253	0.703	0.569	1.721	0.822	2.366
T_8	0.336	0.801	0.718	1.770	1.054	2.585
T_9	0.132	0.267	0.187	0.863	0.319	1.031
SE(m)+	0.03	0.04	0.02	0.02	0.12	0.06
CD(P=0.05)	0.08	0.12	0.07	0.07	0.35	0.16

Note: Initial (1 MAT-1 month after treatment), Final (3MAT-3 months after treatment)

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