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Effect of Chemical, Organic and Bio-Fertilization on Growth and Flowering of *Chrysanthemum frutescens* Plants

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Abstract: This experiment was carried out during the two successive seasons of 2007 /2008 and 2008/2009 aiming to study the effect of bio fertilizers (Nitrobien and Phosphorene), tamarind seed gum, compost and potassium fertilizer on growth, flowering and chemical constituents of *Chrysanthemum frutescence* plants. The study showed that generally all fertilization treatments had a positive effect on growth, flowering and chemical constituents except Tamarind seed gum treatment. phosphorene at the rate of 3g/pot combined with 24g /pot compost resulted in the tallest plants in both seasons. Also, potassium sulphate at 3.0g/ pot showed the highest values of plant width, number of inflorescences / plant, fresh and dry weight of shoots and total fresh and dry weight of shoots+ roots in the first and second seasons and fresh and dry weight of roots in the first season. Phosphorene at 3 g / pot + compost at 24 g / pot gave the highest values of chlorophylls a and b content in fresh leaves. Moreover, total carbohydrates, nitrogen, phosphorus and potassium contents increased according to applying all fertilizers.

Key words: Chrysanthemum · Bio-fertilization · Organic · Chemical fertilization

INTRODUCTION

Chrysanthemum frutescence plants as sun-loving flowers have been garden favorites for centuries. They are used in borders or in contains as cut flowers. They bloom in summer and fall in all colors except blue and flowers range from the immense, showy florists' chrysanthemum to button- sized. The foliage has divided leaves with a strong scent.

Growth of ornamental trees can be greatly improved through regular care.Fertilizer application is one of the most important factors which affect plant growth. Lack of fertilization leads to some symptoms such as small leaves, light green or off-color foliage and less elongation of branches and general lack of thriftiness or vigor [1].Nitrogen is one of the basic plant nutrients that are built into the body of simple and conjugated proteins and many of organic substances of plant cell. Also, phosphorus is considered one of the important macro element nutrients which restrict plant growth. The oxidized P- compounds are an absolute necessary for all living organs science; it is essential constituent for nucleic acid. So that plants which suffer from nitrogen or phosphorus deficiency exhibit specific symptoms [2]. The impact of N and P on plants growth has been illustrated by Abd El-Aziz [3] on *Azadirachta Indica* and El-sayed and Abdou [4] on Khaya. It is known that potassium is one of the most important elements in plant nutrition. Potassium improves drought resistance, the plant needs it in a large quantity to assimilate and improve growth and yield [5]. The main source of K for plant comes from mineral and organic- K sources. In plants, the function of K has several roles such as enzyme activation, stimulation of assimilation and transport of assimilate anion /action balance as well as water regulation through control of stomata [6]. Also, Hart and Quick [7] found that K promotes translocation of newly synthesized to different rated.

Some free living bacteria such as Azotobacter, Azosprillium and Pseudomonas which are dominant inhabitant in arable soil have the capability to fix nitrogen. They also help soil in aggregation [8]. Other soil microorganisms (*Bacillus megatherium*) play a significant role in mobilizing P by lowering the pH in soil rhizosphere, as well as producing chelating substances which lead to solubilization of phosphates. In addition to nitrogen

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fixation and P mobilization these microorganisms increase plant growth by secretion of growth promoting substances and improving soil properties by leaving organic residues. Biofertilizers are important source for supplementing plant nutrients, having special significance in context of both the cost and environmental impact of mineral fertilizers [9]. Nitrobien is a multi- strain biofertilizer consists of symbiotic and symbiotic nitrogen fixation, as well as other microorganism for mobilizing certain macro- elements for plant absorption. Phosphorene is a biofertilizer contains *Bacillus* spp. bacteria which lower the pH in rhizospheric soil and produce chelating substances leading to solubilization of phosphates. Application of biofertilizers such as nitroben and phosphorene enhanced growth and nutritional status of different plants [8, 10].

Composing of agricultural residues by supplying the natural microbial flora present on them with their requirements of inorganic nutrients such as nitrogen and phosphorus and applying a proper moistening and turning resulted in the final product with high ability to improve soils and enhance plant growth [11]. Therefore, this study aimed to evaluate the effect of potassium, compost and some biofertilizers on growth, flowering and chemical constituents of *Chrysanthemum frutescence* plants.

MATERIALS AND METHODS

This experiment had been carried out during 2006/2007 and 2008/2009 seasons at the Department of Ornamental Horticulture, Faculty of Agriculture, Cairo University to investigate the effect of some biofertilizers (Nitrobein and Phosphorene), tamarind seed gum, compost and potassium sulphate on growth, flowering and chemical constituents of *Crysanthemum frutescence* plants. The physical and chemical properties of the experimental soil area are shown in Table 1.

The physical and chemical properties of the soil were determined according to Chapman and pratt [12].

Plant Materials and Procedures: The rooted cuttings of *Chrysanthemum frutescence* plants, taken from vigorous mother plants, were planted on 15 th February in both seasons. Each rooted cutting was planted in a pot of 30 cm in diameter filled with a mixture of clay and sand (1:1 v/v), and cuttings were irrigated regularly. The pots were fertilized with some biofertilizers: Nitrobien (a commercial product, containing live cells of *Azotobacter chroococcum* for N fixation) and phosphorene (a commercial product containing phosphate solubilizing bacteria *Bacillus megathirum*)produced from microbiology unit, Agriculture Research Centre, Ministry of Agriculture, Egypt. Tamarind seed gum (Tejpal Brand, product of India) was used as an organic fertilizer and it was obtained from Eastern Company, Egypt.The chemical properties of the used Tamarind seed gum are shown in Table 2. Potassium fertilizer as potassium sulphate (K_2SO_4) was used.

Basic Dressing and Treatments: The following 17 treatments representing nitrobien, phosphorene, tamarind seed gum, compost and potassium sulphate were conducted as follows :

Control (recommended full dose of mineral fertilizer (NPK). 2) Nitrobien at the rate of 3 g/pot. 3) Nitrobien at the rate of 9 g/pot. 4)Phosphorene at the rate of 3 g/pot. 5)Phosphorene at the rate of 6 g/pot. 6) Tamarind seed gum at the rate of 3 g/pot 7)Tamarind seed gum at the rate of 6 g/pot. 8) Compost at the rate of 24 g/pot. 9) Compost at the rate of 36 g/pot. 10) Potassium salphate at the rate of 1.5 g/pot. 11) Potassium suphate at the rate of 3 g/pot.12) Nitrobien at the rate of 3 g/pot + Phosphorene at the rate of 3.0 g/pot. 13) Nitrobien at the rate of 3 g/pot + tamarind seed gum at the rate of 3 g/pot.14) Nitrobien at the rate of 3 g/pot + compost at the rate of 24 g/pot. 15)Phosphorene at the rate of 3 g/pot+ tamarind seed gum at the rate of 3 g/pot. 16) Phosphorene at the rate of 3 g/pot + compost at the rate of 24 g/pot. 17) Phosphorene at the rate of 3 g/pot + Potassium sulphate at the rate of 1.5 g/pot.

The experiment was designed in complete randomized design with 5 replicates.

Data Recorded: Throught the two successive seasons, a representative plant sample was taken from each treatment and the growth parameters included plant height (cm), plant width, number of inflorescences/ plant and fresh and dry weight of shoots and roots (g). Chemical constituents including photosynthetic pigments of chlorophylls (a and b) and carotenoids (mg/g FW) were determined by using spectrophotometric method developed by Nornai [13]. Total carbohydrates percentage was determined in shoots and roots by using colorimatric method described by Herbert [14]. Nitrogen, phosphorus and potassium percentages were determined according to the method described by Cottenie *et al*. [15]. The data were subjected to statistical analysis of variance and the means were compared using the least significant difference (L.S.D) test at 5% level [16].

Table 1: Physical and chemical properties of the experimental soil

Physical analysis				
Clay	Silt	Coarse sand	Find sand	Texture
26.3%	39.2 %	4.3 %	30.2 %	loamy

Chemical analysis														
Total nutrients Contents (ppm)														
N	P	K	Organic Matter (%)	$CaCO_3$ (%)	pH	EC (ds/m)	Ca^{++} (meq/L)	Mg^{++} (meq/L)	Na^{+} (meq/L)	K^{+} (meq/L)	CO_3^{--} (meq/L)	HCO_3^{-} (meq/L)	CL^{-} (meq/L)	SO_4^{--} (meq/L)
2.02	26.51	530	1.72	3.20	7.54	3.10	18.1	6.5	11.1	1.3	---	7.0	13.5	16.5

Table 2: Chemical properties of the organic fertilizer used

	Soluble anions(meq/I)			Soluble cations (meq/I)			
EC Mmhos/cm	HCO_3^{-}	Cl^{-}	SO_4^{--}	CA++	MG++	NA+	K+
2.4	11.5	11.2	2.3	9.3	4.2	8.3	3.4
PH	K	P	N	Cu	Zn	Mn	Fe
	%			(mg/kg)			
7.10	0.5	0.52	0.44	14.8	062.7	24.8	773.0

RESULTS AND DISCUSSION

Vegetative Growth Characters

Plant Height and Width: Data in Table 3 showed that *Chrysanthemum frutescence* plants treated with phosphorene at the rate of 3g/pot combined with 24g /pot compost resulted in the tallest plants (76.73 cm) followed by compost only at the rate of 24g/pot giving 68.41 cm. This may be due to that phosphate dissolving bacteria (Phosphorene) enhances the plant height by increasing the available P in soil which in turn promotes cell division and develops the meristematic tissue [17]. Also, the effect of compost may be due to their beneficial effects on the physical, chemical and biological characteristics of the soil which in turn influence the growth and increase plants production [18]. Moreover, many investigators reported that adding organic manures as fertilizer led to decreasing soil pH causing solubility increase and availability of some nutrients to the plants [19]. On the other hand, potassium sulphate at the two rates (1.5g/pot and 3 g/pot followed by potassium sulphate at 1.5g/pot combined with Phosphorene at the rate of 3g/pot gave the highest value of plant width compared with other treatments in both seasons. This result may be due to the role of potassium in cell division, activating protein synthesis and enzyme of carbohydrate building up. These results are in agreement with those reported by Elamin *et al*. [20] and Mokadem *et al*. [21]. In this context, the previous character decreased by increasing the rate of Tamarind seed gum treatment in comparison with the control, the greatest decrease in plant height and plant width were found in plant treated by Tamarind seed gum at the rate of 6.0 g /pot, giving the decrement rates of 41.23 and 0.69 %, respectively than the corresponding values of the control plant. So, it could be concluded that using fertilizers without containing Tamarind seed gum had a remarkable effect on increasing plant width.

Number of Inflorescences / Plants: Results in Table 3 showed that number of inflorescences / plant of *Chrysanthemum frutescens* was significantly affected in response to different kinds of fertilizers. All fertilization treatments produced high increment in number of inflorescences / plant except Tamarind seed gum at rate of 12 and 24 g/pot in comparison to control. Using potassium sulphate treatments at the rate of 3g/pot and the rate of 1.5g/pot were the best in this concern which gave the highest value for number of inflorescences / plants recording 594.17 and 307.50 inflorescences, respectively in the first season and 915.11 and 410.23 inflorescences, respectively in the second season followed by results of the treatment phosphorene (3g/ pot) + Potassium salphate (1.5 g/pot) giving 256.67 and 272.14 inflorescences in the first and the second season, respectively. These results might be due to that potassium cation activates enzymes by including conformational changes in the enzyme protein [22]. In this respect, inoculation with phosphrene may cause increasing phosphorus content in the soil as a result of application of phosphate dissolving bacteria as well as producing growth promoting substances such as indole acetic acid and gibberellins by organism used. This result is in line with that found by Gad [23] on *Foeniculum vulgare* and *Anethum graveolens* plants. Meanwhile,

Table 3: Effect of chemical, organic and biofertilization on plant height (cm), width (cm) and number of flowers of *Chrysanthemum frutescens* plants

	Plant height (cm)			Plant width (cm)			Number of inflorescences/plant		
Treatments	First Season	Second Season	Mean	First Season	Second Season	Mean	First Season	Second Season	Mean
Control	38.86	40.39	39.63	45.83	47.00	46.42	41.43	50.90	46.17
N 3g	58.45	64.27	61.36	74.78	87.10	80.94	119.33	140.15	129.74
N 6g	44.12	53.36	48.74	75.78	90.22	83.00	141.33	173.28	157.31
P 3g	52.98	61.88	57.43	71.22	81.36	76.29	78.33	89.17	83.75
P 6g	55.44	68.19	61.82	63.89	76.18	70.04	67.67	78.63	73.15
T s g 12 g	28.67	30.26	29.47	45.22	50.93	48.08	37.50	51.77	44.64
T s g 24 g	26.39	29.73	28.06	43.19	49.00	46.10	28.67	40.10	34.39
Compost 24g	64.89	71.92	68.41	73.42	82.53	77.98	52.50	69.85	61.18
Compost 36g	54.73	60.77	57.75	73.78	81.71	77.75	43.81	55.06	49.44
K_2SO_4 1.5g	61.17	67.81	64.49	80.15	95.86	88.01	307.50	410.23	358.87
K_2SO_4 3g	49.27	53.28	51.28	81.39	98.11	89.75	894.17	915.11	904.64
N + P (3+3)g	43.50	47.00	45.25	61.17	72.34	66.75	153.00	172.00	162.25
N + Tsg (3+12)g	34.67	39.18	36.93	51.87	64.75	58.31	46.67	63.14	54.91
N + C (3+24)g	40.29	46.38	43.34	74.61	83.09	78.85	65.33	80.36	72.85
P + Tsg (3+12)g	38.17	41.76	39.97	67.17	72.38	69.78	51.00	62.91	56.96
P + C (3+24)g	72.80	80.65	76.73	54.16	59.17	56.67	52.50	60.00	56.25
P + K2SO4 (3+1.5)g	57.92	63.17	60.55	78.38	92.33	85.36	256.67	272.14	264.41
LSD at 5%	4.57	4.99	-----	2.79	4.65	-----	13.04	21.22	-----

N=Nitrobien P= Phosphorene T s g = Tamarind seed gum C = Compost

Table 4: Effect of chemical, organic and biofertilization on shoots and roots fresh and dry weights (g) of *Chrysanthemum frutescens* plants

	Fresh weight of shoots (g)			Dry weight of shoots (g)			Fresh weight of roots (g)			Dry weight of roots (g)		
Treatments	First Season	Second Season	Mean	First Season	Second Season	Mean	First Season	Second Season	Mean	First Season	Second Season	Mean
Control	62.83	73.90	68.37	20.94	24.63	22.79	27.67	32.10	29.89	9.22	10.70	9.96
N 3g	228.67	236.52	232.60	76.22	78.84	77.53	44.33	51.11	47.72	14.78	17.04	15.91
N 6g	231.17	248.11	239.64	77.06	82.70	79.88	51.83	60.32	56.08	17.28	20.11	18.70
P 3g	146.33	158.30	152.32	48.78	52.77	50.78	54.00	63.25	58.63	19.00	21.08	20.04
P 6g	119.83	133.00	126.42	39.94	44.33	13.27	39.00	44.61	41.81	13.00	14.87	13.94
T s g 12 g	37.50	42.10	39.80	12.50	14.03	13.27	22.50	28.70	25.60	7.50	9.57	8.54
T s g 24 g	32.83	38.51	35.67	10.94	12.84	11.89	16.17	21.35	18.76	5.39	7.12	6.26
Compost 24g	147.83	159.88	153.86	49.28	53.29	51.29	37.17	42.19	39.68	12.39	14.06	13.23
Compost 36g	179.00	191.07	185.04	59.67	63.69	61.68	34.33	40.00	37.17	11.44	13.33	12.39
K_2SO_4 1.5g	259.67	266.13	262.90	86.56	88.71	87.64	51.50	59.98	55.74	17.17	19.99	18.58
K_2SO_4 3g	261.50	280.20	270.85	87.17	93.40	90.29	58.00	65.38	61.69	19.33	21.79	20.56
N + P (3+3g)	113.17	122.91	118.04	37.72	40.97	39.35	53.83	62.10	57.97	17.94	20.70	19.32
N + Tsg (3+12g)	72.17	83.42	77.80	24.06	27.81	25.94	32.50	41.93	37.22	10.83	13.98	12.41
N + C (3+24)g	189.33	193.52	191.43	63.11	64.51	63.81	37.83	43.16	40.50	12.61	14.39	13.50
P + Tsg (3+12)g	127.83	146.16	137.00	42.61	48.72	45.67	53.67	66.10	59.89	17.89	22.03	19.96
P + C (3+24g)	95.00	100.10	97.55	31.67	33.37	32.52	34.67	62.93	48.80	11.56	20.98	16.27
P + K2SO4 (3+1.5)g	238.50	257.13	247.82	79.50	85.71	82.61	36.83	41.78	39.31	12.28	13.93	13.11
LSD at 5%	9.20	11.51	------	3.06	3.84	-----	5.95	5.04	----	1.20	1.68	-----

N=Nitrobien P= Phosphorene T s g = Tamarind seed gum C = Compost

the lowest number of inflorescences / plant (28.67 and 40.10 inflorescences in the two seasons, respectively) was obtained by applying tamarind seed gum at the rate of 24 g/ pot.

Fresh and Dry Weight of Shoots and Roots: The result recorded in Table 4 show that all fertilization treatments and dry resulted in a high significant increase in the fresh and dry weight of plant shoots and roots as compared to control plants during the two seasons except the two tamarind seed gum treatments. The favorable effect of fertilization was most apparent in plants received K_2SO_4 (at two rates 3.0 and 1.5g/ pot) giving the heaviest fresh weight of shoots (261.50 and 259.69g in the first season and 280.20 and 266.13 g in the second season, respectively). The lowest values for the two seasons were recorded for tamarind seed gum treatments at the two rates (12 and 24 g/ pot).Dry weight of shoots had a similar trend to that observed for fresh weight in both seasons. The highest values were recorded for plants treated with

K_2SO_4 at the two rates, whereas plants received tamarind seed gum at12 and24 g / pot resulted in the lowest values.

The fresh and dry weight of roots was significantly affected in both seasons by fertilization treatments as shown in Table 4. All fertilization treatments (except the two rates of tamarind seed gum) caused considerable increment in root fresh and dry weights. Potassium sulphate (3g/ pot) was the most effective treatment for producing the heaviest fresh and dry weights of roots (58 and 19.33 g, respectively) in the first season. These results are probably due to the positive and beneficial role of k element which increased plant height, plant width and number of inflorescences/plant and hence increased the fresh and dry weights of shoots and roots. On the other hand, phosphorene at 3g / pot + tamarind seed gum at 12g/pot gave the heaviest fresh and dry weights of roots (66.10 and 22.03 g, respectively) in the second season as compared with other treatments. These increases in roots fresh and dry weights may be attributed to the activity of the free -living bacteria of *Bacillus megatherium* found in the rhizosphere of roots as phosphate dissolving bacteria which save the available phosphate. These bacteria proved to be able to produce auxins and other plant growth substances in the plant rhizosphere [24].

Data presented in Table 4 revealed that all treatments significantly increased total fresh and dry weights of *Chrysanthemum frutescens* plant as compared with control plants in both seasons. Potassium sulphate at the two rates was the most effective treatments in this concern and increased total fresh and dry weights reaching its maximum values in both seasons. These results were online with those reported by previous studies [5, 25].

Chemical Constituents

Pigments Content (mg/ g FW): Data in Table 6 revealed that most of the fertilizers treatments affected significantly pigments content. In case of chlorophyll a, the highest values (0.736 and 0.886mg/g in the first and second seasons, respectively) had been determined in plants treated with 3g Phosphorene +24g compost, followed by results recorded for plants treated with compost at 24 g (0.548 and 0.689 mg/g in the first and second seasons,respectively). The untreated plants contained chlorophyll a of 0.017 and 0.120 mg/g for the first and second seasons, respectively.

Under the same treatment the plants contained chlorophyll b at the highest values (0.511 and 0.681 mg/g in the first and second season, respectively). Concerning carotenoides, the highest content had been found in

Table 5: Effect of chemical, organic and biofertilization on total fresh and dry weights (g) of *Chrysanthemum frutescens* plants

	Total fresh weight (g)			Total dry weight (g)		
Treatments	First season	Second season	Mean	First season	Second season	Mean
Control	90.50	106.00	98.25	30.16	35.33	32.75
N 3g	273.00	287.63	280.32	91.00	95.88	93.44
N 6g	283.00	308.43	295.72	94.34	102.81	98.58
P 3g	200.33	221.55	210.94	67.78	73.85	70.82
P 6g	158.83	177.61	168.22	52.94	59.20	56.07
T s g 12 g	60.00	100.80	80.40	20.00	23.60	21.80
T s g 24 g	49.00	59.86	54.43	16.33	19.96	18.15
Compost 24g	185.00	202.07	193.54	61.67	67.35	64.51
Compost 36g	213.33	231.07	222.20	71.11	77.02	74.07
K_2SO_4 1.5g	311.17	326.11	318.64	103.73	10.87	57.30
K_2SO_4 3g	319.50	345.58	332.54	106.50	115.19	110.96
N + P (3+3)g	167.00	185.01	176.01	55.66	61.67	58.67
N + Tsg (3+12)g	104.67	125.35	115.01	34.89	41.79	38.34
N + C (3+24)g	227.16	236.68	231.92	75.72	78.90	77.31
P + Tsg (3+12)g	181.50	212.26	196.88	60.50	70.75	65.63
P + C (3+24)g	129.67	163.03	146.35	43.23	54.35	48.79
P + K2SO4 (3+1.5)g	275.33	298.91	287.12	91.78	99.64	95.71
LSD at 5%	13.92	11.00	-----	3.63	4.06	-----

N=Nitrobien P= Phosphorene T s g = Tamarind seed gum C = Compost

Table 6: Effect of chemical, organic and biofertilization on Chlorophylls (a, b) and carotenoides content of *Chrysanthemum frutescens* plants

	Chlorophyll a			Chlorophyll b			Carotenoides		
Treatments	First Season	Second Season	Mean	First Season	Second Season	Mean	First Season	Second Season	Mean
Control	0.017	0.120	0.069	0.119	0.126	0.123	0.105	0.131	0.118
N 3g	0.368	0.437	0.403	0.236	0.274	0.255	0.212	0.236	0.224
N 6g	0.273	0.391	0.332	0.247	0.213	0.230	0.162	0.175	0.169
P 3g	0.316	0.304	0.310	0.288	0.300	0.294	0.187	0.193	0.190
P 6g	0.414	0.520	0.467	0.351	0.419	0.385	0.335	0.358	0.347
T s g 12 g	0.198	0.289	0.244	0.081	0.122	0.102	0.172	0.185	0.179
T s g 24 g	0.083	0.128	0.106	0.106	0.141	0.124	0.120	0.142	0.131
Compost 24g	0.548	0.689	0.619	0.370	0.325	0.348	0.271	0.286	0.279
Compost 36g	0.472	0.562	0.517	0.319	0.206	0.263	0.516	0.539	0.528
K_2SO_4 1.5g	0.584	0.358	0.471	0.426	0.439	0.433	0.319	0.420	0.370
K_2SO_4 3g	0.313	0.453	0.383	0.207	0.272	0.240	0.462	0.514	0.488
N + P (3+3)g	0.259	0.426	0.343	0.178	0.301	0.240	0.371	0.408	0.390
N + Tsg (3+12)g	0.396	0.613	0.505	0.246	0.452	0.349	0.254	0.271	0.263
N + C (3+24)g	0.453	0.310	0.382	0.310	0.263	0.287	0.358	0.412	0.385
P + Tsg (3+12)g	0.372	0.460	0.416	0.289	0.372	0.331	0.349	0.368	0.359
P + C (3+24)g	0.736	0.886	0.811	0.511	0.681	0.596	0.386	0.422	0.404
P + K2SO4 (3+1.5)g	0.211	0.487	0.349	0.186	0.292	0.239	0.218	0.300	0.259
LSD at 5%	0.051	0.072	----	0.03	0.05	----	0.04	0.06	-----

N=Nitrobien P= Phosphorene T s g = Tamarind seed gum C = Compost

Table 7: Effect of chemical, organic and biofertilization on total carbohydrates (%), Nitrogen (%), Phosphorus (%) and Potassium (%) contents in shoots of *Chrysanthemum frutescens* plants

	Total carbohydrates (%)			Nitrogen (%)			Phosphorus (%)			Potassium (%)		
Treatments	First Season	Second Season	Mean	First Season	Second Season	Mean	First Season	Second Season	Mean	First Season	Second Season	Mean
Control	15.30	17.55	16.43	1.38	1.82	1.60	1.10	1.18	1.14	0.72	0.98	0.85
N 3g	29.16	27.58	28.37	4.00	4.73	4.37	1.12	1.29	1.21	1.25	1.36	1.31
N 6g	32.02	40.26	36.14	5.31	5.62	5.47	1.28	1.32	1.30	1.43	1.68	1.56
P 3g	28.30	35.71	32.01	3.85	4.07	3.96	1.84	1.89	1.87	0.95	1.34	1.15
P 6g	26.04	30.21	28.13	2.61	2.93	2.77	1.46	1.57	1.52	1.36	1.47	1.42
T s g 12 g	19.47	20.04	19.76	2.37	2.46	2.42	1.18	1.31	1.25	1.11	1.26	1.19
T s g 24 g	16.30	18.92	17.60	2.28	2.48	2.38	1.14	1.28	1.21	0.83	1.08	0.96
Compost 24g	31.75	40.15	35.95	6.46	6.72	6.59	1.24	1.33	1.29	1.38	1.45	1.42
Compost 36g	33.16	36.82	34.99	3.11	4.00	3.56	1.35	1.46	1.41	1.19	1.28	1.24
K_2SO_4 1.5g	40.82	43.27	42.05	4.23	4.83	4.53	1.29	1.37	1.33	2.35	3.00	2.68
K_2SO_4 3g	42.73	39.05	40.89	3.63	3.72	3.68	1.27	1.40	1.34	2.00	2.39	2.20
N + P (3+3)g	25.17	28.63	26.90	6.96	7.00	6.98	1.18	1.23	1.21	1.27	1.31	1.29
N + Tsg (3+12)g	28.31	33.17	30.74	5.81	4.32	5.07	1.36	1.47	1.42	1.18	1.26	1.22
N + C (3+24)g	36.83	42.78	39.81	6.88	5.91	6.40	1.27	1.36	1.32	1.05	1.19	1.12
P + Tsg (3+12)g	41.06	53.91	47.08	4.10	4.51	4.31	1.60	1.73	1.67	1.12	1.31	1.22
P + C (3+24)g	45.00	56.88	50.94	3.21	3.72	3.47	1.52	1.62	1.57	1.23	1.46	1.35
P + K_2SO_4 (3+1.5)g	43.07	44.77	43.92	2.68	3.06	2.87	1.58	1.67	1.63	1.56	1.70	1.63
LSD at 5%	3.01	2.64	----	0.32	0.28	-----	0.16	0.19	-----	0.12	0.09	-----

N=Nitrobien P= Phosphorene T s g = Tamarind seed gum C = Compost

plants received 36 compost, giving 0.516 and 0.539 mg/g in the first and second season, respectively.

These effects could be due to that phosphorus had indifferent aspects of cell division and growth, energy transfer, biosynthesis of macromolecules, photosynthesis and respiration [26, 27].In this respect, the superiority of leaf pigments which obtained when organic manure was used for plant fertilization may be attributed to its containing of nutritional minerals especially those playing a great role in the formation and constancy of chlorophyll [28].

Total Carbohydrates Cntent (% of DW): Data present in Table 7 reveal that fertilization treatments stimulated the accumulation of total carbohydrates in *Chrysanthemum frutescens* shoots comparing with control plants in both seasons. The highest values were found in plants treated with phosphorene 3g / pot + compost 24g / pot (45.00 and56.88%DWin the first and second seasons, respectively) compared to control plants (15.30 and 17.55% DW in the first and second seasons, respectively). Similar trend had been found for the content of total carbohydrates in roots of plants which received the same level of phosphorene (3 g) + compost (24 g) giving the

Table 8: Effect of chemical, organic and biofertilization on total carbohydrates content, Nitrogen (%), Phosphorus (%) and Potassium (%) in roots of *Chrysanthemum frutescens* plants

	Total carbohydrates (%)			Nitrogen (%) in roots			Phosphorus (%) in roots			Potassium (%) in roots		
Treatments	First season	second season	Mean	First season	second season	Mean	First season	second season	Mean	First season	second season	Mean
Control	12.59	14.36	13.48	1.00	1.20	1.10	0.68	0.77	0.73	0.55	0.74	0.65
N 3g	17.82	18.92	18.37	1.15	1.36	1.26	1.20	1.26	1.23	0.85	1.00	0.93
N 6g	20.13	22.17	21.15	1.70	2.00	1.85	1.08	1.14	1.11	0.90	1.06	0.98
P 3g	19.60	21.54	20.57	1.40	1.69	1.55	1.32	1.37	1.35	1.40	1.47	1.44
P 6g	18.33	19.81	19.07	1.63	1.82	1.73	1.24	1.30	1.27	1.35	1.29	1.32
T s g 12 g	16.30	17.90	17.10	0.52	0.79	0.66	0.72	0.91	0.82	1.18	1.22	1.20
T s g 24 g	13.10	15.46	14.28	0.47	0.82	0.65	0.63	0.82	0.73	0.96	0.85	0.91
Compost 24g	24.61	30.17	27.39	2.60	2.75	2.68	1.00	1.16	1.08	1.35	1.37	1.36
Compost 36g	22.85	26.82	24.84	2.31	2.46	2.39	0.86	1.00	0.93	1.22	1.31	1.27
K2SO4 1.5 g	20.74	21.55	21.15	2.15	2.50	2.33	0.62	0.89	0.76	1.70	1.65	1.68
K2SO4 3 g	18.91	26.61	22.76	1.72	1.90	1.81	1.22	1.36	1.29	1.84	1.91	1.88
N + P (3+3)g	19.20	22.04	20.62	0.83	1.04	0.94	1.10	1.24	1.17	1.26	1.34	1.30
N + Tsg (3+12)g	23.64	27.18	25.41	1.65	1.60	1.63	1.33	1.42	1.38	0.89	1.12	1.01
N + C (3+24)g	20.82	24.62	22.72	1.42	1.72	1.57	1.13	1.25	1.19	1.07	1.21	1.14
P + Tsg (3+12)g	21.11	26.08	23.60	0.90	1.26	1.08	1.19	1.28	1.24	1.14	1.28	1.21
P + C (3+24)g	28.79	34.17	31.48	1.21	1.53	1.37	1.52	1.64	1.58	1.03	1.10	1.07
P + K2SO4 (3+1.5)g	21.43	25.69	23.56	1.08	0.98	1.03	1.43	1.46	1.45	1.15	1.23	1.19
LSD at 5%	2.94	3.76		0.28	0.24		0.16	0.20	-----	0.09	0.11	-----

N=Nitrobien P= Phosphorene T s g = Tamarind seed gum C = Compost

highest value (28.79 and 34.17 % for the first and second seasons, respectively) and accumulating more carbohydrates in their roots than control plants. This result may be indicating the positive effect of biofertilizer on sugar metabolism and enhancing the plant growth consequently. Also, this may be attributed to the effect of compost as a source of essential nutrients besides improving the physical and chemical properties of soil [29].

Macronutrients Contents (% of D W): Results in Table 7 illustrated that all fertilization treatments raised nitrogen contents in shoots compared with control plants in both seasons. In this context, treating plants with Nitrobien at 3 g / pot + phosphorene at 3g /pot resulted in the highest shoots nitrogen content (6.96 and 7.00% in the first and second seasons, respectively) as compared with control (1.38 and 1.82% in the first and second seasons, respectively). In this concern, El-sayed [30] reported that seed inoculation with phosphate-dissolving bacteria (PDB) increased number of total bacteria generally and particularly in the rhizosphere zone and released ammonia from bound complex nitrogen compound. Regarding the content of nitrogen in roots, data showed that the highest content of N (2.60 and 2.75% in the first and second seasons, respectively) was recorded as a result of treating plants with compost at 24 g / pot compared with control and other treatments. Tamarind seed gum at the two rates (12 and 24g/pot) gave the lowest values of N. This might be due to that compost could increase N content throughout improving soil productivity and higher fertilizer use efficiency [31].

Data exhibited in Table 7 show clearly that all fertilization treatments had a significant effect on increasing the content of phosphorus in shoots. Plants treated with phosphorene at 3g / pot contained the highest values of phosphorus content (1.84 and 1.89 % DW in the first and second seasons, respectively) as compared with control plants which contained the lowest phosphorus content (1.10 and 1.18%DW in the first and second seasons, respectively).Concerning P content, the results revealed that all treatments affected significantly P content in roots. The highest values 1.52 and 1.62 % DW in the first and second seasons, respectively had been determined in the plants received phosphorene at 3g / pot + compost at 24g / pot compared with control plants giving 0.68 and 0.77 % in the first and second seasons, respectively.

Data in Table 7 pointed out that in both seasons; all treatments increased significantly K content in shoots and roots as compared with the control. Treating the plant with K_2SO_4 at the two rates (1.5g and3.0g / pot) increased the content of potassium in shoots giving 2.35 and 2.00% DW in the first and second seasons, respectively and 3.00 and 2.39 % DW in the roots in the first and second seasons, respectively. This result may be due to organic activities that produce organic acids during the course of decomposition which increase the availability of phosphorus in soil [32].

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