The Bioscan 9(2): 617-620, 2014
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.in

YIELD AND QUALITY OF POMEGRANATE AS INFLUENCED BY ORGANIC AND INORGANIC NUTRIENTS.

S. K. DUTTA RAY[1], P. V. TAKAWALE*, R. CHATTERJEE AND V. HNAMTE[2]
[1]*Department of Fruits and Orchard Management, Faculty of Horticulture,
[2]Deparment of Spices and Plantation Crops, Faculty of Horticulture,
Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia - 741 252, West Bengal, INDIA
e-mail: prashant.takawale@gmail.com

KEYWORDS
Pomegranate
Nitrogen
Neem Cake
IPNS

Received on :
13.09.2013

Accepted on :
06.03.2014

***Corresponding author**

ABSTRACT

Pomegranate is rich in sugar, vitamin, and minerals. Pomegranate is used not only as dessert fruit but it is also used as spice. An investigation was therefore undertaken to increase the production and quality of pomegranate with suitable nutrient management. Four levels of nitrogen (1000g, 400g, 300g and 200g plant $^{-1}$) in the form of urea and neem cake (1kg plant $^{-1}$) and in combinations, along with a common dose of 100g phosphorus (Single super phosphate) and 100g potassium (Muriate of potash) were applied. The fruits of the plants treated with 300g nitrogen + 1kg neem cake plant $^{-1}$ recorded highest total soluble solids (12.29°Brix), total sugar (10.74 %), reducing sugar (9.78%), non reducing sugar (1.09%) and ascorbic acid (21.93 mg 100 $^{-1}$ mL of juice). The acidity was also recorded lower (0.39%) with this treatment.

INTRODUCTION

Pomegranate is one of the choicest dessert fruit grown in the tropical and subtropical regions of the world. The edible portion in this fruit is 52 per cent of total fruit weight comprising 78% juice and 22% seeds. The fresh juice contains moisture, total sugar, pectin, carbohydrate, acidity (as citric acid), minerals like calcium, phosphorus, iron, magnesium and vitamins. Fruit rind is rich source of tannin. The seeds are rich source of lipid, protein, crude fibre and ash (Singh *et al.,* 1988).

Juice extracted from fruit makes an excellent drink. 'Anardana' used as spice is obtained from seeds after drying. 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 irrigation potential is generally low are the main features responsible for its spread on a wide scale (Khodade *et al.,*1990).

Mineral nutrition plays an important role in influencing the quality of fruits and it is fact that the soil health deteriorates due to continuous use of chemical fertilizers, Savci (2012). A system approach to nutrient management by tapping all possible sources of organic and inorganic in a judicious manner to maintain soil fertility and crop productivity is the essence of integrated nutrient management (INM). INM has recently become more important for two reasons: firstly, the need for continued increase in agricultural production can be fulfilled by promoting the application of chemical nutrients and/or organic nutrients to compensate the loss of soil nutrients due to uptake by plants and leaching (especially when cultivation is practiced on a commercial scale); secondly, the reports from a number of experiments reveal 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 high intensive cropping systems. Good agricultural practices, especially correct manure and fertilizer applications, could enhance the production as well as improve the fruit physico-chemical quality of pomegranate, to respond to the demand for both as table fruit and for the processing industry and compete even in the export market where it has great potential. Thus, it is possible through integration of organic and inorganic sources of nutrients (Nambiar and Ghosh, 1984). An investigation was therefore, undertaken to assess the effect of nitrogen (Urea) and neem cake on fruit quality of pomegranate cv. Ganesh.

MATERIALS AND METHODS

The investigation was carried out for two years (2009-10 and 2010-11) at the Horticulture Research Station B.C.K.V. Mondouri, North 24 Parganas. The climate of the research station is subtropical humid. Maximum and minimum humidity were 98.82% and 44.83% respectively during the period of investigation. The soil is sandy loam in texture with a pH of 6.8 the fertility status of the soil were i) Organic carbon: 0.65%, ii) Total nitrogen: 0.06%, iii) Available phosphorus (P_2O_5): 27.5 ppm and iv) Available potassium (K_2O): 40.7 ppm Four levels of nitrogen *i.e.* 100 g plant–$^{-1}$ (220 g Urea), 200 g plant^{-1} (440 g Urea), 300 g plant^{-1} (650 g Urea) and 400 g plant^{-1} (870 g Urea) and 1 kg Neem cake constituting the following treatment combinations were employed in the experiment. A common dose of 625 g of Single Super Phosphate (100 g P_2O_5) and 170 g Muriate of Potash (100 g K_20) were applied to all the plants, including control, while the control plants received neither any chemical nitrogen nor neem cake.The treatments details were T_1 = 100 g nitrogen plant^{-1} year^{-1}, T_2 = 200 g nitrogen plant^{-1} year^{-1}, T_3 = 300 g nitrogen plant^{-1} year^{-1}, T_4 = 400 g nitrogen plant^{-1} year^{-1}, T_5 = 1.0 kg neem cake plant^{-1} year^{-1}, T_6 = 1.0 kg neem cake + 100 g N plant^{-1} year^{-1}, T_7 = 1.0 kg neem cake + 200 g N plant^{-1} year^{-1}, T_8 = 1.0 kg neem cake + 300 g N plant^{-1} year^{-1}, T_9 = 1.0 kg neem cake + 400 g N plant^{-1} year^{-1}, T_{10}= Control (no inorganic nitrogen and organic manure). The experiment was conducted in RBD with three replications and the pomegranate cultivar was Ganesh.

Number of fruits was counted at maturity and fruit yield was expressed in kilogram. Fruit morphological characters (weight, length, diameter, juice percentage) along with chemical composition (total soluble solids, total sugar, non-reducing sugar, titrable acidity, T.S.S./acid ratio, ascorbic acid) of fruits were estimated. The data obtained were statistically analysed by the analysis of variance method as suggested by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Number of mature fruits per plant due to different treatments was found statistically non-significant. Though the highest number of mature fruits (29.29) as also yield (6.94kg plant^{-1}) were obtained from 300g nitrogen + 1 kg neem cake plant^{-1}year^{-1} (T_8). The yield of the pomegranate plant significantly increased with different levels of nitrogen. The yield was (2.18 kg plant^{-1}) obtained minimum under control (T_{10}). An increase in yield with application of organic matter as compared to inorganic nutrients was reported by Ghosh *et al.* (2012).

Significant variation was observed in fruit weight due to application of chemical nitrogen and neem cake. Treatment with 300g nitrogen + 1 kg neem cake plant^{-1} (T_8), produced fruits with maximum weight (239.83 g), closely followed by T_9, T_7 and T_6 whereas, minimum fruit weight (146.77 g) was produced by the plants under control (T_{10}). Fruit production was significantly improved, when chemical nitrogen and neem cake were judiciously applied to the plants. The fruit yield was

Table 1: Effect of chemical nitrogen and neem cake on fruit number plant--$^{-1}$, yield (kg plant^{-1}), fruit weight (g), fruit length (cm) and fruit diameter (cm)

Treatments	Number of fruit /plant	Fruit yield (kg/plant)	Fruit weight(g)	Fruit length (cm)	Fruit diameter (cm)
T1	12.67	2.45	157.90	6.32	6.53
T2	17.49	2.71	169.22	6.46	6.49
T3	14.61	3.06	184.06	6.85	6.66
T4	15.48	5.27	188.61	6.95	6.59
T5	20.48	4.00	181.08	6.92	6.98
T6	15.52	4.05	201.93	7.18	7.01
T7	23.71	4.78	205.80	7.38	6.92
T8	29.29	6.94	239.83	7.75	7.23
T9	25.23	5.85	215.71	7.30	7.06
T10	10.26	2.18	146.77	5.70	6.14
S.Em. ±	4.530	0.166	2.725	0.164	0.297
C.D. at 5%	N.S.	0.493	8.097	0.489	N.S.

Treatment Details: T_1 = 100 g nitrogen plant^{-1} year^{-1}, T_2 = 200 g nitrogen plant^{-1} year^{-1}, T_3 = 300 g nitrogen plant^{-1} year^{-1}, T_4 = 400 g nitrogen plant^{-1} year^{-1}, T_5 = 1.0 kg neem cake plant^{-1} year^{-1}, T_6 = 1.0 kg neem cake + 100 g N plant^{-1} year^{-1}, T_7 = 1.0 kg neem cake + 200 g N plant^{-1} year^{-1}, T_8 = 1.0 kg neem cake + 300 g N plant^{-1} year^{-1}, T_9 = 1.0 kg neem cake + 400 g N plant^{-1} year^{-1}, T_{10}= Control (no inorganic nitrogen and organic manure).

Table 2: Effect of chemical nitrogen and neem cake on Juice (%), T.S.S. (ºBrix) Acidity (%), Total sugar (%), Reducing sugar (%), Non-reducing sugar (%), Vitamin - C (mg/100ml of juice) and T.S.S./acid ratio

Treatments	Juice (%)	T.S.S. (ºBrix)	Acidity (%)	Total sugar (%)	Reducing sugar (%)	Non-reducing sugar (%)	Vitamin-C (mg/100ml of juice)	T.S.S./ acid ratio
T1	62.10	10.46	0.52	8.88	7.96	0.94	20.68	20.34
T2	65.12	10.55	0.53	9.31	8.29	0.79	20.97	20.32
T3	64.91	10.69	0.51	9.37	8.68	0.67	20.77	21.28
T4	72.16	10.77	0.44	9.69	9.08	0.58	20.99	25.81
T5	62.65	10.25	0.51	9.13	8.51	0.83	20.68	19.81
T6	69.17	10.90	0.46	9.66	8.67	0.99	20.65	24.27
T7	71.75	10.59	0.47	10.32	9.41	0.80	21.07	22.72
T8	75.63	12.29	0.39	10.74	9.78	1.09	21.93	31.36
T9	73.49	11.59	0.41	10.58	9.36	0.94	21.46	28.44
T10	60.43	10.44	0.56	8.46	7.64	0.80	20.63	19.04
S.Em. ±	1.369	0.323	0.021	0.026	0.016	0.101	0.317	0.928
C.D. at 5%	4.069	0.958	0.061	0.078	0.047	N.S.	N.S.	2.756

Treatment Details: T_1 = 100 g nitrogen plant^{-1} year^{-1}, T_2 = 200 g nitrogen plant^{-1} year^{-1}, T_3 = 300 g nitrogen plant^{-1} year^{-1}, T_4 = 400 g nitrogen plant^{-1} year^{-1}, T_5 = 1.0 kg neem cake plant^{-1} year^{-1}, T_6 = 1.0 kg neem cake + 100 g N plant^{-1} year^{-1}, T_7 = 1.0 kg neem cake + 200 g N plant^{-1} year^{-1}, T_8 = 1.0 kg neem cake + 300 g N plant^{-1} year^{-1}, T_9 = 1.0 kg neem cake + 400 g N plant^{-1} year^{-1}, T_{10}= Control (no inorganic nitrogen and organic manure).

obtained highest from the treatment with 300g nitrogen + 1 kg neem cake plant^{-1} (T_8), which was almost 68.58% more than that of controls (no nitrogen). It was observed that 400 g of chemical nitrogen singly or in combination with neem cake were ineffective for further improvement in fruit production which might be due to the juvenility of the plant and also due to promotion of more vegetative growth. An increase in fruit weight with application of organic matter as compared with inorganic nutrients was also reported by Ghosh *et al.* (2012). The beneficial effect of nitrogen on growth may be explained from the fact that nitrogen is major constituent of many compounds of great physiological importance in metabolism, such as amino acids, proteins, nucleic acids, porphyrins, enzymes, and coenzymes (Agarwala and Sharma, 1976). Beneficial effect of nitrogen in improving yield in pomegranate was also noted by Singh and Chauhan, 1988; Prasannakumar and Dhandar, 1996; Padmavathamma and Hulamani, 1998; Saraf *et al.,* 2004.

Maximum fruit length of 7.75 cm was recorded under 300 g nitrogen + 1 kg neem cake plant^{-1} (T_8) and it was minimum (5.70 cm) under control (T_{10}). Due to application of different levels of chemical nitrogen singly and in combination with neem cake did not exhibit significant variation in fruit diameter. The highest juice percentage (75.63%) was also obtained from the fruits available from the T_8 treatment and lowest (60.43%) in the control (T_{10}). The highest total soluble solids (12.29°Brix) was recorded in the fruits obtained from the plant treated with 300 g nitrogen + 1 kg neem cake plant^{-1} (T_8) while the plants treated with only 1 kg neem cake (T_5) produced fruits of lowest T.S.S. content (10.25°Brix). An increase in TSS with application of organic matter as compared with inorganic nutrients was also reported by Ghosh *et.al.,* (2012). Significant variation in fruit acidity content was observed with the treatments under investigation. Control (T_{10}) plants produced fruits with highest acidity (0.56%), whereas, least acidic fruits (0.39%) were obtained from the plants treated with 300 g nitrogen along with 1 kg neem cake (T_8), followed by T_9 and T_4. Total sugar concentration (10.74%) was recorded highest in the fruits available from plants treated with 300 g nitrogen + 1 kg neem cake plant^{-1} (T_8), while the control plant (T_{10}) produced fruits of lowest total sugar content (8.46%).

Reducing sugar content showed similar trend as that of total sugar content. The highest reducing sugar content (9.78%) was recorded in the fruits of the treatment with 300 g nitrogen + 1 kg neem cake plant^{-1} (T_8) while lowest reducing sugar content (7.64%) was obtained in the fruits under control (T_{10}). The variation of non-reducing sugar content was non-significant due to different treatments of chemical nitrogen and neem cake. However, the highest (1.09%) and the lowest (0.58%) amount of non-reducing sugar content were noted in the treatment T_8 and T_4 respectively (Table 2). The ascorbic acid content was found highest (21.93 mg 100^{-1} ml juice) in the plants treated with 300 g nitrogen along with 1 kg neem cake (T_8) and lowest in control (20.63 mg 100^{-1} ml juice).A significant variation in T.S.S./acid ratio in the fruits was observed due to different treatments of chemical nitrogen and neem cake. The treatment with 300 g nitrogen + 1 kg neem cake plant^{-1}, T.S.S/acid ratio (31.36) was highest with T_8 treatment.

Highest fruit weight, fruit length and lowest seed percentage were recorded from the fruits of the T_8 treatment. The treatment T_8 proved most effective in producing highest total soluble solids, total sugar, reducing sugar, non-reducing sugar Vitamin-C content in the pomegranate fruit. A relatively low percentage of acidity (0.39%) was recorded from fruits of the T_8 treatment which was comparatively lower than the fruits of control (T_{10}). A number of reports were available regarding fruit quality improvement in pomegranate due to inorganic fertilizer application (Sen and Chouhan, 1983; Pathak and Pundir, 1981). Bankar *et al.* (1990) reported that application of nitrogen significantly increases the number of fruits, yield and weight of fruits plant^{-1} while Singh and Chauhan, (1988) indicated that the higher doses of nitrogen increases the qualitative characters of the fruit such as T.S.S., total sugar, reducing sugar, Vitamin-C, juice percentage etc. In the present experiment, it was apparent that combined applications of chemical nitrogen and neem cake along with a common dose of phosphorus and potassium brought about marked improvement in physico-chemical composition of pomegranate fruits. This is in close conformity with the observations of Arora and Singh (1970) in guava, Nijjar *et al.* (1972) in New Castle apricot, and Ghosh *et al.,* 2012 in pomegranate.

The marked effect of nitrogen on various characters of fruits of pomegranate was due to the fact that it increased the efficiency of metabolic process of the trees and thus encouraged the growth of pomegranate plant in general and consequently the various parts of the plant including fruit (Agarwala and Sharma, 1976). Juice percentage of the fruit was increased due to nitrogen application because they caused better hydration in the tree and the fruits became more succulent, or juicy. Nitrogen also stimulates the functioning of a number of enzymes in the physiological process which probably caused an increase in the T.S.S. content of the fruit (Childer, 1966).

REFERENCES

Agarwala, S. C. and Sharma, C. P. 1976. Plant nutrients – their functions and uptake. *Soil Fertility Theory and Practice (Ed. J. S. Kanwar). ICAR, New Delhi,* pp. 7-64

Arora, J. S., and Singh, J. R. 1970. Effect of nitrogen, phosphorus and potassium spray on guava *(Psidium guajava* L.). *J. Jpn. Soc. Hort. Sci.* **39:** 55-62.

Bankar, G. J., Dass, H. C., Prasad, R. N. and Vashishtha, B. B. 1990. Nitrogen nutrition in pomegranate under arid conditions. *Ann. Arid Zone.* **29:** 63-66.

Childer, N. F. 1966. *Fruit nutrition.* Horticultural Publication, Rutgers State University, Nichol-Avenue, New Bransuick, New Jersey, U.S.A.

Ghosh, S. N., Bera, B. Roy, S. and Kundu, A. 2012. Integrated nutrient management in pomegranate grown in laterite soil, *Indian J. Hort.* **69(3):** 333-337.

Khodade, M. S., Wahval, K. N. and Kale, P. N. 1990. Physico-chemical changes during growth and development of pomegranate fruits. *Indian J. Hort.* **47:** 21-27.

Nambiar, K. K. M. and Ghosh, A. B. 1984. Highlights of research of long term fertilizers experiments in India. *LTFE, Research Bulletin No. 1, New Dehhi, IARI.* p. 97.

Nijjar, G. S., Deol, S. S. and Bajwa, M. S. 1972. Effect of nitrogen, phosphorus and potassium on vigour, cropping and quality of New

Castle apricot. *J. Res. Punjab Agril. Univ.* **9:** 261-263.

Padmavathamma, A. S. and Hulamani, N. C. 1998. Effect of N and K nutrition on growth and yield of pomegranates cv. *Jyoti and RCR-1. Karnataka J. Agricultural Sciences.* **11(4):** 1126-1128.

Panse, V. G. and Sukhatme, P. V. 1985. Statistical Methods for Agricultural Workers, I.C.A.R., New Delhi.

Prasannakumar, B. and Dhandar, D. G. 1996. Response of pomegranate to NPK fertilization. *Indian J. Hort.* **53:** 114-117.

Saraf, R. K., Samaiya, R. K. and Shukla, K. C. 2004. Effect of different sources of nutrients on growth of pomegranate. *Proc. Nat. Conf. Biodiversity and Sustainable Utilization of Biological Resources*. pp. 203-208.

Savci, S. 2012. "An agricultural pollutant: chemical fertilizer", *International J. Environmental Science and Development.* **3(1):** 77-80.

Sen, N. L. and Chouhan, K. S. 1983. Effect of differential N, P and K fertilization on physicochemical characters of pomegranate. *Punjab Hort. J.* **23**: 59-63.

Singh, R. R. and Chauhan, K. S. 1988. Effect of nitrogen phosphorus and potassium on physico-chemical composition of pomegranate fruits cv. Local Selection. *Progressive Hort.* **19:** 77-79.