Studies on variable level of N fertigation on growth, yield and quality of pomegranate (*Punica granatum* L.) cv. Kandhari Kabuli

ABSTRACT

A field trial was conducted to study the effect of variable level of N along with recommended dose of P and K through fertigation on growth, yield and quality parameters of pomegranate on eleven year old pomegranate trees cv. Kandhari Kabuli under mid hill conditions of HP. Treatment consisted of five levels of Nitrogen fertilizer 0%, 25%, 50%, 75% and 100% along with 100% recommended dose of Pand K through fertigation and conventional method of fertilizer application (with recommended dose of NPK) kept as control. Fertigation treatments had a promising effect over conventional method and treatment of 75 % RD of N and RD of Pand K through fertigation proved significant over other fertigation treatments and conventional method. Highest tree growth parameters, fruit set, fruit retention, average fruit weight and yield was recorded highest for 75 % RD of N and RD of Pand K through fertigation. Physico-chemical fruit characteristics viz. highest TSS, lower acidity, highest TSS acid ratio, highest sugars and ascorbic acid content (Vit. C) was also recorded for 75 % RD of N and RD of P and K.

KEYWORDS:N Fertigation, growth, yield and quality, pomegranate

Introduction

Pomegranate (*Punica granatum* L.) belongs to *Punicaceae* family and is widely grown in many tropical and subtropical countries, especially in the modertare climate of the Mediterranean regions. In addition, pomegranate trees have great adaptability to adverse climatic conditions, such as drought tolerance and changing climate (Sepulveda *et al.* 2000). Therefore, it is an economically important commercial fruit crop of arid and semi-arid regions of the country. Pomegranate fruit is increasingly recognised as a highly beneficial fruit with a unique combination of appealing appearance, good taste and high content of healthy metabolites (Seeram *et al*. 2006). Pomegranate fruit aril contains several polyphenols and anthocyanolins that are powerful free radical scavangers and have shown potential antioxidant effects of pomegranate juice consumption.Antioxidant content of pomegranate juice is among the highest of any foods (*Guo et al*. 2003), and it is reported that these polyphenol compounds may lower risk of heart disease (Aviram *et al*. 2004) and slow cancer progress in prostrate cancer by decreasing PSA doubling time, decreases cell proliferation and increases apoptosis (Pantuck*et al*. 2006), breast cancer by tumor reduction and chemopreventive (Mehta and Lansky 2004), skin cancer by chemopreventive (Adhansi*et al*. 2009) and lungs cancer by chemopreventive (Khan et al 2007), osteoarthritis by decrease in cell proliferation and inflamatory cells in synovial fluid (HadipurJahroney and Mazzafari Karmani 2010). Its cultivation is growing popularly in the sub- tropics to sub-temperate zone of Himachal Pradesh. Recently, due to changing climate, marginal areas of apple growing area has been receding to higher altitude and pomegranate crop has been found to be one of the most promising crop up to an altitude of 4500 feet. Hence, this crop holds tremendous scope for its cultivation as Himachal is bestowed with agro- climatic conditions suitable for its cultivation. Among the different cultivars, Kandhari Kabuli is a leading cultivar of pomegranate in mid hills and sub tropic area of the state. Area under this crop is increasing enormously in spite of higher cost of fertilizers,

leaching and washing away of nutrients by run of, low water and fertilizer use efficiency and low productivity under conventional irrigation and fertilizer application methods. Fertilizers and irrigation are the most important inputs which directly affect the plant growth, development, yield and quality of produce. Application of fertilizers to the growing crops along with irrigation water through drip system, provide nutrients to the active root zone at different time intervals in accordance to crop growth stages, thus preventing losses of expensive nutrients, which ultimately helps in improving productivity and quality of produce. Fertigation ensures higher fruit yield by 50- 75 % along with saving of water and fertilizers by 40- 50 % besides reducing soil loss up to 20 % under fruit based land use systems and save time and labour, which makes fertigation economically viable (Sharda 2011). Fertilizer applied through broadcasting under basin method of irrigation is not efficiently utilized. Whereas, fertigation ensures application of fertilizers directly into the site of active root zone with vast potential for more accurate and timely crop rotation (Battilani 1997). The conventional practice of fertilizer and irrigation application has detrimental effects on the soil health and quality of produce besides its poor nutrient and water use efficiency. Whereas, fertigation allows an accurate and uniform application of nutrients to the wetted area where the active roots are concentrated. Further, fertigation gives flexibility of fertilization which enables the specific nutritional requirements of the crop to be met at different stages of growth. Fertigation is more useful in rainfed hill agro- ecosystem situations, where most of the orchards are established on undulating topography, shallow and light textured soils with poor retentivity of water and nutrients further aggravates the problem, consequently leading to low yield of poor quality produce.

MATERIALS AND METHODS

Field trials were executed in the Pomegranate Block of Department of Fruit Science of Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan (H.P), India. The experimental farm of the department is located at 30° 50' 45" latitude and 77° 88' 33" longitude at an elevation of 1,320 m amsl, representing mid hill zone of the state. The experiment was laid out on 11 year old pomegranate cv. Kandhari Kabuli in the randomized block design having three tree per replication. The experiment consisted of the following treatments viz; T_1: 0 % N and RD of P and K through fertigation, T_2: 25 % N and RD of P and K through fertigation, T_3: 50 % N and RD of P and K through fertigation, T_4: 75 % N and RD of P and K through fertigation, T_5: 100 % N and RD of P and K through fertigation and T_6: Conventional method of soil application with recommended dose of fertilizers. Fertigation with different kinds of fertilizers viz. Calcium Nitrate as a source for nitrogen, Sulphate of Potash (SOP) as a source for phosphorus and orthophosphoric acid as a source for potassium was accomplished in ten equal splits given at fortnight intervals. Under conventional method of fertilizer application urea, single super phosphate (SSP) and muriate of potash (MOP) were given during basin preparation.Observations were recorded on parameters like Shoot extension growth (cm), Increase in tree height (cm), Increase in tree spread (cm), Fruit set (%),Average Fruit weight (g), Yield kg/tree, TSS (^{o}B), Titratable acidity (%),TSS Acid Ratio, Total sugar (%), Reducing sugar (%),Ascorbic acid (Vit. C) mg/ 100g as per standard procedure and data was subjected to mean analysis through online software OP STAT.

RESULTS AND DISCUSSION

Highest tree growth parameters (Table 1) viz., highest mean shoot extension growth (52.90 cm), highest mean increase in tree height (46.03 cm) and highest mean increase in tree spread (50.33 cm) was recorded in the treatment, T_5 (100% RD of NPK). Similar findings of higher shoot growth rate of shoots, plant spread and plant height in Pomegranate with 100 % recommended dose of fertilizers through fertigation was also reported by Dhakar*et al*. (2010) and Jhakar (2010). Singh (2013)and Chauhan (2006) also reported highest growth parameters in nectarine cv. Snow Queen and kiwifruit with 100 % recommended dose of fertilizers through fertigation. Highest mean fruit set (54.73%), mean fruit retention (44.10%), mean average fruit weight (425.90 g), mean yield (40.72 kg/tree) was recorded (Table 2) in the treatment T_4 (75% RD of N and RD of P and K). Chauhan (2006) recorded highest fruit set, fruit retention, fruit weight and yield in kiwifruit with 75 % recommended dose of NPK through fertigation. Dhillon *et al.* (2011) recorded highest fruit weight and yield in pomegranate cv. Kandhari Kabuli with nearly 67 % RD of N. Singh (2013) while carrying out fertigation in nectarine cv. Snow Queen with variable level of N recorded highest fruit weight with 75 % of RD of N through fertigation.

Highest physico-chemical fruit characteristics were also recorded under fertigation treatment as compared to conventional method of fertilizer application (Table 3). Highest mean TSS (15.5^{o} B), lowest mean acidity (0.31), highest mean TSS acid ratio (50.10), highest mean total sugar (12.90%), highest mean reducing sugar (11.54%), and highest mean ascorbic acid content (15.95mg/100g) were recorded in the treatment , T_4 (75% RD of N and RD of P and K).Singh *et al*. (2006) and Singh (2013) also recorded higher values for TSS in pomegranate and nectarine respectively, with increasing concentration of nitrogen through fertigation. As the fruit maturity approaches in pomegranate, acidity decreases in proportion to TSS, which gives a fruit excellent sugar acid blend and is one of the most desirable characters of excellent fruit quality. Prasad and Mali (2000) found total sugar, reducing sugar and non reducing sugar to be highest at optimum level of N and to decreased level of sugar levels at higher doses of N in pomegranate cv. Jalore Seedless. Singh (2013) also recorded sugar content to increase with N level but decreased at very high level of N. Jia *et al*.(1999) also recorded the same phenomenon and suggested that excessive fertilizer application of N significantly diminishes fruit flavour by reducing certain fruit quality parameters. More reducing sugar in the treatments might be due to higher foliar N as it plays an important role in transformation of organic acids to sugars.

Table 1. Effect of variable N and Recommended dose of P and K on tree growth characters in pomegranate cv. Kandhari Kabuli

Treatment		Shoot extension growth (cm)			Increase in tree height (cm)			Increase in tree spread (cm)		
		2011	2012	Mean	2011	2012	Mean	2011	2012	Mean
T_1	0% N and RD of P and K	28.76	31.83	30.29	27.78	30.2	28.99	26.16	29.10	27.63
T_2	25% RD of N and RD of P and K	30.47	32.38	31.42	29.96	32.87	31.415	37.34	38.26	37.80
T_3	50% RD of N and RD of P and K	37.09	39.44	38.26	35.5	39.4	37.45	40.31	43.75	42.03
T_4	75% RD of N and RD of P and K	49.07	52.27	50.67	42.09	43.45	42.77	43.26	46.15	44.70
T_5	100% RD ofN, P and K	51.82	53.99	52.90	44.82	47.24	46.03	48.70	51.96	50.33
T_6	Conventional method of fertilizer application	37.23	41.27	39.25	35.52	38.59	37.05	34.2	39.74	36.97
$CD_{0.05}$		**2.79**	**3.71**		**2.85**	**3.81**		**6.44**	**4.44**	

Table 2. Effect of variable N and Recommended dose of P and K on fruiting characteristics and yield in pomegranate cv. Kandhari Kabuli

Treatment		Fruit set (%)			Fruit retention (%)			Average Fruit weight (g)			Yield kg/tree		
		2011	2012	Mean	2011	2012	Mean	2011	2012	Mean	2011	2012	Mean
T_1	0% N and RD of P and K	45.28	46.64	45.96	30.47	36.01	33.24	399.80	378.90	389.35	31.66	32.33	32.00
T_2	25% RD of N and RD of P and K	47.47	49.73	48.60	31.37	37.41	34.39	401.10	388.10	394.60	33.10	35.06	34.08
T_3	50% RD of N and RD of P and K	51.52	53.14	52.33	36.35	43.34	39.85	415.00	399.50	407.25	35.21	37.64	36.43
T_4	75% RD of N and RD of P and K	53.40	56.06	54.73	39.69	48.51	44.10	431.20	420.60	425.90	40.01	41.42	40.72
T_5	100% RD of N,P and K	51.73	54.70	53.22	36.32	46.01	41.17	456.60	437.50	447.05	38.96	41.57	40.27
T_6	Conventional method of fertilizer application	48.48	48.60	48.54	31.84	36.68	34.26	383.70	374.20	378.95	35.34	35.46	35.40
$CD_{0.05}$		**1.82**	**3.12**		**2.03**	**3.03**		**30.93**	**40.49**		1.51	**0.91**	

Table 3. Effect of variable N and Recommended dose of P and K on physico-chemical fruit characters of pomegranate cv. Kandhari Kabuli

Treatment		TSS (^{o}B)			Titratable acidity (%)			TSS Acid Ratio			Total sugar (%)			Reducing sugar (%)			Ascorbic acid (Vit. C) mg/ 100g		
		2011	2012	Mean	2011	2012	Mean	2011	2012	Mean	2011	2012	Mean	2011	2012	Mean	2011	2012	Mean
T_1	0% N and RD of P and K	14.1	12.7	13.4	0.45	0.40	0.43	31.30	31.70	31.50	12.21	12.39	12.30	11.06	11.24	11.15	12.82	12.87	12.85
T_2	25% RD of N and RD of P and K	14.3	13.2	13.7	0.43	0.38	0.41	33.20	34.70	33.95	12.31	12.55	12.43	11.11	11.35	11.23	14.01	14.08	14.05
T_3	50% RD of N and RD of P and K	15.0	14.6	14.8	0.37	0.36	0.37	40.50	40.50	40.50	12.48	12.74	12.61	11.21	11.42	11.32	15.26	15.36	15.31
T_4	75% RD of N and RD of P and K	15.7	15.4	15.5	0.31	0.31	0.31	50.60	49.60	50.10	12.87	12.93	12.90	11.53	11.54	11.54	15.81	16.08	15.95
T_5	100% RD of N,P and K	15.3	15.2	15.2	0.34	0.33	0.34	45.00	46.00	45.50	12.60	12.83	12.72	11.30	11.47	11.39	15.67	15.82	15.75
T_6	Conventional method of fertilizer application	14.2	14.5	14.3	0.40	0.34	0.37	35.5	42.6	39.05	12.41	12.63	12.52	11.20	11.35	11.27	15.11	15.12	15.11
$CD_{0.05}$		0.04	0.75		0.03	0.02		-	-		0.10	0.04		0.08	0.05		0.36	0.32	

Conclusion

It is evident from the study that fertigation had a significant effect on fruit growth quality parameters of pomegranate cv. Kandhari Kabuli as compared to the conventional method of fertilizer application and the best results were obtained with 75 % RD of N and RD of P and K through fertigation on growth, yield and quality parameters of pomegranate.

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