Proceedings:
International Conference on
Mango and Date Palm: Culture and Export.
20th to 23rd June, 2005.
Malik *et al.* (Eds), University of Agriculture, Faisalabad.

EFFECT OF FOLIAR FEEDING OF N, P AND K ON VEGETATIVE AND FRUITING CHARACTERS OF MANGO CV. DUSEHRI

Nav Prem Singh, C.S.Malhi and R.C.Sharma*
Punjab Agricultural University,
Fruit Research Station, Gangian (Dasuya)
Hoshiarpur-144 205, Punjab, India
*Department of Horticulture,
Punjab Agricultural University,
Ludhiana-141 004, Punjab, India
Email: anjlee11@yahoo.co.in

ABSTRACT

Studies were carried-out at Fruit Research Station; Gangian situated in sub-montane zone of Punjab, to ascertain the positive effects of chemicals on vegetative, floral and physico-chemical characteristics in Dusehri mango. Chemicals like Urea (2 & 4%), H_3PO_4 (1 & 2%) and KNO_3 (2 & 3%) were sprayed at the time of panicle emergence during the years 1999 and 2000. All the treatments increased shoot growth, panicle size and decreased male/hermaphrodite flowers ratio. Higher fruit set/panicle was recorded with urea, followed by KNO_3 treatments, however; significantly more fruit retention per cent was noted in trees sprayed with KNO_3 (3%) and H_3PO_4 (1%) as compared to other treatments and the control (water spray) in respective years. Foliar feeding of urea and KNO_3 (3%) directly to the metabolite sites considerably enhanced fruit yield by increasing fruit size and weight. Improvement in pulp stone ratio, TSS, reducing sugars, total sugars and reduction in TSS/acid ratio was observed with the application of higher doses of urea and KNO_3. Although, reverse trend was noted in case of fruit acidity, where it was on higher side with these treatments. In conclusion, foliar spray of urea and KNO_3 could be exploited for improving fruit yield and quality attributes of mangoes growing in sandy loam soils of Punjab, which are low to medium in organic matter and available K.

Keywords: Urea, H_3PO_4, KNO_3, vegetative growth, sex ratio, quality.

INTRODUCTION

Mango is one of the most commercially important fruit crop grown in tropical and sub-tropical countries. India has traditionally been the world's largest producer of mangoes and contributes nearly 45 % of the total global production (FAO, 2003). At present, it accounts for 39.5% of the total fruit area and 22.5% of total fruit production in the country. Mango industry also dominates the fresh fruit market and contributes 32 % of the total exports, followed by citrus and apple (Anon., 2005). However, fruit productivity per unit area is very low in comparison to

other mango growing countries. Imbalanced fertilization is considered to be one of the major contributing factors for the low productivity. It is estimated that production of ten tones of mango fruit annually removes 67 kg N, 16 kg P_2O_5 and 73 kg K_2O per ha from the soil (Anon., 2004). Several workers suggested that foliar feeding of nutrients directly to the metabolite sites as a substitute or supplement to soil application considerably enhanced fruit yield and quality attributes (Samra et al., 1977; Singh et al., 1994). It has been also recognized that mango leaves absorbed most of the nutrients within 24-72 hrs after spray and thereafter depletion of leaf nutrients content was noted due to translocation of N, P & K to the active developing organs within plant system (Singh, 2002). Maximum mango production was observed by Chadha et al. (1981), when leaf N content of 1.4 to 1.54 % was maintained. The leaf N, P & K status is directly correlated with the availability of respective nutrients in the soil profile and their absorption by the mango plants (Dhillon et al., 1991). Likely, application of KNO_3 as foliar feeding to Alphonso mango trees substantially improved TSS, total sugars and sugar/acid ratio over the control (Vijayalakshmi and Srinivasan, 2000). In Punjab (India), mango cultivation is practically confined to sub-montane zone and soils of these regions are sandy to loam, low to medium in available N, P & K. Therefore, to ascertain the positive effects, an attempt has been made to improve the vegetative, flowering, fruiting and quality attributes by using different sources of nutrients.

MATERIALS AND METHODS

The experiment was carried out on Twenty-five years old Dusehri mango trees growing under uniform cultural practices at PAU-Fruit Research Station, Gangian, situated in the sub montane region of Punjab during the years 1999 and 2000. The orchard soil was loamy sand with pH 7.9, organic carbon 0.3%, EC 0.2Mmhos/cm with available P & K 12 and 133 kg/ha, respectively. Nutrients from different sources viz. urea (2 & 4%), H_3PO_4 (1 & 2%), KNO_3 (2 & 3%) were sprayed in the morning hours, uniformly to slightly run-off, with rocking sprayer by adding Tween-80 as a surfactant at the time of panicle emergence (I^{st} fortnight of February). The experiment was laid-out in a randomized block design (RBD) and treatments replicated thrice by using single tree as a unit. Ten shoots and panicles from all directions of tree were randomly selected for recording the length after the cessation of growth. Sex ratio was worked out from the data recorded for percentage of male and hermaphrodite flowers at full bloom stage. The number of fruits on ten tagged panicles was counted in II^{nd} week of April for calculating fruit set/panicle. Fruit retention (%) was worked out by subtracting total number of fruits harvested from the initial fruit set on the selected panicles. Ten matured fruits were collected randomly from each replication and kept at room temperature till ripening. Average fruit size, weight and pulp/stone ratio was determined using standard methods. Fruit yield was recorded in kg/tree by counting and multiplying the number of fruits with average fruit weight. The juice was extracted from the pulp by straining through a muslin cloth and total soluble solids was noted with Bausch and Lamb hand refractometer in term of degree Brix (%). Juice acid content, reducing sugars and total sugars were estimated by following the procedure of AOAC (1980).

RESULTS AND DISCUSSION

Effect of NPK on vegetative, flowering and fruiting characteristics

The results in table 1 indicate that shoot length was significantly increased with the foliar feeding of N, P & K as compared to control. Maximum increment in shoot length was observed with urea and KNO_3 at higher doses, which was comparatively more in 1999 (off year) than 2000 (on year). Similarly, panicle length was also enhanced significantly with the application of these nutrients over the control, except H_3PO_4 at 1%. The earliest studies to support the present findings that applications of N, P & K play an effective role in enhancing the shoot and panicle length in mango (Kanwar et al., 1987; Rajput and Singh, 1989).

Male: hermaphrodite flower ratio was the lowest (1.91 in 1999 and 1.80 in 2000) with urea at 4% and the highest with H_3PO_4 at 1% (2.19 in 1999 and 2.06 in 2000). However, the results were statistically non-significant during 1999 and significant during 2000. The application of urea has been proved to lower down the sex ratio in mango cultivars (Vijayalakshmi and Srinivasan, 1998).

During 1999, significantly higher fruit set was recorded in trees sprayed with urea 4% as compared to other treatments, except KNO_3 3% and minimum was registered under the control. During 2000 fruit set was also more under urea 4% treatment but KNO_3 at 2 & 3% too noticeably increased the fruit set over the control. Fruit set was better in 2000 in comparison to 1999, might be due to more mature growth. The highest fruit retention (%) during 1999 was recorded with KNO_3 3% spray. However, during 2000, it was found to be more with H_3PO_4 (2 %). The optimum supply of nutrients to the bearing mango trees help in retaining more number of fruits (Singh, 1974; Sharma et al., 1990a). Nitrogen application might have increased the supply of some hormones to the fruits that tend to reduce abscission, probably auxins (Addicot, 1970).

Effect of NPK on physical quality attributes and fruit yield

The effect of different treatments on fruit length was non-significant in 1999, but significant in 2000 as compared to control (Table 2). In both the years, the highest fruit length was recorded under urea 4% treatment and the lowest in control. Similar trend was also obtained in case of fruit breadth. Increase in fruit size was also reported in mango cultivars with foliar sprays of urea (Samra et al., 1977; Singh et al., 1994) and KNO_3 (Sharma et al., 1990b; Vijayalakshmi and Srinivasan, 2000). The highest fruit weight was too reported with urea 4% spray. The next treatment was found to be KNO_3 3% and H_3PO_4 1% in 1999 and 2000, respectively. The fruit weight was more in 1999 as compared to 2000 and that is accredited to the number of fruits produced on the tree. The sprays of different nutrients have affected the pulp/stone ratio in Dusehri mangoes. Urea at 4% produced the highest fruit pulp/stone ratio as compared to control. However, it was drastically reduced with H_3PO_4 treatments.

The plants sprayed with different nutrients increased fruit yield over the control during 1999, except H_3PO_4 1%. Though, maximum fruit yield was observed with urea 4%, followed by KNO_3 3%. In 2000, fruit yield was the highest as compared to previous season due to 'on' year. Urea treatments were more effective in increasing the fruit yield as compared to other nutrients tried. These results corroborate the findings of Samra et al. (1977). The improvement in fruit yield seems to be related to the increase in fruit retention/panicle and fruit size (Table 1&2).

Effect of NPK on chemical quality attributes

The results in Table 3 show the effect of foliar application of N, P & K on chemical composition of the fruits. Urea at 4% improved total soluble solids significantly over control in both the years. This treatment was closely followed by KNO_3. However, increase in total titratable acid content was recorded in KNO_3 3% treatment. TSS/acid ratio was directly related to the values obtained for total soluble solids and acid contents in the fruit. Maximum TSS/acid ratio was observed with urea 2% and minimum in KNO_3 3% treatments in both the years. Total and reducing sugars show almost the same trend as that of total soluble solids. These results are in line with the findings of Sharma et al. (1990c), Vijayalakshmi and Srinivasan (2000). The beneficial effect of nutrients on physico-chemical characteristics of Dusehri mango is due to their influence on physiological processes such as respiration and photosynthesis, which possibly in turn enhanced the supply of dry matter, minerals and carbohydrates towards the developing fruits.

CONCLUSION

Nutrients viz. urea (2 & 4%), H_3PO_4 (1 & 2%) and KNO_3 (2 & 3%) applied in first fortnight of February as foliar feeding enhanced the shoot growth, fruit set/panicle and fruit yield over the control. Significantly the highest fruit set was registered with KNO_3 (3%) and H_3PO_4 (2%) during 1999 and 2000, respectively. The physico-chemical characteristics of the fruit were improved considerably by urea 4% during both the years.

REFERENCES

Addicot, F.T. 1970. Plant hormones in the control of abscission. Bio. Rev. 45: 485-524.

Anonymous. 2004. Package of Practices for Fruit Crops. Punjab Agricultural University, Ludhiana, India.

Anonymous. 2005. The Hindu Survey of the India Agriculture 2005, Chennai, India.

A.O.A.C. 1980. Officials Methods of Analysis. 12th ed., Washington, D.C.

Chadha, K.L., Thakur, R.S. and Sharma, J.S. 1981. Leaf analysis as a guide to nitrogen fertilization in mango (*Mangifera indica* L.). Indian J. Hort. 38:153-257.

Dhillon, W.S., Malhi, C.S., Singh, R. and Dhatt, A.S. 1991. Leaf N, P and K status of mango cultivar Langra as influenced by the dynamics of the respective nutrients in the soil profile. Indian J. Hort. 48:108-111.

F.A.O. 2002. Production Yearbook of FAO, Rome, Italy.

Kanwar, J.S., Nijjar, G.S. and Kahlon, G.S. 1987. Effect of nitrogen, phosphorus and potassium fertilizers on growth and productivity of Dashehari mango (*Mangifera indica* L.). J. Res. Punjab Agricul. Univ. 24:411-422.

Rajput, C.B.S. and Singh, J.N. 1989. Effects of urea and GA_3 sprays on the growth, flowering and fruiting characters of mango. Acta Hort. 231:301-305.

Samra, J.S., Thakur, R.S. and Chadha, K.L. 1977. Effect of foliar application of urea on yield and yield parameters of mango. Indian J. Hort. 34:26-29.

Sharma, T.R., Nair, P.K.R. and Nema, M.K. 1990a. Effect of foliar sprays of urea, KNO_3 and NAA on fruiting behaviour of mango cv. Langra. Orissa J. Hort. 18:42-47.

Sharma, T.R., Nair, P.K.R. and Nema, M.K. 1990b. Influence of foliar sprays of urea, KNO_3, and NAA on chemical composition of mango cv. Langra. Punjab J. Hort. 30:53-56.

Sharma, T.R., Nair, P.K.R. and Nema, M.K. 1990c. Influence of foliar sprays of urea, KNO_3 and NAA on physical composition of mango cv. Langra. Punjab J. Hort. 30:47-52.

Singh, J.N., Singh, D.K. and Chakravarty, D. 1994. Effect of urea and NAA on fruit retention and physico-chemical composition of mango (*Mangifera indica* L.) cv. Langra. Orissa J. Hort. 22:26-30.

Singh, N.P. 2002. Effect of chemicals and plant regulators on the promotion of flowering and fruiting in mango cv. Dusehri. Ph.D. Dissertation, Punjab Agricultural University, Ludhiana, India.

Singh, R.R. 1974. Effect of foliar spray of nitrogen and phosphorus on flowering and fruiting of mango (*Mangifera indica* L.) cultivar Langra. Haryana J. Hort. Sci. 3:147-154.

Vijayalakshmi, D. and Srinivasan, P.S. 1998. Induction of flowering in 'off' year mango cv. Alphonso as influnced by chemicals and growth regulators. Ann. Pl. Physiol. 12:93-97.

Vijayalakshmi, D. and Srinivasan, P.S. 2000. Improving the quality attributes of 'off' year mango cv. Alphonso through chemicals and growth regulators. Orissa J. Hort. 28:31-33.

TABLES

Table 1: Effect of NPK on vegetative, flowering and fruiting characteristics in mango cv. Dusehri

Treatment	Shoot length (cm)		Panicle length (cm)		Sex-ratio		Fruit set/panicle		Fruit retention (%)	
	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000
Urea 2%	19.13	13.73	14.07	22.40	2.03	1.88	3.87	6.17	22.74	43.05
Urea 4%	19.67	14.52	14.91	23.38	1.91	1.80	5.03	7.01	23.98	39.11
H_3PO_4 1%	17.83	12.53	13.23	21.35	2.19	2.06	3.27	4.59	21.57	47.51
H_3PO_4 2%	18.09	12.94	13.44	21.82	2.16	2.00	3.49	4.88	22.82	49.98
KNO_3 2%	18.59	13.17	13.89	21.75	2.13	1.97	3.95	5.06	23.56	46.63
KNO_3 3%	18.86	13.37	13.99	22.12	2.06	1.94	4.20	5.94	25.90	45.46
Control	17.08	11.76	12.45	20.55	2.18	2.03	2.96	3.32	18.23	36.42
$CD_{0.05}$	0.68	1.05	0.79	1.13	NS	0.13	1.06	0.97	2.56	3.08

Table 2: Effect of NPK on physical quality attributes and fruit yield in mango cv. Dusehri

Treatment	Fruit lenght (cm)		Fruit breadth (cm)		Fruit weight (g)		Pulp/stone ratio		Fruit yield (Kg/tree)	
	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000
Urea 2%	10.95	9.41	6.36	5.74	219.3	147.2	3.60	3.39	30.9	129.6
Urea 4%	11.21	9.52	6.56	5.81	228.3	152.3	3.98	3.76	32.7	135.1
H_3PO_4 1%	10.64	9.38	6.07	5.65	214.2	148.9	3.32	3.26	28.5	125.4
H_3PO_4 2%	10.79	9.17	6.13	5.58	217.1	144.3	3.10	3.41	30.0	123.2
KNO_3 2%	10.88	9.19	6.19	5.48	216.3	141.6	3.24	3.35	30.6	121.9
KNO_3 3%	11.03	9.23	6.39	5.56	219.9	145.1	3.30	3.48	31.8	126.3
Control	10.45	9.04	6.03	5.43	202.3	134.7	3.48	3.30	27.0	111.1
$CD_{0.05}$	NS	0.21	0.28	0.16	11.5	8.3	0.36	NS	2.5	11.3

Table 3: Effect of NPK on chemical quality attributes in mango cv. Dusehri

Treatment	TSS (%)		Acidity (%)		TSS/acid ratio		Total sugars (%)		Reducing sugars (%)	
	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000
Urea 2%	17.65	14.59	0.13	0.20	135.8	72.9	14.2	11.3	3.4	2.9
Urea 4%	18.15	15.35	0.15	0.23	121.0	66.8	14.6	12.0	3.6	3.1
H_3PO_4 1%	17.70	14.44	0.15	0.22	118.0	65.7	13.6	11.2	3.4	2.8
H_3PO_4 2%	17.42	14.70	0.14	0.21	124.4	70.0	13.4	11.5	3.3	2.9
KNO_3 2%	17.80	14.77	0.14	0.22	127.1	67.1	14.4	11.3	3.5	2.9
KNO_3 3%	17.50	14.95	0.16	0.24	109.4	62.3	14.0	11.8	3.3	3.0
Control	17.16	14.08	0.13	0.20	132.0	70.4	13.2	10.8	3.1	2.7
$CD_{0.05}$	0.29	0.35	0.02	0.02	-	-	0.7	0.4	0.2	0.2