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Short communication

Effect of foliar spray of nitrogenous chemicals on flowering, fruit set and yield in mango (*Mangifera indica* L.) cv. Alphonso

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ABSTRACT

Effect of foliar application of various nitrogenous chemicals on flowering, fruit set and yield of mango cv. Alphonso was studied at the orchard of Horticultural College and Research Institute, Coimbatore, during 2010 - 2011. Maximum number of flowering shoots (68.7%), number of panicles (7.5/m^2), panicle length (31.4cm), number of hermaphrodite flowers (282.5/panicle), fruit set (17.0%), number of fruits (146.0/tree) and fruit yield (43.8 kg/tree) was obtained with foliar spray of KNO_3 at 2% concentration. Higher content of chlorophyll (1.7g mg^{-1}), carbohydrate (14.5g 100g^{-1}) and nitrogen (1.43%) and higher C/N ratio (10.18) were also recorded in plants sprayed with 2% KNO_3, followed by 1% KNO_3.

Key words: Mango, flowering, fruit set, nitrogenous chemicals

Mango (*Mangifera indica* L.) is a major commercial fruit crop in many tropical and subtropical countries. India, the world's largest producer of mangoes, has 35.46% of its total area under mango among fruit crops and 28 % of the total production of fruits. However, productivity of mango in India is very low compared to other mango-growing countries, lack of environmental signals for flowering being a limiting factor for obtaining consistent mango production in the tropics. An alternative to dependence on the environmental stimulus for flower initiation is evolving management strategies substitute for these signals. Several workers have suggested that foliar feeding of nutrients directly to the site of metabolism as a substitute for or supplement to soil application considerably enhanced fruit yield and quality attributes (Samra *et al*, 1977; Singh *et al*, 1994). It has also been recognized that mango leaves absorb most of the nutrients within 24-72 hrs after spray and, thereafter, depletion of leaf nutrient content is seen owing to translocation of N, P and K to actively developing organs within the plant system (Singh, 2002). Hence, an attempt was made by us to improve flowering and fruit set in mango using various nitrogenous chemicals as foliar spray.

An experiment was carried out on 25-year old mango trees of cv. Alphonso at the orchard of Horticultural College and Research Institute, Coimbatore, during 2010-2011. The trees were under irrigation on clayey loam soil, with available nitrogen 216.70 kg/ha, available phosphorus 18.32 kg/ha and available potash 453.60 kg/ha. Trees were spaced at 10m x 10m. The experiment was laid out in Randomized Block Design with three replications, and a single tree was treated as a unit/treatment. Treatments included spraying urea @ 1% (T_1) or 2% (T_2); KNO_3@1% (T_3) or 2% (T_4); NH_4NO_3 @ 1% (T_5) or 2% (T_6); $CaNO_3$@1% (T_7) or 2% (T_8), and Control (T_9). The chemicals were sprayed in morning hours with a rocker sprayer (after adding Tween-20 as a surfactant) at fifteen-day intervals from 15th November to 30th December. Data on per cent flowering shoots, number of panicles/square metre, length of the panicle, number of hermaphrodite flowers/panicle, fruit set percentage, number and weight of fruits/tree; chlorophyll, carbohydrate and nitrogen content and C/N ratio, were recorded as per standard procedures.

Estimation of per cent shoots flowered was based on emergence of the flowering panicle in 25 shoots tagged per tree. Numbers of panicles were counted per square meter area at five different locations on a tree with the help of a wooden frame (1m x 1m dimension) and the mean was arrived at. Length of panicle was measured on ten shoots and the mean was expressed in centimetres. Number of hermaphrodite flowers was counted in four panicles at five

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Table 1. Effect of foliar spray of nitrogenous chemicals on flowering, fruit set, yield and biochemical parameters in mango cv. Alphonso

Treatment	Per cent flowering shoots (%)	No. of panicles/ m^2	Length of panicle (cm)	No. of hermaphrodite flowers/panicle	(%) Fruit set	Number of fruits/ tree	Yield/ tree (kg)	Chlorophyll content ($mg\,g^{-1}$)	Carbohydrate content ($g\,100g^{-1}$)	Nitrogen content (%)	C/N ratio
T_1 - Urea 1%	61.2(52.1)	6.5	29.3	196.0	15.5(23.3)	128.0	32.0	1.6	13.1	1.3(6.5)	9.7
T_2 - Urea 2 %	63.7(52.2)	6.3	30.2	218.7	16.2(23.5)	132.0	33.5	1.6	13.3	1.3(6.4)	9.8
T_3 - KNO_3 1%	65.0(52.4)	7.1	30.4	277.5	16.5(23.6)	138.0	41.4	1.7	14.2	1.4(6.6)	10.1
T_4 - KNO_3 2%	68.7(52.6)	7.5	31.4	282.5	17.0(23.6)	146.0	43.8	1.7	14.5	1.4(6.5)	10.1
T_5 - NH_4NO_3 1%	59.2(51.7)	5.8	28.5	152.0	15.0(23.0)	118.0	29.5	1.5	12.3	1.2(6.1)	9.8
T_6 - NH_4NO_3 2%	60.7(51.9)	6.0	29.0	156.2	15.2(23.2)	125.0	31.2	1.5	12.6	1.2(5.9)	10.0
T_7 - $CaNO_3$ 1%	56.2(46.9)	5.2	24.5	117.0	14.1(21.6)	115.0	29.9	1.4	11.6	1.1(5.8)	10.2
T_8 - $CaNO_3$ 2%	57.5(47.0)	5.3	26.5	137.2	14.0(21.4)	120.0	30.0	1.4	11.8	1.1(5.8)	10.2
T_9 - Control	47.0(46.6)	4.5	21.0	118.0	12.2(21.4)	102.0	25.5	1.3	11.0	1.0(5.4)	10.1
Mean	59.9	6.0	27.8	183.6	15.1	125.0	32.9	1.5	12.6	1.2	9.9
F test	**	**	**	**	**	*	**	*	**	*	NS
S.Em±	0.9	0.3	1.1	21.3	0.3	4.3	1.9	0.1	0.4	0.1	0.1
SEd	0.5	0.2	0.5	2.3	0.3	1.7	0.7	0.03	0.4	0.2	0.2
CD *(P=0.05)*	1.0	0.4	1.1	4.8	0.6	3.6	1.5	0.1	1.0	0.5	—
CV (%)	1.1	3.6	3.0	34.7	1.4	10.5	17.9	9.5	9.1	4.5	1.8

Figures in parentheses indicate arcsine transformed values of percentages
NS=Non-significant, ** = Significant at *P=0.01* and * = Significant at *P=0.05*

different locations on the tree during flower opening. Fruit set was recorded at pea-berry stage on five randomly tagged panicles. Number of harvested fruits / tree was counted and their total weight in kilograms (kg) per tree was recorded. Total chlorophyll content was determined in fresh leaves as per Yoshida *et al* (1971) and expressed a mg g^{-1}. Total carbohydrate content was estimated colorimetrically using the procedure of Somogyi (1952) and expressed as g $100g^{-1}$. Per cent nitrogen content was estimated by Micro Kjeldahl method of Piper (1966). The ratio of carbohydrate to nitrogen was calculated. Data collected were subjected to statistical scrutiny (Panse and Sukhatme, 1967).

Results in Table 1 indicate that percent flowering shoots increased significantly with application of nitrogenous chemicals, over the control. Maximum shoot length of 68.2cm was observed in KNO_3 spray at 2%. Number of panicles also increased with foliar spray of nitrogenous chemicals. Highest number of panicles ($7.5/m^2$) was recorded in trees sprayed with KNO_3 2%, and the minimum was seen under control ($4.5/m^2$). Length of panicle was higher (31.4cm) in KNO_3 2% treatment. Other nitrogenous chemicals too increased the length of panicle noticeably over the control. Number of hermaphrodite flowers/panicle was the highest (282.5) in KNO_3 2% spray, and lowest in the control (118.0). KNO_3 spray induced flowering of young shoots, indicating partial substitution of their maturity requirement by KNO_3.

Beevers and Hageman (1969) and Filner *et al* (1969) reported ability of KNO_3 and other nitrate sources as inducing nitrate reductase in many species. Nitrate reductase is a key enzyme in nitrate assimilatory pathway for amino acids synthesis. Methionine has been reported to promote mango flowering and is a precursor of ethylene (Maity *et al*, 1972). Davenport and Nunez-Elisea (1997) stated that KNO_3-stimulated flowering of mango is mediated by increased levels of endogenous ethylene. Potassium nitrate is a universal rest-breaking agent in deciduous fruit trees (Erez and Lavee, 1974) that may simply hasten flower emergence of a differentiated, but dormant, mango bud. Astudillo and Bondad (1978) reported induction of flowering in 'Carabao' mango with KNO_3.

It is evident from the data that yield / tree differed significantly among treatments. Sprays of various nitrogenous chemicals increased fruit set over the control. Though increased fruit set was observed with KNO_3 2% (17.0 %), followed by KNO_3 1% (16.5 %), the former resulted in maximum number of fruits (146/tree) as against the control (102/tree). Highest fruit yield of 43.8kg per tree was observed with KNO_3 2% spray, whereas control recorded least fruit yield of 25.5kg/tree. The next best treatment was KNO_3 1% spray (41.4 kg). KNO_3 treatments were more effective in increasing fruit yield, which may be attributed to a higher number of hermaphrodite flowers, fruit set and number of fruits / tree. Similar report was made by Sergent *et al* (1997) in mango cv. Haden.

Plant biochemical parameters were also influenced by foliar feeding of nitrogenous chemicals. Maximum chlorophyll content was observed in KNO_3 2% (1.7mg g^{-1}) and minimum in control (1.3mg g^{-1}). C/N ratio in leaves was highest with KNO_3 2% (10.1), and lowest in control (10.1). High C/N ratio was probably conducive to floral induction. Highest carbohydrate content was observed in trees sprayed with KNO_3 2% (14.5g $100g^{-1}$) compared to control (11.0g $100g^{-1}$). Plants sprayed with KNO_3 2% registered higher nitrogen content (1.4%) than the control (1.0%). Seasonal changes in carbohydrate and nitrogen content of mango leaves in relation to flowering have been reported earlier by Sen *et al* (1963). The present study illustrates that KNO_3 2% foliar spray can improve flowering, fruit set and yield in mango cv. Alphonso, rather than use of urea, NH_4NO_3 or $CaNO_3$.

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