Effect of foliar application of nitrogen and potassium on leaf nutrient content of fig (*Ficus carica* L)

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ABSTRACT

A field experiment was conducted at the model farm of Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh during the years 2016-17 and 2017-18 to see the effect of foliar application of nitrogen and potassium on leaf nutrient content of fig. Thirteen treatment combinations were arranged in a randomized block design comprising two levels of nitrogen viz $N_{0.5}$ (0.5% urea) and $N_{1.0}$ (1.0% urea); two levels of K viz K_1 (1.0% KNO_3) and K_2 (2.0% KNO_3) and two application times viz September and January. Experiment was replicated thrice. The maximum leaf N was recorded under treatment comprising $N_{1.0}+K_{2.0}$ (2 sprays at 15 days interval in September) (2.71%), $N_{1.0}+K_{1.0}$ (1 spray in September and 1 in January) (2.55%) and $N_{1.0}+K_{2.0}$ (1 spray in September and 1 in January) (2.52%). In 2017, treatment $N_{1.0}+K_{2.0}$ (1 spray in September and 1 in January) resulted in maximum (0.34%) phosphorus content. The same treatment resulted in maximum Ca content of 5.36 per cent in 2018 and 4.64 per cent under pooled data and Cu content of 9.4 ppm in 2017.

Keywords: Fig; foliar spray; urea; potassium nitrate; leaf nutrient content

INTRODUCTION

Fig (*Ficus carica* L) is a small to moderate size deciduous fruit crop of tropical and subtropical countries. Plants usually absorb water and nutrients through their roots, therefore, fertilizers are traditionally applied into the soil. While soil application can supply enough nutrients to improve plant production, it also causes anxiety about environmental contamination for nutrients leaching into groundwater. To add to it, the nutrients supplied through soil take a longer time to be ultimately utilized by the plants. The power of plant leaves to absorb nutrients has resulted in the foliar application of nutrients becoming a recurrent method for supplying nutrients to the plants.

Foliar sprays preclude soil competition factors, irrigation dependence, slow response of nutrients uptake from soil and groundwater accumulation of inorganic salts. Foliar spraying of nutrients has been recommended because it is 10 to 30 times more efficient and there is no risk of groundwater contamination (Weinbaum 1988, Dinnes et al 2002). Foliar uptake of nutrients has also been found to be favourable in terms of predictability and efficiency (Southwick et al 1996) and it is a complementary measure taken to provide nutrients during a critical phase of restricted nutrient supply. The nitrogen supply largely controls the growth and fruiting of most plants when the other factors are not seriously limiting. Nitrogen supply largely controls the use of carbohydrate materials by the plants and determines whether the plants will make vegetative or reproductive growth. In commercial production, it is the element most likely to be deficient.

Potassium deficiency reduces photosynthesis and carbohydrate transport and accelerates premature leaf senescence and abscission. Leaf potassium concentration less than 0.5-0.6 per cent also limits leaf CO_2 exchange rate and reduces leaf carbon fixation by imposing biochemical limitations on photosynthesis (Basile et al 2003). Many workers have shown that fruit trees receiving foliar nitrogen application use fertilizer N more efficiently than trees that receive soil N application. Keeping in view the importance of nitrogen and potassium in plant nutrition as well as for growth, yield and quality coupled with the importance of foliar feeding to increase efficiency of absorption, the present investigations were conducted in order to study the effect of foliar nitrogen and potassium on leaf nutrient content, quality and yield of fig.

MATERIAL and METHODS

The field experiment was conducted at the model farm of Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh during the years 2016-17 and 2017-18. The experimental area is located at 30^o 522' North latitude and 77^o 112' East longitude at an elevation of 1,175 m amsl.

A total of thirteen treatments viz T_1 [Control (no spray)], T_2 [$N_{0.5}$ + $K_{1.0}$ (2 sprays at 15 days interval in January)], T_3 [$N_{0.5}$ + $K_{2.0}$ (2 sprays at 15 days interval in January)], T_4 [$N_{1.0}$ + $K_{1.0}$ (2 sprays at 15 days interval in January)], T_5 [$N_{1.0}$ + $K_{2.0}$ (2 sprays at 15 days interval in January)], T_6 [$N_{0.5}$ + $K_{1.0}$ (2 sprays at 15 days interval in September)], T_7 [$N_{0.5}$ + $K_{2.0}$ (2 sprays at 15 days interval in September)], T_8 [$N_{1.0}$ + $K_{1.0}$ (2 sprays at 15 days interval in September)], T_9 [$N_{1.0}$ + $K_{2.0}$ (2 sprays at 15 days interval in September)], T_{10} [$N_{0.5}$ + $K_{1.0}$ (1 spray in September and 1 in January)], T_{11} [$N_{0.5}$ + $K_{2.0}$ (1 spray in September and 1 in January)], T_{12} [$N_{1.0}$ + $K_{1.0}$ (1 spray in September and 1 in January)] and T_{13} [$N_{1.0}$ + $K_{2.0}$ (1 spray in September and 1 in January)] were used which were replicated thrice in randomized block design.

Field trials were laid out during 2016-17 and 2017-18 on fully grown 6 years old fig cv Badka trees planted at a spacing of 4 m × 2 m. The experiment comprised two levels of N (0.5 and 1.0%) and two levels of K (1 and 2%) applied as foliar sprays in combinations during January and September.

The source of nitrogen was urea and of potassium was potassium nitrate. For the foliar fertilization, different combinations of urea and potassium nitrate (as per treatment) for each tree were made which were mixed in 9 litres of water and each tree was sprayed with 3 litres of the fertilizer solution. Three trees were given the same foliar spray. The FYM application as per the recommended package of practices was applied during the month of December.

Total N content (%) in the plant samples was analyzed by the micro-kjeldhal method (Anon 1975). Total leaf phosphorus was estimated by vanado-molybydate phosphoric yellow colour method (Jackson 1973). Five ml of aliquot (digested) was pipetted out in 25 ml of volumetric flask and 5 ml of vanado-molybdate reagent was added. Solution was diluted to 25 ml with distilled water and allowed to develop colour for half an hour. After the development of colour, concentration of phosphorus in the solution was recorded on a spectrophotometer at 470 nm wavelength and a blank was run simultaneously to adjust zero absorbance. Leaf phosphorus was expressed in per cent on dry weight basis.

Potassium in the di-acid extract was estimated flame photometrically while calcium, magnesium and micronutrients (Zn, Cu, Fe and Mn) were estimated on atomic absorption spectrophotometer. K, Ca, Mg and S were expressed in per cent and micronutrients (Zn, Cu, Fe and Mn) were expressed in ppm on dry weight basis.

RESULTS and DISCUSSION

Nitrogen: The data on leaf nitrogen as influenced by different treatments are presented in Table 1. It was found that the effect of different foliar nutrient sprays on leaf nitrogen content was significant. During the year 2017, the highest leaf N was recorded under T_9 (2.52%), T_{13} (2.49%), T_{12} (2.20%), T_5 (2.06%) and T_8 (1.89%) which were at par as compared to all other treatments. The results of the second year show that the highest N was under T_9 (2.89%), T_{12} (2.75%), T_{13} (2.56%), T_{10} (2.43%) and T_5 (2.36%) all being at par and lowest in control (1.30%). The differences between the years were, however, not significant. The pooled analysis of the data show that the highest leaf N was recorded under treatment T_9 (2.71%), T_{12} (2.55%) and T_{13} (2.52%) which were at par. The data on interaction between years and treatments revealed a significant effect. The present results are in line with the findings of Ystaas (1980) and Baiea et al (2015). These observations indicate that foliar urea spray is effective in augmenting the nitrogen content in the leaves and is a better source of nutrition for the trees that are under stress or are usually less preferred for fertilization.

Phosphorus: The data on leaf content of phosphorus as influenced by different treatments indicate that different foliar nutrient sprays affected leaf phosphorus content significantly (Table 1). The highest leaf P

(0.34%) in 2017 was recorded in the trees receiving nitrogen application through urea spray @ 1.0 per cent and potassium through KNO_3 @ 2.0 per cent twice during September and January and the lowest in control (0.21%). During the second year (2018), the highest P was observed under T_{13} (0.42%), T_3 (0.40%), T_4 (0.39%), T_9 (0.37%), T_{12} (0.36%), T_5 (0.35%), T_8 (0.35%) and T_{10} (0.35%), all being at par. The mean leaf P content obtained for 2018 (0.35%) was found to be significantly higher as compared to the 0.27 per cent in 2017. The pooled data show that the highest leaf P was recorded under treatment T_{13} (0.38%), T_3 (0.34%) and T_4 (0.34%), the three being at par and the minimum in control (0.21%). The data on the interaction between years and treatments revealed a significant effect. Feungchan and Sharma (1974), Bar-Akiva (1975) and (Fouche et al 1977) also found the increase in phosphorus content of leaves with the application of foliar N and K in different fruit crops. The overall improvement in the uptake of N by the leaves leads to an improved physiological functioning within the plant system, as a result of which the concentration of phosphorus also increases. Leaf mineral nutrients other than N have also been shown to be affected by both the amount and method of urea application (Forshey 1963, Fallahi et al 1997, Fallahi et al 2002).

Potassium: The data on leaf potassium as influenced by different treatments are presented in Table 1. The results indicate that effect of different foliar nutrient sprays on leaf potassium content was significant. During the year 2017, the highest leaf K was recorded under T_8 (0.94%) comprising N @ 1.0 per cent and K @ 1.0 per cent in two sprays each at 15 days interval in September which was at par with all other values

Table 1. Effect of foliar nutrient spray of nitrogen and potassium on leaf N, P and K in fig

Treatment	Nitrogen (%)			Phosphorus (%)			Potassium (%)		
	2017	2018	Mean	2017	2018	Mean	2017	2018	Mean
T_1	1.21	1.30	1.26	0.21	0.21	0.21	0.62	0.75	0.69
T_2	1.45	2.15	1.80	0.27	0.34	0.32	0.81	1.07	0.97
T_3	1.49	2.24	1.87	0.29	0.40	0.34	0.86	1.23	1.02
T_4	1.76	2.01	1.89	0.30	0.39	0.34	0.77	1.27	1.02
T_5	2.06	2.36	2.21	0.26	0.35	0.31	0.80	1.62	1.21
T_6	1.49	2.07	1.78	0.27	0.33	0.30	0.88	1.20	1.04
T_7	1.82	2.24	2.03	0.27	0.33	0.30	0.85	1.13	0.99
T_8	1.89	2.29	2.09	0.27	0.35	0.31	0.94	1.17	1.06
T_9	2.52	2.89	2.71	0.28	0.37	0.33	0.86	1.55	1.20
T_{10}	1.45	2.43	1.94	0.25	0.35	0.30	0.84	1.14	0.99
T_{11}	1.68	2.33	2.01	0.25	0.32	0.29	0.82	1.16	0.99
T_{12}	2.20	2.75	2.55	0.30	0.36	0.33	0.87	1.17	1.02
T_{13}	2.49	2.56	2.52	0.34	0.42	0.38	0.91	1.53	1.22
Mean	1.81	2.28		0.27	0.35		0.83	1.23	
$CD_{0.05}$	0.68	0.53		0.03	0.07		0.15	0.27	

T_1: Control (no spray), T_2: $N_{0.5}+K_{1.0}$ (2 sprays at 15 days interval in January), T_3: $N_{0.5}+K_{2.0}$ (2 sprays at 15 days interval in January), T_4: $N_{1.0}+K_{1.0}$ (2 sprays at 15 days interval in January), T_5: $N_{1.0}+K_{2.0}$ (2 sprays at 15 days interval in January), T_6: $N_{0.5}+K_{1.0}$ (2 sprays at 15 days interval in September), T_7: $N_{0.5}+K_{2.0}$ (2 sprays at 15 days interval in September), T_8: $N_{1.0}+K_{1.0}$ (2 sprays at 15 days interval in September), T_9: $N_{1.0}+K_{2.0}$ (2 sprays at 15 days interval in September), T_{10}: $N_{0.5}+K_{1.0}$ (1 spray in September and 1 in January), T_{11}: $N_{0.5}+K_{2.0}$ (1 spray in September and 1 in January), T_{12}: $N_{1.0}+K_{1.0}$ (1 spray in September and 1 in January), T_{13}: $N_{1.0}+K_{2.0}$ (1 spray in September and 1 in January)

$CD_{0.05}$	N	P	K
Years	NS	0.02	0.06
Treatments	0.43	0.04	0.15
Years × Treatments	0.61	0.06	0.21

except control (0.62%) and T_4 (0.77%). During the second year, the highest K was observed under T_5 (1.62%), T_9 (1.55%) and T_{13} (1.53%), the three being at par and lowest under control (0.75%). The mean value for 2018 (1.23%) was found to be significantly higher than that of 2017 (0.83%) signifying a continued response of fig to potash application through foliar fertilization.

The pooled analysis of data reveals that highest leaf K was recorded under treatment T_{13} (1.22%), T_5 (1.21%) and T_9 (1.20%), the three being at par and the minimum in control (0.69%). The data on interaction effect between years and treatments reveal a significant effect on leaf phosphorus content of fig. The results are in line with the findings of Southwick et al (1996) and Shen et al (2016). The increase in leaf K can be attributed to its higher application through foliar KNO_3 sprays and its rapid absorption and utilization by the plants. The results are in agreement with those reported by Mostafa and Saleh (2006) who also observed that spraying potassium in several forms viz KNO_3 or KH_2PO_4 raised N, P and K levels in the leaves.

Calcium: The data on leaf calcium as influenced by different foliar applications are presented in Table 2. The results indicate that different foliar nutrient sprays effected leaf calcium content significantly. During 2017, the highest leaf Ca content was recorded under T_{13} (3.92%), T_6 (3.62%), T_7 (3.69%), T_9 (3.79%) and T_{11} (3.71%) which were at par and lowest was under T_1 (control) (2.59%). During the second year (2018), the highest Ca content in fig leaves was observed under T_{13} (5.36%) and lowest under control (2.67%). The mean Ca content in 2018 (4.21%) was significantly higher as compared to the 3.42 per cent in 2017. The pooled data values show that highest leaf Ca was

Table 2. Effect of foliar nutrient spray of nitrogen and potassium on leaf Ca and Mg in fig

Treatment	Calcium (%)			Magnesium (%)		
	2017	2018	Mean	2017	2018	Mean
T_1	2.59	2.67	2.63	0.98	1.12	1.05
T_2	3.45	3.64	3.55	1.20	1.14	1.17
T_3	3.24	4.24	3.74	1.11	1.20	1.16
T_4	2.61	3.84	3.22	1.10	1.18	1.14
T_5	3.52	4.52	4.02	1.02	1.24	1.13
T_6	3.62	4.45	4.04	0.99	1.17	1.08
T_7	3.69	4.35	4.02	1.04	1.20	1.12
T_8	3.46	4.31	3.89	1.02	1.19	1.11
T_9	3.79	4.69	4.24	1.05	1.25	1.15
T_{10}	3.34	4.28	3.81	1.02	1.17	1.10
T_{11}	3.71	3.81	3.76	1.03	1.18	1.11
T_{12}	3.58	4.62	4.10	1.14	1.16	1.15
T_{13}	3.92	5.36	4.64	1.08	1.24	1.16
Mean	3.42	4.21		1.06	1.19	
$CD_{0.05}$	0.32	0.30		NS	NS	

T_1: Control (no spray), T_2: $N_{0.5}+K_{1.0}$ (2 sprays at 15 days interval in January), T_3: $N_{0.5}+K_{2.0}$ (2 sprays at 15 days interval in January), T_4: $N_{1.0}+K_{1.0}$ (2 sprays at 15 days interval in January), T_5: $N_{1.0}+K_{2.0}$ (2 sprays at 15 days interval in January), T_6: $N_{0.5}+K_{1.0}$ (2 sprays at 15 days interval in September), T_7: $N_{0.5}+K_{2.0}$ (2 sprays at 15 days interval in September), T_8: $N_{1.0}+K_{1.0}$ (2 sprays at 15 days interval in September), T_9: $N_{1.0}+K_{2.0}$ (2 sprays at 15 days interval in September), T_{10}: $N_{0.5}+K_{1.0}$ (1 spray in September and 1 in January), T_{11}: $N_{0.5}+K_{2.0}$ (1 spray in September and 1 in January), T_{12}: $N_{1.0}+K_{1.0}$ (1 spray in September and 1 in January), T_{13}: $N_{1.0}+K_{2.0}$ (1 spray in September and 1 in January)

$CD_{0.05}$

	Ca	Mg
Years	0.08	NS
Treatments	0.21	NS
Years × Treatments	0.29	NS

recorded under treatment T_{13} (4.64%) and minimum in T_1 (2.67%). The interaction effect between years and treatments was also found to be significant.

The results so obtained can be explained by the better absorption of the plant nutrients by the healthy plants as well as indirect availability of moisture through foliar sprays which could have helped in the better uptake. Also, the absorption of Ca and K is synergistic which means that the higher uptake of K is accompanied by an equally higher uptake of Ca in plants. These findings are in line with the work of Childers et al (1983).

Magnesium: The data on leaf magnesium content as influenced by different treatments are presented in Table 2.

During first year, the leaf Mg content vaired from 0.98 to 1.20 per cent; in 2018 from 1.12 to 1.25 per cent and under pooled data from 1.05 to 1.17 per cent. The results indicate that different foliar nutrient sprays did not affect the leaf magnesium content significantly. There were no effects of years as well as the interaction of treatments and years on the Mg leaf content of fig. The results are in line with the findings of Southwick et al (1996) and Shen et al (2016).

Micronutrients content: The data presented in Table 3 reveal that the zinc content in the fig leaves varied significantly with the application of varied levels of N and K foliar fertilization. During 2017, zinc content varied from 12.4 (T_1) to 15.6 ppm (T_{13}) but there were no significant differences among the treatments. In the year 2018, T_{13} (16.0 ppm), T_4 (15.9 ppm), T_5 (15.6 ppm), T_8 (15.6 ppm) and T_9 (15.5 ppm) recorded maximum Zn content, all being at par, whereas, the minimum was in T_1 (12.2 ppm).

The pooled data also followed the same trend with maximum leaf Zn content under T_{13} (15.8 ppm), T_4 (14.9 ppm), T_5 (15.3 ppm), T_8 (15.3 ppm) and T_9 (15.1 ppm), all being at par and the minimum of 12.3 ppm in control. The differences between the years were non-significant. The interaction between years and treatments was also found to be significant.

The data further reveal that the leaf Cu content also varied significantly and the maximum leaf Cu content during 2017 was 9.4 ppm (T_{13}) and the minimum of 6.2 ppm was recorded in control. The leaf Cu in 2018 was maximum in T_{13} (9.9 ppm), T_9 (9.8 ppm) and T_{12} (9.6 ppm), all being at par and minimum in control (6.5 ppm). Cu content in 2018 (8.6 ppm) was significantly higher as compared to 8.2 ppm in 2017. The pooled data show that maximum leaf Cu was maximumin T_{13} (9.6 ppm), T_4 (8.5 ppm), T_5 (8.8 ppm), T_8 (8.8 ppm) and T_9 (9.4 ppm), T_{10} (8.5 ppm), T_{11} (8.6 ppm) and T_{12} (9.3 ppm), all being at par and a minimum of 6.3 ppm in T_1 (control). The interaction effect of years and treatments was also found to be significant.

The leaf Fe content did not show any significant differences between the different treatments nor did it vary between the years or interaction between years and treatments. The leaf Fe content varied from 116.0 to 166.9 ppm in 2017 and 118.0 to 168.9 pmm in 2018. Under pooled data it vaired from 117.0 to 167.4 ppm.

The results reveal that the leaf Mn varied significantly with the foliar treatments. In 2017, maximum Mn content was recorded in T_{13} (246.0 ppm), T_5 (226.4 ppm), T_9 (230.4 ppm), T_{10} (236.0 ppm) and T_{12} (224.2 ppm), all being at par and minimum in T_1 (81.5 ppm), T_2 (88.2 ppm) and T_3 (90.4 ppm), the three being at par. In 2018, maximum Mn content was recorded in T_{13} (249.3 ppm), T_4 (204.8 ppm), T_5 (229.9 ppm), T_9 (232.6 ppm), T_{10} (238.6 ppm), T_{11} (201.3 ppm) and T_{12} (226.7 ppm), all being at par and minimum in T_1 (83.2 ppm), T_2 (90.8 ppm), T_3 (92.4 ppm), T_6 (128.0 ppm), T_7 (137.7 ppm) and T_8 (151.4 ppm) which were at par.

Same trend was observed in the pooled data with maximum Mn content in T_{13} (247.6 ppm), T_4 (202.4 ppm), T_5 (228.1 ppm), T_9 (231.5 ppm), T_{10} (237.3 ppm), T_{11} (200.8 ppm) and T_{12} (225.4 ppm), all being at par and minimum in T_1 (82.3 ppm), T_2 (89.5 ppm), T_3 (91.4 ppm), T_6 (127.4 ppm), T_7 (136.3 ppm) and T_8 (149.7 ppm) which were at par. The interaction between years and treatments was also found to be significant.

The results thus reveal a varied response of foliar N and K applications at different time intervals on the micronutrient cation distribution in the plants of fig. Several workers have also worked on differential response of foliar macronutrient sprays and reported that leaf mineral nutrients other than N were affected by both the amount and method of urea application as reported by Forshey (1963), Fallahi et al (1997) and Fallahi et al (2002).

Table 3. Effect of foliar nutrient spray of nitrogen and potassium on leaf micronutrient content (ppm) in fig

Treatment	Zn			Cu			Fe			Mn		
	2017	2018	Mean	2017	2018	Mean	2017	2018	Mean	2017	2018	Mean
T_1	12.4	12.2	12.3	6.2	6.5	6.3	116.0	118.0	117.0	81.5	83.2	82.3
T_2	13.4	13.5	13.4	7.2	7.6	7.4	121.4	123.6	122.5	88.2	90.8	89.5
T_3	13.2	14.5	13.8	7.4	7.8	7.6	128.2	132.3	130.2	90.4	92.4	91.4
T_4	14.0	15.9	14.9	8.2	8.8	8.5	144.0	146.0	145.0	200.0	204.8	202.4
T_5	15.0	15.6	15.3	8.6	9.0	8.8	156.8	158.8	157.8	226.4	229.9	228.1
T_6	13.6	13.8	13.7	7.8	8.2	8.0	132.4	134.8	133.6	126.8	128.0	127.4
T_7	14.0	14.8	14.4	8.0	8.4	8.0	136.0	138.7	137.3	135.0	137.7	136.3
T_8	15.1	15.6	15.3	8.6	9.0	8.8	140.8	142.9	141.8	148.0	151.4	149.7
T_9	14.8	15.5	15.1	9.0	9.8	9.4	162.4	166.2	164.3	230.4	232.6	231.5
T_{10}	14.1	14.8	14.4	8.3	8.8	8.5	152.0	156.0	154.0	236.0	238.6	237.3
T_{11}	14.2	15.0	14.6	8.4	8.9	8.6	148.0	152.7	150.3	200.4	201.3	200.8
T_{12}	13.0	13.8	13.4	9.0	9.6	9.3	139.0	141.5	140.2	224.2	226.7	225.4
T_{13}	15.6	16.0	15.8	9.4	9.9	9.6	166.0	168.9	167.4	246.0	249.3	247.6
Mean	14.0	14.7		8.2	8.6		141.8	144.7		171.8	174.4	
$CD_{0.05}$	NS	0.61		0.21	0.32		NS	NS		38.4	72.6	

T_1: Control (no spray), T_2: $N_{0.5}+K_{1.0}$ (2 sprays at 15 days interval in January), T_3: $N_{0.5}+K_{2.0}$ (2 sprays at 15 days interval in January), T_4: $N_{1.0}+K_{1.0}$ (2 sprays at 15 days interval in January), T_5: $N_{1.0}+K_{2.0}$ (2 sprays at 15 days interval in January), T_6: $N_{0.5}+K_{1.0}$ (2 sprays at 15 days interval in September), T_7: $N_{0.5}+K_{2.0}$ (2 sprays at 15 days interval in September), T_8: $N_{1.0}+K_{1.0}$ (2 sprays at 15 days interval in September), T_9: $N_{1.0}+K_{2.0}$ (2 sprays at 15 days interval in September), T_{10}: $N_{0.5}+K_{1.0}$ (1 spray in September and 1 in January), T_{11}: $N_{0.5}+K_{2.0}$ (1 spray in September and 1 in January), T_{12}: $N_{1.0}+K_{1.0}$ (1 spray in September and 1 in January), T_{13}: $N_{1.0}+K_{2.0}$ (1 spray in September and 1 in January)

$CD_{0.05}$

	Zn	Cu	Fe	Mn
Years	NS	0.04	NS	NS
Treatments	1.02	1.24	NS	86.4
Years × Treatments	0.21	0.019	NS	106.8

CONCLUSION

The maximum leaf N was recorded under treatment comprising $N_{1.0}+K_{2.0}$ (2 sprays at 15 days interval in September) (2.71%), $N_{1.0}+K_{1.0}$ (1 spray in September and 1 in January) (2.55%) and $N_{1.0}+K_{2.0}$ (1 spray in September and 1 in January) (2.52%). In 2017, treatment $N_{1.0}+K_{2.0}$ (1 spray in September and 1 in January) resulted in maximum (0.34%) phosphorus content. Potassium was maximum in $N_{1.0}+K_{2.0}$ (2 sprays at 15 days interval in January) (1.21%), $N_{1.0}+K_{2.0}$ (1 spray in September and 1 in January) (1.22%) and $N_{1.0}+K_{2.0}$ (2 sprays at 15 days interval in September) (1.20%). In 2018, the treatment $N_{1.0}+K_{2.0}$ (1 spray in September and 1 in January) resulted in maximum Ca content of 5.36 per cent; 4.64 per cent under pooled data for two years and Cu content of 9.4 ppm in 2017.

On the basis of these results it can be conculded that the treatment $N_{1.0}+K_{2.0}$ (1 spray in September and 1 in January) was superior over all other treatments.

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