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Effect of Gypsum and Saline Irrigation Water on Plant Leaf Nutrients of Cashew (*Anacardium occidentale*) CV. Vengurla-4

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A B S T R A C T

The present investigation carried out at Regional Horticultural Research Station, Navsari Agricultural University, Navsari, Gujarat during 2012 for evaluating the plant leaf nutrients of Cashew (*Anacardium occidentale*) CV. Vengurla-4. The experiment was laid out in Factorial Completely Randomized Design (FCRD) with three repetitions and ten treatments comprising of two levels of Gypsum and five levels of salinity. Results revealed that the application of Gypsum increased the plant leaf nutrients *viz*. N, P, K, Mg and Ca. However, Na content of leaves showed the reducing effect by Gypsum application. Pertaining to effect of saline irrigation water, the plant leaf nutrients showed reducing effect with increasing salinity level. However, interaction effect of both Gypsum and salinity water level showed significant effect on Ca and Na content of leaves. Hence, it is said that the treatment combination of G_1S_1 (Gypsum and BAW) was found better.

Introduction

Cashewnut (*Anacardium occidentale* L.), is a member of the family Anacardiaceae with the natural order Sapindales, is an evergreen tree. It is a native of tropical Central and South America, but is now distributed all over the tropics and parts of warm sub-tropics.Cashew is one of the most versatile tree crops which assume higher rank in the international trade of tree nuts. The tree is hardy and the kernels are of high nutritive value. It is rich in protein 21.0 per cent, carbohydrates 22.0 per cent, fats 47.1 per cent, moisture 5.9 per cent, calcium 0.55 per cent and phosphorus 0.45 per cent (Nambiar and Pillai, 1985). The use of cashew in medicine, foods and beverages is well known. The kernel supplies about 6000 calories energy per kg.Cashew apple liquor is used for medicinal purposes, for which the ailments listed are: worm, sickness, cold, body ache, fever or flue, toothache, fresh wounds and cuts. Cramps due to chilled weather, muscular pain, irregular movement of bowels, low blood pressure, diarrhoea and cholera. Salinity is a major contaminant and the limiting parameter for production of crops especially found in both traditional irrigation supplies (surface and ground water) and recycled water. The accumulation of soluble salts in the root zone reduces growth and development of the plants due to the decrease in osmotic potential of the soil solution, resulting in water stress, and also because of toxicity problems and nutritional disorders (Ashraf and Ahmad, 2000). Normally the salinity problems are acute in the arid – semi arid and sea shore regions of the country. The most of the cashew growing area of India and Gujarat are suffering with major problem of salts accumulation. South Gujarat is located at coastal area and affected by saline water. Hence, present experiment was conducted.

Materials and Methods

The current investigation laid out at Regional Horticultural Research Station, Navsari Agricultural University, Navsari, Gujarat during 2012 for evaluating the plant leaf nutrients of Cashew (*Anacardium occidentale* L.) CV. Vengurla-4. The experiment was laid out in Factorial Completely Randomized Design (FCRD) with three repetitions and ten treatments comprising of two levels of Gypsum and five levels of salinity and eight numbers of plants per repetition were taken for experiment. Two levels of Gypsum comprised of G_0= Without Gypsum and G_1= With Gypsum (50 gm) and five levels of saline water comprised of S_1= Best Available Water (BAW), S_2= 4.0 EC, S_3=6.0 EC, S_4=8.0 EC and S_5=10.0 EC and it was prepared by below mentioned formula. Treatments combinations consists of T_1– G_0S_1= (Without Gypsum + BAW), T_2 – G_0S_2= (Without Gypsum + 4.0 EC), T_3– G_0S_3= (Without Gypsum + 6.0 EC), T_4- G_0S_4= (Without Gypsum + 8.0 EC), T_5 –G_0S_5= (Without Gypsum + 10.0 EC), T_6- G_1S_1= (With Gypsum + BAW), T_7- G_1S_2= (With Gypsum + 4.0 EC), T_8- G_1S_3= (With Gypsum + 6.0 EC), T_9- G_1S_4= (With Gypsum + 8.0 EC) and T_{10}- G_1S_5= (With Gypsum + 10.0 EC). Salinity level was prepared by desired diluting the sea water. The sea water was collected from the Dandi Seashore having EC 55 dS/m and diluted with the BAW as per the requirement of treatments and calculated with the below mentioned formula

$$IW= [(A-B) \times C]/D$$

Where, A= Desired level (EC dS/m)

B= EC (dS/m BAW)

C= Desired volume (ml)

D= EC (dS/m) of sea water

Plant chemical analysis done with the oven-dried leaves of Cashew plant and it was grind with stainless steel blades. Parameters consist of N, P, K, Ca, Mg and Na. It was estimated by Jackson, 1967 with respective methods for various parameters.

Results and Discussion

Effect on plant nutrients

Nitrogen (N) content in leaves

Regarding nitrogen content in leaves, higher value of nitrogen content (1.34 %) was recorded with application of gypsum as compared to without application of gypsum. Different salinity level was also significantly affected on nitrogen content of leaves. Treatment of best available water (S_1) had higher content of nitrogen in leaves (1.51 %), which was at par with S_2 *i.e.* 4 dSm^{-1} (1.32 %). Higher salinity level *i.e.* 10 dSm^{-1} had lower content of nitrogen in leaves and it was on same bar with S_4 *i.e.* 8 dSm^{-1}. An interaction between Gx S was found not significant (Table 1).

Phosphorous (P) content in leaves

Phosphorous content in leaves was also significantly affected by gypsum and saline irrigation water (Table 1). Treatment with gypsum (G_1) was found better with higher phosphorous content in leaves (0.078 %). Regarding saline irrigation water, maximum value of phosphorous content of leaves (0.078 %) was recorded with best available water.

However, higher levels of salinity had lower value of phosphorous content (0.026 %) and it was at par with 8 dSm^{-1} level (S_4). An interaction between G x S was found non-significant with respect to phosphorous content leaves (Table 1).

Potassium (K)content in leaves

From the data, potassium content in leaves was significantly affected by gypsum and saline irrigation water (Table 1). An application of gypsum had higher value of potassium content (0.50 %) of leaves as compared to without application of gypsum.

Considering the effect of saline irrigation water, BAW (S_1) treatment had maximum value of potassium content of leaves (0.594 %). It was at par with 4 dSm^{-1} (S_2) treatment.

Least potassium content of leaves (0.341 %) was observed in S_5 (10 dSm^{-1}) treatment which statistically on same bar (0.379 %) with 8 dSm^{-1} (S_4). Potassium content of leaves was not affected by interaction effect of gypsum and saline irrigation water.

Magnesium (Mg) content of leaves

From the data, magnesium content of leaves was significantly influenced by gypsum and saline irrigation water treatment (Table 1). Higher content of magnesium content of leaves (0.17 %) was observed with gypsum treatment (G_1).

In salinity levels, BAW (S_1) treatment was found better with respect to higher amount of magnesium content of leaves (0.188) and it was statistically similar to S_2 and S_3. The treatment S_5 *i.e.*10 dSm^{-1} had lower value of magnesium content of leaves (0.144 %). This treatment was at par with S_4 and S_3. An interaction effect of Gx S shows non-significant variation in magnesium content of leaves.

Calcium (Ca) content of leaves

Treatment of gypsum and saline irrigation were significantly altered the calcium content of leaves (Table 1). Regarding gypsum effect, treatment G_1 (with gypsum) had higher calcium content of leaves (0.133 %) as compared to without gypsum application (G_0). Calcium content of leaves (0.15 %) was higher with S_2 treatment *i.e.* 4 dSm^{-1}, which was statistically on same bar with S_1 (BAW) treatment. Treatment of higher salinity (S_5) had lower content of calcium in leaves (0.08 %), which was at par (0.09 %) with S_4 (8dSm^{-1}).

Effect of salinity on sodium (Na) content in leaves of cashew grafts

The data pertaining to Na content of leaves of plant was influenced by different levels of gypsum and saline irrigation water have been presented in Table 1. Regarding gypsum application, lower content of sodium in leaves (0.32 %) of cashew was recorded with gypsum treatment (G_1). Treatments of saline irrigation water were significantly affected the sodium content of leaves. There was linearly increase in sodium content in leaves of cashew with increasing the salinity levels in irrigation water. Minimum and maximum content of leaves were noted in S_1 (control) BAW treatment and S_5 (10 dSm^{-1}) treatment, respectively. Treatment S_1 was at par with S_2 (4 dSm^{-1}) and treatment S_5 was at par with S_4 (8 dSm^{-1}). The data related to interaction between gypsum and salinity level shows significant variation in sodium content of leaves (Table 1). Least sodium content of leaves (0.22 %) was observed in treatment combination of G_1S_1 (With gypsum and BAW). Treatment combination of G_0S_5 (without gypsum and 10 dSm^{-1} saline irrigation water) had higher content of sodium in leaves of cashew (0.53 %).

Effect of gypsum on plant

Chemical composition of macro and essential nutrients like nitrogen (N), phosphorous (P), potassium (K), calcium (Ca), magnesium (Mg) and sodium (Na) content in leaves of cashew graft after six month of treatment significantly affected by the gypsum treatment as compared to without gypsum treatment.

Elemental composition regarding nutrient content in leaves, higher value of N, P, K, Ca and Mg content was recorded with application of gypsum as compared to without application of gypsum in present investigation. However, lower content of sodium in leaves (0.32 %) of cashew was recorded with gypsum treatment (G_1). Similar findings were made by Zekri and Parsons (1990) in Sour Orange and noted that due to addition of $CaSO_4$ to saline solution reduces Na and Cl concentration. Picchion *et al.,* (2004) also support this result and observed that total dry matter accumulation and net uptake of N, P and K per tree were increased by gypsum application. Izhar-ul-Huq *et al.,* (2007) and Mazhar *et al.,* (2011) also reported the favourable effect on gypsum an uptake of nutrient.

Effect of different level of saline water

Different salinity level also significantly affected the nitrogen content of leaves. Treatment of best available water (S_1) had higher content of nitrogen in leaves (1.51 %), which was at par with S_2*i.e.* 4 dSm^{-1} (1.32 %). Higher salinity level *i.e.* 10 dSm^{-1} had lower content of nitrogen in leaves and it was on same bar with S_4 *i.e.* 8 dSm^{-1}. Regarding phosphorous content, maximum value of phosphorous content of leaves (0.078 %) was recorded with best available water. However, higher levels of salinity had lower value of phosphorous content (0.026 %) and it was at par with 8 dSm^{-1} level (S_4).

The similar reduction in N content in leaves has also been reported in grape (Joolka *et al.,* 1977). guava (Makhija *et al.,* 1980), citrus (Patil, 1976) and banana (Palaniappan and Yerriswamy, 1996) while reduction content of P has been reported in citrus (Patil and Bhambota, 1980), mango (Jindal *et al.,* 1976) and guava Makhija *et al.,* 1980).

Considering the effect of saline irrigation water, BAW (S_1) treatment had maximum value of potassium content of leaves (0.594 %). It was at par with 4 dSm^{-1} (S_2) treatment. Least potassium content of leaves (0.341 %) was observed in S_5 (10 dSm^{-1}) treatment which statistically on same bar (0.379 %) with 8 dSm^{-1} (S_4). Increasing level of salinity thus reduced the uptake of potassium. The similar result has also been reported in various fruit crops *viz.* grape (Joolka *et al.,* 1977). Guava (Makhija *et al.,* 1980), citrus (Patil, 1976) and banana (Palaniappan and Yerriswamy, 1996). Calcium content of leaves (0.15 %) was higher with S_2 treatment *i.e.* 4 dSm^{-1}, which was statistically same bar with S_1 (BAW) treatment.

Table.1 Effect of gypsum and Saline irrigation water on N, P, K, Mg and Ca content in leaves of cashew grafts *cv.* Vengurla -4

Treatment	Nitrogen (%)	Phosphorous (%)	Potassium (%)	Magnesium (%)	Calcium (%)	Sodium (%)
Level of Gypsum						
G_0(Without gypsum)	0.90	0.044	0.44	0.16	0.098	**0.38**
G_1(With gypsum)	1.34	0.057	0.50	0.17	0.133	**0.32**
S.Em.±	0.062	0.003	0.016	0.006	0.004	**0.012**
C. D. at 5 %	0.178	0.008	0.045	0.016	0.011	**0.034**
Levels of Salinity						
S_1 –Control (BAW)	1.51	0.078	0.594	0.188	0.14	**0.24**
S_2- 4 dSm^{-1}	1.32	0.061	0.535	0.175	0.15	**0.27**
S_3 – 6 dSm^{-1}	1.12	0.049	0.489	0.162	0.11	**0.35**
S_4 – 8 dSm^{-1}	0.86	0.037	0.379	0.154	0.09	**0.43**
S_5 – 10 dSm^{-1}	0.79	0.026	0.341	0.144	0.08	**0.49**
S.Em.±	0.098	0.005	0.025	0.009	0.006	**0.019**
C. D. at 5 %	0.281	0.013	0.072	0.026	0.018	**0.054**
Interaction G x S						
S.Em.±	0.046	0.002	0.012	0.004	0.003	**0.009**
C. D. at 5 %	NS	NS	NS	NS	0.008	**0.025**
CV %	**7.17**	**7.56**	**4.38**	**4.53**	**4.37**	**4.38**

Treatment of higher salinity (S_5) had lower content of calcium in leaves (0.08 %), which was at par (0.09 %) with S_4 (8 dSm^{-1}). Zekri and Parsons (1990) also noted that addition of $CaSO_4$ to saline solution reduced Na and Cl and increased Ca content in leaf. Similar results were also made by Picchion *et al.,* (2004) and Mazhar *et al.,* (2011).

There was linear increase in sodium content in leaves of cashew with increase in the salinity levels of irrigation water. Minimum and maximum content of leaves were noted in S_1 (control) BAW treatment and S_5 (10 dSm^{-1}) treatment, respectively.

Treatment S_1 was at par with S_2 (4 dSm^{-1}) and treatment S_5 was at par with S_4 (8 dSm^{-1}). Similar increased to Na contents was also reported by many workers in grape (Joolka *et al.,* 1977), guava (Makhija *et al.,*1980), citrus (Patil, 1976) and banana (Palaniappan and Yerriswamy, 1996) and ber (Dahiya, 1979; Dhankhar and Dahiya, 1980; and Hooda*et al.,* 1990) with higher salinity levels.

In salinity levels, BAW (S_1) treatment was found better with respect to higher amount of magnesium content of leaves (0.188) and it was statistically similar to S_2 and S_3, further increasing beyond this level significantly reduced Mg content in leaves. The treatment S_5 *i.e.* 10 dSm^{-1} had lowest value of magnesium content of leaves (0.144 %). This treatment was at par with S_4 and S_3. The similar results were also obtained in citrus (Kanwar and Bhambota, 1968; Patil 1976 and Patil and Bhambota, 1980), grape (Joolka *et al.,*1977), and mango (Jindal *et al.,* 1976,1979).

Under salt stress environments, plants grow in a medium having the predominance of adverse nutrient concentration. Yet different species basically had got the capacity of selective nutrient absorption. Bernstein *et al.,*(1969) had shown that the salt tolerance of some species may be related to the differential transport of ions to the shoot. As Olsen (1972) had pointed out a specific interaction in saline soil in which the plant parts (roots) closest to the source get enough nutrient element but distantly located parts (leaves) do not get in the same.

Subsequently, in our conditions in India, many workers tried to work out the nutrient content/accumulation in different plants when grown under different salinity levels (Kanwar and Bhambota, 1968; Patil 1976; Jindal *et al.,* 1976; Joolka *et al.,*1977; Jindal *et al.,* 1979; Dahiya, 1979; Dhankhar and Dahiya, 1980; Makhija *et al.,*1980; Patil and Bhambota, 1980; and Palaniappan and Yerriswamy, 1996) and generally observed the reduction in N, P. K, Ca and Mg and the increase in Na with the increase in levels of salinity.

Above depicted results findings concluded that the application of Gypsum increased the plant nutrients *viz*. N, P, K, Mg and Ca while it showed negative effect on N content. Whereas, application of saline irrigation water show the decreasing value of all the plant nutrients except Na content.

However, the Best Available Water was found better for the growth of Cashew followed by the 4 dSm^{-1} saline water. Increasing salinity adversely affected on the plant nutrients of Cashew. Hence, it is concluded that the application of Gypsum and Best Available Water can be applied for betterment of plant in context of plant nutrients.

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