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SHORT COMMUNICATION

EFFECT OF MAGNESIUM LEVELS AND GROWING CONDITIONS ON NUTRIENT UPTAKE OF HYBRID NAPIER

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SUMMARY

A factorial experiment was conducted at the College of Agriculture, Vellayani, Thiruvananthapuram, Kerala during May 2016 to April 2017 to study the effect of different levels of magnesium and growing conditions on nutrient uptake of hybrid napier. The treatments included two factors *viz.* growing conditions- open (S_1) and coconut garden (S_2) and magnesium levels - 0 (M_1), 40 (M_2), 60 (M_3), 80 (M_4), 100 (M_5) and 120 (M_6) kg $MgSO_4$/ha. A significant increase in nutrient uptake was found when hybrid napier was grown in open field than in coconut garden. In open condition, the highest N and P uptake was recorded with the application of 80 kg $MgSO_4$/ha. However in coconut garden, application of 100 kg $MgSO_4$/ha recorded the highest N and P uptake. The K uptake was higher with control treatment (0 kg $MgSO_4$/ha) in both growing conditions. The magnesium level of 100 kg $MgSO_4$/ha recorded the highest Mg uptake in both growing conditions.

Key words : Hybrid napier, magnesium, coconut garden, $MgSO_4$, nutrient uptake

Magnesium is an essential element for plant growth and development. It is an important component of the chlorophyll molecule and is associated with rapid growth, cell division, carbohydrate metabolism, synthesis of amino acids and cell proteins, uptake and migration of P in plants, providing resistance to unfavourable factors like drought etc. It is an essential mineral element for plants and microbes. Magnesium is essential for proper enzyme and nervous system function and for efficient carbohydrate metabolism in cattle. Young cattle can mobilize large amounts of magnesium from bone, but mature cattle are unable to do this. Grass tetany, a condition common among lactating beef cows grazing lush forages, is characterized by low magnesium levels.

Eighty per cent of Kerala soils are deficient in Mg .The availability of Mg is very low in Kerala soils due to leaching under heavy rainfall. The reserve of this nutrient is also very low in the soil. Application of Mg SO_4 @ 80 kg/ha, can be done to solve the problem of Mg deficiency (KAU, 2011). As the per capita land availability is very less in Kerala, expansion of area for fodder cultivation is not possible. Coconut gardens offer good opportunity for fodder production in Kerala. In this context, a study was undertaken with the objective to assess the influence of magnesium on nutrient uptake of hybrid napier under open and coconut garden.

The experiment was conducted in the Instructional Farm attached to the College of Agriculture, Vellayani, Thiruvananthapuram, Kerala during the period from May 2016 to April 2017. The farm is situated at 8.5° North latitude and 76.9° East longitude and at an altitude of 29 m above mean sea level. The mean maximum temperature ranged between 31.6-34.3°C and mean minimum temperature ranged between 22.3°-26.0°C during the crop growing period. The relative humidity ranges between 80.3 to 87.9 per cent. A total rainfall of 1256.8 mm was recorded during the crop period.

The soil of the experimental site was sandy clay loam which belongs to the order oxisols, Vellayani series. Before conducting the field experiment, the composite soil samples were drawn from 0-15 cm depth from the field and the chemical properties were analysed. The laboratory results showed the following chemical composition: pH 4.9, EC0.049 dS/m, 0.98 per cent organic carbon,362.4 kg/ha available nitrogen, 101.91 kg/ha available phosphorus,412.35 kg/ha available potassium, 188.05 mg/kg available calcium and 12.46 mg/kg available magnesium.

The experiment was laid out in factorial RBD with three replications. The treatments included two factors *viz.* growing conditions and magnesium levels. The growing conditions were open (S_1) and coconut garden (S_2) and levels of magnesium were - 0 (M_1), 40 (M_2), 60 (M_3), 80 (M_4), 100 (M_5) and 120 (M_6) kg $MgSO_4$/ha. The hybrid napier variety Suguna, released from Kerala Agricultural University was used for the study. Suguna is a bajra-napier hybrid developed by

crossing Composite 9 and FD 431. It has high tillering capacity (40 tillers/plant), better quality and an average yield potential of 280-300 t/ha. The stem cuttings with three nodes were used as planting material. The three budded cuttings were planted at a spacing of 60 x 60 cm in such a way that two nodes remain within the soil and one above the soil surface.

FYM @ 25 t/ha was applied uniformly to all the plots at the time of final preparation of land. Chemical fertilizers like urea, rajphos and muriate of potash were applied to supply NPK @ 200: 50: 50 kg ha^{-1}. Entire dose of phosphorus and potassium were applied as basal. Nitrogen was applied in equal split doses after all the harvests. Entire dose of magnesium was applied as magnesium sulphate to all plots as per the treatments after one month of planting. The first harvest was taken 75 days after planting and subsequent harvests at an interval of 45 days.

Samples were collected at harvest, chopped, sundried and oven dried (70°C) to a constant weight for nutrient uptake studies. Samples were ground to pass through a 0.5 mm mesh in a Willey Mill and required quantity of samples were digested and used for nutrient analysis**.** The nitrogen content in plant was estimated by modified micro kjeldhal method, phosphorus content by Vanado –molybdate yellow colour method using spectrophotometer, potassium content by the flame photometric method and magnesium content by atomic absorption spectrophotometry. The uptake of nutrients were calculated as the product of the content of the nutrient in plants and the dry weight of plants and expressed as kg/ha.

The results on the effect of growing conditions and magnesium application on the nutrient uptake of hybrid napier are presented in Table 1 and 2. The results revealed that the growing conditions and magnesium application had significant effect on the uptake of N,P, K and Mg by the plant.

Nitrogen uptake of the hybrid napier was significantly higher in open area (919.01 kg/ha) than under coconut garden (571.36 kg/ha). Higher levels of magnesium resulted in higher nitrogen uptake. The treatment M_5 ($MgSO_4$ @ 100 kg/ha) recorded the highest nitrogen uptake (824.10 kg/ha) and was significantly superior to other five treatments. Interaction effect was also significant. Under open condition and coconut garden, an increase in magnesium resulted in an increase in nitrogen uptake. The highest nitrogen uptake (993.64 kg/ha) was recorded in open condition with application of 80 kg $MgSO_4$/ha and it was significantly superior to all other treatments. However in coconut garden 100 kg/ha $MgSO_4$ resulted in the highest nitrogen uptake (690.25 kg/ha). The lowest nitrogen uptake was obtained under control (M_1) in both growing conditions.

Phosphorus uptake of hybrid napier was significantly higher in open area (69.17 kg/ha) than under coconut garden (54.07 kg/ha). Application of magnesium

TABLE 1
Effect of growing conditions and magnesium on the uptake of nitrogen, phosphorus, potassium and magnesium by hybrid napier (kg/ha)

Treatments	N uptake	P uptake	K uptake	Mg uptake
Growing conditions (S)				
S_1	919.01	69.17	766.59	0.46
S_2	571.36	54.07	556.09	0.11
S. Em±	3.06	0.09	1.35	0.01
CD	9.022	0.289	3.998	0.008
Magnesium levels (M)				
M_1	644.83	53.85	691.94	0.15
M_2	703.93	57.59	684.27	0.22
M_3	744.27	61.69	673.54	0.28
M_4	791.18	66.79	660.24	0.34
M_5	824.10	65.81	642.09	0.37
M_6	762.78	63.99	615.95	0.35
S. Em±	2.92	0.17	2.35	0.01
CD	8.623	0.5	6.925	0.013

S_1-Open, S_2-Coconut garden
M_1- 0 kg/ha, M_2-40 kg/ha, M_3-60 kg/ha, M_4-80 kg/ha, M_5-100 kg/ha, M_6-120 kg/ha

TABLE 2
Interaction effect of growing conditions and magnesium on the uptake of nitrogen, phosphorus, potassium and magnesium by hybrid napier (kg/ha)

Treatments	N uptake	P uptake	K uptake	Mg uptake
S x M				
S_1M_1	813.02	62.89	795.77	0.23
S_1M_2	901.04	65.62	792.89	0.36
S_1M_3	899.15	68.58	782.74	0.46
S_1M_4	993.64	75.29	767.18	0.56
S_1M_5	957.96	69.89	735.32	0.58
S_1M_6	949.23	72.74	725.62	0.57
S_2M_1	476.64	44.81	588.10	0.08
S_2M_2	506.83	49.56	575.64	0.07
S_2M_3	589.38	54.79	564.33	0.10
S_2M_4	588.73	58.30	553.30	0.13
S_2M_5	690.25	61.72	548.87	0.16
S_2M_6	576.33	55.26	506.28	0.13
S. Em±	4.13	0.24	3.32	0.01
CD	12.195	0.707	9.793	0.019

S_1-Open, S_2-Coconut garden
M_1- 0 kg/ha, M_2-40 kg/ha, M_3-60 kg/ha, M_4-80 kg/ha, M_5-100 kg/ha, M_6-120 kg/ha

significantly increased the phosphorus uptake of hybrid napier. Higher levels of magnesium resulted in higher phosphorus uptake. The treatment M_4 ($MgSO_4$ @ 80 kg/ha) recorded the highest phosphorus uptake (66.79 kg/ha) and was significantly superior to all other treatments. The lowest phosphorus uptake (53.85 kg/ha) was recorded under M_1 (control). Interaction effect was also significant. Under open condition and coconut garden, an increase in magnesium levels resulted in an increase in phosphorus uptake. The highest phosphorus uptake (75.29 kg/ha) was recorded in open condition with application of 80 kg $MgSO_4$/ha and it was significantly superior to all other treatments. However in coconut garden 100 kg/ha$MgSO_4$ resulted in highest phosphorus uptake (61.72 kg/ha). The lowest phosphorus uptake was obtained under control (M_1) in both growing conditions.

Potassium uptake of hybrid napier was significantly higher in open area (766.59 kg/ha) than under coconut garden (556.09 kg/ha). Potassium uptake of hybrid napier reduced significantly with increasing levels of magnesium. The highest potassium uptake (691.94 kg/ha) was obtained under the control treatment (M_1) which was significantly superior to other five treatments. Interaction effect was also found to be significant. Increasing levels of magnesium resulted in decrease in potassium uptake in open area and coconut garden. The highest potassium uptake (795.77 kg/ha) was recorded in s_1m_1(open + control treatment) and was on par with s_1m_2 (open+40 kg $MgSO_4$/ha) and s_1m_3 (open+60 kg $MgSO_4$/ha). Same trend was also observed under coconut garden; the highest potassium uptake (588.10 kg/ha) was recorded under control treatment. The lowest potassium uptake was obtained with the application of 120 kg $MgSO_4$/ha in both growing conditions.

A significant increase in magnesium uptake with decrease in shade levels was observed. Magnesium uptake of hybrid napier was significantly higher in open area (0.46 kg/ha) than under coconut garden (0.11kg/ha). Magnesium uptake of hybrid napier was significantly increased with the application of magnesium. Higher levels of magnesium resulted in higher magnesium uptake. The treatment M_5 (100 kg $MgSO_4$/ha) recorded the highest magnesium uptake (0.37 kg/ha) and it was significantly superior to other treatments. The lowest magnesium uptake (0.15 kg/ha) was recorded under the control treatment M_1. Interaction effect was also significant. Under open condition and coconut garden, an increase in magnesium resulted in an increase in magnesium uptake. The magnesium level of 100 $MgSO_4$kg/ha recorded the highest magnesium uptake in open condition (0.58 kg/ha) and was on par with the application of 120 kg $MgSO_4$/ha. In coconut garden also, the highest magnesium uptake (0.16 kg/ha) was recorded with the application of 100 kg $MgSO_4$/ha.

Highest nitrogen uptake was recorded when hybrid napier was grown in open area. The total nitrogen content increased under shade compared to open condition. However, N uptake was found higher in open condition. This may be due to the increase in dry fodder yield in open condition. Similar findings was reported by Pillai (1986) in guinea grass. Application of magnesium also resulted in higher nitrogen uptake. Higher levels of magnesium resulted in higher nitrogen uptake which was due to increased dry matter production. Similar results were reported by Anna *et al*. (2012) in spring triticale (*Triticosecale Wittm*) and by Cardoso *et al*. (2016) in *Panicum maximum* cv. Massai. Interaction also significantly influenced the uptake of nitrogen. Medium dose of $MgSO_4$ (80 kg/ha) recorded the highest nitrogen uptake in open condition. However in coconut garden higher dose of magnesium (100kg$MgSO_4$/ha) resulted in highest nitrogen uptake. This might be due to the higher dry fodder yield recorded with medium dose of magnesium in open condition and with higher dose of magnesium in coconut garden.

Phosphorus uptake of hybrid napier was significantly higher in open area than under coconut garden. Higher P uptake found in open condition may be due to the increase in dry fodder yield under open condition. Similar findings were reported by Watson *et al*. (1984) in marshall rye grass. Application of magnesium significantly influenced the phosphorus uptake of hybrid napier. Higher levels of magnesium resulted in increase in phosphorus uptake. This might be due to the association of magnesium with the uptake and migration of P in plants. Similar results were observed by Higgins *et al*. (2012) in some fodder grasses and by Anna *et al*. (2012) in spring triticale.

Interaction also significantly influenced the uptake of phosphorus. Under open condition and coconut garden, an increase in magnesium levels resulted in an increase in phosphorus uptake. Medium dose of $MgSO_4$ (80 kg/ha) recorded the highest phosphorus uptake in open condition and in coconut garden application of 100 kg $MgSO_4$/ha resulted in highest phosphorus uptake. This might be due to the higher dry fodder yield recorded with medium dose of magnesium in open condition and with higher dose of magnesium in coconut garden.

Hybrid napier grown in open area recorded higher potassium uptake than those grown under coconut garden. This may be due to the lower dry fodder yield in coconut garden compared to open area. Increasing levels of magnesium resulted in decreased uptake of potassium. Highest potassium uptake by hybrid napier was recorded under the control treatment. This might be due to the antagonistic interaction between magnesium and potassium in the soil. Tuma *et al.* (2004) also reported that magnesium application decreased the potassium content in the leaves (by 19%) and in stalks (by 11%) in *Phaseolus vulgaris.* Similarly, Rahmawati *et al*. (2015) observed that foliar application of increasing levels of magnesium fertilizer up to 12000 ppm decreased potassium of *Murdiannia bracteata*. Interaction also significantly influenced the uptake of potassium. In both growing conditions, zero level of magnesium showed higher potassium uptake.

Magnesium uptake of hybrid napier was observed significantly higher in open area than under coconut garden. This may be due to the lower dry fodder yield in coconut garden compared to open area. Magnesium uptake of hybrid napier was significantly influenced with the application of magnesium. Higher levels of magnesium application resulted in increased magnesium uptake. Mayland and Grunes (1974a) reported that in the presence of 150 kg/ha applied N, fertilization with 600 kg Mg/ha as $MgSO_4$. $7H_2O$ in *Agropyron desertorum* increased the forage Mg content to 0.2% which is recommended for ruminants against grass tetany and also found that N and Mg fertilizers were additive in increasing forage Mg concentrations. Magnesium application enhanced magnesium uptake by the grass because magnesium sulphate fertilizer release its constituents quickly with the remainder in the soil being leached away from week to week or due to a natural dilution process and translocation of nutrients to the root system (Humphreys, 1978).

Interaction effect was also found significant. Under open condition and coconut garden, an increase in magnesium resulted in an increase in magnesium uptake. Higher dose of magnesium (100 kg $MgSO_4$/ ha) resulted in higher magnesium uptake in both growing conditions.

CONCLUSION

A significant increase in nutrient uptake was found when hybrid napier was grown in open field than in coconut garden. In open condition, the highest N and P uptake was recorded with the application of 80 kg $MgSO_4$/ha. However in coconut garden, application of 100 kg $MgSO_4$/ha recorded the highest N and P uptake. The K uptake was higher with control treatment (0 kg $MgSO_4$/ha) in both growing conditions. The magnesium level of 100 kg $MgSO_4$/ha recorded the highest Mg uptake in both growing conditions.

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