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EFFECT OF GRADED LEVELS OF UREA FERTILIZER ON GROWTH AND BIOMASS YIELD OF MAIZE UNDER LOW-COST HYDROPONIC FODDER PRODUCTION SYSTEM

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SUMMARY

An experiment was conducted at the livestock farm complex, College of Veterinary Science, Proddatur to study the effect of urea fertilizer on growth and biomass yield of maize fodder under low cost hydroponic production unit. The five treatments composed of T_1 (control), T_2 (0.5 % urea), T_3 (1.0% urea), T_4 (1.5% urea) and T_5 (2.0% urea) groups. Urea solutions at different levels in the corresponding treatment groups was sprinkled daily ones for a total period of 8 days and attributes of plant height, root length, leaf area and biomass yield were recorded daily. Among the different treatments T_2 group proven to be greater for plant height, leaf area, root length and biomass yield of hydroponic maize. The lowest values were noticed in the T_5 group.

Key words : Maize, urea, growth, biomass yield, hydroponic production system

Availability of the green fodder decides the productivity and profitability of the dairy farming. Despite that, the major constraints in green fodder production are lesser area under fodder production, unequal distribution of rains, shortage of water, frequent droughts, more labour requirement etc, hydroponic fodder can be produced and fed in situation where cultivated fodder cannot be grown successfully. The word hydroponics has been derived from two greek words hydro means water and ponic means working. Thus fodder produced by growing plants in water or nutrient rich solutions but without using any soil is known as hydroponic fodder or sprouted grains or sprouted fodder (Dung *et al.*, 2010).

Sprouting of grains affected the enzyme activity, increases total protein and changes in amino acid profile, and enhances the levels of sugars, crude fibre, certain vitamins and minerals, but decreases starch and loss of total dry matter (Lorenz K., 1980). The concept of putting one kilogram of grain into a hydroponic system and producing 6 to 10 kilograms of fresh green sprouts, independent of weather and at any time of year, is of interest (Kruglyakov and Yu A., 1989). Hydroponic green fodder production system is complementary (not competitive) to the conventional forage production from suitable species such as oats, clover and grass mixture, alfalfa etc., (Sanchez Del castillo *et al.*, 2013). Nitrogen is an important constituent of protein and chlorophyll. It imparts dark green colour to the plants, promotes vegetative and rapid early growth. It improves the quality by increasing the protein content of fodder crops (Patel *et al.*, 2017). Hydroponically grown plants have been shown to have faster growth rate than soil based plants and are an ideal medium and platform for conveniently evaluating whole plant physiology (Conn *et al.*, 2013). Therefore, the present investigation was carried out to verify the effect of different doses of urea on the growth and biomass yield of maize under low cost hydroponic production system.

MATERIALS AND METHODS

The experiment was conducted in livestock farm complex, college of veterinary science, Proddatur of Sri Venkateswara Veterinary University. There are five treatments composed of T_1 (control), T_2 (0.5% urea *i.e.* 3 grams/600 ml of water), T_3 (1% urea *i.e.* 6 grams/ 600 ml of water), T_4 (1.5 % urea *i.e.* 9 grams/600 ml of water) and T_5 (2% urea *i.e.* 12 grams/600 ml of

Fig 1. Hydroponic fodder production Unit at Livestock Farm Complex, College of Veterinary Science, Proddatur.

water) with four replicates under each treatment. Maize grain was soaked for 12 hours in water and later kept in gunny bag in air tight condition for 36 hours. The 1.5 kg sprouted seed was uniformly spread in each plastic tray measuring 2.5' × 1.5' and kept in hydroponic unit. Automatic sprinkling of water was managed by cyclic timer which was fixed 30 sec for every one hour. Urea solutions at different levels in the corresponding treatment groups was sprinkled daily ones for a total period of 8 days and attributes of plant height, root length, leaf area and biomass yield were recorded daily.

Data on biomass yield was recorded using electronic weighing balance while plant height and root length were measured using measuring scale and expressed in centimeters. Leaf area was recorded by measuring the length and maximum width of third leaf from the top, multiplied with the factor 0.75 and expressed in Square centimeters (Elsahookie, 1985).The data was statistically analysed by using SPSS for its significance. The objective of this experiment was to investigate the possibility of using urea as nitrogen source in the enhancement of biomass and growth performance of maize under low cost hydroponic fodder production system.

TABLE 1
Day wise Plant height (cm) of hydroponic maize as influenced by graded urea levels

Treatment	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8
T_1 (control)	0.77±0.01	1.73±0.07	3.50±0.02	5.70±0.01	9.10±0.06	11.75±0.07	15.13±0.03
T_2 (0.5% urea)	0.85±0.07	1.93±0.04	3.84±0.07	5.93±0.06	9.80±0.03	12.78±0.02	17.15±0.06
T_3 (1.0% urea)	0.70±0.04	1.54±0.02	2.83±0.03	5.44±0.05	8.75±0.01	10.63±0.03	13.81±0.09
T_4 (1.5% urea)	0.68±0.03	1.41±0.08	2.52±0.08	4.83±0.03	7.83±0.06	9.50±0.04	12.51±0.02
T_5 (2.0% urea)	0.53±0.04	1.35±0.09	2.38±0.09	4.43±0.07	7.50±0.02	9.29±0.08	12.35±0.01
P value	0.019	0.029	0.037	0.031	0.023	0.045	0.010

TABLE 2
Day wise root length (cm) of hydroponic maize as influenced by graded urea levels

Treatment	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8
T_1 (control)	1.89±0.01	2.50±0.03	3.34±0.02	4.74±0.07	5.55±0.09	7.43±0.02	8.95±0.02	12.93±0.01
T_2 (0.5% urea)	1.99±0.07	2.85±0.09	3.53±0.03	4.90±0.03	6.58±0.06	7.86±0.06	9.95±0.01	13.60±0.09
T_3 (1% urea)	1.69±0.05	2.33±0.03	3.23±0.07	4.34±0.01	4.40±0.02	6.70±0.09	7.85±0.05	10.55±0.03
T_4 (1.5% urea)	1.58±0.02	2.07±0.05	2.60±0.06	3.95±0.04	4.03±0.04	6.20±0.03	6.19±0.06	7.50±0.02
T_5 (2% urea)	1.44±0.06	1.77±0.01	2.48±0.01	3.10±0.02	3.33±0.08	3.83±0.07	4.80±0.03	6.48±0.03
P Value	0.047	0.039	0.040	0.025	0.037	0.050	0.035	0.010

TABLE 3
Day wise leaf area of hydroponic maize (cm2) as influenced by graded urea levels

Treatment	Day 6	Day 7	Day 8
T_1 (control)	5.50±0.06	6.97±0.02	7.56±0.05
T_2 (0.5% urea)	5.80±0.07	7.73±0.04	7.88±0.02
T_3 (1.0% urea)	5.31±0.01	5.86±0.07	7.30±0.06
T_4 (1.5% urea)	4.81±0.08	5.32±0.01	6.87±0.09
T_5 (2.0% urea)	4.31±0.01	5.05±0.09	6.02±0.04
P Value	0.035	0.042	0.052

TABLE 4
Day wise fodder yield (kg) of hydroponic maize as influenced by graded urea levels

Treatment	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8
T_1 (control)	2.48±0.03	2.75±0.06	3.33±0.04	3.51±0.01	4.50±0.02	5.13±0.05	5.43±0.03
T_2 (0.5% urea)	2.65±0.04	2.98±0.03	3.52±0.03	3.66±0.05	4.70±0.03	5.34±0.04	6.87±0.02
T_3 (1.0% urea)	2.40±0.02	2.65±0.04	3.10±0.05	3.40±0.03	4.33±0.04	4.79±0.07	5.29±0.04
T_4 (1.5% urea)	2.35±0.06	2.45±0.01	3.05±0.07	3.00±0.07	4.10±0.08	4.53±0.06	5.07±0.07
T_5 (2.0% urea)	2.10±0.04	2.37±0.02	2.65±0.02	2.09±0.08	3.80±0.07	4.25±0.03	4.71±0.06
P Value	0.045	0.05	0.025	0.025	0.040	0.040	0.010

RESULTS AND DISCUSSION

Plant height

The data recorded on day wise height of the maize plants was presented in Table 1. The data revealed that the highest height of the plants after the end of the 8th day was recorded in T_2 group (17.15± 0.06cm) followed by T_1 (15.13± 0.03cm), T_3 (13.81± 0.09cm), T_4 (12.51± 0.02cm) and T_5 (12.35± 0.01cm) groups. The difference ($P \leq 0.05$) among all the treatments in respect of plant height was found to be significant. The highest plant height of 17.15 ± 0.06cm recorded in T_2 group (0.5% urea) could be attributed to the optimum content of nitrogen which stimulates the vegetative growth of the plants. It was also observed that there was a decline in plant height with the gradual increase in the concentration of urea which might be due to the detrimental effect of urea at higher concentrations. The results of the present study are in close agreement with the findings of Deivis Suarez Riveroa *et al*. (2016) who reported that an increase of the vegetative growth (height of the plant) is more pronounced in treatments that were fertilized with the synthetic nutritious solution indistinctly in oats and rye grass.

Root length

The data on day wise root length of the maize plants was presented in Table 2. Perusal of the values revealed that the highest root length after the end of the experiment was noticed in T_2 group (13.60± 0.09 cm) followed by T_1 (12.93± 0.01cm), T_3 (10.55± 0.03cm), T_4 (7.50 ± 0.02cm), T_5 (6.48± 0.03cm) and the differences between the groups was significant (P ? 0.05). The highest root length of 13.60 ±0.09 cm observed in T_2 group might be due to the effect of auxins at an optimum concentration of urea application. It was further observed that there was a gradual decrease in root length with the enhancement of urea concentration as it has a detrimental effect of root development.

Leaf area

The data on the leaf area of hydroponic maize plants are given in Table 3. Perusal of the results revealed that the leaf area values were 7.56 ± 0.05, 7.88± 0.02,7.30± 0.06, 6.87± 0.09 and 6.02± 0.04 cm^2 in T_1,

T_2, T_3,T_4 and T_5 groups, respectively and there was significant difference (P≤0.01) between them. The highest leaf area of 7.88± 0.02 cm^2 was associated with T_2 group which might be due to the synergistic effect of cytokinins that promotes the formation and development of plant tissue at an optimum concentration of 0.5% urea application. The results of this study are in agreement with Hasmah Mohidin *et al.* (2015) who reported that leaf area at level N_2 (100 mg ltr^{-1}) was significantly higher (383.16 cm^2) and begin to decline significantly as the N level was raised 300 mg ltr^{-1} of the oil palm seedlings in solution culture.

Biomass yield

The data recorded on the biomass yield of the hydroponic maize for the entire experimental period was presented in Table 4. The data revealed that the highest biomass yield was observed in T2 (6.87 ± 0.02 kg) and it is significantly (P? 0.01) superior than the fodder yield obtained with T1 (5.43 ± 0.03 kg), T3 (5.29 ± 0.04 kg), T4 (5.07 ± 0.07 kg) and T5 (4.71 ± 0.06 kg) groups. The highest biomass yield of 7.88 ± 0.02 kg noticed in T2 group could be due to the additive effect of 0.5% urea on growth assimilates which in turn increased plant metabolism resulting in tissue development, dry matter accumulation and finally increased the biomass yield. The present findings are in conformity with Mutum Lamnganbi and US Surve (2017) who reported a maximum yield in 19-19-19 WSF@ 0.5% sprayed treatments (6.96 kg and 6.85 kg in yellow and white maize) followed by treatments with urea @ 0.5% applied (6.43 and 6.29 kg in yellow and white maize) in hydroponic fodder production system.

Finally it could be concluded that urea application at 0.5% concentration (3 gm of urea in 600 ml of water) is optimum for hydroponic maize production as it favors the cell division, maintains the higher auxin and cytokinins levels which stimulate the cell elongation along the main axis leading to better growth and finally enhances the biomass yield. On the contrary, higher urea concentrations (> 0.5%) didn't have beneficial effect on growth and yield rather a negative effect was observed on hydroponic maize production.

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