EVALUATION OF THE EFFECT OF CCC (2 CHLOROETHYLTRIMETHYLAMMONIUM CHLORIDE) ON THE GROWTH OF *MUCUNA PRURIENS* (L.) DC.

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Abstract: The effect of CCC (2 chloroethyltrimethylammonium chloride) on the growth of *Mucuna pruriens* (velvet bean, Family: Fabaceae) was evaluated in the present study. Different concentrations (500, 1000 and 2000ppm) of CCC were administered to viable seeds in pots of garden soil, with growth parameters including plant height, leaf surface area, number of leaves, fresh weight and dry weight considered. CCC caused reduction in plant height and number of leaves as the plant grew as well as leaf area in a concentration-dependent manner. Very minimal effect was observed on fresh and dry weight of root while the stem and leaves experienced concentration-dependent reduction in both weight parameters. Reduction in mitotic activity is probably responsible for the retarding effects observed.

Keywords: CCC, *Mucuna pruriens*, Fabaceae, Growth regulators, Seeds

INTRODUCTION

Generally growth regulators (stimulators and inhibitors) commonly occur naturally and interact in seed to affect its dormancy and germination mechanisms or its environment. A typical example is Gibberellic acid, a natural growth regulator which causes increase in the height of *Catharanthus roseus* (Cheruth *et al*., 2008). Natural growth regulator can be synthesized and exogenously applied to achieve the same effect as the endogenous ones. Growth retardants are characterized by their ability to slow the growth of plants without formative effects and this is achieved by the inhibition of gibberellin biosynthesis.

CCC(2-chloroethytrimethylammonium chloride) is a synthetic growth regulator used on ornamentals in greenhouses, thus enhancing their aesthetic appeals, durability and handling. Crops treated with CCC appear more compact with shorter internodes, stronger stem and greener leaves (Wasfy, 1995). CCC has been shown to improve the physiological state of chlorotic plants (Nenova and Stoyanov, 2000), reduce number of inflorescence and mean seed yield in lettuce (Passam *et al*., 2007) and by foliar spray resulted in increased fruit set and productivity in *Vigna unguiculata* (Resmi and Gopalarakrishnan, 2004).

Soil fertility in tropical regions is deteriorating at an alarming rate. Among the dozens of well known Green Manure Cover Crops, *Mucuna pruriens* has received most attention and has been described as one of the most popular green manure crops currently grown for the tropics and an example of green manure contribution to sustainable agricultural systems.

Mucuna pruriens (cow hage or velvet bean) is a tropical legume of the family Fabaceae, sub-family Papilionaceae. It is a climber with imparipinnate and stipulate leaves, inflorescences are racemose. The flowers are zygomorphic, with sepals, petals and stamens in whorls of five. The calyx usually forms a calyx tube with free petals. The corolla is constant and makes members of this family very easy to recognize. It has ten stamens, in two whorls of five, with the lower parts of the filaments connate and the adaxial stamen free, the ovary is superior and monocarpellary, with marginal placentation and the fruit is a legume. Cow hage can be used as food for ruminants, non-ruminants and fishes and it has potential as an energy and protein supplement (Ukachukwu *et al*., 2003).

Idu and Omoruyi (2002) described *Mucuna pruriens* as a pulse. Its low usage as food when compared to other pulses has been identified as a major obstacle to its adoption. This may have

been due to the presence of L. dopa (an alkaloid). It is however now successfully used as feed crop in Southern U.S.A. (Eilitta *et al.*, 2003).

Ethnomedicinally, Cowhage can be used as an anthelminthic and a rubefacient, which has been linked to its alkaloids, mucunine and mucunadine constituents. The hairs on the pods are administered with honey for expelling intestinal worms (Gill, 1992). *Mucuna pruriens* is also used in the treatment of Parkinson's disease due to its DOPA constituent (Buckles, 1995).

The objective of this study was to evaluate the effect of various concentrations of CCC on the growth of *Mucuna pruriens.*

MATERIALS AND METHOD

Source of Materials

Seeds: The seeds of *Mucuna puriens* were obtained from Ekrejeta, Abraka in Ethiope East local government Area of Delta State, Nigeria

Soil: The Garden soil was collected from a vegetable farm in Ekrejeta, Abraka, Delta State, Nigeria.

Growth Regulator: 2-Chloroethyltrimethy-lammonium chloride (CCC) was obtained from the chemical/equipment store of the Department of Plant Biology and Biotechnology, University of Benin, Benin City, Nigeria.

METHODOLOGIES

Twelve (12) pots were filled with loam (garden) soil and kept at field capacity with tap water.

Eight seeds of *Mucuna pruriens* were sown in each pot after a week with number of seedlings reduced to 5 seeds per bag after germination.

Values of stem elongation were obtained and recorded one week after sowing.

Concentrations of 500, 1000 and 2000ppm of CCC were prepared and administered. The administration of each concentration was done in triplicate and the soil served as control.

Values of stem height for each seedling from soil line to apical bud were obtained and averages calculated and recorded every ten days. The average number of leaves was also obtained and calculated for each concentration for every ten days.

After harvesting, values of leaf surface area, fresh and dry weight of leaves, stem and root were also obtained and recorded.

RESULTS AND DISCUSSION

In the present investigation CCC was found to have no effect on the germination of *Mucuna pruriens*. This is probably due to the presence of enough gibberellin in the seeds to allow germination or the fact that the concentrations of CCC used were too low to prevent gibberellin synthesis at this stage of the life cycle of this species.

A summary of the results of the effect of CCC on the growth of *Mucuna pruriens* are presented in Fig. 1, 2, 3, 4, 5 and 6.

Plant Height

The effect of the various concentrations of CCC on cumulative heights of *Mucuna pruriens* with the corresponding respective number of days is presented in Fig.1. On the tenth day of observation, values of 24cm were recorded in control and 500ppm, while value of 66cm was recorded for CCC concentration of 1000ppm and 2000ppm respectively. Values of 190cm, 97cm 90cm and 82cm were obtained on the ninetieth day of observation. However, curves obtained in treated portion of the experiments show a gentle progression in plant height as against that obtained in control. This may be due to the fact that CCC prevents cell elongation and inhibits cell division due to its antigibbrellic nature (Hammer *et al.*, 1975). The result is in agreement with reports by Sharad *et al*. (2000) and Porwal *et al*. (2002) who demonstrated the effect of plant growth regulators on *Chrysanthemum morifolium* and *Rosa damascene* respectively.

The relationship between the final heights of *Mucuna pruriens* and various concentrations of CCC recorded at harvest are shown in Fig. 2. It was observed that the final heights reduced as the concentration of CCC increased with highest values of height recorded in control and lowest recorded in 2000ppm. From Fig. 1 and 2, the plants treated with 2000ppm of CCC were only 35% of the stem height of the untreated plants (control). This decrease in length may be due to

a reduction in mitotic activity, thereby lowering the number of cells. Furthermore, the decrease in mitotic activity may have been responsible for the delay in flower initiation and the growth curve is converted into an almost straight-line curve of lower gradient at 500ppm (Fig.1). This indicates that the rate of development must have been lowered. These observations agree with those of Baskaran and Sathiamoorthy (2003) while working with *Carica papaya*.

Number of leaves

Fig. 3 shows the cumulative number of leaves recorded for each number of days respectively. The highest number of leaves was recorded at the concentration of 500ppm, followed by control and 2000ppm respectively. Values recorded in 1000ppm remained steady until after the fortieth day where a gradual increase in number of leaves was noticed. However after eighty days, a sharp increase in number of leaves was recorded in 1000ppm. Values obtained ninety days of administration showed highest values of number of leaves recorded in 500ppm followed by 1000ppm, control and 2000ppm respectively. CCC reduces initiation of leaf premordia which probably led to reduction in the number of leaves produced (Hoda and Heikal, 2008). Auda *et al*., 2002 using CCC on *Barleria cristata* showed a reduction in the number of leaves with increasing concentration of CCC. Wheeler (2008) reported decreased growth of primary leaves and stem internodes above the hypocotyls in dwarf French bean due to CCC.

Leaf surface area

Fig. 4 brings to bear the relationship between the values obtained for leaf surface area with their corresponding concentrations of CCC. There was a progressive decline in leaf surface area as the concentration increased. Highest values of leaf surface area were recorded in control. The result is in agreement with those presented by Hoda and Heikal (2008) on *Encelia farinosa*. Holocomb and Gohn (1995) attributed decreased leaf area of poinsettias to the inhibitory effect of CCC on cell size, elongation and enlargement.

Fresh and dry weight

Fig. 5 and 6 shows the fresh and dry weight relationship of the stem, root and leaves of *Mucuna pruriens* at various concentration of CCC. The highest values of fresh and dry weight of stem, leaves and roots were recorded in control. Weight values at other concentrations of roots remained fairly constant with very little effect on fresh and dry weight of root as compared to other vegetative parts. At higher concentrations of CCC, lower values of fresh and dry weight of stem and leaves were obtained, however the values recorded for the stem at 1000ppm were higher than the other concentrations applied. CCC increase the amount of stomata produced on the upper surface which in turn causes increased evaporation leading to the weight loss experienced in the leaves (Ahn and Yeam, 1977). Hoda and Heikal (2008) showed similar retarding effect of CCC on fresh weight and alteration of growth habit of *Encelia farinosa.* However, Usha *et al*. (2009) reported increased fresh weight and number of viable buds when *Rheum rhabarbarum* were treated with both Prohexadione-Ca and CCC.

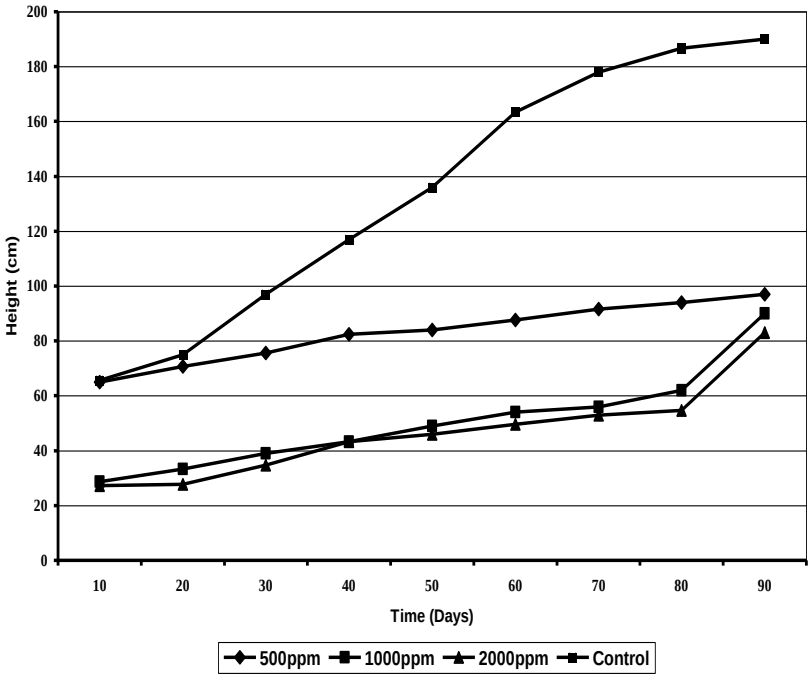

Fig.1: Effect of CCC on the cumulative heights (cm) of *Mucuna pruriens* with time (days).

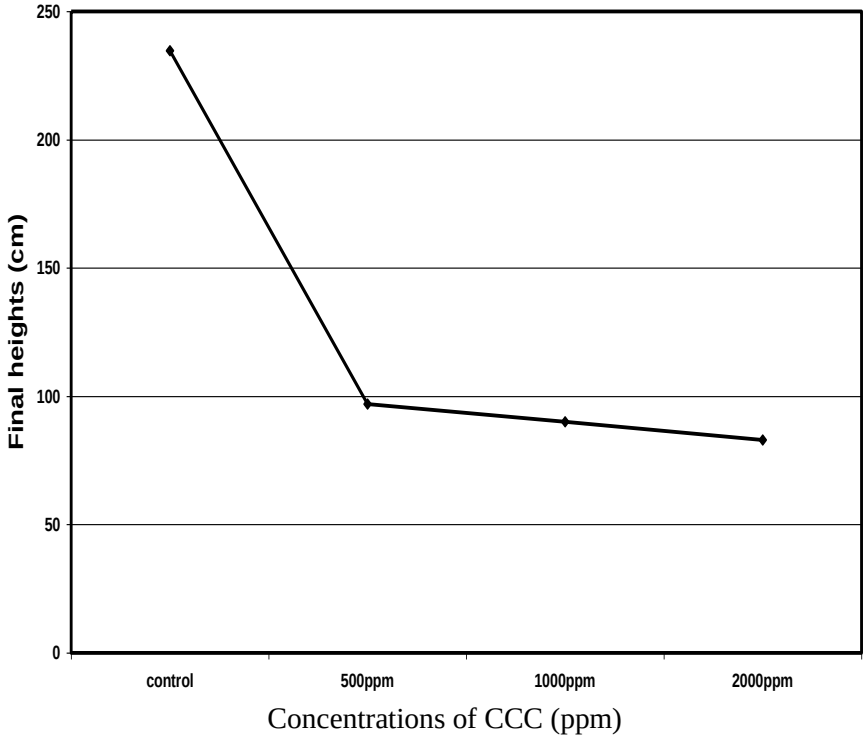

Fig.2: Effect of CCC on the final height (cm) of *Mucuna pruriens* at harvest.

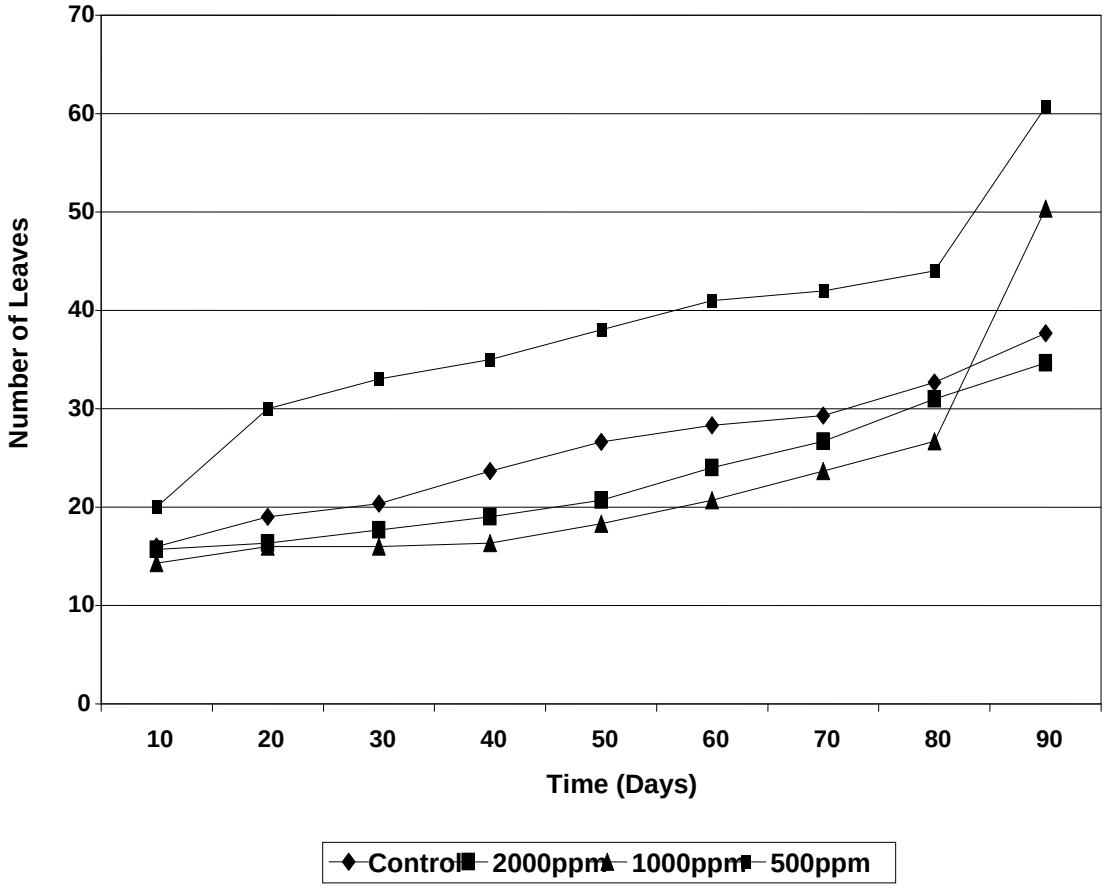

Fig.3. Cummulative Number of Leaves vs Time

Fig.3: Effect of CCC on the cumulative number of leaves of *M. pruriens* with time (days)

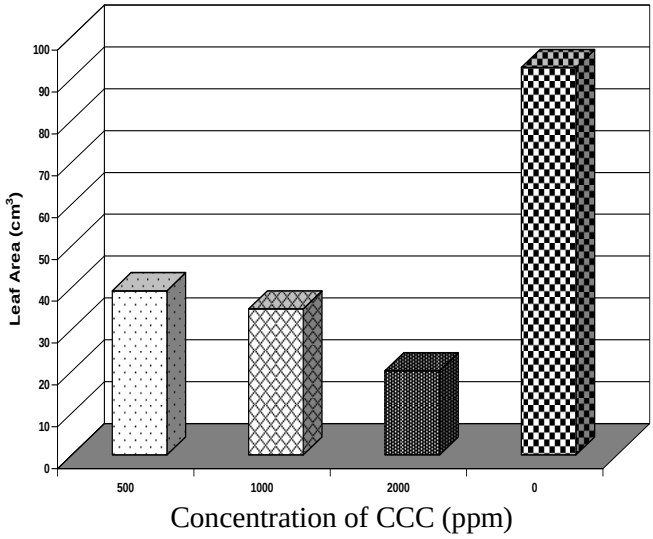

Fig.4: Effect of CCC on the leaf surface area of M. *pruriens*.

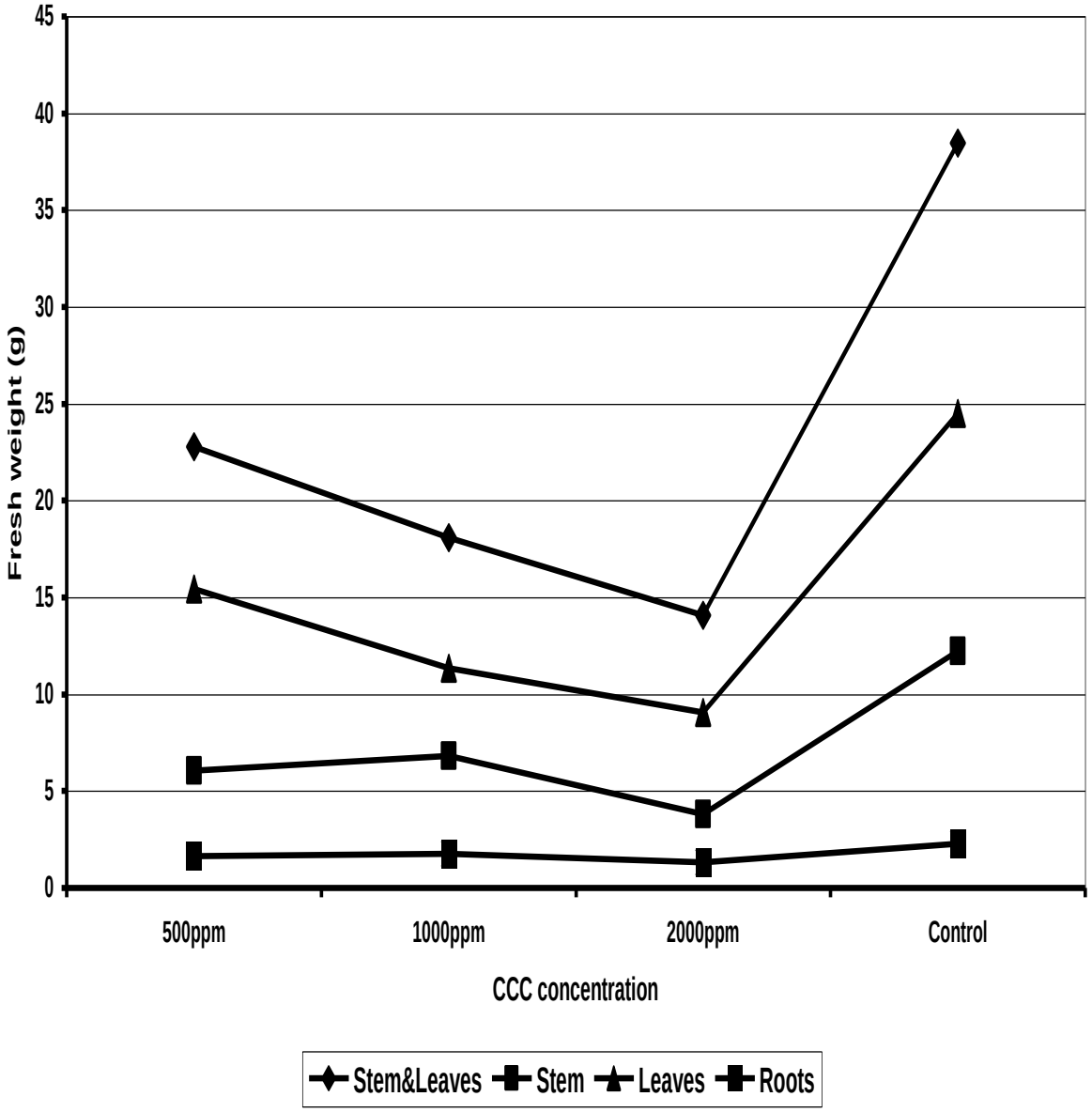

Fig.5: Effect of CCC on the fresh weight of the vegetative parts (stem, roots and leaves) of *M. pruriens*

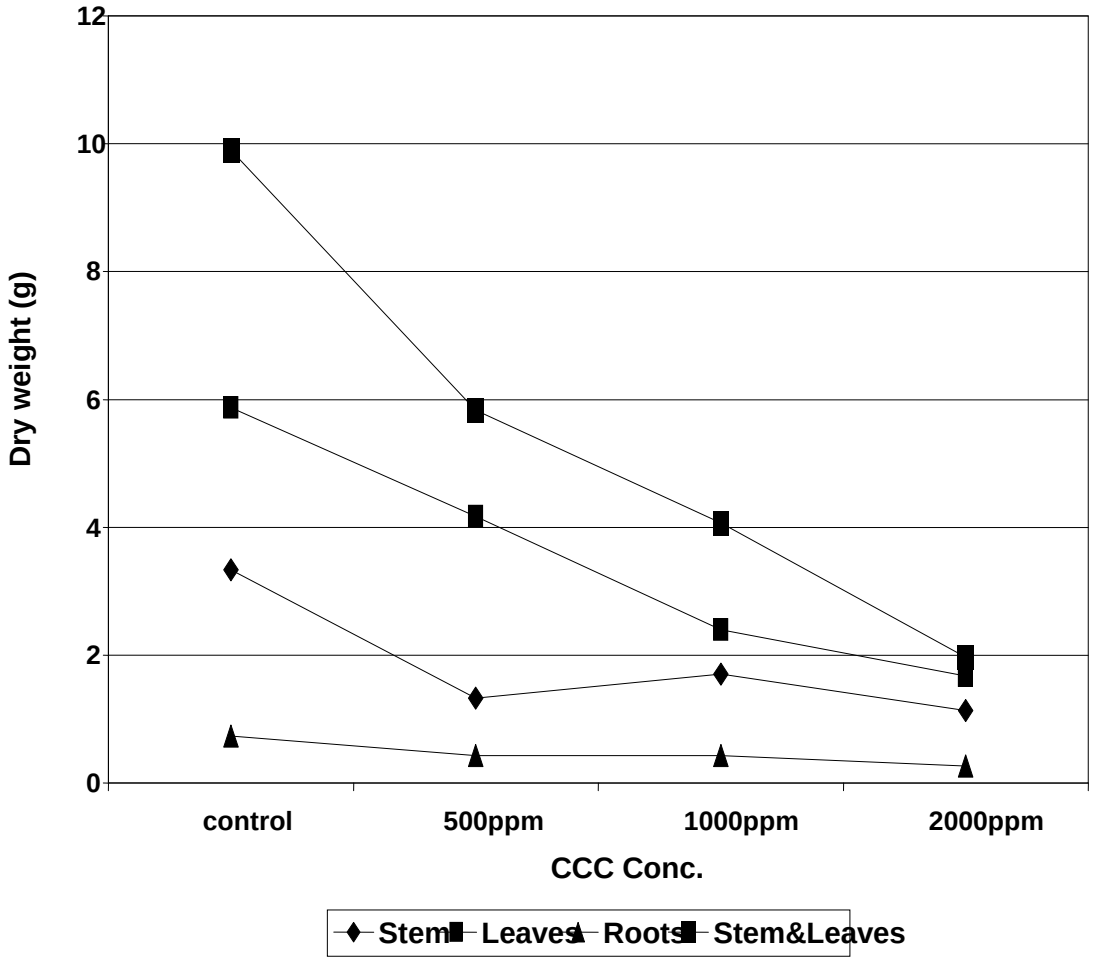

Fig.6. Dry weight vs CCC treatments

Fig.6: Effect of CCC on the dry weight of the vegetative parts (leaves, roots and tem) of *M. pruriens.*

REFERENCES

Ahn, Y.S. and Yeam, D.Y (1977). Studies on the reduction of SO_2 injury to *Hibiscus syriacus* L. by the use of growth regulator CCC. *Journal of the Korean Society for Hort. Sci.*, **18**(2):203-214

Auda, M.S., Shahin, S.M. and EL-Shakhs, M.H (2002). The dwarf barleria: a new pot plant product. *Arab University Journal of Agricultural Sciences*, **10**(1): 319-333

Baskaran, A. and Sathiamoorthy, S. (2003). Effect of growth retardants on growth, flowering and yield of papaya (*Carica papaya* Linn.) . *Res. On Crops*, **4**(1): 69-73

Buckles, D. (1995). Food and feed from *Mucuna* current uses and the way forward. *Economic Botany*, **49**(1); 13-25

Cheruth, A .J.; Gopi, R.; Zhao, X.; Azooz, M. and Panneerselvam, R. (2008). Plant growth regulators and fungicides alters growth charecteristics in *Catharanthus roseus*; comparative study. *Global Journal of Molecular Sciences*, **3**(2): 93-99

Eilitta, M. J.; Mureithi, R.; Muinga, C. S. and Szabo, N. (2003). Increasing

Mucuna's Potential as a Food and Feed Crop. Proceedings of an international workshop held September 23-26, 2002, Mombasa, Kenya.

Gill, L. S. (1992). Ethnomedicinal uses of plant in Nigeria. University of Benin Press, Benin City. 276p

Hammer, P.L.; Kiplinger, D.C. and Tayama, H.K. (1975). Greenhouse studies on the effect of chemical growth retardants on shoot growth of *Chrysanthemum* and *Poinsettias. Ohio Florist Association Bulletin*, **549**:2-5

Hoda, E.E and Heikal, H, A (2008). Induction of dwarfism in *Encelia farinosa* by cycocel and evaluation of regenerants using RAPD and ISSR markers. *Australian Journal of Basic and Applies Sciences*, **2**(3): 331-341

Holocomb, E. J. and Gohn, L. (1995). Poinsettia response to growth retardant drenches or sprays. *Bulletin Pennsylvania Flower Growers*, **430**: 1-2

Idu, M and Omoruyi, O.M. (2002). Seed-coat structure and anatomy of some Nigerian pulses. *Plant Biology*, **45**(4): 189-195.

Nenova, V. R. and Stoyanov, I. G. (2000). Effects of some growth regulators on young iron deficient maize plants. *Biologia Plantarum*, **43**(1)**:** 35-39

Passam, H. C., Koutri, A.C. and Karapanos, I. C. (2007). The effect of chlormequat chloride (CCC) application at the boiling stage on the flowering and seed production of lettuce plants previously treated with water or gibberellic acid (GA_3). *Scientia Horticulturae*, **112**(2): 117-121

Porwal, L., Nagda, C.L. and Pundir, J.P.S. (2002). Influence of plant growth regulators on vegetative and flower earliness of damask rose. *South Indian Horticulture*, **50**(1/3): 119-123

Resmi, R. and Gopalarakrishnan, T, R. (2004). Effect of plant growth regulators on the performance of yard long bean (*Vigna unguiculata* var. s*esquipedalis* L. Verdcourt). *Journal of Tropical Agriculture*, **42**(1-2): 55-57

Sharad, G., Sharma, L.K. and Ashwani, K. (2000). Study on the influence of growth regulators on growth and flowering of *Chrysanthemum*. *Journal of Phytological Research*, **13**(2): 175-178

Ukachukwu, S.N., Shoyinka, V.O and Obioha, F.C. (2003). Chronic toxicity of raw lyon's bean *(Mucuna cochinchinensis)* in broilers. *Tropical and Subtropical Agroecosystems*, **2**(1):23-30.

Usha, P. R.;Rajasekaran R. L., Claude, D. C.; Samuel, K. A.; Kevin, J. S. and Azure, D. A. (2009). CCC and Prohexadione-Ca enhance rhizome growth and lateral bud production in Rhubarb (*Rheum rhabarbarum* L.). *Journal of Plant Growth regulation*, **28**(2): 137-146

Wasfy, E. E. (1995). Growth Regulators and Flowering. Academic Bookshop, Modern Egyptian Press.pp 503-510

Wheeler, A. W. (2008). Effect of CCC and glycine betaine on growth and growth-substance content of primary leaves of dwarf French bean (*Phaseolus vulgaris* L.). *Annals of Applied Biology*, **63**(1): 127-133.