Efficacy of Graded Doses of Pusa Hydrogel on Growth and Quality of Coleus (Coleus Blumeil.) under Polyhouse Condition

Abdul Saboor Dawlatzai, R. Jayanthi, Saidajan Atiq Abdiani
University of agricultural Science, GKVK, Bangaluru, India. Dept. of Horticulture

Abstract-
An experiment was carried out to study the efficacy of graded doses of Pusa Hydrogel on growth and quality of Coleus (Coleus blumei L.) under polyhouse condition" at the University of Agricultural Sciences, Bangaluru during 2016-17. Four different concentrations of Pusa Hydrogel @10g, 20g, 30g and 40g each mixed with 5kg of potting media were set as treatments. Application of 40gm of pusa hydrogel per 5kg of potting media resulted in significantly higher plant height (38.5cm), branches per plant (18.1), plant spread (41.6 cm^2) stem diameter (1.27 cm), leaves per plant (92.2), leaf length and width (8.2 and 5.4 cm respectively), chloropyll content (SPAD value of 30.63) as compared to control (without Pusa Hydrogel) at 120 days after planting. Significantly least quantity of water requerment (22.7 litre) and frequency of watering (once in 2.9 days) with a water saving of 39% were also recorded in the same treatment when compared to control.

Keywords: *Growth, quality, Coleus blumei L., Pusa hydrogel*

I. INTRODUCTION

Coleus blumeiL. belongs to the family Labiatae .and it is an ornamental plant growing all over the world. It is a perennial herbaceous plant very commonly grown in the garden for its attractive colourfulfoliage and grows to a height of 30-50cm. The plants are more commonly grown as pot plants, but are a great favourite for the window box garden and a few dwarf types are also suitable for carpet bedding. They are available in large number of different cultivars that vary in color, size and shape of the leaves. They have long been prized for their colourful foliage, which they may combine shades of green, yellow, pink, red and maroon. They also form an integral part of indoor gardening.

Pusa Hydrogel is an indigenous product designed and developed by IARI, New Delhi to enhance the crop productivity per unit available water and nutrients, particularly in moisture stress agriculture. Synthetic polymers in the form of crystals or tiny beads available under several trade names such as Pusa Hydrogel, super absorbent polymers, root watering crystals and drought crystals are collectively known as hydrogels. The term hydrogel itself is rather generic referring to hydrogels used in oil recovery, (Emesih*et al.*,1999),in clarification of potable and waste water, dewatering sludges, food processing, personal care products, and laboratory supplies (Barvenik, 1994) as well as in agriculture. They have enormous capacity to absorb water and makes it available to plants over time.

II. MATERIALS AND METHODS

The experiment was conducted, under polyhouse conditions, in the University of Agricultural Sciences, GKVK, Banglore, (India) during 2016-17,using CRD with five treatments and four replications. Four concentrations of Pusa Hydrogel@ (10, 20, 30 and 40 gm)were used along with control(without pusa hydrogel)different concentration ofPusa Hydrogel were added to 5kg of potting media [soil+ vermi compost+ Sand(1:1:1v/v)]and mixedthoroughly before planting in 12 inch earthen pots. Ten plants of coleus (*Coleus blumei* L.)under each replication and five plants were randomly selected and tagged for recording various morphological observations at different stages of plant growth. Observation on plant height(cm), number of branches per plant, number of leaves, plant spread (cm^2), stem diameter (cm), internondal length (cm) were recorded at 20 days interval upto 120 day. Whereas leaf length (cm) and width (cm) were recorded at 20 days interval upto60 days. Total chlorophyll content of leaves were recorded with SPAD meter. Soil moisture content was checked daily using digital soil moisture meter. Frequency of watering was measured between two successive watering and total number of watering were recorded treatment wise during the crop growth period and cumulative quantity (litre) of water applied was calculated from the beginning of the experiment up to end of experiment (120) days after planting.

III. RESULTS AND DISCUSSION

A. *Growth Characters as Influenced by Different Concentration of Pusa Hydrogel:*

Pusa hydrogel had significant effecton all the plant growth charecters at different stages of growth of Coleus. The data on growth parameters at 120 days after planting is shown in table 1.With an increase in Pusa Hydrogel concentration there was an increase in plant height, intermodal length and stem girth. The highest plant height (38.5 cm) was recorded in T_5 (40g of Pusa Hydrogel/5kg of potting media) followed by T_4 (36.5 cm) and lowest plant height (31.9 cm) was observed in T_1 (without Pusa Hydrogel) (Table 1).Pusa hydrogel had significant effect on internodal length. The highest internodal length (5.0 cm) was observed in T_5 (40g of Pusa Hydrogel/5kg of potting media), followed by T_4 (4.1 cm) and lowest internodal length (3.5 cm) was observed in T_1 (without Pusa Hydrogel) (Table 1). Among all the treatments T_5 (40g of Pusa Hydrogel/5kg of potting media) was found to have maximum stem girth (1.27 cm) and minimum (1.12 cm) stem girth was recorded in control (without Pusa Hydrogel).An increase in plant height might be attributed to water availability and indirectly nutrients provided by superabsorbent polymer, which have been reported to increase the activity of cell division, cell expansion and cell elongation, ultimately leading to an increased plant height. Similar results have been reported by Al-Harbi*et al*. (1999) in cucumber, SendurKumaran*et al*. (2001) in tomato and Sivalapan (2001) in soybean. The positive effect of super absorbent on stem elongation is reported by Brar*et al*. (2001) in maize. This effect could be a result of high potential of superabsorbent to absorb water and conserve water in the soil in sunflower (Boman and Evans, 1991).

With an increase Pusa Hydrogel concentration there was significant increase in plant spread, number of leaves and branches per plant. Highest plant spread (41.6 cm^2) was observed in T_5 (40g of Pusa Hydrogel/5kg of potting media) at all stages of growth as compared to control (without Pusa Hydrogel) (37.8 cm^2). Highest number of leaves and branches(92.2 and 18.1 respectively) were observed in T_5 (40g of Pusa Hydrogel/5kg of potting media) and lowest leaves and branches (70.1 and 12.3 respectively) were observed in T_1 (without Pusa Hydrogel).Plant spread, number of leaves and branches per plant significantly increased with increased concentration of Pusa Hydrogel which may be due to significant amount of water in hydrogel structure and subsequently, putting the absorbed water into the soil around plant roots, thereby increasing soil's water holding capacity and providing a buffer against the product loss during the time between two irrigations, (Johnson and Woodhouse, 1990). Because of the uninterrupted water availability, plants obtained continuous supply of water and nutrients and thereby resulted in leaf longevity on the plant compared to control plants. Pusa Hydrogel have been used as water-retaining materials in agricultural and horticultural fields because, when incorporated with soil, they can retain large quantities of water and nutrients, as reported by Yazdani*et al*., (2007) in soybean. The stored water and nutrients are released slowly as required by the plant to improve growth under limited water supply in *Pinushalepensis*,(Huttermann*et al*., 1999).

With an increase Pusa Hydrogel concentration there was significant increase in leaf length and width. Highest leaf length and width (8.2 and 5.4cm respectively) were observed in T_5 (40g of Pusa Hydrogel/5kg of potting media) at all stages of growth as compared to control (6.8 and 4.3 cm respectively).It may be due to the fact that the water content of the plantdecreases, cell shrinks and turgor pressure against cell walls relaxes. Thisdecrease in cell volume resulting from lower turgor pressure subsequentlyconcentrates solutes in cells. SAP increase the turgor pressure inside the cells bymaintaining sufficient amount of water as per plant need and thus causingincrease in leaf area and other related parameters as reported by (Al-Harbi*et al*., (1999) andYazdani*et al*., (2007) in soybean.

In the present investigation significant increase in the above growth parameters of coleus plants grown in the potting media containing higher concentration of Pusa Hydrogel. Maybe due to higher total chlorophyll content of leaves (30.63 and 29.33 respectively) recorded in T_5 (40gm of pusa hydrogel per 5kg of potting media) and T_4 (30gm of pusa hydrogel per 5kg of potting media) respectively as compared to control (26.63). The variation in chlorophyll content due to super absorbent polymer may be attributed to decrease in chlorophyll degradation or increased chlorophyll biosynthesis due to supply of sufficient amount of water and nutrients to the plant in water deficit condition as reported by El-Sayed*et al*., (1995) in cotton and maize.

B. *Effects of Different Concentrations of Pusa Hydrogel on Frequency of Watering and Cumulative Quantity of Water*

Significant reduction in watering frequency and cumulative quantity of water were observed in coleus by application different concentrations of Pusa Hydrogel. Significantly less cumulative quantity water applied in treatment, T_5 (40 g of Pusa Hydrogel /5 kg of potting media) (22.7 litre). Whereas, higher cumulative quantity of applied to control (without Pusa Hydrogel) (37.8 litre).Moisture content of the media increased with an increase in the concentration of Pusa Hydrogel at all the stages of growth. Significantly less frequency of watering (2.85 day) was recorded in treatment, T_5

(40 g of Pusa Hydrogel /5 kg of potting media), whereas, higher frequency of watering was observed in control (without Pusa Hydrogel) (1.09 days).Significant reduction in watering frequency and cumulative quantity of water in coleus by application of Pusa Hydrogel may be due to increasing water holding capacity of media which is in accordance with the results observed by Sivalapan (2001) in soybean, Cookson *et al*., (2001) in okra and Abedi-Koupai*etal*., (2004) in *Cupressus.* The moisture content of the mediaincreased with an increase in the concentration of Pusa Hydrogel at all the stages of growth. An increase in moisturecontent of plant may be due to sufficient availability of the soil moisture and itssupply to plant as per need by Pusa Hydrogel. According to El-hady*et al*., (1980) the increase water use efficiency may be due to decrease in evapo-transpiration ratio which in turn might have helped the crop growth. Wallace and Wallace (1990) also reported increased level of water content of plant due tohydrophilic polymer (Grogel).

IV. CONCLUSION

Application of Pusa Hydrogel had significant positive effect on all morphological characters of *Coleus blumei* L. plant. Among all the treatments, T_5 (40 g of Pusa Hydrogel per 5kg of potting media) showed significantly better plant growth and quality as compared to control (without pusa hydrogel) and required significantly less quantity of water and least frequency of watering as compared to control. Hence, application of Pusa Hydrogel @ 40 g of Pusa Hydrogel per 5kg of potting media resulted in higher plant growth and production with lesser quantity of water (22.7) and there by water saving to an extent of 39% could be achieved.

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Table 1: Growth parameters, chlorophyll content as influenced by different concentration of Pusa Hydrogel in Coleus

Treatment	Plant height (cm)	Internodal length (cm)	Stem diameter (cm)	Plant spread(cm 2)	Number of leaves	No. of branches/ plant	Leaf length (cm)	Leaf width (cm)	Chlorophyll content (SPAD value)
T_1	31.9	3.50	1.12	38	70.1	12.3	6.83	4.33	26.6
T_2	32.3	3.75	1.12	38	74.8	13.2	7.25	4.38	27.3
T_3	33.9	3.80	1.19	38.5	80.6	15.2	7.45	4.68	28.1
T_4	36.5	4.10	1.24	39.5	84	17	7.78	5.23	29.3
T_5	38.5	5.00	1.27	42	92.2	18.1	8.20	5.38	30.6
Mean	34.6	4.03	1.19	39.2	80.3	15.2	7.50	4.80	28.4
SEm±	0.4	0.14	0.03	0.37	4.2	1.2	0.20	0.17	0.6
CD at 5%	1.1	0.43	0.10	1.1	12.8	3.6	0.62	0.52	1.8

T_1: Control
T_4: Pusa Hydrogel @ 30 g/5kg potting media
T_2: Pusa Hydrogel @ 10 g/5kg potting media
T_5: Pusa Hydrogel @ 40 g/5kg potting media
T_3: Pusa Hydrogel @ 20 g/5kg potting media

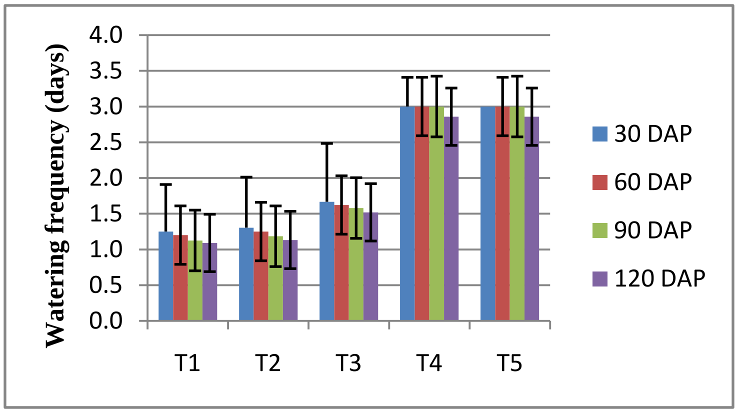

Fig.1: Watering frequency as influenced by different concentrations of Pusa Hydrogel in Coleus

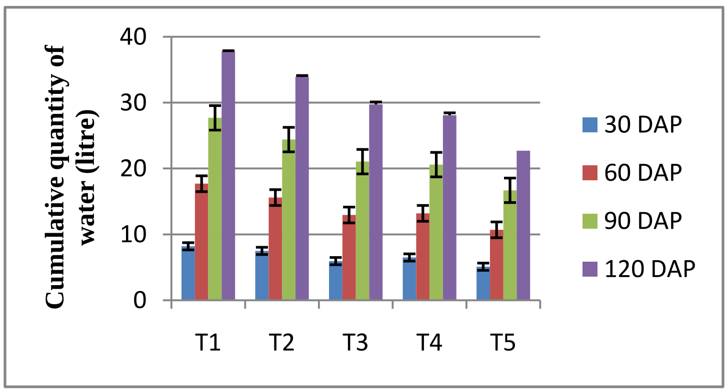

Fig.2: Cumulative quantity of water as influenced by different concentrations of Pusa Hydrogel in Coleus

T_1: Control
T_2: Pusa Hydrogel @ 10 g/5kg potting media
T_3: Pusa Hydrogel @ 20 g/5kg potting media
T_4: Pusa Hydrogel @ 30 g/5kg potting media
T_5: Pusa Hydrogel @ 40 g/5kg potting media