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EFFECT OF PLANT GROWTH REGULATORS ON PHYSICAL PARAMETERS OF TARO (*Colocasia esculenta* Var. *antiquorum* L. schott.)

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ABSTRACT

Colocasia [*Colocasia esculenta* var. *antiquorum* (L.) Schott.], which is also known as taro, arvi, katchu and eddode belongs to the family Araceae is an important edible aroid. Africa ranks first in area and production of colocasia and in India colocasia are favourite among Gujarat, Konkan region of Maharashtra and several other parts of south India. The cormels, corms, leaves and petioles are used as a vegetable and considered as rich source of carbohydrates, proteins, minerals and vitamins. Due to increasing demand of taro, there is a need to increase its yield. Foliar application of plant growth regulators is reported to improve growth and tuber yield. Hence, the present investigation has been carried out in the Horticulture Research unit, Department of Horticulture, Faculty of Agriculture, Birsa Agricultural University, Kanke, Ranchi during *Kharif* season of 2017-18. There were eleven treatments used namely T_1- Naphthalene acetic acid (25 ppm), T_2- Naphthalene acetic acid (50 ppm), T_3- Indole Acetic Acid (25 ppm), T_4- Indole Acetic Acid (50 ppm), T_5- Maleic hydrazide (50 ppm), T_6- Maleic hydrazide (100 ppm), T_7- Gibberellic acid (100 ppm), T_8- Gibberellic acid (200 ppm), T_9- Ethrel (75 ppm), T_{10}- Ethrel (150 ppm) and T_{11}- Control (water spray only). To find out feasibility of increment in growth of taro by means of application of plant growth regulators on the till date most accepted variety of taro, Muktakeshi by the growers in the state of Jharkhand. Among the eleven treatments used GA_3 at 200 ppm was found to record maximum physical parameters in cultivation of taro.
***Keywords* :** *Colocasia esculenta*, Plant growth regulators, physical parameters of taro.

Introduction

Among the tuber crop produced, colocasia [*Colocasia esculenta* (L.) Schott.], a member of family Araceae which is native to south central Asia is one of the important tuber crop particularly grown in Africa and Asia and occupies a very selective and special position. Some species are widely cultivated and naturalized in other tropical and subtropical regions. It is grown throughout the humid tropics and in the warmer regions of the temperate zones. *Colocasia* is the most important vegetable crop among the arum family due to its delicious taste, nutritive and medicinal value (Mishra and Roy Chowdhury, 1996). It is mainly cultivated for the edible cormels but the leaves and its young petioles are also cooked and used like spinach. The cormels, corms, leaves and petioles are used as a vegetable and considered as rich source of carbohydrates, proteins, minerals and vitamins. The corm is rich in starch and contains 17- 25% amylase. Planting of *Colocasia esculenta* is normally done during the rainy season but it can be done any time if irrigation facilities are available. The crop is harvested after 6 to 8 months of planting. It grows on all kinds of soil but thrives best in deep, well-drained, well manured, friable loam. Where rainfall is insufficient, the fields are frequently irrigated.

Moreover, the climate of Jharkhand is very favorable for the growth, development and expansion of this crop. Muktakeshi variety of taro has performed well in eastern and southern part of our country including Jharkhand. It is light brown skin coloured high yielding and itching free choicest variety of farmers of state of Jharkhand. Taro is a promising tuber crop for the state of Jharkhand. It can be found in most of the farmer's field of Jharkhand on small holding for domestic consumption or as commercial crop.

Growth and yield of plants are greatly influenced by a wide range of factors, among which plant growth regulators are one. Plant growth regulators usually are defined as organic compounds, other than nutrients which in small concentration influence the physiological processes of plants.

Foliar application of plant growth regulators is reported to improve growth and tuber yield. Plant growth regulators are also reported to improve yield of many horticultural crops those in which the underground part is economically important. Though, agronomical practices for taro have been standardized and there is always demand for enhancing its growth and yield from the growers. Hence, the present investigation has been formulated to find out feasibility of increment in yield of parameters of taro by means of applications of growth regulators in the date most accepted variety of taro, Muktakeshi by the growers in the state of Jharkhand. Hence, present study was undertaken with the objectives to evaluate growth and yield of taro with application of different plant growth regulators in the context of growth, yield and yield attributes.

Materials and Methods

The present investigation entitled Effect of plant growth regulators on growth and yield of Colocasia [*Colocasia esculenta* (L.) Schott.], was conducted in the experimental field of the Department of Horticulture, Faculty of Agriculture, Birsa Agricultural University, Kanke, Ranchi during the *Kharif* season of 2017-18. There were eleven treatments used namely T_1- Naphthalene acetic acid (25 ppm), T_2- Naphthalene acetic acid (50 ppm), T_3- Indole Acetic Acid (25 ppm), T_4- Indole Acetic Acid (50 ppm), T_5- Maleic hydrazide (50 ppm), T_6- Maleic hydrazide (100 ppm), T_7- Gibberellic acid (100 ppm), T_8- Gibberellic acid (200 ppm), T_9- Ethrel (75 ppm), T_{10}- Ethrel (150 ppm) and T_{11}- Control (water spray only) which was carried out in randomized block design with three replications.

Number of Cormels per plant

Cormels obtained from different replications of tagged five plants were harvested separately and weighed with the help of electronic balance. Thereafter, average number of cormels per plant was calculated in number.

Length of Cormel (cm)

The length of cormels from each treatment was measured with scale and then average length of five cormel was calculated.

Girth of Cormel (cm)

Girth of cormels from each treatment was measured by with the help of scale and tape then average girth of cormel was calculated.

Length of mother Corm (cm)

The length of five mother corm from each treatment was measured with scale and then average length of five mother corm was calculated.

Girth of mother Corm (cm)

The girth of five mother corm from each treatment was measured with scale and then average length of five mother corm was calculated.

Volume of cormel/plant (cubic centimeter)

The volume of five cormels from each treatment were obtained with the help of measuring bucket by volume displacement method in terms of litre and then average volume per tuber in cubic centimeter (cm^3) was calculated.

Weight of Cormels (g)

The weight of cormels from five plants under each treatment was measured with electronic balance and then average weight of five cormel was calculated.

Weight of mother Corm (g)

The weight of five mother corm from each treatment was measured with electronic balance and then average weight of five mother corm was calculated.

Dry matter percentage of Cormels

The dry matter percent of five cormels were obtained from each treatment by drying the 100 g cormels sample (crushed) over oven for 24 hours and then average dry matter percentage of cormel was calculated.

Harvest index (%)

Economic yield and biological yield of five plants from each treatment were recorded and expressed in kg to estimate harvest index of plants with the help of following formula, expressed in percentage and then the average harvest index per plant was calculated :-

$$\text{Harvest index} = \frac{\text{Economic yield}}{\text{Biological yield}} \times 100$$

Organoleptic evaluation of cormels

The data and observation were taken after harvesting of taro cormels then after grading and marking for different characters to organoleptic evalution.

Results and Discussion

The data presented in table 1 shows that maximum volume of cormel , weight of cormel (g) and weight of the mother corm (g) was observed in T_8 [GA_3 (100 ppm)] (326.65 cm^3, 369.12 g & 94.68 g respectively) followed by treatment T_7 [GA_3 (200 ppm)] (305.68 cm^3, 348.48 g & 92.10 g) in comparison to others treatments including control (only water spray).

Table 1 : Effect of Plant growth regulators on Volume of cormel, Weight of cormels and Weight of mother corm of taro.

Treatments	Volume of cormel (cm^3)/plant	Weight of cormels (g)	Weight of mother corm (g)
T_1-Naphthalene Acetic Acid (25ppm)	273.55	322.80	86.93
T_2-Naphthalene Acetic Acid (50ppm)	251.50	304.32	83.25
T_{3-} Indole Acetic Acid (25 ppm)	292.96	339.84	89.48
T_{4-} Indole Acetic Acid (50 ppm)	263.19	313.20	85.16
T_{5-} Maleic hydrazide (50 ppm)	220.41	275.52	77.86
T_{6-} Maleic hydrazide (100 ppm)	210.14	266.88	75.37
T_7- Gibberellic Acid (100 ppm)	305.68	348.48	92.10
T_{8-} Gibberellic Acid (200 ppm)	326.65	369.12	94.68
T_{9-} Ethrel (75 ppm)	248.65	303.36	82.38
T_{10-} Ethrel (150 ppm)	231.41	284.64	79.76
T_{11}- Control (Only water spray)	211.12	270.24	72.34
SEm ±	19.36	22.43	6.28
CD (p=0.05)	57.11	66.20	18.52
CV (%)	13.01	12.57	13.01

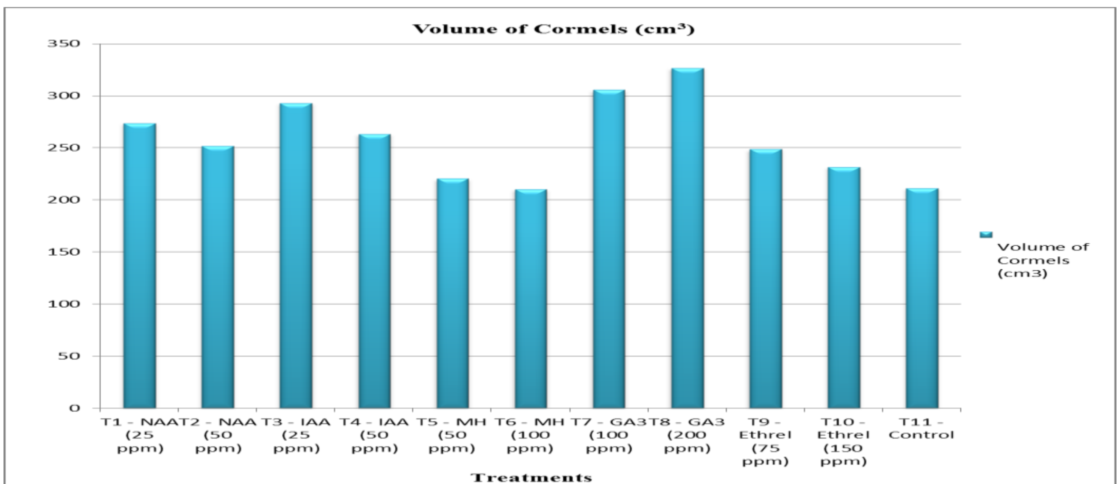

Fig. 1: Effect of Plant growth regulators on Volume of Cormels (cm^3) of Taro

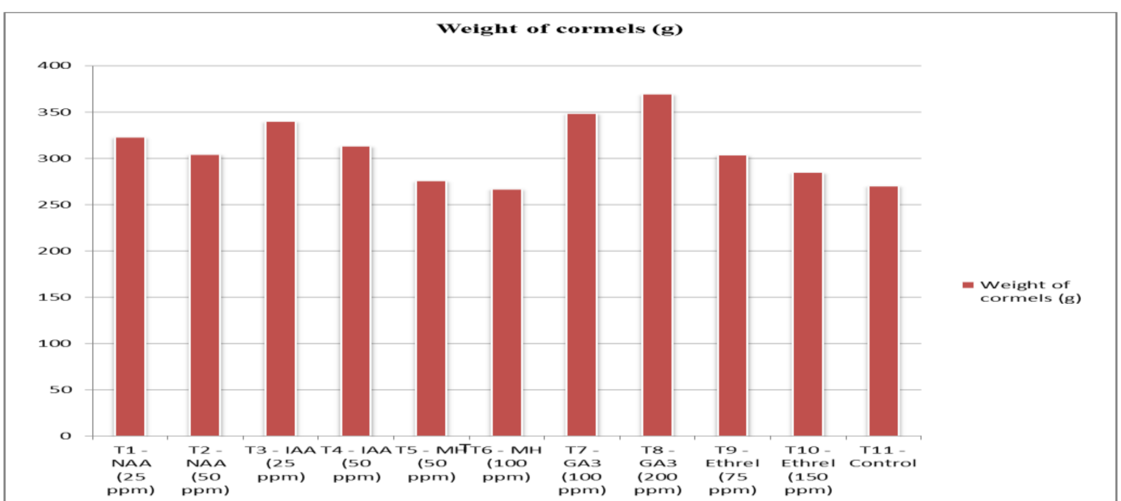

Fig. 2 : Effect of Plant growth regulators on Volume of Cormels (cm^3) of Taro

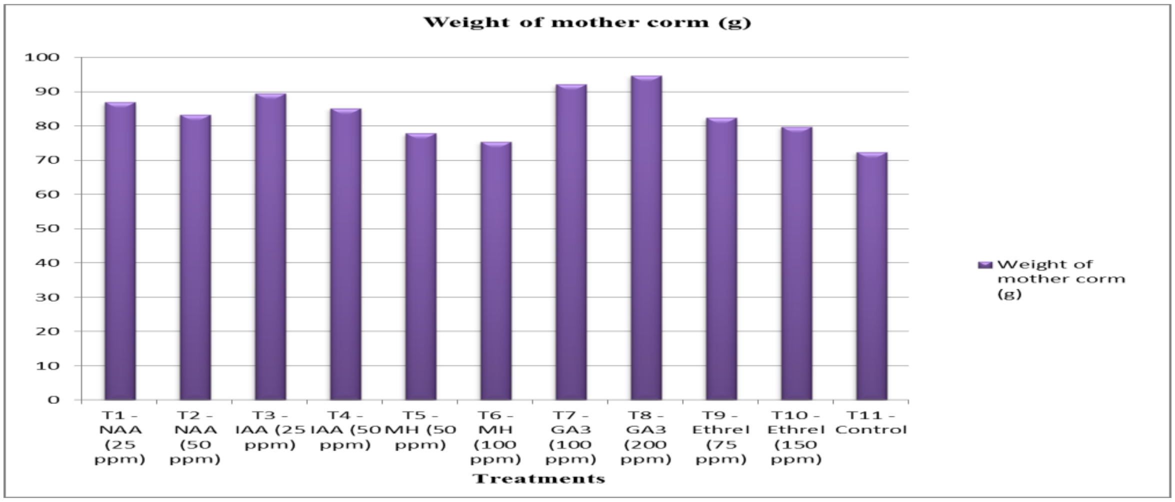

Fig. 3 : Effect of plant growth regulators on Dry matter percentage of Cormels of taro

Table 2 : Effect of Plant growth regulators on cormel dry matter percentage, Harvest index and yield/ha (tonnes) of taro.

Treatments	Cormel dry matter (%)	Harvest index (%)	Yield/ha (tonnes)
T_1- Naphthalene Acetic Acid (25 ppm)	23.40	74.75	13.45
T_2- Naphthalene Acetic Acid (50 ppm)	22.60	71.80	12.68
T_3 Indole Acetic Acid (25 ppm)	23.60	75.69	14.16
T_4 Indole Acetic Acid (50 ppm)	22.80	73.30	13.05
T_5 Maleic hydrazide (50 ppm)	21.40	67.09	11.48
T_6 Maleic hydrazide (100 ppm)	21.20	64.50	11.12
T_7- Gibberellic Acid (100 ppm)	23.80	75.90	14.52
T_8 Gibberellic Acid (200 ppm)	24.10	77.46	15.38
T_9 Ethrel (75 ppm)	22.20	70.34	12.64
T_{10} Ethrel (150 ppm)	21.80	68.94	11.86
T_{11}- Control (Only water spray)	21.00	62.81	11.26
SEm ±	1.67	5.09	1.03
CD (p=0.05)	4.93	15.01	3.03
CV (%)	12.83	12.39	13.83

The data presented in table 2 shows that maximum cormel dry matter (%), harvest index (%) and yield/ha (tonnes) was observed in T_8 [GA_3 (100 ppm)] (24.10 %, 77.46 % & 15.38 tonnes respectively) followed by treatment T_7 [GA_3 (200 ppm)] (23,80 %, 75.90 % & 14.52 tonnes) in comparison to others treatments including control (only water spray).

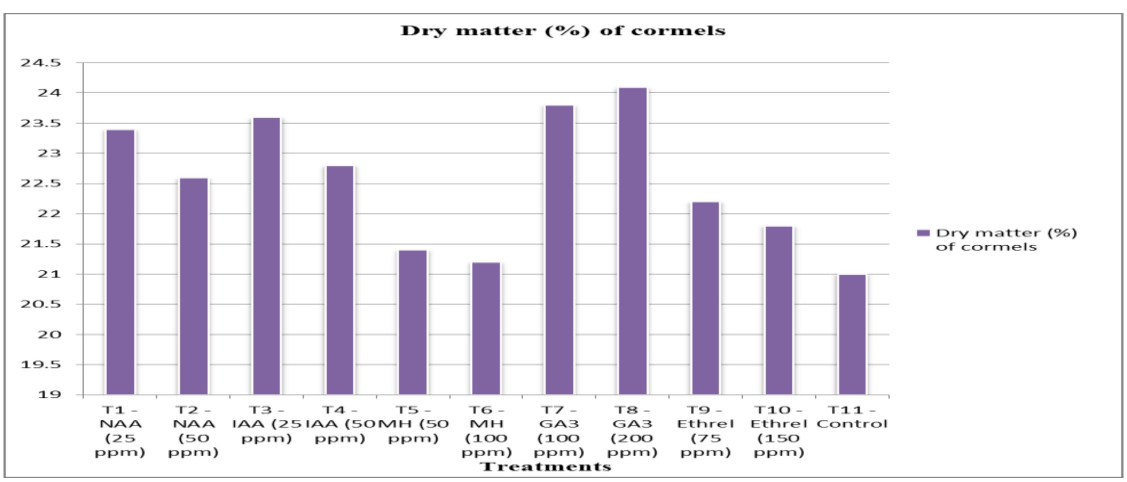

Fig. 4 : Effect of plant growth regulators on Dry matter percentage of cormels of taro

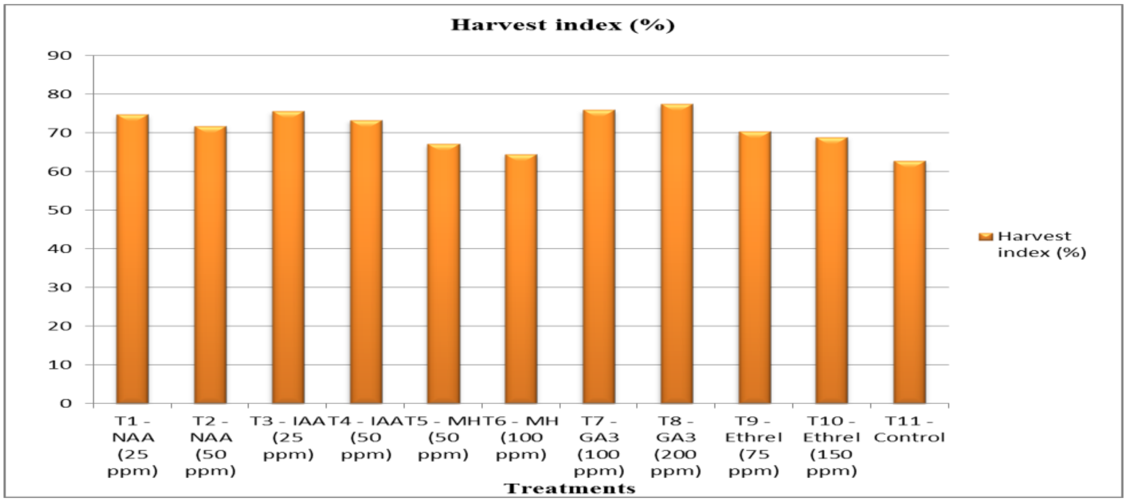

Fig. 5 : Effect of plant growth regulators on Harvest index of colocasia (Taro)

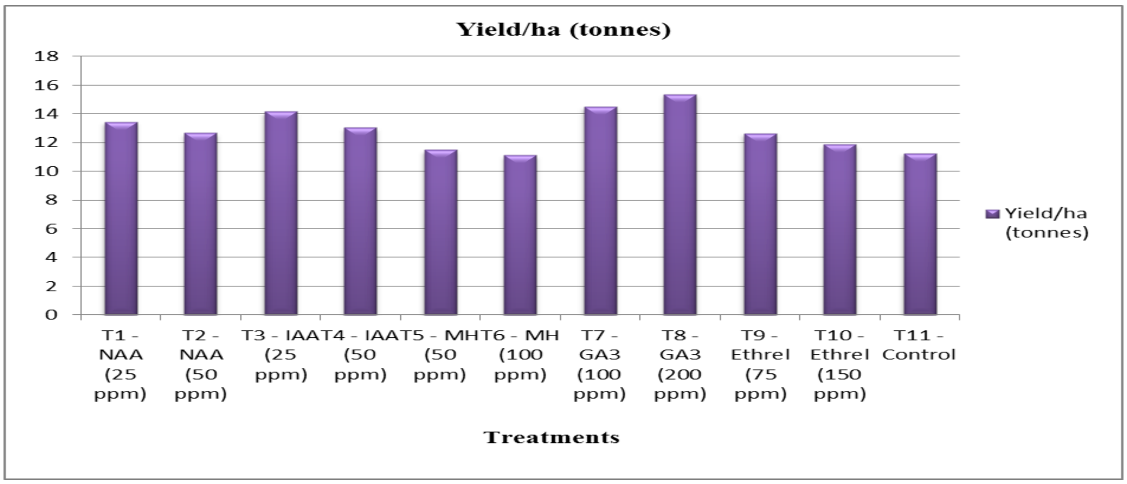

Fig. 6 : Effect of plant growth regulators on Yield per hectare (tonnes) of colocasia (Taro)

Increased in dry matter production by GA_3 might be due to as it was involved in increasing photosynthetic activity resulting in increased production of photosynthates and translocation of this photo-assimilates from stem and leaves to the economical parts (cormel). It indicated that plant growth regulators have the capacity to alter source-sink relationship to a greater extent. Similar results were found by Remison *et al.* (2002) and Pal *et al.* (2009) and Stuti and Kumar (2013).

It is known that GA_3 promotes the activity of RuBP (Ribulose, 1,5-bisphosphate) enzyme probably due to which rate of photosynthesis also increased thereby producing higher economic yield and increments in harvest index. Similar findings were also opined by Stuti and Kumar (2013).

The increase in the yield probably due to the stimulatory effect of the GA_3 which prolonged the stomatal openings and induces the large no. of reproductive sinks leading to the greater activity of RuBP enzyme resulting in higher photosynthetic rates with greater translocation and accumulation of metabolites in the sink. The results of yield of tubers are in consonance to that of Pandey *et al.* (2001), Shivakumar *et al*. (2002), Khan *et al.* (2006), Sharma (2006), Samui and Roy (2007), Sarada *et al.* (2008), Birbal *et al.* (2009), Mallick *et al.* (2009), Pal *et al.(*2009), Verma *et al.* (2009), Farhan *et al.* (2010), Singh (2010), Kumar *et al.* (2011), Perveen *et al.* (2014), Thapa *et al.* (2014) and Khan *et al.* (2014).

Table 3 : Effect of Plant growth regulators on organoleptic evaluation of taro

Treatment details	Organoleptic evaluation				Appearance	Hedonic scale	%
	Colour of skin	Shape of tuber	Texture & colour of flesh	Taste			
T_1-NAA (25 ppm)	8.5	8.6	7.7	7.8	7.2	7.96	88.43
T_2-NAA (50ppm)	8.3	8.4	7.5	7.4	6.9	7.70	85.54
T_3-IAA (25 ppm)	8.6	8.7	7.8	8.2	7.4	8.14	90.43
T_4 - MH (50 ppm)	8.4	8.5	7.6	7.6	7.0	7.82	86.88
T_5-MH (100 ppm)	8.1	8.2	7.2	7.0	6.5	7.40	82.21
T_6- IAA (50 ppm)	8.1	8.1	7.2	6.8	6.4	7.32	81.32
T_7 - GA_3 (100 ppm)	8.7	8.8	7.9	8.4	7.7	8.30	92.21
T_8 - GA_3 (200 ppm)	8.9	9	8	8.5	7.8	8.44	93.76
T_9 -Ethrel (75 ppm)	8.2	8.3	7.4	7.2	6.8	7.58	84.21
T_{10}- Ethrel (150 ppm)	8.2	8.3	7.3	7.1	6.7	7.52	83.54
T_{11}-Control (only Water spray)	5.4	5.3	5	4.9	5.2	5.16	57.32

The data presented in table 3 shows that the maximum grading point of taro (8.44) was recorded and in percentage i.e. 93.76 % under T_8 [GA_3 (200 ppm)] which was best to other and was closely followed by (8.30) in percentage (92.21%) in T_7 [GA_3 (100 ppm)] in comparison to others treatments including control (only water spray). It is evident from 9-point hedonic scale, L. Nicolas (2010).

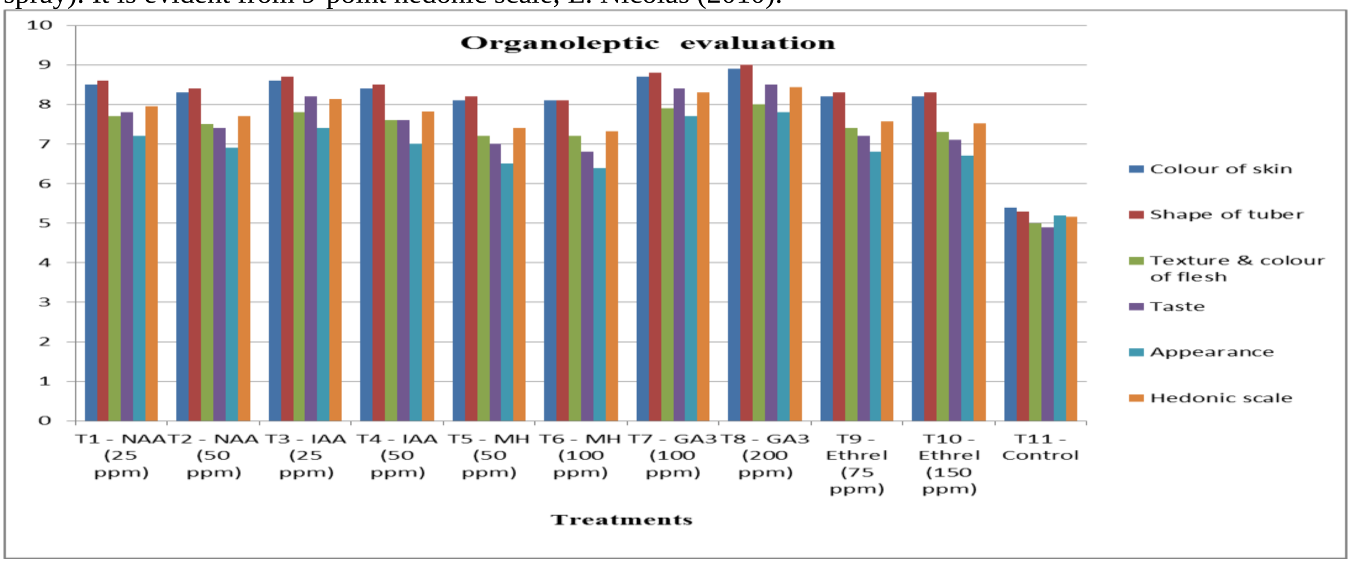

Fig. 7 : Effect of plant growth regulators on Organoleptic evaluation of Colocasia (taro)

Conclusion

Thus, on the basis of results obtained in one year investigation (2017-18) and in the light of the facts as mentioned above, it can be concluded that foliar spray of plant growth regulators not only increased the vegetative growth but also increased the yield, physical and physico-chemical parameters except non-reducing sugar percentage. The present investigation revealed that the effective concentration of undertaken plant growth regulators can be used to improve the growth, yield & physical parameters of Taro especially treatment with GA_3 @ 200 ppm & GA_3 @ 100 ppm. Considering these parameters, it is inferred that GA_3 at 200 ppm can be administered with a view for getting maximum net returns in cultivation of Taro.

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