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Effect of plant growth regulators on yield attributes 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 is 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 the Horticulture Research unit, Department of Horticulture, Faculty of Agriculture, Birsa Agricultural University, Kanke, Ranchi during Kharif season of 2017. 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 & yield 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 yield parameters in cultivation of taro.

Keywords: Plant growth regulators, yield attributes, colocasia, corm, cormels

Introduction
Among the tuber crop produced, colocasia [*Colocasia esculenta* var. *antiquorum* (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) [13]. 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 favourable 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 an promising tuber crop for the state of Jharkhand. It can be found in most of the farmers 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 has 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* var. *antiquorum* (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.

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 Randomised Block Design with three replications.

Results and Discussion

The data presented in table 1 shows that maximum Average No. of cormels/plant,

Length of cormel and girth of cormel was observed in T_8 [GA_3 (100 ppm)] (17.51, 7.94 cm & 11.45 cm respectively) followed by treatment T_7 [GA_3 (200 ppm)] (15.98, 6.69 & 10.68 cm) in comparison on to others treatments including control (only water spray).

Table 1: Effect of Plant growth regulators on Number of cormels/plant, Length of cormel and Girth of cormel of taro

Treatments	No. of cormels/ plant	Length of cormel (cm)	Girth of cormel (cm)
T_1-Naphthalene Acetic Acid (25 ppm)	15.13	5.52	9.96
T_2-Naphthalene Acetic Acid (50 ppm)	13.94	4.94	9.18
T_3-Indole Acetic Acid (25 ppm)	15.64	5.83	10.41
T_4-Indole Acetic Acid (50 ppm)	14.79	5.14	9.68
T_5-Maleic Hydrazide (50 ppm)	12.07	4.03	8.20
T_6-Maleic Hydrazide (100 ppm)	11.39	3.79	7.72
T_7-Gibberellic Acid (100 ppm)	15.98	6.69	10.68
T_8-Gibberellic Acid (100 ppm)	17.51	7.94	11.45
T_9-Ethrel (75 ppm)	13.43	4.64	8.96
T_{10}-Ethrel (150 ppm)	12.58	4.30	8.50
T_{11}- Control (Only spray)	10.54	3.34	7.69
SEm ±	1.09	0.39	0.69
CD (p=0.05)	3.21	1.15	2.03
CV (%)	13.54	13.21	12.78

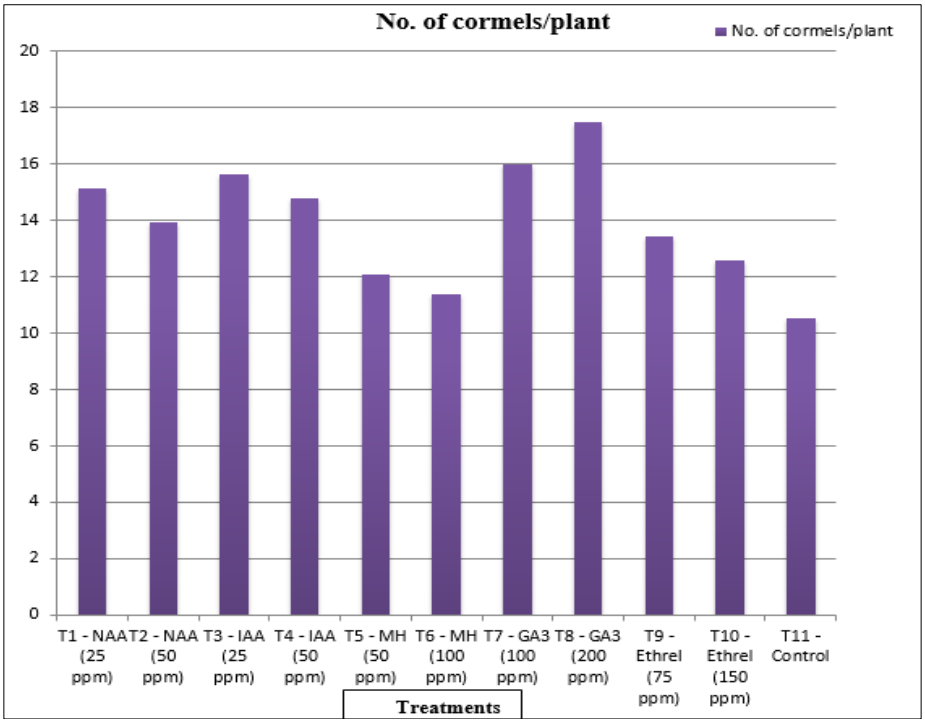

Fig 1: Effect of plant growth regulators on number of cormels/plant of Colocasia (Taro)

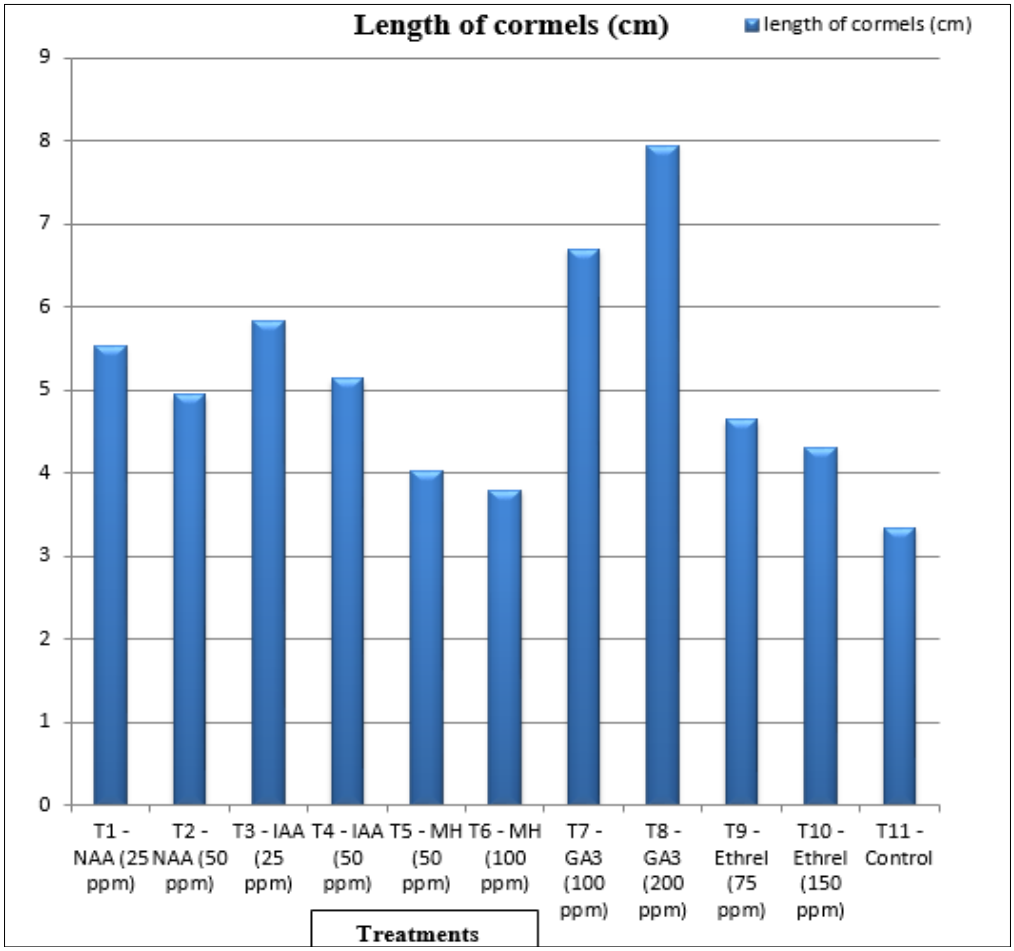

Fig 2: Effect of plant growth regulators on length of cormel (cm) of Colocasia (Taro)

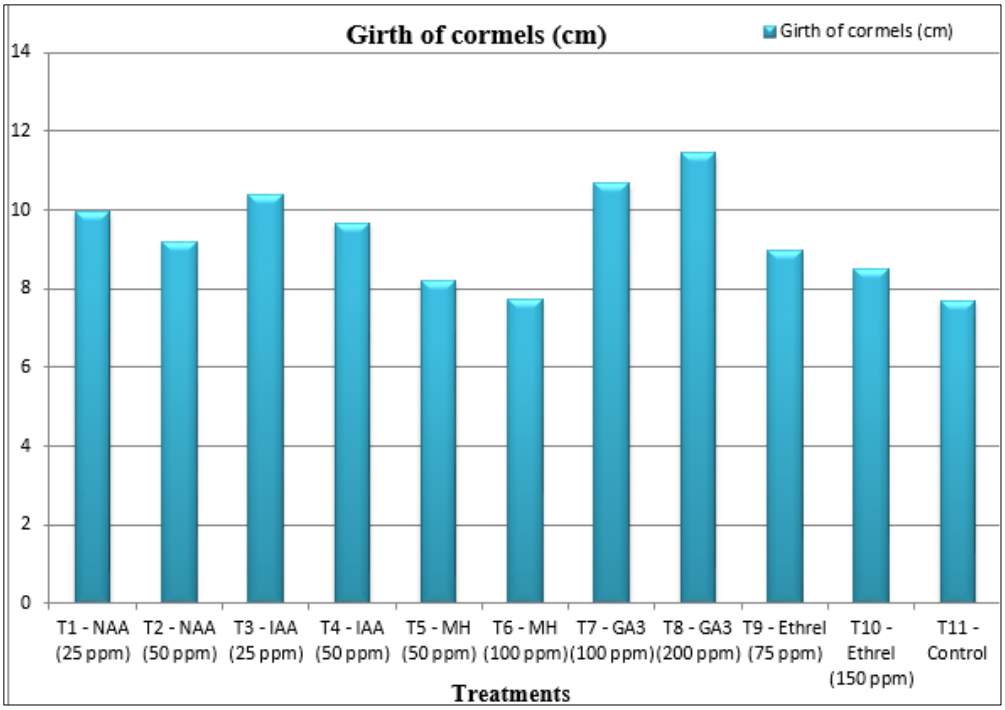

Fig 3: Effect of plant growth regulators on girth of cormel of Colocasia (Taro)

The increase in number of cormel might be due to enhanced photosynthetic activities and efficiency and rapid metabolic processes thereby increase in photosynthates pool and energy which along with increased cell division and elongation processes resulted to force the plant to produce more number of branches. Similar findings with respect to number of branches were also reported by Poudel (2006) [15], Khan *et al.* (2007) [9], Sarada *et al.* (2008) [17] and Singh (2010) [21].

The increase in length of cormel might be due to increase in meristematic activity of the apical tissue on GA_3 application. Also GA_3 was involved in increasing photosynthetic activity, efficient translocation and utilization of photosynthates

causing rapid cell division, cell elongation and cell differentiation at growing region of the plant leaves leading to stimulation of growth. Similar findings were observed by Kadiri *et al.* (1996) [7], Iqbal *et al.* (2001) [5], Poudel (2006) [15], Sharma (2006) [19], Kumar *et al.* (2008) [10], Sengupta *et al.* (2008) [18], Sarada *et al.* (2008) [17], Ud-Deen (2009) [24], Kumar *et al.* (2011) [12], Sitapara *et al.* (2011) [23], Rohamare *et al.* (2013) [16], Chaudhary *et al.* (2013) [2], Thapa *et al.* (2014), Chaurasiya *et al.* (2014) [3], Netam and Sharma (2014) [14] and Kumar *et al.* (2014) [11].

Increased in the Girth of cormel is due to crucial role of GA_3 in cell enlargement and cell division, increase in the intercellular space in peripheral cells of the cormel and higher translocation of photo-assimilates & mineral nutrients from vegetative parts towards the developing tuber that are extremely active metabolic sink. The results were similar to the trend found by Kaddour *et al.* (2006) [6], Sud (2008), Chowdhury *et al.* (2009) and Thapa *et al.* (2013) [23]

Table 2: Effect of Plant growth regulators on Length of mother corm, Girth of mother corm and yield/ha (tonnes) of taro

Treatments	Length of mother corm	Girth of mother corm	Yield/ha (tonnes)
T_1-Naphthalene Acetic Acid (25 ppm)	5.80	11.44	13.45
T_2-Naphthalene Acetic Acid (50 ppm)	5.58	10.88	12.68
T_3-Indole Acetic Acid (25 ppm)	6.42	12.06	14.16
T_4-Indole Acetic Acid (50 ppm)	5.72	11.26	13.05
T_5-Maleic Hydrazide (50 ppm)	4.80	10.04	11.48
T_6-Maleic Hydrazide (100 ppm)	4.38	9.59	11.12
T_7-Gibberellic Acid (100 ppm)	6.78	12.61	14.52
T_8-Gibberellic Acid (100 ppm)	7.64	13.43	15.38
T_9-Ethrel (75 ppm)	5.31	10.69	12.64
T_{10}-Ethrel (150 ppm)	5.12	10.28	11.86
T_{11}- Control (Only spray)	4.14	8.76	11.26
S.Em ±	0.47	0.86	1.03
CD (p=0.05)	1.38	2.54	3.03
CV (%)	14.43	13.54	13.8

The data presented in table 2 shows that maximum Length of mother corm, girth of mother corm and yield/ha (tonnes) was observed in T_8 [GA_3 (100 ppm)] (7.64 cm, 13.43 cm & 15.38 tonnes respectively) followed by treatment T_7 [GA_3 (200 ppm)] (6.78 cm, 12.61 cm & 14.52 tonnes) in comparison to others treatments including control (only water spray).

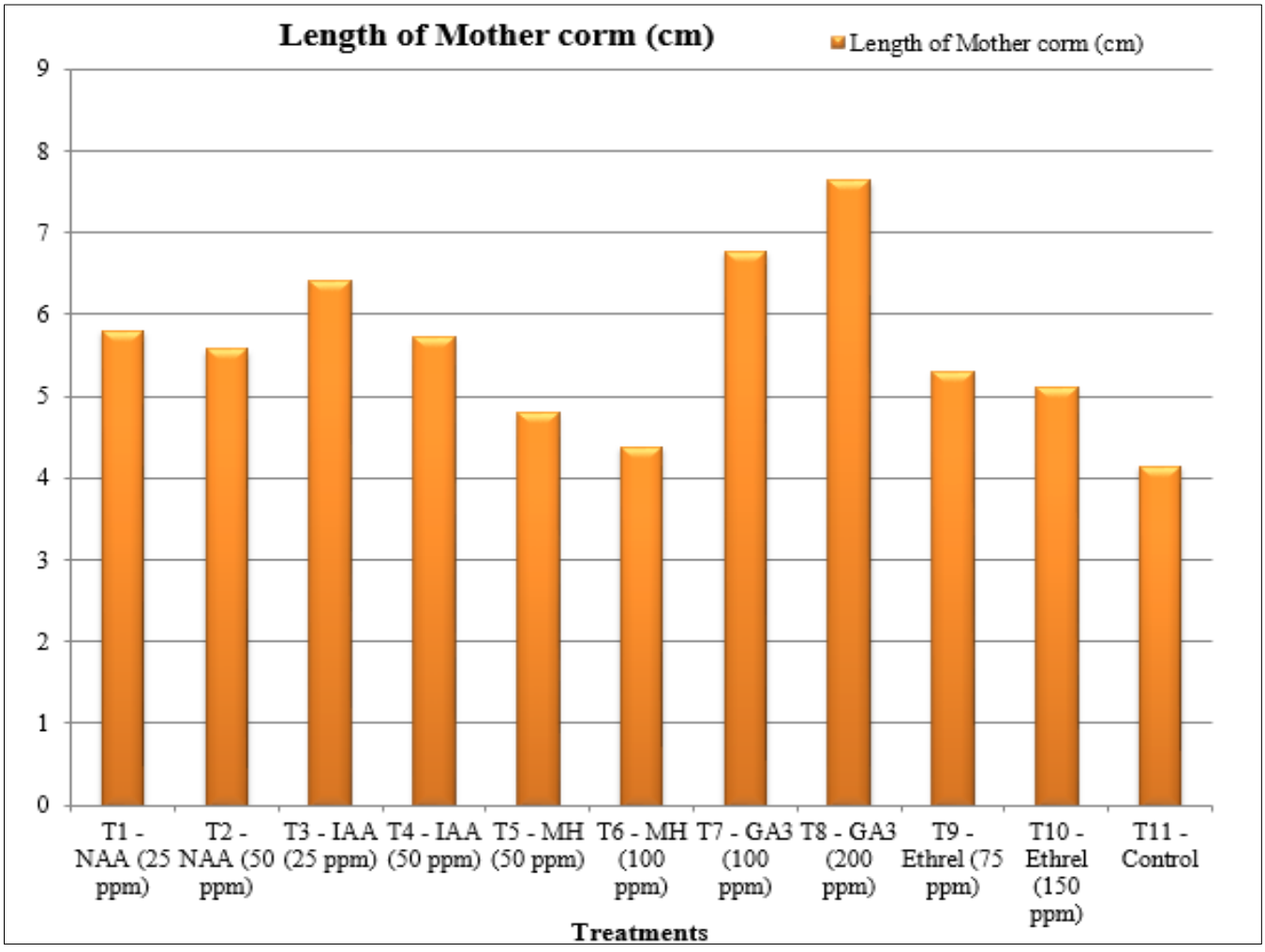

Fig 4: Effect of plant growth regulators on length of mother corm (cm) of colocasia (Taro)

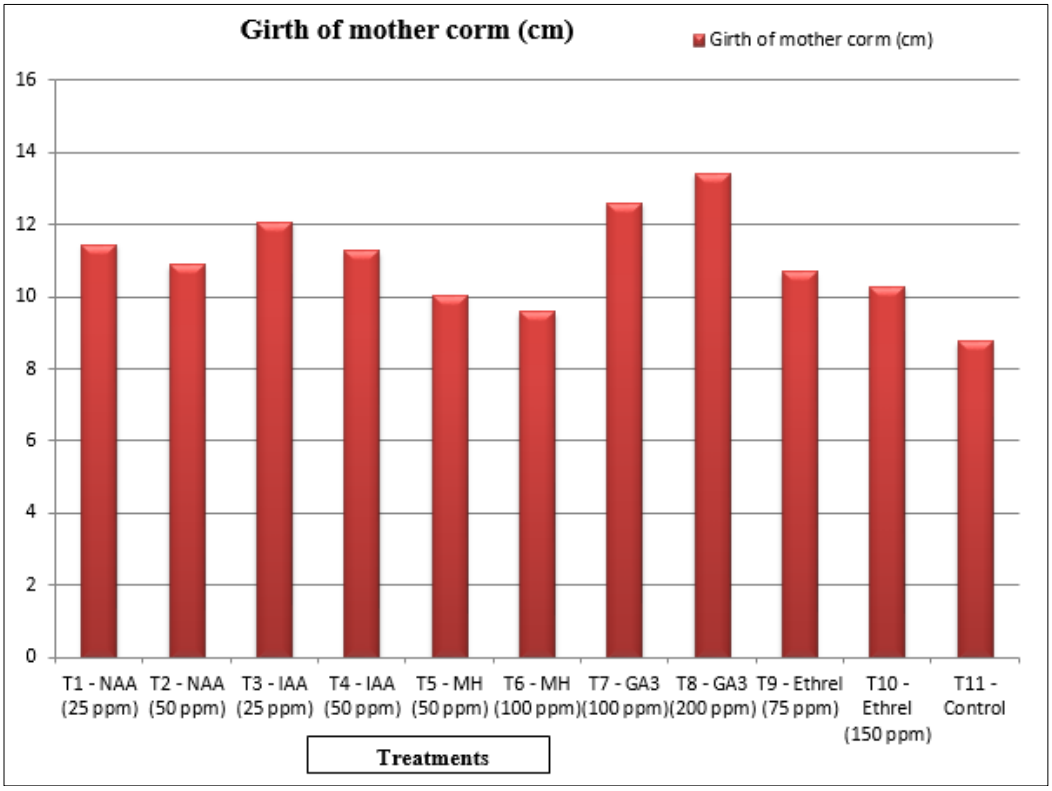

Fig 5: Effect of plant growth regulators on girth of mother corm (cm) of colocasia (Taro)

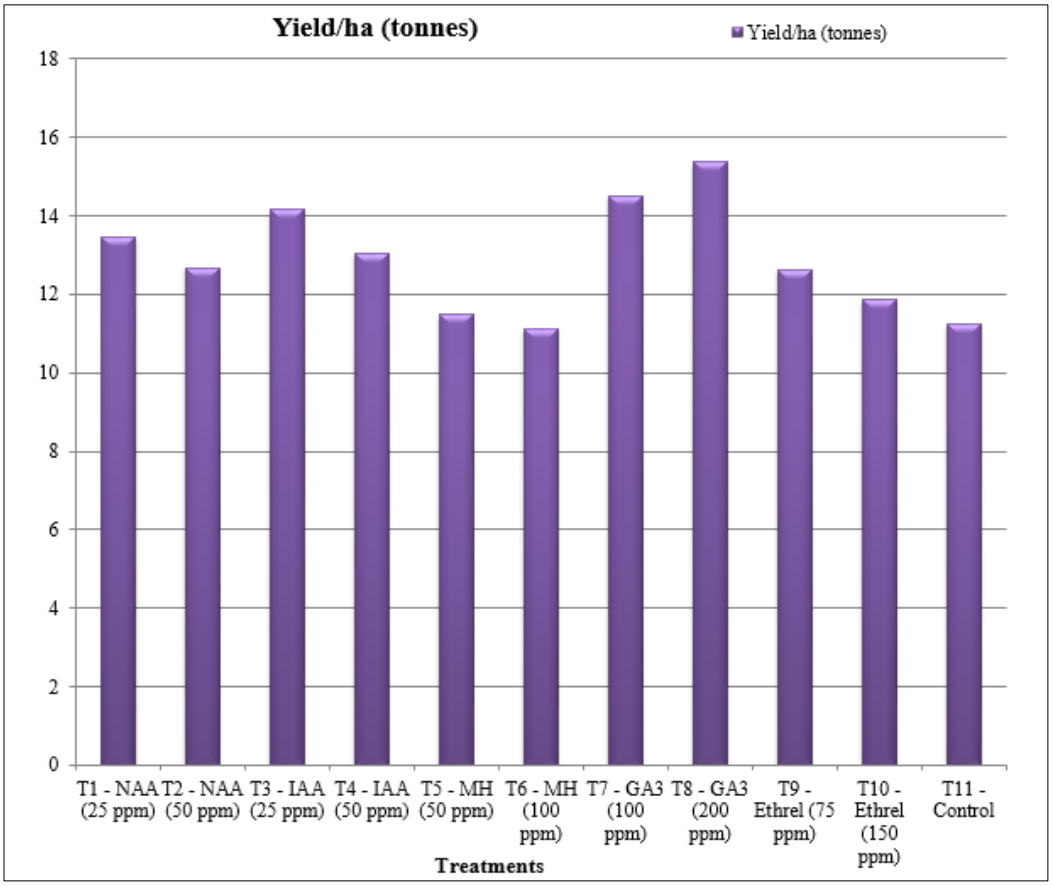

Fig 6: Effect of plant growth regulators on Yield per hectare (tonnes) of colocasia (Taro)

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 Shivakumar *et al.* (2002) [20], Khan *et al.* (2006), Sharma (2006) [19], Sarada *et al.* (2008) [17], Birbal *et al.* (2009) [1], Verma *et al.* (2009) [25], Farhan *et al.* (2010) [4], Singh (2010) [21], Kumar *et al.* (2011) [12], Perveen *et al.* (2014), Thapa *et al.* (2014) and Khan *et al.* (2014).

Conclusion

Thus, on the basis of results obtained in one year investigation (2017-18), it can be concluded that foliar spray of plant growth regulators increases the yield and yield attributes. The present investigation revealed that the effective concentration of undertaken plant growth regulators can be used to improve the yield 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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