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Influence of Plant Growth Regulators on Chlorophyll Content of Different Sesame (*Sesamum indicum* L.) Cultivars

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ABSTRACT

The present experiment was conducted at the Central farm OUAT during Rabi season 2014-15 with five sesame varieties viz. Uma, Amrit, Smarak, Prachi and Nirmala to study the efficiency of growth regulators such as NAA, GA_3 and IAA in two conc. (10 ppm and 20 ppm) sprayed at 30 and 45 DAS. The experiment was laid out in the split-plot design with three replications. The highest value was exhibited by Nirmala as regards to chlorophyll content. The chlorophyll content both chlorophyll-a (4.32 mg/g F wt of leaf), chlorophyll-b (1.29 mg/g F wt of leaf) and total chlorophyll (5.57 mg/g F wt of leaf) increased due to spraying growth regulators over the control. In view of the present findings, Nirmala was found to shows better response among all the varieties and may be recommended to farmers for cultivation.

Key words: *Chlorophyll, cultivars, gibberellic acid and growth regulators.*

INTRODUCTION

Sesame (*Sesamum indicum* L.) adorned as queen of oil seeds. It is commonly known as Til, Gingeli, Sim and it is the oldest important oil seed crop in the tropics. It has been believed as sesame probably originated in Africa. Sesame was introduced into India by the earliest human migrants from Africa, this crop is grown in a period when atmospheric evaporative demand is high and availability of irrigation water is low. Under the circumstances there is a need for efficient utilization of water resources or Physiological manipulation of the crop with the growth regulator to overcome the water stress situation[1] even through it is grown all over the world for its importance in food, medicine and industries.

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In the world the major countries producing sesame are china (19.97), Myanmar (16.68), Sudan (9.98) and the countries like Uganda, Nigeria, Pakistan, Ethiopia and Bangladesh contributed less than 5% in Production. It has been observed that the productivity of sesame in India was 6.76 kg/ha as compared to the worlds' average 48.87 kg/ha as per the report. India has a leading edge over its area (29.3 %) and by production (25 %). Among the oilseed crops sesame ranks 1st for its higher oil content (46-62 %) with 63.35 k.cal /kg of dietary energy in seeds[2] the yield of sesame has the yield potential of around 20t/ha but low in productivity (346 kg/ha) and hence has tremendous options for management technologies.Sesame seed provides excellent food nutrition, health care, edible oil and bio-medicine. It is digestive, regenerative, anti aging and resource of quality oil. It is rich in Vitamin C, Vitamin A, Vitamin B complex, niacin, minerals like calcium, phosphorous, iron, copper, magnesium, zinc, and potassium. From an industrial point of view, sesame is used is used in manufacturing soaps, cosmetics, perfumes, insecticides and Pharmaceutical Products. Sesame cake is a byproduct of the oil milling industry and valued as livestock feed because of its high methane content. It has been observed as the international market of sesame has been increasing in the recent past due to high demand and various uses. In India Gujarat alone contributed 30% of total production followed by West Bengal 17.8 % Rajasthan 17.6 %. West Bengal ranks 1st with 8.6 kg/ha followed by Gujarat 5.98 kg/ha. In Odisha sesame is cultivated both in Kharif and Rabi season. The average production of sesame is 70.74 Mt during *Kharif* season where as in Rabi season it is 23.42 Mt. During Rabi season sesame is cultivated under non-irrigated situation for which water deficit situation in one of the major abiotic stress which adversely affect the crop growth and yield. Although many reasons have been attributed to explain such low productivity remain hindrance lies in physiological problems associated with hormonal imbalance which leads to a reduction in the yield of the crop plant growth regulators are known as to change the growth and development pattern of growth plants. The localized application of some plant growth regulators is reported to have profound effects on assimilate partitioning, enhancing the crop productivity plant growth regulators are effective on several crop plants to balance the source sink relationship and thereby increasing them, they used as an aid to enhance in many crops, Indole acetic acid (IAA) and Gibberellic acid (GA_3) can manipulate a variety of growth and developmental phenomena in various crops, with the increase in population our compulsion is not only to stabilize agriculture production but also to increase it further in sustainable manner. Keeping these things under consideration use of plant growth regulators as target dose of the application on chlorophyll content of different Sesame (*Sesamum indicum* L.) cultivars, the present study was conducted.

MATERIALS AND METHODS

The present experiment entitled "Influence of plant growth regulators on chlorophyll content of different Sesame (*Sesamum indicum* L.) cultivars" was conducted at the Central Research Station, Orissa University of Agriculture and Technology, Bhubaneswar, situated at $20^0$15' N latitude and $85^0$52'E longitude of the Department of Plant Physiology, College of Agriculture, OUAT, Bhubaneswar during Rabi 2014-2015. Five sesame varieties viz., Uma, Amrit, Smarak (AVTS-13-9), Prachi, Nirmala (5 Variety) were taken for the study. Breeder seeds of the above varieties were collected from the AICRP on Sesame, OUAT, Bhubaneswar farm for the purpose. A field experiment was conducted with 35 numbers of Field plots which laid out in a complete split-plot Design for 7 treatments and 3 replications. The experiment was carried out in the medium land with well drained sandy loam soil and the chemical properties of the soil were analyzed in the Department of Soil Science and Agricultural Chemistry OUAT, Bhubaneswar having pH (5.4) (Table.2).The data on climatic parameters *viz.*, rainfall, maximum and minimum temperature, relative humidity and bright sunshine hours recorded during the period of investigation (2013-14) at the

meteorological observatory, OUAT is depicted in table.1.Seed treatment was done one day before the sowing on field plot. Seed treatment with saffaya on slurry like water and fungicidal solution and shed dried for 3-4 hours. The crop was grown in *Rabi season*, 2014-15 using 5 varieties viz., Uma, Amrit, Smarak, Prachi and Nirmala of sesame in a plot size 5.5 ' × 3.4 ' with spacing of 30 cm ×15 cm. The meteorological conditions were suitable for raising of crop sesame. Fertilizer was applied @ 40kg N, 20kg $P_2O_5$and 20 kg K_2O along with 10 cartloads of FYM per hectare before sowing of seeds. Two hand weeding was done to keep the crop from weeds and prophylactic plant protection measures were adopted to protect the crop from weeds, diseases and pests attack. The field was irrigated as and when required. Sowing was done manually on 18th Nov 2014, the plots of different treatments were harvested at harvestable maturity stage on 5th, 7th and 10th March 2015. Seeds after threshing were sun dried to about nine percent moisture level and stored in small cloth bags under ambient condition. The required pre and post-harvest observations were recorded in the laboratory of the Department of Plant Physiology. There were seven treatments involving three plant growth regulators (IAA, NAA and GA_3) applied along with a control. The detail procedures of application of these Plant growth regulators are provided in the following table 4. Foliar application of these plant growth regulators was made at 30 and 45 days after sowing. Observation of the chlorophyll-a, chlorophyll-b and total chlorophyll content in the leaves were determined by replication wise. The second leaf from the top was sampled for the purpose. The leaf samples were collected in moist polythene bags to keep them turgid, 100 mg of the fresh leaf was taken from the middle portion of the leaf and were cut into small pieces. The leaf discs were then placed in 10 ml of 80 % v/v acetone solution and kept in dark for 24 hours. Then the extract was filtered through Whatman Number1 filter paper and the filtrate was used to record the absorbance (OD) at 645 nm and 663 nm. The respective fraction and total chlorophyll content were calculated using the following formulae out lined by Arnon[3] and expressed as mg g^{-1} F Wt leaf. The data collected from the experiment relating biochemical observation were subjected to statistical analysis as per the method obtained for Split-Plot Design[4].

RESULTS AND DISCUSSION

The present investigation was carried out at the research station of O.U.A.T to assess the influence of growth regulators such as Indole acetic acid (IAA), Naphthalene acetic acid (NAA) and Gibberellic acid (GA_3) on chlorophyll content of Sesame (*Sesamum indicum* L.) cultivars. Variation in chlorophyll-a, chlorophyll-b and total chlorophyll at 90 DAS due to the effect of growth regulator has been presented in table 5. From the data it is revealed that irrespective of varieties the chlorophyll a content was increased due to spraying of growth regulator. The maximum chlorophyll-a content was recorded from NAA 20 ppm conc. (4.49 mg/g fresh wt of leaf) followed by GA_3 20 ppm conc, (4.43 mg/g fresh wt. of leaf) where as the lowest value was recorded from control (3.72 mg/g fresh wt of leaf). Significant difference among the treatment was found. Among the varieties, Nirmala gave the highest value (4.32 mg/g fresh wt. of leaf) where as the minimum value was recorded from Smarak (4.04 mg/g fresh wt. of leaf). The interaction effect between the treatment and the variety was found significant. Similar trends were also found by Padhiary *et al.*,[5] in case of rice in water logged and submerged conditions. Data presented in table 5. indicated that significant increase in chlorophyll –b content was noted due to different conc. of growth regulator irrespective of varieties. Maximum percentage of increase was recorded from GA_3 10 ppm conc. (24.75 %) followed by IAA 20 ppm conc. (21.78%) over the control. Higher conc. of all growth regulators contributed more chlorophyll –b content as compared to lower conc. Nirmala exhibited the highest chlorophyll –b content (1.29 mg/g F wt of leaf) followed by Amrit (1.26 mg/g F wt of leaf). The interaction effect as regards to chlorophyll –b content between treatment and variety was significant. The chlorophyll content estimated at 90 DAS

computed in table 5. revealed that there was significant increase of total chlorophyll content of leaf in all conc. of growth regulator higher conc. of growth regulators gave more total chlorophyll content. The highest value was recorded in IAA 20 ppm conc. (5.80 mg/g F wt of leaf) with an increase 22.62 % over the control. Among the varieties, the maximum total chlorophyll content was recorded from Nirmala (5.57 mg/g F wt of leaf) followed by Amrit (5.32 mg/g F wt of leaf) but the lowest value of the same was shown in Smarak (5.07 mg/g F wt of leaf). Significant difference among the varieties and treatments was found, the interaction effect between variety and the treatment was significant. Leaf analysis for the different fraction of the chlorophyll indicated that all the growth regulators without exception displayed their ability to increase the chlorophyll content of the leaves, higher concentration of all growth regulators produced the maximum chlorophyll content of the leaves and highest chlorophyll production was recorded in 20 ppm IAA followed by same concentration of GA_3, these findings are in close agreement with Akhtar *et al.*,[6] and Kokare *et al.*[7].

Table 1: Meteorological Data at the experimental site

Month	Avg. Temp		Avg. Rh (%)		Bright sunshine hours (BSH)	Rain Fall	
	Max.	Min.	Morning	Afternoon		mm	Days
November	30.9	18	90	44	7.2	0.0	-
December	27.7	13.9	88	45	5.8	0.0	-
January	27.8	14.2	91	43	6.7	21.5	2
February	32.5	17	94	39	8.3	18.4	1
March	35.8	21.5	91	40	8	24.8	3

Table 2: Soil properties of the experimental field

Sl. No.	Particular	Percentage of composition
1	Texture	Sandy loam
2	pH	5.4
3	Total nitrogen	0.09
4	Available P	17.8 (kg ha-1)
5	Available K	110.3 (kg ha-1)

Table 3: Varieties used five

Name of the Varieties	**Symbol**
UMA	V1
AMRIT	V2
SMARAK (AVTS-13-9)	V3
PRACHI	V4
NIRMALA	V5

Table 4: Details of Plant growth regulators application

Sl No.	Treatment symbol	Micronutrients	Concentration/ Dose of Application	Mode of application
1	T_0	Control	-	-
2	T_1	NAA	@10 PPM	Foliar Spray
3	T_2	NAA	@20 PPPM	Foliar Spray
4	T_3	GA3	@10 PPM	Foliar Spray
5	T_4	GA3	@20 PPPM	Foliar Spray
6	T_5	IAA	@10 PPM	Foliar Spray
7	T_6	IAA	@20 PPPM	Foliar Spray

Table 5: Effect of NAA, GA3 and IAA on Chlorophyll content of different sesame cultivars

Treatment		Chl- a	Chl- b	Total chlorophyll
T_0		3.72	1.01	4.73
T_1		3.89	1.11	4.99
T_2		4.49	1.26	5.73
T_3		3.82	1.12	4.94
T_4		4.43	1.22	5.63
T_5		4.22	1.15	5.50
T_6		4.27	1.23	5.80
Mean		4.12	1.16	5.28
Varieties		Chl- a	Chl- b	Total chlorophyll
V_1		4.07	1.07	5.14
V_2		4.11	1.26	5.32
V_3		4.04	1.07	5.07
V_4		4.07	1.09	5.16
V_5		4.32	1.29	5.57
Mean		4.12	1.15	5.25

DAS		SE(m)±	C.D.at 5%	CV%
Chl-a	V	0.013	0.042	1.447
	T	0.013	0.037	1.23
	VxT	0.023	0.068	
	TxV	0.029	0.083	
Chl-b	V	0.011	0.036	4.386
	T	0.012	0.036	4.315
	VxT	0.022	0.064	
	TxV	0.028	0.081	
Total Chlorophyll	V	0.015	0.040	1.323
	T	0.016	0.048	1.29
	VxT	0.023	0.052	
	TxV	0.03	0.09	

CONCLUSION

It was concluded that the total as well as both the components of chlorophyll increased in all the treatments irrespective of varieties over the control. Chlorophyll –a content was higher than chlorophyll –b, among the varieties maximum value, was exhibited in all the components of chlorophyll by Nirmala and may be recommended to farmers for cultivation.

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